



**NOTICE TO CONTRACTORS,  
PROPOSAL,  
AGREEMENT, &  
SPECIAL PROVISIONS**

FOR CONSTRUCTION ON  
**Project No: 19-51B**  
**Columbia Pool Improvements**

IN STANISLAUS COUNTY,  
TURLOCK, CALIFORNIA.

---

Public Works Department/ Engineering Division

Phone: (209) 668-6021  
Contact Person: Randall Jones, P.E.

---

**William D. Morris, P.E.**  
City Engineer

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Proposals shall be delivered to Turlock, California  
at or before 11:00AM on Wednesday, September 6, 2023  
at the office of the City Engineer,  
Public Works: Engineering Division  
156 S. Broadway, Suite 150  
Turlock, CA 95380

## LICENSEES RESPONSIBLE FOR SPECIFICATIONS

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Contract documents prepared by or under the direction of the following registered persons:

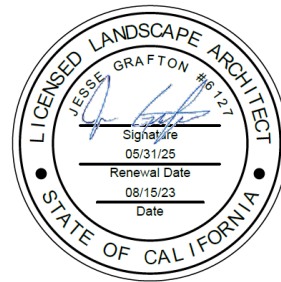
City Engineer (Front end specifications)

William D. Morris  
Public Works Department  
Engineering Division  
156 S. Broadway, Suite 150  
Turlock, CA 95380  
(209) 668-5520



Landscape Architect

Jesse Grafton  
O'Dell Engineering  
1165 Scenic Drive, Suite A  
Modesto, CA 95350  
209-571-1765



Civil Engineer

Stephanie S. Kong  
O'Dell Engineering  
1165 Scenic Drive, Suite A  
Modesto, CA 95350  
209-571-1765



Electrical Engineer

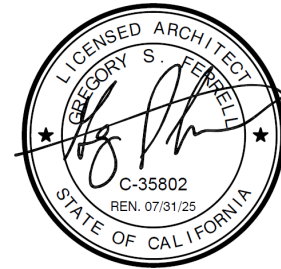
Kevin Pezzoni

Pezzoni Engineering, Inc.  
1150 9<sup>th</sup> Street, Suite 1415  
Modesto, CA 95354  
209-554-4602



Architect

Gregory S. Ferrell  
Aquatic Design Group  
2226 Faraday Ave.  
Carlsbad, CA 92008  
800-938-0542



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**CITY OF TURLOCK, CALIFORNIA  
NOTICE TO CONTRACTORS**

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Sealed proposals will be received by the City Engineer of the City of Turlock, Public Works/Engineering Division, 156 S. Broadway, Suite 150, Turlock, California 95380, until 11:00AM on Wednesday, September 6, 2023, for:

**City Project No. 19-51B  
Columbia Pool Improvements**

In accordance with and as described and provided in the plans, specifications and the proposed form of contract therefore, all of which are on file in the office of the City Engineer, and to which special reference is hereby made.

No verbal, telegraphic, electronic mail, facsimile, or telephone Proposals shall be considered.

**An optional Pre-Bid meeting will be held on Tuesday, August 29, 2023, 10:00 AM at Turlock City Hall, 156 S. Broadway Turlock, CA 95380, Suite 150 Engineering Conference Room.** Prime contractors, subcontractors, and suppliers may attend, but are not required to do so.

Proposals are required to be complete and for the entire work, materials and improvements unless the contrary is indicated in the specifications.

In accordance with the provisions of California Business and professions Code, Section 7028, Contractor shall possess one of the following Contractor license(s) at the time of bid and for the duration of the contract:

1. A-General Engineering Contractor

Failure to possess a specified license shall render the Bid as non-responsive, shall act as a bar to award of the contract to any Bidder not possessing said license(s) at the time of Bid opening and shall result in the forfeiture of the security of said Bidder. Furthermore, any Bidder or Contractor not so licensed shall be subject to all legal penalties imposed by law, including, but not limited to, any appropriate disciplinary action by the Contractor's License Board.

Each proposal must be accompanied by cash, cashier's check, or check certified by a responsible bank, or by a bid bond, the proposed form of which is on file in the office of the City Engineer of said City and to which special reference is hereby made in a sum not less than ten percent (10%) of the total amount bid, payable to the City of Turlock as liquidated damages in the case the bidder is awarded the contract and fails within ten (10) days after the date of mailing to him by the City Engineer of a notice of award of the contract and that the contract is ready for signature to execute the above-

mentioned written contract and file with the City Engineer satisfactory insurance certificates as required by the terms of said contract and satisfactory bonds as required by law for the faithful performance of said contract and for the protection of material, men and laborers. Special reference is hereby made to Sections 5100, et. seq., of the Public Contracts Code of the State of California and to the proposed forms for said bonds now on file in the office of the said City Engineer for further particulars regarding bonds.

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county Stanislaus in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at 156 S. Broadway St, Turlock, CA 95380 and available from the California Department of Industrial Relations' Internet web site at <http://www.dir.ca.gov/DLSR/PWD>.

Bidders' attention is directed to the insurance requirements in the contract. It is highly recommended that bidders confer with their respective insurance carriers or brokers to determine in advance of bid submission the availability of insurance certificates and endorsements prescribed and provided herein. If an apparent low bidder fails to comply strictly with the insurance requirements, that bidder may be disqualified from award of the contract.

No proposal will be considered unless made on forms furnished by the City Engineer of said City at his office of said City. Each proposal must be sealed, and the envelope containing the same must be addressed to the City Engineer of the City of Turlock and must be plainly marked. Each proposal shall clearly identify the bidders name and address on the sealed envelope.

Each bid shall separately state in figures the price offered for the approximate quantity of each item set forth and shall also state in words and figures the total contract price. Quantities set forth in the proposal form and in the specifications are approximate only, being given as a basis for comparison of bids, and the City of Turlock does not expressly or implied agree that the actual amount of work or materials will correspond therewith, but reserves the right to increase or decrease the amount of any class or portion of the work or materials as may be deemed necessary by the City Engineer.

Proposals may not be withdrawn for a period of sixty (60) days after the time fixed for opening of proposals. The City Council of the City of Turlock reserves the right to reject any and all proposals or any part thereof and to waive any errors or informalities in any proposals and to set and act as sole judge of the merit and qualifications of the equipment, supplies or services offered.

At the request and expense of Contractor, pursuant to Division 2, Part 5, Section 22300, et. seq., of the Public Contracts Code, securities equivalent to any funds withheld as retention from progress payments made under this contract may be deposited with the City of Turlock or with a State or Federally chartered bank as escrow agent, who shall pay such moneys to Contractor upon completion of the contract.



Copies of the Contract Documents, including Instructions to Bidders, Bid Proposal forms, Plans and Specifications, may be downloaded from the engineering division's web site or purchased for a non-refundable fee of **One Hundred dollars (\$100)** at the Office of the City Engineer, 156 S. Broadway, Ste. 150, Turlock, CA 95380, Phone (209) 668-5520. For additional information, go to <http://www.cityofturlock.org/capitalprojects>

The U.S. Department of Transportation (DOT) provides a toll-free "hotline" service to report bid rigging activities. Bid rigging activities can be reported Mondays through Fridays, between 8:00 a.m. and 5:00 p.m., Eastern Time, Telephone No. 1-800-424-9071. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report these activities. The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

No contractor or subcontractor may be listed on a bid proposal for a public works unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5. No contractor or subcontractor may be awarded a contract for public work on a public works unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations. The contractors and subcontractors must furnish electronic certified payroll records to the Labor Commissioner.

The contractor shall post job site notices prescribed by regulation. (See 8 Calif. Code Reg. §16451(d) for the notice that previously was required for projects monitored by the CMU.)

DATED: 8/9/2023

CITY OF TURLOCK

By: 

William D. Morris, PE  
City Engineer

# PROPOSAL

---

Project No. 19-51B

## Columbia Pool Improvements

City of Turlock, California

DATED: \_\_\_\_\_

To: The Honorable City Council of the City of Turlock, California:

NAME OF BIDDER: \_\_\_\_\_

BUSINESS ADDRESS: \_\_\_\_\_

PLACE OF RESIDENCE: \_\_\_\_\_

Bids are to be submitted for the entire work. The amount of the bid for comparison purposes will be the total of all items. The bidder shall set forth for each unit basis item of work a unit price and a total for the item, and for each lump sum item a total for the item, all in clearly legible figures in the respective spaces provided for that purpose.

In the case of unit basis items, the amount set forth under the "Item Total" column shall be the product of the unit price bid and the estimated quantity for the item. In case of discrepancy between the unit price and the total set forth for a unit basis item, the unit price shall prevail except as provided in (a) or (b), as follows:

(a) If the amount set forth as unit price is unreadable or otherwise unclear, or is omitted, or is the same as the amount as the entry in the item total column, then the amount set forth in the item total column for the item shall prevail and shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price;

(b) (Decimal Errors) If the product of the entered unit price and the estimated quantity is exactly off by a factor of ten, one hundred, etc., or one-tenth, or one-hundredth, etc. from the entered total, the discrepancy will be resolved by using the entered unit price or item total, whichever most closely approximates percentage wise the unit price or item total in the Department's Final Estimate of cost.

## PROPOSAL SUBMITTAL CHECKLIST

The bidder shall provide a complete proposal in a sealed envelope before 11:00AM on Wednesday, September 6, 2023 at the address shown on the cover sheet of these specifications. FAILURE TO PROVIDE ALL THE REQUIRED DOCUMENTS LISTED IN THE TABLE BELOW MAY CAUSE THE PROPOSAL TO BE CONSIDERED NON-RESPONSIVE.

<b>Complete Proposal</b>	<b>Page No.</b>
<input type="checkbox"/> PROPOSAL AND BIDDING FORM.....	5-11
<input type="checkbox"/> AFFIDAVIT .....	12
<input type="checkbox"/> INFORMATION REQUIRED OF BIDDER .....	13-14
<input type="checkbox"/> BIDDER’S BOND .....	15-16
<input type="checkbox"/> LIST OF SUBCONTRACTORS.....	17-18
<input type="checkbox"/> IRAN CONTRACTING ACT CERTIFICATION .....	19

### **Special Note Regarding Escrow Bid Documents:**

The apparent low bidder shall submit one copy of all documentary information generated in preparation of Bid prices for this Project within one week after the bid opening. This material is hereinafter referred to as "Escrow Bid Documents." The Escrow Bid Documents of the low bidder will be held in escrow for the duration of the contract. See Special Provisions Section “Escrow Bid Documents.”

In accordance with the annexed Notice to Contractors, the undersigned, as bidder, declares that he has carefully examined the location of the proposed work, the plans, specifications and technical requirements therefore, and the proposed forms of contract and bonds mentioned or referred to in said Notice and on file in the office of the City Engineer of the City of Turlock, together with the prevailing rate of per diem wages for each craft or type of workmen needed to execute said contract; and he proposes and agrees that if this proposal is accepted, he will furnish all labor, materials, equipment, plant transportation, service, sales taxes, permit fees and other costs necessary to complete the construction in strict conformity to the plans and specifications and he will enter into a written contract with the City of Turlock in the form of contract on file in the Office of the City Engineer for such purposes, and that he will execute and/or provide all bonds and insurance certificates required by law and/or by said contract and/or mentioned in said Notice to Contractors all in accordance with and subject to all applicable laws, and that he will take in full payment therefore the following unit prices, to wit:

## BIDDER'S FORM

**PROJECT TITLE:** Columbia Pool Improvements

**PROJECT NUMBER:** 19-51B

**OPENING DATE:** September 6, 2023

**OPENING TIME:** 11:00AM

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total
1	Mobilization and Demobilization (Max 5%)	LS	1		
2	General Conditions (Max 3%)	LS	1		
3	Construction Project Sign	EA	1		
4	Temporary Erosion and Sediment Control	LS	1		
5	Temporary Construction Fencing	LF	770		
6	Temporary Tree Protection	LS	1		
7	Tree Removal	LS	1		
8	Sawcut & Removal of Concrete	SF	1,504		
9	Sawcut & Removal of AC	SF	4,287		
10	Site Clearing & Grubbing	SF	39,527		
11	Site Grading (Rough/ Fine)	SF	57,765		
12	4 Unit Pedestal Shower	EA	2		
13	Tri-Level Pedestal Drinking Fountain w/ Bottle Filler	EA	2		
14	6' Tall CMU Block Wall with 4' Tall Steel Fence Above	LF	162		
15	Updated Gate Hardware (2 Sets EA w/ Self Closing Hinges & Panic Hardware	LS	1		
16	8' CLR x 10' Tall Wrought Iron Double Swing Gates	EA	1		
17	6' CLR x 10' Tall Wrought Iron Double Swing Gates	EA	1		
18	5' CLR x 6' Tall Wrought Iron Swing Gate	EA	1		
19	10' Tall Wrought Iron Fencing	LF	174		

20	City Std Concrete Backed Benches	EA	3		
21	Concrete Backless Benches	EA	9		
22	Concrete Picnic Tables	EA	6		
23	Concrete Accessible Picnic Tables	EA	2		
24	Concrete Trash Receptacles	EA	4		
25	Concrete Recycle Receptacles	EA	4		
26	Custom Concrete Pool Entry Sign	EA	1		
27	Shade Structure (16'x16')	EA	2		
28	Shade Structure (12'x42')	EA	1		
29	Shade Structure (20'x30')	EA	1		
30	Bike Racks	EA	10		
31	24" High Metal Debris Panels on N&E Fencing and Gates	LF	363		
32	Paint Existing Perimeter Pool Fence	LS	1		
33	20' Tall Flag Pole w/ 3x5 Flag	EA	1		
34	City Std Trash Enclosure w/ 4' Tall Wrought Iron Fence	LS	1		
35	Pool Mechanical Building Shell Only (Pad Prep & Install)	LS	1		
36	4" Concrete Flatwork	SF	5,035		
37	4" Concrete Flatwork w/ Non-Slip Coating	SF	10,038		
38	6" Concrete Flatwork	SF	643		
39	12" Wide Concrete Band	LF	208		
40	6" Pad Base Prep for Public Restroom Company Buildings	SF	740		
41	3" HMA/ 4" A.B.	SF	3,696		
42	4" HMA/ 6" A.B.	SF	345		
43	2" Gas Main for Pool Heater	LS	1		
44	Connect 8" Water Line to Existing 6" Water Main	EA	1		
45	2" Water Line	LF	735		
46	2" Water Meter	EA	2		
47	2" Water Valve	EA	5		

48	3" Water Line	LF	226		
49	4" Water Meter	EA	1		
50	6" Water Line	LF	45		
51	8" Water Line	LF	105		
52	8" Water Valve	EA	1		
53	2" Backflow Prevention Assembly w/ Enclosure	EA	2		
54	4" Backflow Prevention Assembly w/ Enclosure	EA	1		
55	Fire Hydrant Assembly	EA	1		
56	Connect 6" to Existing 6" Sanitary Sewer	EA	3		
57	6" Sanitary Sewer Line	LF	442		
58	Sanitary Sewer Manhole	EA	3		
59	Sanitary Sewer Clean-out	EA	11		
60	Sanitary Sewer Inlet	EA	4		
61	6" Storm Drain Line	LF	96		
62	60" Manhole with 30" Drain Inlet Grate	EA	3		
63	48" French Drain Section	LF	155		
64	Storm Drain Inlet	EA	1		
65	Swimming Pool & Mechanical Equipment	LS	1		
66	Swimming Pool Deck & Drainage	LS	1		
67	Swimming Pool Deck Equipment	LS	1		
68	Swimming Pool Thermal Covers & Reels	LS	1		
69	Swimming Pool Safety Covers & In-Deck Anchors	LS	1		
70	Swimming Pool Surge Chamber & Access Hatch	LS	1		
71	Swimming Pool Heater	LS	1		

72	Site Electrical System	LS	1		
73	Site Security System	LS	1		
74	Soil Conditioning & Amendments	SF	15,454		
75	Decomposed Granite Mulch (3" Minimum Depth)	SF	3,917		
76	Sod Turf Renovation	LS	1		
77	5 Gallon Shrubs	EA	82		
78	24" Box Trees	EA	13		
79	Tree Root Barriers	LF	112		
80	Irrigation System – Tree Root Watering	EA	26		
81	Irrigation System – Low Flow Bubblers	SF	3,917		
82	Irrigation System – Turf Rotary Spray	SF	11,537		
83	Irrigation Controller & Weather Sensor	LS	1		
84	Irrigation Flow Sensor & Master Valve	LS	1		
85	Landscape Maintenance Establishment Period (60 Day)	LS	1		
<b>Subtotal</b>					

**Bidder has examined and carefully studied the Bidding documents and other related data identified in the Bidding Documents and the following Addenda, receipt of which is hereby acknowledged.**

**ADDENDA**

No. \_\_\_\_\_ Date \_\_\_\_\_ Signed \_\_\_\_\_  
 No. \_\_\_\_\_ Date \_\_\_\_\_ Signed \_\_\_\_\_  
 No. \_\_\_\_\_ Date \_\_\_\_\_ Signed \_\_\_\_\_  
 No. \_\_\_\_\_ Date \_\_\_\_\_ Signed \_\_\_\_\_  
 No. \_\_\_\_\_ Date \_\_\_\_\_ Signed \_\_\_\_\_

**TOTAL BID WRITTEN IN FIGURES:** \$ \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ . \_\_\_\_\_

**TOTAL BID WRITTEN IN WORDS:** \_\_\_\_\_

**CONTRACTOR:** \_\_\_\_\_

COMPANY'S NAME: \_\_\_\_\_

BY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

(Number)

(Street)

(City)

(State)

(ZIP)

CONTRACTOR'S PHONE #: \_\_\_\_\_

**NOTE: CONTRACTOR WILL BE REQUIRED TO LIST THEIR LICENSE NUMBER, EXPIRATION DATE, AND APPROPRIATE STATEMENT REGARDING PERJURY AND SIGNED BY INDIVIDUAL AUTHORIZED TO DO SO. FAILURE TO INCLUDE THE ABOVE ITEMS MAY CAUSE SAID CONTRACTOR'S BID TO BE REJECTED.**

\_\_\_\_\_, Contractor's License # \_\_\_\_\_, Class \_\_\_\_  
(Company's Name)

Expires \_\_\_\_\_ . DIR #: \_\_\_\_\_

This information is true, is provided as per Section 7028.15 of the Business and Professions Code, and is made herein under penalty of perjury.

X \_\_\_\_\_  
(Bidder's Signature) (Date)

If the proposal is accepted and the undersigned shall fail to contract as aforesaid and fail to file with the City insurance certificates as required by said contract, within fourteen (14) days after the bidder has received notice from the City Engineer or his representative of the City of Turlock that the contract has been awarded to bidder and is ready for signature, the City of Turlock may, at its option, determine that the bidder has abandoned his contract, and thereupon this proposal and the acceptance thereof shall be null and void.

*Also accompanying this proposal is an affidavit of non collusion and questionnaire to general contractors, a statement of proposed sub contractors, if any, the address of mill, shop or office of any sub contractor, and a statement of work to be performed by sub contractors.*

The names and addresses of persons interested in the foregoing proposal as principals are as follows:

**(IMPORTANT NOTICE:** If bidder or other interested person is a corporation, state legal name of corporation, also names of the president, secretary, treasurer, and manager thereof; if a partnership, state true name of firm, also names of all individual co partners composing firm; if bidder or other interested person is an individual, state first and last name in full.)



Licensed in accordance with an act providing for the registration of Contractors,  
License No. \_\_\_\_\_ Expiration Date \_\_\_\_\_.

DATED: \_\_\_\_\_, 20 \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

X \_\_\_\_\_  
Signature of Bidder

NOTE: If bidder is a corporation, the legal name of the corporation shall be set forth above together with the signature of the officers authorized to sign contracts on behalf of the corporation; if bidder is a co partnership, the true name of the firm shall be set forth above together with the signature of the partner or partners authorized to sign contracts in behalf of the co partnership; and, if bidder is an individual, his signature shall be placed above. If a signature is by an agent other than an officer of a corporation or a member of the partnership, a Power of Attorney must be on file with the City Clerk prior to opening or submitted with the bid; otherwise, the bid will be disregarded as irregular and unauthorized.

**AFFIDAVIT**

The undersigned bidder, being first duly sworn, deposes and says that he/she are the party making the foregoing proposal or bid, that this bid is genuine and not collusive or sham, that said bidder has not colluded, conspired, connived or agreed, directly or indirectly, with any other person or bidder, to put in a sham bid, or that said other person shall refrain from bidding, and has not in any manner sought by collusion to secure any advantage against the said City or any person interested in said improvement, for him/herself or any other person.

X \_\_\_\_\_  
Signature of Bidder

Jurat (Government Code Section 8202)

State of California

County of \_\_\_\_\_

Subscribed and sworn to (or affirmed) before me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

by \_\_\_\_\_ proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

(AFFIX SEAL)

\_\_\_\_\_  
NOTARY PUBLIC SIGNATURE

\_\_\_\_\_  
NOTARY PUBLIC PRINTED NAME

## INFORMATION REQUIRED OF BIDDER

The bidder is required to provide the following information. Additional sheets may be attached if necessary.

Contractor's mailing address: \_\_\_\_\_

Contractor's telephone number: \_\_\_\_\_

Number of years experience as a contractor in construction work or installation work similar to that required in these specifications:

\_\_\_\_\_

Name of person who inspected the site of the proposed work for your firm:

\_\_\_\_\_

Date of Inspection: \_\_\_\_\_

List at least four projects completed as of recent date:

Project No. and Title:	_____
Class and Type of Work:	_____
Name, Address, and Phone No. of Owner	_____
Registered Engineer in Charge of Project:	_____
Total Contract amount:	_____
Contract amount you performed:	_____
Name of Prime Contractor if you were Sub:	_____
Date Completed:	_____
Liquidated Damages Assessed:	_____

Project No. and Title:	_____
Class and Type of Work:	_____
Name, Address, and Phone No. of Owner	_____
Registered Engineer in Charge of Project:	_____
Total Contract amount:	_____
Contract amount you performed:	_____
Name of Prime Contractor if you were Sub:	_____
Date Completed:	_____
Liquidated Damages Assessed:	_____

Project No. and Title: \_\_\_\_\_  
Class and Type of Work: \_\_\_\_\_  
Name, Address, and Phone No. of Owner \_\_\_\_\_  
Registered Engineer in Charge of Project: \_\_\_\_\_  
Total Contract amount: \_\_\_\_\_  
Contract amount you performed: \_\_\_\_\_  
Name of Prime Contractor if you were Sub : \_\_\_\_\_  
Date Completed: \_\_\_\_\_  
Liquidated Damages Assessed: \_\_\_\_\_

Project No. and Title: \_\_\_\_\_  
Class and Type of Work: \_\_\_\_\_  
Name, Address, and Phone No. of Owner \_\_\_\_\_  
Registered Engineer in Charge of Project: \_\_\_\_\_  
Total Contract amount: \_\_\_\_\_  
Contract amount you performed: \_\_\_\_\_  
Name of Prime Contractor if you were Sub : \_\_\_\_\_  
Date Completed: \_\_\_\_\_  
Liquidated Damages Assessed: \_\_\_\_\_



IN WITNESS WHEREOF, we have hereunto set our hands and seals on  
this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

BIDDER

\_\_\_\_\_  
(Bidder's Name and Corporate Seal)

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Print Name and Title)

**(ATTACH ACKNOWLEDGMENT OF BIDDER)**

SURETY

\_\_\_\_\_  
(Surety's Name and Corporate Seal)

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Print Name and Title)

**(ATTACH ACKNOWLEDGMENT OF SURETY'S  
ATTORNEY-IN-FACT)**

**NOTE: ATTACH CERTIFIED COPY OF POWER OF ATTORNEY**

**SUB-CONTRACTORS**  
**City Project No. 19-51B**  
**Columbia Pool Improvements**

Prime Contractor: \_\_\_\_\_ DIR NUMBER: \_\_\_\_\_

Pursuant to California Public Contract Code §4100, the Bidder shall list each subcontractor who will perform Work or labor or who will render service to the prime Contractor in or about the construction of the Work or improvement, or a subcontractor duly licensed who, under subcontract to the prime Contractor, specially fabricates and installs a portion of the Work or improvement according to detailed Drawings contained in the Contract Documents, in an amount in excess of 1/2 of 1 percent of the prime Contractor's total Bid or, in the case of Bids or offers for the construction of streets or highways, including bridges, in excess of 1/2 of 1 percent of the prime Contractor's total Bid or \$10,000, whichever is greater. After the opening of Bids, no changes or substitutions will be allowed except as otherwise provided by law. The listing of more than one subcontractor for each item of Work to be performed with the words "and/or" will not be permitted.

IF NO SUBCONTRACTORS WILL FURNISH WORK, THEN WRITE "NONE" BELOW IN THE SPACE PROVIDED.

NAME	LICENSE NUMBER	DIR NUMBER	ADDRESS	WORK ITEMS TO BE PERFORMED AND % OF ITEM





## IRAN CONTRACTING ACT CERTIFICATION

Reference: Public Contract Code Section 2200 et seq.

As required by California Public Contract Code Section 2204, the Contractor certifies subject to penalty for perjury that the option checked below relating to the Contractor's status in regard to the Iran Contracting Act of 2010 (Public Contract Code Section 2200 et seq.) is true and correct:

- The Contractor is not:
  - (i) identified on the current list of persons and entities engaging in investment activities in Iran prepared by the California Department of General Services in accordance with subdivision (b) of Public Contract Code Section 2203; or
  - (ii) a financial institution that extends, for 45 days or more, credit in the amount of \$20,000,000 or more to any other person or entity identified on the current list of persons and entities engaging in investment activities in Iran prepared by the California Department of General Services in accordance with subdivision (b) of Public Contract Code Section 2203, if that person or entity uses or will use the credit to provide goods or services in the energy sector in Iran.
  
- The City of Turlock has exempted the Contractor from the requirements of the Iran Contracting Act of 2010 after making a public finding that, absent the exemption, the City of Turlock will be unable to obtain the goods and/or services to be provided pursuant to the Contract.
  
- The amount of the Contract payable to the Contractor for the Project does not exceed \$1,000,000.

Bidder's Signature: \_\_\_\_\_

Bidder's Name and Title: \_\_\_\_\_

Firm: \_\_\_\_\_

Date: \_\_\_\_\_

Note: In accordance with Public Contract Code Section 2205, false certification of this form shall be reported to the California Attorney General and may result in civil penalties equal to the greater of \$250,000 or twice the Contract amount, termination of the Contract and/or ineligibility to bid on contracts for three years.



## AGREEMENT

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### FOR PUBLIC IMPROVEMENT

**Project No. 19-51B**

#### **Columbia Pool Improvements**

**THIS PUBLIC IMPROVEMENT AGREEMENT** (the “Agreement”) is entered into by and between the CITY OF TURLOCK, a California municipal corporation (“City”), and \_\_\_\_\_, a \_\_\_\_\_ (“Contractor”), on this \_\_\_\_ day of \_\_\_\_\_ 20\_\_ (the “Effective Date”). City and Contractor may be collectively referred to herein as the “Parties” or individually as “Party.” There are no other parties to this Agreement.

#### **RECITALS**

- A. City seeks a duly qualified and licensed firm experienced in the construction of \_\_\_\_\_ (the “Project”).
- B. The Project involves the expenditure of funds in excess of \$5,000 and constitutes a “public project” pursuant to Public Contract Code section 20161.
- C. Contractor has made a proposal to City to provide construction services, a copy of which is attached and incorporated hereto as **Exhibit A** (the “Services”).
- D. City has determined it is necessary and desirable to employ the services of Contractor to perform construction work on the Project.
- E. City has taken appropriate proceedings to authorize construction of the Project and execution of this contract pursuant to Public Contract Code section 20160 et seq.; specifically, on \_\_\_\_\_, 20\_\_, at a duly noticed meeting of the City Council of the City of Turlock, this contract for the construction of the improvements hereinafter described was awarded to Contractor as the lowest responsive and responsible bidder for said improvements.

**NOW, THEREFORE,** in consideration of the promises and covenants set forth below, the Parties agree as follows:

## **AGREEMENT**

**1. Contract Documents:** This Agreement, together with the following documents, are collectively referred to herein as the “Contract Documents”:

- i. Notice to Bidders;
- ii. Contractor’s Bid or Proposal accepted by City;
- iii. General Conditions, Supplementary Conditions, and Special Provisions of the City of Turlock for Columbia Pool Improvements ;
- iv. Plans and detailed drawings prepared for this Project and approved by City (“Project Plans”);
- v. All bonds and insurance required by the Contract Documents;
- vi. Any and all supplemental agreements amending, decreasing, or extending the work contemplated or which may be required to complete the work in a substantial and acceptable manner; and
- vii. The current edition of the City of Turlock Standard Specifications and Drawings.

All of the Contract Documents are intended to incorporate the terms of the others so that any work called for in one and not mentioned in the other, or vice versa, is to be executed the same as if mentioned in all said documents. The documents comprising the complete contract will hereinafter be referred to as the “Contract.” In case of any dispute regarding the terms of the Contract, the decision of the City Engineer shall be final.

**2. Term.** The Contract shall be effective as of the Effective Date first stated above. Contractor shall not commence work on the Project until it has been given notice by City (“Notice to Proceed”). The Contract shall terminate one (1) year(s) after City accepts Contractor’s performance of the Services by recording a Notice of Completion with the County of Stanislaus Clerk Recorder (the “Term”), unless the Parties mutually agree in writing to terminate the Contract earlier or extend the Term in an agreed writing executed by both Parties.

**3. Scope of Work.**

(a) *Services.* Contractor shall perform the Services described in Exhibit A, subject to all terms and conditions in the Contract. Contractor shall not receive additional compensation for the performance of any Services not described therein.

(b) *Modification.* City, at any time, by written order, may make changes within the general scope of the work under this Agreement or issue additional instructions, require additional work or direct deletion of work. Contractor shall not proceed with any change involving an increase or decrease in the Contract Price, as defined in Section 4 of this Agreement, without prior written authorization from City. Contractor shall not be entitled to compensation for the performance of any such unauthorized work. Contractor further waives any and all right or remedy by way of restitution or quantum meruit for any and all extra or changed work performed without express and prior written authorization of City. Notwithstanding the foregoing, Contractor shall promptly commence and diligently complete any change

to the work subject to City's written authorization issued pursuant to this Section ; Contractor shall not be relieved or excused from its prompt commencement of diligent completion of any change subject to City's written authorization by virtue of the absence or inability of Contractor and City to agree upon the extent of any adjustment to the completion schedule or Contract Price on account of such change. The issuance of a change order pursuant to this Section 3 in connection with any change authorized by City shall not be deemed a condition precedent to Contractor's obligation to promptly commence and diligently complete any such change authorized by City hereunder. City's right to make changes shall not invalidate the Contract nor relieve Contractor of any liability or other obligations under the Contract. Any requirement of notice of changes in the scope of work to Contractor's surety shall be the responsibility of Contractor.

(c) *Specific Materials & Performance of Work.* Contractor shall furnish all tools, equipment, facilities, labor, and materials necessary to perform and complete, in good workmanlike manner, the work of general construction as called for and in the manner designated in, and in strict conformity with, the plans and specifications for said work entitled, "**General Conditions and Special Provisions for Columbia Pool Improvements .**" The equipment, apparatus, facilities, labor, and material shall be furnished, and said work performed and completed as required by the Contract under the direction and supervision, and subject to the approval, of the City Engineer of or City Engineer's designated agent.

(d) *Exhibits.* All "Exhibits" referred to below or attached hereto are, by this reference, incorporated into the Contract.

	<u>Exhibit Designation</u>	<u>Exhibit Title</u>
1.	Exhibit A	Scope of Services
2.	Exhibit B	Payment by Force Account
3.	Exhibit C	Workers' Compensation Insurance Certification
4.	Exhibit D	Performance Bond
5.	Exhibit E	Payment Bond

**4. Contract Price.** City shall pay, and Contractor shall accept in full payment for the work set forth above in Section 3, Scope of Work, an amount not to exceed \_\_\_\_\_ **Dollars** (\$ \_\_\_\_\_ .00) (the "Contract Price"). Said amount shall be paid pursuant to Section 8 of this Agreement. The Contract Price may only be changed by a contract change order. The value of any work covered by a contract change order for an adjustment in the Contract Price will be determined in the sole discretion of City as follows:

(a) If the work performed is on the basis of unit prices contained in the Contract Documents, the change order will be determined in accordance with the provisions in Section 4-1.05, "Changes and Extra Work", of the Caltrans Standard Specifications, as applicable; or

(b) If the work performed is not included on the engineer's estimate associated with a unit price, the change order will be by a mutually agreed lump sum; or

(c) If the change order is not determined as described above in either subdivision (a) or (b), the change order will be determined on the basis of force account in accordance with the provisions set forth in **Exhibit B**, "Payment by Force Account," attached hereto and incorporated herein by reference.

**5. Time for Performance.** The time fixed for the commencement of work under the Contract is within ten (10) working days after the Notice to Proceed has been issued. The work on this project, including all punch list items, shall be completed on or before the expiration of **Ninety Five (95)** working days (the “Completion Date”) beginning on the first day of work or no later than the tenth day after the Notice to Proceed has been issued.

(a) *Right of City to Increase Working Days:* If Contractor fails to complete the Services by the Completion Date, the City Engineer shall have the right to increase the number of working days in the amount the City Engineer may determine will best serve the interests of City, and if the City Engineer desires to increase said number of working days, the City Engineer shall have the further right to charge Contractor and deduct from the final payment for the work the actual cost of engineering, inspection, superintendence, and other overhead expenses which are directly chargeable to Contractor, and which accrue during the period of such extension, except that the cost of the final service and preparation of the final estimates shall not be included in such charges. No extension of time for completion of Services under the Contract shall be considered unless requested by Contractor at least twenty (20) calendar days prior to the Completion Date, in writing, to the City Engineer.

The Completion Date may only be changed by a contract change order. The value of any work covered by a contract change order for an adjustment in the Completion Date will be determined as follows:

- i. Additional working days will be awarded where the amount of time is mutually agreed upon by Contractor and the City Engineer; or
- ii. Additional working days will be awarded where Contractor is prevented from completing any part of the work identified on the critical path and:
  1. where the delay is caused by acts of public enemy, fire, floods, tsunamis, earthquakes, epidemics, quarantine restrictions, strikes, labor disputes, shortage of materials and freight embargos, provided that Contractor shall notify Engineer in writing of the causes of delay within fifteen (15) days from the beginning of that delay; or
  2. where the delay is caused by actions beyond the control of Contractor; or
  3. where the delay is caused by actions or failure to act by the City Engineer.

Contractor shall not be entitled to an adjustment in the Completion Date for delays within the control of Contractor. Delays resulting from and within the control of a subcontractor or supplier of Contractor shall be deemed to be delays within the control of Contractor.

(b) *Excusable Delays.* Contractor shall not be in breach of the Contract in the event that performance of Services is temporarily interrupted or discontinued due to a “Force Majeure” event which is defined as: riots, wars, sabotage, civil disturbances, insurrections, or explosions; natural disasters, such as floods, earthquakes, landslides, and fires; strikes, lockouts, and other labor disturbances; or other catastrophic events, which are beyond the reasonable control of Contractor. Force Majeure does not include Contractor’s financial inability to perform, Contractor’s failure to obtain any necessary permits or licenses from other governmental agencies, or Contractor’s failure to obtain the right to use the facilities of any public utility where such failure is due solely to the acts or omissions of Contractor. If Contractor’s performance of the Services is delayed by an excusable delay, the Completion Date shall be

extended for such reasonable time as determined by the City Engineer. Extensions in time must be requested by Contractor within fifteen (15) calendar days of the excusable delay in order to receive consideration.

(c) *Emergency - Additional Time for Performance - Procurement of Materials.* If, because of war or other declared national emergency, the federal or state government restricts, regulates, or controls the procurement and allocation of labor or materials, or both, and if solely because of said restrictions, regulations or controls, Contractor is, through no fault of Contractor, unable to perform the Services, or the work is thereby suspended or delayed, any of the following steps may be taken:

- i. City may, pursuant to resolution of the City Council, grant Contractor additional time for the performance of the Contract, sufficient to compensate in time, for delay or suspension.

To qualify for such extension in time, Contractor within ten (10) days of Contractor's discovering such inability to perform, shall notify the City Engineer in writing thereof, and give specific reasons therefore; the City Engineer shall thereupon have sixty (60) days within which to procure such needed materials or labor as is specified in this agreement, or permit substitution, or provide for changes in the work in accordance with subdivision (b) of this Section.

Substituted materials, or changes in the work, or both, shall be ordered in writing by the City Engineer, and the concurrence of the City Council shall not be necessary. All reasonable expenses of such procurement incurred by the City Engineer shall be defrayed by the Contractor; or

- ii. If such materials or labor cannot be procured through legitimate channels within sixty (60) days after the filing of the aforesaid notice, either Party may, upon thirty (30) days' written notice to the other, terminate this agreement. In such event, Contractor shall be compensated for all work executed upon a unit basis in proportion to the amount of the work completed, or upon a cost-plus-ten-percent (10%) basis, whichever is the lesser. Materials on the ground, in process of fabrication or in route upon the date of notice of termination specially ordered for the Project and which cannot be utilized by Contractor, shall be compensated for by City at cost, including freight, provided Contractor shall take all steps possible to minimize this obligation; or
- iii. The City Council, by resolution, may suspend the Contract until the cause of inability to perform is removed for a period of not to exceed sixty (60) days.

If the Contract is not canceled, and the inability of Contractor to perform continues without fault on Contractor's part, beyond the time during which the Contract may have been suspended, as herein above provided, the City Council may further suspend the Contract, or either Party hereto may, without incurring any liability, elect to declare the Contract terminated upon the ground of impossibility of performance. In the event City declares this agreement terminated, such declaration shall be authorized by the City Council by resolution, and Contractor shall be notified in writing thereof within five (5) days after the adoption of such resolution.

Upon such termination, Contractor shall be entitled to proportionate compensation at the Contract Price for such portion of the Contract as may have been performed; or

- iv. City may terminate the Contract, in which case Contractor shall be entitled to proportionate compensation at the agreed rate for such portion of the Contract as may have been performed. Such termination shall be authorized by resolution of the City Council. Notice thereof shall be forthwith given in writing to Contractor, and the Contract shall be terminated upon receipt by Contractor of such notice.

In the event of the termination provided in this sub-paragraph (iv), none of the covenants, conditions or provisions hereof shall apply to the Services not performed, and City shall be liable to Contractor for the proportionate compensation last herein mentioned.

(d) *Delay Damages.* In the event Contractor, for any reason, fails to perform the Services to the satisfaction of the City Engineer by the Completion Date, City may, in accordance with Section 7203 of the Public Contract Code, in lieu of any other of its rights authorized by Section 6 of this agreement, deduct from payments or credits due Contractor after such breach a sum equal to **Six Thousand** and no/100ths Dollars (**\$6000.00**) for each calendar day beyond the Completion Date. This deduction shall not be considered a penalty but shall be considered as delay damages. The aforementioned rate of deduction is an amount agreed to by the Parties as reasonably representing additional construction engineering costs incurred by City if Contractor fails to complete the Services by the Completion Date. However, any deduction assessed as delay damages shall not relieve Contractor from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed Contractor to complete the Services by the Completion Date. Due account shall be taken of any time extensions granted to Contractor by City. Permitting Contractor to continue work beyond the Completion Date shall not operate as a waiver on the part of City of any of its rights under the Contract nor shall it relieve Contractor from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed Contractor to complete the Services by the Completion Date.

## **6. Termination.**

(a) *Option of City to Terminate Contract for Failure to Complete Services.* If a Party should fail to perform any of its obligations hereunder within the time and in the manner herein provided, or otherwise violates any of the terms of the Contract (the "Defaulting Party"), the other Party shall give notice to the Defaulting Party and allow the Defaulting Party ten (10) days to correct such deficiency. If the Defaulting Party does not correct such deficiency, the other Party may immediately terminate the Contract by giving written notice of such termination, stating the reason for such termination. In such event, Contractor shall be entitled to receive payment for all Services satisfactorily rendered until such termination, provided, however, there shall be deducted from such amount the amount of damage, if any, sustained by virtue of any breach of the Contract by Contractor, including Delay Damages. If payment under the Contract is based upon a lump sum in total or by individual task, payment for Services satisfactorily rendered shall be an amount which bears the same ratio to the total fees specified in this Agreement as the Services satisfactorily rendered hereunder by Contractor to the total services otherwise required to be performed for such total fee, provided, however, that there shall be deducted from such amount the amount of damage, if any sustained by City by virtue of any breach of the

Contract by Contractor. Upon termination, Contractor shall deliver copies of all Work Product, as defined in Section 19 of this Agreement, to City. If District terminates the Contract before Contractor commences any Services hereunder, City shall not be obligated to make any payment to Contractor.

(b) If Contractor should be adjudged bankrupt or if it should make a general assignment for the benefit of its creditors, or if a receiver should be appointed on account of its insolvency, or if it or any of its subcontractors should violate any of the provisions of the Contract, City may serve written notice upon it and its surety of its intention to terminate the Contract. Such notice shall contain the reasons for City's intention to terminate the Contract, and unless such violations shall cease within five (5) calendar days after serving of such notice, the Contract shall cease and terminate upon the expiration of said five (5) calendar days. In the event of any such termination, City shall immediately serve written notice thereof upon the surety and Contractor, and the surety shall have the right to take over and perform the Contract; provided however, that, if the surety does not give City written notice of its intention to take over and perform the Contract or does not commence performance thereof within thirty (30) calendar days from the date of the service of such notice, City may take over the work and prosecute the same to completion by contract or any other method it may deem advisable, for the account and at the expense of Contractor, and Contractor and its surety shall be jointly liable to City for any excess cost occasioned City thereby, and in such event City may, without liability for so doing, take possession of and utilize in completing the work, such materials, appliances, and other property belonging to Contractor as may be on the Project site and necessary thereof.

**7. Liability for Breach:** Neither Party waives the right to recover direct damages against the other for breach of the Contract, including any amount necessary to compensate City for all detriment proximately caused by Contractor's failure to perform its obligations hereunder or which in the ordinary course of things would be likely to result therefrom. City reserves the right to offset such damages against any payments owed to Contractor. City shall not, in any manner, be liable for special or consequential damages, including but not limited to Contractor's actual or projected lost profits had Contractor completed the Services required by the Contract. In the event of termination by either Party, copies of all finished or unfinished Work Product, as defined in Section 19 of this Agreement, shall become the property of City. Notwithstanding the foregoing, in no event shall City be liable, regardless of whether any claim is based on contract or tort, for any special, consequential, indirect or incidental damages, including, but not limited to, lost profits or revenue, arising out of or in connection with the Contract or the Services performed in connection with the Contract.

**8. Compensation:** City shall make payments to Contractor in accordance with the provisions of Section 9 of the General Conditions in legally executed and regularly issued warrants of City, drawn on the appropriate fund or funds as required by law and order of the City Council thereof. Contractor shall be administered a progress payment approximately every thirty (30) calendar days from the time work begins according to the payment schedule furnished by the City Engineer at the time work begins. Contractor shall provide access at all reasonable times to all reports, contract records, contract documents, contract files, and personnel necessary to audit and verify Contractor's charges to City under this Contract.

Monthly progress payments in the amount of 95 percent (95%) of the value of the work will be made to Contractor based on the Contractor's estimate and the schedule of prices contained in the accepted bid. The remaining 5 percent (5%) will be retained by City as partial security for the fulfillment of the Contract except that at any time after 50 percent (50%) of the work has been completed, if the City Engineer finds that satisfactory progress is being made and the Project's critical path of work are on



schedule, City may discontinue any further retention. Such discontinuance will only be made upon the written request of Contractor. City may, at any time the City Engineer finds that satisfactory progress is not being made, again institute retention of 5 percent (5%) as specified above. Payment will be made as soon as possible after the preparation of the Contractor's estimate. City shall pay the remaining 5 percent (5%) of the value of the Services completed under this Contract, if unencumbered by retentions for claims, not sooner than the expiration of thirty-five (35) calendar days from the date of recordation of the Notice of Completion, pursuant to Section 2 of this agreement, and not later than sixty (60) days from the "completion" of the Services as said term is defined in Public Contract Code section 7107(c).

No estimate or payment shall be made if, in the judgment of the City Engineer, the work is not proceeding in accordance with the provisions of the Contract, or when, in his judgment, the total value of the work done since the last estimate amounts to less than \$1,000. No progress payments will be made if the time allotted for the job is thirty (30) working days or less. Payment of any progress payment, or the acceptance thereof by Contractor, shall not constitute acceptance of the work performed under this Contract, or any portion thereof, and shall in no way reduce the liability of Contractor to replace unsatisfactory work or materials, though the unsatisfactory character of such work or materials may not have been apparent or detected at the time such payment was made.

Additionally, as a precondition to City's progress payments hereunder, Contractor shall provide to City, prior to payment, unconditional waivers and releases of stop notices pursuant to Civil Code section 8128 et seq. from each subcontractor and materials supplier. The form of said waivers and releases shall be as set forth in Civil Code section 3262(d)(2).

Pursuant to Public Contract Code section 22300 et seq., Contractor may request the right to substitute securities for any moneys withheld by City to ensure the performance required of Contractor under the Contract, or that City make payment of retentions earned directly into an escrow account established at the expense of Contractor.

**9. Disputes Pertaining to Payment for Work:** Should any dispute arise respecting the true value of any work performed, of any work omitted, or of any extra work which Contractor may be required to do, or respecting the size of any payment to Contractor during the performance of the Contract, such dispute shall be decided by the City Engineer, and the decision of the latter shall be final and conclusive. The Parties agree to comply with the claims resolution procedures set forth in Public Contract Code section 9204 when applicable.

(a) *Claims Processing.* Any submission of a claim by Contractor must comply with the requirements of Public Contract Code section 9204. Upon receipt of a claim pursuant to this section, City shall conduct a reasonable review of the claim and, within a period not to exceed forty-five (45) days, shall provide Contractor a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, the Parties may, by mutual agreement, extend the time period provided in this subdivision. Contractor shall furnish reasonable documentation to support the claim. Any payment due on an undisputed portion of the claim shall be processed and made within sixty (60) days after City issues its written statement. If Contractor disputes City's written response, or if City fails to respond to a claim issued pursuant to this section within the time prescribed, Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute.

(b) *Meet-and-Confer Conference.* Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, City shall schedule a meet-and-confer conference within thirty

(30) days for settlement of the dispute. Within ten (10) business days following the conclusion of the meet-and-confer conference, if the claim or any portion of the claim remains in dispute, City shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within sixty (60) days after the City issues its written statement.

(c) *Nonbinding Mediation.* Any disputed portion of the claim, as identified by Contractor in writing, shall be submitted to nonbinding mediation, with the Parties sharing the associated costs equally. The Parties shall mutually agree to a mediator within ten (10) business days after the disputed portion of the claim has been identified in writing. If the Parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each Party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject judicial review pursuant to Section 23 of this Agreement.

Notwithstanding any claim, dispute, or other disagreement between the Parties regarding performance under the Contract, the scope of work hereunder, or any other matter arising out of or related to, in any manner, the Contract, Contractor shall proceed diligently with performance of the Services in accordance with City's written direction, pending any final determination or decision regarding any such claim, dispute, or disagreement.

**10. Permits and Care of Work:** Contractor shall, at Contractor's expense, obtain all necessary permits and licenses for the construction of each improvement, give all necessary notices and pay all fees and taxes required by law, except those City fees set forth in Section 1 of the Special Provisions. Contractor has examined the Project site and is familiar with its topography and condition, location of property lines, easements, building lines, and other physical factors and limitations affecting the performance of the Contract. Contractor, at Contractor's expense, shall obtain any permission necessary for any operations conducted off the property owned or controlled by City. Contractor shall be responsible for the proper care and protection of all materials delivered and work performed until completion and final acceptance.

**11. Public Works and Payment of Prevailing Wage:**

(a) *Monitoring and Enforcement.* In accordance with the provisions of Sections 1725.5, 1771.1, 1771.3, and 1771.4 of the Labor Code, all work performed under the Contract is subject to compliance monitoring and enforcement by the Department of Industrial Relations (“DIR”). All work performed by Contractor or its subcontractors under the Contract is subject to the requirements of Labor Code section 1720 et seq. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions Code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 of the Labor Code at the time the contract is awarded. Contractor and its subcontractors shall furnish the records specified in Section 1776 of the Labor Code directly to the Labor Commissioner, at least monthly, in the format prescribed by the Labor Commissioner.

In accordance with the provisions of Section 1773.3 of the Labor Code, City shall provide notice to DIR of the award of this Contract within thirty (30) working days of the award. The notice shall be transmitted electronically in a format specified by DIR and shall include the name of Contractor, any

subcontractor listed on the successful bid, the bid and contract award dates, the contract amount, the estimated start and completion dates, Project location, and any additional information DIR specifies that aids in the administration and enforcement of Section 1720 et seq. of the Labor Code.

(b) *Wages & Hours of Employment*: In the performance of the Services under the Contract, eight (8) hours shall be the maximum hours of labor on any calendar day, and the minimum wages of compensation of persons performing labor in the execution of this agreement shall be the current prevailing scale of wages determined by DIR for the community. Contractor shall forfeit as penalty Twenty-five and no/100ths Dollars (\$25.00) to be paid to City for each workman employed in the execution of the Contract by Contractor or its subcontractor(s), for each calendar day during which any workman is required or permitted to labor more than eight (8) hours, in violation of provisions of Labor Code section 1810 et seq. Contractor shall post prevailing wage rates at the Project no later than the first day Contractor commences performance of the Services under the Contract.

**12. Superintendence by Contractor:** Contractor shall give personal superintendence to the work on the Project or have a competent foreman or superintendent satisfactory to the City Engineer on the Project at all times during construction and performance of work under the Contract, with authority to act for Contractor.

**13. Inspection and Testing by City:** Contractor shall at all times maintain proper facilities and provide safe access for inspection by City to all parts of the work performed on the Project and to the shops wherein the work is in preparation. Contractor shall notify City with sufficient time in advance of the manufacture of production materials to be supplied by Contractor under the Contract in order for City to arrange for mill or factory inspection and testing of same. Any materials shipped by Contractor from factory prior to having satisfactorily passed such testing and inspection by City's representative or prior to the receipt of notice from such representative that such testing and inspection will not be required shall not be incorporated on the Project. Contractor shall also furnish to City, in triplicate, certified copies of all factory and mill test reports upon request.

**14. Conformity with Law and Safety:** Contractor shall observe and comply with all applicable laws, ordinances, codes, and regulations of governmental agencies, including federal, state, municipal, and local governing bodies having jurisdiction over any or all of the scope of Services, including all provisions of the Occupational Safety and Health Act of 1979 as amended, all California Occupational Safety and Health Regulations, the California Building Code, the American with Disabilities Act, any copyright, patent, or trademark law, and all other applicable federal, state, municipal, and local safety regulations, appropriate trade association safety standards, and appropriate equipment manufacturer instructions. All Services performed by Contractor or its subcontractors must be in accordance with these laws, ordinances, codes, and regulations. Contractor's failure to comply with any laws, ordinances, codes, or regulations applicable to the performance of the Services hereunder shall constitute a breach of contract. In cases where standards conflict, the standard providing the highest degree of protection shall prevail.

If a death, serious personal injury or substantial property damage occurs in connection with the performance of the Contract, Contractor shall immediately notify City's risk manager by telephone. If any accident occurs in connection with the Contract, Contractor shall promptly submit a written report to City, in such form as City may require. This report shall include the following information: (a) name and address of the injured or deceased person(s); (b) name and address of Contractor's subcontractor, if any; (c) name and address of Contractor's liability insurance carrier; and (d) a detailed description of the accident, including whether any of City's equipment, tools, or materials were involved.

If a release of a hazardous material, substance, or waste occurs in connection with the performance of the Contract, Contractor shall immediately notify City. Contractor shall not store hazardous materials or hazardous waste within City limits without a proper permit from City.

**15. Other Contracts:** City may award other contracts for additional work on the Project, and Contractor shall fully cooperate with such other contractors and carefully fit Contractor's own work to that provided under other contracts as may be directed by the City Engineer. Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor.

**16. Bonds:** Concurrently with the execution hereof, Contractor shall furnish, on the forms provided herein as **Exhibits D and E**, respectively, corporate surety bonds to the benefit of City, issued by a surety company acceptable to City and authorized and admitted to do business in the state of California, as follows:

(a) *Faithful Performance Bond.* In an amount equal to at least one hundred percent (100%) of the Contract Price as security for the faithful performance of the Contract. The bond shall contain a provision that the surety thereon waives the provisions of Sections 2819 and 2845 of the Civil Code.

(b) *Payment Bond.* In an amount equal to at least one hundred percent (100%) of the Contract Price as security for the payment of all persons performing labor and furnishing materials in connection with the Contract. The bond shall be in accordance with the provisions of Sections 3225, 3226, and 3247 through 3252, inclusive, of the Civil Code and Section 13020 of the Unemployment Insurance Code of California. Said bond shall also contain a provision that the surety thereon waives the provisions of Sections 2819 and 2845 of the Civil Code.

The surety companies shall familiarize themselves with all provisions and conditions of the Contract. It is understood and agreed that the surety or sureties waive the right of special notification of any modification or alterations, omissions or reductions, extra or additional work, extensions of time, or any other act or acts by City or its authorized agents under the terms of this Contract and failure to so notify the surety or sureties of such changes shall in no way relieve the surety or sureties of their obligations under the Contract.

**17. Indemnification:**

(a) *Indemnity for Professional Liability.* When the law establishes a professional standard of care for Contractor's Services, to the fullest extent permitted by law, Contractor shall indemnify, protect, defend, and hold harmless City and any and all of its elective and appointive boards, officers, officials, agents, employees or volunteers ("City's Agents") from and against any and all losses, liabilities, damages, costs, and expenses, including legal counsel's fees and costs but only to the extent Contractor or its subcontractors are responsible for such damages, liabilities and costs on a comparative basis of fault between Contractor or its subcontractors and City in the performance of professional services under the Contract. Contractor shall not be obligated to defend or indemnify City for City's own negligence or for the negligence of others.

(b) *Indemnity for other than Professional Liability.* Other than in the performance of professional services and to the full extent permitted by law, Contractor shall indemnify, defend, and hold harmless City and any and City's Agents from and against any liability, including liability for claims, suits, actions,

arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses or costs of any kind, whether actual, alleged or threatened, including legal counsel's fees and costs, court costs, interest, defense costs, and expert witness fees, where the same arise out of, are a consequence of, or are in any way attributable to, in whole or in part, the performance of the Contract by Contractor or by any individual or agency for which Contractor is legally liable, including, but not limited to, officers, agents, employees, or subcontractors of Contractor.

**18. Contractor's Insurance:** Concurrently with the execution hereof, Contractor shall furnish City with satisfactory proof of carriage of the insurance required under this section, and that Contractor shall give City at least sixty (60) days prior notice of the cancellation of any policy during the Term of this contract. Contractor shall not commence work under this Agreement until Contractor has obtained City's approval regarding all insurance requirements, forms, endorsements, amounts, and carrier ratings, nor shall Contractor allow any subcontractor to commence work on a subcontract until all similar insurance required of the subcontractor shall have been so obtained and approved. Contractor shall procure and maintain for the duration of the Contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the Services hereunder by Contractor, its agents, representatives, employees or subcontractors. Failure to maintain or renew coverage or to provide evidence of renewal may constitute a material breach of the Contract. Any available insurance proceeds in excess of the specified minimum limits and coverage shall be available to City.

(a) *General Liability Insurance.* Contractor shall maintain commercial general liability insurance with coverage at least as broad as Insurance Services Office form CG 00 01, in an amount not less than Two Million Dollars (\$2,000,000.00) per occurrence, Four Million Dollars (\$4,000,000.00) general aggregate, for bodily injury, personal injury, and property damage, including, without limitation, blanket contractual liability and coverage for explosion, collapse, and underground property damage hazards. Contractor's general liability policies shall be primary and not seek contribution from City's coverages and be endorsed using Insurance Services Office form CG 20 10 to provide that City and its officers, officials, employees, and agents shall be additional insureds under such policies. For construction contracts, an endorsement providing completed operations to the additional insured, ISO form CG 20 37, is also required. The policy shall contain, or be endorsed to contain, the following provisions:

- (1) City, its elective and appointive boards, officers, agents, employees, and volunteers are to be covered as additional insureds with respect to liability arising out of work or operations performed by or on behalf of Contractor, including materials, parts or equipment furnished in connection with such work or operations, which coverage shall be maintained in effect for at least three (3) years following the completion of the work specified in the Contract. General liability coverage can be provided in the form of an endorsement to Contractor's insurance (at least as broad as CG 20 10 for ongoing operations and CG 20 37 for products/completed operations), or as a separate Owners and Contractors Protective Liability policy providing both ongoing operations and completed operations coverage.
- (2) For any claims related to the Project, Contractor's insurance coverage shall be primary insurance as respects City and any insurance or self-insurance maintained by City shall be excess of Contractor's insurance and shall not contribute with it.

- (3) In the event of cancellation, non-renewal, or material change that reduces or restricts the insurance coverage afforded to City under the Contract, the insurer, broker/producer, or Contractor shall provide City with thirty (30) days' prior written notice of such cancellation, non-renewal, or material change.
- (4) Coverage shall not extend to any indemnity coverage for the active negligence of the additional insured in any case where an agreement to indemnify the additional insured would be invalid under Subdivision (b) of Section 2782 of the Civil Code.

(b) *Workers' Compensation Insurance.* Contractor shall maintain Workers' Compensation Insurance (Statutory Limits) and Employer's Liability Insurance with limits of at least One Million Dollars (\$1,000,000.00). Contractor shall submit to City, along with the certificate of insurance, a Waiver of Subrogation endorsement in favor of City, its officers, agents, employees, and volunteers.

(c) *Auto Insurance.* Contractor shall provide auto liability coverage for owned, non-owned, and hired autos using ISO Business Auto Coverage form CA 00 01, or the exact equivalent, with a limit of no less than Two Million Dollars (\$2,000,000.00) per accident. If Contractor owns no vehicles, this requirement may be met through a non-owned auto endorsement to the CGL policy.

(d) *Builder's Risk Insurance.* Upon commencement of construction and with approval of City, Contractor shall obtain and maintain Builder's Risk/Course of Construction insurance. The policy shall be provided for replacement value on an "all-risk" basis. City shall be named as Loss Payee on the policy and there shall be no coinsurance penalty provision in any such policy. The policy must include: (1) coverage for removal of debris and insuring the buildings, structures, machinery, equipment, materials, facilities, fixtures, and all other properties constituting a part of the project; (2) coverage with limits sufficient to insure the full replacement value of any property or equipment stored either on or off the project site, whether provided from within a Builder's Risk policy or through the addition of an Installation Floater. Such insurance shall be on a form acceptable to City to ensure adequacy of terms and limits. Contractor shall not be required to maintain property insurance for any portion of the Project following transfer of control thereof to City.

(e) *Contractors Pollution Insurance.* Pollution Coverage shall be provided on a Contractors Pollution Liability form, or other form acceptable to City, providing coverage for liability arising out of sudden, accidental, and gradual pollution and remediation. The policy limit shall be no less than One Million Dollars (\$1,000,000.00) per claim. All activities contemplated in the Contract shall be specifically scheduled on the policy as "covered operations." The policy shall provide coverage for the hauling of waste from the Project site to the final disposal location, including non-owned disposal sites.

(f) *Professional Liability Insurance.* When applicable, Contractor shall maintain professional liability insurance that insures against professional errors and omissions that may be made in performing the Services to be rendered in connection with the Contract, in the minimum amount of One Million Dollars (\$1,000,000.00) per claim and in the aggregate. Any policy inception date, continuity date, or retroactive date must be before the effective date of this Agreement, and Contractor agrees to maintain continuous coverage through a period no less than three (3) years after completion of the services required by the Contract.

(g) *Deductibles and Self-Insured Retentions.* Upon request of City, any deductibles or self-insured retentions must be declared to and approved by City. At the option of City, either: (1) the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects City and City's Agents; or (2) Contractor shall provide a financial guarantee satisfactory to City guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

(h) *Acceptability of Insurers.* Insurance is to be placed with insurers with a current A.M. Best's rating of no less than A-:VII or with an insurer to which City has provided prior approval.

(i) *Verification of Coverage.* Contractor shall furnish City with original certificates and amendatory endorsements or copies of the applicable policy language effecting coverage required by this Section 18. All certificates and endorsements are to be received and approved by City before work commences. However, failure to obtain the required documents prior to the work beginning shall not waive Contractor's obligation to provide them. City reserves the right, at any time, to require complete, certified copies of all required insurance policies and endorsements.

(j) *Waiver of Subrogation.* With the exception of professional liability, Contractor hereby agrees to waive subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. The commercial general liability policy and workers' compensation policy shall be endorsed to contain a waiver of subrogation in favor of City for all work performed by Contractor, its agents, employees, independent contractors and subcontractors. Contractor agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation.

(k) *Subcontractors.* Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.

**19. Ownership of Work Product:** Any and all work, artwork, copy, posters, billboards, photographs, videotapes, audiotapes, systems designs, software, reports, designs, specifications, drawings, diagrams, surveys, source codes, professional or technical information or data, photographs, notes, letters, emails, or any original works of authorship created by contractor or its subcontractors or subcontractors in connection with Services performed under the Contract ("Work Product") shall be works for hire as defined under Title 17 of the United States Code, and all copyrights in such works are the property of City. In the event that it is ever determined that any Work Product created by Contractor or its subcontractors or subcontractors under the Contract are not works for hire under U.S. law, Contractor hereby assigns all copyrights to such Work Product to City. With the prior written approval of the City Engineer, Contractor may retain and use copies of such Work Product for reference and as documentation of its experience and capabilities.

All Work Product shall become the property of City irrespective of where located or stored and Contractor agrees to deliver all such documents and information to City, without charge and in whatever form it exists, upon the Completion Date, as may be extended. Contractor shall have no ownership interest in such Work Product.

All Work Product of Contractor under the Contract, including written information which City will cause to be distributed for either internal or public circulation, including both preliminary and final drafts, shall be delivered to City in both printed and electronic form, or as may be specific in Exhibit A.

When the Contract is terminated, Contractor agrees to return to City all documents, drawings, photographs, and other written or graphic material, however produced, that it received from City or City's Agents, in connection with the performance of its Services under the Contract. All materials shall be returned in the same condition as received.

**20. Taxes:** Payment of any taxes, including California sales and use taxes, levied upon the Contract, the transaction, or the Services or goods delivered pursuant hereto, shall be the obligation of Contractor. Contractor shall cooperate with City to the full extent possible to maximize the local allocation of California sales and use tax to City. Such cooperation shall include, but not be limited to:

(a) *Use Tax Direct Payment Permits.* Contractor shall apply for, obtain, and utilize, to the maximum extent reasonable, a California Use Tax Direct Payment Permit.

(b) *Purchases of \$500,000 or More.* Contractor shall require vendors and suppliers located outside California from whom Contractor makes purchases of \$500,000 or more to allocate the use tax to City.

**21. Independent Contractor:** At all times during the Term of the Contract, Contractor shall be deemed to be an independent contractor and shall be wholly responsible for the manner in which Contractor performs the Services required under the Contract. Contractor shall be liable for its acts and omissions, and those of its employees, contractors, subcontractors, representatives, volunteers, and its agents. Nothing contained herein shall be construed as creating an employment, agency, or partnership relationship between City and Contractor. City shall have the right to control Contractor only insofar as the result of Contractor's Services rendered pursuant to the Contract; however, City shall not have the right to control the means by which Contractor accomplishes Services rendered pursuant to the Contract.

**22. Contractor Not Agent:** Except as City may specify in writing, Contractor shall have no authority, express or implied, to act on behalf of City in any capacity whatsoever as an agent. Contractor shall have no authority, express or implied, pursuant to the Contract to bind City to any obligation whatsoever.

**23. Arbitration of Disputes:** All claims, disputes, and other matters in question between City and Contractor arising out of, or relating to, this Contract or the breach thereof, including claims of Contractor for extra compensation of Services related to the project, shall be decided by arbitration before a single arbitrator in accordance with the provisions of Sections 1281 through 1284.2 of the Code of Civil Procedure (the "Arbitration Laws") unless the Parties mutually agree otherwise. The provisions of Section 1283.05 of the Arbitration Laws apply to any arbitration proceeding except as otherwise provided in the Contract. The arbitrator shall have authority to decide all issues between the Parties including, but not limited to, claims for extras, delay, and liquidated damages, if any, provided for the Contract, matters involving defects in the Services performed by Contractor or its subcontractors, rights to payment, and whether the necessary procedures for arbitration have been followed. The award rendered by the arbitrator shall be final and judgment may be entered upon it in accordance with applicable law in any court having competent jurisdiction thereof.



Notice of the demand for arbitration shall be filed in writing with the other Party. The demand for arbitration shall be made within a reasonable time after the claim, dispute, or other matter in question has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such claim, dispute, or other matter in question would be barred by the applicable statute of limitations.

The parties shall jointly appoint an arbitrator within fifteen (15) calendar days of the date of giving the notice of the demand for arbitration. If the Parties are unable to jointly agree upon the appointment of an arbitrator within said fifteen (15) calendar day period, and do not agree in writing to extend said period for a fixed period, then either Party may seek to have the arbitrator appointed by the Superior Court of Stanislaus County in accordance with the Arbitration Laws.

If any proceeding is brought to contest the right to arbitrate and it is determined that such right exists, the losing Party shall pay all costs and attorney's fees incurred by the prevailing Party.

In addition to the other rules of law which may be applicable to any arbitration hereunder, the following shall apply:

(a) Promptly upon the filing of the arbitration, each Party shall be required to set forth in writing and to serve upon each other Party a detailed statement of its contentions of fact and law.

(b) All Parties to the arbitration shall be entitled to the discovery procedures provided under Section 1283.05 of the California Code of Civil Procedure.

(c) The arbitration shall be commenced and conducted as expeditiously as possible consistent with affording reasonable discovery as provided herein.

(d) These additional rules shall be implemented and applied by the arbitrator.

The costs of arbitration shall be borne by the Parties as determined by the arbitrator, but each Party shall bear its own attorney's fees associated with the dispute with the other Party and to the arbitration.

All administrative remedies required under Section 9 of this Agreement or pursuant to Public Contract Code section 9204, or required by any other law, shall be exhausted prior to commencement of any arbitration under this Section 23.

**24. Provisions Cumulative:** The provisions of the Contract are cumulative, and in addition to and not in limitation of, any other rights or remedies available to City.

**25. Notices:** All notices shall be in writing and delivered in person or transmitted by certified mail, postage prepaid. Any Party hereto may at any time, by giving ten (10) days' written notice to the other Party hereto, designate any other address in substitution of the address to which such notice or communication shall be given. Such notices or communications shall be given to the Parties at their addresses set forth below.

If to City:

**City of Turlock  
Attn: City Engineer  
156 S. Broadway, Suite 150  
Turlock, CA 95380-5461**

With courtesy copies to:

**Petrulakis Law & Advocacy, APC  
Attn: George A. Petrulakis, Interim City Attorney  
P.O. Box 92  
Modesto, Ca 95353**

If to Contractor:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

If to Contractor's Sureties:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**26. City Contract Administrator:** The City's contract administrator and contact person for this Agreement is:

Gloria Aguilar  
City of Turlock Engineering Division  
156 S. Broadway, Suite 150  
Turlock, California 95380-5461  
Telephone: (209) 668-5520  
E-mail: Gaguilard@turlock.ca.us

**27. Interpretation:** As used herein, any gender includes each other gender, the singular includes the plural and vice versa.

**28. Antitrust Claims:** Contractor or its subcontractors offer and agree to assign to City all rights, title, and interest to any causes of action under Section Four of the Clayton Act and the Cartwright Act concerning antitrust claims.

**29. Use of City Project Number:** Contractor or its subcontractors agree to use the aforementioned City project number on all maps, drawings, submittals, billing, and written correspondence that involve City staff or contracted consultants. Nothing in this section shall preclude Contractor or its subcontractors from using their own project numbers for their own internal use.

**30. No Conflict of Interest:** Contractor represents that no conflict of interest will be created under state or federal law by entering into or in carrying out the Contract.

**31. Confidentiality:** Contractor understands and agrees that, in the performance of Services under the Contract, or in the contemplation thereof, Contractor may have access to private or confidential information that may be owned or controlled by City and that such information may contain proprietary or confidential details, the disclosure of which to third parties may be damaging to City (“Confidential Information”). Contractor shall not, either during or after the Term, disclose to any third party any Confidential Information without the prior written consent of City. If City gives Contractor written authorization to make any such disclosure, Contractor shall do so only within the limits and to the extent of that authorization. Contractor may be directed or advised by the City Attorney on various matters relating to the performance of Services on the Project or on other matters pertaining to the Project, and in such event, Contractor agrees that it will treat all communications between itself, its employees, and its subcontracts as being communications which are within the attorney-client privilege.

**32. Modification.** No alteration, amendment, modification, or termination of the Contract shall be valid unless made in writing and executed by all Parties to the Contract.

**33. Waiver:** No covenant, term, or condition or the breach thereof shall be deemed waived, except by written consent of the Party against whom the waiver is claimed, and any waiver of the breach of any covenant, term, or condition shall not be deemed to be a waiver of any preceding or succeeding breach of the same or any other covenant, term, or condition.

**34. Assignment:** No Party to the Contract shall assign, transfer, or otherwise dispose of this Agreement in whole or in part to any individual, firm, or corporation without the prior written consent of the other Party. Subject to the foregoing provisions, the Contract shall be binding upon, and inure to the benefit of, the respective successors and assigns of the Parties hereto.

**35. Authority:** All Parties to this Agreement warrant and represent that they have the power and authority to enter into this Agreement and the names, titles, and capacities herein stated on behalf of any entities, persons, states, or firms represented or purported to be represented by such entities, person, states, or firms and that all former requirements necessary or required by state or federal law in order to enter into the Contract have been fully complied with. Further, by entering into this Agreement, neither Party hereto shall have breached the terms or conditions of any other contract or agreement to which such Party is obligated, which such breach would have a material effect hereon.

**36. Governing Law:** The Contract shall be governed and construed in accordance with the laws of the state of California.

**37. Severability:** If the Contract in its entirety is determined by an arbitrator or a court of competent jurisdiction to be invalid or unenforceable, the Contract shall automatically terminate as of the date of final entry of judgment. If any provision of the Contract shall be determined to be invalid and unenforceable, or if any provision of the Contract is rendered invalid or unenforceable according the terms of any federal or state statute, which becomes effective after the Effective Date of this Agreement, the remaining provisions shall continue in full force and effect and shall be construed to give effect to the intent of this Agreement.

**38. Counterparts:** This Agreement may be executed simultaneously and in several counterparts, each of which shall be deemed an original but together shall constitute one and the same instrument.

**39. Mandatory and Permissive:** “Shall” and “will” and “agrees” are mandatory. “May” and “can” are permissive.

**40. Headings:** Headings used in this Agreement are for reference purposes only and shall not be considered in construing this Agreement.

**41. Attorney’s Fees and Costs:** Except as expressly provided for in Section 23 of this Agreement, if any action at law or in equity, including action for declaratory relief, is brought to enforce or interpret the provisions of the Contract, the prevailing Party shall be entitled to reasonable attorney’s fees and costs, which may be set by the court in the same action or in a separate action brought for that purpose, in addition to any other relief to which such Party may be entitled.

**42. Necessary Acts and Further Assurances:** The Parties shall, at their own cost and expense, execute and deliver such further documents and instruments and shall take such other actions as may be reasonably required or appropriate to evidence or carry out the intent and purposes of the Contract.

**43. Recitals:** The recitals set forth above (“Recitals”) are true and correct and are hereby incorporated into and made part of this Agreement by this reference. In the event of any inconsistency between the Recitals and Section 1 through 43 of this Agreement, Sections 1 through 43 shall prevail.

***[Signatures on Following Page]***

**IN WITNESS WHEREOF**, two identical counterparts of this agreement, consisting of a total of \_\_\_ pages, each of which counterparts shall for all purposes be deemed an original of said agreement, have been duly executed by the parties hereinabove named, on the day and year first herein above written.

**CONTRACTOR**

**CITY OF TURLOCK, a municipal corporation**

By: \_\_\_\_\_

By: \_\_\_\_\_  
Reagan M. Wilson, City Manager

\_\_\_\_\_  
Print Name

Date: \_\_\_\_\_

Address: \_\_\_\_\_

APPROVED AS TO SUFFICIENCY:

\_\_\_\_\_

Phone: \_\_\_\_\_

By: \_\_\_\_\_  
William D. Morris, P.E., City Engineer

Date: \_\_\_\_\_

Federal Tax ID or Social Security No:

APPROVED AS TO FORM:

\_\_\_\_\_

By: \_\_\_\_\_  
George A. Petrulakis, City Attorney

DIR Registration Number:

ATTEST:

\_\_\_\_\_

By: \_\_\_\_\_  
Julie Christel, City Clerk

Attach Contractor's Seal Here

**EXHIBIT A**  
**CONTRACTOR'S PROPOSAL FOR SERVICES**

**EXHIBIT B**  
**PAYMENT BY FORCE ACCOUNT**

For work paid by force account, the City Engineer compares City's records to Contractor's daily force account work report. When the City Engineer and Contractor agree on the contents of the daily force account work reports, the City Engineer accepts the report and City pays for the work. If the records differ, City pays for the work based only on the information shown on City's records. If a subcontractor performs work at force account, work paid at force account will be accepted at an additional 2 percent (2%) markup to the total cost of that work, including markups, as reimbursement for additional administrative costs. The markups specified in labor, materials, and equipment includes compensation for all delay costs, overhead costs, and profit. If an item's unit price is adjusted for work-character changes, City excludes Contractor's cost of determining the adjustment. Payment for owner-operated labor and equipment is made at the market-priced invoice submitted.

**A. Labor.** Labor payment is full compensation for the cost of labor used in the direct performance of the work plus a fifteen percent (15%) markup, as set forth below, and consistent with California Labor Code section 1770 et seq. Force account labor payment consists of:

1. Employer payment to the worker for:
  - 1.1 Basic hourly wage
  - 1.2 Health and welfare
  - 1.3 Pension
  - 1.4 Vacation
  - 1.5 Training
  - 1.6 Other State and federal recognized fringe benefit payments
  
2. Labor surcharge percentage in *Labor Surcharge and Equipment Rental Rates* current during the work paid at force account for:
  - 2.1 Workers' compensation insurance
  - 2.2 Social security
  - 2.3 Medicare
  - 2.4 Federal unemployment insurance
  - 2.5 State unemployment insurance
  - 2.6 State training taxes
  
3. Subsistence and travel allowances paid to the workers
  
4. Employer payment to supervisors, if authorized

The fifteen percent (15%) markup consists of payment for all overhead costs related to labor but not designated as costs of labor used in the direct performance of the work including:

- (a) Home office overhead
- (b) Field office overhead
- (c) Bond costs
- (d) Profit
- (e) Labor liability insurance

- (f) Other fixed or administrative costs that are not costs of labor used in the direct performance of the work

**B. Materials.** Material payment is full compensation for materials the Contractor furnishes and uses in the work. The City Engineer determines the cost based on the material purchase price, including delivery charges, except:

- 1. A fifteen percent (15%) markup is added;
- 2. Supplier discounts are subtracted whether the Contractor takes them or not;
- 3. If the City Engineer believes the material purchase prices are excessive, City pays the lowest current wholesale price for a similar material quantity;
- 4. If Contractor procured the materials from a source Contractor wholly or partially own, the determined cost is based on the lower of the:
  - 4.1 Price paid by the purchaser for similar materials from that source on Contract items; and
  - 4.2 Current wholesale price for those materials;
- 5. If Contractor does not submit a material cost record within thirty (30) days of billing, the determined cost is based on the lowest wholesale price:
  - 5.1 During that period
  - 5.2 In the quantities used

**C. Equipment Rental.** Equipment rental payment is full compensation for:

- 1. Rental equipment costs, including moving rental equipment to and from the change order work site using its own power.
- 2. Transport equipment costs for rental equipment that cannot be transported economically using its own power. No payment is made during transport for the transported equipment.
- 3. Fifteen percent (15%) percent markup.

If Contractor wants to return the equipment to a location other than its original location, the payment to move the equipment must not exceed the cost of returning the equipment to its original location. If Contractor uses the equipment for work other than work paid by force account, the transportation cost is included in the other work.

Before moving or loading the equipment, Contractor must obtain authorization for the equipment rental's original location.

The City Engineer determines rental costs:

- 1. Using rates in *Labor Surcharge and Equipment Rental Rates*:



- 1.1. By classifying equipment using manufacturer's ratings and manufacturer-approved changes.
- 1.2. Current during the work paid by force account.
- 1.3. Regardless of equipment ownership but City uses the rental document rates or minimum rental cost terms if:
  - 1.3.1. Rented from equipment business Contractor does not own.
  - 1.3.2. The Labor Surcharge and Equipment Rental Rates hourly rate is \$10.00 per hour or less.
2. Using rates established by the City Engineer for equipment not listed in *Labor Surcharge and Equipment Rental Rates*. Contractor may submit cost information that helps the City Engineer establish the rental rate but City uses the rental document rates or minimum rental cost terms if:
  - 2.1. Rented from equipment business Contractor does not own.
  - 2.2. The City Engineer establishes a rate of \$10.00 per hour or less.
3. Using rates for transport equipment not exceeding the hourly rates charged by established haulers.

Equipment rental rates include the cost of:

- |   |                            |
|---|----------------------------|
| 1. Fuel                                     | 7. Repairs and maintenance |
| 2. Oil                                      | 8. Depreciation            |
| 3. Lubrication                              | 9. Storage                 |
| 4. Supplies                                 | 10. Insurance              |
| 5. Small tools that are not consumed by use | 11. Incidentals            |
| 6. Necessary attachments                    |                            |

City pays for small tools consumed by use. The City Engineer determines payment for small tools consumed by use based on Contractor-submitted invoices.

The City Engineer may authorize rates in excess of those in the *Labor Surcharge and Equipment Rental Rates* if:

1. Contractor submits a request to use rented equipment
2. Equipment is not available from Contractor's normal sources or from one of Contractor's subcontractors
3. Rented equipment is from an independent rental company
4. Proposed equipment rental rate is reasonable
5. The City Engineer authorizes the equipment source and the rental rate before Contractor uses the equipment

**D. Equipment on the Job Site.** For equipment on the job site at the time required to perform work paid by force account, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to move the equipment to another location on the job site when the work paid by force account is completed

2. To load and unload equipment
3. Equipment is operated to perform work paid by force account and:
  - 3.1. Hourly rates are paid in 1/2-hour increments
  - 3.2. Daily rates are paid in 1/2-day increments

**E. Equipment Not on the Job Site Required for Original-Contract Work.** For equipment not on the job site at the time required to perform work paid by force account and required for original-Contract work, the time paid is the time the equipment is operated to perform work paid by force account and the time to move the equipment to a location on the job site when the work paid by force account is completed.

The minimum total time paid is:

1. 1 day if daily rates are paid
2. 8 hours if hourly rates are paid

If daily rates are recorded, equipment:

1. Idled is paid as 1/2 day
2. Operated four (4) hours or less is paid as 1/2 day
3. Operated four (4) hours or more is paid as one (1) day

If the minimum total time exceeds eight (8) hours and if hourly rates are listed, City rounds up hours operated to the nearest 1/2-hour increment and pays based on the hours shown in the following table. The table does not apply when equipment is not operated due to breakdowns, in which case rental hours are the hours the equipment was operated.

**Equipment Rental Hours**

Hours operated	Hours paid
0.0	4.00
0.5	4.25
1.0	4.50
1.5	4.75
2.0	5.00
2.5	5.25
3.0	5.50
3.5	5.75
4.0	6.00
4.5	6.25
5.0	6.50
5.5	6.75
6.0	7.00
6.5	7.25
7.0	7.5
7.5	7.75
≥8.0	hours used

**F. Equipment Not on the Job Site Not Required for Original-Contract Work.** For equipment not on the job site at the time required to perform work paid by force account and not required for original-Contract work, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to return the equipment to its source when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account

**G. Non-Owner-Operated Dump Truck Rental.** Contractor shall submit the rental rate for non-owner-operated dump truck rental to City. The City Engineer shall determine the payment rate. Payment for non-owner-operated dump truck rental is for the cost of renting a dump truck, including its driver. For the purpose of markup payment only, the non-owner-operated dump truck is rental equipment and the owner is a subcontractor.

The above markups shall constitute full compensation for all home office overhead, field office overhead, bond costs, profit, labor liability insurance, and other fixed or administrative costs that are not costs specifically designated as cost or equipment rental as stated above. The total payment made as provided above shall be deemed to be the actual cost of the work and shall constitute full compensation therefor.

When extra work to be paid for on a force account basis is performed by a subcontractor, an additional markup of 2 percent (2%) will be added to the total cost of that extra work including all markups specified in this Section. The additional 2 percent (2%) markup shall reimburse Contractor for additional administrative costs, and no other additional payment will be made by reason of performance of the extra work by a subcontractor.

**WORKERS' COMPENSATION INSURANCE CERTIFICATION**

Pursuant to Section 18(b) of the Agreement, Contractor certifies as follows:

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_  
(Typed or Printed Name)

Business Address (Street Address, City, State & Zip Code):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Business Phone: (     ) \_\_\_\_\_

**PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the **City of Turlock**, State of California, has awarded to \_\_\_\_\_, hereinafter designated as the “Principal,” a contract for **Project No. 19-51B, “Columbia Pool Improvements ”**; and,

WHEREAS, said Principal is required under the terms of said contract to furnish a bond for the faithful performance of said contract.

NOW, THEREFORE, we the Principal, and \_\_\_\_\_ as Surety, are held and firmly bound unto the City of Turlock in the penal sum of \_\_\_\_\_ (\$\_\_\_\_\_), lawful money of the United States for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if the above bounden Principal, or Principal’s heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in said contract and any alteration thereof made as therein provided, on the Principal’s part, to be kept and performed at the time and in the manner therein specified and in all respects according to their true intent and meaning; and shall defend, indemnify and save harmless the City of Turlock, its officers and agents as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and virtue.

And the Surety, for value received hereby stipulates and agrees that, in accordance with the Plans, Standard Specifications, Special Provisions, and other contract documents, no change, extension of time, alteration, or addition to the terms of the contract, or to the work to be performed hereunder, or to the specifications accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration of additions to the terms of the Contract to the work, or to the specifications.

The City of Turlock reserves the right to refuse use of any Contractor assigned by any surety to complete the work.

*[Signatures on Following Page]*

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their seals this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

(Corporate Seal)

**Principal** \_\_\_\_\_

By \_\_\_\_\_

Title \_\_\_\_\_

(Attach Notarial Acknowledgment)

(Corporate Seal)

**Surety** \_\_\_\_\_

Address \_\_\_\_\_

Phone No.: ( ) \_\_\_\_\_ Fax No.: ( ) \_\_\_\_\_

\_\_\_\_\_

By \_\_\_\_\_

Attorneys-in-Fact

Title \_\_\_\_\_

(Attach Notarial Acknowledgment)

**NOTE TO SURETY COMPANY: There must be submitted a certified copy of unrevoked resolution of authority for the attorneys-in-fact.**

(Seal)

**Witness** \_\_\_\_\_

Approved as to form:

\_\_\_\_\_  
Risk Manager

**PAYMENT BOND**

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the **City of Turlock**, a municipal corporation, has awarded to \_\_\_\_\_, hereinafter designated as the “Principal”, a contract for **Project No. 19-51B, “Columbia Pool Improvements ”**; and

WHEREAS, said Principal is required to furnish a bond in connection with said contract, to secure payment of claims of laborers, mechanics, or materialmen employed on work under said contract, as provided by law.

NOW, THEREFORE, we the undersigned Principal and Surety are held and firmly bound unto the City of Turlock in the sum of \_\_\_\_\_ (\$\_\_\_\_\_), said sum being equal to the estimated amount payable by said City of Turlock under the terms of the contract, for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that if said Principal, or Principal’s heirs, executors, administrators, successors, or assigns, or subcontractors shall fail to pay for any material, provisions, provender, or other supplies, implements, or machinery used in, upon, for or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Code with respect to such work or labor, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board from these wages of employees of the Contractor and Contractor’s subcontractors pursuant to the Revenue and Taxation Code, with respect to such work and labor, the Surety or Sureties hereon will pay for the same in an amount not exceeding the sum specified in this bond, otherwise the above obligation shall be void. In case suit is brought upon this bond, said Surety will pay a reasonable attorney’s fee to be fixed by the court.

This bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under Section 3138 of the Civil Code of the State of California so as to give a right of action to them or their assigns in any suit brought upon this bond.

Said Surety, for value received, hereby stipulates and agrees that, in accordance with the Plans, Standard Specifications, Special Provisions, and other Contract Documents, no change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed there under, or to the specifications accompanying the same, shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work, or to the specifications.

*[Signatures on Following Page]*

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their seals this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

(Corporate Seal)

**Principal** \_\_\_\_\_

By \_\_\_\_\_

Title \_\_\_\_\_

(Attach Notarial Acknowledgment)

(Corporate Seal)

**Surety** \_\_\_\_\_

Address \_\_\_\_\_

Phone No.: ( ) \_\_\_\_\_ Fax No.: ( ) \_\_\_\_\_

\_\_\_\_\_

By \_\_\_\_\_

Attorneys-in-Fact

Title \_\_\_\_\_

(Attach Notarial Acknowledgment)

**NOTE TO SURETY COMPANY: There must be submitted a certified copy of unrevoked resolution of authority for the attorneys-in-fact.**

(Seal)

**Witness** \_\_\_\_\_

Approved as to form:

\_\_\_\_\_

Risk Manager



# SPECIAL PROVISIONS

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City Project No: 19-51B

## Columbia Pool Improvements

### SECTION 1 SPECIFICATIONS AND PLANS

#### SPECIAL NOTES:

1. Official bid documents including plans and specifications are available online at <http://www.cityofturlock.org/capitalprojects>. All bids submitted for this project must conform to the requirements of the official bid documents, including plans and specifications.
2. An optional pre-bid meeting will be held at the Engineering Conference Room at Turlock City Hall on Tuesday, August 29, 2023 at 10:00AM.

#### 1.01 CONTRACT DOCUMENTS:

The work described herein shall be done in accordance with the current City of Turlock Standard Specifications and the 2018 Edition of the State of California, Department of Transportation Standard Specifications and Standard Plans and in accordance with the following Special Provisions.

The Contract Documents are complementary; what is required by one is as binding as if required by all.

It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to City.

Clarifications and interpretations of the Contract Documents shall be issued by Engineer.

In case of conflict or discrepancy between any of the Contract Documents, the order of documents listed below shall be the order of precedence, with the first item listed having the highest precedence.

1. Contract Change Order (Modifications or changes last in time are first in precedence).
2. Addenda to Contract Agreement
3. Contract Agreement
4. Permits
5. Special Provisions
6. Notice Inviting Bids and Instructions to Bidders
7. Project Drawings
8. City of Turlock Standard Specifications
9. City of Turlock Standard Drawings
10. Caltrans Standard Specifications

## 11. Caltrans Standard Plans

With regards to discrepancies or conflicts between written dimensions given on drawings and the scaled measurements, the written dimensions shall govern.

With regards to discrepancies or conflicts between large-scale drawings and small-scale drawings, the larger scale shall govern.

With regards to discrepancies or conflicts between detailed drawings and referenced standard drawings or plans, the detailed drawings shall govern.

In the event where provisions of codes, safety orders, contract documents, referenced manufacturer's specifications or industry standards are in conflict, the more restrictive and higher quality shall govern.

Should it appear that the work to be done or any of the matters relative thereto are not sufficiently detailed or explained in these specifications, the special provisions, or the plans, the Contractor shall apply to the Engineer in writing for such further explanations as may be necessary and shall conform to them as part of the contract. All responses from the Engineer shall also be in writing. In the event of any doubt or question arising respecting the true meaning of these specifications, the special provisions or the plans, reference shall be made to the Engineer, whose decision thereon shall be final.

### **1.02 CONTRACTOR'S RESPONSIBILITY:**

The Contractor shall examine carefully the site of the work and the plans and specifications therefore. The Contractor shall investigate to their satisfaction as to conditions to be encountered, the character, quality and quantity of surface, subsurface materials or obstacles to be encountered, the work to be performed, materials to be furnished, and as to the requirements of the bid, plans and specifications of the contract.

### **1.03 COMPLETENESS AND ACCURACY OF PLANS AND SPECIFICATIONS:**

Pursuant to the California Public Contract Code, the bidder is required to review architectural or engineering plans and specifications prior to submission of a bid, and report any errors and omissions noted by Contractor to the architect, engineer or owner five days prior to the bid opening date.

## **SECTION 2 PROPOSAL REQUIREMENTS AND CONDITIONS**

### **2.01 GENERAL:**

The Contractor's attention is directed to the "Notice to Contractor" for the date, time and location of the mandatory Pre-Bid meeting, if applicable.

The bidder's attention is directed to the provisions in Proposal for this bid for the requirements and conditions which the bidder must observe in the preparation of and the submission of the bid.

The bidder's bond shall conform to the bond form in the Bid book for the project and shall be properly filled out and executed. The bidder's bond form included in that book must be used.

In conformance with Public Contract Code Section 7106, a Noncollusion Affidavit is included in the Bid book. Signing the Bid book shall also constitute signature of the Noncollusion Affidavit.

The contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of Title 49 CFR (Code of Federal Regulations) part 26 in the award and administration of US DOT assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the recipient deems appropriate. Each subcontract signed by the bidder must include this assurance.

Failure of the bidder to fulfill the requirements of the Special Provisions for submittals required to be furnished after bid opening, including but not limited to escrowed bid documents, where applicable, may subject the bidder to a determination of the bidder's responsibility in the event it is the apparent low bidder on a future public works contracts.

## **2.02 EXISTING UTILITIES, FACILITIES, AND SITE CONDITIONS:**

The actual sizes, locations and materials of existing utilities and facilities shown on the plans may vary from what is shown on the plans. Attention is directed to the possible existence of underground facilities not indicated on the plans or in the special provisions. Contractor shall be responsible for verifying the locations and nature of the existing utilities, protecting them from damage and notifying Engineer of their location and nature.

Contractor shall examine carefully the site of the work. It is assumed that Contractor has investigated and is satisfied as to the conditions to be encountered as to the character, quality and quantities of work to be performed.

Unless otherwise noted in a geotechnical report made available to the Contractor for the project, Contractor shall assume for bidding purposes that near surface native soil material is generally homogenous and that soil meets the uniform soil classification of a silty sand (SM) without cementation.

If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any technical data on which Contractor is entitled to rely is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith, notify Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith until instructed in writing to do so. After receipt of written notice, Engineer will promptly review the pertinent condition and advise in writing (with a copy to Contractor) of Engineer's findings and conclusions.

The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; provided that such condition meets any one or more of the categories described in the paragraphs above.

Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

1. Contractor knew of the existence of such conditions prior to the submission of a Bid; or
2. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's submittal of a bid; or
3. Contractor failed to give the written notice as required above.

Full compensation for furnishing all labor, materials, tools, equipment (including dewatering devices), and incidentals, and for doing all the work involved with and/or in verifying existing utilities, facilities, site and subsurface conditions as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

### **2.03 ESCROW BID DOCUMENTS:**

#### 1. SCOPE

The lowest Bidder shall submit, within the specified time after receipt of Bids, one copy of all documentary information generated in preparation of Bid prices for this Project. This material is hereinafter referred to as "Escrow Bid Documents." The Escrow Bid Documents of the Successful Bidder will be held in escrow for the duration of the contract.

The Successful Bidder agrees, as a condition of award of the contract, that the Escrow Bid Documents constitute the complete, only, and all documentary information used in preparation of his Bid. No other Bid preparation information shall be considered in resolving disputes.

Nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract Documents.

#### 2. OWNERSHIP

The Escrow Bid Documents are, and shall always remain, the property of CONTRACTOR, subject only to joint review by OWNER and CONTRACTOR, as provided herein.

OWNER stipulates and expressly acknowledges that the Escrow Bid Documents, as defined herein, constitute trade secrets. This acknowledgment is based on OWNER's express understanding that the information contained in the Escrow Bid Documents is not known outside the Bidder's business, is known only to a limited extent and only by a limited number of employees of the Bidder, is safeguarded while in Bidder's possession, is extremely valuable to Bidder, and could be extremely valuable to Bidder's competitors by virtue of it reflecting Bidder's

contemplated techniques of construction. OWNER acknowledges that the Bidder expended substantial sums of money in developing the information included in the Escrow Bid Documents and further acknowledges that it would be difficult for a competitor to replicate the information contained therein. OWNER further acknowledges that the Escrow Bid Documents and the information contained therein are made available to OWNER only because such action is an express prerequisite to award of the contract. OWNER further acknowledges that the Escrow Bid Documents include a compilation of information used in the Bidder's business, intended to give the Bidder an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. OWNER agrees to safeguard the Escrow Bid Documents, and all information contained therein, against disclosure to the fullest extent permitted by law.

### 3. PROGRAM

Escrow Bid Documents will be used to assist in the negotiation of price adjustments and Change Orders and in the settlement of disputes, claims, and other controversies. They will not be used for pre-award evaluation of CONTRACTOR's anticipated methods of construction or to assess CONTRACTOR's qualifications for performing the Work.

### 4. FORMAT AND CONTENTS

Bidders may submit Escrow Bid Documents in their usual cost estimating format. It is not the intention of this section to cause the Bidder extra work during the preparation of the Bid, but to ensure that the Escrow Bid Documents will be adequate to enable complete understanding and proper interpretation for their intended use. The Escrow Bid Documents shall be in the language of the Specifications.

The Escrow Bid Documents shall include all quantity takeoffs; crew; equipment; calculations of rates of production and progress; copies of quotations from equipment manufacturers, Subcontractors, and Suppliers; and memoranda, narratives, consultants' reports, add/deduct sheets, and all other information used by the Bidder to arrive at the prices contained in the Bid Form. Estimated costs should be broken down into the Bidder's usual estimate categories, such as direct labor, repair labor, equipment operation, equipment ownership, expendable materials, permanent materials, and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the Bidder's usual format. CONTRACTOR's allocation of plant and equipment, indirect costs, contingencies, markup, and other items to each Bid item shall be included.

Bidding Documents provided by the OWNER should not be included in the Escrow Bid Documents unless needed to comply with the requirements of this section.

### 5. SUBMITTAL

The Escrow Bid Documents shall be submitted in a sealed container within one week after the time of receipt of Bids. The container shall be clearly marked on the outside with the Bidder's name, date of submittal, project name, and the words "Escrow Bid Documents."

The Escrow Bid Documents shall be accompanied with a certification signed by an individual authorized by the Bidder to execute the Bid Form, stating that the material in the Escrow Documentation constitutes the complete, only, and all documentary information used in preparation of the Bid and that he has personally examined the contents of the Escrow Bid Documents container and has found that the documents in the container are complete.

Prior to award, Escrow Bid Documents of the apparent Successful Bidder will be unsealed, examined, organized, and inventoried by representatives of OWNER, together with members of CONTRACTOR's staff who are knowledgeable in how the Bid was prepared. This examination is to ensure that the Escrow Bid Documents are authentic, legible, and complete. It will not include review of, and will not constitute approval of, proposed construction methods, estimating assumptions, or interpretations of Contract Documents. This examination is subject to the condition that, as trade secrets, the Escrow Bid Documents are proprietary and confidential as described in Paragraph 2. Examination will not alter any condition(s) or term(s) of the contract.

If all the documentation required in Part 4, "Format and Contents," has not been included in the original submittal, additional documentation shall be submitted, at OWNER's discretion, prior to award of the contract. The detailed breakdown of estimated costs shall be reconciled and revised, if appropriate, by agreement between CONTRACTOR and OWNER before making the award.

If the contract is not awarded to the apparent Successful Bidder, the Escrow Bid Documents of the Bidder next to be considered for award shall be processed as described above.

Timely submission of complete Escrow Bid Documents is an essential element of the Bidder's responsibility and a prerequisite to contract award. Failure to provide the necessary Escrow Bid Documents will be sufficient cause for OWNER to reject the Bid.

If the Bidder's proposal is based on subcontracting any part of the Work, each Subcontractor whose total subcontract price exceeds 5 percent of the total Contract Price proposed by the Bidder shall provide separate Escrow Bid Documents to be included with those of the Bidder. These documents will be opened and examined in the same manner and at the same time as the examination described above for the apparent Successful Bidder.

If CONTRACTOR subcontracts any portion of the Work after award, OWNER retains the right to require CONTRACTOR to submit Escrow Bid Documents from the Subcontractor before the subcontract is approved.

Escrow Bid Documents submitted by unsuccessful Bidders will be returned unopened, unless opened as provided above, as soon as they are no longer needed by OWNER and no later than immediately following award of the contract.

## 6. STORAGE

The Escrow Bid Documents of the Successful Bidder will be placed in escrow prior to award of the contract, for the life of the contract, in a mutually agreeable institution. The cost of storage will be paid by OWNER.

## 7. EXAMINATION AFTER AWARD OF CONTRACT

The Escrow Bid Documents shall be examined by both OWNER and CONTRACTOR, at any time deemed necessary after award of the contract by either OWNER or CONTRACTOR, to assist in the negotiation of price adjustments and Change Orders, or the settlement of disputes.

Examination of the Escrow Bid Documents after award of the contract is subject to the following conditions:

- a. As trade secrets, the Escrow Bid Documents are proprietary and confidential as described in Paragraph 2.
- b. OWNER and CONTRACTOR shall each designate, in writing to the other party and a minimum of 10 days prior to examination, representatives who are authorized to examine the Escrow Bid Documents. No other person shall have access to the Escrow Bid Documents.
- c. Access to the Escrow Bid Documents will take place only in the presence of duly designated representatives of both OWNER and CONTRACTOR.

## 8. FINAL DISPOSITION

The Escrow Bid Documents will be returned to CONTRACTOR at such time as the contract has been completed and final settlement has been achieved.

## SECTION 3 AWARD AND EXECUTION OF CONTRACT

### 3.01 GENERAL:

The Contractor's attention is directed to the provisions in the Contract for the requirements and conditions concerning award and execution of contract.

The contract shall be executed by the successful bidder and shall be returned, together with the contract bonds and insurance, to the City so that it is received within 10 working days after the bidder has received the contract for execution. Failure to do so shall be just cause for forfeiture of the proposal guaranty. The executed contract documents shall be delivered to the following address:

Attention: Gloria Aguilar  
City of Turlock, Engineering Division  
156 S Broadway, Suite 150  
Turlock, CA 95380

Bid protests are due in writing by the fifth calendar day after the bid opening and are to be delivered to the following address:

Stephen Fremming, PE  
156 S Broadway Suite 150

The award of the contract, if it be awarded, will be to the lowest responsible bidder whose bid complies with all the requirements prescribed.

## **SECTION 4 BEGINNING OF WORK, TIME OF COMPLETION AND DELAY DAMAGES**

### **4.01 NOTICE TO PROCEED:**

The Notice to Proceed is defined as a letter issued by the City to the Contractor indicating that the Work may begin at the designated site and outlines the anticipated construction start and end dates. The Notice to Proceed is issued after award of the Contract by the City Council and after the Contractor has provided all bonds, insurance documentation, and any other information required by the project specifications prior to beginning the Work. At no time shall construction begin prior to the issuance of the Notice to Proceed. Any work performed prior to issuance of the Notice to Proceed shall be done at the Contractor's own risk.

Attention is directed to Section 6 "Time For Performance" of the Contract.

The Contractor shall follow the sequence of construction and progress of work as specified in the Section, "Order of Work," of these Special Provisions.

Attention is directed to Section 9 "Delay Damages" of the Contract.

### **4.02 PRE-CONSTRUCTION MEETING:**

A pre-construction meeting will be held between Contractor and City prior to the beginning of construction. The exact time and place of this conference will be determined by City after award of the construction contract. Contractor's superintendent, Contractor's project manager(s), City's project manager, City's public works inspector, major subcontractors and others involved in performance of the Work, are required to be present.

The purpose of the meeting is to establish a working understanding between parties and to discuss the construction schedule, review the process for the review of submittals, RFIs, Change Order Requests, applications for payment, and other subjects pertinent to execution of the Work.

### **4.03 COPIES OF CONTRACT DOCUMENTS:**

At the request of the Contractor, City shall furnish up to five (5) hard copies of the project plans and specifications. Contractor may produce additional copies as needed at Contractor's expense.

### **4.04 STAGING OF MATERIALS AND EQUIPMENT:**

Contractor shall coordinate, arrange, and pay for leasing of area(s) for the staging materials and equipment, as necessary. Any areas utilized for staging shall be included in the Contractor's Erosion and Sediment Control Plan or Storm Water Pollution Prevention Plan (SWPPP). Contractor shall take photos of staging area(s) to use of the area and shall restore the areas to pre-construction conditions prior to completion.



Contractor may contact City personnel to request if there is City-owned land in the vicinity of the project available for staging. The City may grant access to City-owned land for staging, but shall not be obligated to do so.

#### **4.05 SUBSTANTIAL COMPLETION:**

Substantial Completion is the stage in the progress of the project when the work is sufficiently complete in accordance with the Contract so that the intended purpose of the project has been achieved. Substantial completion shall include all Work for the Project, except the following:

- Completion of minor punchlist items that do not prohibit use of the completed facility for its intended use and purpose
- Delivery of Operations and Maintenance manuals
- Completion of As-built drawings

When the Contractor considers the project to be substantially complete, the Contractor shall submit a request for City's concurrence in writing. Upon receipt of the Contractor's request, the City will inspect and determine whether the project is substantially complete within three (3) working days of the request. If the inspection yields that the project is not sufficiently complete, the Contractor shall complete or correct such item upon notification by the City. In such case, the Contractor shall then submit a request for another inspection by the Engineer to determine Substantial Completion. When Engineer is satisfied that the work is substantially complete, a written notice of Substantial Completion shall be transmitted by City to Contractor within 24 hours of the successful inspection.

#### **4.06 FINAL COMPLETION:**

Final Completion is the stage in the progress of the project when all work is complete in accordance with the Contract. Contractor shall inform City when, in the opinion of the Contractor, all work has been complete as per the requirements of the Contract. The City shall promptly inspect the work and make a determination as to whether all work of the project has been fully performed. Should any items of work be incomplete, the City shall provide a written list of outstanding items to the Contractor for completion (final punchlist). When City staff is satisfied that the work is complete, a written notice of Final Completion shall be transmitted by City to Contractor and contract working days shall cease to be counted on the project.

## **SECTION 5 GENERAL**

#### **5.01 INTERNET BASED CONSTRUCTION MANAGEMENT SYSTEM:**

The Engineer and Contractor shall utilize Virtual Project Manager (VPM; [www.new.virtual-pm.com](http://www.new.virtual-pm.com)), for submission of all construction documents for the duration of the construction contract and shall utilize VPM for project correspondence to the maximum extent possible. VPM is an online electronic project management system used to create, share, and review construction management documentation. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, electronic notification of project activity, and overall management of contract documentation between City and Contractor. VPM shall be the primary means of project document submission and management.

VPM access is provided to the Contractor at no cost to the Contractor. The Contractor shall use computer hardware and software that meets the requirements of the VPM system. Upgrading of the Contractor's computer systems will not be justification for a cost or time modification to the Contract. The Contractor shall ensure its own connectivity to VPM by providing their own internet service and provide staff knowledgeable in the use of computers.

The Engineer will establish the Contractor's access to VPM by enabling access and assigning user profiles to Contractor's personnel. Contractor may request that access be granted to subcontractors, suppliers, or consultants, though access to these groups will be limited to read-only permissions. All communication to the Engineer shall be made directly through the Contractor. All authorized personnel shall have an individual user profile; no joint-use or shared user profiles will be allowed. Each user profile shall be assigned to a user group and have specific permission settings and privileges based on the user's need within VPM. The Contractor shall be responsible for the validity of the information entered by the Contractor into VPM.

Contractor will submit attachments within VPM in formats acceptable to the Engineer, such as PDF files, Microsoft Office files, and picture files (JPG, TIFF, BMP, JPEG, etc.). PDF documents shall be created through electronic conversion prior to uploading, rather than optically scanned, whenever possible.

Contractor shall upload relevant documents for review and approval under the corresponding module within VPM (submittal, RFI, etc.). Each document submittal shall have a unique title and description that references the item and the section number from the specifications.

Engineer shall provide training to the Contractor in the basic use of the VPM system, as requested by the Contractor.

The Contractor shall create a RFI upon recognition of any event or question of fact arising from the contract work. The Engineer will respond to a RFI submitted by the Contractor within seven (7) calendar days, not including legal holidays.

Inspector's daily logs shall be used by the City to document the activities of the work, any correspondence or direction given in the field, safety concerns and general comments about the project. The weekly statement of working days report (WSWD) will be generated by VPM and approved by the City. The WSWD shows the working days and non-working days charged for the reporting week, any time adjustments, a work completion date with the remaining working days left in the contract and the controlling activities for the week. The Contractor will be allowed 15 days to protest in writing the correctness of the statement.

## **5.02 BUSINESS LICENSE:**

Contractor shall obtain a City of Turlock business license prior to issuance of the Notice to Proceed. The cost of the business license is a up-front fee of eighty four dollars (\$84) plus fifty cents per thousand dollars in revenue received for work performed on the project, made payable on a semi-annual basis. Business Licenses are obtained through the Finance Division at Turlock City Hall, 156 S. Broadway, Suite 114. Additional information can be found on the City's website at <http://ci.turlock.ca.us/doingbusinessinturlock/businesslicenses/newbusinesslicense.asp>.

Full compensation for obtaining a business license as specified above shall be considered as included in the prices paid for the various contract bid items and no additional compensation will be allowed therefore.

### **5.03 PROGRESS SCHEDULE:**

Contractor shall furnish City with a Critical Path Method progress schedule. The progress schedule shall show the construction activities extending for the duration of the working days. Any deviation from the outline must be approved by Engineer. Contractor shall not be allowed to start construction activities until the progress schedule is accepted by Engineer.

### **5.04 PUBLIC COMMUNICATIONS:**

The Contractor shall notify adjacent property owners, residents, and/or tenants when the execution of work may affect their everyday activities.

Any time the Contractor is acting on behalf of the City to perform work, the communication material between the Contractor and the public shall adhere to these Special Provisions and is subject to review and approval by the City. All communication materials shall be in English and Spanish.

#### **Work Notice**

Provide notice to affected property owners in advance of work. Notice is required for any work within an easement, within the City's right-of-way, outside of street, etc. Contractor shall notify the resident by door knocking and leaving a flier. Notices shall be received by the affected properties no less than two (2) and no more than seven (7) calendar days prior to starting the work.

#### **Denial of Access**

Provide notice for when it is necessary to temporarily deny access to public parking, residential property, or commercial property. Notify residents, businesses, and local agencies at least 24 hours before starting activities. The type of notification shall be a written communication prepared and distributed by the Contractor. The written communication shall contain, at a minimum, the following information:

- Describe the work to be performed
- Detail streets and limits of activities
- Indicate dates and work hours
- Be authorized by the City

Attention is directed to Section 12.02, "Traffic Management Plan," of these Special Provisions.

#### **Utility Service Interruption**

Provide notice for when any City's utility service connection must be interrupted. The type of notification shall be a written communication prepared and distributed by the Contractor. The written communication shall contain, at a minimum, the following information:

- The type of service (e.g. water or sewer) that will be interrupted
- The date and length of time service will be interrupted
- Contractor's Name and Contact Information

Notices shall be received by the affected properties no less than two (2) and no more than seven (7) calendar days prior to the work.

### 5.05 PERMITS:

Contractor is required to obtain the following permits.

<b>Permit:</b>	<b>Agency / Division:</b>	<b>Required for:</b>	<b>Fee</b>	<b>Notes</b>
Erosion and Sediment Control Plan	City of Turlock	Any ground disturbing work	\$0	See Special Provisions section "EROSION CONTROL"
Encroachment Permit	City of Turlock	Any work within City limits, including traffic control	\$0	Issued by City Engineering Division after contract execution
Building Permit	City of Turlock	Pool facilities; fence	\$0	Issued by City Building Division after contract execution
Monthly Hydrant Use Permit	City of Turlock Municipal Services Department	Use of construction water from hydrants	\$0, though a deposit is required for meter	See Special Provisions section "USE OF HYDRANTS FOR CONSTRUCTION PURPOSES"

### 5.06 SUBMITTALS:

#### General

Before making submittals, Contractor shall ensure that products and materials will be available in the quantities and in the time required by the Contract and the approved outline of construction activity. Each submittal shall clearly identify, by highlighting, arrows or other defined and permanent mark, the products and materials proposed for use.

All Submittals shall be made to Engineer by Contractor, including those generated by subcontractors and suppliers. Contractor shall carefully review all subcontractor and supplier submittals before submitting to Engineer for review. Submittals received from sources other than Contractor's office shall be returned without action. If a submittal contains extraneous information, unmarked options or is incomplete, it will be returned to Contractor for correction and require re-submittal.

#### Submission

Submittals shall be made electronically in accordance with the Section "Internet Based Construction Management System," of these special provisions.

Each submittal shall contain, at a minimum, the following information:

1. Title page including the following information:

Name of Contractor  
Name of subcontractor (if applicable)  
Description of item  
Item Number on Bid Schedule  
Contractor's initials and date indicating approval of item for submittal to Engineer

2. The brochure, product data sheet or catalog cut sheet. For all Product Data and Manufacturer's Instructions, excise or cross out non-applicable information and clearly mark applicable information with citations to and terminology consistent with Contract Documents.

3. Submittals that involve engineering computations or original design work shall show the name, the California State registration number, seal, and signature of the Professional Engineer certifying that such computations or design work are correct and in conformance with applicable standards, codes and accepted engineering practices.

4. For product samples, Contractor shall submit two (2) representative samples, one of which may be retained for the duration of the project or indefinitely at the discretion of Engineer. Although a reasonable attempt will be made to maintain the samples in good condition, neither City nor its representative will be responsible for the condition of the samples if returned to Contractor.

5. For material samples, unless a specific quantity is called for in the contract documents, Contractor shall submit a representative sample of the material, which may be retained for the duration of the project or indefinitely at the discretion of Engineer.

6. Certificates of compliance shall be submitted by Contractor to Engineer for those materials and products for which no sample and test results are specified. Certificates of compliance shall include the following information:

- Statement that the product complies with the respective contract specifications.
- Producer's name and address, product trade name and catalog number (if applicable), place of product origin, quantity of product to be furnished, and related contract plans and specification section numbers.
- A certified copy of test results pertaining to the product from a certified independent testing laboratory. At the option of Engineer certified test results shall be signed and sealed by a Professional Engineer licensed to practice in the state of California.
- Material Safety Data Sheets (MSDS) for all materials used or stored on the site that possess a MSDS, including materials used by Contractor for maintenance of equipment.

## Review

Submittals will be processed by Engineer within fourteen (14) calendar days after receipt, not including legal holidays. When a submittal cannot be returned within that period, the Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned. Submittal shall receive one of four review actions:

1. No Exceptions Taken – The submittal is approved without comments.
2. Supply as Noted / Make Corrections Noted – The submittal is approved, provided that the Contractor addresses the included comments.
3. Resubmit – The information provided with the submittal does not meet project requirements, however, Engineer has commented on some missing items that, if provided, may meet project requirements. Contractor shall resubmit the same product and provide additional information per the Engineer's comments.
4. Rejected – The submitted product cannot meet project requirements and is rejected. Contractor shall provide a separate product that meets project requirements as a resubmittal.

Engineer will review submittals for general conformance with the Contract Documents. The work shall be in accordance with approved submittals except that the Contractor shall not be relieved of the responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal as part of a cover letter to the submittal itself, and as a written communication separate from the submittal cover letter, and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof. The Engineer's review does not extend to accuracy of dimensions, quantities, or performance of equipment and systems designed by the Contractor, or means, methods, techniques, sequences, or procedures. Unless specifically authorized to do so by Engineer, Contractor shall not procure, manufacture, or fabricate any part of the contract work until submittals related to said contract work have been favorably reviewed by Engineer.

### **“Or Equal” Items**

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to for review under the circumstances described below.

1. "Or Equal" Items: If in the Engineer's discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item,

in which case review and approval of the proposed item may be accomplished. A proposed item of material or equipment will be considered functionally equal to a named item if:

- a. In the exercise of reasonable judgment Engineer determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function of the named item, and;
- b. Contractor certifies that: (i) there is no increase in cost to the City; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

#### **5.07 CHANGE ORDER PROCEDURES:**

The contract price and contract time may only be changed by an executed Contract Change Order. A Contract Change Order is a written instrument prepared by the Owner, authorized by the City, stating agreement of the following:

1. The change in the Work;
2. The amount of the adjustment, if any, in the Contract Price; and
3. The extent of the adjustment, if any, in the Contract Time.

When a change in the work is contemplated by the Engineer, a Construction Change Directive may be issued by the Engineer. A Construction Change Directive is a written order prepared by the Engineer directing a change in the Work prior to agreement on adjustment in the Contract Price or Contract Time, or both, in a Contract Change Order. The Engineer may, by Construction Change Directive and without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Price and Contract Time being adjusted accordingly thereafter according to the terms of the Agreement.

A Change Order Request is a document created by the Contractor which notifies the Engineer of changes in scope, changed conditions, errors, omissions, or inconsistencies in the contract documents which may or may not require an adjustment in the Contract Price and/or Contract Time.

Upon issuance of either a Construction Change Directive by the Engineer or a Change Order Request by the Contractor, the Contractor shall promptly prepare documentation proposing a contract cost and/or time adjustment for review by the Engineer for the purposes of arriving at a mutually agreeable lump sum. Contractor shall submit backup information for costs of labor, equipment, material, and agreeable markups. Backup information shall contain sufficient detail to allow a thorough review. The Engineer will review backup documentation and issue a response to the Contractor as to agreement or disagreement with proposed adjustments to contract price and/or time. Contractor shall not proceed with the change in the Work involved until the proposed cost and time adjustment is acceptable to the Engineer. If attempts to arrive at a mutually agreeable lump sum amount fail, the Engineer may direct that the work proceeds on the basis of force account in accordance with the terms of the Agreement.

#### **5.08 NOTICE OF POTENTIAL CLAIM:**

Attention is directed to Section 5-1.43 "Potential Claims and Dispute Resolution," of the Caltrans Standard Specifications.

**5.09 LABOR NONDISCRIMINATION:**

Attention is directed to the following Notice that is required by Chapter 5 of Division 4 of Title 2, California Code of Regulations.

NOTICE OF REQUIREMENT FOR NONDISCRIMINATION PROGRAM  
(GOV. CODE, SECTION 12990)

Your attention is called to the "Nondiscrimination Clause", set forth in Section 7 1.01A(4), "Labor Nondiscrimination," of the Caltrans Standard Specifications, which is applicable to all nonexempt state contracts and subcontracts, and to the "Standard California Nondiscrimination Construction Contract Specifications" set forth therein. The Specifications are applicable to all nonexempt state construction contracts and subcontracts of \$5,000 or more.

**5.10 PREVAILING WAGE:**

Attention is directed to Section 7-1.02K "Labor Code," of the Caltrans Standard Specifications, however certified payroll is not submitted to Caltrans for this project. Contractor shall submit certified payroll records both to the DIR and to the Engineer on a weekly basis. Contractor may submit certified payroll records to the Engineer via mail, email, or uploaded to VPM.

State Prevailing Wage Rates

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county Stanislaus in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at 156 S. Broadway St, Turlock, CA 95380 and available from the California Department of Industrial Relations' Internet web site at <http://www.dir.ca.gov/DLSR/PWD>. Changes, if any, to the general prevailing wage rates, will be available at the same location. Future effective general prevailing wage rates, that have been predetermined and are on file with the California Department of Industrial Relations are referenced but not printed in the general prevailing wage rates.

**5.11 SUBCONTRACTING:**

No subcontract releases the Contractor from the contract or relieves the Contractor of their responsibility for a subcontractor's work.

If the Contractor violates Pub Cont Code § 4100 et seq., the City may exercise the remedies provided under Pub Cont Code § 4110. The City may refer the violation to the Contractors State License Board as provided under Pub Cont Code § 4111.

Each subcontract must comply with the contract.

Each subcontractor must have an active and valid State contractor's license with a classification appropriate for the work to be performed (Bus & Prof Code, § 7000 et seq.).



At the pre-construction meeting, prior to starting work, Contractor shall submit a complete listing of subcontractors and the value of the work each subcontractor will perform. This list shall contain all information identified on Exhibit 12-G of the Local Assistance Procedures Manual.

Before subcontracted work starts, submit a Subcontracting Request form.

Do not use a debarred contractor; a current list of debarred contractors is available at the Department of Industrial Relations' Web site.

Upon request by the Engineer, immediately remove and not again use a subcontractor who fails to prosecute the work satisfactorily.

#### **5.12 PAYMENTS:**

Attention is directed to Section 19, "Payments to Contractor," of the Contract.

At the end of each month the Contractor shall submit a proposed progress invoice. The invoice shall delineate each bid item, the amount of work performed for the invoice period (previous month) and the total amount of work performed to date. A sample invoice with all of the required items will be given to the Contractor at the pre-construction meeting.

The Engineer will review the progress invoice and after any changes the Engineer makes, will issue an official invoice for the Contractor to sign. The Contractor shall sign the official invoice and return to the Engineer. After the Engineer receives the signed, official invoice, the progress payment will be processed.

Retention in the amount of 5% of the progress payment amount shall be held from all progress payments. Retention will be released 35 days after the Notice of Completion has been filed, insofar as no stop notices were filed.

#### **5.13 GUARANTY:**

Attention is directed to Section 9-4, "Guaranty," of the City of Turlock Standard Specifications.

#### **5.14 PROMPT PROGRESS PAYMENT TO SUBCONTRACTORS:**

A prime contractor or subcontractor shall pay any subcontractor not later than 10 days of receipt of each progress payment in accordance with the provision in Section 7108.5 of the California Business and Professions Code concerning prompt payment to subcontractors. The 10 days is applicable unless a longer period is agreed to in writing. Any delay or postponement of payment over 30 days may take place only for good cause and with the agency's prior written approval. Any violation of Section 7108.5 shall subject the violating contractor or subcontractor to the penalties, sanction and other remedies of that section. This requirement shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to the contractor or subcontractor in the event of a dispute involving late payment or nonpayment by the prime contractor, deficient subcontract performance, or noncompliance by a subcontractor.

#### **5.15 PROMPT PAYMENT OF FUNDS WITHHELD TO SUBCONTRACTORS:**

The agency shall hold retainage from the prime contractor and shall make prompt and regular incremental acceptances of portions, as determined by the agency of the contract work and pay retainage to the prime

contractor based on these acceptances. The prime contractor or subcontractor shall return all monies withheld in retention from all subcontractors within seven (7) days for construction contracts and fifteen (15) days for consultant contracts after receiving payment for work satisfactorily completed and accepted including incremental acceptances of portions of the contract work by the agency. Any delay or postponement of payment may take place only for good cause and with the agency's prior written approval. Any violation of these provisions shall subject the violating prime contractor or subcontractor to the penalties, sanctions, and other remedies specified in Section 7108.5 of the California Business and Professions Code and Section 10262 of the California Public Contract Code for construction contracts, and Section 3321 of the California Civil Code for consultant contracts. This requirement shall not be construed to limit or impair any contractual, administrative or judicial remedies otherwise available to the contractor or subcontractor in the event of a dispute involving late payment or nonpayment by the contractor; deficient subcontractor performance and/or noncompliance by a subcontractor. This clause applies to both DBE and non-DBE subcontractors.

#### **5.16 ORDER OF WORK:**

Order of work shall be in accordance with the provisions in Section 5-1.05, "Order of Work," of the Caltrans Standard Specifications and these Special Provisions.

#### **5.17 PUBLIC SAFETY:**

In addition to any other measures taken by Contractor pursuant to the provisions of the Standard Specifications and the General Conditions, Contractor shall install temporary precast concrete barrier rail between any lane carrying public traffic and any excavation, obstacle or storage area when the following conditions exist:

Excavations: Any excavation, the near edge of which is 12 feet or less from the edge of the lane, except;

- (a) Excavations covered with sheet steel or concrete covers of adequate thickness to prevent accidental entry by traffic or the public.
- (b) Excavations less than one foot deep.
- (c) Trenches less than one foot wide for irrigation pipe or electrical conduit or excavations less than one foot in diameter.
- (d) Excavations parallel to the lane for the purpose of pavement widening or reconstruction.
- (e) Excavations in side slopes where the slope is steeper than 4:1.
- (f) Excavations protected by existing barrier or railing.

At the end of each working day, if a difference of 0.50 feet exists between the elevation of the existing pavement and the elevation of any excavation within 2 feet of the traveled way, material shall be placed and compacted against the vertical cuts adjacent to the traveled way. During excavation operations, native material may be used for this purpose, however, once the placing of the structural section commences, structural material shall be used. The material shall be placed to the level of the elevation of the top of the existing pavement and tapered at a slope of 4:1 or flatter to the bottom of the excavation. Treated

base shall not be used for the taper. Full compensation for placing the material on a 4:1 slope, regardless of the number of times it is required, and subsequent removing or reshaping of the material to the lines and grades shown on the plans shall be considered as included in the cost for other contract items of work and no additional compensation will be allowed therefore.

Personal vehicles of Contractor's employees shall not be parked on the traveled way or shoulders, including any section closed to public traffic. Whenever vehicles or equipment are parked on the shoulder within 6 feet of a traffic lane, the shoulder area shall be closed with traffic cones or portable delineators placed on a taper in advance of the parked vehicles or equipment and along the edge of the pavement at 25-foot intervals to a point not less than 25 feet past the last vehicle or piece of equipment.

A minimum of one paved traffic lane, not less than 12 feet wide, shall be open for use by public traffic in each direction of travel. The full width of the traveled way shall be open for use by public traffic on Saturdays, Sundays and designated legal holidays, after 4:00 p.m. on Fridays and the day preceding designated legal holidays and when construction operations are not actively in progress.

#### **5.18 REMOVAL OF ASBESTOS AND HAZARDOUS SUBSTANCES:**

The contractor shall promptly, and before the following conditions are disturbed, notify the local public entity, in writing, of any:

1. Material that the contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.
2. Subsurface or latent physical conditions at the site differing from those indicated by information about the site made available to bidders prior to the deadline for submitting bids.
3. Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

Upon notification of any of the above, the City shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the contractor's cost of, or the time required for, performance of any part of the work, a change order shall be issued to modify the contract scope.

In the event that a dispute arises between the City and Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the contractor's cost of, or time required for, performance of any part of the work, the contractor shall not be excused from any scheduled completion date provided for by the contract, but shall proceed with all work to be performed under the contract. The contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between the contracting parties.

When the presence of asbestos or hazardous substances are not shown on the plans or indicated in the specifications and the Contractor encounters materials which the Contractor reasonably believes to be asbestos or a hazardous substance as defined in Section 25914.1 of the Health and Safety Code, and the asbestos or hazardous substance has not been rendered harmless, the Contractor may continue work in

unaffected areas reasonably believed to be safe. The Contractor shall immediately cease work in the affected area and report the condition to the Engineer in writing.

In conformance with Section 25914.1 of the Health and Safety Code, removal of asbestos or hazardous substances including exploratory work to identify and determine the extent of the asbestos or hazardous substance will be performed by separate contract.

If delay of work in the area delays the current controlling operation, the delay will be considered a right of way delay and the Contractor will be compensated for the delay in conformance with the provisions in Section 8 1.07, "Delays," of the Caltrans Standard Specifications.

#### **5.19 WORKING HOURS:**

Contractor's working hours shall be between 7:00 a.m. and 5:00 p.m., Monday through Friday, excluding legal holidays.

Contractor shall notify Engineer 48 hours prior to beginning work.

Contractor shall not work outside the above-mentioned working hours without prior written consent of Engineer.

Designated legal holidays are: January 1st, the third Monday in January, the third Monday in February, the last Monday in May, June 19<sup>th</sup>, July 4<sup>th</sup>, the first Monday in September, November 11<sup>th</sup>, Thanksgiving Day, the day after Thanksgiving, and December 25<sup>th</sup>. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When a designated legal holiday falls on a Saturday, the preceding Friday shall be a designated legal holiday.

Should the Contractor desire to work on a Saturday, Sunday or Legal Holiday, the Contractor shall request approval of the Engineer. The Engineer may reject the request with or without cause. Should approval be granted, the Contractor shall reimburse the City of Turlock the premium portion of cost of engineering, inspection, testing, superintendent, and/or other overhead expenses due to overtime which are directly chargeable to the contract. Should such work be undertaken at the request of the City, reimbursement will not be required.

#### **5.20 SOUND CONTROL REQUIREMENTS:**

Sound control shall be in accordance with Section 7 1.01I, "Sound Control Requirements," of the Caltrans Standard Specifications and these special provisions.

The noise level from Contractor's operations, between the hours of 9:00 p.m. and 6:00 a.m., shall not exceed 86 dba at a distance of 50 feet. This requirement in no way relieves Contractor from responsibility for complying with local ordinances regulating noise level.

Said noise level requirements shall apply to all equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by Contractor. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety law for the protection of personnel.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

#### **5.21 UNDERGROUND SERVICE ALERT REQUIREMENTS:**

Contractor shall contact Underground Service Alert of Northern California at least 48 hours in advance of any construction activity, will or could damage or affect any underground utility or subsurface improvement, and obtain an inquiry identification number. Contractor shall notify Underground Service Alert in the event of change in the project limits or change in original work previously shown on the plans or indicated in the specifications. Contractor shall not commence construction prior to City Inspector receiving City's notice from USA North regarding this construction activity.

#### **5.22 SURVEYING:**

Construction survey staking shall be provided by City. Contractor shall provide the initial staking request no less than 1 week prior to Contractor starting work. Contractor shall submit subsequent staking requests no less than 48 hours before the staking is required to continue construction. Contractor shall post all staking requests to Virtual Project Manager (VPM) under the Request for Information (RFI) tab. The Contractor shall provide unimpeded access to the site and allow the survey crew to perform their work.

Contractor shall protect all survey stakes and markers during construction. If survey stakes and/or markers are damaged or destroyed during the course of construction, by vandalism or by any other means, Contractor may submit a request to have the survey re-staked. If re-staking is required, Contractor may be back charged at the fully burdened hourly rate for the survey crew and shall fully reimburse City for all necessary materials and equipment as a deductive change order.

Prior to installation of formwork for concrete building structures, Contractor shall be required to notify the City a minimum of 48 hours in advance of scheduled formwork activities so that the City may complete a survey for the purposes of verifying horizontal and vertical placement. The Engineer shall review the survey results and determine if the preparation of the building pad area is in conformance with the project plans and specifications. Contractor shall not proceed with installing formwork until after it is determined that the building pad area is in conformance with the project plans and specifications. After formwork is in place and prior to pouring any concrete, Contractor shall notify the City a minimum of 48 hours in advance for a survey of formwork. Upon completion of the survey, the Engineer may either approve or reject the formwork. Contractor shall not proceed with pouring concrete until after the Engineer has certified that the area is in compliance with the project plans and specifications. Contractor shall be required to correct this work in a manner acceptable to the Engineer if found to not be in conformance with the project plans and specifications at its own expense.

#### **5.23 PRESERVATION OF PROPERTY:**

The work performed in connection with various existing facilities shall be in accordance with Section 7-8, "Preservation of Property," of the Standard Specifications and these special provisions.

Due care shall be exercised to avoid injury or damage to existing improvements or facilities, utility facilities, adjacent property, and roadside trees, shrubs and other plants that are to remain in place.

Roadside trees, shrubs and other plants that are not to be removed and pole lines, fences, signs, markers and monuments, buildings and structures, conduits, pipelines under or above ground, sewer and water lines, sprinkler systems above or below ground, all roadway facilities, and any other improvements or facilities within or adjacent to the right-of-way shall be protected from injury or damage, and if ordered by Engineer, Contractor shall provide and install suitable safeguards, approved by Engineer, to protect such objects from injury or damage. If such objects are injured or damaged by reason of Contractor's operations they shall be replaced or restored at Contractor's expense. The facilities shall be replaced or restored to a condition as good or better as when Contractor entered upon the work, or as good as required by the specifications accompanying the contract, if any such objects are a part of the work being performed under the contract. Engineer may make or cause to be made such temporary repairs as necessary to restore to service any damaged facility. The cost of such repairs shall be borne by Contractor and may be deducted from any moneys due or to become due to Contractor under the contract.

The fact that any underground facility is not shown upon the plans shall not relieve Contractor of his responsibility under the Section "Existing Utilities and Facilities", of these provisions. It shall be Contractor's responsibility, pursuant thereto, to ascertain the location of such underground improvements or facilities that may be subject to damage by reason of construction operations.

Full compensation for furnishing all labor materials, tools, equipment, and incidentals, and for doing all the work involved in protecting or repairing property as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

#### **5.24 PRESERVATION OF EXISTING MONUMENTS:**

Contractor shall be responsible for protecting all survey monuments identified on the plans. Any monuments identified on the plans that are damaged or destroyed by Contractor that have not been tied off by City's surveyor shall be replaced at the Contractor's cost and deducted from the Contract Price by Change Order. Contractor shall notify City of all monuments that may or will be disturbed by necessary construction operations. City's surveyor will tie off said monuments and provide Contractor a notice to proceed prior to demolition of existing monuments.

Once Contractor is finished with its construction operations, the City's surveyor shall be responsible to set new survey monuments. New monument wells that conform to the City of Turlock Standard Specifications and Drawings will be required to be installed by the Contractor prior to setting new monuments. Contractor shall include the cost of new monument well(s) if shown on the project plans in its contract price. If no new monument wells are shown to be installed by Contractor on the project plans, installation of monument well(s) will be added to the project scope by Contract Change Order. Contractor shall confirm location of each monument well with City's surveyor prior to installation of the monument well. Once Contractor has installed monument well(s), City's surveyor will reset the monument(s).

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved with protecting existing monuments as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

### **5.25 DUST CONTROL:**

Dust Control shall conform to the provisions in Section 10, "Dust Control", of the Standard Specifications and these special provisions.

Full compensation for Dust Control will be considered as included in the various contract items of work requiring Dust Control, as determined by Engineer, and no separate payment will be made therefor.

### **5.26 WATERING:**

Watering shall be in accordance with Section 17, "Watering," of the Caltrans Standard Specifications.

Full compensation for Watering will be considered as included in the various contract items of work requiring Watering, as determined by Engineer, and no separate payment will be made therefor.

### **5.27 USE OF HYDRANTS FOR CONSTRUCTION PURPOSES:**

City will permit the use of a hydrant for construction purposes provided that the following are abided by:

1. A spanner wrench shall be the only type of wrench used on fire hydrants.
2. Contractor shall be liable for the damages to or loss of all hydrants and associated water lines and equipment which result from the use of this equipment.
3. Water shall only be used within City limits.
4. The vehicle must be approved by Engineer for approved backflow device.
5. Contractor shall pay a deposit on a water meter provided by the City. After the project ended the Contractor shall return the meter to the City for the release of the deposit.

Contractor shall obtain a no-fee monthly hydrant use permit for use of construction water for this project from the City of Turlock Municipal Services Department located at 156 S. Broadway Suite 270, Turlock, California 95380, ph:209-668-5590.

Use of city hydrants does not exempt Contractor from providing a water truck where hydrants cannot be utilized due to unsafe working conditions as deemed by Engineer.

### **5.28 TEMPORARY CONSTRUCTION POWER:**

If temporary construction power is determined to be needed by the Contractor to perform the work, Contractor shall arrange and pay for all temporary electric power. The cost of temporary power shall be considered as included in the various contract bid items and no additional compensation will be allowed therefore.

### **5.29 SALVAGE MATERIALS:**

If Contractor is directed to salvage materials in the Contract Documents, Contractor shall arrange for delivery of said item(s) to the City of Turlock Corporation Yard located at 701 S. Walnut Road, unless noted otherwise. Contractor shall coordinate delivery of salvaged materials through the public works inspector.

### **5.30 TESTING:**

Unless otherwise noted, City of Turlock will supply all acceptance testing. Coordination of said testing is the responsibility of Contractor through the project's inspector. The Contractor shall provide at least 24

hours' notice to the Engineer in advance of needing acceptance testing. If the Contractor request testing and the Contractor is not ready for the testing to occur, the Contractor shall be back charged the cover the cost of the testing firm.

At sites chosen by the project inspector, City's testing laboratory will conduct all tests. Contractor shall supply any necessary equipment and or labor required to obtain all samples for the completion of the testing process.

City of Turlock shall compensate the testing laboratory for all initial tests. Secondary and all other follow-up tests required due to failure of initial testing shall be reimbursed to City of Turlock based on the following schedule:

Water sample test: \$300.00 Per Test

Compaction test: \$100.00 Per Test

### **5.31 AS-BUILTS:**

When the job is complete, Contractor shall provide City with as-built drawings. These as-built drawings shall show any and all differences (revisions, additions, etc.) between the signed improvement plans and the installed improvements. The Contractor shall identify all utilities that are located in the field. The as-builts will consist of redlined signed improvement plans. The NOC will not be issued until acceptable as-builts have been received by the Engineer.

## **SECTION 6 WORK RESTRICTIONS**

### **6.01 WORK RESTRICTIONS**

#### **Concrete alley approach construction:**

Contractor shall sequence its work for the construction of alley approaches such that the public's vehicles and Turlock Scavenger trucks may enter and exit alley approaches at all times, except when construction work is actively taking place. Contractor shall pour concrete for new alley approaches no less than five (5) days before Turlock Scavenger picks up garbage.

Turlock Scavenger pick up date is Friday.

## **SECTION 7 (BLANK)**

## **SECTION 8 MATERIALS**

### **8.01 MINOR CONCRETE:**

Minor Concrete shall conform to the requirements of Section 90-2, "Minor Concrete," of the Caltrans Standard Specifications.

## **SECTION 9 DESCRIPTION OF WORK**

The work consists, in general of: Install pool, pool chemical and mechanical equipment, pool piping, pool decking, earthwork and grading, flatwork concrete, construct a chemical and mechanical building shell,



prepare base and coordinate with Public Restroom Company building installation, paving, CMU wall, steel fencing, safety lighting, water services, fire hydrant assembly, storm drain improvements, sewer lines, cleanouts, and manholes, gas line, arbors, benches, drinking fountains, landscaping and irrigation improvements, and other associated work.

The work includes all necessary labor, materials, tools, equipment and any incidentals needed to perform the improvements as shown on the contract plans.

## **SECTION 10      CONSTRUCTION DETAILS**

### **10.01 MOBILIZATION & DEMOBILIZATION (MAX 5%)**

Mobilization is intended to compensate the Contractor for operations including, but not limited to, those necessary for the movement of personal, equipment, supplies and incidentals to / from the project site; for the payment of premium cost and insurance for the project; for any necessary costs of acquisition of equipment, including purchase and mobilization expense; and for any other work and operations which must be performed or costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided in the contract.

- (1) When 5 percent of the original contract amount is earned, 50 percent of the amount bid for mobilization, or 5 percent of the original contract amount, whichever is less, may be paid.
- (2) When 10 percent of the original contract amount is earned, 75 percent of the amount bid for mobilization or 7.5 percent of the original contract amount, whichever is less, may be paid.
- (3) When 20 percent of the original contract amount is earned, 95 percent of the amount bid for mobilization, or 9.5 percent of the original contract amount, whichever is less, may be paid.
- (4) When 50 percent of the original contract amount is earned, 100 percent of the amount bid for mobilization, or 10 percent of the original contract amount, whichever is less, may be paid.
- (5) Upon completion of all work on the project, payment of any amount bid for mobilization in excess of 10 percent of the original contract amount will be paid.

### **10.02 GENERAL CONDITIONS (MAX 3%)**

General Conditions will be paid for on a lump sum basis and is limited to 3% maximum of the total bid cost. The contract lump sum price paid for General Conditions shall include full compensation for conforming to these requirements, furnishing all the fees, permitting, bonding, labor, and materials for doing all the work involved in administration and oversight of the project necessary for completion of the work as specified in the General Provisions, these Project Specifications and as directed by the City.

### **10.03 CONSTRUCTION PROJECT SIGN**

Contractor shall furnish and install 8'x 4' project sign as detailed in the project plans at locations within the project site as directed in the field. Project signs shall have a white background with black lettering, borders, graphics and lines. The Engineer shall provide all necessary funding information at the preconstruction meeting. The Contractor shall install project signs before performing any other work on

the site. Contractor shall remove all project signs and fill postholes after all punch list items have been completed and signed off by the City Inspector.

#### **PAYMENT**

The contract price paid for each construction project sign shall include full compensation for furnishing all labor, material, tools, equipment and incidentals, and for doing all the work involved in constructing, installing and removing construction project signs, complete in place, as shown on the plans, specified in the standard specifications and these special provisions, and as directed by Engineer.

#### **10.04 REMOVE EXISTING IMPROVEMENTS:**

Concrete, asphalt concrete and all other items designated on the plans to be removed or must be removed in order to install the improvements as shown on the plans, shall be removed and disposed of outside the highway right of way in accordance with the provisions in Section 7-10 of the Standard Specifications. Saw-cut all concrete and asphalt materials surfaces prior to removal.

#### **PAYMENT**

##### **Tree Removal**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in tree removal, including soil clearing, grubbing and removal to the depth below finish grade as specified in the Specifications and Plans.

##### **Sawcut & Removal of Concrete**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in sawcut & removal of concrete, including sawcutting and removal of concrete flatwork, vertical curbs, and curb and gutters, and removal as specified in the Specifications and Plans.

##### **Sawcut & Removal of AC**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in sawcut & removal of AC, including sawcutting and removal of AC flatwork, and removal as specified in the Specifications and Plans.

#### **10.05 UTILITY COORDINATION:**

All coordination with the utility companies shall be the Contractors responsibility. All fees and permits associated with the City of Turlock shall be waived.

#### **10.06 POTHOLE EXISTING UTILITIES:**

Prior to the beginning or continuation of any trenching for the installation of utilities, the Contractor shall:

1. Pothole all utility crossings shown on the plans and identified by Underground Service Alert (USA) utility markings. Contractor shall exercise due diligence to utilize techniques and practices which will limit damage to located utilities, including vacuum truck and hand digging, or other means as required by the buried utility owner. Damage to buried utilities as a result of Contractor's failure to perform potholing work per these Special Provisions shall be repaired at the Contractor's expense.

2. Measure depth from top of pavement to top of all utilities and mark depths on the project plans and provide a copy to the Engineer (electronic PDF or hard copy is acceptable)
3. Notify the Engineer of potential conflicts with the proposed location of new utilities. See Section 2.02, "EXISTING UTILITIES, FACILITIES, AND SITE CONDITIONS,"
4. Backfill, compact, and patch or plate potholes prior to opening the paved surface up to traffic.

The project plans depict sizes, horizontal locations, and materials of existing utilities based on surface evidence and facility maps from utility companies. Attention is directed to the possibility of utility locators marking utilities in locations other than what is shown on the plans or the possible existence of underground facilities not indicated on the plans or in the special provisions. Should additional pothole effort be needed to locate underground facilities beyond that which could be reasonably estimated at the time of bid, the change in contract price will be determined as per Section 4 "Contract Price" of the Agreement.

The price paid for utility potholing shall be included in the specific bid item and include full compensation for furnishing all labor, material, tools, equipment and incidentals, and for doing all the work involved in utility potholing as shown on the project plans, specified in the City of Turlock Standard Specifications, these Special Provisions, and as directed by Engineer.

#### **10.07 DEWATERING:**

Contractor shall examine carefully the site of the work. It is assumed that Contractor has investigated and is satisfied as to the conditions to be encountered, the character, quality and quantities of work to be performed, including the degree of presence or absence of groundwater.

The Contractor shall furnish, install, operate and maintain all machinery, appliances, and equipment to maintain all excavations free from water during construction. The Contractor shall dispose of the water so as not to cause damage to public or private property, or to cause a nuisance or menace to the public or violate the law. The dewatering system shall be installed and operated so that the ground water level outside the excavation is not reduced to the extent which would cause damage or endanger adjacent structures or property. The static water level shall be drawn down a minimum of one foot below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. The Contractor shall have on hand, pumping equipment and machinery in good working condition for emergencies and shall have workmen available for its operation. Dewatering systems shall operate continuously until backfill has been completed to one foot above the normal static groundwater level.

The contractor shall control surface water to prevent entry into excavations. At each excavation, a sufficient number of temporary observation wells to continuously check the groundwater level shall be provided.

The control of groundwater shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils", does not occur. Dewatering systems shall be designed and operated so as to prevent removal of the natural soils. The release of groundwater at its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundations soils, prevent disturbance of compacted backfill, and prevent flotation or movement of structures, pipelines and sewers. If an NPDES (National Pollutant Discharge Elimination system) permit is required for disposal of water from

construction dewatering activities, it shall be obtained by the Contractor prior to any dewatering activities.

Full compensation for furnishing all labor, materials, tools, equipment (including dewatering devices), and incidentals, and for doing all the work involved with and/or in verifying existing utilities, facilities, site and subsurface conditions as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore

**10.08 EARTHWORK AND SITE GRADING:**

Earthwork shall conform to the provisions in Section 19, "Earthwork", of the Caltrans Standard Specifications and these special provisions.

Surplus excavated material shall become the property of Contractor and shall be disposed of outside the right-of-way and shall conform to the provisions in Section 7-10, "Disposal of Materials Outside the Right of Way", of the Standard Specifications.

All import borrow shall meet the requirements of Structure Backfill as defined in Section 19 of the Caltrans Standard Specifications. All backfill material shall be compacted at 95% relative compaction for the entire depth of imported material. The maximum thickness of each layer of material before compaction shall be one foot and shall be composed of import borrow, existing material, or a combination of both.

**PAYMENT**

**Site Clearing & Grubbing**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in site clearing & grubbing, including removal of utilities, removal of site furnishings, signage and other miscellaneous demolition items, soil clearing, grubbing and removal as specified in the Specifications and Plans.

**Site Grading (Rough/ Fine)**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in site grading (round & fine), including rough grading, fine grading, soil removal and disposal, as specified in the Specifications and Plans.

**10.09 TEMPORARY TREE PROTECTION:**

Contractor shall install Temporary Tree Protection in accordance with the project plans, and the Standard Specifications and Drawings.

**PAYMENT**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in tree protection, including temporary fencing, as specified in the Specifications and Plans.

**10.10 TEMPORARY CONSTRUCTION FENCING:**

Contractor shall install Temporary Construction Fencing in accordance with the project plans, and the Standard Specifications and Drawings.

## **PAYMENT**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in temporary construction fencing, including removal of fencing, as specified in the Specifications and Plans.

### **10.11 EROSION CONTROL:**

Contractor is required to provide an Erosion and Sediment Control Plan (ESCP) for review and approval by the City of Turlock Engineering Division. A blank ESCP worksheet is available to download from the City's website at <https://ci.turlock.ca.us/buildinginturlock/landdevelopment/improvementplan.asp>. The plan must be approved prior to beginning of work on-site. Contractor shall implement Best Management Practices (BMPs) before construction occurs both in the area of work, as well as staging areas. Contractor shall maintain BMPs in good working condition at all times. Contractor shall provide drain inlet protection, at a minimum. The completed ESCP and required BMPs must be in place prior to soil disturbing construction activities.

## **PAYMENT**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in temporary erosion and sediment control, including installation and removal of erosion and sediment control, as specified in the Specifications and Plans.

### **10.12 ADJUST FRAMES AND COVERS TO GRADE:**

Frames and covers of new and existing manholes, valve boxes, monuments, etc, shall be adjusted to grade and shall conform to the provisions in Section 12-12, "Adjusting Manhole Frames, Monuments and Valve Boxes", of the Standard Specifications and these special provisions.

## **PAYMENT**

The contract price paid per each for Adjusting Frames and Covers to Grade shall include full compensation for furnishing all labor, material, tools, equipment and incidentals, and for doing all the work involved in Adjusting Frames and Covers to Grade, complete in place, as shown on the plans, specified in the standard specifications and these special provisions, and as directed by Engineer.

### **10.13 SHADE STRUCTURES:**

Contractor shall install Shade Structures in accordance with the manufacture's specifications, project plans, and the Standard Specifications and Drawings.

## **PAYMENT**

### **Shade Structure (16'x16')**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in shade structure (16'x16'), including fabrication, shipment and installation of a fully functioning prefabricated 16'x16' shade structure, as specified in the Specifications and Plans. Contractor shall also be responsible for coordinating the structural engineering package with the City prior to installation and securing applicable building permit/s.

### **Shade Structure (12'x42')**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in shade structure (12'x42'), including fabrication, shipment and installation of a fully functioning prefabricated 12'x42' shade structure, as specified in the Specifications and Plans. Contractor shall also be responsible for coordinating the structural engineering package with the City prior to installation and securing applicable building permit/s.

### **Shade Structure (20'x30')**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in shade structure (20'x30'), including fabrication, shipment and installation of a fully functioning prefabricated 20'x30' shade structure, as specified in the Specifications and Plans. Contractor shall also be responsible for coordinating the structural

#### **10.14 TRASH ENCLOSURE:**

Contractor shall install Trash Enclosure in accordance with the project plans, and the Standard Specifications and Drawings.

#### **PAYMENT**

##### **City Std Trash Enclosure w/ 4' Tall Wrought Iron Fence**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in city std trash enclosure w/ 4' tall wrought iron fence, including installation of a fully functioning City standard trash enclosure including, concrete masonry unit (CMU) block wall with masonry block caps, masonry block, rebar, grout, and mortar, bollards, and metal doors with all hardware. This item also includes 4' tall wrought iron fencing embedded on top of wall to match existing adjacent fencing on site. This item also includes forming, excavation, pouring and finishing of a continuous concrete footing and raised curbing in the areas, as specified in the Specifications and Plans. Contractor shall also be responsible for coordinating the structural engineering package with the City prior to installation and securing applicable building permit/s.

#### **10.15 PUBLIC RESTROOM COMPANY BUILDINGS:**

Contractor shall complete work in accordance with the project plans, manufacture's specifications, and the Standard Specifications and Drawings.

#### **PAYMENT**

##### **6" Pad Base Prep for Public Restroom Company Bldgs**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 6" pad base prep for three (3) Public Restroom Company prefabricated buildings, including sub-grade compaction, coordination with Public Restroom Company, and aggregate base, per approved manufacturer's instructions using building packages pre-purchased by city, as specified in the Specifications and Plans.

#### **10.16 POOL MECHANICAL BUILDING:**

Contractor shall install the Pool and Mechanical Building in accordance with the project plans, manufacture's specifications, and the Standard Specifications and Drawings.

## **PAYMENT**

### **Pool Mechanical Building Shell Only (Pad Prep & Install)**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in pool mechanical building shell only (pad prep & install), including sub-grade compaction, aggregate base, concrete additives, pigments and sealers, pouring concrete pavement, reinforcement, finishing, joints, and joint sealants, construction of building shell per approved manufacturer's plans using building materials pre-purchased by city, as specified in the Specifications and Plans. See related Bid Item for swimming pool surge chamber & access hatch.

### **10.17 ASPHALT AND AGGREGATE BASE:**

Contractor shall install the Asphalt and Aggregate Base in accordance with the project plans and the Standard Specifications and Drawings.

Aggregate base shall conform to the provisions in Section 26, "Aggregate Base", of the Caltrans Standard Specifications and these special provisions. Paragraph 2 of Section 26-1.02A, "Class 2 Aggregate Base", shall be amended to read as follows:

"Aggregate shall conform to the grading and quality requirements shown in the following tables."

The aggregate base grading shall be  $\frac{3}{4}$ " maximum and shall be class 2.

Hot Mix Asphalt (HMA) shall conform to the provisions in Section 39, "Hot Mix Asphalt," of the 2018 Caltrans Standard Specifications.

The HMA construction process shall be standard. The aggregate gradation of the top lift shall be  $\frac{1}{2}$ " and the HMA type shall be type A. The binder shall be PG 70-10.

Contractor shall tack coat all surfaces to receive HMA and shall conform to the Caltrans Standard Specifications Section 39, "Hot Mix Asphalt."

## **PAYMENT**

### **3" HMA/ 4" AB**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in pavement (HMA) for alley area, including installation and preparation of sub-grade, aggregate base and asphalt surfacing to the depths, as specified in the Specifications and Plans.

### **4" HMA/ 6" AB**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in pavement (HMA) for alley area, including installation and preparation of sub-grade, aggregate base and asphalt surfacing to the depths, as specified in the Specifications and Plans.

### **10.18 CONCRETE:**

Contractor shall install the Concrete in accordance with the project plans and the Standard Specifications and Drawings. Material for minor concrete shall conform to Section 8.01 "Minor Concrete," of these special provisions.

Contractor shall submit a certificate of compliance for all minor concrete.

Lines, grades, dimensions and general construction of curb & gutter and sidewalk shall conform to the City of Turlock Standard Drawings

#### **PAYMENT**

##### **4” Concrete Flatwork**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 4” concrete flatwork, including installation, soil preparation forming, sub-grade compaction, aggregate base, concrete additives, pigments and sealers, pouring concrete pavement, finishing, joints, and joint sealants, as specified in the Specifications and Plans.

##### **4” Concrete Flatwork w/ Non-Slip Coating**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 4” concrete flatwork, including installation, soil preparation forming, sub-grade compaction, aggregate base, concrete additives, pigments and sealers, pouring concrete pavement, finishing, joints, and joint sealants, as specified in the Specifications and Plans.

##### **6” Concrete Flatwork**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 6” concrete flatwork, including installation, soil preparation forming, sub-grade compaction, aggregate base, concrete additives, pigments and sealers, pouring concrete pavement, finishing, joints, and joint sealants, as specified in the Specifications and Plans.

##### **12” Wide Concrete Band**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 12” wide concrete band, including installation, forming, sub-grade, reinforcement and compaction, concrete additives, sealers, pouring concrete band, finishing and joints, as specified in the Specifications and Plans.

#### **10.19 STORM DRAIN SYSTEM:**

Contractor shall install the Storm Drain System in accordance with the project plans and the Standard Specifications and Drawings.

#### **PAYMENT**

##### **6” Storm Drain Line**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 6” storm drainage line including trenching, fittings, and storm drainage line, as specified in the Specifications and Plans.

##### **60” Manhole with 30” Drain Inlet Grate**



The unit price bid for this item shall include all costs for purchase and installation of the 60” manholes, and related components and connections to stormwater system, as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item.

#### **48” French Drain Section**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 48” French Drain section including trenching, fittings, perforated storm drain line, membrane, and gravel as specified in the Specifications and Plans.

#### **Storm Drain Inlet**

The unit price bid for this item shall include all costs for purchase and installation of storm drainage inlet, and related components and connections to storm drainage system, as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item.

#### **10.20 POTABLE WATER:**

Contractor shall install the Potable Water in accordance with the project plans and the Standard Specifications and Drawings.

Fire Hydrants shall conform to the provisions in Section 15-8, “Fire Hydrants”, of the City of Turlock Standard Specifications and these Special Provisions.

Thrust blocks shall conform to the provisions in Section 15-1.09, “Thrust Blocks”, of the Standard Specifications and these Special Provisions.

Chlorination shall conform to the provisions in Section 15-2.01, “Chlorination and Isolation of New Mains”, of the Standard Specifications and these Special Provisions.

### **PAYMENT**

#### **Connect 8” Water Line to Existing 6” Water Line**

The unit price bid for this item shall include all costs for purchase and installation including water valves, fittings, components, thrust blocks, and street tie-ins and final connections as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item, as specified in the Specifications and Plans.

#### **2” Water Line**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 2” water line including trenching, fittings, thrust blocks, gate valves and boxes, and water line, as specified in the Specifications and Plans.

#### **2” Water Meter**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the 2” water meter per plan details and in location, as specified in the Specifications and Plans.

### **2" Water Valve**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the 2" water valve per plan details and in location, as specified in the Specifications and Plans.

### **3" Water Line**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 3" water line including trenching, fittings, thrust blocks, gate valves and boxes, and water line, as specified in the Specifications and Plans.

### **4" Water Meter**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the 4" water meter per plan details and in location, as specified in the Specifications and Plans.

### **6" Water Line**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 6" water line including trenching, fittings, thrust blocks, gate valves and boxes, and water line, as specified in the Specifications and Plans.

### **8" Water Line**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 8" water line including trenching, fittings, thrust blocks, gate valves and boxes, and water line, as specified in the Specifications and Plans.

### **8" Water Valve**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the 8" water valve per plan details and in location, as specified in the Specifications and Plans.

### **2" Backflow Prevention Assembly w/ Enclosure**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the 2" backflow prevention assembly w/ enclosure per plan details and in location, as specified in the Specifications and Plans.

### **4" Backflow Prevention Assembly w/ Enclosure**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the 4" backflow prevention assembly w/ enclosure per plan details and in location, as specified in the Specifications and Plans.

### **Fire Hydrant Assembly**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the installation of the fire hydrant assembly per plan details and in location, as specified in the Specifications and Plans.

## **10.21 SANITARY SEWER:**

Contractor shall install the Sanitary Sewer in accordance with the project plans and the Standard Specifications and Drawings.

### **PAYMENT**

#### **Connect 6” to Existing 6” Sanitary Sewer**

The unit price bid for this item shall include all costs for purchase and installation including fittings, components, and street tie-ins and final connections as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item, as specified in the Specifications and Plans.

#### **6” Sanitary Sewer Line**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 6” sewer line including trenching, fittings, and sewer line, as specified in the Specifications and Plans.

#### **Sanitary Sewer Manhole**

The unit price bid for this item shall include all costs for purchase and installation of sewer manholes, and related components and connections to sewer system, as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item.

#### **Sanitary Sewer Clean-out**

The unit price bid for this item shall include all costs for purchase and installation of sewer cleanouts, and related components and connections to sewer system, as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item.

#### **Sanitary Sewer Inlet**

The unit price bid for this item shall include all costs for purchase and installation of sewer inlet, and related components and connections to sewer system, as indicated on the Drawings. The item also includes labor, materials and all other work required by the Drawings and Specifications which is not specifically set forth in the Bid Form as a pay item.

## **10.22 LANDSCAPING AND IRRIGATION:**

Contractor shall install the landscaping and irrigation as identified on the project plans and in accordance with the Standard Specifications and Drawings, these special provisions and good horticultural practices.

### **PAYMENT**

#### **Soil Conditioning & Amendments**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in soil conditioning and amendment, including soil testing, installation of fertilizers, organic material and soil conditioners as indicated by soil laboratory tests, as specified in the Specifications and Plans.

### **Decomposed Granite Mulch (3” Min Depth)**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in decomposed granite mulch (3” min depth), including installation of a 3” min depth of decomposed granite mulch, as specified in the Specifications and Plans.

### **Sod Turf Renovation**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in sod turf – renovation at edge of new construction, including soil testing, installation of fertilizers, organic material and soil conditioners as indicated by soil laboratory tests (contractor responsibility) and turf sod, as specified in the Specifications and Plans.

### **5 Gallon Shrubs**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 5-gallon shrubs, including installation of fertilizers, fertilizer packs, as indicated by soil laboratory tests, and installation of 5-gallon plants, as specified in the Specifications and Plans.

### **24” Box Trees**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 24” box trees, including installation of fertilizers, fertilizer packs, as indicated by soil laboratory tests, tree stakes, tree ties, and installation of 24” box trees as indicated on the Drawings, as specified in the Specifications and Plans.

### **Tree Root Barriers**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in tree root barriers, including installation of root barriers, as specified in the Specifications and Plans.

### **Irrigation System – Tree Root Watering**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in irrigation system – tree root watering (RWS), including installation of irrigation root watering systems, bubblers, pipe, fittings, wires, remote control valves, valve boxes, and all other miscellaneous irrigation components for a fully functioning system, as specified in the Specifications and Plans.

### **Irrigation System – Low Flow Bubblers**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in irrigation system – low flow bubblers, including installation of low flow irrigation emitters/ bubblers, pipe, fittings, wires, remote control valves, valve boxes, and all other miscellaneous irrigation components for a fully functioning system, as specified in the Specifications and Plans.

### **Irrigation System – Turf Rotary Spray**

The square foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in irrigation system – turf rotary spray, including installation of irrigation turf rotor nozzles, pipe, fittings, wires, remote control valves, valve boxes, and all other miscellaneous irrigation components for a fully functioning system, as specified in the Specifications and Plans.

#### **Irrigation Controller & Weather Sensor**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in irrigation controller & weather sensor, including installation of irrigation controller and weather sensor, wiring connections, wires, conduits, fittings, controller wall mount inside new restroom building and weather sensor eave mount outside new restroom building, and all other miscellaneous components for a fully functioning irrigation system and required in the field, as specified in the Specifications and Plans.

#### **Irrigation Flow Sensor & Master Valve**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in irrigation master valve & flow sensor, including installation of pipe, fittings, wires, valve boxes, and all other miscellaneous irrigation components for a fully functioning system, as specified in the Specifications and Plans.

#### **Landscape Maintenance Establishment Period (60 Day)**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in landscape maintenance establishment period (60 days), as well as replacements for plants and equipment, as specified in the Specifications and Plans.

#### **10.23 SECURITY CAMERA SYSTEM CONDUIT AND CABLING:**

Contractor shall install conduit and cabling for a future Security Camera System in accordance with the Standard Specifications and Drawings, the project plans and these special provisions.

##### **PAYMENT**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in new cameras throughout the park with communication infrastructure as shown in the plans for a complete and operational system, as specified in the Specifications and Plans.

#### **10.24 SITE ELECTRICAL SYSTEM:**

Contractor shall install Site Electrical System in accordance with the Standard Specifications and Drawings, the project plans and these special provisions.

##### **PAYMENT**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in a fully functional electrical power and lighting system, including TID service & transformer pad, panels, feeders, electrical to pool equipment, all buildings, shade structures, and pool entry sign, grounding, conduits, conductors, light fixtures (included poles), devices, and equipment, as specified in the Specifications and Plans.

## **10.25 SWIMMING POOL**

Contractor shall install Swimming Pool in accordance with the Standard Specifications and Drawings, the project plans and these special provisions.

### **PAYMENT**

#### **Swimming Pool & Mechanical Equipment**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the construction of the swimming pool and its fittings, swimming pool pipes, mechanical equipment, chemical equipment, and associated systems, as specified in the Specifications and Plans.

#### **Swimming Pool Deck & Drainage**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the construction of the swimming pool deck and drainage, as specified in the Specifications and Plans.

#### **Swimming Pool Deck Equipment**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the code and program required rail goods, lane lines and reels, ADA lift and other equipment, as specified in the Specifications and Plans.

#### **Swimming Pool Thermal Covers & Reels**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the thermal pool covers and their reels, as specified in the Specifications and Plans.

#### **Swimming Pool Safety Covers & In-Deck Anchors**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the safety pool covers and the installation of their in- deck anchors, as specified in the Specifications and Plans.

#### **Swimming Pool Surge Chamber & Access Hatch**

The lump sum bid for this shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the construction of the swimming pool surge chamber and access hatch, as specified in the Specifications and Plans.

#### **Pool Heater – High Efficiency**

The lump sum bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the construction and installation of a high efficiency pool heater including fittings, piping, building penetrations as required by AHJ for the for the combustion and ventilation air, and other misc. equipment needed for a complete fully functioning pool heater system including combustion and makeup air, as specified in the Specifications and Plans.

## **Gas Line**

The lump sum bid for this shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in the construction of the Gas Line chamber and access hatch, as specified in the Specifications and Plans.

### **10.26 FENCING:**

Contractor shall complete Fencing work in accordance with the manufacture's specifications, project plans, and the Standard Specifications and Drawings. Contractor shall use existing 10ft steel fence panels to construct new fence. Fencing materials were salvaged from the original fence and stored at the City's Corporation Yard at 701 S. Walnut Rd, Turlock, CA 95380. The City will make the site accessible for contractors to view the existing materials during bidding.

### **PAYMENT**

#### **24" High Metal Debris Panels on N&E Fencing & Gates**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 24" high metal debris panels on north & east fencing and gates, including fabrication, hardware, and installation of panels, per plan details and in locations, as specified in the Specifications and Plans.

#### **Paint Existing Perimeter Pool Fence**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in painting existing perimeter pool fence, including, cleaning, prep, primer, and paint, as specified in the Specifications and Plans.

#### **6' Tall CMU Block Wall with 4' Tall Steel Fence Above**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 6' tall x 8' wide concrete masonry unit (CMU) block wall including masonry block caps, masonry block, rebar, grout, and mortar and 4' tall wrought iron fencing embedded on top of wall to match existing adjacent fencing on site. The item also includes forming, excavation, pouring and finishing of a continuous concrete footing in the areas indicated on the Drawings, and stamped and signed structural drawings and calculations for review and approval, as specified in the Specifications and Plans.

#### **Updated Gate Hardware (2 Sets EA w/ Self Closing Hinges & Panic Hardware**

The lump sum price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in updated gate hardware with code compliant self-closing hinges and panic hardware. The item also includes all gate hardware for fully operational AHJ code compliant upgrades to existing gates, as specified in the Specifications and Plans.

#### **8' CLR x 10' Tall Wrought Iron Double Swing Gates**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in one (1) set of two (2) 4' wide x 10' tall double swing gates to match existing adjacent fencing on-site. The item also includes all gate hardware with code compliant self-closing hinges and panic hardware, and forming, excavation, pouring and finishing of

concrete footings in the areas indicated on the Drawings, and stamped and signed structural drawings and calculations for review and approval, as specified in the Specifications and Plans.

### **6' CLR x 10' Tall Wrought Iron Double Swing Gates**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in one (1) set of two (2) 3' wide x 10' tall double swing gates to match existing adjacent fencing on-site. The item also includes all gate hardware with code compliant self-closing hinges and panic hardware, and forming, excavation, pouring and finishing of concrete footings in the areas indicated on the Drawings, and stamped and signed structural drawings and calculations for review and approval, as specified in the Specifications and Plans.

### **5' CLR x 6' Tall Wrought Iron Swing Gate**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in a 5' clr x 6' tall swing gate to match existing adjacent fencing on-site. The item also includes all gate hardware, and forming, excavation, pouring and finishing of concrete footings, as specified in the Specifications and Plans.

### **10' Tall Wrought Iron Fencing**

The linear foot price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 10' tall wrought iron fencing, including purchase, fabrication and installation of 10' tall wrought iron fencing to match existing adjacent fencing on-site. The item also includes forming, excavation, pouring and finishing of concrete footings in the areas indicated on the Drawings, and stamped and signed structural drawings and calculations for review and approval, as specified in the Specifications and Plans.

## **10.27 PARK AMENITIES:**

Contractor shall install Park Accessories in accordance with the manufacture's specifications, project plans, and the Standard Specifications and Drawings.

### **PAYMENT**

#### **City Std Concrete Backed Benches**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in concrete backed benches, including installation of a precast concrete backed bench, per plan details and in locations, as specified in the Specifications and Plans.

#### **Concrete Backless Benches**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in concrete backless benches, including installation of a precast concrete backless bench, per plan details and in locations, as specified in the Specifications and Plans.

#### **Concrete Picnic Tables**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in concrete std picnic tables, including installation



of a precast concrete standard picnic table, per plan details and in locations, as specified in the Specifications and Plans.

#### **Concrete Accessible Picnic Tables**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in concrete accessible picnic tables, including installation of a precast concrete accessible picnic table, per plan details and in locations, as specified in the Specifications and Plans.

#### **Concrete Trash Receptacles**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in concrete trash receptacles, including installation of a precast concrete trash receptacle w/ city logo cast in, drain hole at bottom, and lid, per plan details and in locations, as specified in the Specifications and Plans.

#### **Concrete Recycle Receptacles**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in concrete recycling receptacles, including installation of a precast concrete recycling receptacle w/ painted recycle logo, drain hole at bottom, and lid, per plan details and in locations, as specified in the Specifications and Plans.

#### **Custom Concrete Pool Entry Sign**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in custom concrete pool entry sign, including installation of a precast concrete sign, sub-grade reinforcement, aggregate base and pouring of concrete footing per plan details, as specified in the Specifications and Plans.

#### **20' Tall Flag Pole w/ 3x5 Flag**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in a fully functioning 20' tall flag pole w/ 3x5 flag, including installation of pole, hardware, flag, sub-grade reinforcement, and pouring of concrete footing per plan details and in locations, as specified in the Specifications and Plans.

#### **Bike Racks**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in bike racks, including installation of bike racks, per plan details and in locations, as specified in the Specifications and Plans.

#### **4 Unit Pedestal Shower**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in 4-unit pedestal shower, including installation of a fully functioning unit, including water line connection, in locations, as specified in the Specifications and Plans. Water line shall be part of separate Bid Item.

### **Tri-Level Pedestal Drinking Fountain w/ Bottle Filler**

The unit price bid for this item shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals; for doing all work involved in drinking fountain, including installation of a fully functioning tri-level drinking fountain with bottle filler, sewer line and water line connections, in locations, as specified in the Specifications and Plans.

#### **10.28 FINAL CLEANUP:**

Upon completion of the work, the Contractor shall remove all equipment, debris, and shall leave the site in a neat clean condition to the satisfaction of the Engineer. The Contractor shall clean the area of all construction related materials and sweep the entire project area including sidewalk and gutter thoroughly. All construction signs, cones, barricades, and conflicting markings shall be removed. At the request of the Contractor, a final punchlist will be provided. After all items of the punchlist have been completed to the satisfaction of the Engineer, the Engineer will issue substantial completion. The accrual of working days will cease after substantial completion has been issued.

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## **SECTION 12 WORK ZONE MOBILITY**

#### **12.01 PEDESTRIAN MANAGEMENT PLAN:**

Contractor shall develop and submit a pedestrian management plan for the Engineer's review and approval. Contractor shall implement the pedestrian management plan upon approval of the Engineer. The pedestrian management plan shall mitigate impact to existing sidewalks and pedestrian crossings at intersections disturbed during construction. Acceptable pedestrian management plans will include sequenced construction activities to keep at least one existing crossing at each intersection accessible to the public as well as temporary pedestrian access routes placed by contractor with accessibility features that meet or exceed the level of features provided on the disturbed route. The pedestrian management plan shall be approved by the Engineer prior to disturbing existing pedestrian routes.

Full compensation for Pedestrian Management Plan, including furnishing all labor, materials, tools, equipment and incidentals necessary to develop and implement the plan shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefor.

#### **12.02 TRAFFIC MANAGEMENT PLAN:**

Contractor shall comply with the City of Turlock Standard Specifications Section 11 "Traffic Safety." Contractor shall submit a completed Temporary Traffic Control Plan Checklist with submittal of the Temporary Traffic Control Plan. The checklist may be found online at the City's website at <https://ci.turlock.ca.us/pdf/trafficengineeringdoc.asp?id=4>

If construction activities affect access to public parking, residential property, or commercial property, contractor shall post signs at 100-foot intervals on the affected streets at least 48 hours prior to starting construction. Signs must display No Parking – Tow Away. Signs must state the dates and hours parking or access will be restricted. Notify residents, businesses, and local agencies at least 24 hours before starting activities. The notice must:

1. Describe the work to be performed

2. Detail streets and limits of activities
3. Indicate dates and work hours
4. Be authorized

Compensation shall be made at the respective lump sum bid price included on the Bidder's Form. If no separate bid item is included, the cost shall be included in the various other bid items and no additional compensation will be made therefor.

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## APPENDIX A: TECHNICAL SPECIFICATIONS



TECHNICAL SPECIFICATIONS FOR:

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**COLUMBIA POOL  
IMPROVEMENTS  
PHASE 2  
CITY OF TURLOCK**

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AUGUST, 2023

BID SUBMITTAL

Prepared by:



1165 Scenic Drive, Suite A  
Modesto CA 95350  
Phone: (209) 571-1765  
[www.odellengineering.com](http://www.odellengineering.com)

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**END OF TECHNICAL SPECIFICATIONS**

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## SECTION 012500

### SUBSTITUTION PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

##### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

##### 1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request: Submit to City's VPM web-based software for each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific

features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. City's Action: If necessary, City will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. City will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if City does not issue a decision on use of a proposed substitution within time allocated.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

## 1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## 1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than five days prior to time required for preparation and review of related submittals.
1. Conditions: City will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, City will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION (Not Used)**

### **END OF SECTION**

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## SECTION 013100

### PROJECT MANAGEMENT AND COORDINATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. RFIs.
  - 3. Digital project management procedures.
  - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

##### 1.3 DEFINITIONS

- A. RFI: Request for Information. Request from City, Construction Manager, or Contractor seeking information required by or clarifications of the Contract Documents.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within Ten (10) days prior to starting construction operations, contractor shall submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities;

list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Keep list current at all times.

## 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  1. Preparation of Contractor's construction schedule.
  2. Preparation of the schedule of values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.

## 1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  1. City will return without response those RFIs submitted to City by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  1. Project name.

2. Project number.
3. Name of City and Construction Manager.
4. Date.
5. Name of Contractor.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
  - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms:

1. Attachments shall be electronic files in PDF format.

D. City's Action: City will review each RFI, determine action required, and respond. Allow five working days for City's response for each RFI. RFIs received by City after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
  - a. Requests for approval of submittals.
  - b. Requests for approval of substitutions.
  - c. Requests for approval of Contractor's means and methods.
  - d. Requests for coordination information already indicated in the Contract Documents.
  - e. Requests for adjustments in the Contract Time or the Contract Sum.
  - f. Requests for interpretation of City's actions on submittals.
  - g. Incomplete RFIs or inaccurately prepared RFIs.
2. City's action may include a request for additional information, in which case City's time for response will date from time of receipt by City of additional information.

## 1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Landscape Architect's and Engineer's Data Files Not Available: Landscape Architect and Engineer will not provide CAD drawing digital data files for Contractor's use during construction.
- B. Use of Landscape Architect's and Engineer's Digital Data Files: Digital data files of Landscape Architect's and Engineer's CAD drawings will be provided by City for Contractor's use if requested by Contractor during construction.

1. Digital data files may be used by Contractor if requested in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Landscape Architect and Engineer make no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to City, Landscape Architect and Engineer.
  - a. Subcontractors and other parties granted access by Contractor to Landscape Architect's and Engineer's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to City, Landscape Architect and Engineer.

C. PDF Document Preparation: Where PDFs are required to be submitted to City, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

## 1.8 PROJECT MEETINGS

A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated by City.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify City of scheduled meeting dates and times a minimum of seven (7) days prior to meeting.
2. Agenda: Contractor shall prepare the meeting agenda. Distribute the agenda to all invited attendees a minimum of one (1) day in advance of meeting.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including City, within three (3) working days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to City, but no later than five (5) working days after execution of the Agreement.

1. Attendees: Authorized representatives of City, Construction Manager, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
  - a. Responsibilities and personnel assignments.
  - b. Tentative construction schedule.
  - c. Critical work sequencing and long lead items.
  - d. Designation of key personnel and their duties.



- e. Lines of communications.
  - f. Use of web-based Project software.
  - g. Procedures for processing field decisions and Change Orders.
  - h. Procedures for RFIs.
  - i. Procedures for testing and inspecting.
  - j. Procedures for processing Applications for Payment.
  - k. Distribution of the Contract Documents.
  - l. Submittal procedures.
  - m. Preparation of Record Documents.
  - n. Use of the premises and existing buildings.
  - o. Work restrictions.
  - p. Working hours.
  - q. City's occupancy requirements.
  - r. Responsibility for temporary facilities and controls.
  - s. Procedures for disruptions and shutdowns.
  - t. Construction waste management and recycling.
  - u. Parking availability.
  - v. Office, work, and storage areas.
  - w. Equipment deliveries and priorities.
  - x. First aid.
  - y. Security.
  - z. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Project Closeout Conference: City will schedule and conduct a project closeout conference, at a time convenient to City, Authorized Representatives of City and Construction Manager, but no later than 30 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: City, Authorized representatives of City, Construction Manager, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for preparing operations and maintenance data.
    - e. Requirements for delivery of material samples, and spare parts.
    - f. Requirements for demonstration and training.
    - g. Preparation of Contractor's punch list.
    - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - i. Submittal procedures.
    - j. Coordination of separate contracts.

- k. City's partial occupancy requirements.
    - l. Installation of City's furniture, fixtures, and equipment.
    - m. Responsibility for removing temporary facilities and controls.
  - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- D. Progress Meetings: City/ Construction Manager will conduct progress meetings at biweekly intervals.
  - 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of City and Construction Manager, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site use.
      - 8) Temporary facilities and controls.
      - 9) Progress cleaning.
      - 10) Quality and work standards.
      - 11) Status of correction of deficient items.
      - 12) Field observations.
      - 13) Status of RFIs.
      - 14) Status of Proposal Requests.
      - 15) Pending changes.
      - 16) Status of Change Orders.
      - 17) Documentation of information for payment requests.
  - 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

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## SECTION 013300

### SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

- B. Related Requirements:

- 1. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
  - 2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

##### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require City's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require City's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
- D. Virtual Project Manager (VPM): A web-based management software that allows project management through virtual teams, including but not limited to uploading, monitoring and tracking of submittals.

## 1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
  2. Date.
  3. Name of City.
  4. Name of Construction Manager.
  5. Name of Contractor.
  6. Name of firm or entity that prepared submittal.
  7. Names of subcontractor, manufacturer, and supplier.
  8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
  9. Category and type of submittal.
  10. Submittal purpose and description.
  11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  12. Drawing number and detail references, as appropriate.
  13. Indication of full or partial submittal.
  14. Location(s) where product is to be installed, as appropriate.
  15. Other necessary identification.
  16. Remarks.
  17. Signature of transmitter.
- B. Options: Identify options requiring selection by City.
- C. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- D. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
  - a. City reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
  
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on City's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. City will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Resubmittal Review: Allow 15 days for review of each resubmittal.
  3. Sequential Review: Where sequential review of submittals by City's consultants, or other parties is indicated, allow 21 days for initial review of each submittal.
  
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from City's/ City Representative's action stamp.
  
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
  
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from City's/ City Representative's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.

- f. Application of testing agency labels and seals.
  - g. Notation of coordination requirements.
  - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
- a. Wiring diagrams that show factory-installed wiring.
  - b. Printed performance curves.
  - c. Operational range diagrams.
  - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
- a. Identification of products.
  - b. Schedules.
  - c. Compliance with specified standards.
  - d. Notation of coordination requirements.
  - e. Notation of dimensions established by field measurement.
  - f. Relationship and attachment to adjoining construction clearly indicated.
  - g. Seal and signature of professional engineer if specified.
2. Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 24 by 36 inches.
- a. PDF electronic file.
  - b. Three opaque copies of each submittal. City will retain two copies; remainder will be returned.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
- a. Project name and submittal number.
  - b. Generic description of Sample.
  - c. Product name and name of manufacturer.
  - d. Sample source.
  - e. Number and title of applicable Specification Section.
  - f. Specification paragraph number and generic name of each item.



3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
  5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as City's property, are the property of Contractor.
  6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. City will return submittal with options selected.
  7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. City will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within project site.

- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
  - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  - 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  - 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  - 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
  - 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  - 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  - 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  - 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
  - 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to City.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. City will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.8 CITY'S ACTION

- A. Action Submittals: City will review each submittal, make marks to indicate corrections or revisions required, and return. City will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
  1. No Exceptions Taken – Contractor is advised that fabrication, manufacture, or construction may proceed, providing it complies with contract documents.
  2. Make Corrections Noted – Contractor is advised that fabrication, manufacture, or construction may proceed, providing it complies with the City's notation and contract documents.
  3. Amend and Resubmit – Contractor is advised that NO work shall be fabricated, manufactured, or constructed. Contractor shall revise the submittal and resubmit.
  4. Rejected – Contractor is advised that NO work shall commence.
- B. Informational Submittals: City will review each submittal and will not return it, or will return it if it does not comply with requirements. City will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from City.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. City will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by City without action.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## SECTION 015000

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

##### 1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, City, occupants of Project, testing agencies, and authorities having jurisdiction.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
  - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these

operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

3. Indicate methods to be used to avoid trapping water in finished work.
- E. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the City. Include the following:
1. Methods used to meet the goals and requirements of the City.
  2. Concrete cutting method(s) to be used.
  3. Location of construction devices on the site.
  4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
  5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the City.
  6. Indicate locations of sensitive areas or other areas requiring special attention as identified by City. Indicate means for complying with City's requirements.

## 1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before City's acceptance, regardless of previously assigned responsibilities.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

## 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as City's property.

### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
  - E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
  - F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
  - G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
  - H. Temporary Construction Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
    1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations As indicated on Drawings.
    2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Contractor shall allow City lock to be part of locking mechanism.
  - I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
  - J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
- B. Traffic Controls: Comply with authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel.
- D. Dewatering Facilities and Drains: Comply with authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.



1. Dispose of rainwater in lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
- E. Construction Waste Disposal: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. City reserves right to take possession of Project identification signs.
  2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

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## SECTION 015639

### TEMPORARY TREE AND PLANT PROTECTION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
  - 1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.

##### 1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
- B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.
- F. DBH: Diameter at breast height as described in The Guide for Plant Appraisal 10<sup>th</sup> edition, by the Council of Tree and Landscape Appraisers and the International Society of Arboriculture, Champaign, Illinois.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
  - 2. Detail fabrication and assembly of protection-zone fencing and signage.
  - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Samples: For each type of the following:
  - 1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
  - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
  - 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
  - 1. Species and size of tree.
  - 2. Location on site plan. Include unique identifier for each.
  - 3. Reason for pruning.
  - 4. Description of pruning to be performed.
  - 5. Description of maintenance following pruning.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
  - 1. Use sufficiently detailed photographs or video recordings.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- E. Quality-control program.
- F. Arborist Reports: From arborist, stating conditions on site during each site visit. Report shall include the area of construction activity, I.D. number of tree/trees within activity zone, protection methods used, photographs of construction and any corrective measures taken by the arborist.

## 1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA, Licensed arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.
- D. Guarantee: Contractor is responsible for the health of existing trees designated for protection for three years. The guarantee period is measured from the start of construction. Trees with declining health due to construction activities will be replaced per the tree replacement section of these specifications.

## 1.7 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Moving or parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation, digging, trenching, tilling, grading or soil disturbance unless otherwise indicated.
  - 7. Addition, removal, or storage of soil.
  - 8. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
  - 9. Mechanical damage to tree trunks, roots or branches.
  - 10. Burning of construction materials or cement wash out.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Topsoil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth more than 1 inch in diameter, and free of weeds, roots, and toxic and other nonsoil materials.
  - 1. Mixture: Well-blended mix per the latest soils report.
  - 2. Planting Soil: Planting soil as specified in the latest soils report.
  - 3. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more, do not obtain from bogs or marshes.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
  - 1. Type: Ground or shredded bark.
  - 2. Size Range: 2 inches maximum, 1/2 inch minimum.
  - 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements:
  - 1. Temporary Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch-diameter wire chain-link fabric; with pipe posts, corner and pull posts with bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
    - a. Height: 72 inches.
  - 2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.
    - a. Height: 48 inches.
    - b. Color: High-visibility orange, nonfading.
  - 3. Gates: Single and Double swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width as required.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: As indicated on Drawings.
2. Lettering: 3-inch- high minimum, black characters on white background.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

### **3.2 PREPARATION**

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.
- B. Improvement project limits to be clearly staked prior to arborist's first site visit.
- C. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- D. Maintain pre-existing moisture levels under existing trees.
- E. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
  1. Apply 3-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within base of tree trunks.

### **3.3 TREE PROTECTION ZONES**

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
  1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
  2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to City.

3. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by City. Install one sign spaced approximately every 35 feet on protection-zone fencing, but no fewer than two (2) signs with each facing a different direction.
  - C. Maintain protection zones free of weeds and trash.
  - D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by City.
  - E. Maintain protection-zone fencing and signage in good condition as acceptable to City and remove when construction operations are complete and equipment has been removed from the site.
    1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
    2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.
  - F. Encroachment: When necessary to encroach within the driplines of existing trees:
    1. Arborist must be on site to manage construction activities.
    2. Minimum of 3" layer of bark shall be installed (settled depth).
    3. 3/4" plywood panels to be installed on surface of bark for mechanical access to site.
    4. Fence to be restored immediately following completion of work.

### 3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.
  1. Digging done by hand shall conform to the following:
    - a. Mechanical digging tools shall have flat edges and be no wider than 4".
    - b. Mechanical tools shall be primarily used for loosening of soil and not for removal.
    - c. A water or air spade may also be used to excavate trenches within tree protection zone.
    - d. Vacuum excavation shall be utilized to remove soil from trenches.
    - e. Excavated soil shall be deposited outside of the tree protection zones.



- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
- E. Backfill: Backfill of trenches within tree protection zone shall be performed such that:
  - 1. Root zones are free from large air cavities.
  - 2. Soil is moist at all strata levels of trench during backfill operations.
  - 3. Trench is not compacted greater than original conditions.

### 3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
  - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  - 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
  - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  - 4. Cover exposed roots with burlap and water regularly.
  - 5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."
- B. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.
- C. Roots larger than 4-inch diameter are not to be cut without arborist approval.

### 3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
  - 1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.

2. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
  3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
    - a. Type of Pruning: Cleaning where indicated.
    - b. Specialty Pruning: Structural where indicated.
- B. Unless otherwise directed by arborist and acceptable to City, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and dispose of off-site.

### 3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
  1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 6 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in layers not exceeding 3 inches and hand grade to required finish elevations.

### 3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

### 3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by City.
  1. Submit details of proposed pruning and repairs.

2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
  3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by City.
- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that City determines are incapable of restoring to normal growth pattern.
1. Provide new trees of same size and species as those being replaced for each tree that measures 6 inches or smaller in caliper size.
  2. A tree appraisal shall be performed by the arborist at the cost of the contractor.
  3. Replacement trees shall be installed within 6 months of the request.
- C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 3-inch uniform thickness to remain.
- D. Soil Aeration: Where directed by City, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk.

### 3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off City's property.

### 3.11 COMPENSATION

- A. Full compensation for tree protection measures and arborist fees as set forth in these specifications to be included within the contract price.

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## SECTION 017700

### CLOSEOUT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Requirements:
  - 1. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

##### 1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the City's use prior to City's inspection, to determine if the Work is substantially complete.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

##### 1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting City unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by City. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain City's signature for receipt of submittals.
  5. Submit testing, adjusting, and balancing records.
  6. Submit changeover information related to City's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise City of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to City. Advise City's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct City's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
  6. Advise City of changeover in utility services.
  7. Participate with City in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, City will either proceed with inspection or notify Contractor of unfulfilled requirements. City will prepare the Certificate of Substantial Completion after

inspection or will notify Contractor of items, either on Contractor's list or additional items identified by City, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

## 1.6 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of City's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by City. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, City will either proceed with inspection or notify Contractor of unfulfilled requirements. City will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## 1.7 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Include the following information at the top of each page:
  - a. Project name.
  - b. Date.
  - c. Name of City.
  - d. Name of Contractor.
  - e. Page number.
2. Submit list of incomplete items in the following format:

- a. MS Excel Electronic File: City will return annotated file.
- b. PDF Electronic File: City will return annotated file.
- c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

## 1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of City for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit City's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  1. Submit by uploading to web-based project software site.
- D. Warranties in Paper Form:
  1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.



## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - f. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - g. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
    - h. Vacuum and mop concrete.
    - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - j. Remove labels that are not permanent.
    - k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
    - n. Clean strainers.
    - o. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations as described below, before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 2. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 3. When concrete pavement, mow band or curbing shall be replaced, contractor shall sawcut and removed to the nearest tooled control joint.
- C. Replace burned-out light bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in LED fixtures to comply with requirements for new fixtures.

**END OF SECTION**

## SECTION 017839

### PROJECT RECORD DOCUMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for general closeout procedures.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set of marked-up record prints through VPM.
  - 2. Number of Copies: Submit copies of Record Drawings as follows through VPM:
    - a. Initial Submittal:
      - 1) Submit one paper-copy set of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and one set of file prints through VPM.
      - 3) City will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit three paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned Record Prints through VPM.
      - 3) Print each drawing, whether or not changes and additional information were recorded.

- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications through VPM.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal through VPM.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal through VPM.
- E. Reports: Submit written report through VPM indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

#### 1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Work Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with City, Architect, and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  4. Refer instances of uncertainty to Architect through Construction Manager for resolution.
  5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect and Construction Manager.
    - e. Name of Contractor.

## 1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

#### 1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

#### 1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

#### 1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for

construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

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## SECTION 024119

### SELECTIVE DEMOLITION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected site elements.
  - 2. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
  - 2. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

##### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to City ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

##### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to City that may be uncovered during demolition remain the property of City.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to City.

#### 1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure City's building manager's and other tenants' on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Submit before Work begins.
- D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

#### 1.7 FIELD CONDITIONS

- A. City will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so City's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by City as far as practical.
  - 1. Before selective demolition, coordinate with the City for the removal of any items.

- C. Notify City of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify City. Hazardous materials will be removed by City under a separate contract.
- E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## 1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

## 1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with City's operations.

## **PART 2 - PRODUCTS**

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Contractor shall coordinate with City to disconnect, cut and cap all utilities Contractor is responsible for as indicated on Drawings.
- C. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by City. City does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- D. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video and templates.
  - 1. Inventory and record the condition of items to be removed and salvaged.

### **3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS**

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. City will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of park.
  - 4. Disconnect, demolish, and remove site utilities, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to City.

### **3.3 PROTECTION**

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area.
  2. Protect adjacent concrete flatwork, fencing and site furnishings, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  3. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  4. Maintain fire watch during and after flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Dispose of demolished items and materials promptly. Comply with all City requirements for removal.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to City.
  4. Transport items to City's storage area off-site or as indicated on Drawings.
  5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by City, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to City standards.
  1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.

### 3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION**

## SECTION 033000

### CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This section includes furnishing all labor, material, equipment, tools, and services required for cast-in-place concrete for concrete flatwork, curbs and gutter, wall and post footings, and other minor concrete work.
- B. Concrete sidewalk construction shall be completed in accordance with the City of Turlock Standard Specifications.

##### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

##### 1.3 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
  - 1. ACI 301 Specifications for Structural Concrete for Buildings
  - 2. ACI 305R Hot Weather Concreting
  - 3. ACI 318/318R Building Code Requirements for Reinforced Concrete
  - 4. ACI 347 Formwork for Concrete
- B. American Society for Testing and Materials (ASTM)
  - 1. ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
  - 2. ASTM A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 3. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
  - 4. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
  - 5. ASTM C94 Standard Specification for Ready-Mixed Concrete
  - 6. ASTM C150 Standard Specification for Portland Cement

7. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete
8. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
9. ASTM C494 Standard Specification for Chemical Admixtures for Concrete
10. ASTM C618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
11. ASTM D994 Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice, 1990, 25th Edition
2. Recommended Practice for Placing Reinforcing Bars

1.4 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings to City for review and approval as indicated on approved plans.

B. Quality Control Submittals

1. Manufacturer's application instructions and data for curing compound.
2. Complete data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.
3. Certified Testing Laboratory report consisting of a minimum of 30 previous compression tests with slump data and 10 previous drying shrinkage tests, for each mix design submitted. The report shall include samples that were taken within the last year (within one year of the bid opening date).
4. Ready-mix delivery tickets for each truck in accordance with ASTM C94

1.5 QUALITY ASSURANCE

- A. Formwork: Unless otherwise specified, follow the recommendations of ACI 347.
- B. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and 318/318R.
- C. Hot Weather Concreting: Conform to ACI 305R.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not use curing compound where solvents in the curing compounds are prohibited by federal, state, or local air quality laws. Use only water curing methods.



## **PART 2 - PRODUCTS**

### 2.1 CONCRETE

- A. Ready-mixed meeting ASTM C94, Option A.
- B. Portland Cement: ASTM C150, Type II.
- C. Water: Potable.
- D. Aggregates: Furnish from one source.
  - 1. Non-Potentially Reactive: In accordance with ASTM C33, Appendix XI, paragraph X1.1.
  - 2. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33 and ASTM C88 using sodium sulfate solution.
  - 3. Natural Aggregates
    - a. Free from deleterious coatings and substances in accordance with ASTM C33, except as modified herein.
    - b. Free of materials and aggregate types causing pop outs, discoloration, staining, or other defects on surface of concrete.
  - 4. Coarse Aggregate
    - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
    - b. Materials Passing 200 Sieve: 0.5 percent maximum.
  - 5. Fine Aggregates
    - a. Clean, sharp, natural sand.
    - b. ASTM C33.
    - c. Materials Passing 200 Sieve: 4 percent maximum.
    - d. Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 200 sieve limited to three percent, coal and lignite limited to 0.5 percent.
- E. Admixtures
  - 1. Air-Entraining: ASTM C260.
    - a. Air-Tite, Cormix Construction Chemicals
    - b. Air Mix or Perma-Air, Euclid Chemical Co.
    - c. MB-VR or Micro-Air, Master Builders, Inc.
    - d. or equal
  - 2. Water-Reducing: ASTM C494, Type A or D.
    - a. PSI N, Cormix Construction Chemicals
    - b. Eucon WR-75, Euclid Chemical Co.

- c. Pozzoloth Normal or Polyheed, Master Builders, Inc.
- d. or equal
- 3. Superplasticizers: ASTM C494, Type F or G.
  - a. Cormix 200, Cormix Construction Chemicals
  - b. Eucon 37, Euclid Chemical Co.
  - c. Rheobuild or Polyheed, Master Builders, Inc.
  - d. or equal
- 4. Fly Ash: ASTM C618, Class C or F.
- 5. Color Pigments: Inert mineral or metal oxide pigments, either natural or synthetic; resistant to lime and other alkalis.

F. Mix Design

- 1. Minimum Allowable 28-day Compressive Field Strength (when cured and tested in accordance with ASTM C31 and C39):
  - a. Miscellaneous Site Concrete: 3,000 psi.
- 2. Coarse Aggregate Size: 1 inch and smaller.
- 3. Slump Range: three to five inches.
- 4. Air Entrainment: Between three and five percent by volume.
- 5. Water Reducers: Use in concrete without plasticizers.

G. Proportions

- 1. Design mix to meet aesthetic and structural concrete requirements.
- 2. Water-cement ratio (or water-cement plus fly ash ratio) shall control amount of total water added to concrete as follows:

<u>Coarse Aggregate Size</u>	<u>W/C Ratio</u>
1 inch	0.40
$\frac{3}{4}$ inch	0.40

- 3. Minimum Cement Content (or Combined Cement Plus Fly Ash Content when fly ash is used):
  - a. 564 pounds per cubic yard for one-inch maximum size aggregate.
  - b. 517 pounds per cubic yard for three quarter-inch maximum size aggregate.
  - c. Increase cement content or combined cement plus fly ash content, as required to meet strength requirements and water-cement ratio. For the substitution of fly ask, a maximum of 15 percent by weight of cement at rate of 1.2-lb fly ash for 1-lb of cement.

- H. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Non-agitating equipment is not allowed.

## 2.2 REINFORCING STEEL

- A. Deformed Bars: ASTM A615, Grade 60.
- B. Deformed Bars to be welded: ASTM A706, Grade 60.
- C. Welded Wire Fabric: ASTM A185.

## 2.3 ANCILLARY MATERIALS

- A. Expansion Joint Filler: ASTM D994, ½ inch thick, or as shown.
- B. Waterstops, if specified or shown on the Plans, shall be manufactured from virgin polyvinylchloride (PVC) conforming to the Corps of Engineers Specification No. CRD-C572. Waterstops shall be 6-inch, heavy-duty Flex-Bulb or flat strip as manufactured by the Greenstreak Company, Water Seals, Inc., or equal; and as shown on the structural drawing details.
- C. Bonding Compounds
  - 1. Epoxy resin bonding compounds shall be used for wet areas and shall be Master Builder, Concrevive Nos. 1001, 1001-LPL or 1180 as applicable; Sika Chemical Corporation, Sikadur 35, Hi-Mod LV, Sikadur 32, Hi-Mod, or Sikadur 31, Hi-Mod Gel as applicable; Burke Company 881 LPL Epoxy; or equal.
  - 2. Non-epoxy bonding compounds shall be used for dry areas and shall be Burke Company, Acrylic Bondcrete; Imperial Chemical Industrial, Inc., Thoro System Products, Acryl 60; Thorobond; or equal. Bonding compounds shall be applied in accordance with the manufacturer's instructions.
- D. Curing Compound
  - 1. Material: Solvent based containing chlorinated rubber solids in accordance with ASTM C309, with additional requirement that the moisture loss not exceed 0.030 gram per centimeter squared per 72 hours.
  - 2. Manufacturers and Products:
    - a. Chemrex Inc., Shakopee, MN; Masterkure CR.
    - b. Euclid Chemical Co.; Euco Super Floor Coat.
- E. Surface Hardener, if specified or shown on the Plans, shall be premixed, noncolored, nonmetallic Master Builders, Mastercron; Sonneborn, Harcol; A. C. Horn Inc., Durafax; Burke Company Non-Metallic Floor Hardener; or equal. Surface hardener shall be applied in accordance with manufacturer's instructions.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Form Materials
  - 1. Use hard plastic finished plywood for exposed areas, and new ship lap or plywood for unexposed areas.

2. Earth cuts may be used for forming footings.

B. Form Ties

1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.
2. Ties shall withstand pressures and limit deflection of forms to acceptable limits.
3. Wire ties are not acceptable.

C. Construction

1. In accordance with ACI 347.
2. Make joints tight to prevent escape of mortar and to avoid formation of fins.
3. Brace as required to prevent distortion during concrete placement.
4. On exposed surfaces locate form ties in uniform pattern or as shown.
5. Construct so ties remain embedded in the wall with no metal within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

D. Form Removal

1. Remove after concrete has attained 28-day strength, or approval is obtained in writing from Engineer.
2. Remove forms with care to prevent scarring and damaging the surface.

### 3.2 PLACING REINFORCING STEEL

A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars

B. Splices and Laps

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
2. Horizontal wall bars are considered top bars.
3. All bar lap splices shall be in accordance with ACI 318.
4. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

### 3.3 EQUIPMENT BASES & FOUNDATION

A. Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

### 3.4 JOINTS

A. Locate as shown or as directed.

B. Maximum Spacing Between Construction Joints: 40 feet.

C. Construct joints true to line, with faces perpendicular to surface plane of concrete.

D. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Landscape Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of slabs.
  3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- E. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least  $\frac{3}{4}$ "-1" of concrete thickness as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- F. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- G. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

### 3.5 CONCRETE PLACEMENT

- A. Place concrete in accordance with ACI 301.

- B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.
- C. Before depositing new concrete on old concrete, clean surface using sandblast or bush hammer or other mechanical means to obtain a ¼ inch rough profile, and pour a cement-sand grout to minimum depth of ½ inch over the surface. Proportion 1 part cement to 2.5 parts sand by weight.
- D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over two feet deep. Place within 1½ hours after adding cement to mix.
- E. Eight feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.
- F. Hot Weather
  - 1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 305R.
  - 2. Maintain concrete temperature below 80 degrees F at time of placement, or furnish test data or provide other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking due to heat of hydration. Ingredients may be cooled before mixing to maintain fresh concrete temperatures at 80 degrees F or less.
  - 3. Make provisions for windbreaks, shading, fog spraying, sprinkling, ice, or wet cover, or other means to provide concrete with temperature specified.
  - 4. Prevent differential temperature between reinforcing steel and concrete.

### 3.6 COMPACTION

- A. Vibrate concrete as follows:
  - 1. Apply vibrator at points spaced not farther apart than vibrator's effective radius.
  - 2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
  - 3. Vibrate until concrete becomes uniformly plastic.
  - 4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

### 3.7 FINISHING

- A. Floor Slabs and Tops of Walls
  - 1. Screed surfaces to true level planes.
  - 2. After initial water has been absorbed, float with wood float and trowel with steel trowel to smooth finish free from trowel marks.
  - 3. Do not absorb wet spots with neat cement.
- B. Unexposed Slab Surfaces: Screed to true surface, bull float with wood float, and wood trowel to seal surface.
- C. Smooth Wall Finish
  - 1. Patch tie holes.
  - 2. Grind off projections, fins, and rough spots.

3. Patch defective areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.
- D. Tolerances: Floors shall not vary from level or true plane more than ¼ inch in 10 feet when measured with a straightedge.
  - E. Exterior Slabs and Sidewalks
    1. Bull float with wood float, wood trowel, and lightly trowel with steel trowel.
    2. Finish with broom to obtain nonskid surface.
    3. Finish exposed edges with steel edging tool.
    4. Mark walks transversely at 5 foot intervals with jointing tool.

### 3.8 FINISHING AND PATCHING FORMED SURFACES

- A. Cut out honeycombed and defective areas.
- B. Cut edges perpendicular to surface at least one inch deep. Do not feather edges. Soak area with water for 24 hours.
- C. Finish surfaces to match adjacent concrete.
- D. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.
- E. Fill form tie holes with Nonshrink Grout.

### 3.9 PROTECTION AND CURING

- A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
- B. Keep concrete slabs continuously wet for a seven-day period. Intermittent wetting is not acceptable.
- C. Use curing compound only where approved by Engineer. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.
- D. Remove and replace concrete damaged by freezing.

### 3.10 FIELD QUALITY CONTROL

- A. Provide adequate facilities for safe storage and proper curing of concrete test cylinders onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
- B. Provide concrete for testing of slump, air content, and for making cylinders from the point of discharge into forms.
- C. Evaluation will be in accordance with ACI 301, Chapter 17 and Specifications.

- D. Specimens will be made daily, cured, and tested in accordance with ASTM C31 and ASTM C39.
- E. The Contractor shall prepare test cylinders daily during concrete placement. Frequency of testing may be changed at discretion of City.
- F. Reject concrete represented by cylinders failing to meet the strength and air content specified.

**END OF SECTION**



**SECTION 042200**  
**CONCRETE UNIT MASONRY**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Mortar and grout.
  - 3. Steel reinforcing bars.
  - 4. Masonry-joint reinforcement.
  - 5. Miscellaneous masonry accessories.
  - 6. Masonry-cell fill.
  
- B. Products Installed but not Furnished under This Section:
  - 1. Masonry block cap.
  
- C. Related Requirements:
  - 1. Section 033000 "Cast-In-Place Concrete" for installing wall footings.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
  
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
  - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
  
- C. Samples for Initial Selection:

1. CMUs, in the form of small-scale units.
2. Colored mortar.

D. Samples for Verification: For each type and color of the following:

1. Exposed or Decorative CMUs.
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
  - a. Include data on material properties.
  - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Protect accepted mockups from the elements with weather-resistant membrane.
  - 3. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by City in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless City specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## **PART 2 - PRODUCTS**

### 2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
  1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602/ACI 530.1/ASCE 6.
  2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

## 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

## 2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, movement joints, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent where indicated.
  - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
- C. Insulated CMUs: Where indicated, units contain rigid, specially shaped, molded-polystyrene insulation units complying with ASTM C578, Type I, designed for installing in cores of masonry units.
- D. CMUs: ASTM C90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
  - 2. Density Classification: Normal weight unless otherwise indicated.
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
  - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
  - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
- E. Decorative CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
4. Pattern and Texture: As indicated on Drawings.
5. Colors: As indicated on Drawings.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

## 2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
- E. Mortar Cement: ASTM C1329/C1329M.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime, masonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
  1. Colored Portland Cement-Lime Mix:
  2. Colored Masonry Cement:
  3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  4. Pigments does not exceed 10 percent of portland cement by weight.
  5. Pigments does not exceed 5 percent of masonry cement or mortar cement by weight.
- H. Aggregate for Mortar: ASTM C144.
  1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  3. White-Mortar Aggregates: Natural white sand or crushed white stone.

4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C404.

J. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by City from manufacturer's colors.

K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

M. Water: Potable.

## 2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

## 2.7 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.

2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.

3. Stainless Steel Wire: ASTM A580/A580M, Type 304.

4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.

5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
- E. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated bent to configuration indicated.
  - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A153M.

## 2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neopren, eurethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

## 2.9 MASONRY-CELL FILL

- A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Lightweight-Aggregate Fill: ASTM C331/C331M.

## 2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.



1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.
  3. For exterior masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
  4. For reinforced masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
  5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
  2. For reinforced masonry, use Type S.
  3. For mortar parge coats, use Type S or Type N.
  4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  5. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments does not exceed 10 percent of portland cement by weight.
  2. Pigments does not exceed 5 percent of masonry cement or mortar cement by weight.
  3. Mix to match Architect's sample.
  4. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Cap units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match Architect's sample.
  2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Cap units.
- F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
  3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.
- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
  4. Verify that substrates are free of substances that would impair mortar bond.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

#### **3.3 TOLERANCES**

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
  - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  - 2. Wet joint surfaces thoroughly before applying mortar.
  - 3. Rake out mortar joints for pointing with sealant.
- D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

### 3.6 MASONRY-CELL FILL INSTALLATION

- A. Pour lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.
- B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

### 3.7 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

### 3.10 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  - 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

### 3.11 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches.

### 3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: City will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level B in TMS 402/ACI 530/ASCE 5.
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- I. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 7 days and at 28 days.

### 3.13 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

### 3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain City's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in each dimension.



2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
  3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off City's property.

**END OF SECTION**

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## SECTION 131100 – SWIMMING POOL GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. The scope of the work included under this Section of the Specifications shall include swimming pool(s) as illustrated on the Drawings and specified herein. The General and Supplementary Conditions of the Specifications shall form a part and be included under this Section of the Specifications. The Swimming Pool Contractor shall provide all supervision, labor, material, equipment, machinery, plant and any and all other items necessary to complete the work. ALL OF THE WORK IN SECTIONS 131100-131108 IS TO BE THE RESPONSIBILITY OF ONE EXPERIENCED SWIMMING POOL CONTRACTOR PRIMARILY ENGAGED IN THE CONSTRUCTION OF COMMERCIAL PUBLIC-USE SWIMMING POOLS. A CONTRACTOR SHALL BE CONSIDERED PRIMARILY ENGAGED AS REQUIRED HEREIN IF THE CONTRACTOR DERIVED 50% OF ITS ANNUAL REVENUE FROM PUBLIC-USE SWIMMING POOL CONSTRUCTION FOR EACH OF THE LAST FIVE YEARS. THE CONTRACTOR MUST HAVE ALSO, IN THE LAST FIVE YEARS CONSTRUCTED AT LEAST FIVE (5) COMMERCIALY DESIGNED MUNICIPAL AND PUBLIC-USE SWIMMING POOLS, EACH OF WHICH SHALL HAVE INCORPORATED A MINIMUM SIZE OF 6,000 SQUARE FEET OF WATER SURFACE AREA WITH A CONCRETE AND CERAMIC TILE PERIMETER OVERFLOW GUTTER AND SELF-MODULATING BALANCE TANK. The Swimming Pool Contractor shall furnish and install the swimming pool structures, finishes, complete swimming pool mechanical and electrical systems, and all accessories necessary for a complete, functional swimming pool system, as herein described. Work shall include start-up, instruction of City's personnel, as-built plans, and warranties as required.

#### 1.2 CODES, RULES, PERMITS, FEES

- A. The swimming pools shall be constructed in strict accordance with the applicable provisions set forth by authorities having jurisdiction over swimming pool construction and operation in the State of California.
- B. The Swimming Pool Contractor shall give all necessary notices, obtain all permits, and pay all government sales taxes, fees, and other costs in connection with their work; file all necessary plans, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction; obtain all required certificates of inspection for their work and deliver same to the City's Representative before request for acceptance and final payment for the work.
- C. The Swimming Pool Contractor shall include in the work any labor, materials, services, apparatus, or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.
- D. The Swimming Pool Contractor shall submit all required documents and materials to all Governmental Departments having jurisdiction of any deferred approval items or substituted materials or products to obtain final approval to installation.

### 1.3 DESCRIPTION OF WORK

- A. Furnish and perform supervision, coordination, all layout, formwork, excavation, hand trim, disposing off-site of all unused material or debris to complete the swimming pool excavation to the dimensions shown on the plans.
- B. Furnish and install complete swimming pool structures, including reinforcing steel and cast-in-place or pneumatically placed concrete walls and floors.
- C. Furnish and install swimming pool finishes, including ceramic tile and marble plaster or other waterproof finishes.
- D. Furnish and install complete swimming pool mechanical system(s), including, but not limited to, circulation systems, filtration systems, pool water heating systems, water chemistry control systems, domestic water fill line systems, booster pump and special effects systems, and all pumps, piping, valves, and connections between system(s) and swimming pool(s).
- E. Furnish and install complete swimming pool electrical system(s), including, but not limited to, underwater lighting systems, water level control systems, timing systems, scoreboards, special effects systems, control circuitry, motor starters, time clocks, bonding, and all conduits, conductors, contactors, and switches between the system(s) and swimming pool(s).
- F. Furnish and install all swimming pool deck equipment and required anchors and inserts for the specified equipment as required by code, shown on the Drawings and specified herein.
- G. After the initial filling of the swimming pool system(s), should any repairs, continuing work, or other contractor responsibility require drainage or partial drainage of the swimming pool systems, the Swimming Pool Contractor shall be responsible for any subsequent refilling and shall complete the project with the swimming pool system(s) full of water, water in chemical balance, complete in every way, and in full operation.

### 1.4 ASSIGNED RESPONSIBILITIES AND RELATED WORK

- A. It is the intent of this section of the specifications to clarify work responsibilities of the trades directly and indirectly involved in construction of the pool system. All labor, equipment, materials and supplies furnished by the Swimming Pool Contractor and other subcontractors per the contractual agreement with the General Contractor and City and shall be as directed by the City through their designated representative .
- B. THE SWIMMING POOL CONTRACTOR SHALL NOT SUBCONTRACT ANY PORTION OF THE SWIMMING POOL CONSTRUCTION OR SWIMMING POOL EQUIPMENT INSTALLATION TO ANYONE OTHER THAN A CONTRACTOR THAT SATISFIES THE REQUIREMENTS OF SECTION 131100.
- C. References to “swimming pool systems” shall include the swimming pool, equipment, and accessories.
- D. The City will provide one complete water filling of the swimming pool(s), but will not assume any responsibility for the swimming pool system(s) until they have been proved fully operational, complete in every way and accepted by the City’s Representative.

## 1.5 RESPONSIBILITIES OF THE SWIMMING POOL CONTRACTOR

- A. The Swimming Pool Contractor shall grade the swimming pool site(s), establish benchmarks, cut and fill as necessary to provide as level an area as possible at swimming pool deck elevation before swimming pool layout, and over-excavate, install membranes, and place engineered fill soils as required.
- B. The Swimming Pool Contractor shall be responsible for horizontal dimensions and grade elevations accurately from established lines and benchmarks (as indicated on the Drawings) and be responsible for those grades.
- C. The Swimming Pool Contractor shall not permit any heavy equipment activity over any area or within five (5) feet of any area under which swimming pool piping is buried. There shall be no exceptions to this requirement.
- D. The Swimming Pool Contractor shall keep the swimming pool excavation(s) and swimming pool structure(s) free of construction residue and waste materials of their workmen or subcontractors, removing said material from the swimming pools as required.
- E. The Swimming Pool Contractor shall protect the swimming pool(s) from damage caused by their construction equipment and /or workmen and subcontractors.
- F. The Swimming Pool Contractor shall provide an adequate storage area as required to protect materials and equipment stored on jobsite from damage, weather, and theft.
- G. The Swimming Pool Contractor shall provide a representative at time of swimming pool start-up to coordinate all trades related to swimming pool system(s).

## 1.6 RESPONSIBILITIES OF THE SWIMMING POOL MECHANICAL CONTRACTOR

- A. The Swimming Pool Mechanical Contractor shall not utilize any swimming pool piping trench for installation of any sanitary sewer, storm sewer, domestic water, hot water, chilled water or natural gas line.
- B. The Swimming Pool Mechanical Contractor shall furnish and install all storm sewer piping, including deck drainage systems within the confines of the pool deck area as required by code, shown on the Drawings, and herein specified.
- C. The Swimming Pool Mechanical Contractor shall confirm that there is a minimum 75 psi water supply provided by others for swimming pool construction work within the confines of the swimming pool construction site(s).
- D. The Swimming Pool Mechanical Contractor shall furnish and install reduced pressure backflow protected domestic water lines to P.O.C. within swimming pool mechanical room(s) as required by code, shown on the Drawings, and herein specified.
- E. The Swimming Pool Mechanical Contractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

1.7 RESPONSIBILITIES OF THE SWIMMING POOL ELECTRICAL SUBCONTRACTOR

- A. The Swimming Pool Electrical Contractor shall furnish and install all conduits, conductors, starters/disconnects, panels, circuits, switches and equipment as required for proper swimming pool and pool equipment installation in accordance with manufacturer’s recommendations and shop drawings within swimming pool mechanical rooms and pool areas required by code, shown on the Drawings, and herein specified to provide a complete working system.
- B. All equipment, material and installation shall be as required under Section 131122 of the Specifications and shall conform to NEC Article 680 (latest revision), State and Local Codes, and as may be required by all authorities having jurisdiction over swimming pool construction within the State of California.
- C. The Swimming Pool Electrical Contractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

1.8 INTENT

- A. It is the intention of these specifications and Drawings to call for finished work, tested and ready for operation. Wherever the work “provide” is used, it shall mean “furnish and install complete and ready for use.”
- B. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.9 SCHEDULE OF VALUES

- A. Provide a Schedule of Values for all work specified in each of the technical specifications listed in the table below, regardless of whether the work is performed by the swimming pool contractor or others. Values listed shall be fully burdened, with contractor general conditions, overhead, profit and bonds included. Payments for swimming pool work completed shall not be approved until Schedule of Values has been submitted to and approved by Architect.

SWIMMING POOL SCHEDULE OF VALUES			
No.	Section #	Description	Value
1.	131101	Swimming Pool Excavation	
2.	131102	Swimming Pool Concrete	
3.	131103	Swimming Pool Shotcrete	
4.	131104	Swimming Pool Ceramic Tile	
5.	131105	Swimming Pool Plaster	
6.	131106	Swimming Pool Equipment	
7.	131107	Swimming Pool Mechanical	
8.	131108	Swimming Pool Electrical	
Total			

## 1.10 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing submittals with performance construction activities
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 1 Section 013000 for time requirements for schedules performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for re-submittals as follows. Time for review shall commence on Architect's receipt of submittal.
  - 1. Initial Review: Allow fifteen (15) days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contract when a submittal being processed must be delayed for coordination.
  - 2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, City, or other parties is required, allow twenty-one (21) days for initial review of each submittal.
  - 3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Submittal will be returned to Architect before being returned to Contractor.
  - 4. If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 5. Allow fifteen (15) days for processing each submittal.
  - 6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a title block on each submittal for identification.
  - 1. Indicate name of firm or entity that prepared each submittal on title block.
  - 2. Provide a space on title block to record Contractor's review and approval markings and action taken by Architect.
  - 3. Include the following information on title block for processing and recording action taken: (See Attached Sample)
    - a. Project name.
    - b. Date.
    - c. Name and address of Contractor.
    - d. Name of Subcontractor.
    - e. Name of Supplier.
    - f. Name of Manufacturer.
    - g. Unique identifier, including revision number.
    - h. Number and title of appropriate Specification Section.
    - i. Drawing number and detail references, as appropriate.
    - j. Other necessary identification.

<b>SUBMITTAL FOR:</b> (Project Name) (Project Address) (City, State, Zip)	<b>SUBMITTAL TO:</b> (Contact) (Address) (City, State Zip Code)	<b>CONTRACTOR:</b>
--	--	--------------------

Item Number:	_____
Section Number:	_____
Section Description:	_____
Contractor:	_____
Supplier:	_____
Manufacturer:	_____
Product Code:	_____
Quantity:	_____

<b>Contractor Certification:</b>  It is hereby certified that the equipment or material designated in this submittal is proposed to be incorporated in the above named project and is in compliance with the contract drawings and / or specifications and is submitted for approval.  Certified by: _____  Date: _____  Job _____ Superintendent: _____  Revisions: _____	<b>Contractor's Submittal Stamp:</b>
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Architect's Review Stamp and Comments



- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract documents on submittal.
- G. On all catalogue or cut sheets identify which model or type is being submitted.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Product data and shop drawings shall be packaged within a three ring binder and colored samples shall be packaged on a heavy cardboard. Transmit each submittal using a transmittal form.
  - 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, request for data, revisions other than those requested by Architect on previous submittals and deviations from requirements of the Contract documents, including minor variations and limitations. Include the same label information as the related submittal.
  - 2. Include Contractor's certification stating that information submitted complies with requires of the Contract Documents.
  - 3. Transmittal Form: Provide locations on form for the following information:
    - a. Project name.
    - b. Date.
    - c. Destination (To:).
    - d. Source (From:).
    - e. Names of Contractor, manufacturer, and supplier.
    - f. Category and type of submittal.
    - g. Submittal purpose and description.
    - h. Remarks.
- I. Distribution: Furnish copies of final submittals to manufacturers, Contractors, suppliers, fabricators, installers, authorities having jurisdiction and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

#### 1.11 SUBSTITUTIONS

- A. To obtain approval to use unspecified products, bidders shall submit requests for substitution at least ten (10) days prior to bid date. Requests shall only be considered if they clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. All unspecified products and equipment will be considered on an "or equal" basis at the discretion of the City's Representative. Requests for substitution received after the specified deadline will not be considered. Where a conflict exists between the requirements of the General Conditions / Special Conditions / Division 1 concerning substitutions and the requirements of this Article, this Article (Section 131100, Article 1.10) shall govern.
- B. Where the Swimming Pool Contractor proposes to use an item of equipment other than that specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the architectural, mechanical, or electrical layout, all such redesign and all new drawings (stamped by California Licensed Engineer) and detailing required shall be prepared by the Swimming Pool Contractor, at their own expense, submitted for review and approval by the City's Representative prior to bid.

- C. Where such approved deviation requires a different quantity and arrangement of piping, supports and anchors, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Swimming Pool Contractor shall furnish and install any such piping, structural supports, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the City.

1.12 SURVEYS AND MEASUREMENTS

- A. The Swimming Pool Contractor shall base all measurements, both horizontal and vertical, from benchmarks established on site. All work shall agree with these established lines and levels. The mechanical Drawings do not give exact details as to elevations of piping, exact locations, etc. and do not show all offsets, control lines, pilot lines and other installation details. Verify all measurements at site and check the correctness of same as related to the work.

1.13 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of the systems and work included in the contractor. Drawings are not to be scaled. The architectural drawings and details shall be examined for exact dimensions. Where they are not definitely shown, this information shall be obtained from the City's Representative.

1.14 SWIMMING POOL SUBSUBCONTRACTOR

- A. The swimming pool construction work as herein described and specified in Section 13 of the Project Manual shall be the complete responsibility of a qualified and specifically licensed (C-53 license classification within the State of California) Swimming Pool Contractor with extensive experience in commercial public use swimming pool installations. The Swimming Pool Contractor shall submit the swimming pool project experience list in accordance with the 1.13.A.
- B. The Swimming Pool Contractor shall furnish performance and payment bonds in the amount of 100% of the Swimming Pool Contractor's bid written by a Surety Company properly registered in the State of California and listed by the U.S. Treasury. The expense of the bond(s) is to be borne by the Contractor.
- C. The Swimming Pool Contractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Conditions, Section 131100, as follows:
  - 1. Swimming Pool Contractor has derived 50% of its annual revenue from public-use swimming pool construction for each of the last five (5) years.
  - 2. Swimming Pool Contractor has, in the last five (5) years, constructed at least five (5) commercially designed municipal and public-use swimming pools, each of which have incorporated a minimum size of 6,000 square feet of water surface area with a concrete and ceramic tile perimeter overflow gutter and self-modulating balance tank.
  - 3. The Swimming Pool contractor certifies that the following list of the Swimming Pool Contractor's swimming pool construction experience meets the requirements of section (1.13.3.2)

a. City: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_

Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

b. City: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

c. City: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

d. City: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

e. City: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

D. Swimming Pool Contractor certifies that it meets the qualifications and pool deck construction experience requirements established in Swimming Pool General Requirements, Section 131100, as follows:

1. Swimming Pool Contractor has, in the last five (5) years, constructed at least five (5) commercially designed cantilevered pool decks over perimeter gutters, each of which have incorporated a minimum size of 6,000 square feet of water surface area of the swimming pool.
2. The following list of projects meet the requirements of section (b) above and the contact as reference by the General Contractor, the Awarding Authority of their agent or designee.
3. The Swimming Pool contractor certifies that the following list of the Swimming Pool Contractor's pool deck construction experience meets the requirements of section (1.14.D.1)

- a. City: \_\_\_\_\_  
 Scope of Project: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Architect for Project: \_\_\_\_\_
  
- b. City: \_\_\_\_\_  
 Scope of Project: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Architect for Project: \_\_\_\_\_
  
- c. City: \_\_\_\_\_  
 Scope of Project: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Architect for Project: \_\_\_\_\_
  
- d. City: \_\_\_\_\_  
 Scope of Project: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Architect for Project: \_\_\_\_\_
  
- City: \_\_\_\_\_  
 Scope of Project: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Architect for Project: \_\_\_\_\_

1.15 OPERATING INSTRUCTIONS

- A. The Swimming Pool Contractor shall determine from actual samples of pool water supplied by the City, the proper water management program necessary for maximum operating efficiency and comfort. The Swimming Pool Contractor shall provide the services of experienced personnel familiar with this type of pool system operation, in conformance with Section 131105 of the Specifications.

1.16 MAINTENANCE MANUALS

- A. The Swimming Pool Contractor shall provide four (4) bound sets for delivery to the City's Representative of instructions for operating and maintaining all systems and equipment included in this Contract. Manufacturer's advertising literature or catalog pictures will not be acceptable for operating and maintenance instructions.

- B. Bound in ring binders shall be all parts lists, periodic maintenance instructions and troubleshooting guidelines for all pool equipment, including but not limited to filters, pumps, controllers, water chemistry control equipment, etc.

1.17 SECURE FROM THE CITY

- A. A complete City-furnished filling of the swimming pools.
- B. The City's assistance, as specified herein, from the time of start-up until final written acceptance of the swimming pool system(s).
- C. Chemicals as required for swimming pool operation after Swimming Pool Contractor completes balance of water chemistry and maintenance period described in Section 131105 of the Specifications.

1.18 WARRANTY

- A. The Swimming Pool Contractor shall warrant all swimming pool structures, finishes and systems against defects in material and workmanship for a period of one year after the date of acceptance by the City. Any repair or replacement required due to defective material or workmanship will be promptly corrected by the Swimming Pool Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 131100

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## SECTION 131101 – SWIMMING POOL EXCAVATION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Finish and fine grading to bring the surface of the ground to the required grades and elevations as indicated on the Drawings.
- B. Subgrade improvements and placing of compacted fills.
- C. Excavation and backfill for all swimming pool, pool deck, surge chamber and backwash retention tank structural requirements, including footings, foundations, slabs and walls.

#### 1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Conform with requirements of the General Conditions, and more specifically the following:
  - 1. Comply with California Building Code, 2022 edition.
  - 2. Comply with applicable construction safety orders, latest edition, Federal and State OSHA.
  - 3. Comply with applicable trench safety provisions, latest edition, Federal and State OSHA.
- B. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- C. Project/Site Conditions:
  - 1. No Geotechnical Report was provided by the Owner.
  - 2. Be familiar with site and subsurface conditions.
  - 3. Excavation is unclassified and includes excavation to sub-grade elevations indicated or necessary, regardless of character of materials and obstructions encountered.

4. Provisions for mitigation of wet soils due to seepage or rain shall be made during excavation and throughout construction. If wet soils are encountered within the swimming pool excavations, de-watering shall be provided and the Geotechnical Engineer shall make recommendations for moist soil mitigation.
5. Where slope instability is encountered, all excavations within those areas shall be 1:1 or flatter. Forming of vertical walls may be necessary, and all soil conditions shall be field verified by the Geotechnical Engineer.
6. Refer to General Requirements, Articles 3.17 and 3.18.

D. Adverse Weather Conditions:

1. During the periods when site soil moisture content is substantially in excess of moisture content required for optimum compaction, do not perform fill compaction.
2. When unfavorable weather conditions necessitate interrupting filling and grading operations, prepare areas by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion.

### 1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with requirements of Section 01 33 00. Requests for substitution shall conform to requirements of Article 1.10.A of Section 13 11 00.
- B. Required submittals include:
  1. Offsite fill material, if applicable.
- C. Submit proof of qualifications as specified in Article 1.2.B of this Section.

### 1.4 EXCAVATING & TRENCHING, GENERAL REQUIREMENTS

- A. Refer to Section 01 50 00, Temporary Facilities and Controls.
- B. All trenches, holes, etc. are to be completely protected using solid barricades, steel plates, and plywood both during construction and during off hours, including night time.
- C. Flashing warning light barricades are required on sidewalks, roads, and any other critical areas that require night time protection.
- D. Roads, paths and sidewalks shall not be blocked at any time or in any way. Trenching across roads, paths or sidewalks involves special instructions and review of the construction procedure by the Owner at least three (3) days prior to the Work actually being started.
- E. Construction equipment, including all trucks, cars, etc. shall not be parked or driven on roads, paths or sidewalks. Items not allowed on roads, paths or sidewalks include hoses, power cords, ropes, construction materials, dirt and debris, etc.



- F. All roads, paths and sidewalks must remain clear and the Contractor shall maintain temporary safe and effective pedestrian access at all times.
- G. Drawings show existing major underground utilities using the best information available. The Contractor shall also fully check public works reference drawings prior to excavation. Call local Dig Alert to locate utilities to ensure safety.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Fill Material, General: All material shall be subject to the review of the Geotechnical Engineer to determine acceptability.
- B. On-site Fill Material: All on-site fill material shall be soil or soil-rock mixture which is free from organic matter and other deleterious substances; it shall contain no rocks or lumps over three (3) inches in greatest dimension and not more than fifteen percent (15%) of the rocks or lumps shall be larger than two (2) inches in greatest dimension. Material from the pool excavations may not be acceptable native fill material. A determination must be made before their use by the Geotechnical Engineer.
- C. Imported Fill Material: All imported fill material shall meet the requirements of Paragraph 2.1(A) and 2.1(B) above and shall in addition, be predominately granular and non-expansive, with a maximum particle size of three (3) inches.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Verify drawing dimensions and elevations with actual field conditions. Inspect related Work and adjacent surfaces and report discrepancies and conditions which prevent proper execution of the Work to the Owner's Representative.

### 3.2 SUBGRADE IMPROVEMENTS

- A. Clearing: Strip site area (as defined within the Drawings) of any topsoil containing vegetation, trees and roots, organic matter, and other debris, and dispose of as specified.
- B. Placement of Fills: Place fill, consisting of approved soils, clean and free of all vegetation, debris, and rocks larger than three (3) inches, in uniform six (6) inch lifts. Fill to be compacted at optimum moisture to ninety-five percent (95%) maximum density with approved mechanical compaction equipment.

### 3.3 EXCAVATION

- A. Checking Layout: Contractor shall, before commencing the excavation work, check all lines, stakes and levels for dimensions, angles, elevations and grades with the survey.
- B. Over-Excavation:
  - 1. Any overexcavation that may be required shall be subject to Geotechnical observation for any onsite conditions. Prior to placing fill, the subgrade exposed by the overexcavation should be scarified to a depth of at least eight (8) inches, moisture-conditioned to at least three percent (3%) above optimum moisture content, and compacted to at least ninety percent (90%) relative compaction.
  - 2. Excavate for footings, foundations, grade beams and slabs to depths indicated on Drawings. Elevations and depths of excavations shown on the Drawings shall govern and will be basis for bidding and execution of work except as otherwise may be directed by the Owner's Representative. Greater or lesser quantities of excavation and backfill required by authorized instructions shall be adjusted in accordance with the General Conditions.
  - 3. In areas where proposed swimming pool decking is anticipated, the site should be excavated to a depth of one (1) foot below existing grade and backfilled with compacted engineered fill. The intent of this recommendation is to remove soils susceptible to compressibility.
  - 4. Except where extra excavation is directed by the Owner's Representative or Geotechnical Engineer, excavations made to a greater depth or size than indicated or required shall be filled with concrete or shotcrete as specified in Sections 13 11 02 / 13 11 03.
- C. Dimensions: Excavate to proper dimensions as shown, cut square and smooth with firm level bottoms. Prepared excavations shall be approved by Geotechnical Engineer. Excavations shall be free of loose or disturbed materials.
- D. Excess Water Control: Keep all excavations free from standing water by pumping, draining or providing proper protection against water intrusion. If soil becomes soft, soggy or saturated, perform additional excavation to firm soil not affected by water.
- E. Form Removal: Make all excavations of sufficient size to permit installation and removal of forms and all other required work.
- F. Alternate Forming: Sides of structures may be formed by neat excavations where banks will stand without caving. If banks cave, provide forming as required and widen excavation to permit forming, bracing and inspection. Provide forming in conformance with Section 13 11 02 and all recognized safety standards. Form all grade beams.

### 3.4 BACKFILLING

- A. Method: After concrete has been placed, forms removed and concrete work approved, backfill the excavations with earth to indicated or required grades. Carry on backfilling simultaneously on each side of walls or grade beams. Remove all rubbish and wood from the excavations before placing backfill.

- B. Concrete Protection: Prior to placing any backfill, adequately cure all concrete and provide any bracing required to ensure the stability of the structure. Protect waterproofing and dampproofing against damage in a manner acceptable to the Owner's Representative. Remove bracing as backfill operations progress.
- C. Material: Use the material from the excavations for backfilling, subject to approval by Soils Testing Agency. The earth shall be free from debris, large clods or stones.
- D. Lifts: Place backfill in six (6) inch loose layers, bring to optimum moisture content and compact to ninety percent (90%) of maximum density, sloping down and away from the structures being backfilled.
- E. Moisture: Rigidly control the amount of water used to insure optimum moisture conditions for the type of fill material used. Excessive amounts of water causing saturation of earth will not be permitted. Compaction by flooding or jetting is prohibited.

### 3.5 GRADING

- A. Slopes: Grade to finish grades indicated on Drawings, with uniform slopes between all points.
- B. Subgrades: Blade to required grade and roll or tamp subgrades for exterior slabs, decks and paving.

### 3.6 CLEAN-UP

- A. Disposal: Haul away rubbish, debris, and rocks from site promptly and dispose of legally. Burning rubbish on site is prohibited.
- B. Dust and Noise Abatement: During entire period of construction keep area and material being loaded sprinkled to reduce dust in air and annoyance to premises and surrounding property.

END OF SECTION 131101

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## SECTION 131102 – SWIMMING POOL CONCRETE

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Forming for cast-in-place concrete and shotcrete associated with swimming pools and pool decks.
- B. Reinforcement for cast-in-place concrete and shotcrete associated with swimming pools and pool decks.
- C. Cast-in-place concrete for swimming pool structures. Do not use waterproofing admixture of any kind.
- D. Cast-in-place concrete for swimming pool decks with Xypex C-500 crystalline waterproofing admixture. Waterproofing admixture for swimming pool decks only.
- E. Provide labor, materials and equipment as required to install sealant for all pool deck expansion joints, or any other caulking, as indicated on the aquatic Drawings and herein specified.

#### 1.2 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards:
  - 1. In addition to complying with the California Building Code (2022 edition), 1908 comply with all pertinent recommendations contained in "Guide to Formwork for Concrete" Publication ACI 347R-14 of the American Concrete Institute.
  - 2. In addition to complying with California Building Code (2022 edition), comply with all pertinent recommendations contained in "Guide to Presenting Reinforcing Steel Design Details," Publication ACI 315R-18 of the American Concrete Institute
  - 3. In addition to complying with all local codes and regulations, comply with all pertinent recommendations contained in American Society for Testing and materials (ASTM); ASTM C 920 "Standard Specification for Elastometric Joint Sealants."
- C. Tolerances: Construct all swimming pool concrete straight, true, plumb and square within a tolerance horizontally of one in 200 and vertically of one in 2000.

### 1.3 SUBMITTAL AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 013300.
- B. Samples and Certificates, Concrete Reinforcement:
  - 1. Provide all data and access required for testing as described in Section 014500 of the Specifications.
  - 2. All material shall bear mill tags with heat number identification. Mill analysis and report shall be made available upon request.
  - 3. Material not so labeled and identifiable may be required by the City to be tested by the testing laboratory selected by the City and at no additional cost to the City, in which case random samples will be taken for one series of tests from each 2-1/2 tons or fraction thereof of each size and kind of reinforcing steel.
  - 4. Design mix from batch plant demonstrating previous use history and associated strengths at 28 days.
  - 5. The Contractor shall submit a mix design stamped and signed by a licensed engineer for acceptance by the City's Representative prior to any placement of concrete.
  - 6. The Contractor shall submit a separate mix design stamped and signed by a licensed engineer for the swimming pool decks which contains the specified Xypex C-500 crystalline waterproofing admixture for acceptance by the City's Representative prior to any placement of concrete.
- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.
- D. Submit reinforcing shop drawings for pool walls, gutters, floors, dike walls and balance tank, etc. as shown on the construction drawing.

### 1.4 PRODUCT HANDLING

- A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.
- C. Protection: Use all means necessary to protect the swimming pool concrete before, during, and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City.

## PART 2 - PRODUCTS

### 2.1 CONCRETE FORMWORK

- A. Form Materials:

1. Form Lumber: All form lumber in contact with exposed concrete shall be new except as allowed for reuse of forms in Part 3 of this Section, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the City's Representative.
    - a. "Plyform," Class I or II, bearing the label of the Douglas Fir Plywood Association; "Inner-Seal" Form as manufactured by Louisiana-Pacific, or approved equal.
    - b. Douglas Fir-Larch, number two grade, seasoned, surfaced four sides.
  2. Form Release Agent: Colorless, non-staining, free from oils; chemically reactive agent that shall not impair bonding of paint or other coatings intended for use.
- B. Ties and Spreaders:
1. Type: All form ties shall be a type which do not leave an open hole through the concrete and which permits neat and solid patching at every hole.
  2. Design: When forms are removed, all metal reinforcement shall be not less than two (2) inches from the finished concrete surface.
  3. Wire Ties and Wood Spreaders: Do not use wire ties or wood spreaders.
- C. Alternate Forming Systems: Alternate forming systems may be used subject to the advance acceptance of the City's Representative.

## 2.2 CONCRETE REINFORCEMENT

- A. Bars: Bars for reinforcement shall conform to "Specifications for Deformed Carbon-Steel Bars for Concrete Reinforcement," ASTM A-615, Grade 60.
- B. Wire Fabric: Wire fabric shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete," ASTM A1064.
- C. Tie Wire: Tie wire for reinforcement shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete," ASTM A1064 black annealed 16-gauge tie wire.

## 2.3 CAST-IN-PLACE CONCRETE

- A. Concrete:
  1. All concrete, unless otherwise specifically permitted by the City's Representative, shall be transit-mixed in accordance with ASTM C94. Concrete for water retaining structures that do not receive a waterproofing finish such as ceramic tile or swimming pool plaster shall receive a topical waterproofing finish.
  2. The control of concrete production shall be under the supervision of a recognized testing agency, selected by the City in accordance with Section 01 2500 of the Specifications.
  3. Quality: All concrete shall have the following minimum compressive strengths at twenty-eight (28) days and shall be proportioned within the following limits:

- a. 4,000 psi minimum compressive strength for cast-in-place concrete swimming pool structures.
  - b. 4,000 psi minimum compressive strength for cast-in-place swimming pool decks with Xypex C-500 waterproofing admixture.
  - c. 1" maximum size aggregate.
  - d. 6.0 minimum sacks of cement per cubic yard.\*
  - e. Maximum water to cement ratio of 0.40 minimum-0.45 maximum
  - f. 4" maximum slump.
  - g. Xypex Admix C-500 2% - 2.5% by weight of cement content. Contact Xypex Technical Services to confirm dosage. (To be used for swimming pool decks only.)  
\* For estimate only: to be determined by mix design.
4. Cement: All cement shall be Portland Cement conforming to ASTM C-150, Type II or V and shall be the product of one manufacturer.
5. Aggregates:
- a. Shall conform to "Standard Specifications for Concrete Aggregates," ASTM C33, except as modified herein.
  - b. Coarse Aggregate: Clean sound washed gravel or crushed rock. Crushing may constitute not more than 30% of the total coarse aggregate volume. Not more than 5% flat, thin, elongated or laminated material nor more than 1% deleterious material shall be present. 1" aggregate graded from 1/4" to 1", fineness modulus 6.90 to 7.40. 1-1/2" graded from 1/2" to 1-1/2", fineness modulus 7.80 to 8.20.
  - c. Fine Aggregate: Washed natural sand of hard, strong particles and shall contain not more than 1% of deleterious material, fineness modulus 2.65 to 3.05.
  - d. Aggregate must be certified, non-expansive from a "known" good source.
6. Water: ASTM C1602, Clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the concrete (potable).
7. Admixtures: Admixtures shall be used upon approval of the City's Representative.
- a. Air-entraining admixture: Conform to ASTM C260.
  - b. Water-reducing admixture: Conform to ASTM C494.
  - c. Waterproofing admixture for swimming pool decks only: Xypex Admix C-500, no substitutions permitted. Conform to ASTM C494.
8. Xypex Admix C-500 Dosage: To be used for swimming pool decks only.
- a. General: Xypex Admix must be added to concrete mix at time of batching. It is important to obtain a homogeneous mixture of Xypex Admix with the concrete. Do not add dry Admix powder directly to wet mixed concrete as this could cause clumping and thorough dispersion may not occur.
  - b. Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at the following rates:
    - 1) Xypex Admix C-500 2% – 2.5% by weight of cement content
  - c. Weather Conditions: For mixing, transporting and placing concrete under conditions of high temperature or low temperature, follow concrete practices such as those referred to in ACI 305R (Hot Weather Concreting) and ACI 306R (Cold Weather Concreting) or other applicable standards.



- d. Concrete Batching & Mixing Procedures: Procedures for the addition of Xypex admixture will vary according to type of batch plant operation and equipment. Prior to the placement of any concrete, the concrete batch plant and the contractor shall be responsible to consult with the local Xypex representative concerning additional procedures for the addition, mixing and to confirm dosage.
  - e. Note: For enhanced chemical protection or for meeting specific project requirements or where the concrete mix design contains higher than 25% type F fly ash content or includes a Portland cement/slag cement/type C fly ash blend, consult with manufacturer or its authorized representative to determine appropriate dosage rates.
- B. Construction Joints: Use keyform for slab pour joints. Either preformed galvanized or PVC construction joint forms of a standard manufacturer may be used. Install per manufacturer's recommendations and tool edges of slabs.
  - C. Waterstops: PVC bulb-type for use between concrete pours / lifts, conforming with ASTM D 570, D 624, and D 638. Provide in configuration(s) as recommended by manufacturer for specific application. Greenstreak, W.R. Meadows, or approved equal.
  - D. Curing Materials:
  - E. Liquid Membrane (covered slab): Chlorinated rubber membrane forming, curing-sealing compound conforming to ASTM C309.
  - F. Liquid Membrane (exposed slab): Clear methyl and butyl methacrylate non-staining, membrane forming, curing-sealing compound conforming to ASTM C309.
  - G. Cement Grout and Drypack:
    - 1. Cement Grout: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make mixture flow under its' own weight.
    - 2. Drypack: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make a stiff mix that will mold into a ball. Mix no more than can be used in 30 minutes.

#### 2.4 JOINT SEALANT MATERIALS

- A. Caulking: Multipart, non-sag gun grade polyurethane-based sealant meeting the requirements of ASTM C920-02, Type S or M, Mamemco International, Pecora, Sika Corp., Sonneborn Building Products, Tremco or approved equal. Self-leveling caulking materials are not allowed.
- B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- C. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- D. Sealant Backer Rod: Provide compressible polyethylene or polyurethane backer rod as recommended by the sealant manufacturer.

- E. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.
- F. Sand: Cover the surface of the caulking with #30 silica sand.

## 2.5 OTHER MATERIALS

- A. All other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the advance review by the City's Representative.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
  - 2. Verify that all Work may be constructed in accordance with all applicable codes and regulations, the referenced standards, the original design, and in accordance with site specific Geotechnical Report.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the City's Representative.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive work.

### 3.2 CONCRETE FORMWORK

- A. Construction of Forms:
  - 1. General: Construct all required forms to be substantial, sufficiently tight to prevent leakage of concrete paste, and able to withstand excessive deflection when filled with wet concrete.
  - 2. Layout:
    - a. Form for all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the Drawings.
    - b. Exercise particular care in the layout of forms to avoid necessity for cutting concrete after placement.
    - c. Make proper provisions for all openings, offsets, recesses, anchorages, blocking and other features of the Work as shown or required.

- d. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installation.
    - e. Carefully examine the Drawings and Specifications and consult with other trades as required relative to providing for pipe and conduit penetrations, reglets, chases and other items in the forms.
  3. Imbedded Items: Set all required steel frames, angles, bolts, inserts and other such items required to be anchored in the concrete prior to concrete being placed.
  4. Bracings:
    - a. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to workmen.
    - b. Construct all bracing, supporting members and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
    - c. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
  5. Wetting: Keep forms sufficiently wetted to prevent joints from opening up before concrete is placed.
- B. Plywood Forms:
  1. Design: Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
  2. Joints: Make all panel joints tight butt joints with all edges true and square.
- C. Footing Forms:
  1. Wood Forms: All footing forms shall be wood unless otherwise specifically accepted by the City's Representative, or as specified in paragraph 3.2(C)(2).
  2. Earth Forms:
    - a. Side walls for footings may be of earth provided the soil will stand without caving and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the Drawings.
    - b. For excavation and backfill of earth forms, conform with applicable provisions of Section 13 1101.
- D. Reuse of Forms:
  1. Reuse of forms shall be subject to advance acceptance of the City's Representative.
  2. Except as specifically approved in advance by the City's Representative, reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
  3. Except as specifically accepted in advance by the City's Representative, reuse of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete.
- E. Removal of Forms:

1. General:
  - a. In general, side forms of footings may be removed seven (7) days after placement of concrete, but time may be extended if deemed necessary by the City's Representative.
  - b. Forms for footings, foundations, grade beams, slabs, walls, and other formed concrete may be removed fourteen (14) days after placement of concrete.
2. Removal:
  - a. Use all means necessary to protect workers, passersby, the installed Work of other trades and the complete safety of the structure.
  - b. Cut nails and tie wires or form ties off flush, and leave all surfaces smooth and clean.
  - c. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.
  - d. Flush all holes resulting from the use of spreader ties and sleeve nuts using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be one-part Portland Cement to 2-1/2 parts sand; apply grout immediately after removing forms.

### 3.3 CONCRETE REINFORCEMENT

#### A. Bending:

1. General:
  - a. Fabricate all reinforcement in strict accordance with the Drawings.
  - b. Do not use bars with kinks or bends not shown on the Drawings.
  - c. Do not bend or straighten steel in a manner that will injure the material. (When opposite end is already encased in concrete.)
2. Design:
  - a. Bend all bars cold.
  - b. Make bends for stirrups and ties around a pin having a diameter of not less than four (4) times the minimum thickness of the bar (#3-#5) per ACI.
  - c. Make bends for other bars, including hooks, around a pin having a diameter of not less than six (6) times the minimum thickness of the bar.

#### B. Placing:

1. General: Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by concrete blocks, metal chairs or spacers, or by metal hangers.
2. Clearance:
  - a. Preserve clear space between bars of not less than one and one-half (1-1/2) times the nominal diameter of the round bars.

- b. In no case let the clear space be less than one and one-half (1-1/2) inches nor less than one and one-third (1-1/3) times the maximum size of the aggregate.
  - c. Provide the following minimum concrete covering of reinforcement:
    - 1) Concrete deposited against earth: three (3) inches minimum.
    - 2) Concrete below grade deposited against forms: two (2) inches minimum.
    - 3) Concrete elsewhere: As indicated on Drawings or otherwise approved by the City's Representative.
3. Splicing:
- a. Horizontal Bars:
    - 1) Place bars in horizontal members with minimum lap at splices sufficient to develop the strength of the bars.
    - 2) Bars may be wired together at laps except at points of support of the member, at which points preserve clear space described above.
    - 3) Whenever possible, stagger the splices of adjacent bars.
    - 4) Splice forty (40) bar diameters minimum.
    - 5) Provide non-contact lap slices for shotcrete.
  - b. Wire Fabric: Make all splices in wire fabric at least one and one-half (1-1/2) meshes wide.
  - c. Other Splices: Make only those other splices that are indicated on the Drawings or specifically approved by the City's Representative.
4. Dowels: Place all required steel dowels and securely anchor them into position before concrete is placed.
5. Obstructions: In the event conduits, piping, inserts, sleeves and other items interfere with placing reinforcement as indicated on the Drawings or otherwise required, immediately consult with the City's Representative and obtain approval of a new procedure prior to placing concrete.
- C. Cleaning Reinforcement: Steel reinforcement, at the time concrete is placed around it, shall be free from rust scale, loose mill scale, oil, paint and all other coatings which will destroy or reduce the bond between steel and concrete. Bend down all tie wire away from the top of the pool deck. Maintain a 2" clear from top of concrete to the tie wire.

### 3.4 SHOTCRETE REINFORCEMENT

- A. Shotcrete reinforcement shall be in accordance with the requirements of CBC 1908A and ACI 318-19, along with the provisions of ACI 506R and ACI 506.2. For parallel nonprestressed reinforcement in shotcrete members, the clear spacing between bars shall be at least the greater of 6 bar diameters and 2-1/2 in. Where two curtains of reinforcement are provided, the clear spacing between bars in the curtain nearer the nozzle shall be at least 12 bar diameters; the clear spacing between bars in the remaining curtain shall be at least the greater of 6 bar diameters and 2-1/2 in. Adequate encasement of bars larger than No. 5 shall be demonstrated by a preconstruction test shotcrete mockup panel.

Subject to the approval of the building official, it shall be permitted to use a clear spacing that does not meet the clear spacing provisions listed above provided that shotcrete mockup panels are used to demonstrate the proper reinforcement encasement in accordance with the following:

1. Lap splices in reinforcing bars shall be by the non-contact lap splice method with at least 2 inches clearance between bars.
2. The shotcrete mockup panels shall be representative of the most complex reinforcement configurations to be encountered.
3. The licensed design professional shall specify the shotcrete mockup panel quantity, frequency of shooting per nozzleman and member type, and panel thickness to verify reinforcement encasement.

B. Non-contact lap splices for reinforcement in shotcrete shall have clear spacing in accordance with the following:

1. For No. 6 and smaller bars, the clear spacing between bars shall be at least greater of 6 bar diameters and 2-1/2" in.
2. For No. 7 and larger bars, the clear spacing shall be established using a shotcrete mockup panel to demonstrate that the reinforcement is properly encased.
3. Subject to the approval of the building official, contact lap splices for reinforcement in shotcrete shall be oriented with the plane of the spliced bars perpendicular to the surface of the shotcrete and approved by the licensed design professional based on a shotcrete mockup panel to demonstrate that the reinforcement is properly encased.

### 3.5 CAST-IN-PLACE CONCRETE

A. Conveying and Placing Concrete:

1. Before placing concrete, mixing and conveying equipment shall be well cleaned, and the forms and space to be occupied by concrete shall be thoroughly cleaned and wetted. Ground water shall be removed until the completion of the work.
2. No concrete shall be placed in any unit of work until all formwork has been completely constructed, all reinforcement has been secured in place, all items to be built into concrete are in place, and form ties at construction joints tightened.
3. Concrete shall be conveyed from mixer to place of final deposit in such a way to prevent the separation or loss of ingredients. It shall be placed as nearly as practicable in its' final position to avoid rehandling or flowing. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six (6) feet. Use tremies, spouts and dump boxes in deep sections. Vibrators are not acceptable for facilitating concrete transport.
4. Concrete shall be tamped and spaded to insure proper compaction into all parts of forms and around reinforcement. A mechanical vibrator shall be used to thoroughly compact the concrete. Vibration must be by direct action in the concrete and not against forms or reinforcement.
5. Mixing and transport time as indicated in ASTM C94 is required. If air temperatures are between 85° and 90° F the delivery time is to be reduced to 75 minutes. When air temperatures are in excess of 90° F the delivery time should be reduced to 60 minutes.
6. Truck mixes without batch certificates will be rejected.

- B. Construction Joints / Expansion Joints: Construction joints and expansion joints shall be provided at locations and in the manner shown on the Drawings. With exception of existing concrete / new shotcrete joints, use PVC bulb-type waterstops appropriate for design condition between all concrete pours / lifts to avoid cold joints. Waterstops shall be placed in such a way to protect reinforcing steel from rust and oxidation. All expansion joints must be the full depth of the concrete section in which they are located.
- C. Slab Finishes: Concrete slabs shall be compacted and screeded uniformly to grades shown. Push large aggregates below the surface with a screen tamper, screed and bull float. As soon as the surface becomes workable, it shall be wood floated, then finished as indicated on the Drawings to a uniform smooth, true surface in a neat and workmanlike manner. Carefully coordinate slab finish requirements with other trades (ceramic tile, pool plaster) to ensure concrete finish is appropriate substrate for final finish material.
1. Contractor shall provide three mock-up deck samples, minimum 3'x 3', with a wedge anchor installed in one sample. These (3) samples shall be constructed; one with a light broom finish, one (1) with a medium broom finish and one (1) with a heavy broom finish for determination and selection of an appropriate deck finish. Each sample shall be edged on all four sides to demonstrate a 3/4" radius edge. Anchor installation shall demonstrate acceptable interface between anchor and the top of deck. Deck samples shall remain on job site through final inspection for reference.
  2. Pool Floor Slab: Heavy Wire Broom Finish.
- D. Protection and Curing:
1. Concrete shall be protected from injurious action of the elements and defacement of any nature during construction.
  2. All forms must be kept wet to prevent drying out of the concrete.
  3. All concrete surfaces including footings must be kept wet for at least seven (7) days after concrete is placed.
  4. Apply the appropriate curing materials, as specified in 2.3 of this Section, immediately after finishing slabs. Application shall be as specified by the manufacturer.
- E. Form Removal:
1. Take care in removing forms so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
  2. No steel spreaders, ties or other metal shall project from or be visible on any concrete surfaces.
- F. Defective Work:
1. Should the strength of any concrete for any portion of the work indicated by tests of molded cylinders and core tests fall below minimum 28 days strength specified or indicated, concrete will be deemed defective work and shall be replaced.
  2. Concrete work that is not formed as indicated, is not true to intended alignment, not plumb or level where so intended, not true to intended grades or elevations, not true to specified or selected finish, contains sawdust shavings, wood, or embedded debris, which exhibits cracks or contains fine or coarse sulfide particles, or expansive aggregates detrimental to performance or appearance of the concrete shall be deemed defective.

3. Promptly perform work required to replace and properly clean (by sandblasting if necessary) any defective concrete panels (control joint or expansion joint to control joint or expansion joint), at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective concrete.

### 3.6 EXPANSION JOINTS

- A. Temperatures: Do not install sealants when air temperature is less than 40°F.
- B. Tooling: Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer. The tooling procedure shall press sealant against the sides of the joint. No materials shall be left “feathered” out or smeared on the abutting materials. Completed joints shall have a uniform professional appearance.
- C. Joint Construction: Sealant joint width, thickness and cross-sectional profile to be constructed in strict accordance with the sealant manufacturer’s recommendations.
- D. Sand: At the appropriate time cover the sealant with sand to provide a sanded finish.

### 3.7 CLEAN-UP

- A. Upon completion of the Work of this Section, immediately remove all swimming pool concrete materials, debris and rubbish occasioned by this Work to the approval of the City’s Representative.

END OF SECTION 131102



## SECTION 131103 – SWIMMING POOL SHOTCRETE

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Provide labor, materials and equipment as required to install structural wet mix shotcrete for swimming pool structures as indicated on the Drawings and herein specified.

#### 1.2 QUALITY ASSURANCE

##### A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.

- B. Standards: Except as otherwise indicated, provide shotcrete per American Concrete Institute Standard ACI 506R, ACI 506.2, ACI 318-19, and the California Building Code, 2022 edition.

- C. Mix Design: The shotcrete subcontractor shall submit a mix design stamped and signed by a licensed engineer for approval by the City's Representative prior to any placement of shotcrete. Mix design shall indicate source of aggregate and brands of cement and admixtures used. All mix designs shall take character of locally available aggregate into consideration and make adjustments as necessary to conform with specified design criteria.

- D. Testing and Inspection: : A test panel shall be shot, cured, cored or sawn, examined and tested (representing the most congested and difficult project scenario) prior to commencement of the project in accordance with ASTM C1140. All project conditions and personnel shall be represented in the test panel. Additionally, one test panel shall be provided for each 50 yards (or portion thereof) of shotcrete placed for each day or each nozzleman, whichever is greater. The size of the strength test panel shall be per the direction of the Special Shotcrete Inspector. At least three (3) cores shall be taken from each test panel. (At least three (3) cores shall be taken from the completed work for each day of shotcrete operation.) Testing shall be performed by the Owner's designated Testing Lab and comply with Section ACI 318-19 and CBC 2022 1705A.3.9. Continuous inspection of the shotcrete operation by a deputy inspector provided by the Owner shall be required.

- E. Tolerances: Construct all swimming pool shotcrete straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 500.

### 1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in accordance with the requirements of Section 013300 and ACI 506.2.
- B. Materials List: Within thirty (30) days after issuance of Notice to Proceed, and before shotcrete materials are delivered to the project site, submit to the City's Representative a complete list of materials proposed to be used in this portion of the Work, showing manufacturer's name and catalog number of all items such as admixtures and curing membranes, and the name and address of the supplier of cement and aggregate to be used.
- C. Submit proof of qualifications as specified in Article 1.02.A of this Section.

### 1.4 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect shotcrete materials before, during and after installation and to protect the installed Work of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City's Representative and at no additional cost to the City.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cement: Cement shall be Type II Portland Cement conforming to ASTM C150. Cement type shall be the same for all shotcrete work.
- B. Aggregate: ASTM C33, washed hard dense durable clean sharp sand from approved pit, free of organic matter and opaline, feldspar, or siliceous magnesium substances and containing not more than 3% by weight of deleterious substances. Maximum size aggregate for shotcrete is ¾" per ACI 318-19. When tested for organic impurities by ASTM C40 method, fine aggregate color not darker than reference standard color. When tested for soundness by ASTM C88 method, grading No. 2 of ASTM C1436, loss after 5 cycles not over 10% of fine aggregate
- C. Water: Potable, clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the shotcrete.
- D. Admixtures: Admixtures shall conform to ASTM C1141 and only be used upon acceptance of the City's Representative.

## PART 3 - EXECUTION

### 3.1 EXECUTION

- A. Inspection:

1. Prior to all Work of this Section carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
2. Verify that items to be imbedded in shotcrete are in place and that shotcrete may be placed to the lines and elevations shown on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the City's Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

### 3.2 PREPARATION

A. General:

1. Thoroughly clean all areas where shotcrete is to be placed to insure proper bonding of shotcrete.
2. Where shotcrete is to be placed against smooth surfaces (i.e., cast-in-place concrete), sandblast surfaces to receive shotcrete to provide clean aggregate surface, thereby insuring proper bond between materials.

- B. Ground Wires: Adequate ground wires, to be used as screeds, shall be installed to establish the thickness and surface planes of the shotcrete work. Ground wires shall be placed so that they are tight and true to line and grade and in such a manner that they can be easily tightened.

### 3.3 PROPORTIONING AND MIXING

- A. Accurately control proportion of water to Portland cement to produce thorough and uniform hydration of the shotcrete that, when shot, forms a homogeneous mass containing neither sags nor dry sand formation. Proportion by mass per ASTM C94 or by volume per ASTM C685.
- B. Shotcrete shall have a minimum compressive strength of 4,000 PSI at 28 days. Shotcrete material shall have a water/cement ratio of 0.40 minimum - 0.45 maximum per ACI 506R, Chapter 6, Proportioning and Preconstruction Testing; Section 6.3.3, Wet Mix Process.
- C. Discontinue shotcrete work if the time between the addition of mixing water to cement and aggregate, or cement to aggregates, and placement of shotcrete exceeds ninety (90) minutes when the ambient temperature is below 85 degrees Fahrenheit, or exceeds sixty (60) minutes when the ambient temperature is above 85 degrees Fahrenheit. Batch, mix and deliver wet-mixture shotcrete per ASTM C94 or C685.
- D. Hot Weather Shotcreting – Unless otherwise specified, do not place shotcrete when shotcrete temperature is above 95°F, unless prequalification testing shows that the required quality of

materials can be achieved at high temperatures. The temperature of reinforcement and receiving surfaces shall be below 90°F prior to shotcrete placement.

- E. Cold Weather Shotcreting – Unless otherwise specified, shooting may proceed when ambient temperature is 40°F and rising. Stop shooting when ambient temperature is 40°F and falling, unless measures are taken to protect the shotcrete. Shotcrete material temperature, when shot, shall not be less than 50°F. Do not place against frozen surfaces.

### 3.4 SHOTCRETE PLACING, FINISHING, AND CURING

- A. Operations: Utilize a standard type of air compressor, capable of providing a minimum of 250 cubic feet of air per minute per nozzle.
- B. Placing: Except when shooting reinforcing, hold the nozzle perpendicular to and 2-1/2 to 3 feet from surface. At reinforcing bars, hold the nozzle so as to direct shotcrete behind the bars, and shoot each side of each bars separately. A nozzleman's helper equipped with an air jet shall precede the nozzle and blow out rebound or sand lodged behind bars, on forms, or placed shotcrete. Placing shotcrete horizontal members from the top is not allowed unless approved methods are employed to eliminate all rebound. Material shall emerge from the nozzle in a uniform flow. If flow becomes intermittent for any reason, direct the nozzle away from the surface until the flow is again steady and constant. Do not reuse rebound or loose sand for any purpose.
- C. Puddled Shotcrete: Use of "puddled shotcrete" in which the air pressure is reduced and the water content is increased to facilitate placing in difficult locations is not allowed. Do not place shotcrete where nozzle stream cannot impinge directly on the involved surface. Where difficult shooting conditions occur, obtain proper results by maintaining correct air pressure and water ratio and reduce supply of material.
- D. Construction Joints: Form joints with sloping beveled edges. Clean and dampen the hardened joint surfaces before placing additional shotcrete. Square edged construction joints are not allowed.
- E. Finishing: Rod exposed surfaces to true planes and lines on reaching the thickness and plane established by forms and ground wires. Tamp and wood float surfaces level and provide a rough raked finish. Carefully coordinate finish requirements with other trades (ceramic tile, pool plaster) to insure shotcrete finish is appropriate substrate for final finish material.
- F. Curing: Keep shotcrete continuously damp with mist for not less than twenty-eight (28) days after placing. Do not use curing compound of any kind.

### 3.5 DEFECTIVE WORK

- A. Cut out, remove and replace, or repair to the satisfaction of the City's Representative, shotcrete not meeting minimum strength, not true, plumb or level, not to required elevations, containing cracks detrimental to performance or appearance, containing shavings, debris or with honeycombs or voids.

- B. Promptly perform Work required to repair, patch, replace, render properly cleaned surfaces (by sandblasting if necessary) or otherwise make good any defective shotcrete at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective shotcrete.

3.6 CLEAN-UP

- A. Upon completion of the Work of this Section, immediately remove all swimming pool shotcrete materials, debris and rubbish occasioned by this work to the acceptance of the City's Representative.

END OF SECTION 131103

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## SECTION 131104 – SWIMMING POOL CERAMIC TILE

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Furnish and install all swimming pool ceramic tile detailed on the Drawings, including, but not limited to, the following:
  - 1. Gutter Bullnose Tile (Rim Flow Pool)
  - 2. Bond Beam / Waterline tile / Ramp Tile (Rim Flow Pool)
  - 3. Lane Line / Target Tile / 4'-6" Depth Tile
  - 4. Depth / Caution Marker Tile (Rim Flow Pool)
  - 5. Trim Tile (at Underwater Steps)
  - 6. Waterline Face Tile
  - 7. Depth Marker Tile

#### 1.2 QUALITY ASSURANCE

- A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.
- B. Qualifications of Workers:
  - 1. The contractor / subcontractor for this portion of the Work shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of this work, and shall demonstrate to the approval of the City's Representative that his record of workmanship is satisfactory.
  - 2. For actual construction operations, use only thoroughly trained and experienced workers completely familiar with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.
- C. Standards: In addition to complying with all pertinent codes and regulations:
  - 1. Manufacture of all tile shall be in accordance with ANSI A-137.1.
  - 2. Install ceramic tile in accordance with the recommendations contained in 2023 Handbook for Ceramic Tile Installation of the Tile Council of America, Inc.
- D. Tolerances: Install all swimming pool ceramic tile straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 500. Waterline and gutter bullnose tile shall be level to 1/8" (+/- 1/16") around entire perimeter of swimming pool(s).

#### 1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in accordance with the requirements of Section 013300.

- B. Samples: Submit samples of each color and pattern in the specified groups. Character samples can be representative for review prior to screening of actual tile.
- C. Master Grade Certificate: Prior to opening ceramic tile containers, submit a Master Grade Certificate, signed by the manufacturer of the tile used and issued when the shipment is made, stating the grade, kind of tile, identification marks for the tile containers, and the name and location of the Project.
- D. Specifications: Submit manufacturer's recommended installation specifications for this Work.
- E. Submit proof of qualifications as specified in Article 1.2.B of this Section.

#### 1.4 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool ceramic tile before, during and after installation and to protect the installed Work of all other trades.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City's Representative.

### PART 2 - RODUCT

#### 2.1 TILE

- A. Gutter Bullnose Tile (Rim Flow Pool):
  1. Material: All gutter bullnose tile shall be unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal. Contact Kylee Midura at [kylee.midura@daltile.com](mailto:kylee.midura@daltile.com) (858)344-0019.
  2. Size: 1 x 2 inches (#C-701).
  3. Color: Blue throughout the body of the tile #D-621 'Nautical Blue'
- B. Bond Beam / Waterline Tile / Ramp Tile (Rim Flow Pool):
  1. Material: All bond beam tile shall be unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  2. Size: 1 x 1 inches.
  3. Color: Blue throughout the body of the tile #D-621 'Nautical Blue'
- C. Lane Line / Target Tile / 4'- 6" Depth Tile:
  1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  2. Size: 1 x 1 inches.
  3. Color: Dal-Tile #D-311, 'Black' in 25-yard direction, Dal-Tile D023 'Galaxy' at 4'-6" depth marker tile.



- D. Depth / Caution Marker Tile (on Deck Surface and Waterline at Rim Flow Pool):
  - 1. Material: All depth/caution markers tile shall be unglazed, ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  - 2. Size: 1x1 inches.
  - 3. Color: Integral color throughout the body of the tile #D-104 'Light Gray' numbers and letters on 'Blue' field of #D-621 "Nautical Blue".
  
- E. Trim Tile (on Underwater Steps):
  - 1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  - 2. Size: 1 x 1 inches with S-812 quarter round. Color: Dal-Tile #D-311, 'Black'
  - 3. Size: 2 x 6 inches with integral quarter round. Color: Black, non-slip. Inlays#CPC00022.
  
- F. Waterline Face Tile
  - 1. Material: All waterline face tile shall be glazed ceramic tile (Group III standard) as manufactured by Dal-Tile or approved equal.
  - 2. Size: 1 x 1 inches
  - 3. Color: Dal-Tile #D-621 "Nautical Blue"

## 2.2 MORTAR

- A. Laticrete 3701 fortified mortar #LCR-37-1017
  
- B. Site mortar mix shall comply with ASTM C270 standards
  - 1. Sand for Mortar: Comply with requirements of fine aggregate for concrete.
  - 2. Cement: Type I Portland Cement, conforming to ASTM C150.
  - 3. Hydrated Lime: Conforming to ASTM C206 or 207, Type S.
  - 4. Water: From a potable source.
  
- C. Mortar shall meet ASTM C627 standards.

## 2.3 THIN SET MORTAR

- A. Laticrete 254 Platinum. Laticrete, Custom or equal.
  
- B. Water from potable source.
  
- C. Mortar shall meet ASTM C627.

## 2.4 GROUT

- A. All tile grout shall be waterproof grout complying with the recommendations of referenced standards. Grout color shall be grey for dark backgrounds, white for light backgrounds (verify colors with Architect).

## 2.5 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installation of ceramic tile as indicated on the Drawings, shall be new, first quality of their respective kinds, and subject to the acceptance of the City's Representative.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
  - 2. Verify that ceramic tile can be installed in accordance with the original design and all referenced standards.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the City's Representative.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive its Work.

### 3.2 INSTALLATION

- A. Method:
  - 1. Install all ceramic tile in strict accordance with installation method P601-90 of the 2023 Handbook for Ceramic Tile Installation of the Tile Council of America, Inc.
  - 2. Be certain to install all ceramic tile perfectly level, flush, plumb, and to the finish grades and elevations indicated on the Drawings.
- B. Interface:
  - 1. Carefully establish and follow the required horizontal and vertical elevations to insure proper and adequate space for the work and materials of other trades.
  - 2. Coordinate and cooperate as required with other trades to insure proper and adequate interface of ceramic tile Work with the Work of other trades.

### 3.3 GROUTING

- A. Follow grout manufacturer's recommendations as to grouting procedures and precautions.

- B. Remove all grout haze, observing grout manufacturer's recommendations as to use of acid and chemical cleaners.

3.4 EXTRA STOCK

- A. Provide one (1) unopened box of extra tile for 2.1.A-F for City's use at a future time.

3.5 CLEAN-UP

- A. Upon completion of the swimming pool ceramic tile installation, thoroughly clean and polish the exposed surfaces of tile work. Completely clean work area of debris and rubbish occasioned by this Work and dispose of to the approval of the City's Representative.

END OF SECTION 131104

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## SECTION 131105 – SWIMMING POOL PLASTER

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. All preparation of swimming pool structures and labor and materials required to provide swimming pool plaster as indicated on the Drawings and herein specified.
- B. Provide start-up and operation instructions to City and properly balance swimming pool chemistry until the City takes acceptance.

#### 1.2 QUALITY ASSURANCE

- A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.
- B. Qualifications of Workers:
  - 1. The contractor / subcontractor for this portion of the Work shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of this work, and shall demonstrate to the acceptance of the City's Representative that his record of workmanship is satisfactory.
  - 2. For actual construction operations, use only thoroughly trained and experienced workers completely familiar with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.
- C. Standards: Swimming pool plaster shall conform with requirements of the California Building Code, 2022 edition. In addition, meet requirements of applicable portions of most current edition of the "Technical Manual" National Plasterers Council, Wauconda, Illinois.
- D. Start-up:
  - 1. Retain a qualified chemistry consultant, familiar with operation and maintenance of aquatic facilities, to supervise and properly balance swimming pool chemistry.
  - 2. Demonstrate to the City's Representative and appropriate officials (including State of California) that all systems are fully operational and that calcium hardness, total alkalinity, chlorine residual and pH levels are within specified limits.
  - 3. Standards: Contractor shall furnish labor and chemicals as required to condition the water properly to the following specifications:
    - a. Calcium Hardness: 200-400 ppm

- b. Total Alkalinity: 80-100 ppm
- c. Chlorine Residual: 1.00-2.00 ppm
- d. pH Factor: 7.2 to 7.6

### 1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in accordance with the requirements of Section 013300.

### 1.4 PRODUCT HANDLING

- A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.
- C. Protection: Use all means necessary to protect the swimming pool plaster before, during, and after installation and to protect the installed Work and materials of all other trades.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the City's Representative.

### 1.5 ENVIRONMENTAL CONDITIONS

- A. No plastering shall be done under unsuitable conditions of weather or temperature. No plastering shall be done when prevailing temperature is 40 degrees Fahrenheit or less.
- B. Do not install plaster during rain and, if rain commences after plastering has begun, immediately protect the plaster from rain by all means necessary until the plaster has set.
- C. Do not install plaster during wind greater than 10 mph and, if wind commences after plastering has begun, immediately protect the plaster from wind by all means necessary until the plaster has set.

## PART 2 - PRODUCTS

### 2.1 CEMENT / AGGREGATE

- A. Luna Quartz® tiny pebble finish by Wet Edge Technologies. Altima® quartz finish by Wet Edge Technologies. Pebble-Fina® pool finish by Pebble Technologies.

## 2.2 COLOR

- A. All swimming pool plaster shall be white in color. Wet Edge Technologies shall be Luna Quartz® “Polar White”. Wet Edge Technologies shall be Altima® “White”. Pebble Technology shall be Pebble-Fina® “Classico”. Contractor to obtain written approval on selected pebble color from the local Health Department and City prior to installation. Submit cut sheet, color sample and written approval for review by Architect and City.

## 2.3 WATER

- A. Water for swimming pool plaster shall be clean and free from injurious amounts of acid, alkali, and organics.

## 2.4 PUMP PIT & SURGE CHAMBER WATERPROOFING

- A. Xypex, Miracote Miraflex Membrane C Hycrete Waterproofing System or approved equal. Mix and apply per manufacturer’s recommendations for specific application. Color shall be Gray.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation can properly commence.
  - 2. Verify that swimming pool plaster can be installed in accordance with the original design and all referenced standards.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the City's Representative.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

### 3.2 INSTALLATION OF PUMP PIT & SURGE CHAMBER WATERPROOFING

- A. Provide two (2) coats of the specified gutter and surge chamber waterproofing prior to plastering the swimming pool. Prepare surfaces to receive waterproofing and cure in conformance with manufacturer's recommendations. Provide steel trowel application method to ensure uniform smooth, dense surface finish.

### 3.3 INSTALLATION OF POOL PLASTER

#### A. Outdoor Pools:

1. Completion of other work: DO NOT commence plastering of swimming pool(s) until the following conditions have been met:
  - a. The Health Department and/or other governing agencies have approved the pool(s) for plaster.
  - b. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
  - c. All landscaping in areas adjacent to the pool(s) is complete and the landscape irrigation system is operable.
  - d. All painting in the pool area is complete.
  - e. All welding and grinding in locations adjacent to the pool area are complete.
  - f. The backwash sewer connection is complete.
  - g. Pool(s) area(s) perimeter fencing installation is complete.
  - h. All trash and debris have been removed from areas adjacent to the pool(s), particularly those areas that are normally upwind from the pool(s).
  - i. All dust raising construction and/or activities in areas adjacent to the pool(s) are complete or mitigated.
  - j. The circulation pump(s) is/are operational.
  - k. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.
  - l. All necessary chemicals (Chlorine, pH adjuster, Sodium Bicarbonate and Calcium Chloride or any other required chemicals) are on site and ready for use.
  - m. Obtain written approval from the City and the Architect.

B. Contractor accepts all liability from damage done to the pool plaster if the pool(s) is (are) plaster before the completion of the above listed items or without the written approval of the City and the Engineer.

#### C. POOL PLASTER AUTHORIZATION FORM:

1. The pool(s) at Columbia Park is/are hereby approved for the installation of the pool plaster. Pursuant to the requirements of specification section 131105, paragraph 3.3.



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City

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Date

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Engineer, Project Manager

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Date

D. Preparation:

1. Do not apply plaster over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions otherwise detrimental to the formation of a durable plaster finish.
2. Consult with manufacturer on application to specific surfaces being treated. Follow manufacturer's recommendation for curing of cast-in-place concrete or shotcrete surfaces prior to application of plaster.
3. Protect ceramic tile, decking, deck equipment, gratings, fittings and other items by suitable covering or masking.
4. Mask or remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place not to receive pool plaster. Following completion of plaster for each space or area remove masking. Re-install all removed items utilizing workers skilled in the trades involved.

E. Application:

1. Finish shall be applied to a uniform thickness of 3/8" to 1/2" over the entire surface. The walls shall be scratch-coated followed by a finish coat. Material applied to the floor after the walls have been applied shall be accelerated to assure uniform setting time throughout the pool surface.
2. Float the plaster to a uniform plane and trowel to a smooth, dense, impervious surface using extreme care to avoid stains.
3. Take special care in finishing around pool fittings, making sure to mask off or plug openings so as not to fill such openings with excess plaster. Be certain to completely enclose pool fittings with plaster to insure a leak-proof seal around pipes, fittings, lights, anchors, etc.
4. Accurately interface with the finish planes of items installed by other trades.
5. Quartz and pebble plaster finish is to be applied by a licensed applicator as approved by the manufacturer, and in accordance with manufacturer's training.

### 3.4 CURING

- A. Preparation: Anticipate the need for required equipment and have all such equipment immediately available for use upon completion of pool plastering.
- B. Pool Filling:

1. After the plaster has sufficiently dried and before drying has proceeded to a damaging point, cure the plaster by gradually filling the pool with water, preventing all damage to finished plaster surfaces.
2. Flow the water continuously until the pool is filled.
3. When the weather is hot and/or water pressure is low, keep the pool walls damp while the pool is filling.
4. Coordinate with Contractor to ensure that the pool is continuously monitored while filling to prevent overfill.

### 3.5 EQUIPMENT ACTIVATION

- A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.
- B. For the first fourteen (14) calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.
- C. Start-up and provide qualified personnel to operate pool equipment for a period not less than fourteen (14) days after the pool is placed in operation, or until the City accepts the facility for City use. During this time, Contractor shall instruct and supervise the City's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than fourteen (14) day period and at time of turnover to City, chemical storage tanks shall be full. (City's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before City acceptance).

### 3.6 CLEAN-UP

- A. Upon completion of swimming pool plaster, remove all materials, equipment and debris occasioned by this Work and leave the job site in a clean and presentable condition. Perform all such clean-up to the approval of the City's Representative.

### 3.7 WARRANTY

- A. All applicators must provide a minimum of five (5) year warranty for application and workmanship additional to the manufacturer's warranty for product.

END OF SECTION 131105

## SECTION 131106 – SWIMMING POOL EQUIPMENT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Supply and install pool equipment items as required for this Work as indicated on the Drawings and specified herein.

#### 1.2 QUALITY ASSURANCE

- A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.
- B. Qualifications of Workers:
  - 1. The contractor / subcontractor for this portion of the Work shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of this work, and shall demonstrate to the acceptance of the City's Representative that his record of workmanship is satisfactory.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.
- C. All equipment supplied or work performed shall comply with regulations governing public swimming pools and spas as contained within Chapter 31 of the California Building Code, 2022 edition.

#### 1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 013300.
- B. Required submittals include:
  - 1. Swimming Pool Safety Equipment and Maintenance Equipment as specified in Articles 2.1 and 2.2 of this Section.
  - 2. Swimming Pool Fittings, Deck and Mechanical Equipment as specified in Article 2.3 to 2.15 of this Section.
- C. Submit proof of qualifications as specified in Article 1.2.B of this Section.
- D. The equipment shown on the plans represent the first listed items in the technical specifications. The Contractor shall be responsible for all required field coordination and installation of any approved equal product to provide a fully working and warranted system. The Contractor shall submit detailed shop drawings for any products used other than the first listed specified items.

Contractor provided shop drawings shall include details and quality equal to the original plans and construction documents. The Contractor shall provide any and all required engineering including but not limited to structural and anchorage requirements for any proposed equipment other than the first listed specified equipment. The Contractor is responsible to provide a factory certified representative(s) to start-up and provide on-site training for all swimming pool mechanical equipment provided.

#### 1.4 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect swimming pool equipment items before, during and after installation and to protect the installed Work of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the City's Representative.

### PART 2 - PRODUCTS

#### 2.1 SAFETY EQUIPMENT

- A. First Aid Kit for 50 Persons: Kiefer, United Industries, or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- B. Rescue Tubes (minimum 49" long) and Life Ring Buoy (minimum 24" in diameter), U.S. Coast Guard Approved: 'Marine Rescue', or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- C. Throw Rope (3/16" diameter) complete with lemon foot, for use with Life Ring Buoy: Kiefer, United Industries, or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- D. Rescue Hooks, 16' long x 1-1/2" aluminum pole and stainless-steel mounting hardware: Kiefer, 'Pentair', or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- E. Pool Safety Signs: As required by the Department of Health. Submittal required. Placement at the pool site shall be in conformance with Health Department Inspector. Provide two (2) sets.
- F. Spine Board: C.J. Penton Aquatics long board with "L" bracket head immobilizer with foam pads and Velcro strap, 4 Velcro body straps, or equal. One (1) required.

#### 2.2 MAINTENANCE EQUIPMENT

- A. Commercial Pool Vacuum: Commercial Pool Vacuum: Provide pool vacuum cart with a 155-square foot single-cartridge filter, lid-mounted handle, separate lid-mounted bracket for electrical cord, and two rubber-tired ball bearing wheels with grease fittings. Cart and filter shall be fabricated from schedule 304 stainless steel with welds treated and passified. Provide Whisperflo pump with a 1 1/2 hp, 115/230 volt, maximum 20 amp draw @ 120 volts, single phase motor and integral trap. Pump shall be UL and NSF listed, have 2" suction and 1 1/2" discharge fittings,

and have a brass priming valve with hose bib. Entire pump assembly shall be anchored to vacuum cart with two stainless steel bolts. Provide a 100 foot 10 AWG 3/C SJ electrical cord with ground fault interrupter (GFI) plus. Cord shall be wired to a double pole, 30-amp switch which shall be mounted on pump motor. One (1) required.

- B. Heavy Duty Vacuum Hose: 2" x 50' with hose connector. Pentair, Smooth Bore or approved equal. One (1) required.
- C. Pool Wall Brush: 36" wide professional quality. 'Pentair', or approved equal. One (1) required.
- D. Utility Pole: 24' fiberglass with connectors. Pentair, Skimlite or approved equal. One (1) required.
- E. Commercial Vacuum Head: 24" wide "flexible" vacuum head. Pentair Model #R201186 or approved equal. One (1) required.
- F. Leaf Skimmer: 30" x 8" x 12", professional quality. 'Pentair', 'Spectrum', or approved equal. One (1) required.
- G. Water Quality Test Kit, Professional Grade, 'Taylor Technologies' Model #1741C, LaMotte Model #PRO250-NJ, or approved equal. Two (2) required.
- H. Pool Robotic Pool Cleaner: The automatic pool cleaner shall be Enduro – Turbo Clean XL50, One (1) required. Capable of operation via 120V, 220V in 50/60 Hz, or 24 VDC incoming power; 242 GPM or 14,530 gallons per hour. Utilize 20, 70, 105, 250 and 1,000 or 2,000 micron filter screens – all constructed of mesh.
  - 1. Warranty: The robotic cleaner shall carry a 7-year anti-corrosion warranty on the stainless-steel frame from the date of product start-up. The cleaner shall carry a two-year warranty against all defects in material and workmanship, from date of product start-up, including all components in the system not including wearable items

## 2.3 FITTINGS

- A. Main Drain / Suction Frame & Grate 18" x 18" Lawson Aquatics #MLD-SG-1818, two (2) total. Lawson Aquatics # MLD-FGD-1818, two (2) total. Provide with two (2) hydrostatic relief valves. Contractor shall provide to the City a Certificate of Compliance, signed by a licensed design professional, for main drain sump(s) and frame(s) and grate(s), as required by the Virginia Graeme Baker Act.
- B. Swimming Pool Underwater Lights: 'Pure White' LED #LPL-F5W-120-100 with polished stainless steel face rings, 87-watt lamps and LWC (J & J Electronics); provide stainless steel light niches, #78210600 with 1" rear hubs, 'Pentair' or approved equal. Sixteen (16) required.
- C. Junction Box: Hydrel #1719, Appleton, or approved equal. Eight (8) required.
- D. Floor Return Inlet 1-1/2" Adjustable: StaRite #08417-0000, Hayward #1419-B or approved equal. Twenty-seven (27) required.

## 2.4 DECK EQUIPMENT

- A. Hand Rails: 'Paragon' #34202, 1.90" O.D. x .065" wall, KDI-Paragon, S.R. Smith, Paddock, or Spectrum; nine (9) required.
- B. Figure 4 Grab Rails: 'KDI Paragon' #30102, 1.90" O.D. x .109" wall KDI-Paragon, S.R. Smith, Paddock, or Spectrum; five (5) sets required.
- C. Recessed Steps, Set of 3: SR Smith #62-209-4001, KDI-Paragon #32102. Five (5) sets of three required.
- D. Anchor Sockets for Hand Rails and Grab Rails: KDI-Paragon 28102, KDI-Paragon, S.R. Smith, Paddock, or Spectrum. Sixty (60) required. Verify with supplier prior to ordering.
- E. Escutcheon Plates for Hand Rails and Grab Rails: KDI-Paragon 28301, KDI-Paragon, S.R. Smith, Paddock, or Spectrum. Sixty (60) required. Verify with supplier prior to ordering.
- F. Aqua Creek Mighty 400 F-MTY400 (400 lb. lifting capacity) self-operated, or approved equal. Furnish complete with anchors, cover, extra battery pack and transporter cart. All parts and accessories shall be 'Coastal Gray'. One (1) required.
- G. Commercial rope anchor with insert. 'Spectrum' #58316 stainless steel, Spectrum, KDI-Paragon, S.R. Smith, Paddock. Two (2) required.
- H. Pool Cover Systems:
  - 1. 'Meyco' 'Permaguard' solid cover with stainless steel buckles, aluminum tips and solid brass anchors. Provide shop drawings from 'Meyco' and post install all deck anchors after decking is poured. Anchors to be set 38" back from pool edge. Covers to have 12-year warranty. One (1) total.

## 2.5 SWIMMING POOL STRAINER

- A. 'Mer Made' F.O. Series FRP reducing basket strainer: one (1) 8" x 6" standard with acrylic lid and two (2) stainless steel strainer baskets. (150 lbs. each.)

## 2.6 SWIMMING POOL CIRCULATION PUMP

- A. 'Paco' #5012-3, 5" x 6" 11.8" Type LC end suction centrifugal pump, 1187 RPM 460V 3PH; 15 HP, rated at 650 GPM each at 60 ft. TDH 83.92% efficient, premium efficiency TEFC motor; epoxy coat all wet surfaces. 'Paco', 'Aurora', or equal (600 lbs.) Provide 'SPCS' smart pump control system variable speed drive model SPCS015EF4 system 20.5" x 41" x 13.9" deep. Coordinate mounting location to maintain desired clearances, 460V 3PH. (126 lbs.)

## 2.7 SWIMMING POOL FILTER

- A. 'EKO<sup>3</sup> System' Gen 2 #42230-0806-T-2 automatic filter control (AFC) fully automatic hi-rate permanent media filter with 46 sq. ft. of filter area. Rated at 690 GPM at 15 GPM/sq. ft. Complete with 8" face piping, 6" backwash, seismic anchorage. Provide all utilities, piping, valving, etc.

(8,155 lbs. per tank). 'EKO<sup>3</sup>', 'Stark' SS series, or equal. Provide Signet #MK-515 flosensor with digital readout.

## 2.8 SWIMMING POOL HEATER (ADDITIVE ALTERNATE)

- A. Indirect fired pool heating package system; 'Aguas' crest smarttouch control condensing modulating boiler, titanium heat exchanger with CPVC connections, factory assembled skid mounted package, California Code Controls, 1 ½" liquid propane connection, 3" water connections, 8" diameter air inlet and 8" diameter sidewall vent size, PBC vented; 1,99,000 BTU per hour input, 97% efficient. Provide ¾" cold water connection 'Lochinvar' APO2000N', weight = 3,397 lbs. each. One (1) total. ,

## 2.9 CHLORINE STORAGE / FEED SYSTEM(S)

- A. Provide 'PPG' Accu-Tab powerbase chlorination unit model 3070AT with 528 lb./day output, 140 lbs tablet capacity, complete with 1 1/2 HP booster pump, piping, valving, and venturi injection. One (1) system total.

## 2.10 ACID STORAGE / FEED SYSTEM

- A. Provide 'Acid Rite 450'; flow rate = 10 GPM from sodium bisulfate tablet feed. Complete system with flowmeter piping, valving and ¾ HP booster pump. NSF 50 certified. Two (2) systems total.

## 2.11 SWIMMING POOL FILL SYSTEM

- A. 'Cla-Val' fill system, 3" to include 'Cla-Val' solenoid control valve #136-01BY, 3" duct iron, epoxy coated body with cast iron disc retainer and diaphragm washer, bronze trim, flanged globe pattern, 120V at 60 hz solenoid wiring shall be wired to water chemistry controller. Provide 6" air gap at fill point. Two (2) total. Provide manual by-pass valving per detail on plan.

## 2.12 SWIMMING POOL WATER CHEMISTRY CONTROLLER

- A. Provide ethernet connection to 'BecSys' CS-BECSYS7-BP-E water chemistry controller. Provide complete system control package. 'BecSys 7', 'Impact', Wallace & Tiernan' or equal.

## 2.13 BACKWASH PIT

- A. 9'-0" x 8'-0" x 5'-0" deep with 8" ø P-trap outlet to sewer. Provide waterproofing per section 131105. Coordinate with structural and plumbing plans.

## 2.14 PUMP PIT

- A. 9'-0" x 8'-0" x 5'-0" deep. Provide 1 ½" ø galv. steel guardrail. Provide floor drain to waste. Provide waterproofing per section 131105. Access ladder to be 'Fibergrate' Dynarail or equal. Coordinate with structural.

## 2.15 POOL OPERATOR WORKSTATION DESK

- A. 'Total Lab Solutions' epoxy countertop with drop in sink and two (2) end cabinets. Furnish with wall mounted two (2) faucets 'Broen Boss' or approved equal. See MEP plans for water supply piping.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to installing the items of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
  - 2. Verify that the swimming pool equipment items may be installed in strict accordance with original design, pertinent codes and regulations, and the manufacturers' recommendations.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the City's Representative.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies are fully resolved.
  - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive its Work.

### 3.2 INSTALLATION

- A. Supply and install items of swimming pool equipment in strict accordance with applicable codes and regulations, the original design, and the manufacturer's published recommendations, anchoring firmly and securely for long life under hard use.
- B. Coordinate with other trades to insure all imbedded items are set plumb and flush. Railing ends must have anchor sockets and escutcheon plates. Be certain that deck equipment and railings are properly bonded prior to imbedding.
- C. All equipment shall be braced and/or anchored to resist horizontal force acting in any direction using the criteria shown on the Drawings.

### 3.3 INSTRUCTION

- A. The Contractor shall provide a factory certified representative(s) to start-up and certify proper installation, operation and full warranty status of all swimming pool mechanical equipment. The Contractor shall provide not less than two 8-hour days of on-site training for facility staff in the operation and maintenance of the swimming pool mechanical equipment and systems. The two 8-hour days shall be separated by a minimum of seven calendar days and be completed within the 14-day start-up period



### 3.4 EQUIPMENT ACTIVATION

- A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.
- B. For the first fourteen (14) calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.
- C. Start-up and provide qualified personnel to operate pool equipment for a period not less than fourteen (14) days after the pool is placed in operation, or until the City accepts the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the City's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than fourteen (14) day period and at time of turnover to City, chemical storage tanks shall be full. (City's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before City accepts project).

### 3.5 CLEAN-UP

- A. Upon completion of swimming pool equipment, remove all debris, materials and equipment occasioned by this Work to the acceptance of the City's Representative.

END OF SECTION 131106

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## SECTION 131107 – SWIMMING POOL MECHANICAL

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Swimming pool mechanical piping as indicated on the Drawings for circulation and filtration systems, pool water heating systems, chemical control systems, booster pump systems and all appurtenances.
- B. Domestic water system from points of connection within swimming pool equipment room(s) to make-up water system.
- C. Filter backwash piping to point of connection with backwash retention pit as required.

#### 1.2 QUALITY ASSURANCE

- A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.
- B. Qualifications of Workers:
  - 1. The contractor / subcontractor for this portion of the Work shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of this work, and shall demonstrate to the approval of the City's Representative that his record of workmanship is satisfactory.
  - 2. For actual construction operations, use only thoroughly trained and experienced workers completely familiar with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.
- C. Standards:
  - 1. All equipment supplied or work performed shall comply with regulations governing public swimming pools and spas.
  - 2. Work shall be performed in accordance with the applicable editions of all National, State and local codes, laws, regulations and ordinances, including the following:
    - a. American National Standards Institute (ANSI).
    - b. American Society for Testing Materials (ASTM).
    - c. American Waterworks Association (AWWA).
    - d. American Welding Society (AWS).
  - 3. Do not construe anything in the Drawings or Specifications to permit Work not conforming to these requirements.

### 1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in accordance with the requirements of Section 013300.
- B. Required submittals include:
  - 1. Pipe and Fittings as specified in Article 2.2 of this Section.
  - 2. Valves as specified in Article 2.3 of this Section.
  - 3. Pressure / Vacuum Gauges as specified in Article 2.4 of this Section.
  - 4. Pipe Hangers and Supports as specified in Article 2.5 of this Section.
  - 5. Sleeves and Waterstops as specified in Article 2.6 of this Section.
- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

### 1.4 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool mechanical items before, during and after installation and to protect the installed Work of all other trades.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the City's Representative and at no additional cost to the City.

### 1.5 JOB CONDITIONS

- A. Cooperate with other trades in coordinating their respective Work, so that no conflict of new construction or occupied space may occur. Should any installation Work be done without such craft coordination, that Work so installed shall be removed and reinstalled.

## PART 2 - PRODUCTS

### 2.1 PRODUCT QUALITY

- A. Materials and equipment shall be new, of the best quality for the purpose intended, and shall be clearly marked with the manufacturer's name and nameplate data or stamp and rating. As far as practicable, materials and equipment shall be of one manufacturer.

### 2.2 PIPE AND FITTINGS

- A. PVC Schedule 40: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be white. Dura, Lasco, or approved equal.

- B. PVC Schedule 80: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or approved equal.
- C. CPVC Schedule 80 Influent / Effluent Heater Piping: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or approved equal.
- D. PVC DR25: Conforming to ASTM D-1784, use with epoxy coated bell and spigot-type fittings or epoxy coated mechanical joint by flange adapters with epoxy coated cast iron fittings as specified in Article 2.2 (F), below. Johns-Manville "Big Blue", Diamond Plastics, or approved equal.
- E. Copper Tubing: ASTM Specification B-88, hard drawn, with ANSI Standard B16.22 wrought copper fittings.
- F. Steel: ASTM Specification A-120, Schedule 40 black or galvanized pipe with ASTM A-47 150 lb. banded malleable iron threaded fittings.
- G. Cast Iron: ASTM Specification B16.1, cast iron flanged fittings, provide epoxy coating as required for use with chlorinated water.

## 2.3 VALVES

- A. Ball Valves:
  1. For pool system: True-Union design, PTFE seat material with FPM or FKM Double O-ring stem seals, locking handle, NSF certified. PVC schedule 80 body for below grade installation. PVC Schedule 80 body for above grade installation. Furnish ball valves on all pipe diameters 2 ½" or less with a rating of at least 200psi at 73° F, Asahi, Ipex or Nibco.
  2. For copper pipe system: 3-piece full-port Bronze body valve with Teflon seat, 'Apollo', 'Nibco' or approved equal.
- B. Butterfly Valves:
  1. Epoxy coated cast or ductile iron body, 316 stainless steel disc and stem, viton seat material, furnish hand wheel/gear operators on all valves 8" and larger. DeZurick, Keystone, Ipex or equal.
  2. PVC body, PVC disc and EPDM construction suitable for chlorinated water applications. Stem shall be of 316 stainless steel and non-wetted. Valves shall be self-gasketed design with a convex sealing arrangement. Valves 1-1/2" – 10" shall be rated to 150 psi and 12" valves shall be rated to 100 psi at 70°F. Asahi Pool-Pro, no known equal.
- C. Check Valves: Wafer-type, epoxy coated cast or ductile iron body, 316 stainless steel plates and shaft, viton seat material. Centerline, Metraflex, or approved equal.
- D. RP Backflow Preventer: Febco #835-B for 2" and smaller; #825 for 2-1/2" and larger. Febco, Watts, or approved equal.

## 2.4 PRESSURE / VACUUM GAUGES

- A. Furnish and install pressure and vacuum gauges on the discharge and suction sides of all pumps, 2" or 2-1/2" dial, bottom connection, chrome ring and shut-off cock and snubber. Ranges shall be selected to indicate between mid-point and two-thirds of maximum range under design conditions. Marsh, Terice, or approved equal.

## 2.5 PIPE HANGERS AND SUPPORTS

### A. General:

- 1. The requirements of this Section relates to various requirements of the Agreement, General and Supplementary Conditions, Specifications, Drawings, and modifying documents which are part of the Construction Contract. Responsibility for coordination of all such applicable requirements will be that of the Contractor.

### B. Description:

- 1. This section provides guidelines and limitations for the support of all mechanical, electrical, plumbing or architectural items from the building structure, and for the seismic bracing of such items.
- 2. Design and install all support and bracing systems as required for the swimming pool systems. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design these systems to not overstress the building structure.

### C. Quality Assurance:

- 1. Design and install all support systems to comply with the requirements of the 2022 California Building Code, Chapter 16A.
- 2. Seismic bracing is to be designed by a professional engineer licensed in the State of California.
- 3. For the seismic bracing of mechanical, electrical and plumbing system, refer to "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" by Sheet Metal and Air conditioning Contractors National Association, Inc., (SMACNA) for guidelines.

### D. Submittals:

- 1. Submit shop drawings for all substructures and attachment methods.
- 2. Submit proposed alternative methods of attachment for review and approval by the Architects, prior to deviating from the requirements given below.
- 3. For all pipe hangers and support systems, submit structural calculations and details which include all resultant forces applied to the building structure and are prepared and signed by the Contractor's licensed California professional engineer. Calculations will be reviewed for compliance with design criteria, not for arithmetic.

### E. Materials:

- 1. Use Kin-Line, Grinnel, or approved equal.

2. Support all pipelines individually with hangers, each branch having at least one hanger. Lateral brace as noted and required.
3. Support piping near floor with steel stanchions welded to end plates secured to pipe and floor.
4. Support vertical piping at each floor level. Install coupling in piping at each support. Coupling shall rest on and transmit load to support. Isolate copper from steel supports with vinyl electrician's tape around pipe and coupling.
5. Use Stoneman "Trisolator," Unistrut, or approved equal, isolators at each hanger and other support points on bare copper tubing system.
6. For PVC pipe, space hangers four (4) feet apart for pipe sizes 1" and under, five (5) feet apart for pipe sizes 1-1/4" to 2", and six (6) feet apart for pipe sizes over 2". Space hangers for horizontal pipes at a maximum of six (6) feet for copper 2" and smaller and for steel 1-1/4" and smaller; ten (10) feet for copper 2-1/2" and larger and for steel 1-1/2" and larger.
7. Size hanger rods, screws, bolts, nuts, etc., according to manufacturer's sizing charts.
8. Trapeze hangers may be used for parallel lines.
9. Use galvanized or cadmium plated hangers, attachments, rods, nuts, bolts, and other accessories in pool mechanical room, high humidity areas, or where exposed to weather. Hot dip galvanize all items which are not factory furnished. Plating for hinged movements must be done at the factory.
10. Lateral Bracing: To prevent swaying of the piping systems, provide angle iron bracing and anchor into wall or overhead framing. Piping shall be braced or anchored in such a way as to resist a horizontal force of 50% of its operating weight in any direction.
11. Do not use wire or other makeshift devices for hangers.
12. Furnish all substructures and fasteners required to comply with the limitations given below. Use material as specified in the various sections and as appropriate to their use.

F. Guidelines & Limitations:

1. Each Contractor will coordinate the load requirements from all subcontractors so that no combination of loads overstresses the building structure or exceed the limitations given below.
2. Concrete Structure:
  - a. Support all loads hung from concrete structure with cast-in-place inserts, unless drilled-in anchors are specifically approved in writing prior to placing the concrete.
  - b. Concrete anchors must not penetrate into reinforcing bars. Where the anchors boring indicates the presence of reinforcing bar, patch hole with an epoxy type grout and relocate anchor 12 diameters away.
  - c. Individual expansion anchors cannot support any loads greater than 300 pounds or manufacturer's specified load capacity without approval.
3. Steel Structure:
  - a. Hang no more than 20 pounds per metal deck rib in any span.
  - b. At beams, hang all beam loads greater than 40 pounds concentric to beam, not off the flanges.
  - c. Attached no loads to the beams or girders greater than the following without specific approval from the architect;
    - 1) Roof beams and girders: 300-pound point load or 600 pound total load for a single span.

G. Seismic Bracing:

1. Design and install seismic bracing to not ground out vibration and sound isolation systems.
2. All items of mechanical and electrical equipment 60” or more in height are to be seismically braced whether such bracing is shown or not.

2.6 SLEEVES AND WATERSTOPS

- A. Provide sleeves where work of this Section passes through fire rated partitions, floors and ceilings, concrete slabs or exterior of structure. Caulk clearance space using sealant appropriate for application in conformance with manufacturer's recommendations and Title 24 of California Code of Regulations. 3m, Dow Corning, or approved equal. In lieu of sleeves and caulking, "Link Seal" products may be used.
- B. Provide prefabricated waterstops as indicated on the Drawings at all pipe penetrations through structures containing stored water (i.e., swimming pools, balance/surge tanks, etc.) to insure leak-proof seals.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that such work is complete to the point where this installation may properly commence.
2. Verify that items of this Section may be installed in accordance with the original design and referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the City’s Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the City’s Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive his work.

3.2 ABBREVIATIONS AND SYMBOLS

- A. Abbreviations and symbols on the Drawings are those most commonly used. Obtain clarification from the City’s Representative on any questionable items before bid.

3.3 GENERAL PIPING REQUIREMENTS

- A. Size any section of pipe for which size is not indicated or any intermediate section erroneously shown undersized the same size as the largest pipe connecting to it. Sizes listed are nominal.



- B. Cut pipe accurately to job measurements and install without springing or forcing, true to line and grade, generally square with building and/or structures and adequately supported to prevent undue stress on pipe, fittings and accessories.
- C. Make changes of direction with manufactured fittings. Street ells, bushings, reducing flanges, close nipples or bending of pipe is not allowed.
- D. Use great care to install piping in accordance with best practice. Plastic pipe shall be “snaked” in trenches to allow for thermal expansion.
- E. All above grade, below grade and buried or imbedded PVC shall be installed using solvent weld fittings. Also, each and every fitting and pipe end shall be prepared with solvent primer. Fittings shall be joined individually and with enough time between assembly of adjacent joints to allow them to seal solidly. After joining, an even ring of primer must be visible around the entire fitting. If any fittings are installed without visible primer, the fitting shall be removed and discarded and piping recut, rechamfered, and joint made up again using a new fitting. All procedures, methods and techniques used to make up solvent weld joints shall be in strict accordance with manufacturer's recommendations.
- F. Arrange pipe and hangers to allow for expansion, contraction and structural settlement. No pipe shall contact structure except penetrations as shown on the Drawings.
- G. Provide dielectric connections between copper and dissimilar metals. In copper systems, threaded piping including connections to equipment shall be brass pipe and fittings. Install dielectric connections in vertical sections of piping only.
- H. Run pipe full size through shut-off valves, balancing valves, etc. Change pipe size within three (3) pipe diameters of final connection to control valves, fixtures and other equipment.
- I. Provide unions or flanges at connections to equipment, on service side of valves and elsewhere as required to facilitate ease of maintenance.
- J. Locate equipment shut-off valves as close to equipment as possible maintaining easy valve access.
- K. Make all connections between domestic water systems and equipment or face piping with approved backflow prevention devices as required.
- L. All PVC pipe exposed to direct sunlight shall be painted with two coats of Exterior Acrylic Semi-Gloss Paint, Sherwin Williams or equal. Color to be selected by the Architect. Prior to painting the PVC pipes, the exterior of all PVC pipes shall be wiped with Methyl Ethyl Ketone, or an approved equal, to remove the glaze from the pipes.
- M. The Main Drain pipe must run either level or uphill from the main drain sump, through the surge pit (if applicable) and then to the circulation pump.

### 3.4 TRENCH EXCAVATION AND BACKFILL

- A. Excavation:

1. Excavate and backfill trenches as required for the Work of this Section. Conform with requirements of Section 13 11 01.
2. The Contractor shall perform all excavation of every description and of whatever materials encountered, to the depths indicated on the Drawings or as necessary. The Contractor shall dispose of the excavated materials not required or suitable for backfill as directed, and shall perform such grading as may be necessary to prevent surface water from flowing into the trenches. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters which may accumulate in the excavated areas.

B. Trenching:

1. Excavate trenches to lines and grades as indicated on the Drawings and with banks as nearly vertical as practicable.
2. Bottoms of trenches shall be accurately graded to provide uniform bearing on undisturbed soil for the entire length of each section of pipe.
3. The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8" on either side of the pipe. The width of trench above the top of pipe may be wider if necessary.
4. Over-depth excavations shall be filled with tamped sand to required grades.
5. Excavations of five (5) feet or more in depth shall be shored or supported in conformance with rules, and regulations of State and Federal Governments. Shoring shall be constructed, maintained and removed in a manner to prevent caving of the excavation walls or other load on the pipe.

C. Backfilling:

1. Material for backfilling of pipes shall be approved granular material less than two (2) inches in diameter obtained from the excavation. No material of a perishable, spongy or otherwise unsuitable nature shall be used as backfill.
2. Backfilling of pipe trenches shall commence immediately after installation and testing to preclude damage to the installed pipe. Backfill around pipe shall be carefully placed so as not to displace or damage the pipe, and shall be carried up symmetrically on each side of the pipe to one foot above the top of the pipe. The material shall be carefully compacted or consolidated before additional backfill is placed.
3. Backfill above an elevation of one foot above the top of pipe in conformance with requirements of Section 13 11 01. Material for balance of backfill shall be approved granular material less than six (6) inches in diameter taken from the excavation.
4. Unless otherwise indicated on the Drawings, all pipe shall have a minimum of eighteen (18) inches of cover.

### 3.5 GENERAL EQUIPMENT REQUIREMENTS

- A. Position equipment to result in good appearance and easy access to all components for maintenance and repairs.
- B. Install piping, flues, breeching and ducts so that they do not interfere with equipment access.
- C. Install level, secure and out of moisture. Provide shims, anchors, support straps, angles, grouted bases, or other items as required to accomplish proper installation.

- D. All screws, nuts, bolts and washers shall be galvanized, cadmium plated or stainless steel. After fabrication, hot-dip galvanize unfinished ferrous items for outdoor, below grade or other use subject to moisture.
- E. Extend 1/2" Schedule 40 black steel pipe lubrication tubes from all hard to reach locations to front of equipment or to access points. Terminate with proper type of lubrication fitting.

### 3.6 VALVES AND STRAINERS

- A. If no shut-off is indicated, provide ball valves at inlet connections and balance valves at outlet connections to fixtures and equipment. Provide proper valve trim for service intended.
- B. Use no solder end valves unless noted otherwise; provide adapters in copper tubing systems.
- C. Locate valves with stems above horizontal plane of pipe. In general, locate valves within six (6) feet of floor, out from under equipment, in accessible locations with adequate clearance around hand wheels or levers for easy operation.
- D. Provide all valves, cocks and strainers, full pipe size unless indicated otherwise.
- E. Provide hand wheel operators on all valves 6" and larger, under 6" lever operators may be used.
- F. Provide tool operated valve with stainless steel shaft extension and 'on deck' tool operation for surge chamber butterfly isolation valve.

### 3.7 IDENTIFICATION OF PIPING

- A. Identify each valve by a numbered brass tag with hole and brass chain mounted on valve stem or handle. Tag to be a minimum of 1" in diameter and numbers at least 1/4" high stamped into tag. Valves and plumbing lines shall be labeled clearly with the source or destination descriptions.
- B. Install an identification chart in a plastic or glass framed enclosure, which schematically illustrates the proper operation of all piping systems and indicates number and location of all valves and control devices within the system.
- C. The direction of flow for the recirculation equipment shall be labeled clearly with directional symbols such as arrows on all piping in the equipment area. Where the recirculation equipment for more than one pool is located on site, the equipment shall be marked as to which pool the system serves.

### 3.8 TESTS

- A. Perform tests in presence of City's Representative with no pressure loss or noticeable leaks.
- B. Do not include valves and equipment in tests. Include connection to previously tested sections if systems are tested in sections.
- C. Perform tests as follows:

System	Test Pressure	Test Medium	Duration
Skimmer Lines and Lawson Main Drain sump lines	20 psig	Water*	4 hours
Pool Piping	50 psig	Water*	4 hours
Pool Main Drains	30 psig	Water*	4 hours
Domestic Water	150 psig	Water*	4 hours

\*Never test PVC pipe or fittings with air or other gases, always use water.

### 3.9 PIPE MATERIAL APPLICATION

- A. PVC Schedule 40: Below grade swimming pool piping and domestic water piping up to 12” line size; use standard solvent weld fittings.
- B. PVC Schedule 80: Above grade swimming pool piping up to 12” line size; use solvent weld Schedule 80 or epoxy coated cast iron fittings.
- C. Type L Hard Copper: Above grade domestic water piping.
- D. CPVC Schedule 80; Pool Heater Piping.
- E. Schedule 40 Steel: Natural gas piping.

### 3.10 CUTTING AND DRILLING

- A. Cutting or drilling necessary for installation of Work of this Section shall be done only with approval of City’s Representative.

### 3.11 CLOSING-IN OF UNINSPECTED WORK

- A. Do not cover or enclose Work before testing and inspection. Re-open Work prematurely closed and restore all Work damaged.

### 3.12 QUIETNESS

- A. Quietness is a requirement. Eliminate noise, other than that caused by specified equipment operating at optimum conditions, as directed by City’s Representative.

### 3.13 FLUSHING OF LINES

- A. Flush or blow out pipes free from foreign substances before installing valves, stops or making final connections. Clean piping systems of dirt and dust prior to initial start-up.
- B. Just prior to plastering the pool, under the observations of the Inspector of Record (IOR), the pool mechanical system shall be flushed using the pool circulation pump. Circulate water through the mechanical system until the effluent water from the pool return heads runs clean.

3.14 CLEAN-UP

- A. After all Work has been tested and approved, the Swimming Pool Subcontractor shall thoroughly clean all parts of the equipment installations, including all pool pipe and fittings in the pool mechanical room. Exposed parts shall be cleaned of cement, plaster and other materials and all grease and oil spots removed with solvent.
- B. The Swimming Pool Subcontractor shall remove debris from the Project site. Cartons, boxes, packing crates and excess materials not used, occasioned by this work shall be disposed of to the satisfaction of the City's Representative.
- C. If the above requirements of clean-up are not performed to the satisfaction of the City's Representative, the City reserves the right to order the work done, the cost of which shall be borne by the Swimming Pool Subcontractor.

END OF SECTION 131107

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## SECTION 131107 – SWIMMING POOL ELECTRICAL

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Provide labor, materials and equipment as required to install the swimming pool electrical system including but not limited to:
1. A complete and operable system of service equipment, switchboards, panelboards, conduits, switches, time clocks and wiring for power and lighting, motor control centers.
  2. Junction and/or pull boxes, conduits, disconnects, starters, contactors, wiring and connection of all motors and mechanical equipment, including connection and wiring of line voltage controls associated with the mechanical systems.
  3. Swimming pool underwater lighting systems.
  4. Complete grounding system as required and shown on the Drawings.
  5. Complete equipotential bonding system as required and shown on the Drawings.
  6. Adjusting and preliminary operation of the completed electrical system as described in Article 3.6, A of this Section.
  7. Cleaning of all completed Work and installation adjustment of all trim and decorative items.

#### 1.2 QUALITY ASSURANCE

- A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.
- B. Qualifications of Workers:
1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
  3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- C. Ordinances and Codes: Materials and construction shall conform with applicable sections of the:
1. National Electrical Code; Electrical Safety Orders of the State of California; Department of Industrial Relations; regulations of the State Fire Marshal; rules and regulations of the Board of Underwriters of the Pacific; UL 50, 50E and NEMA 250 rating.
  2. Chapter 31 of California Building Code, latest edition.
- D. Verification of Conditions:
1. The locations shown on the Drawings are diagrammatic only and the exact finish location of equipment and materials cannot be indicated. Therefore, locations of all Work and

equipment shall be verified to avoid interferences, preserve head room and keep openings and passageways clear. Changes shall be made in locations of equipment and materials which may be necessary to accomplish these purposes.

E. Preliminary Operations and Testing:

1. Motor driven equipment shall be tested for correct rotation and completion of all connections.

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in conformance with the requirements of Section 013300. Requests for substitutions shall conform with requirements of Article 1.10.A of Section 131100.

B. Required submittals include:

1. Conduit and Fittings as specified in Article 2.2 of this Section.
2. Panelboards as specified in Article 2.6 of this Section.
3. Circuit Breakers as specified in Article 2.7 of this Section.
4. Motor Starters as specified in Article 2.10 and 2.11 of this Section.
5. Fuses as specified in Article 2.13 of this Section.
6. Time Clocks as specified in Article 2.14 of this Section.
7. Ground Fault Circuit Interrupters as specified in Article 2.15 of this Section.
8. NEC required corrosion resistant enclosures, cabinets and boxes as specified in Article 2.8, 2.11, 2.16 & 2.18 of this Section.

C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.

B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.

C. Protection: Use all means necessary to protect swimming pool electrical materials before, during, and after installation and to protect the installed Work of all other trades.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Materials shall be new, in unbroken packages and bear the U.L. label of approval.

B. Equipment of one type shall be by same manufacturer. One type of equipment for classifications such as:



1. Switchboards, panels, buss duct, disconnect switches and allied items.
2. Conduit.
3. Wire.
4. Conduit fittings.
5. Fixtures of the same general type.
6. Wiring devices.

## 2.2 CONDUIT AND FITTINGS

- A. Conduit within or under buildings or where exposed outdoors shall be rigid metal threaded, hot dipped, galvanized, or U.L. approved plastic except where noted otherwise on the Drawings. Metallic conduit shall be of the same metal between outlets or terminals.
- B. Use flexible metallic conduit only for short connections of motors and where specifically called for on Drawings. Maximum length shall be 40". Use only liquid tight flexible metal conduit. Install an unbroken #12 AWG insulated copper grounding conductor in each liquid tight flexible conduit with permanent connection at motor junction box and service panel ground.
- C. Protect, before installation, metallic conduit runs in all slabs laid on grade or in contact with the earth or exposed in damp locations, with two (2) heavy coats of asphaltum rust-resisting compound.
- D. Encase conduits 2-1/2" or larger run underground, outside, or under buildings, in concrete envelopes a minimum of 3" thick, except as indicated otherwise on Drawings or stubouts. Conduits 2 and smaller laid 18" below finish surface in soil.
- E. Low voltage runs underground outside buildings, 1-1/4" or smaller, may be G.I. or sherardized steel conduit, with machine applied wrapping equal to double wrap or Scotch-Wrap #50 tape, half lapped and quadrupled at joints in lieu of concrete encasement.
- F. Service conduits through foundations or concrete members shall run through metal sleeves with adequate clearances for full movement of the conduit. Do not run conduits through footings.
- G. Secure conduits run exposed on surfaces with one-hole heavy-duty straps or fasten with matching fittings to inserts or trapezes, parallel to building walls and ceilings.
- H. Cap all conduit or duct stub-outs with standard factory caps; except cap threaded steel conduit with B.I. water pipe caps in outdoor locations.
- I. Use conduit fittings as manufactured by Crouse-Hinds Company, Appleton Electric Co., or approved equal.
- J. Employ U.L. liquid tight fittings for use with liquid tight flexible metal conduit.
- K. Use unions as manufactured by Appleton, O-Z/Gedney, or approved equal. The use of running threads will not be permitted.
- L. Exposed conduit and fittings in chemical rooms shall be nonmetallic rigid polyvinyl chloride, corrosion resistant rated suitable for installation in corrosive environments and in accordance with the latest NEC requirements.

## 2.3 EQUIPOTENTIAL BONDING / GROUNDING

- A. Bond together and ground to a common ground at a single point all metallic conduit, piping systems, pool reinforcing steel, metal parts of ladders, lifeguard stands, handrails and their supports and the like. The solid copper bonding conductor shall not be smaller than #8 copper.

## 2.4 WIRING CONNECTIONS

- A. Make connections without strain on conductors, allowing the conductors to take a natural position after connections or taps are made. Include all strand of wire in making the connection.
- B. Make connections for wiring by one of the following means:
  - 1. Make all taps or connections to conductors with compression type connectors except those smaller than #8 B&S gauge may have soldered connections. Solderless connections for #10 AWG or smaller may be used and shall be "Scotchlok", Buchanan, or approved equal. For #8 AWG or larger, they shall be T&B "LockTite", Burndy "Versitaps", or approved equal.
  - 2. All cable or conductor terminal lugs shall be Burndy "Quicklug", IlSCO, or approved equal. Two-piece stamped lugs and solder lugs will not be approved.
  - 3. Paint taped splices in damp or outdoor locations with two (2) coats of insulating paint.
  - 4. Tag all branch circuit wires with circuit number at the panelboard and at each point of use with linen or plastic tags.

## 2.5 CONDUCTORS

- A. Copper RHW or THW. Do not make splices between boxes.

## 2.6 CONDUCTOR IDENTIFICATION

- A. Neutrals (identified conductors shall be white).
- B. Phase conductors shall be red for phase B; blue for phase C.
- C. Green shall be used for mechanical equipment and receptacle grounds only.

## 2.7 MOTOR WIRING

- A. Make final connections to motors with the required AWG (Minimum #12), Flamenol machine tool wire, 19 strand. Control wiring for equipment shall be Flamenol machine tool wire, 19 strand of required AWG. Provide corrosion resistant junction boxes at each item of equipment to change from standard building wiring to machine tool wire.
- B. Phase motors as proper in direction of rotation.

2.8 PANELBOARDS

- A. Panelboards shall be flush or surface mounting as indicated with circuit breakers as shown on panel schedule, hinged lockable doors, index card holders and proper bussing.
- B. Where indicated on the drawings, panelboards shall be furnished with subfeed breakers and/or lugs, split bussing, contractors, time switches, relays, etc., as required.
- C. All panelboards shall be keyed alike.
- D. All panelboard enclosures shall be corrosion resistant rated in accordance with the latest NEC requirements.
- E. Furnish corrosion resistant panelboard enclosures and terminal cabinets with Yale 46515 flush locks and LL806 keys except where indicated otherwise herein. Fasten the trim to panel boards and terminal cabinet by means of concealed, bolted or screwed fasteners accessible only when the door is open.
- F. Panelboards 208/120 volt, three phase, 4 wire, S/N or 120/240 volt, single phase, 3 wire, S/N.

Panelboard types as manufactured by:

Westinghouse	Type B10B
General Electric	Type NLAB
Square D	Type NQOB

- G. Panelboards for 480/277 volt, three panes, 4 wire, S/N.

Panelboard types as manufactured by:

Westinghouse	Type Pow-R-Line 2
General Electric	Type AE
Square D	Type NEHB
Sylvania	Type NH1B
I.T.E.	Type Approved Equal

- H. Panelboard for bussing sizes thru 400 amp shall be 20" wide surface mounted type. Recess mounted type shall have a 20" wide (maximum) recess metal enclosure with trim plate cover extending 1" on all sides of enclosure. Depth shall be 5-3/4" nominal. Height of panel as required for devices.
- I. Provide 6" additional gutter space in all panels where double lugs are required, or where cable size exceeds bus size. Minimum bottom gutter space shall be 6" high. 12" additional gutter space may be required for aluminum feeders where used.
- J. Panelboards shown on the drawings with relays, time clocks or other control devices shall have a separate metal barriered compartment mounted above panel with separate hinged locking door to match panelboard. Provide mounting sub-base in cabinet for control devices and wiring terminal strips.

- K. Panelboard shall have a circuit index card holder removable type, with clear plastic cover. Index card shall have numbers imprinted to match circuit breaker numbers.

## 2.9 CIRCUIT BREAKERS

- A. Breakers shall have a minimum short circuit interrupting rating of 10,000A symmetrical for panelboard voltage thru 240 volt and 14000A for panelboards thru 600 volts or as specified on the drawings. In no case shall the interrupting rating be less than the bus withstand rating unless noted otherwise on the drawings.
- B. Circuit breakers as manufactured by the following companies only are acceptable:
  - 1. General Electric Company
  - 2. Square D Company
  - 3. Westinghouse Company
  - 4. I.T.E. Company
- C. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the drawings. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs which can readily be changed from front of panel will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
- D. Where two or three pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
- E. All circuit breakers shall be padlockable in the "off" position. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval). Other means of attachment shall not be accepted without prior written approval of Architect.
- F. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall be furnished with lockout clips, mounted in the "on" position. The breakers shall be able to trip automatically with lockout clips in place.
- G. Panelboard circuit breakers shall be bolt-on type.

## 2.10 BUSSING

- A. Bussing shall be rectangular cross section copper, or full length silver or tin-plated aluminum.
- B. Bussing shall be braces to withstand symmetrical short circuit ratings as follows or as noted on drawings. In no case shall bus short circuit bracing be less than specified circuit breakers.
- C. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

2.11 POOL MECHANICAL EQUIPMENT ENCLOSURES, TERMINAL CABINETS & MISC CABINETS

- A. All pool mechanical equipment enclosures, terminal cabinets and miscellaneous cabinets in the pool mechanical room or chemical storage rooms shall be corrosion resistant rated in accordance with the latest NEC requirements. Enclosures and all cabinets shall be flush mounted (except where noted a surface) of the size indicated on the drawings, and complete with hinged lockable doors and the number of 2-way screw terminals required for termination of all conductors. Terminal cabinet locks to operated form same key used for panelboards. The trim to terminal cabinets shall be fastened by means of concealed bolted or screwed fasteners accessible behind door to terminal cabinets. Terminal cabinets shall have 5/8" plywood backing.
- B. Provide engraved nameplate on each enclosure and cabinet indicating its designation and system (i.e., Swimming Pool - Panel 'SP').

2.12 MOTOR CONTROL INDIVIDUAL STARTERS

A. Manual Motor Starters:

- 1. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one for each motor lead). Back boxes shall be supplied with all flush mounting starters whether they are toggle type requiring only a 4" square outlet box or the larger type requiring a special box and cover designed to accept the particular unit. All box types shall be corrosion resistant rated in accordance with the latest NEC requirements.
- 2. Unless otherwise noted on the drawings, all manual starters for single phase motors, smaller than 1 h.p., shall be the compact toggle type. Manual starters for all single phase motors, 1 to 5 h.p., and all three phase motors up to 5 h.p. shall be the heavy duty type.
- 3. Where manual motor starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet, and engraved nameplate in indicate function of pilot light.
- 4. The following motor starters as manufactured by:

Manufacture	Single Phase 1HP and Below	Others
Arrow Hart	Type RL	Type LL
General Electric	CR 101	Class CR 1062
I.T.E.	Class C10, C11 or C12	Class C20
Square D Company	Class 2510, Type A	Class 2510, Type B & C
Westinghouse	Type MS	Type A100
Allen Bradley	Approved Equal	Approved Equal.

B. Individual Magnetic Motor Starters:

- 1. Magnetic motor starters shall be A.C. line voltage, across-the-line units in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.
- 2. All starters located outside of a building whether or not indicated shall be W.P. (weatherproof), and all starters noted W.P. shall be furnished in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.

3. Starter shall be horsepower rated for the motor controlled, and shall be equipped with properly sized overload elements. Every pole shall be with overload element.
4. Verify the exact motor current and voltage characteristics with the Contractor supplying the motor before installation of a starter.
5. Each starter shall be equipped with "Hand-Off-Auto" switch or stop-start pushbutton as required.
6. Coils shall be designed to operate on voltage indicated on control diagrams and have built-in-under the voltage release for coil circuit to drop motor starter off the line when the line voltage drops below normal operating voltage.
7. The coil control circuit shall be independently fused, sized to protect coil.
8. Starters to be equipped with running pilot light indication with a "Push-to-Test" feature.
9. Magnetic starters shall have a minimum of two auxiliary contacts. Additional auxiliary contacts shall be provided as required to comply with the requirements of the wiring diagrams on the electrical and mechanical drawings and the description of the function in the Mechanical Section of the Specifications.
10. Minimum starter size shall be NEMA size I unless indicated otherwise.
11. The following types of magnetic motor starters as manufactured by:

Manufacture	Type
General Electric	Class CR 106
I.T.E.	Class A20
Square D Company	Class 8536
Westinghouse	Type A200 (Size 4 Max.) or Class II-200 (Sizes 5-8)

## 2.13 INDIVIDUAL COMBINATION MOTOR STARTERS

- A. Combination starter shall incorporate fused disconnect switch and individual magnetic motor starter in a common enclosure. Combination starters shall be mounted in corrosion resistant rated enclosure in accordance with the latest NEC requirements.
- B. Starters shall comply with NEMA standards, size and horsepower as indicated on drawings General Electric, Square D, Westinghouse or I.T.E.
- C. The disconnect handle used on combination starters shall control the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "ON" or "OFF", and shall include a two-color handle grip, the black side visible in the "OFF" position indicating a safe condition, and the red side visible in the "ON" position indicating an unsafe or danger condition.
- D. All starters used in combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes, and horsepower ratings. These starters shall be furnished with three melting alloy type thermal overload relays.
- E. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if a thermal unit is removed.

## 2.14 MOTOR CONTROL CENTER, INTERLOCKS AND CONTROL DEVICES

- A. Refer to mechanical and plumbing drawings and specifications and provide all control devices including timeswitches, relays and interconnection of starters of required.
- B. Mount all relays and timeswitches in a separate compartment in motor control center unless otherwise indicated.
- C. Whether shown on mechanical and plumbing drawings or control center schedules or not, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, each motor starter to be equipped with a "Hand-Off-Auto" selector switch in starter cover. Other starters equipped with a "Start/Stop" pushbutton station in starter cover. The Contractor shall be responsible to submit a complete and detailed set of shop drawings, electrical schematic design along with electrical component cut sheets from the MCC panel or the interlock control device manufacturer. RSD Total Control: Allan Pearson 949-380-7878, South Coast Controls: Anthony Ellis 714-998-5656 or approved equal.

## 2.15 FUSES

- A. Fuses shall be dual element, current limiting type, U.L. Class RK5 unless otherwise indicated on the drawings. Provide one spare set of fuses of each size and type in each motor control center.

## 2.16 TIME CLOCKS

- A. Time clocks shall be provided for all underwater lighting systems and swimming pool circulation pumps not controlled by filter microprocessors.
- B. Contacts shall have a minimum rating of 40 amperes at 277V.
- C. Timing motor shall be heavy duty synchronous, self starting, high torque type, and shall be rated at 120, 208, 240, 277 volt 60 Hz.
- D. Motor shall operate normally at temperature range of -60 degrees Fahrenheit to +120 degrees Fahrenheit.
- E. Dial shall be 3" diameter, clearly calibrated with day/night zones and 24 hour rotation, with gear to provide one revolution yearly which automatically varies the on/off settings each day according to seasonal changes. Day and month of the year shall show clearly through calendar window on the dial.
- F. Time clocks shall be equipped with 7-spoke omitting wheel marked with days of the week.
- G. Time clocks shall be housed in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.
- H. Acceptable manufacturers are Intermatic, Tork, Paragon, or approved equal.

## 2.17 GROUND FAULT CIRCUIT INTERRUPTERS

- A. Minimum rating shall be 20 amperes, 125V, 5 milliampere trip setting, Class A per UL943.
- B. Manufacturer to be Crouse-Hinds, Leviton, or approved equal.

## 2.18 BOXES

- A. Boxes shall be of the size required by ordinances or larger, must be corrosion resistant in accordance with the latest NEC requirements where concealed or exposed on ceilings or walls.
- B. Outlets to be surface where wiring is exposed and flush in areas where conduit is concealed.
- C. Provide surface outlets with proper corrosion resistant surface covers. Box and cover shall be deep enough to provide at least 1/4" clearance between back of device and back of box. Where box contains more than one device, use a corrosion resistant rated gang box with proper cover in accordance with the latest NEC requirements. Surface outlet boxes shall be of the threaded hub type wherever below 8'0".
- D. If necessary for cable installation, additional pull boxes or junction boxes may be installed in accessible locations. Exposed pull boxes and junction boxes shall be corrosion resistant rated in accordance with the latest NEC requirements.
- E. Where exposed to weather pull boxes larger than outlet boxes are required, galvanized code gauge sheet steel boxes may be used with covers attached by brass machine screws. Boxes exposed to the weather shall be approved for the purpose, and conduit entrances shall be on the bottom made by means of an interchangeable hub with gasket and adapter nut. Pull boxes not shown on Drawings may be added only after approval of size and location is obtained.
- F. For outlets exposed to weather or where noted, cast outlet boxes shall be Crouse-Hinds, Appleton, or approved equal. Boxes shall have proper number and size hubs. Device plates, covers, adapters and boxes shall be as manufactured by Crouse-Hinds, Appleton, or approved equal.
- G. Exposed junction boxes, outlet boxes and pull boxes for pool chemical rooms shall be non-metallic suitable for a corrosive environment and in accordance with the latest NEC requirements.

## 2.19 IDENTIFICATION MARKINGS

- A. Plainly mark all motor and electrical appliance control equipment indicating the equipment controlled with engraved metal tags.
- B. Provide laminated plastic nameplates on panelboards on the outside of the door at the top indicating panel designation and feeder source.
- C. Provide laminated plastic nameplates on distribution switchboards and motor control centers at the top center indicating panel designation and feeder source.
- D. Identify each distribution switchboard and motor control center circuit breaker with a laminated plastic nameplate indicating its' use.



- E. Type panelboard directories on the forms provided with the equipment, indicating the use of each branch circuit breaker.
- F. Fasten all laminated plastic nameplates to surfaces with two (2) or more screws.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Verify conditions at the Project site before submitting bid. Be responsible for providing all necessary wiring for the new electrical systems. Wherever wiring is being disrupted due to remodeling or changes, reconnect existing and provide new wiring circuits to accomplish a fully operable system at no additional cost to the City.

### 3.2 COORDINATION

- A. The Drawings are essentially diagrammatic and indicate the desired location, size, routes, connection points, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the Work so as to provide the best possible installation in the available space and to overcome difficulties, limitations or interference wherever encountered. Be responsible for the correct placement of this Work, the proper location and connection in relation to Work of other trades, for determining the exact location of all conduits, outlets and equipment, and for installing the conduits in such a manner as to conform to the structure, avoid obstruction, preserve headroom and keep openings and passageways clear. Particular attention is directed to the close coordination required on exposed Work. Locations shown on Architectural or Mechanical Drawings if different than those shown on Electrical Drawings should be communicated to the City's Representative in writing for clarification.

### 3.3 INSTALLATION

- A. Trenching and Backfill: Conform with requirements of Section 131101. Provide minimum cover as required by Code.
- B. Conduit Installation:
  - 1. Conduit and metallic raceway systems shall be mechanically and electrically continuous from sources of current to all outlets in a manner to provide a continuous grounding path. Close ends of conduit during construction to prevent entrance of dirt or moisture.
  - 2. Securely fasten conduit to the building construction within three feet of each outlet and within every ten feet thereafter. Secure it to boxes, cabinets, pull boxes, terminals with two locknuts and ends equipped with bushings or a terminal fitting. Cut square with ends carefully reamed.
  - 3. Make bends or elbows so that the conduit will not be injured or flattened.
  - 4. Use insulated metallic bushings in all places where bushings are required.
  - 5. Run exposed conduits level or plumb and parallel to the construction members of the building. No cutting across or diagonal runs will be permitted. Neatly surmount structural obstructions encountered on conduit runs by the use of fittings or pull boxes.

6. Identify feeder conduits by stamped metal tags secured to exposed section of conduit in main or sub-panels.
7. Make up all threaded conduit joints gas and watertight with conductive sealer except conduit above ground in dry indoor locations.
8. Rigidly support all boxes independently of the conduit system.

C. Connections to Equipment:

1. Fully connect, in an approved manner, all electrical outlets, apparatus, motors, equipment, fixtures, wiring devices and appliances whether they are installed under the Electrical Contract or not, which require electrical connections, to the corresponding electrical system outlet.
2. Where the Work of this Section requires connections to be made to equipment that is furnished and set-in-place under other Sections, obtain such roughing-in dimensions from the manufacturer or supplier of each item as required and assume full responsibility for the installation of the connections thereto.

3.4 ADJUSTMENT AND CLEAN-UP

- A. Preliminary Operation: Should the City's Representative deem it necessary to operate the electrical installation or any part thereof prior to Substantial Completion of the Work, consent to such preliminary operation and supervise conduction of same. Subcontractor shall pay all costs occasioned by such operation. Preliminary operation shall not be construed as an acceptance of any Work installed under this Contract.
- B. Clean-up: Upon completion of the Work of this Section, immediately remove all swimming pool electrical materials, debris and rubbish occasioned by this Work to the acceptance of the City's Representative.

END OF SECTION 131108

**SECTION 26 05 00  
COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 — GENERAL**

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under Division 26.

B. Related work under this section

1. Labor and materials required to furnish and install the electrical systems in a complete and operational fashion.
2. Carpentry, masonry, steel and concrete materials and labor required for construction of proper stands, bases and supports for electrical materials and equipment.
3. Cutting and patching of holes required by installation including flashing and counter-flashing of roof and exterior wall penetrations.
4. Excavating, pumping and backfilling required for installation.
5. Repair of damage to the premises resulting from construction activities under this Section to Owner's satisfaction.
6. Removal of work debris from construction activities to Owner's satisfaction.
7. Testing and cleaning of equipment installed.

C. Work not under this section

1. Furnishing of motors, fans, compressors, water heaters, thermostats and motor starters included under Division 23, or as noted otherwise.
2. Furnishing of motors, fans, compressors, water heaters, thermostats and motor starters included under Division 23, or as noted otherwise.
3. Electrical Contractor shall provide connections to mechanical equipment where voltage exceeds 50 V and all necessary raceways for low voltage controls.

D. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.

2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and nature of related work and properly coordinate work specified herein with that specified elsewhere to provide a complete and working installation.
  - a. The General Conditions and General Requirements, Division 1, are a part of and are to apply to all the work of this Division.
  - b. Site Construction –Division 31: Earthwork, Boring
  - c. Concrete –Division 3: All sections
  - d. Metals –Division 5: Structural Metal Framing
  - e. Wood and Plastic –Division 6: Rough Carpentry
  - f. Thermal and Moisture Protection – Division 7: Dampproofing and Waterproofing, Flashing, Fire and Smoke Protection
  - g. Doors and Windows – Division 8: Access Doors
  - h. Finishes – Division 9: Painting and Coatings
  - i. Equipment – Division 11: As provided
  - j. Special Construction – Division 13: As provided
  - k. Mechanical –Division 23: Heat-Generation Equipment, Refrigeration Equipment, HVAC Equipment, HVAC Instrumentation and Controls

## 1.02 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  1. CCR –California Code of Regulations
    - a. Title 8 –Industrial Relations; Division 1 –Department of Industrial Relations
      - 1) Chapter 3.2 -California Occupational Safety and Health Regulations (CAL/OSHA)
      - 2) Chapter 4 –Division of Industrial Safety
        - a) Subchapter 4 -Construction Safety Orders (CSO)
        - b) Subchapter 5 -Electrical Safety Orders (ESO)
    - b. Title 24 –California Building Standards

- 1) Part 1 -Building Standards Administrative Code
  - 2) Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
  - 3) Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  - 4) Part 4 -California Mechanical Code (MEC); IAPMO Uniform Mechanical Code (UMC) with California amendments
  - 5) Part 5 -California Plumbing Code; IAPMO Uniform Plumbing Code (UPC) with California amendments
  - 6) Part 6 -California Energy Code
  - 7) Part 7 -California Elevator Safety Construction Code
  - 8) Part 9 -California Fire Code; International Fire Code (IFC) with California amendments
  - 9) Part 12 -California Reference Standards Code
2. CPUC –California Public Utilities Commission
    - a. GO-95; Rules for Overhead Electric Line Construction
    - b. GO-128; Rules for Construction of Underground Electric Supply and Communication Systems
  3. IEEE –Institute of Electrical and Electronic Engineers
    - a. C2; National Electrical Safety Code (NESC)
  4. NECA –National Electrical Contractors Association
    - a. 1; Standard Practices for Good Workmanship in Electrical Contracting
    - b. 4090; Manual of Labor Units
  5. All applicable local municipal codes and ordinances.
  6. Applicable rules and regulations of local utility companies.

### 1.03 SUBMITTALS

#### A. Product data

1. Prior to commencement of work and within 35 days after award of Contract, submit in ample time for approval in accordance with Division 1 a complete list of furnished

equipment, material and shop drawings, including all substitutions. Partial or incomplete lists of materials will not be considered. Substitutions will be considered thereafter.

- a. Where it is in the best interest of Owner, Engineer may give written consent to a submittal received after expiration of designated time limits or for an additional re-submittal.

B. Closeout submittal

1. Furnish three complete sets of maintenance and operating instructions bound in a binder and indexed to Owner. Start compiling data upon approval of materials and equipment. Final inspection will not be made until Engineer approves binders. Refer also to Division 1 for additional requirements.
2. Provide one of each tool required for proper equipment operation and maintenance provided under this Section. All tools shall be delivered to the Owner at project completion.
3. Provide two keys to Owner for each lock furnished under Division 26.
4. Record drawings
  - a. Upon completion of Work, furnish Engineer with complete sets of plans (not marked blueprints) upon which shall be shown all work installed under Contract, which are not in accordance with the Construction Documents. Refer to Division 1 requirements.
  - b. All symbols and designations used in preparing Record Drawings shall match those used in Construction Documents.

1.04 SUBSTITUTIONS

- A. If it is desired to make a substitution, the Contractor shall clearly identify each substitution on the submittal, and to submit complete information or catalog data to show equality of equipment or material offered to that specified. Substitutions will be interpreted to be all manufacturers other than those specifically listed by model or catalog number within these Specifications and Drawings. No substitution will be allowed unless identified, requested and approved in writing. Materials of equal merit and appearance, in the opinion of the Engineer, will be approved for use. Architect and Engineer reserve the right to require originally specified items at no additional costs to Owner. Only one request for substitutions will be considered on each item of material or equipment.
- B. Acceptance of a substitute is not to be considered a release from the Specifications. Correct any deficiencies in an item, even though approved at the Contractor's expense.
- C. Responsibility for installation of approved substitution is included herein. Make any changes required for installation of approved substituted equipment without additional costs.
- D. Failure to comply with any of the requirements of the above will necessitate that the specified materials be submitted and supplied.

## 1.05 CHANGE ORDER PROPOSALS

- A. Shall comply with the requirements set forth by the General Conditions
- B. All change order proposals and requests, both additive and deductive, shall be accompanied by a detailed materials and labor breakdown for each specific task and/or item.
  - 1. All change order proposals and change orders, both additive and deductive, shall be based upon and be accompanied by a detailed materials and labor breakdown for each specific task and/or item. The breakdown shall include actual materials costs plus overhead and profit, as well as labor units base upon the most recent NECA Manual of Labor Units (NECA Index #4090) or equivalent publication for each specific task and item. Labor costs shall be computed as outlined within the General Conditions, based upon the NECA labor tables for each task required. Materials costs shall include actual Contractor invoice plus no more than 15% markup. The Owner and Contractor agree to the above change order cost procedure, for both additive and deductive change orders.

## 1.06 QUALITY ASSURANCE

- A. References to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to bid submittal. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.
- B. Work and materials shall be in full accordance with the latest rules and regulations of applicable state or local laws or regulations and standards of following:
  - 1. National Fire Protection Association (NFPA)
  - 2. California Electrical Code (CEC)
  - 3. California Occupational Safety Health Act (Cal-OSHA)
  - 4. California State Fire Marshall (CSFM)
  - 5. California Code of Regulations (CCR)
  - 6. Electrical Safety Orders, CAC Title 8 (ESO)
  - 7. California Public Utilities Commissions, General Order 95 (GO-95)
  - 8. Applicable rules and regulations of local utility companies.
  - 9. NECA 1-2000, Standard Practices for Good Workmanship in Electrical Contracting
- C. All electrical equipment and material furnished under Division 26 shall conform to all CEC/NEC requirements and bear the Underwriters' Laboratories (UL) label where applicable.
- D. Nothing in the Construction Documents shall be construed to permit work not conforming to these Codes. Whenever the indicated material, workmanship, arrangement or construction is

of high quality or capacity than that required by the above rules and regulations, the Construction Documents shall take precedence. Should there be any direct conflict between the rules and regulations and Construction Documents, the rules shall govern.

- E. All electrical equipment and material furnished under this Section shall conform to NEMA and ASTM standards, NEC/CEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.
- F. All electrical work shall conform to manufacturer's written instruction, and the NECA Standard Practices for Good Workmanship in Electrical Contracting and all published recommended practices at the time of project. The Contractor shall use the requirements within the Specifications whenever they exceed NECA guidelines.
- G. Follow manufacturer's direction where these direction cover points not included with the Construction Documents.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Packing, shipping, handling and unloading
  - 1. Damage to the equipment delivered to the site or in transit to the job shall be the responsibility of the Electrical Contractor.
  - 2. Equipment and material delivery of shall be scheduled as required for timely, expeditious progress of work.
- B. Storage and protection of job equipment is the responsibility Contractor.
- C. Comply with Division 1 requirements with regards to waste management and disposal.

#### 1.08 PROJECT CONDITIONS

- A. Discrepancies
  - 1. In the event of discrepancies with the Contract Documents, Engineer shall be notified with sufficient time as stated within Division 1 to allow the issuing of an addendum prior to the bid opening.
  - 2. If, in the event that time does not permit notification of clarification of discrepancies prior to the bid opening, the following shall apply:
    - a. The drawings govern in matters of quantity and specifications govern in matters of quality.
    - b. In the event of conflict within the drawings and specifications involving quantities or quality, the greater quantity or higher quality shall apply. Such discrepancies shall be noted and clarified within the contractor's bid. No additional allowances will be made because of errors, ambiguities or omissions which reasonably should have been discovered during the bid preparation.



- B. Verify all power and communication utilities' requirements prior to commencement of any utility work. Make proper adjustments to the construction to satisfy the serving utility.
- C. Information shown relative to services is based upon available records and data, but shall be regarded as approximate only. Make minor deviations found necessary to conform to actual locations and conditions without extra cost. Verify locations and elevations of utilities prior to commencement of excavation for new underground installation.
- D. Exercise extreme care in excavating near existing utilities to avoid any damage thereto; be responsible for any damage caused by such operations. Contact all utility companies to obtain exact locations prior to commencement of construction.
- E. The electrical plans indicate the general layout and arrangement; the architectural drawings and field conditions shall determine exact locations. Field verify all conditions and modify as required to satisfy design intent. Maintain all required working clearances.
- F. Fees, permits and utility services
  - 1. Obtain and pay for all permits and service charges required for the installation of this work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Arrange for all utility connections and pay charges incurred including excess service charges if any.
  - 2. Extra charges imposed by the electrical and communication utility companies shall be included in the bid, if available. Unless otherwise stated, these charges will be assumed to be included in the bid.
- G. Provide and maintain temporary construction power. The General Contractor or Owner will pay for electric energy charges; refer to Division 1 for details. Should the Electrical Contractor be the prime contractor, the Electrical Contractor shall pay for energy charges unless negotiated with Owner.

#### 1.09 SEQUENCING

- A. Coordinate work within phasing plans as provided by the Owner.

#### 1.10 WARRANTY

- A. Furnish one-year minimum guarantee in accordance with and in form required under Division 1. Repair or replace as may be necessary any defective work, material, or part without cost to the Owner, include repair or replacement of other work, furnishing, equipment or premises caused by such repair or replacement of defective work.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS

- A. Materials mentioned herein or on Drawings require that the items be provided and of quality noted or an approved equal. All materials shall be new, full weight, standard in all respects

and in first-class condition. Insofar as possible, all materials used shall be of the same brand or manufacturer throughout for each class of material or equipment.

- B. Trade names or catalog numbers stated herein indicate grade or quality of material desired. Materials, where applicable, shall be UL labeled and in accordance with NEMA standards.
- C. Dimensions, sizes and capacities shown are a minimum. Do not make changes without written permission of Engineer

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine Construction Documents and Site; be familiar with types of construction where electrical installation is involved. Note carefully other sections of Specifications with their individual cross-references, standard details, etc.
- B. Any electrical work or materials shown either in Construction Documents, but not mentioned herein, or vice versa, shall be executed the same as if mentioned herein, in a workmanlike manner in accordance with all published NECA Standards of Installation.
- C. Coordinate work with other crafts to avoid conflicts, and check all outlet locations with Architectural and Mechanical drawings and specifications. Make minor adjustments without additional cost to Owner.
- D. Engineer will make clarifications and rulings concerning any obvious discrepancies or omissions in work prior and after bidding. Perform all work involved in correcting obvious errors or omissions after award of contract as directed by Engineer at Contractor's expense.
- E. Examine site dimensions and locations against Drawings and become informed of all conditions under which work is to be done before submitting proposals. No allowance will be made for extra expense due to error.
- F. Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial), but shall be followed as closely as possible. Construction Documents are for assistance and guidance, and exact locations, distance, levels, etc., will be governed by construction; accept same with this understanding.
- G. Horsepower of motors or wattage of equipment indicated in Construction Documents is estimated horsepower or wattage requirement of equipment furnished under other sections of Specifications. Size all feeders (conduit and wiring), motor starters, overload protection and circuit breakers to suit horsepower of motors or wattage of equipment actually furnished under various sections of specifications. However, in no case shall feeders and branch circuits (conduit and wiring) and circuit breakers be of smaller capacities or sizes than those indicated on Drawings or specified, unless approved in writing by Engineer.

### 3.02 PREPARATION

- A. Seal all exterior wall penetrations in an approved watertight manner and to the satisfaction of Engineer and Architect.
- B. Channels, joiners, hangers, caps, nuts and bolts and associated parts shall be plated electrolytically with zinc followed immediately thereafter by treating freshly deposited zinc surfaces with chromic acid to obtain a surface which will not form a white deposit on surface for an average of 120 hours when subjected to a standard salt spray cabinet test, or shall be hot dipped galvanized

### 3.03 INSTALLATION

#### A. Equipment identification

- 1. Properly identify panelboards, remote control switches, push buttons, terminal boxes, etc. with a descriptive nameplate. Make nameplate with 3/32" laminated plastic with black background and white letters. Machine engraved letters 1/8" high for equipment in device box(es) and 1/4" high for panelboards, terminal cabinets or larger items. Punched strip type nameplates and cardholders in any form are not acceptable. Fasten nameplates with oval head machine screws, tapped into front cover/panel.

#### B. Working spaces

- 1. Provide adequate working space around electrical equipment in compliance with Article 4 of Electrical Safety Orders and CEC/NEC 110.26. In general provide 78" of headroom and 30" wide minimum clear workspace in front of panelboards and controls. In addition to the above, provide the following minimum working clearances:
  - a. 0V – 150V (line-to-ground) provide 36" minimum clear distance.
  - b. 151V – 600V (line-to-ground) provide 42" minimum clear distance.

#### C. Equipment supports

- 1. Anchor all electrical equipment to structure. Support systems shall be adequate to withstand seismic forces per CBC.

#### D. Excavating and backfilling

- 1. Excavate and backfill as required for installation of Work. Restore all surfaces, roadways, walks, curbs, walls existing underground installations, etc., cut by installations to original condition in an acceptable manner. Maintain all warning signs, barricades, flares and lanterns as required by ESO and local ordinances.
- 2. Dig trenches straight and true to line and grade, with bottom clear of any rock points. Support conduit for entire length on undisturbed original earth. Minimum conduit depth of pipe crown shall be 24" below finished or natural grade, unless otherwise noted.

E. Forming, cutting and patching

1. In new construction, General Contractor shall provide any special forming, recesses, chased, etc., and provide wood blocking, backing and grounds as necessary for the proper installation of electrical work. Be responsible for notifying General Contractor that such provision is necessary; layout work and check to see that it suits his requirements.
  - a. Provide metal backing plates, anchor plates and such that are required for anchorage of electrical work under Division 26; securely weld or bolt to metal framing. Wood blocking or backing will not be permitted in combination with metal framing.
2. Be responsible for proper placement of pipe sleeves, hangers, inserts and supports for this Work.

F. Concrete work

1. Provide concrete work related solely to electrical work. Concrete work, including forming and reinforcing steel installed for all electrical work, shall comply with all applicable requirements of Division 3, or in accordance with the State of California Standard Specifications issued by the Department of Transportation (CALTRANS).

3.04 REPAIR/RESTORATION

- A. Cutting, patching and repairing of existing construction to permit installation of work under Division 26 is the responsibility of Contractor. Repair or replace all damage to existing work in kind to Owner's satisfaction.
- B. Obtain Engineer's approval prior to performing any cutting or patching of concrete, masonry, wood or steel structure within building.

3.05 FIELD QUALITY CONTROL

A. Inspection of work

1. Working parts shall be readily accessible for inspection, repair and renewal. The right is reserved to make reasonable changes in equipment location shown on Drawings prior to rough in without additional costs to the Owner.
2. During construction all work will be subject to observation by the Engineer and his representatives. Assist in ascertaining any information that maybe required.
3. Do not allow or cause any work installed hereunder to be covered up or enclosed before it has been inspected and approved. Should any work be enclosed or covered prior to approval, uncover work, and after it has been inspected and approved, restore work of all others to the condition in which it was found at the time of cutting, all without additional costs to Owner.

B. Furnish all testing equipment as maybe required.

C. Test all wiring and connections for continuity and grounds; where such tests indicate faulty insulation or other defects, locate, repair and re-test.

D. Check rotation of all motors and correct if necessary.

3.06 CLEANING

- A. Repair or replace all broken, damaged or otherwise defective parts without additional cost to Owner, and leave entire work in a condition satisfactory to Engineer. At completion, carefully clean and adjust all equipment, fixtures and trim installed as part of this work; leave systems and equipment in satisfactory operating condition.
- B. Clean out and remove from the site all surplus materials and debris resulting from this work; this includes surplus excavated materials.

3.07 DEMONSTRATION

- A. At project completion, Contractor shall allot a period of not less than 8 hours for instruction of operating and maintenance personnel in the use of all systems installed under this Section. This time is in addition to any instruction time stated in the Specifications of other sections for other equipment (i.e., fire alarm, security, intercom, etc.). All personnel shall be instructed at one time, the Contractor shall make all necessary arrangements with manufacturer's representatives as may be required. Contractor, if any, for the above services shall pay all costs.

3.08 PROTECTION

- A. In performance of work, protect work of other trades as well as work under this Section from damage.
- B. Protect electrical equipment, stored and installed, from dust, water or other damage.

**END OF SECTION**

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## SECTION 26 05 19

### LOW-VOLTAGE POWER CONDUCTORS AND CABLES

#### PART 1 -- GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary for the installation of all conductors and cables under this Section related to lighting, power, mechanical, control, and signal systems.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ASTM -American Society for Testing and Materials
  - a. B3; Standard Specification for Soft or Annealed Copper Wire
  - b. B8; Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - c. B787/B787M; Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation
  - d. D1000; Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
2. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments

3. UL -Underwriters Laboratories, Inc.
  - a. UL 83; Thermoplastic-Insulated Wire and Cables
  - b. UL 486A 486B; Wire Connectors
  - c. UL 486C; Splicing Wire Connectors
  - d. UL 486D; Standard for Insulated Wire Connector Systems for Underground Use or In Damp or Wet Locations
  - e. UL 486E; Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
  - f. UL 493; Thermoplastic-Insulated Underground Feeders and Branch Circuit Cables
  - g. UL 510; Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
  - h. UL 854; Service-Entrance Cables
4. NEMA –National Electrical Manufacturer’s Association
  - a. WC 70-1999; Nonshielded Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy
5. IEEE –Institute of Electrical and Electronic Engineers
  - a. 82; Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors

1.03 SUBMITTALS

- A. Submit manufacturer’s data for equipment and materials specified within this Section in accordance to Section 26 05 00.

1.04 DELIVERY

- A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.

**PART 2 - PRODUCTS**

2.01 BUILDING WIRE

- A. Conductor material

1. Provide annealed copper for all wire, conductor and cable of not less than 98% conductivity.



2. Wire #8 AWG and larger shall be stranded.
3. Wire #10 AWG and smaller shall be solid.

B. Insulation material

1. All insulated wire, conductor and cable shall be 600 Vac rated.
2. Feeder and branch circuits larger than #6 AWG shall be type THW, XHHW or THHN/THWN.
3. Feeder and branch circuits #6 AWG and smaller shall be type TW, THW, XHHW or THHN/THWN.
4. Control circuits shall be type THW or THHN/THWN.
5. Wires shall bear the UL label, be color-coded and marked with gauge, type and manufacturer's name on 24" centers.

2.02 METAL-CLAD CABLE (MC CABLE)

- A. MC cable shall be an armored assembly of two or more dual rated THHN/THWN conductors and a full sized green insulated grounding conductor.
- B. MC cable shall be fabricated in continuous lengths from galvanized steel strip, spirally wound and formed to provide an interlocking design.
- C. Fitting connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Fittings shall be UL listed for use with MC cable type specified.

2.03 FLEXIBLE CORDS AND CABLES

- A. Provide flexible cords and cables of size, type and arrangement as indicated on Drawings.
- B. Type S flexible cords and cable shall be manufactured in accordance with NEC Article 400 and composed of two or more conductors and a full sized green insulated grounding conductor with an outer rubber or neoprene jacket.
- C. Flexible cords and cables shall be fitted with wire mesh strain relief grips either as an integral connector component or an independently supported unit.
- D. Suspended flexible cords and cables shall incorporate safety spring(s).

2.04 WIRE CONNECTIONS AND TERMINATIONS

- A. Electrical spring wire connectors

1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-sectional steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.
  2. Self-striping pigtail and tap U-contact connectors are not acceptable.
- B. Compression type terminating lugs
1. Provide tin-plated copper high compression type lugs for installation with hand or hydraulic crimping tools as directed by manufacturer. Notch or single point type crimps are not acceptable.
  2. Two hole, long barrel lugs shall be provided for size #4/O AWG and larger wire where terminated to bus bars. Use minimum of three crimps per lug where possible.
- C. Splicing and insulating tape
1. Provide black, UV resistant, self extinguishing, 7 mil thick vinyl general purpose electrical tape per UL 510 and ASTM D1000. 3M Scotch 33 or equal.
- D. Insulating putty
1. Provide pads or rolls of non-corrosive, self-fusing, 125 mil thick rubber putty with PVC backing sheet per UL 510 and ASTM D1000. 3M Scotchfil or equal.
- E. Insulating resin
1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. 3M Scotchcast 4 or equal.
  2. Use resin with thermal and dielectric properties equal to the cable's insulating properties.
- F. Terminal strips
1. Provide box type terminal strips in the required quantities plus 25% spare. Install in continuous rows.
  2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.
  3. Identify all terminal strips and circuits.
- G. Crimp type connectors
1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support.
  2. Fasten crimp type connectors or terminals using a crimping tool recommended by the manufacturer.

3. Provide insulated overlap splices with tinned seamless electrolytic copper-brazed barrel with funnel wire entry and insulation support.
4. Provide insulated butt splices with tinned seamless electrolytic copper-brazed barrel with center stop, funnel wire entry and insulation support.

#### H. Cable ties

1. Provide harnessing and point-to-point wire bundling with nylon cable ties. Install using tool supplied by manufacturer as required.

#### I. Wire lubricating compound

1. UL listed for the wire insulation and conduit type, and shall not harden or become adhesive.
2. Shall not be used on wire for isolated type electrical power systems.

#### J. Bolt termination hardware

1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE Grade 5; or silicon bronze alloy ASTM B-9954 Type B.
2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, conforming to ANSI B27.2. SAE or narrow series shall be used.
4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
  - a. 1/4" bolt – 125 A
  - b. 5/16" bolt – 175 A
  - c. 3/8" bolt – 225 A
  - d. 1/2" bolt – 300 A
  - e. 5/8" bolt – 375 A
  - f. 3/4" bolt – 450 A

## **PART 3 -EXECUTION**

### **3.01 EXAMINATION**

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

### 3.02 INSTALLATION

- A. All wire, conductor, and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient conditions.
- B. Feeders and branch circuits in wet locations shall be rated 75°C minimum.
- C. Feeders and branch circuits in dry locations shall be rated 90°C minimum.
- D. Minimum conductor size
  - 1. #12 AWG copper for all power and lighting branch circuits.
  - 2. #14 AWG copper for all line voltage signal and control wiring, unless otherwise indicated.
  - 3. Aluminum conductors may be substituted on the basis of equal performance for sizes greater than #10 AWG with the approval of Engineer.
- E. Remove and replace conductors under the following conditions at no additional costs to the Owner:
  - 1. Installed within wrong specified conduit or raceway.
  - 2. Damaged during installation.
  - 3. Of insufficient length to facilitate proper splice of conductors

### 3.03 WIRING METHODS

- A. Install wires and cable in accordance with manufacturer's written instructions, as shown on Drawings and as specified herein.
- B. Install all single conductors within raceway system, unless otherwise indicated.
- C. Parallel circuit conductors and terminations shall be equal in length and identical in all aspects.
- D. Provide adequate length of conductors within electrical enclosures and neatly train to termination points with no excess. Terminate such that there is no bare conductor at the terminal.
- E. Splice cables and wires only in junction boxes, outlet boxes, pull boxes, manholes or handholes.

- F. Group and bundle with tie wrap each neutral with its associated phase conductors where more than one neutral conductor is present within a conduit.
- G. Install cable supports for all vertical feeders in accordance with NEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.
- H. Seal cable where exiting a conduit from an exterior underground raceway with a non-hardening compound (i.e., duct seal or equal).
- I. Provide UL listed factory fabricated, solder-less metal connectors of size, ampacity rating, material, type and class for applications and for services indicated. Use connectors with temperature ratings equal or greater than the conductor or cable being terminated.
- J. Stranded wire shall be terminated using fittings, lugs or devices listed for the application. Under no circumstances shall stranded wire be terminated solely by wrapping it around a screw or bolt.
- K. Flexible cords and cables supplied as part of a pre-manufactured assembly shall be installed according to manufacturer's published instructions.

#### 3.04 WIRING INSTALLATION IN RACEWAYS

- A. Install wire in raceway after interior of building has been physically protected from weather, and all mechanical work likely to injure conductors has been completed.
- B. Pull all conductors into raceway at the same time.
- C. Use UL listed, non-petroleum base and insulating type pulling compound as needed.
- D. Completely mandrel all underground or concrete encased conduits prior to installation.
- E. Completely and thoroughly swab raceway system prior to installation
- F. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors smaller than #1 AWG.
- G. Wire pulling
  1. Provide installation equipment that will prevent cutting or abrasion of insulation during installation.
  2. Maximum pull tension shall not exceed manufacturer's recommended value during installation for cable being measured with tension dynamometer.
  3. Use rope made of non-metallic material for pulling.
  4. Attach pulling lines by means of either woven basket grips or pulling eyes attached directly to the conductors.

5. Pull multiple conductors simultaneously within same conduit.

### 3.05 MC CABLE INSTALLATION

- A. MC cable shall be installed where clearly indicated on Drawings or with explicit, written permission by Engineer or Owner.
- B. Install MC cable in accordance with manufacturer's instructions and NEC Article 334. Follow manufacturer's instruction when connecting the cable to fittings and boxes. Connectors and boxes shall be firmly secured to the cable, but not over-tightened.
- C. Support cable every 6 feet and with 12 inches of boxes per NEC Article 334 using separate spring clip or metal cable ties (not steel tie wire) for each cable. Do not bundle cables together.
- D. Install separate drop wires above accessible, tile ceilings.
- E. Do not rest cables on ceiling tiles or allow contact with metal piping systems.
- F. Provide separate sleeves and/or fire barriers where cables penetrate firewalls, unless cable is UL listed for the application.

### 3.06 WIRE SPLICES, JOINTS AND TERMINATIONS

- A. Join and terminate wire, conductors and cables in accordance with UL 486, NEC and manufacturer's instructions.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full conductor ampacity without perceptible temperature rise, and shall be made mechanically and electrically secure.
- D. Terminate wires in terminal cabinets using terminal strips, unless otherwise indicated.
- E. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere within panel or cabinet.
- F. Encapsulate splices in wet locations using specified insulating resin kits.
- G. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as feed conductor with at least 6 inches of tail, all neatly packed within box.
- H. Where conductors are to be connected to metallic surfaces, coated surfaces shall be cleaned to base metal surface before installing connector. Remove lacquer coating of conduits where ground clamps are to be installed.
- I. Branch circuits (#10 AWG and smaller) connectors shall comply with 2.01.D.2 and 2.01.D.2 above.

J. Branch circuits (#8 AWG and larger)

1. Join or tap conductors using insulated mechanical compression taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over-wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of joint.
2. Terminate conductors using mechanical compression lugs in accordance with manufacturer's recommendation or as specified elsewhere.
3. Field installed compression connectors for 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.
4. Insulate splices and joints with materials approved for the particular use, location, voltage and temperature.

K. Termination hardware assemblies

1. Al/Cu lugs connected to aluminum plated or copper bus shall be secured with steel bolt, flat washer (two per bolt), Belleville washer and nut.
2. Copper lugs connected to copper buss shall bus shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer and nut.
3. The crown of Belleville washers shall be under the nut.
4. Bolt assemblies shall be torque to manufacturer's recommendations. Where manufacturer recommendation is not obtainable, the following shall be used:
  - a. 1/4" -20 bolt at 80 inch-pound torque
  - b. 5/16" -18 bolt at 180 inch-pound torque
  - c. 3/8" -20 bolt at 20 inch-pound torque
  - d. 1/2" -20 bolt at 40 inch-pound torque
  - e. 5/8" -20 bolt at 55 inch-pound torque
  - f. 3/4" -20 bolt at 158 inch-pound torque

3.07 IDENTIFICATION

- A. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.
- B. Provide all terminal strips with each individual terminal identified using specified vinyl markers.

C. In manholes, pullboxes and handholes provide tags of embossed brass type with cable type and voltage rating. Attach tags to cable with slip-free plastic cable lacing units.

D. Color coding

1. For 120/208 Volt (or 120/240 Volt), 1 phase, 3 wire systems:

- a. Phase A – Black
- b. Phase B – Red
- c. Neutral – White
- d. Ground – Green

2. For 120/208 Volt, 3 phase, 4 wire systems:

- a. Phase A – Black
- b. Phase B – Red
- c. Phase C – Blue
- d. Neutral – White
- e. Ground – Green

3. For 277/480 Volt, 3 phase, 4 wire systems:

- a. Phase A – Brown
- b. Phase B – Orange
- c. Phase C – Yellow
- d. Neutral – Gray
- e. Ground – Green

4. Switch leg individually installed shall be the same color as the branch circuit to which they originate, unless otherwise indicated.

5. Travelers for 3-way and 4-way switches shall be a distinct color and pulled with the circuit switch leg or neutral.

### 3.08 FIELD QUALITY CONTROL

A. Supply labor, materials and test equipment required to perform continuity and ground tests.

B. Electrical testing



1. Perform feeder and branch circuit insulation test after installation and prior to connection to device.
2. Tests shall be performed by 600 Vdc megger for a continuous 10 seconds from phase-to-phase and phase-to-ground.
3. Torque test conductor connections and terminations for conformance to Specifications.
4. If any failure is detected, locate failure, determine cause and replace or repair cable to Engineer's satisfaction at no additional costs.
5. Furnish test results in type written report form for review by Engineer.

**END OF SECTION**

## SECTION 26 05 26

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the item specified under this Section, including but not limited to power system grounding

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. IEEE –Institute of Electrical and Electronic Engineers
  - a. 142; Recommend Practices for Grounding of Industrial and Commercial Power Systems
3. NFPA –National Fire Protection Association
  - a. 780; Lightning Protection Code
4. UL –Underwriters Laboratories, Inc.
  - a. 467; Grounding and Bonding Equipment

### 1.03 SYSTEM DESCRIPTION

- A. This Section provides for the grounding and bonding of all electrical and communication apparatus, machinery, appliances, components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.
- B. Ground the electrical service system neutral at service entrance equipment as shown on the Drawings.
- C. Ground each separately derived system, as defined in CEC/NEC 250-5(d) and on the Drawings, unless specifically noted otherwise.
- D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, equipment and metallic raceways, boxes and cabinets shall be completely and effectively grounded in accordance with all CEC/NEC requirements, whether or not such connections are specifically shown or specified.

### 1.04 SUBMITTALS

- A. Submit manufacturer's data for equipment and materials specified within this Section in accordance to Section 26 05 00.

### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

## **PART 2 - PRODUCTS**

### 2.01 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND)

- A. #3/O AWG minimum bare stranded copper conductor.

### 2.02 DRIVEN (GROUND) RODS

- A. Copper clad steel, minimum ¾" diameter by 10'-0" length, sectional type with copper alloy couplings and carbon steel driving stud; Weaver, Cadweld or equal.

### 2.03 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron body with 150°C molded plastic insulated throat and lay-in ground lug; OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

### 2.04 CONNECTION TO PIPE

- A. Cable to pipe connections; OZ/Gedney G-100B series, Thomas & Betts #290X series or equal.

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## 2.05 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPICES

- A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds, Cadweld or equal, or high pressure compression type connectors, Cadweld, Thomas & Betts or equal.

## 2.06 BONDING JUMPERS

- A. OZ/Gedney Type BJ, Thomas & Betts #3840 series or equal.

## 2.07 GROUND CONDUCTOR

- A. Ground conductor shall be code size UL labeled, Type THWN insulated copper wire, green in color.

## 2.08 MAIN BUILDING REFERENCE GROUND BUS (BGB)

- A. Provide 1 24"x4"x1/4" TK copper bus bar mounted on wall with insulating stand-offs at +18" AFF. Furnish complete with cast copper alloy body Thomas Betts Series 310 or equal lugs for connecting grounding conductors. Attach lugs to bus with appropriate size bronze bolt, flat washer and Belleville washer. All connections shall be torque, and all holes shall be drilled and tapped for single hole lugs. Provide 4 spare lugs with respective spaces.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

### A. Grounding electrodes

#### 1. Concrete encased grounding electrode (Ufer ground)

- a. Provide a #3/O AWG minimum bare copper conductor encased along the bottom of concrete foundation, footing or trench which is in direct contact with the earth and where there is no impervious waterproofing membrane between the footing and soil. The electrode shall extend through a horizontal length of 30' minimum and shall be encased in not less than 2" or more than 5" of concrete separating it from surrounding soil. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to BGB or as shown on Drawings.

#### 2. Supplementary grounding electrode (ground ring, grid and driven rod)

- a. Provide as shown driven ground rod(s). Interconnect ground rod with structural steel and adjacent rods with code size bare copper conductor. Ground rods shall be space no less than 6'-0" on centers from any other electrode or electrodes of another electrical system.

3. Separately derived electrical system grounding electrode
    - a. Ground each separately derived system per CEC/NEC 250-26 or as shown on Drawings, whichever is greater.
  4. Metal underground water pipe
    - a. Contractor shall install an accessible grounding electrode conductor from the main incoming cold water line to BGB. The electrode conductor shall be sized per CEC/NEC Table 250-94 or as shown on Drawings, whichever is greater.
- B. Grounding electrode conductor
1. Provide grounding electrode conductors per CEC/NEC Table 250-94 or as shown on Drawings, whichever is greater.
- C. Power system grounding
1. Connect the following items using code size copper grounding conductors to BGB or as shown on Drawings:
    - a. Concrete encased electrode (Ufer ground)
    - b. Ground rod(s)
    - c. Incoming cold and fire water pipes
    - d. Gas pipe
    - e. Structural steel
    - f. Distribution transformer secondary
- D. Equipment Bonding/Grounding
1. Provide a code sized copper ground conductor, whether indicated or noted on the drawings, in each of the following:
    - a. All power distribution conduits and ducts
    - b. Distribution feeders
    - c. Motor and equipment branch circuits\
    - d. Device branch circuits
  2. Provide a separate grounding bus at distribution panelboards, loadcenters, switchboards and motor control centers. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35V above ground.

3. Metallic conduits terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
4. Provide bonding jumpers across expansion and deflection coupling in conduit runs, pipe connections to water meters and metallic cold water dielectric couplings.
5. Provide ground wire in flexible conduit connected at each end via grounding bushing.
6. Provide bonding jumpers across all cable tray joints.
7. Bond each end of metallic conduit longer than 36" in length to grounding conductor using a #6 AWG pigtail.

### 3.02 FIELD QUALITY CONTROL

- A. Contractor using test equipment expressly designed for that purpose shall perform all ground resistance tests in conformance with IEEE guidelines. Contractor shall submit typewritten records of measured resistance values to Engineer for review and approval prior to energizing the system.
- B. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with the following resistance limits:
  1. Resistance from ground bus to ground electrode and to earth shall not exceed 5 ohms unless otherwise noted.
  2. Resistance from the farthest panelboard, loadcenter, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed 20 ohms maximum.
- C. Inspection
  1. The Engineer or Inspector prior to encasement, burial or concealment thereto shall review the grounding electrode and connections.

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**SECTION 26 05 33**  
**RACEWAYS AND BOXES**

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to electrical conduits; outlet, junction and pull boxes; and related supports.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI –American National Standards Institute
  - a. C33.91; Specification for Rigid PVC Conduit
  - b. C80.1; Specification Rigid Steel Conduit, Zinc-Coated
  - c. C80.3; Specification for Electrical Metallic Tubing, Zinc-Coated
  - d. C80.6; Intermediate Metal Conduit (IMC), Zinc-Coated
2. CCR –California Code of Regulations, Title 24
  - a. Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments

- b. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
- 3. NECA –National Electrical Contractors Association
  - a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT)
  - b. 111, Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)
- 4. NEMA –National Electrical Manufacturer’s Association
  - a. FB 1; Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  - b. FB 2.10; Selection and Installation Guidelines for Fittings for Use with Non-flexible Electrical Metal Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)
  - c. FB 2.20; Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable
  - d. OS 1; Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
  - e. OS 3; Selection and Installation Guidelines for Electrical Outlet Boxes
  - f. RN 1; Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
  - g. TC 2; Electrical Plastic Tubing and Conduit
  - h. TC 3; PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - i. TC 14; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
- 5. OSHPD Anchorage Pre-approvals
  - a. OPA-0003; Superstrut Seismic Restraint System
  - b. OPA-0114; B-Line Seismic Restraints
  - c. OPA-0120; Unistrut Seismic Bracing System
  - d. OPA-0242; Power-Strut Seismic Bracing System
- 6. UL –Underwriter’s Laboratories, Inc.
  - a. 1; Standard for Flexible Metal Conduit
  - b. 6; Rigid Metal Electrical Conduit
  - c. 360; Standard for Liquid-Tight Flexible Steel Conduit

- d. 514A; Metallic Outlet Boxes, Electrical
- e. 514B; Fittings for Conduit and Outlet Boxes
- f. 651; Schedule 40 & 80 PVC Conduit
- g. 797; Electrical Metallic Tubing
- h. 1242; Intermediate Metal Conduit
- i. 1684; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

### 1.03 SYSTEM DESCRIPTION

- A. Furnish, assemble, erect, install, connect and test all electrical conduits and related raceway apparatus required and specified to form a complete installation.

### 1.04 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to the NECA installation guidelines unless otherwise indicated within this Section

## **PART 2 - PRODUCTS**

### 2.01 MATERIALS

#### A. Conduits and Fittings

##### 1. Rigid steel conduit (RMC)

- a. Conduit: Standard weight, mild steel pipe, and zinc coated on both inside and outside by a hot dipping or shearardizing process manufactured in accordance with UL 6 and ANSI C80.1 specifications.
- b. Fittings (couplings, elbows, bends, etc.)
  - 1) Shall be steel or malleable iron.
  - 2) Coupling and unions shall be threaded type, assembled with anti-corrosion, conductive and anti-seize compound at joints made absolutely tight to exclude water.

- c. Bushings
  - 1) Insulating bushings: Threaded polypropylene or thermosetting phenolic rated at 150°C minimum.
  - 2) Insulating grounding bushing: Threaded cast body with insulating throat and steel “lay-in” ground lug.
  - 3) Insulating metallic bushing: Threaded cast body with plastic insulated throat rated at 150°C minimum.
- 2. Coated rigid steel conduit (CRMC)
  - a. Conduit: Equivalent to RMC with a Polyvinyl chloride (PVC) coated bonded to the galvanized outer surface of the conduit. The bonding between the PVC coating and conduit surface shall be ETL PVC-001 compliant. The coating thickness shall be a minimum of 40mil.
  - b. Fittings (couplings, elbows, bends, etc.)
    - 1) Equivalent to RMC above with bonded coating same as conduit.
    - 2) The PVC sleeve over fittings shall extend beyond hub or coupling approximately one diameter or 1 1/2” whichever is smaller.
  - c. Bushing equivalent to RMC above.
- 3. Intermediate metallic conduit(IMC)
  - a. Conduit: Intermediate weight, mild steel pipe, meeting the same requirements for finish and material as rigid steel conduit manufactured in accordance with UL 1242 and ANSI C80.6 specifications
  - b. Fittings (couplings, elbows, bends, etc.) equivalent to RMC above.
  - c. Bushing equivalent to RMC above.
- 4. Electrical metallic tubing (EMT)
  - a. Conduit: Cold rolled steel tubing with zinc coating on outside and protective enamel on inside manufactured in accordance with UL 797 and ANSI C80.3 specifications.
  - b. Couplings: Steel or malleable iron with compression type fastener via a nut.
  - c. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
- 5. Rigid non-metallic conduit (PVC)
  - a. Conduit: PVC composed Schedule 40, 90°C manufactured in accordance with NEMA TC 2 and UL 651 specifications.

- b. Fittings: Molded PVC, slip on solvent welded type in accordance to NEMA TC 3.
6. Reinforced thermosetting resin conduit (RTRC)
- a. Conduit: Fiber impregnated with a cured thermosetting resin compound in accordance with NEMA TC 14 and UL1684.
  - b. Fittings: Molded resin with glass reinforcement manufactured in the same process as the conduit bonded with an epoxy adhesive.
7. Flexible metallic conduit (FMC)
- a. Conduit: Continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 1.
  - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
8. Liquidtight flexible metallic conduit (LFMC)
- a. Conduit: PVC coated, continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 360.
  - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
9. Miscellaneous Fittings and Products
- a. Conduit sealing bushings: Steel or cast malleable iron body and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Supplied with neoprene sealing rings between body and PVC sleeve.
  - b. Watertight cable terminators: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel screws and zinc plated cast iron locking collar.
  - c. Watertight cable/cord connectors: Liquidtight steel or cast malleable iron body with sealing neoprene bushing and stainless steel retaining ring.
  - d. Expansion fittings: Multi-piece unit of hot dip galvanized malleable iron or steel body and outside pressure bussing design to allow a maximum of 4" movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. UL listed for both wet and dry locations.
  - e. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve, internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling to provide minimum of 3/4" movement and 30 degrees deflection from normal. UL listed for both wet and dry locations.
  - f. Conduit bodies: Raintight, malleable iron, hot-dip galvanized body with threaded hubs, stamped steel cover, stainless steel screws and neoprene gasket.

- g. Other couplings, connectors and fittings shall be equal in quality, material and construction to items specified herein.

## B. Boxes

### 1. Outlet boxes

- a. Standard: Galvanized one-piece of welded pressed steel type in accordance with NEMA OS 1 and UL 514. Boxes shall not be less than 4" square and at least 1 1/2" deep.
- b. Concrete: Galvanized steel, 4" octagon ring with mounting lug, backplate and adapter ring type in accordance with NEMA OS 1 and UL 514. Depth as required by application.
- c. Masonry: Galvanized steel, 3.75" high gang box in accordance with NEMA OS 1 and UL 514.
- d. Surface cast metal: Cast malleable iron body, surface mounted box with threaded hubs and mounting lugs as required in accordance with NEMA OS 1 and UL 514. Furnish with ground flange, steel cover and neoprene gasket.

### 2. Pull and junction boxes

- a. Sheet metal boxes: Standard or concrete outlet box wherever possible; otherwise use 16 gauge galvanized sheet metal, NEMA 1 box sized per CEC with machine screwed cover.
- b. Cast metal boxes: Install standard cast malleable iron outlet or device box when possible.
- c. Flush mounted boxes: Install overlapping cover with flush head screws.
- d. In-ground mounted pull holes/boxes: Install pre-cast concrete box, sized per Drawing or CEC with pre-cast or traffic rated lid.

### 3. Floor boxes

- a. Floor boxes shall be adjustable, cast metal body with threaded conduit openings, adjustable rings, brass flange or Lexan ring and cover plate with threaded plug. Include provisions to accommodate surface mounted telephone or receptacle outlet, or flush floor mounted telephone or receptacle outlet where shown on Drawings.

## C. Pull line/cord

- 1. Polypropylene braided line or Let-line #232 or equal of 1/8" diameter with a minimum break strength of 200 pounds.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

### **3.02 PREPARATION**

#### **A. Conduit**

1. Provide all necessary conduit fittings, connectors, bushings, etc. required to complete conduit installation to meet the CEC/NEC and intended application whether noted, shown or specified within.
2. Location of conduit runs shall be planned in advance of the installation and coordinated with other trades.
3. Where practical, install conduits in groups in parallel vertical or horizontal runs that avoid unnecessary offsets.
4. All conduits shall be parallel or at right angles to columns, beams and walls whether exposed or concealed.
5. Conduits shall not be placed closer than 12” to a flue, parallel to hot water, steam line or other heat sources; or 3” when crossing perpendicular to the above said lines when possible.
6. Install exposed conduit as high as practical to maintain adequate headroom. Notify Engineer if headroom will be less than 102”.
7. Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.
8. The largest trade size conduit in concrete floors and walls shall not exceed 1/3 thickness or be spaced a less than three conduit diameters apart unless permitted by Engineer. All conduits shall be installed in the center of slab or wall, and never between reinforcing steel and bottom of floor slab.
9. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
10. When installing underground conduits to specified depth; depth shall be taken from finished grade as it will be at project completion. Should finish grade be above existing grade by an amount equal to or greater than specified depth, conduit shall be installed not less than 6” below existing grade.

11. Verify that information concerning finish grade is accurate, for should the underground run be less than the specified depth, Contractor may be required to re-install conduit to meet the required depth.
12. Unless otherwise specified, underground conduits shall be installed with top side not less than 24" below finished grade; this depth applies to all conduits outside of building foundations including those under walks, open corridors or paved areas.
13. Utility company service conduits installation depth shall be as directed by their respective specifications and requirements.

#### B. Boxes

1. Before locating outlet boxes, check Construction Documents for type of construction and make sure that there is no conflict with other equipment. Locate outlet boxes as shown and locate so as not to interfere with other Work or equipment.
2. Install all outlet boxes flush within walls, ceiling and floors except where installed within non-finished rooms, cabinetry, attic spaces or as indicated on Drawings.
3. Locate pull boxes and junction boxes within concealed, accessible locations where possible.
4. Do not install outlet boxes back-to-back with same stud space. Where shown back-to-back, offset as required, and fill void with sound dampening material where requested by Owner.
5. In fire rated walls separate boxes by 24" minimum and with stud member.
6. Adjust position of outlet boxes within masonry wall to accommodate course lines.

### 3.03 INSTALLATION

#### A. Conduit

1. Minimum conduit size shall be 3/4" unless otherwise indicated.
2. All conduit work shall be concealed unless otherwise indicated. Exposed conduits shall be permitted within unfinished rooms/spaces to facilitate installation.
3. Install conduit in complete runs prior to installing conductors or cables.
4. Make long radius conduits bends free from kink, indentations or flattened surfaces. Make bends carefully to avoid injury or flattening. Bends 1 1/4" size and larger shall be factory made ells, or be made with a manufactured mechanical bender. Heating of steel conduit to facilitate bending or that damage galvanized coating will not be permitted.
5. Remove burrs and sharp edges at end of conduit with tapered reamer.
6. Protect and cover conduits during construction with metallic bushings and bushing "pennies" to seal exposed openings.



7. Assemble conduit threads with anti-corrosion, conductive, anti-seize compound and tighten securely.
8. Install conduits shall that no traps to collect condensation exist.
9. Fasten conduit securely to boxes with locknuts and bushings to provide good grounding continuity.
10. Install pull cords/line within any spare or unused conduits of sufficient length to facilitate future cable installation.
11. Penetrations
  - a. Locate penetrations within structural members as shown on Drawings and as directed by Architect or Engineer. Should it be necessary to notch any framing member, make such notching only at locations and in a manner as approved by Engineer.
  - b. Do not chase concrete or masonry to install conduit unless specifically approved by Engineer.
  - c. Cutting or holes
    - 1) Install sleeves for cast-in-place concrete floors and walls. After installing conduit through penetration, seal using dry-pack grouting compound (non-iron bearing, chloride free and non-shrinking) or fire rated assembly if rated floor or wall. Use escutcheon plate on floor underside to contain compound as necessary.
    - 2) Cut holes with a hole saw for penetrations through non-concrete or non-masonry members.
    - 3) Provide chrome plated escutcheon plates at all publicly exposed wall, ceiling and floor penetrations.
  - d. Sealing
    - 1) Non-rated penetration openings shall be packed with non-flammable insulating material and sealed with gypsum wallboard taping compound.
    - 2) Fire rated penetration shall be sealed using a UL classified fire stop assembly suitable to maintain the equivalent fire rating prior to the penetration.
    - 3) Use escutcheon plates to hold sealing or fire rated compound as necessary.
  - e. Waterproofing
    - 1) Make penetrations through any damp-proofed/waterproofed surfaces within damp/wet locations as such as to maintain integrity of surface.
    - 2) Install specified watertight conduit entrance seals at all below grade wall and floor penetrations.

- 3) At roof penetrations furnish roof flashing, counter flashing and pitch-pockets compatible to roof assembly.
- 4) Where possible conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration's exterior side.
- 5) Make penetrations through floors watertight with mastic, even when concealed within walls or furred spaces.

## 12. Supports

- a. Conduits shall be support and braced per OSHPD pre-approved anchorage systems when those methods are implemented and installed.
- b. Sizes of rods and cross channels shall be capable of supporting 4 times and 5 times actual load, respectively. Anchorage shall support the combined weight of conduit, hanger and conductors.
- c. Support individual horizontal conduit 1 1/2" and smaller by means of 2 hole straps or individual hangers.
- d. Galvanized iron hanger rods sizes 1/4" diameter and larger with spring steel fasteners, clips or clamps specifically design for that purpose for 1 1/2" conduits and larger.
- e. Support multi-parallel horizontal conduits runs with trapeze type hangers consisting of 2 or more steel hanger rods, preformed cross channels, 'J' bolts, clamps, etc.
- f. Support conduit to wood structures by means of bolts or lag screws in shear, to concrete by means of insert or expansion bolts and to brickwork by means of expansion bolts.
- g. Support multi-parallel vertical conduits runs with galvanized Unistrut, Power-Strut or approved equal type supports anchored to wall. Where multi-floored conduits pass through floors, install riser clamps at each floor.
- h. Maximum conduit support spacing shall be in accordance with NECA Standard of Installation:
  - 1) Horizontal runs:
    - a) 3/4" and smaller at 60" on centers, unless building construction prohibits otherwise, then 84" on centers.
    - b) 1" and larger at 72" on centers, unless building construction prohibits otherwise or any other condition, then 120" on centers.
  - 2) Vertical runs:
    - a) 3/4" and smaller @ 84" on centers.
    - b) 1" and 1 1/4" @ 96" on centers.

c) 1 1/2" and larger @ 120" on centers.

d) Any vertical condition such as shaftways and concealed locations for any sized conduit, 120" on centers.

i. Anchorage for RMC/IMC supports unless otherwise specified:

1) < 1" IMC/RMC = #10 bolt/screw.

2) 1" IMC/RMC = 1/4" bolt/screw.

3) 1 1/2" and 2" IMC/RMC = 3/8" bolt/screw.

4) 3" IMC/RMC, 4" EMT = 1/2" bolt/screw.

5) > 3" IMC/RMC = 5/8" bolt/screw.

j. Anchorage for EMT supports unless otherwise specified:

1) < 1 1/2" EMT = #10 bolt/screw.

2) 1 1/2" EMT = 1/4" bolt/screw.

3) 2, 2 1/2" and 3" EMT = 3/8" bolt/screw.

4) 4" EMT = 1/2" bolt/screw.

5) > 4" EMT = 5/8" bolt/screw.

## B. Boxes

1. Install boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
2. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
3. Install plaster rings on all outlet boxes in stud walls or in furred, suspended or exposed ceilings. Covers shall be of a depth suited for installation.
4. Provide gasketed cast metal cover plates where boxes are exposed in damp or wet locations
5. Install access door for boxes installed within concealed locations without access.
6. Install approved factory made knockout seal where knockouts are not present.
7. Refer to Architectural interior elevations and details shown for exact mounting heights of all electrical outlets. In general, locate outlets as shown or specific and complies with Americans with Disabilities Act:

- a. Convenience outlets: +18" AFF or +6" above counter or splash.
  - b. Local switches: +48" AFF or +6" above counter or splash.
  - c. Telecommunication outlets: +18" AFF or +48" AFF for wall telephone or intercom device.
  - d. Verify all mounting heights with Architectural Drawings, and where heights are not suited for construction or finish please consult Engineer or Architect.
8. Use conduit bodies to facilitate pulling of conductor or cables or change conduit direction. Do not splice within conduit bodies.
  9. Enclose pull box with additional rated gypsum board as necessary to maintain wall's original fire rating.
  10. Install galvanized steel coverplates on all open boxes within dry listed areas.
  11. Install in-ground pull holes/boxes flush to grade finish at finished areas or 1" above finished landscaped grade. Seal all conduits terminating in pull hole/box watertight. Install and grout around bell ends where shown. Cover and lids shall be removable without damage to adjacent finish surfaces.
  12. Support
    - a. Accurately place boxes for finish, independently and securely supported by adequate blocking or manufacturer channel type heavy-duty box hangers for stud walls. Do not use nails to support boxes.
    - b. Support boxes independent of conduit system.
    - c. Mount boxes installed within ceilings to 16 gauge metal channel bars attached to main runners or joists.
    - d. Support boxes within suspended acoustical tile ceilings directly from structure above when light fixture are to be installed from box.
    - e. Use auxiliary plates, bar or clips and grouted in place for masonry, block or pour-in-place concrete construction.

### 3.04 APPLICATION

#### A. Conduit

1. RMC/IMC suitable for all damp, dry and wet locations except when in contact with earth. IMC not suitable for hazardous locations as stated within CEC/NEC.
2. CRMC suitable for damp or wet locations, concealed within concrete or in contact with earth.
3. EMT suitable for exposed or concealed dry, interior locations.

4. PVC/RTRC suitable for beneath ground floor slab, except when penetrating, and direct earth burial. Do not run exposed within concrete walls or in floor slab unless indicated on Drawings or per Engineer's permission.
  5. FMC suitable for dry locations only for connections to motors, transformers, vibrating equipment/machinery, controllers, valves, switches and light fixtures in less than 6 foot lengths.
  6. LFMC application same as FMC above but for damp or wet locations.
- B. Termination and joints
1. Use raceway fittings compatible with associated raceway and suitable for the location.
  2. Raceways shall be joined using specified couplings or transitions where dissimilar raceway systems are joined.
  3. Conduits shall be securely fastened to cabinets, boxes and gutters using (2) two locknuts and insulating bushing or specified insulated connector. Where joints cannot be made tight and terminations are subject to vibration, use bonding jumpers, bonding bushings or wedges to provide electrical continuity of the raceway system. Use insulating bushings to protect conductors where subjected to vibration or dampness. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
  4. Terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
  5. Stub freestanding equipment conduits through concrete floors for connections with top of coupling set flush with finished floor. Install plugs to protect threads and entrance of debris.
  6. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating within interior switchboard, panel, cabinet or gutters. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.
  7. Where conduits enter building from below grade inject into filled raceways pre-formulated rigid 2 lbs. density polyurethane foam suitable for sealing against water, moisture, insects and rodents.
  8. Install expansion fitting or expansion/deflection couplings per manufacturer's recommendations where:
    - a. Any conduit that crosses a building structure expansion joint; secure conduit on both sides to building structure and install expansion fitting at joint.
    - b. Any conduit that crosses a concrete expansion joint; install expansion/deflection at joint.

- c. Any conduit greater than 1-1/4" is routed along roof top in runs greater than 100 feet; install expansion fittings every 100 feet.
- d. Engineer may allow FMC or LFMC in lieu of expansion fitting or expansion/deflection couplings on conduits 2" and smaller within accessible locations upon further review and written consent.

C. Boxes

- 1. Standard type suitable for all flush installations and all dry concealed locations.
- 2. Concrete type suitable for all flush concrete installations.
- 3. Masonry type suitable for all flush concrete and block installations.
- 4. Surface cast metal type suitable for all exposed damp and wet surface mounted locations, and dry surface mounted locations less than 96" from finished floor

**END OF SECTION**

## SECTION 26 24 16

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to panelboards.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
  - b. 26 28 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
  - a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service
3. NECA –National Electrical Contractors Association
  - a. 407, Recommended Practice for Installing and Maintaining Panelboards
4. NEMA –National Electrical Manufacturer’s Association
  - a. AB 1; Molded Case Circuit Breakers
  - b. PB 1; Panelboards
  - c. PB 1.1; Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
5. UL -Underwriters Laboratories, Inc.
  - a. 50; Cabinets and Boxes

- b. 67; Panelboards
- c. 98; Enclosed and Dead Front Switches
- d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- e. 891; Dead-Front Switchboards
- f. 943; Ground Fault Circuit Interrupters
- g. 977; Fused Power Circuit Devices<sup>50</sup>; Enclosures for Electrical Equipment

### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

## **PART 2 - PRODUCTS**

### 2.01 MANUFACTURERS

- A. Square D, Cutler-Hammer or approved equal.

### 2.02 MATERIALS

#### A. Panelboards

##### 1. Interior

- a. Shall be factory-assembled with voltage, ampacity, and short circuit rating as shown in Drawings.
- b. Provide 1 continuous copper bus bar per phase. Each bus bar shall have sequentially phase branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and CEC/NEC 230.F and 230.G.



- c. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength material.
  - d. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trims shall have pre-formed twist-out covering unused mounting spaces.
  - e. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior.
  - f. Main and sub-feed circuit breakers shall be vertical mounted. Interior leveling provisions shall be provided for flush mounted applications.
2. Main Circuit Breaker
- a. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 28 11 – Overcurrent Protection Devices.
3. Branch Circuit Breakers
- a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 28 11 – Overcurrent Protection Devices.
4. Enclosures
- a. Type NEMA 1 Boxes
    - 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvanealed steel will not be acceptable.
    - 2) Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
    - 3) Box width shall be 20 in wide.
  - b. Type NEMA 1 Fronts
    - 1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
    - 2) Fronts shall be hinged 1-piece with door. Mounting shall be as indicated in Drawings.
    - 3) Panelboards rated 225 amperes and below shall flat fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 225 amperes shall have fronts with trim clamps and concealed door hinges. Front doors shall have rounded corners and edges shall be free of burrs.
    - 4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
  - c. Type NEMA 3R, 5, and 12
    - 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

- 2) All doors shall be gasketed and equipped with a tumbler type vault lock. All lock assemblies shall be keyed alike. 2 keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
- 3) Maximum enclosure dimensions shall not exceed 20 in wide and 6.5 in deep.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's written instructions and NEMA PB 1.1.
- B. Installation shall conform to NECA 407 where not specified under this Division.
- C. Anchor panelboards to structural members and as shown on Drawings. Provide additional support as required. Anchor freestanding distribution panels to concrete pad.
- D. Mount panelboards level and plumb.
- E. Install flush mounted panel backbox front edges flush with finished wall. Where flush panel backbox is deeper than wall depth, install closing trim of wood or metal to provide a finished trim.
- F. Where panelboard is flush in wall, provide one ¾" conduit stub into accessible ceiling above for every 5 spare circuit breaker or available space.
- G. After installation, make all feeder connections to circuit breaker load side lugs and incoming secondary feeders.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.
- B. Check tightness of bolted connections and circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

### **3.03 ADJUSTING**

- A. Measure steady state load line currents at each panelboard feeder; rearrange panelboard circuits to balance the phase loads with 20% of each other. Maintain proper phasing for multi-wire branch circuits.

### **3.04 SCHEDULES**

- A. Fill out panelboard circuit identification card, typewritten, with list of circuits in use. Identification shall be specific with room designation and other information as necessary. For distribution panels, use engraved laminated phenolic plates showing load served.

## **END OF SECTION**

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to wiring devices.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. Federal Specification
  - a. W-C-596; Connector, Electrical, Power, General Specification for
  - b. W-S-896; Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification)
2. NEMA –National Electrical Manufacturer’s Association
  - a. WD 1; General Color Requirements for Wiring Devices
  - b. WD 6; Wiring Devices-Dimensional Requirements
3. UL -Underwriters Laboratories, Inc.
  - a. 20; General-Use Snap Switches

- b. 498; Standard for Attachment Plugs and Receptacles
- c. 943; Standard for Ground-Fault Circuit-Interrupters
- d. 1449; Standard for Transient Voltage Surge Suppressors

1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

**PART 2 - PRODUCTS**

2.01 SWITCHES

A. Wall switches

- 1. Specification grade, quiet, AC rated, mechanical, snap type with silver alloy contacts, and shall comply with NEMA WD-1 and Fed. Spec W-S-896.
- 2. Rating shall be 20A at 120/277Vac, unless otherwise shown.
- 3. Handles shall be nylon; color shall be compatible with adjacent wall finish.
- 4. Manufacturers and types
  - a. Single pole, single throw
    - 1) Cooper Wiring Devices #CSB120, Hubbell #CSB120, or equal.
  - b. Double pole, single throw
    - 1) Cooper Wiring Devices #CSB220, Hubbell #CSB220, or equal.
  - c. Three way
    - 1) Cooper Wiring Devices #CSB320, Hubbell #CSB320, or equal.

B. Wall dimmer switches

- 1. Linear slide type dimmer with smooth and continuous square law dimming curve that complies with UL 20 and is UL listed for the specified load.

2. Dimmers shall have power failure memory to bring lights back on at same level prior to power interruption.
3. Dimmers shall incorporate air-gap switch accessible with wall plate installed.
4. Furnish dimmer switch of rating to connected loads; de-rate as required by manufacturer's information for ganged installations.
5. Coverplate shall be snap-on type with no visible attachments or fins. Color shall be compatible with adjacent wall finish.
6. Manufacturer and type
  - a. Lutron Nova series or approved equal.

## 2.02 RECEPTACLES

### A. Standards

1. Specification grade, NEMA 5-15R configuration grounding type, rated 15A at 125/250Vac that conform to NEMA WD-6 and Fed. Spec W-C-596.
2. At dedicated receptacle locations and as otherwise noted, use specification grade, NEMA 5-20R configuration grounding type, rated 20A at 125/250Vac that conform to NEMA WD-6 and when possible Fed. Spec W-C-596.
3. Specialty receptacles shall conform to NEMA WD-6 and UL standards as applicable.

### B. Color

1. General purpose receptacle face shall be nylon; color shall be compatible with adjacent wall finish, unless otherwise indicated.

### C. Receptacle types

1. General purpose single
  - a. Provide self-grounding back and side wired with binding head staked terminal screw.
  - b. Use Cooper Wiring Devices #5261, Hubbell #5261, or equal for NEMA 5-15R.
  - c. Use Cooper Wiring Devices #5361, Hubbell #5361, or equal for NEMA 5-20R.
2. General purpose duplex
  - a. Provide self-grounding back and side wired with binding head staked terminal screws and break-off strip for two circuit wiring.
  - b. Use Cooper Wiring Devices #5262, Hubbell #5262, or equal for NEMA 5-15R.
  - c. Use Cooper Wiring Devices #5362, Hubbell #5362, or equal for NEMA 5-20R.

3. Transient voltage surge suppressor (TVSS) duplex
  - a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral TVSS protection circuit.
  - b. Provide LED indicator to verify surge protection and ground, and audible alarm to notify bad ground connection or surge protection expiration.
  - c. TVSS characteristics:
    - 1) 400V clamping voltage.
    - 2) 280J energy rating.
    - 3) 150Vac RMS MOV rating
    - 4) 18kA maximum surge current in all modes (L-N, L-G and N-G)
  - d. Use Cooper Wiring Devices #5362\_S, no known equal.
4. Isolated ground
  - a. Provide receptacle specified within this Section with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.
5. Ground fault circuit interrupter (GFCI) duplex
  - a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral solid state sensing and signaling circuitry capable of detecting and interrupting a maximum 5mA line-to-ground fault current in approximately 1/40<sup>th</sup> of a second per UL 943.
  - b. Provide visual device with trip indication, manual reset and test mechanisms per UL 943.
  - c. Device shall be capable of point of use and multi-outlet protection.
  - d. Use Cooper Wiring Devices #XGF20, Hubbell #GF53, or equal.
6. Hospital grade and tamper resistant
  - a. Provide receptacle specified within this Section that conforms to UL 498 “Hospital Grade” requirements.
  - b. Tamper resistance receptacle shall have integral protection mechanism to prevent accidental shock from foreign object contacting energized blades.

7. Special purpose

- a. Provide specification grade devices with NEMA configuration, voltage, ampacity, poles and ground provisions as noted on Drawings.

2.03 WALL PLATES

A. Interior locations

1. Finished Areas: 0.032” stainless steel, brushed or satin finish with required number of openings for location.
2. Exposed Areas: galvanized, raised type.

B. Exterior: die-cast copper-free aluminum, gasketed, raintight cover UL listed for exterior and wet locations while in use. Use Hubbell #WP8M (duplex), #WP26M (GFCI) or equal.

C. Screws shall match plate.

D. Tamper resistance receptacles shall have exposed screws of temper resistant type.

E. Individual, gangable wall plates are not acceptable where two or more devices are installed at one location.

**PART 3 - EXECUTION**

3.01 PREPARATION

- A. Coordinate device heights with architectural drawings and details.
- B. Locate switches on latch side of door, unless otherwise indicated.

3.02 INSTALLATION

- A. Mount and align device and wall plates level and plumb. Insure wall plates fit flat against wall and tight against device without strain on plate.
- B. Comply with manufacturer’s instructions regarding termination of conductors to wiring device.
- C. Derate ganged dimmer switches as instructed by manufacturer and use dedicated neutrals within all dimmer circuits.
- D. Provide wall plates for all outlet boxes with devices.
- E. Install blank wall plates on all outlet boxes in which no device is present or installed.

**END OF SECTION**

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## SECTION 26 28 11

### OVERCURRENT PROTECTION DEVICES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to overcurrent protection devices.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
  - a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service
3. NEMA –National Electrical Manufacturer’s Association
  - a. AB 1; Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
  - b. PB 2.2; Application Guide for Ground Fault Protective Devices for Equipment
4. UL -Underwriters Laboratories, Inc.

- a. 248; Low Voltage Fuses
- b. 468; Wire Connectors
- c. 508E; IEC Type "2" Coordination Short Circuit Tests
- d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- e. 943; Standard for Ground-Fault Circuit-Interrupters

### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Production test of circuit breakers upon request of Engineer.
- C. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

## **PART 2 - PRODUCTS**

### 2.01 FUSES

- A. All power distribution fuses shall be time-delay, high interrupting (200kAIC minimum) and current limiting type, unless otherwise indicated. All fuses shall be of same manufacturer and model.
  - 1. Motor branch circuit fuses (0 – 600A): UL Class RK5 dual element, time delay type shall be size for UL 508E "Type 2" coordination for the motor controller. Coordinate fuse selection with motor starter overload relay heaters as required.
  - 2. General purpose feeder fuses (0 – 600A): UL Class RK1 dual element, time delay type shall be size per Drawings.

- B. Control and instrumentation fuses shall of type and rating as recommended by equipment manufacturer, suitable for fuse blocks or holders installation.

## 2.02 MOLDED CASE CIRCUIT BREAKERS

### A. General

1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication.
4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker after installation.
5. Circuit breakers shall have an RMS interrupting capacity not less than shown on Drawings, or if not shown shall not be less than:
  - a. 25kA for 480V systems
  - b. 22kA for 240V (or less) systems
6. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
7. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on Drawing. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
8. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
9. Circuit breakers shall be constructed with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs. Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the CEC.
10. All circuit breakers shall be capable of accepting bus connections.

### B. Thermal-Magnetic Circuit Breakers

1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.
3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker.
4. Provide equipment ground fault protection where shown on Drawing with the following features.
  - a. Ground fault sensing system shall be modified zero sequence sensing type and not require any external power to trip the circuit breaker.
  - b. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
  - c. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
  - d. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
  - e. A means of testing the ground fault system to meet the on-site testing requirements of CEC/NEC 230-95(c) shall be provided.
  - f. Local visual ground fault trip indication shall be provided.
  - g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

#### C. Electronic Trip Circuit Breakers

1. Circuit breaker trip system shall be a microprocessor-based true RMS sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on Drawings.
2. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
3. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and adjustment positions shall be clearly

marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 80% (or 100% where noted on Drawings) of their ampere rating continuously.

4. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.
  - a. Instantaneous Pickup
  - b. Long Time Pickup
  - c. Long Time Delay
  - d. Short Time Pickup
  - e. Short Time Delay
  - f. Ground Fault Pickup (when specified with ground fault protection)
  - g. Ground Fault Delay (when specified with ground fault protection)
5. A means to seal the trip unit adjustments in accordance with CEC/NEC 240-6(b) shall be provided.
6. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
7. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. All current values shall be displayed in true RMS with 2% accuracy.
8. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
9. The trip system shall include a Long Time memory circuit to sum the time increments of intermittent overcurrent conditions above the pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
10. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in true RMS with 2% accuracy.
11. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
12. Equipment Ground Fault Protection shall be provided where noted on Drawings.
  - a. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
  - b. A separate neutral current transformer shall be provided for three-phase, four-wire systems.

- c. Ground fault sensing system shall be residual sensing type.
  - d. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
  - e. A means of testing the ground fault system to meet the on-site testing requirements of CEC/NEC 230-95(c) shall be provided.
  - f. Local visual trip indication for a ground fault trip occurrence shall be provided.
  - g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.
13. Circuit breaker trip system shall be equipped with an externally accessible test port. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.

### 2.03 INSULATED CASE CIRCUIT BREAKERS

- A. Circuit breaker trip system shall be a microprocessor-based true RMS sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on Drawings.
- B. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
- C. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
- D. Circuit breakers shall have an RMS interrupting capacity not less than shown on Drawings, or if not shown shall not be less than:
  - 1. 100kA for all frame sizes at 208V
  - 2. 65kA for all 800A - 2,000A frames at 480V
  - 3. 100kA for all 3,000A - 4,000A frames at 480V
- E. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and switch adjustments shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 100% of their ampere rating continuously.
- F. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent from all other adjustments.
  - a. Instantaneous Pickup

- b. Long Time Pickup
  - c. Long Time Delay
  - d. Short Time Pickup
  - e. Short Time Delay
  - f. Ground Fault Pickup (when specified with ground fault protection)
  - g. Ground Fault Delay (when specified with ground fault protection)
- G. Circuit breakers with adjustable short-time function shall be provided with defeatable instantaneous adjustment and 30 cycle short-time withstand ratings. Short-time withstand ratings shall be specified in RMS symmetrical amperes, as shown on the [drawings] [schedules].
- H. A means to seal the rating plug and trip unit adjustments in accordance with CEC/NEC 240-6(b) shall be provided.
- I. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
- J. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. [Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection]. All current values shall be displayed in True RMS with 2% accuracy.
- K. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
- L. The trip system shall include a Long Time memory circuit to protect against intermittent overcurrent conditions above the long time pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
- M. True two-step stored energy mechanism with five (5) cycle closing time shall be provided. All circuit breakers shall have multiple CHARGE/CLOSE provisions allowing the following sequence: CHARGE, CLOSE, RECHARGE, OPEN/CLOSE/OPEN
- N. Local control pushbuttons to OPEN and CLOSE circuit breaker shall be provided. Color coded visual indication of contact position (OPEN or CLOSED) shall be provided on the face of the circuit breaker. Local manual charging following CLOSE operation shall be provided. Color coded visual indication of mechanism CHARGED and DISCHARGED position shall be provided on the face of the circuit breaker. Visual indicator shall indicate CHARGED only when closing springs are completely charged.
- O. Each circuit breaker shall be electrically operated to permit remote CHARGE, CLOSE, and OPEN capabilities. Electrically operated circuit breaker shall be equipped with charge contact switch for remote indication of mechanism charge status.

- P. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. [Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection]. All current values shall be displayed in True RMS with 2% accuracy.
- Q. All circuit breakers shall be equipped with electrical accessories as noted on Drawings.
- R. Provide the following interlocking capabilities:
  - 1. cell door interlock
  - 2. key interlock for main-tie-main
  - 3. lock off
- S. Circuit breaker trip system shall be equipped with an externally accessible test port. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.
- T. Equipment Ground Fault Protection shall be provided where noted on Drawings.
  - 1. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
  - 2. A separate neutral current transformer shall be provided for three-phase, four-wire systems.
  - 3. Ground fault sensing system shall be residual sensing type.
  - 4. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
  - 5. A means of testing the ground fault system to meet the on-site testing requirements of CEC/NEC 230-95(c) shall be provided.
  - 6. Local visual trip indication for a ground fault trip occurrence shall be provided.
  - 7. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

## 2.04 DRAWOUT INSULATED CASE CIRCUIT BREAKERS

- A. Main circuit breaker shall meet the same requirements of insulated case circuit breakers and be individually drawout mounted where shown on Drawings.
- B. Sturdy drawout rails shall be permanently attached to the sides of the breaker compartment and retract into the compartment when not in use.



- C. When fully withdrawn, the circuit breaker shall permit access for inspection and testing. Circuit breaker(s) shall also be removable from the rails completely.
- D. When the circuit breaker is in the Connected, Test, or Disconnected positions, or when the circuit breaker is removed from the compartment, the compartment door shall be able to be fully closed and secured.
- E. A removable crank shall be supplied for racking the circuit breaker between the Connected, Test, or Disconnected positions.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Notify Engineer no later than 10 working days for adjustable circuit breaker settings not shown within Drawings. Submit to Engineer the following information:
  - 1. Panel, switchboard name/ID
  - 2. Circuit breaker identifier (i.e., main circuit breaker, load served, etc.)
  - 3. List of necessary settings (i.e., trip settings, time delays, etc.)

### **3.02 INSTALLATION**

- A. Install equipment and their accessories in to manufacturer's instructions, pertinent Codes, and with recognized industry practices to insure device operates properly.
- B. Tighten electrical connectors and terminals in accordance to manufacturer's requirements. Where the manufacturer does not have published torque tightening values, comply with the requirements of UL 468.

### **3.03 FIELD QUALITY CONTROL**

- A. Check tightness of circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.
- B. Obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests for
  - 1. Check each circuit breaker above 100A on a 225A frame for long-time and short-time delay pickup and instantaneous pickup.
    - a. Instantaneous pickup current shall be determined by 4 cycles or less.
    - b. Perform timing test with 300% of breaker trip unit rated current.
    - c. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.

2. Test and calibrate ground fault protection trip and pickup time on 225A frame breakers and larger.
- C. Physically test key interlock systems to check for proper functionality.
- D. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

#### 3.04 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Adjust circuit breaker trip and time delay settings to values indicated as instructed by Engineer.
  1. Check each circuit breaker above 100A, long-time and short-time delay pickup and instantaneous pickup. Instantaneous pickup current shall be determined by 4 cycles or less. Perform timing test with 300% of breaker trip unit rated current. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.
  2. Main circuit breaker ground fault setting shall be per CEC/NEC 230-95(a) or as directed by Engineer.

#### 3.05 PROTECTION

- A. When directed by Engineer provide physical means to "permanently fix" settings for rotary and DIP type switches with a thin coat of clear lacquer.

#### 3.06 CLEANING

- A. Remove marks, dirt and debris from installed equipment surfaces for "new like" appearance.

**END OF SECTION**

## SECTION 26 28 16

### SAFETY SWITCHES AND INDIVIDUAL MOUNTED CIRCUIT BREAKERS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to heavy duty fusible, non-fusible and double throw safety switches.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
  - b. 26 28 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  1. CCR –California Code of Regulations, Title 24
    - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  2. NEMA –National Electrical Manufacturer’s Association
    - a. KS 1; Enclosed Switches
    - b. 250; Enclosures for Electrical Equipment
  3. UL -Underwriters Laboratories, Inc.

- a. 98; Enclosed and Dead Front Switches
- b. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures

### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

## **PART 2 - PRODUCTS**

### 2.01 MANUFACTURERS

- A. Square D, Cutler Hammer or approved equal.

### 2.02 MATERIALS

- A. Heavy-duty safety switches

#### 1. Switch interior

- a. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
- b. Lugs shall be front removable and UL Listed for 75°C conductors, aluminum or copper.
- c. 30A through 100A switches shall be equipped with factory or field installed fuse pullers.
- d. Switches required for Type 12, 12K or Type 4-4X-5 stainless steel applications shall have all copper current carrying parts.
- e. All current carrying parts shall be plated to resist corrosion.
- f. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

- g. Switches shall have provisions for a field installable electrical interlock.
2. Switch mechanism
- a. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
  - b. The operating handle shall be an integral part of the box, not the cover.
  - c. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
  - d. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle.
  - e. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
3. Switch enclosures
- a. All enclosures shall be NEMA 1 general purpose unless otherwise noted.
  - b. Switch covers shall be attached:
    - 1) with welded pin-type hinges (Type 1, 12, 12K, 4-4X-5 stainless steel).
    - 2) top hinged, attached with removable screws and securable in the open position (Type 3R).
    - 3) by molded hinges and type 316 stainless steel hinge pins (Type 4X polyester).
    - 4) by type 316 stainless steel bolts (Type 7/9).
  - c. The enclosure shall be finished with:
    - 1) gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1).
    - 2) gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel (Type 3R, 12, 12K).
    - 3) a brush finish on type 304 stainless steel (Type 4-4X-5 stainless steel).
    - 4) Gray baked enamel on copper free cast aluminum alloy (Type 7/9).

- d. The enclosure shall have ON and OFF markings:
  - 1) stamped into the cover (Type 1, 3R, 4-4X-5 stainless steel, 12, 12K).
  - 2) cast into the cover (Type 7/9).
  - 3) inked on a adhesive label (Type 4X polyester).
- e. The operating handle shall be provided with a dual colored, red/black position indication.
- f. All switches shall have provisions to accept up to three 3/8” hasp padlocks to lock the operating handle in the OFF position.

4. Switch ratings

- a. Switches shall be horsepower rated for ac and/or dc as indicated on Drawings.
- b. The UL Listed short circuit current rating of the switches shall be:
  - 1) 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600A).
  - 2) 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600A switches employing appropriate fuse rejection schemes).
  - 3) 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200A)

B. Double throw switches

- 1. Shall have the same characteristics as heavy-duty safety switches above for switch interior, mechanism, enclosure and rating.
- 2. Additional switch operating mechanism characteristics shall be:
  - a. quick-make, quick-break for 60A through 200A, 2 pole and 3 pole devices.
  - b. Slow-make, slow-break for
    - 1) 30A and greater than 200A, 2 pole and 3 pole devices.
    - 2) 60A through 200A, 4 pole devices.

C. Individual Mounted Circuit Breakers

- 1. Circuit Breaker
  - a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 28 11 – Overcurrent Protection Devices.

2. Enclosure

- a. Enclosure shall be galvanized steel constructed in accordance with UL 50 requirements, and be NEMA 1, unless specifically shown or specified otherwise.

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. The equipment shall be installed per the manufacturer's recommendations.
- B. Anchor safety switches to structural members and as shown on Drawings. Provide additional support as required.
- C. Mount safety switches level and plumb.

3.02 FIELD QUALITY CONTROL

- A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.
- B. Check tightness of bolted connections per manufacturer's written specifications.

**END OF SECTION**

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## SECTION 26 50 00

### LIGHTING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to fixtures, lamps, standards, bases, hangers, supports, reflectors, glassware, lenses, auxiliary equipment, ballasts and sockets.

###### B. Related work under this section

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI -American National Standards Institute
  - a. C78; American National Standard for Electric Lamps
  - b. C81; American National Standard for Electric Lampholders
  - c. C82; American National Standard for Lamp Ballasts
  - d. C136; American National Standard for Roadway and Area Lighting Equipment
2. California Codes of Regulations
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  - b. Part 6 -California Energy Code
3. IESNA –Illuminating Engineering Society of North America
  - a. RP-16; Nomenclature and Definitions for Illuminating Engineering
4. NECA –National Electrical Contractors Association
  - a. NECA/IESNA 500, Recommended Practice for Installing Indoor Commercial Lighting Systems
  - b. NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems
  - c. NECA/IESNA 502, Recommended Practice for Installing Industrial Lighting Systems

5. UL -Underwriter's Laboratories, Inc.
  - a. 935; Standard for Fluorescent-Lamp Ballasts
  - b. 1029; Standard for High-Intensity-Discharge Lamp Ballasts
  - c. 1574; Standard for Track Lighting Systems

#### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Substituted fixtures shall be submitted with manufacturer's specification sheet and published photometric reports, verified by testing to IES and NEMA standards under controlled laboratory conditions.

#### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to the following standards:
  1. NECA/IESNA 500, Recommended Practice for Installing Indoor Commercial Lighting Systems
  2. NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems
  3. NECA/IESNA 502, Recommended Practice for Installing Industrial Lighting Systems

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

#### 1.06 WARRANTY

- A. Furnish one-year guarantee in accordance with and in form required under Section 26 05 00.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

- A. Fixtures shall be of the types, wattages and voltages shown on Drawings.
- B. Fixtures shall be UL listed as an entire assembly and for the installed location.
- C. Fixtures' mounting trim shall be compatible with ceiling material, coordinate with Architect Drawings for each location. Fixtures delivered which are not compatible shall be returned and replaced at Contractor's expense.

- D. Luminaire recessed in fire rated ceiling shall conform to UL Standards, equipped with yoke where in tee ceiling and field fabricated fire protection box in accordance with latest UL Fire Resistance Directory.
- E. Fluorescent luminaire lenses shall be Pattern 12 of 100% virgin acrylic with 0.125" thickness except shown or specified otherwise.
- F. Equip exposed fluorescent lamps with safety lamp holders or wire guard.
- G. Deliver fixtures and other lighting equipment complete with suspension accessories, canopies, castings, sockets, holders, reflectors, ballasts, diffusing material, louvers, frames, and recessing boxes all wired and assembled.
- H. Hangers: Swivel-type to allow for free movement of 45 degrees from vertical at canopy and at luminaire housing. Steel tube hangers shall include a 1/16-inch diameter galvanized wire cord or equivalent (100-pound break strength) in stem assembly attached to luminaire housing and building structure. Attach loop with C-type tool applied compression splice.
- I. All metal halide lamp luminaires shall be the enclosed type with diffuser or lens to withstand an arc tube rupture.
- J. Louvers for fluorescent luminaires which are removable for re-lamping but not hinged shall be securely fastened near each end between the fixture housing and louvers using No. 16 jack chain.

## 2.02 BALLASTS

- A. Ballast(s) in luminaire recessed in fire rated ceiling shall be approved for such use.
- B. Ballast installed indoors shall be of encapsulated type for noise control.
- C. Use appropriate rated ballast in high or low temperature applications.
- D. Compact fluorescent and fluorescent lamp ballasts
  - 1. Ballasts shall be programmed rapid start.
  - 2. Ballasts shall be UL 935 listed, Class P, Type 1 Outdoor, CSA Certified where applicable.
  - 3. The ballast shall meet or exceed ANSI C82.11, where applicable.
  - 4. The ballast shall withstand transients specified within ANSI C62.41 Cat. A.
  - 5. THD (Total Harmonic Distortion) shall be less than 10%.
  - 6. Ballast power factor shall be greater than 98%.
  - 7. The ballast shall have an audible noise rating of Class A or better.
- E. High intensity discharge (HID) lamp ballasts
  - 1. Ballasts shall be premium constant wattage (regulator stabilized) type, designed in accordance with all applicable ANSI specifications including ANSI C82.4 and UL 1029.
  - 2. Power factor shall be greater than 90%.
  - 3. Provide protective fusing with HID ballasts or HID fixtures.
- F. Lamps
  - 1. Provide lamps in all lighting fixtures shown.

2. Type as noted on the plans, T8 unless noted otherwise.
3. Approved manufacturers are General Electric, Osram Sylvania or equal.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Locate all lighting fixtures by reference to Drawings, both electrical and architectural.
- B. Report proposed changes for luminaire locations found necessary due to interference with structure, pipes, ducts, and other items to Owner's representative for direction before installation. Luminaires specified with overall lengths are subject to change. Adjust as directed by Owner's representative.
- C. Contractor shall be responsible to coordinate with ceiling installation trade. This will assure that proper fixture type will be furnished to match ceiling system specified.

### **3.02 INSTALLATION**

- A. Luminaires shall be properly grounded per CEC Article 410, Parts 17 through 21.
- B. Luminaires recessed in fire rated ceilings shall be in accordance with UL Fire Resistance Directory.
- C. Install all luminaires true and plumb. Support and mount in accordance manufacturer's instructions and with CEC Article 410, Parts 16 and 76.
- D. Install recessed luminaires with separate junction box, flexible conduit, and heat-resisting wire as required by CEC. Set junction box in furred space facing luminaire for maximum accessibility. Furnish and install metal ceiling frame so luminaire can be removed without damaging finish.
- E. Suspended ceiling mounting
  1. Attach all light fixtures to ceiling grid runners to resist a horizontal force equal to the weight of the fixtures. Use a #10 Tek-screw or approved fastener.
  2. Flush or recessed light fixtures weighing less than 56lbs. May be supported directly on runners of a heavy duty grid system, but in addition, they must have a minimum of (2) 12ga slack safety wires attached to the fixtures at diagonal corners and anchored to the structure above in the same fashion as the grid system. All 4'x4' light fixtures must have slack safety wires at each corner.
  3. All flush or recessed light fixtures 56lbs. Or greater must be independently supported by not less than (4) taut 12ga wires each attached to the fixture and the structure above regardless of the grid system used. The 4 taut 12ga wires including their attachment to the structure above must be capable of supporting 4 times the fixture weight.
  4. All light fixtures supported on intermediate grid system must be independently supported by not less than (4) taut 12ga wires each attached to the fixture and the structure above.
  5. Support surface mounted light fixtures by at least 2 positive devices which surround the ceiling runner and which are each supported from the structure above by a 12ga wire.

Spring clips or clamps that connect only to the runner are not acceptable. Provide additional supports for 8' or longer fixtures.

6. Support pendant mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger & capable of supporting 4 times the fixture weight.

### 3.03 ADJUSTING

- A. Particular care shall be used to eliminate light leaks around edge of recessed fixture trims.

### 3.04 CLEANING

- A. Clean all glass and plastic and polish all visible metal parts before submitting job to Owner's representative for final acceptance. Remove all fingerprints and dirt from exposed surfaces. Replace scratched or damaged components.

**END OF SECTION**

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## SECTION 27 05 26

### GROUNDING AND BONDING FOR COMMUNICATIONS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

- a. Provide all labor, materials and equipment necessary to complete the installation required for the item specified under this Section, including but not limited to telecommunication system grounding.

###### B. Related sections

1. Where items specified in other Division 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 27 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. IEEE –Institute of Electrical and Electronic Engineers
  - a. 1100; Recommended Practices Powering and Grounding Electronic Equipment
3. NFPA –National Fire Protection Association
  - a. 780; Lightning Protection Code
4. TIA/EIA – Telecommunications Industry Association/Electronic Industries Alliance
  - a. 607; Commercial Building Grounding and Bonding Requirements for Telecommunications

5. UL -Underwriters Laboratories, Inc.
  - a. 467; Grounding and Bonding Equipment

### 1.03 SYSTEM DESCRIPTION

- A. This Section provides for the grounding and bonding of all electrical and communication apparatus, appliances, components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.
- B. Except as otherwise indicated, the complete electrical installation including equipment and metallic raceways, boxes and cabinets shall be completely and effectively grounded in accordance with all Code requirements, whether or not such connections are specifically shown or specified.
- C. Provide telecommunication system ground bus bars with each building main telecommunications equipment room or cabinet/rack location. Provide connection between the bus bar and main building reference ground bus, the ground bus of the panelboard serving power to telecommunication equipment, and all telecommunication conduit, cable trays, cable ladders and boxes.

### 1.04 SUBMITTALS

- A. Submit manufacturer's data for equipment and materials specified within this Section in accordance to Section 26 05 00.

### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

## **PART 2 - PRODUCTS**

### 2.01 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron body with 150°C molded plastic insulated throat and lay-in ground lug; OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

### 2.02 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPICES

- A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds, Cadweld or equal, or high pressure compression type connectors, Cadweld, Thomas & Betts or equal.

### 2.03 BONDING JUMPERS

- A. OZ/Gedney Type BJ, Thomas & Betts #3840 series or equal.

### 2.04 GROUND CONDUCTOR



- A. Ground conductor shall be #6 AWG UL labeled, Type THWN insulated copper wire, green in color.

## 2.05 TELECOMMUNICATION MAIN GROUNDING BUS BAR (TMGB)

- A. Provide grounding bus bar at telecommunication backboards, racks and cabinets of the following type:
  - 1. Backboards 4'X8' and greater, floor mounted telecommunication equipment racks/cabinets larger than 60" height or wall mounted cabinets greater than 36"Wx36"H
    - a. Provide 1 13.5"x2"x1/4" TK copper bus bar mounted on wall with insulating stand-offs at +96" AFF. Furnish complete with cast copper alloy body Thomas Betts Series 310 or equal lugs for connecting grounding conductors. Attach lugs to bus with appropriate size bronze bolt, flat washer and Belleville washer. All connections shall be torque, and all holes shall be drilled and tapped for single hole lugs. Provide 4 spare lugs with respective spaces.
  - 2. Backboards less than 4'X8', floor/wall mounted telecommunication equipment racks/cabinet less than 60" or wall mounted cabinets less than 36"Wx36"H
    - a. Provide an aluminum loadcenter ground kit with 14 terminals minimum, General Electric TGL2 or equal. A minimum of 3 terminals shall accommodate #6 AWG. Mount within enclosure or on backboard at +96" AFF.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Telecommunication system grounding
  - 1. Bond all telecommunication conduit, cable tray, ladder rack, equipment racks and all other metallic telecommunication infrastructure components to the nearest TMGB using a #6 AWG conductor.
  - 2. Provide #6 AWG ground within 3/4" conduit from each secondary backboard, cabinet, rack, etc. to the BGB.
  - 3. Install #6 AWG grounding conductor in nonmetallic underground raceways containing only fiber optic cable.
  - 4. Provide an engraved nameplate mechanically fastened to wall or enclosure adjacent to each TMGB. Nameplate shall be blue with 1/4" high white lettering to read "TMGB-(name of enclosure or building)".

### 3.02 FIELD QUALITY CONTROL

- A. Contractor using test equipment expressly designed for that purpose shall perform all ground resistance tests in conformance with IEEE Standard 1100. Contractor shall submit

- typewritten records of measured resistance values to Engineer for review and approval prior to energizing the system.
- B. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with the following resistance limits:
    - 1. Resistance from ground bus to ground electrode and to earth shall not exceed 5 ohms unless otherwise noted.
    - 2. Resistance from the farthest panelboard, loadcenter, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed 20 ohms maximum.
  - C. Obtain and record ground resistance measurements (DC, 60Hz, 10MHz, 20MHz, 33 MHz, 66MHz and 100MHz) both from each TMGB to the ground electrode and from the ground electrode to earth.
  - D. Inspection
    - 1. The Engineer or Inspector prior to encasement, burial or concealment thereto shall review the grounding electrode and connections.

**END OF SECTION**

## SECTION 27 05 28

### PATHWAYS FOR COMMUNICATION SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to electrical conduits; outlet, junction and pull boxes; and related supports.

###### B. Related sections

1. Where items specified in other Division 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 27 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 27 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI –American National Standards Institute
  - a. C33.91; Specification for Rigid PVC Conduit
  - b. C80.1; Specification Rigid Steel Conduit, Zinc-Coated
  - c. C80.3; Specification for Electrical Metallic Tubing, Zinc-Coated
  - d. C80.6; Intermediate Metal Conduit (IMC), Zinc-Coated
2. CCR –California Code of Regulations, Title 24
  - a. Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments

- b. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
- 3. NECA –National Electrical Contractors Association
  - a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT)
  - b. 111, Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)
- 4. NEMA –National Electrical Manufacturer’s Association
  - a. FB 1; Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  - b. FB 2.10; Selection and Installation Guidelines for Fittings for Use with Non-flexible Electrical Metal Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)
  - c. FB 2.20; Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable
  - d. OS 1; Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
  - e. OS 3; Selection and Installation Guidelines for Electrical Outlet Boxes
  - f. RN 1; Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
  - g. TC 2; Electrical Plastic Tubing and Conduit
  - h. TC 3; PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - i. TC 14; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
- 5. OSHPD Anchorage Pre-approvals
  - a. OPA-0003; Superstrut Seismic Restraint System
  - b. OPA-0114; B-Line Seismic Restraints
  - c. OPA-0120; Unistrut Seismic Bracing System
  - d. OPA-0242; Power-Strut Seismic Bracing System
- 6. UL –Underwriter’s Laboratories, Inc.
  - a. 1; Standard for Flexible Metal Conduit
  - b. 6; Rigid Metal Electrical Conduit
  - c. 360; Standard for Liquid-Tight Flexible Steel Conduit

- d. 514A; Metallic Outlet Boxes, Electrical
- e. 514B; Fittings for Conduit and Outlet Boxes
- f. 651; Schedule 40 & 80 PVC Conduit
- g. 797; Electrical Metallic Tubing
- h. 1242; Intermediate Metal Conduit
- i. 1684; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

### 1.03 SYSTEM DESCRIPTION

- A. Furnish, assemble, erect, install, connect and test all electrical conduits and related raceway apparatus required and specified to form a complete installation.

### 1.04 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to the NECA installation guidelines unless otherwise indicated within this Section

## **PART 2 - PRODUCTS**

### 2.01 MATERIALS

#### A. Conduits and Fittings

##### 1. Rigid steel conduit (RMC)

- a. Conduit: Standard weight, mild steel pipe, and zinc coated on both inside and outside by a hot dipping or shearardizing process manufactured in accordance with UL 6 and ANSI C80.1 specifications.
- b. Fittings (couplings, elbows, bends, etc.)
  - 1) Shall be steel or malleable iron.
  - 2) Coupling and unions shall be threaded type, assembled with anti-corrosion, conductive and anti-seize compound at joints made absolutely tight to exclude water.

- c. Bushings
  - 1) Insulating bushings: Threaded polypropylene or thermosetting phenolic rated at 150°C minimum.
  - 2) Insulating grounding bushing: Threaded cast body with insulating throat and steel “lay-in” ground lug.
  - 3) Insulating metallic bushing: Threaded cast body with plastic insulated throat rated at 150°C minimum.
- 2. Coated rigid steel conduit (CRMC)
  - a. Conduit: Equivalent to RMC with a Polyvinyl chloride (PVC) coated bonded to the galvanized outer surface of the conduit. The bonding between the PVC coating and conduit surface shall be ETL PVC-001 compliant. The coating thickness shall be a minimum of 40mil.
  - b. Fittings (couplings, elbows, bends, etc.)
    - 1) Equivalent to RMC above with bonded coating same as conduit.
    - 2) The PVC sleeve over fittings shall extend beyond hub or coupling approximately one diameter or 1 1/2” whichever is smaller.
  - c. Bushing equivalent to RMC above.
- 3. Intermediate metallic conduit(IMC)
  - a. Conduit: Intermediate weight, mild steel pipe, meeting the same requirements for finish and material as rigid steel conduit manufactured in accordance with UL 1242 and ANSI C80.6 specifications.
  - b. Fittings (couplings, elbows, bends, etc.) equivalent to RMC above.
  - c. Bushing equivalent to RMC above.
- 4. Electrical metallic tubing (EMT)
  - a. Conduit: Cold rolled steel tubing with zinc coating on outside and protective enamel on inside manufactured in accordance with UL 797 and ANSI C80.3 specifications.
  - b. Couplings: Steel or malleable iron with compression type fastener via a nut.
  - c. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
- 5. Rigid non-metallic conduit (PVC)
  - a. Conduit: PVC composed Schedule 40, 90°C manufactured in accordance with NEMA TC 2 and UL 651 specifications.

- b. Fittings: Molded PVC, slip on solvent welded type in accordance to NEMA TC 3.
6. Reinforced thermosetting resin conduit (RTRC)
- a. Conduit: Fiber impregnated with a cured thermosetting resin compound in accordance with NEMA TC 14 and UL1684.
  - b. Fittings: Molded resin with glass reinforcement manufactured in the same process as the conduit bonded with an epoxy adhesive.
7. Flexible metallic conduit (FMC)
- a. Conduit: Continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 1.
  - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
8. Liquidtight flexible metallic conduit (LFMC)
- a. Conduit: PVC coated, continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 360.
  - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
9. Miscellaneous Fittings and Products
- a. Conduit sealing bushings: Steel or cast malleable iron body and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Supplied with neoprene sealing rings between body and PVC sleeve.
  - b. Watertight cable terminators: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel screws and zinc plated cast iron locking collar.
  - c. Watertight cable/cord connectors: Liquidtight steel or cast malleable iron body with sealing neoprene bushing and stainless steel retaining ring.
  - d. Expansion fittings: Multi-piece unit of hot dip galvanized malleable iron or steel body and outside pressure bussing design to allow a maximum of 4" movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. UL listed for both wet and dry locations.
  - e. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve, internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling to provide minimum of 3/4" movement and 30 degrees deflection from normal. UL listed for both wet and dry locations.
  - f. Conduit bodies: Raintight, malleable iron, hot-dip galvanized body with threaded hubs, stamped steel cover, stainless steel screws and neoprene gasket.

- g. Other couplings, connectors and fittings shall be equal in quality, material and construction to items specified herein.

## B. Boxes

### 1. Outlet boxes

- a. Standard: Galvanized one-piece of welded pressed steel type in accordance with NEMA OS 1 and UL 514. Boxes shall not be less than 4" square and at least 1 1/2" deep.
- b. Concrete: Galvanized steel, 4" octagon ring with mounting lug, backplate and adapter ring type in accordance with NEMA OS 1 and UL 514. Depth as required by application.
- c. Masonry: Galvanized steel, 3.75" high gang box in accordance with NEMA OS 1 and UL 514.
- d. Surface cast metal: Cast malleable iron body, surface mounted box with threaded hubs and mounting lugs as required in accordance with NEMA OS 1 and UL 514. Furnish with ground flange, steel cover and neoprene gasket.

### 2. Pull and junction boxes

- a. Sheet metal boxes: Standard or concrete outlet box wherever possible; otherwise use 16 gauge galvanized sheet metal, NEMA 1 box sized per CEC with machine screwed cover.
- b. Cast metal boxes: Install standard cast malleable iron outlet or device box when possible.
- c. Flush mounted boxes: Install overlapping cover with flush head screws.
- d. In-ground mounted pull holes/boxes: Install pre-cast concrete box, sized per Drawing or CEC with pre-cast or traffic rated lid.

### 3. Floor boxes

- a. Floor boxes shall be adjustable, cast metal body with threaded conduit openings, adjustable rings, brass flange or Lexan ring and cover plate with threaded plug. Include provisions to accommodate surface mounted telephone or receptacle outlet, or flush floor mounted telephone or receptacle outlet where shown on Drawings.

## C. Pull line/cord

- 1. Polypropylene braided line or Let-line #232 or equal of 1/8" diameter with a minimum break strength of 200 pounds.

## PART 3 - EXECUTION



### 3.01 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

### 3.02 PREPARATION

#### A. Conduit

1. Provide all necessary conduit fittings, connectors, bushings, etc. required to complete conduit installation to meet the CEC/NEC and intended application whether noted, shown or specified within.
2. Location of conduit runs shall be planned in advance of the installation and coordinated with other trades.
3. Where practical, install conduits in groups in parallel vertical or horizontal runs that avoid unnecessary offsets.
4. All conduits shall be parallel or at right angles to columns, beams and walls whether exposed or concealed.
5. Conduits shall not be placed closer than 12" to a flue, parallel to hot water, steam line or other heat sources; or 3" when crossing perpendicular to the above said lines when possible.
6. Install exposed conduit as high as practical to maintain adequate headroom. Notify Engineer if headroom will be less than 102".
7. Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.
8. The largest trade size conduit in concrete floors and walls shall not exceed 1/3 thickness or be spaced a less than three conduit diameters apart unless permitted by Engineer. All conduits shall be installed in the center of slab or wall, and never between reinforcing steel and bottom of floor slab.
9. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
10. When installing underground conduits to specified depth; depth shall be taken from finished grade as it will be at project completion. Should finish grade be above existing grade by an amount equal to or greater than specified depth, conduit shall be installed not less than 6" below existing grade.
11. Verify that information concerning finish grade is accurate, for should the underground run be less than the specified depth, Contractor may be required to re-install conduit to meet the required depth.

12. Unless otherwise specified, underground conduits shall be installed with top side not less than 24" below finished grade; this depth applies to all conduits outside of building foundations including those under walks, open corridors or paved areas.
13. Utility company service conduits installation depth shall be as directed by their respective specifications and requirements.

#### B. Boxes

1. Before locating outlet boxes, check Construction Documents for type of construction and make sure that there is no conflict with other equipment. Locate outlet boxes as shown and locate so as not to interfere with other Work or equipment.
2. Install all outlet boxes flush within walls, ceiling and floors except where installed within non-finished rooms, cabinetry, attic spaces or as indicated on Drawings.
3. Locate pull boxes and junction boxes within concealed, accessible locations where possible.
4. Do not install outlet boxes back-to-back with same stud space. Where shown back-to-back, offset as required, and fill void with sound dampening material where requested by Owner.
5. In fire rated walls separate boxes by 24" minimum and with stud member.
6. Adjust position of outlet boxes within masonry wall to accommodate course lines.

### 3.03 INSTALLATION

#### A. Conduit

1. Minimum conduit size shall be 3/4" unless otherwise indicated.
2. All conduit work shall be concealed unless otherwise indicated. Exposed conduits shall be permitted within unfinished rooms/spaces to facilitate installation.
3. Install conduit in complete runs prior to installing conductors or cables.
4. Make long radius conduits bends free from kink, indentations or flattened surfaces. Make bends carefully to avoid injury or flattening. Bends 1 1/4" size and larger shall be factory made ells, or be made with a manufactured mechanical bender. Heating of steel conduit to facilitate bending or that damage galvanized coating will not be permitted.
5. Remove burrs and sharp edges at end of conduit with tapered reamer.
6. Protect and cover conduits during construction with metallic bushings and bushing "pennies" to seal exposed openings.
7. Assemble conduit threads with anti-corrosion, conductive, anti-seize compound and tighten securely.
8. Install conduits shall that no traps to collect condensation exist.

9. Fasten conduit securely to boxes with locknuts and bushings to provide good grounding continuity.
10. Install pull cords/line within any spare or unused conduits of sufficient length to facilitate future cable installation.
11. Penetrations
  - a. Locate penetrations within structural members as shown on Drawings and as directed by Architect or Engineer. Should it be necessary to notch any framing member, make such notching only at locations and in a manner as approved by Engineer.
  - b. Do not chase concrete or masonry to install conduit unless specifically approved by Engineer.
  - c. Cutting or holes
    - 1) Install sleeves for cast-in-place concrete floors and walls. After installing conduit through penetration, seal using dry-pack grouting compound (non-iron bearing, chloride free and non-shrinking) or fire rated assembly if rated floor or wall. Use escutcheon plate on floor underside to contain compound as necessary.
    - 2) Cut holes with a hole saw for penetrations through non-concrete or non-masonry members.
    - 3) Provide chrome plated escutcheon plates at all publicly exposed wall, ceiling and floor penetrations.
  - d. Sealing
    - 1) Non-rated penetration openings shall be packed with non-flammable insulating material and sealed with gypsum wallboard taping compound.
    - 2) Fire rated penetration shall be sealed using a UL classified fire stop assembly suitable to maintain the equivalent fire rating prior to the penetration.
    - 3) Use escutcheon plates to hold sealing or fire rated compound as necessary.
  - e. Waterproofing
    - 1) Make penetrations through any damp-proofed/waterproofed surfaces within damp/wet locations as such as to maintain integrity of surface.
    - 2) Install specified watertight conduit entrance seals at all below grade wall and floor penetrations.
    - 3) At roof penetrations furnish roof flashing, counter flashing and pitch-pockets compatible to roof assembly.
    - 4) Where possible conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration's exterior side.

- 5) Make penetrations through floors watertight with mastic, even when concealed within walls or furred spaces.

## 12. Supports

- a. Conduits shall be support and braced per OSHPD pre-approved anchorage systems when those methods are implemented and installed.
- b. Sizes of rods and cross channels shall be capable of supporting 4 times and 5 times actual load, respectively. Anchorage shall support the combined weight of conduit, hanger and conductors.
- c. Support individual horizontal conduit 1 1/2" and smaller by means of 2 hole straps or individual hangers.
- d. Galvanized iron hanger rods sizes 1/4" diameter and larger with spring steel fasteners, clips or clamps specifically design for that purpose for 1 1/2" conduits and larger.
- e. Support multi-parallel horizontal conduits runs with trapeze type hangers consisting of 2 or more steel hanger rods, preformed cross channels, 'J' bolts, clamps, etc.
- f. Support conduit to wood structures by means of bolts or lag screws in shear, to concrete by means of insert or expansion bolts and to brickwork by means of expansion bolts.
- g. Support multi-parallel vertical conduits runs with galvanized Unistrut, Power-Strut or approved equal type supports anchored to wall. Where multi-floored conduits pass through floors, install riser clamps at each floor.
- h. Maximum conduit support spacing shall be in accordance with NECA Standard of Installation:
  - 1) Horizontal runs:
    - a) 3/4" and smaller at 60" on centers, unless building construction prohibits otherwise, then 84" on centers.
    - b) 1" and larger at 72" on centers, unless building construction prohibits otherwise or any other condition, then 120" on centers.
  - 2) Vertical runs:
    - a) 3/4" and smaller @ 84" on centers.
    - b) 1" and 1 1/4" @ 96" on centers.
    - c) 1 1/2" and larger @ 120" on centers.
    - d) Any vertical condition such as shaftways and concealed locations for any sized conduit, 120" on centers.

i. Anchorage for RMC/IMC supports unless otherwise specified:

- 1) < 1" IMC/RMC = #10 bolt/screw.
- 2) 1" IMC/RMC = 1/4" bolt/screw.
- 3) 1 1/2" and 2" IMC/RMC = 3/8" bolt/screw.
- 4) 3" IMC/RMC, 4" EMT = 1/2" bolt/screw.
- 5) > 3" IMC/RMC = 5/8" bolt/screw.

j. Anchorage for EMT supports unless otherwise specified:

- 1) < 1 1/2" EMT = #10 bolt/screw.
- 2) 1 1/2" EMT = 1/4" bolt/screw.
- 3) 2, 2 1/2" and 3" EMT = 3/8" bolt/screw.
- 4) 4" EMT = 1/2" bolt/screw.
- 5) > 4" EMT = 5/8" bolt/screw.

B. Boxes

1. Install boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
2. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
3. Install plaster rings on all outlet boxes in stud walls or in furred, suspended or exposed ceilings. Covers shall be of a depth suited for installation.
4. Provide gasketed cast metal cover plates where boxes are exposed in damp or wet locations
5. Install access door for boxes installed within concealed locations without access.
6. Install approved factory made knockout seal where knockouts are not present.
7. Refer to Architectural interior elevations and details shown for exact mounting heights of all electrical outlets. In general, locate outlets as shown or specific and complies with Americans with Disabilities Act:
  - a. Convenience outlets: +18" AFF or +6" above counter or splash.
  - b. Local switches: +48" AFF or +6" above counter or splash.

- c. Telecommunication outlets: +18”AFF or +48”AFF for wall telephone or intercom device.
  - d. Verify all mounting heights with Architectural Drawings, and where heights are not suited for construction or finish please consult Engineer or Architect.
8. Use conduit bodies to facilitate pulling of conductor or cables or change conduit direction. Do not splice within conduit bodies.
  9. Enclose pull box with additional rated gypsum board as necessary to maintain wall’s original fire rating.
  10. Install galvanized steel coverplates on all open boxes within dry listed areas.
  11. Install in-ground pull holes/boxes flush to grade finish at finished areas or 1” above finished landscaped grade. Seal all conduits terminating in pull hole/box watertight. Install and grout around bell ends where shown. Cover and lids shall be removable without damage to adjacent finish surfaces.
  12. Support
    - a. Accurately place boxes for finish, independently and securely supported by adequate blocking or manufacturer channel type heavy-duty box hangers for stud walls. Do not use nails to support boxes.
    - b. Support boxes independent of conduit system.
    - c. Mount boxes installed within ceilings to 16 gauge metal channel bars attached to main runners or joists.
    - d. Support boxes within suspended acoustical tile ceilings directly from structure above when light fixture are to be installed from box.
    - e. Use auxiliary plates, bar or clips and grouted in place for masonry, block or pour-in-place concrete construction.

### 3.04 APPLICATION

#### A. Conduit

1. RMC/IMC suitable for all damp, dry and wet locations except when in contact with earth. IMC not suitable for hazardous locations as stated within CEC/NEC.
2. CRMC suitable for damp or wet locations, concealed within concrete or in contact with earth.
3. EMT suitable for exposed or concealed dry, interior locations.
4. PVC/RTRC suitable for beneath ground floor slab, except when penetrating, and direct earth burial. Do not run exposed within concrete walls or in floor slab unless indicated on Drawings or per Engineer’s permission.

5. FMC suitable for dry locations only for connections to motors, transformers, vibrating equipment/machinery, controllers, valves, switches and light fixtures in less than 6 foot lengths.
  6. LFMC application same as FMC above but for damp or wet locations.
- B. Termination and joints
1. Use raceway fittings compatible with associated raceway and suitable for the location.
  2. Raceways shall be joined using specified couplings or transitions where dissimilar raceway systems are joined.
  3. Conduits shall be securely fastened to cabinets, boxes and gutters using (2) two locknuts and insulating bushing or specified insulated connector. Where joints cannot be made tight and terminations are subject to vibration, use bonding jumpers, bonding bushings or wedges to provide electrical continuity of the raceway system. Use insulating bushings to protect conductors where subjected to vibration or dampness. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
  4. Terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
  5. Stub freestanding equipment conduits through concrete floors for connections with top of coupling set flush with finished floor. Install plugs to protect threads and entrance of debris.
  6. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating within interior switchboard, panel, cabinet or gutters. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.
  7. Where conduits enter building from below grade inject into filled raceways pre-formulated rigid 2 lbs. density polyurethane foam suitable for sealing against water, moisture, insects and rodents.
  8. Install expansion fitting or expansion/deflection couplings per manufacturer's recommendations where:
    - a. Any conduit that crosses a building structure expansion joint; secure conduit on both sides to building structure and install expansion fitting at joint.
    - b. Any conduit that crosses a concrete expansion joint; install expansion/deflection at joint.
    - c. Any conduit greater than 1-1/4" is routed along roof top in runs greater than 100 feet; install expansion fittings every 100 feet.

- d. Engineer may allow FMC or LFMC in lieu of expansion fitting or expansion/deflection couplings on conduits 2" and smaller within accessible locations upon further review and written consent.

C. Boxes

1. Standard type suitable for all flush installations and all dry concealed locations.
2. Concrete type suitable for all flush concrete installations.
3. Masonry type suitable for all flush concrete and block installations.
4. Surface cast meta type suitable for all exposed damp and wet surface mounted locations, and dry surface mounted locations less than 96" from finished floor

**END OF SECTION**



## SECTION 27 15 13

### COPPER TELECOMMUNICATIONS/DATA CABLING AND DEVICES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to copper data communication cabling systems and copper based telecommunication, which include.

###### a. Category 6 cabling

- 1) Provide scheduled station plates at each indicated location. Provide labeled Category 6 modules in the plates, and document per Specifications.
- 2) Homerun all station cabling from each universal Category 6 data jack to the indicated MDF or IDF.
- 3) Provide Category 6 patch panels where indicated. Terminate and test Category 6 cabling as detailed within the Specifications.
- 4) Terminate, test and document Category 5E cabling as detailed within the Specifications.

###### b. Category 3, RUS (REA) and USOC telephone cabling

- 1) Provide scheduled station plates at each indicated location.
- 2) Homerun all station cabling from each telephone jack to indicated cabinet/telephone backboard.
- 3) Provide punch blocks as necessary; terminate and test as detailed within the Specifications.

###### B. Related sections

1. Where items specified in other Division 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 27 05 26 – Grounding and Bonding for Communications
  - b. 27 11 16 – Data Racks and Enclosures

- c. 27 05 28 – Pathways for Communication System
- 2. The requirements of this Section apply to all Division 27 work, as applicable.
- 3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

## 1.02 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  - 1. ANSI –American National Standards Institute
    - a. ISO/IEC 11801; Information technology - Generic cabling for customer premises
  - 2. CCR –California Code of Regulations, Title 24
    - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  - 3. CFR –Code of Federal Regulations
    - a. Title 7 –Agriculture, Part 1755 – Telecommunications Standards and Specifications for Materials, Equipment and Construction
    - b. Title 47 –Telecommunication, Part 68 – Connection of Terminal Equipment to the Telephone Network.
  - 4. TIA/EIA – Telecommunications Industry Association/Electronic Industries Alliance
    - a. Wiring/Cabling Standards
      - 1) TIA/EIA-568-B.1; Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
      - 2) TIA/EIA-568-B.2; Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components
      - 3) TIA/EIA-569-A; Commercial Building Standards for Telecommunications Pathways and Spaces
      - 4) TIA/EIA-606; Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
      - 5) TIA/EIA/IS-729; Technical Specifications for 100 Ohm Screened Twisted-Pair Cabling
      - 6) TIA/EIA-758; Customer Owned Outside Plant Telecommunications Cabling Standard

- 7) TSB67; Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
  - 8) TSB95; Additional Transmission Performance Guidelines for 4-Pair 100 Category 5 Cabling
5. ICEA –Insulated Cable Engineers Association
    - a. S-56-434; Polyolefin Insulated Communications Cables for Outdoor Use
    - b. S-80-576; Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems
    - c. S-90-661; Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems
    - d. S-101-699; Standard for Category 3 Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose Non-Lan Telecommunication Wiring Systems
  6. IEEE –Institute of Electrical and Electronic Engineers
    - a. C2; National Electrical Safety Code (NEC)
    - b. 802.3; Information Technology -Local and Metropolitan Area Networks
    - c. 820; Standard Telephone Loop Performance Characteristics
  7. NECA –National Electrical Contractors Association
    - a. NECA/BICSI 568; Standard for Installing Commercial Building Telecommunications Systems
  8. UL –Underwriters Laboratories, Inc.
    - a. 444; Communications Cables
    - b. 497; Standard for Protectors for Paired-Conductor Communications Circuits
    - c. 1581; Reference Standard for Electrical Wires, Cables, and Flexible Cords
    - d. 1666; Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
    - e. 1685; Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
    - f. 1863; Standard for Communications-Circuit Accessories
  9. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA) Standards

- a. PC-2; Splicing Plastic Insulated Cables
- b. PC-4; Acceptance Tests and Measurements of Telephone Plant
- c. PE-22; Aerial and Underground Telephone Cable
- d. PE-33; Shield Bonding Connectors
- e. PE-39; Filled Telephone Cables
- f. PE-52; Telephone Cable Splicing Connectors
- g. PE-60; Trunk Carrier Systems
- h. PE-74; Filled Splice Closures
- i. PE-87; Terminating (TIP) Cable
- j. PE-89; Filled Telephone Cable with Expanded Insulation
- k. TE&CM Section 644; Design and Construction of Underground Cable

1.03 SYSTEM PERFORMANCE STANDARDS

A. Voice copper plant

- 1. To Universal Service Ordering Code (USOC) Standards (CFR Title 47, Part 68, Subpart F, Section 68.502) and other appropriate authorities.
- 2. Where voice plant cabling is specified for connection to RJ-11 or RJ-14 jacks conform to USOC and Category 3 standards as demonstrated using the appropriate test equipment.

B. Category 6 copper cabling plant:

- 1. To applicable EIA/TIA standards using a digital cable analyzer as specified herein.

1.04 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. Installer Qualifications

- 1. The work performed under this Section shall be certified by the manufacturer of the equipment and components being furnished and be authorized by the manufacturer to

install and convey the product warranty and performance guarantee to the Owner upon completion of Contract.

2. Installing Contractor must have a minimum of three years previous experience in data communications and/or telecommunication systems installation. All Contractors and/or Vendors supplying all or parts of the work described herein shall supply three project references within the Submittal package at the Engineer's request, which substantiate the Contractor/Vendors' previous experience as noted herein.

#### C. Testing Equipment

1. Furnish in conformance with the applicable requirements of this Section.
2. Test systems using at least one each of the following test measurement devices or approved functional equivalents:
  - a. Digital cable analyzer with applicable copper and/or fiber testing standards required within this Section.
  - b. Cabling plant tester capable of detecting shorts, opens, reversals and miswires.
  - c. Tone test set capable of analyzing line condition of voice lines.
  - d. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.
- B. Handle carefully to avoid damage to internal components, enclosure and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

#### 1.07 WARRANTY

- A. Furnish guarantee in accordance with and in form required under Section 26 05 00.
- B. Provide 15 year manufacturer's warranty covering application assurance, product, cable, and labor for installations performed by a certified installer using the manufacturer's connecting hardware and qualified cables.

### **PART 2 - PRODUCTS**

#### 2.01 DATA/VOICE CATEGORY-6 RATED COPPER CABLES

##### A. General

1. Exceeds EIA/TIA-568 Category 6 requirements and tested to 300Mhz.
  2. Conductors shall be no small than 24AWG solid annealed bare copper.
  3. Outdoor, underground cables must be UL listed for wet applications.
  4. Cabling construction and use shall comply with CEC Article 800.
- B. Indoor, General (Type CM/CMG/CMR/CMP)
1. Drawing Reference: UTP6-4
  2. Cables installed within vertical shafts or risers shall be Type CMR or CMP listed.
  3. Construction: Thermoplastic insulated 8 conductor (4 pair) assembly with flame retardant PVC jacket.
  4. Manufacturer: Commscope UltraMedia, Mohawk AdvanceNet, Superior Essex NetGain or approved equal.
- C. Indoor, Plenum (Type CMP)
1. Drawing Reference: UTP6-4P
  2. Construction: FEP/PE insulated 8 conductor (4 pair) assembly with low smoke PVC/FEP jacket.
  3. Manufacturer: Commscope UltraMedia, Mohawk AdvanceNet, Superior Essex NetGain or approved equal.
- D. Outdoor, Underground
1. Drawing Reference: UTP6-4OP
  2. Construction: FEP/PE insulated 8 conductor (4 pair) assembly with floodant compound and PE jacket.
  3. Manufacturer: Mohawk AdvanceNet or approved equal.
- E. Indoor, Shielded (Type CM/CMG/CMR/CMP)
1. Drawing Reference: STP6-4
  2. Construction: FEP/PE insulated 8 conductor (4 pair) with an overall tape/drain shield and flame retardant PVC or low smoke PVC/FEP jacket.
  3. Manufacturer: Mohawk AdvanceNet or approved equal.
- F. Outdoor, Underground Shielded
1. Drawing Reference: STP6-4OP

2. Construction: PE/PVC insulated 8 conductor (4 pair) with an overall tape/drain shield, floodant compound and PE/PVC jacket.
3. Manufacturer: Mohawk AdvanceNet or approved equal.

## 2.02 TELEPHONE PLANT COPPER CABLES

### A. General

1. Cables which interconnect interior distribution centers and terminate at station jacks shall conform to ICEA S-80-576, Category 1 or Category 3 standards.
2. Conductors shall be 22AWG solid annealed bare copper with minimum pair counts indicated on the plans.
3. Outdoor, underground cables must be UL listed for wet applications.
4. Cabling construction and use shall comply with CEC Article 800.

### B. Indoor, General (Type CM/CMG/CMR/CMP)

1. Drawing Reference: UTP-##, where ## refers to required pair count
2. Cables installed within vertical shafts or risers shall be Type CMR or CMP listed.
3. Construction: Thermoplastic insulated conductors situated as paired assemblies with a flame retardant PVC jacket.
4. Manufacturer: Belden, Mohawk or approved equal.

### C. Indoor, Plenum (Type CMP)

1. Drawing Reference: UTP-##P, where ## refers to required pair count
2. Construction: FEP/PE insulated conductors situated as paired assemblies with a low smoke PVC/FEP jacket
3. Manufacturer: Belden, Mohawk or approved equal.

### D. Outdoor, Underground Within Duct

1. Less than ( $\leq$ ) 4 pair trunk cables
  - a. Drawing Reference: STP-##OP, where ## refers to required pair count
  - b. Construction: Polyolefin, PE or PVC insulated conductors situated as paired assemblies with a foil shield, floodant compound and PE jacket.
  - c. Manufacturer: Belden, Westpenn Aquaseal or approved equal.

2. Greater than (>) 4 pair trunk cables
  - a. Drawing Reference: STP-##OP, where ## refers to required pair count
  - b. Construction:
    - 1) Shall be RUS (REA) PE-89 listed, and suitable for direct burial.
    - 2) PE jacket with aluminum tape shield and flooded core assembly.
    - 3) The core assembly shall consist of twisted pair cables with polyolefin insulation.
  - c. Manufacturer: General Cable, Superior Essex SEALPIC-FSF or approved equal.

## 2.03 DATA/VOICE STATION JACKS & MODULES

### A. General Jack and Module Requirements

1. Meets or exceeds the following configuration and performance standards where applicable:
  - a. EIA/TIA 568B
  - b. ISO/IEC 11801, Class E
  - c. UL1863
  - d. CEC/NEC Article 800
  - e. FCC Part 68
2. High impact, flame retardant thermoplastic.
3. Integral locking mechanism upon insertion of a modular plug.

### B. Voice jack USOC grade

1. Six (6) position, RJ25 configuration jack conforming to USOC requirements.
2. Manufacturers
  - a. Leviton, Siemon or approved equal.

### C. Voice and/or data jack, Category 3

1. Eight (8) position, RJ45 configuration jack conforming to EIA/TIA 568B and USOC requirements.
2. Manufacturers
  - a. Leviton, Siemon or approved equal.



D. Data jack Category 6

1. Eight (8) position, RJ45 configuration jack conforming to EIA/TIA 568B requirements.
2. Manufacturers
  - a. Leviton eXtreme, Siemon Ultra Max or approved equal.

2.04 TELECOMMUNICATION STATION PLATES

A. Modular plates

1. Construction
  - a. Modular, with snap-in receptacle options as scheduled.
  - b. Single gang plate size and mounting.
  - c. Options for 1 to 6 modular jacks per plate.
  - d. Plate face shall be nylon; color shall be compatible with adjacent wall finish, unless otherwise indicated.
  - e. Integral labeling provided for plate identifier and identifier for each receptacle on the plate. Provide as follows:
    - 1) Plate nominally 1-½” by ½” recessed slot with clear plastic cover over paper label. See labeling requirements in Part 3 of this Section.
    - 2) Receptacle identifier(s) shall be iconic or literal descriptions of each receptacle type.
  - f. System shall provide at minimum the following receptacle options:
    - 1) RJ45 Category 3 or RJ25 voice
    - 2) RJ45 Category 6 data
    - 3) 75Ω BNC
    - 4) 75ΩF
    - 5) Phono (RCA) type
    - 6) ST fiber adapter
    - 7) SC fiber adapter
    - 8) S video
    - 9) Blank plate fillers as required to fill unused area.

2. Manufacturers
  - a. Leviton QuickPort MOS, Siemons CT or approved equal
- B. Wall phones plates (non-VOIP or Category-6 jack type)
  1. Construction
    - a. Single gang plate size and mounting.
    - b. Plate face shall be stainless steel with 2 mounting stud type screws for mounting of telephone handset; unless otherwise indicated.
    - c. Jack shall be USOC voice grade as described above.

## 2.05 CABLE TERMINATION EQUIPMENT AND RELATED, CATEGORY RATED

### A. Data Patch Panels, Category 6 Rated, Rack Mounted

1. Drawing Reference: ##C6PP, where ## refers to port count.
2. Functions/Features
  - a. 19" EIA rack mountable.
  - b. 24 ports per one (1) EIA rack unit (1.75") minimum, unless otherwise noted on Drawings.
  - c. Keyed, block form RJ-45/Category 6 jacks and 110 terminations meeting specifications elsewhere herein.
    - 1) Arranged in rows on steel panel.
    - 2) Jacks on front and terminations on rear.
  - d. Port identifier label space on front.
  - e. Provide wire management rings in a ratio of at least 4 rings for every 24 ports.
3. Manufacturers
  - a. Leviton, Siemon or approved equal.

### B. Category 3 Terminal Block with Pre-Wired RJ21C Connector

1. Drawing reference: 110PWTB##, where ## refers to pair count.
2. Features/Functions
  - a. Type 110 terminal block with pre-wired RJ21C 50 pin connector on block or on end of pigtail stub cable.

- b. Meets Category 3 specifications.
  - 3. Manufacturers
    - a. Siemon S110A series, Siemon S700 or approved equal.
- C. Category 3 Rack Mount Patch Panels with Pre-Wired RJ21C Connector
  - 1. Drawing reference: ##110PWC3PP, where ## designates port count.
  - 2. Features/Functions/Construction
    - a. 19" EIA rack mount panel.
    - b. Front face: RJ45 jacks
    - c. Rear face: Pre-wired RJ21C 50 pin connector(s).
    - d. Printed Circuit board linking RJ45's to RJ21C – all four pairs wired straight through.
    - e. Meets Category 3.
    - f. At least 24 Jacks per rack unit (RU).
  - 3. Manufacturers
    - a. Siemon, Signamax or approved equal.

## 2.06 MISCELLANEOUS DEVICES

### A. Shield Connectors

- 1. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar or wire.
- 2. The connector shall be made of tin-plated tempered brass.
- 3. RUS PE-33 compliant.
- 4. Manufacturers
  - a. Preformed Line Products Servi-Bond or approved equal.

### B. Grounding Braid

- 1. Ground braid shall provide low electrical impedance connections for dependable shield bonding.
- 2. The braid shall be made from 1/2" wide flat tin-plated copper, length as required.
- 3. Provide eyelets as necessary for bonding purposes.

4. Manufacturers
  - a. Thomas Betts, 3M or approved equal.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that all raceways have been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceways are clear of foreign matter and substances prior to installation of wire or cable.
- B. Inspect all conduit bends to verify proper radius. Comply with Code and cable manufacturer requirements for minimum permissible radius and maximum permissible deformation.

### **3.02 INSTALLATION**

- A. Separation of Wires: Comply with EIA/TIA-569 rules and CEC/NEC 800-52 for separation of unshielded copper voice and data system cables from potential EMI sources, including electrical power lines and equipment.
- B. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and CEC/NEC 800.
- C. Unless otherwise noted, all trunk and backbone cables and conductors shall have surge and ground protection installed at each end which meets RUS PE-60 requirements. Refer to requirements herein and within the referencing Section as to the acceptable products in each application.
- D. Wire and cable installation:
  1. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
  2. At designated splices, maintain conductor color code across all splices.
  3. Copper conductor voice cable outside plant splicing shall be accomplished in accordance with RUS PC-2.
  4. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
  5. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.
  6. Outdoor splices shall not be permitted except where specifically noted or where required by the run length. Where run lengths require outdoor splices not noted on the drawings, notify Engineer in writing for direction before proceeding.

7. Do not subject wire and cable to tension greater than that recommended by the cable manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
8. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
9. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties, kellem grip or similar approved devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.
10. Where drawings specifically permit use of exposed cable installation in Plenum and/or Suspended Ceiling voids, conform to the following:
  - a. Conform to EIA/TIA 569 with respect to separation from power and radio frequency (RF) sources. Provide at least twice the listed separation at fluorescent light fixtures, ballasts and similar high intensity EMF sources (including but not limited to motors, transformers and copiers).
  - b. Support: Provide support for all cabling. Do not place or attach directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures.
    - 1) Provide supports at least 48" on center, with cables installed with slight sag to ensure conformance with EIA TSB40 tensioning and stress limits.
  - c. Placement: Do not obscure access to access doors, hatches, air dampers, valves, cable trays, junction boxes, pull boxes or similar areas of access.
  - d. Place EMT pipe sleeves at all wall penetrations. Fire stop sleeves and cables where penetrating a rated wall with an approved UL assembly.
11. Wiring practices
  - a. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor's option and at no additional costs to Owner, such terminals may be located in the equipment racks or in the terminal cabinets provided.
  - b. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size; pliers type crimp tooling shall not be acceptable.
  - c. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations, and make connections with automatic impact type tooling set to a recommended force.

- d. Make all connections to screw-type barrier blocks with insulated cirmp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to “Sharpie”.
  - e. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
  - f. Use only rosin core 60/40 tin/lead solder for all solder connections.
  - g. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harness of different classes cross or where hinged panels are to be interconnected.
  - h. Termination and build-out resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.
  - i. Correct any and all of the following unacceptable wiring conditions:
    - 1) Deformed, brittle or cracked insulation.
    - 2) Torn or worn cable jacket.
    - 3) Excessively scored cable jackets
    - 4) Insulation shrunken or stripped further than 1/8” away from the actual point of connection within a connector, or on a punch block.
    - 5) Cold solder joints.
    - 6) Flux joints.
    - 7) Solder splatter.
    - 8) Ungrommed, unbushed, or uninsulated wire or cable entries.
    - 9) Deformation or improper radius of wire or cable.
12. Data cabling wiring practice (For copper cabling used in circuits of >1.0 Mbps conform to the following, in addition to the general requirements above.)
- a. Limit cable bends to a minimum radius of eight (8) times cable diameter except where otherwise noted herein.
  - b. At junction boxes, form circular radius bends of eight times cable diameter minimum. Up to two (2) flat bends of 90° or less are permitted in any single cable run where necessary to accommodate field wiring conditions. Flat bends exceeding 90° will not be accepted.

- c. At the receptacle, a single bend of 90° or less and a 1 inch radius shall be permitted subject to the cable manufacturer certification of such an installation meeting Category 5E requirements. Contractor to field verify the performance of the proposed installation in a mockup using the proposed cabling, jacks, raceway and listed test equipment prior to proceeding.
- d. Tie wraps to be hand (not tool) tightened.
- e. Total run not to exceed 92 meters (300 feet). If condition exists report exceeded requirements to Engineer.

### 13. Labeling

- a. Provide permanent identification of run destination at all raceway terminations. Identify at each manhole, vault, handhole, terminal cabinet, pull box, equipment rack and receptacle/outlet.
- b. Unless otherwise noted, conform to the standards and methods of EIA/TIA 606.
- c. Identify all wire and cable clearly with permanent labels rapped about the full circumference within one (1) inch of each connection. Provide any of the following:
  - 1) Continuous permanent imprint; equivalent to Clifford of Vermont, Inc. “Quick-Pull”.
  - 2) Direct hot stamp.
  - 3) Heat shrinkable factory hot stamped; equivalent to Bradysleeve Heatshrink.
  - 4) Adhesive strip printed labels wrapped the full circumference of the wire and sealed with clear heat shrink tubing; equivalent to Thomas Betts or Panduit Insta-code with clear heat-shrunk tubing equivalent to Alpha.
  - 5) Outside Plant, in Manholes or Pull Boxes. Panduit Fiber Optic Cable Marker Tags (Type PST-FO) or Lead tags, 2” square, drilled for cable attachment. Use cable ties or THWN #12 or 2 #14 wrapped twice around the cable bundle and secure to tag using a crimp fastener.
- d. Indicate:
  - 1) Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.
  - 2) Indicate installation date.
- e. Terminal cabinet, pull box and manhole, handhole, vault or similar locations subject to abuse, label in accordance to Section 26 05 00.

- 1) Patching Bays and Jacks and Receptacles containing six or fewer jacks/outlets: Provide designation strip holders with clear plastic covers to retain replaceable designation strips. Provide designation strips with block lettering on permanent background in contrasting color. Use photographic print, laser print on acid free paper, plotting ink on Mylar, or equivalent non-fading process. Alternatively, provide black on white adhesive labels equivalent to those produced by Brother brand P-Touch Letter Machine. Embossed plastic (Dymo) labels shall not be acceptable. The presence of manufacturer provided silk screen iconic identification labels shall not relieve the contractor from the requirement to identify the receptacle with its associated cabling and circuit.

#### 14. Signal grounding procedures

- a. Where items specified in Section 28 05 26 conflict with the requirements of this Section, the most stringent requirement shall govern.
- b. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.
- c. Ground and bond equipment racks and similar equipment enclosures containing powered equipment exclusively to a telecommunication grounding bus bar.
- d. At each rack, provide a lug bonded to the rack frame with a #10 Cu THWN stranded wire to the rack isolated ground bus.
- e. Equipment signal ground shall be to racks isolated ground bus via the green wire of the equipment power cord. Where equipment uses an ungrounded power cord, provide #12 green bond wire to rack isolated ground bus bar. At equipment housing, provide crimp lug and suitable hardware for bonding.
- f. Shielded cables of this section shall be grounded exclusively to a telecommunication grounding bus bar by a single path. Shield shall be tied to ground bar at one end only, i.e., at the low potential (receiving) end of run, unless otherwise noted.

### 3.03 FIELD QUALITY CONTROL

#### A. General

1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications closet wiring.
2. Test each end to end cable link.
3. Submit copy of final results on paper and in machine readable form, organized by circuit number, consistent with circuit numbering scheme used in preparing submittal drawings and in labeling receptacles and terminations.
  - a. Submit machine-generated documentation and raw data of all test results on Contractor-provided, Owner approved forms; and in electronic format approved by the Owner.



- b. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the Owner with 1 licensed copy of the software.
- c. Provide registered testing software used for the actual tests to the Owner/Engineer for review of test data as may be required.

B. Station Wiring, General

1. Test station wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.
2. Correct any and all transpositions found, and retest.
3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced and retested.

C. Inside Cabling

1. Using a listed Category 6 cable test set, test and submit report on the parameters specified. Report whether tested link passes or fails the Category 5E standards outline within EIA/TIA-568.
2. Note exceptions to required Category standards. Remedy and retest.

D. Telephone: Outside Plant, Inside Riser Wire, Voice Station Wire (where not Category rated):

1. General

- a. A new cable shall be tested only after all wires within the cable have been terminated at both ends.
- b. For unshielded cable, “measurements to ground” means an electrical connection to the Telecommunications Ground Bus, building steel, electrical metallic conduit or a water pipe.
- c. The Contractor shall correct all defects possible.
- d. If the maximum number of un-repairable defective pairs exceeds 4% of the cable’s pair count, the cable shall be deemed unacceptable and shall be replaced. Replace, re-terminate and retest new cable at no additional cost to the Owner.

2. Test procedures

a. Test #1 – Continuity:

- 1) Meter set for 20 $\Omega$  full scale ohm reading. Each pair shall be shorted at one end and the loop resistance value read at the other.
- 2) The difference between the largest and the smallest resistance reading from each pair in the cable shall be no more than 10 percent of the largest reading.

b. Test #2 – Balance, Polarity and Conductor Transpositions:

- 1) Upon passing Test #1, the tester at one end of cable shall ground tip side of each pair in turn. The tester at other end of cable reads resistance to building ground of same conductor.
- 2) Reading for each tip conductor in pair of approximately on-half of loop resistance value from Test #1.

3. Test Report

- a. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions as well as corrective actions.

**END OF SECTION**

## SECTION 28 23 00

### CCTV SURVEILLANCE SYSTEM

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to surveillance systems and their components.

###### B. Related sections

1. Where items specified in other Division 28 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 27 05 26 – Grounding and Bonding for Communications
  - b. 27 05 28 – Pathways for Communication Systems
  - c. 27 11 16 – Data Racks and Enclosures
  - d. 27 15 13 – Telecommunication and Data Cabling (CAT-6)
  - e. 27 15 23 - Telecommunication and Data Cabling (Fiber Optic)
2. The requirements of this Section apply to all Division 28 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 SYSTEM DESCRIPTION

###### A. Install a CCTV system that provides video surveillance of the facility.

###### B. Install a digital recording system (DVR) that shall provide high quality images that can be utilized in the identification of persons in designated areas. The DVR shall allow reviewing, control and storage over a standard LAN/WAN network.

###### C. Install high-resolution colors cameras with high speed pan, tilt and zoom functions where specified.

###### D. Provide camera position programming and remote control of all camera functions.

###### E. The following major components shall be a part of this system:

###### 1. Headend

###### a. Digital Video Recorder with the following accessories:

- 1) 650VA UPS
- 2) 19” wide screen, 1440 x 900, 250 cd/m<sup>2</sup> LED Backlight LCD Monitor

###### 2. Cameras

###### a. As shown in quantities and types on Drawings

###### 3. Cabling as required in accordance to Division 27.

1.03 SUBMITTALS

- A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.
- B. Operating, maintenance and instruction manuals shall be furnished in accordance with General Conditions and Section 26 05 00.
- C. Operating instruction manuals outlining the step-by-step procedures required for system start-up and operation shall be furnished. The instructions shall include manufacturer’s name, model number, service manual parts list, and brief description of all equipment and their basic operating features.
- D. Maintenance instruction manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdowns and repairs and a simplified connection wiring diagram for the system as installed.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

1.06 WARRANTY

- A. Furnish guarantee in accordance with and in form required under Section 26 05 00.

1.07 SYSTEM STARTUP

- A. Refer to manufacturer’s documentation to start-up procedures and requirements.
- B. The Contractor shall demonstrate the system functionality to manufacturer’s specifications and requirements after completion of installation.

**PART 2 - PRODUCTS**

2.01 DIGITAL VIDEO RECORDER

- A. Manufacturer
  - 1. AXIS Camera Station S1016 Recorder or approved equal.
- B. The digital video recorder (DVR) shall provide a high-quality recorder capable of storage and playback of images from 1 to 16 camera inputs at a simultaneous refreshing recording rate of up to 480 images per second (NTSC) at CIF resolution with a CD-RW as standard equipment. The DVR shall possess a watchdog system, triplex operation, Windows 2000 operating system with Service Pack 4 with the latest security updates from Microsoft, watermarking of each frame, inputs for

external alarms, video motion detection, and scheduled event recording. Remote software shall be provided for operation via PC, web, and Pocket PC handheld devices.

C. The DVR shall meet or exceed the following design and performance specifications:

1. Processor

- a. Processing Unit: Intel i5 4570S, 2.90 GHz processor with 4096 MB of RAM
- b. Recording Modes: Continuous, motion detection, alarm activation, or scheduled recording
- c. Storage: Hard drives with 8 TB of storage
- d. Operating Software: Microsoft Windows Professional Embedded 7

2. System Performance Specification

3. Live Video streams: Qualified for resolutions up to 5 megapixels, up to 15 fps at compression level 30.
4. Recording: Qualified for recording up to 24 video channels with a total recording rate up to 96 Mbit per second

D. AXIS Camera Station – Video Management Software

E. Software: AXIS Camera Station 4.x

F. Video

1. Audio: Two-way audio streaming, AAC, G.711, G.726 compression
2. Video compression: H.264 (MPEG-4 Part 10/AVC), Motion JPEG

G. Live view

1. Map function: Yes
2. PTZ Control: Yes

H. Playback

1. Smart Search for recordings: Yes
2. Playback
  - a. Up to 64x or frame by frame
  - b. Up to 25 cameras synchronized playback
3. Export: Manual and scheduled export, Single images in JPEG format, Video in ASF format, Digital signature on exported recordings, Standalone player

I. Triggers and events

1. Event triggers: Events triggered by video motion detection, Active Tampering Alarm, AXIS Cross Line Detection, External I/O, Action button, System triggers and device event triggers
2. Scheduled recording: Schedule per camera for continuous recording or customization of weekday and weekend recordings
3. Alarm manager: Yes

## 2.02 INTEGRATED CCTV CAMERA AND DOME ENCLOSURE

A. Type I

1. Manufacturer AXIS Q3505-V 9mm

2. Camera
  - a. Image sensor Progressive scan RGB CMOS 1/2.8"
  - b. Lens:
    - 1) Varifocal, Remote focus and zoom, P-Iris control, IR corrected, Megapixel resolution
    - 2) 9 mm: 3–9 mm, F1.3 Horizontal angle of view: 105°–35°
  - c. Day and night Automatically removable infrared-cut filter
  - d. Minimum illumination:
    - 1) 9 mm: HDTV 1080p 25/30 fps with WDR - forensic capture and Lightfinder: Color: 0.18 lux, F1.3; B/W: 0.04 lux, F1.3
    - 2) HDTV 1080p 50/60 fps: Color: 0.36 lux, F1.3; B/W: 0.08 lux, F1.3
  - e. Shutter time 1/142850 s to 2 s
  - f. Camera angle adjustment
    - 1) Pan: 360°
    - 2) Tilt: -5° to 90° (0° = Parallel to camera mount/bottom)
    - 3) Rotation: ±95°
3. Video
  - a. Video compression H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High profiles, Motion JPEG
  - b. Resolutions 1920x1200 (WUXGA) to 160x90
  - c. Frame rate HDTV 1080p (1920x1080) with WDR: 25/30 fps with power line frequency 50/60 Hz HDTV 1080p (1920x1080) without WDR: 50/60fps with power line frequency 50/60 Hz WUXGA (1920x1200) without WDR: 25/30 fps with power line frequency 50/60 Hz
  - d. Video streaming Multiple, individually configurable streams in H.264 and Motion JPEG Axis' Zipstream technology in H.264 Controllable frame rate and bandwidth VBR/MBR H.264
  - e. Image settings Compression, Color, Brightness, Sharpness, Contrast, White balance, Exposure control, Exposure zone, Backlight compensation, Fine tuning of behavior at different light levels, WDR-forensic capture: Up to 120 dB depending on scene, Electronic Image Stabilization, Barrel distortion correction, Text and image overlay, Privacy masks, Mirroring of images Rotation: 0°, 90°, 180°, 270°, Auto, Including Corridor Format
  - f. Pan/Tilt/Zoom Digital PTZ, Optical zoom, Preset positions 9 mm: 3x Optical zoom, 2x Digital zoom 22 mm: 2.4x Optical zoom, 2x Digital zoom
4. General
  - a. Casing IP52-rated, IK10 impact-resistant casing with polycarbonate dome, aluminum base and dehumidifying membrane Casing Color: White NCS S 1002-B For repainting instructions of casing or skin cover and impact on warranty, contact your Axis partner
  - b. Memory 512 MB RAM, 128 MB Flash
  - c. Power Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 2, max. 5.5 W
  - d. Connectors RJ45 10BASE-T/100BASE-TX PoE, Terminal block for two configurable inputs/outputs (12 V DC output, max. load 50 mA), 3.5 mm mic/line in, 3.5 mm line out

- e. Edge storage Support for SD/SDHC/SDXC card Support for recording to dedicated network-attached storage (NAS) For SD card and NAS recommendations see [www.axis.com](http://www.axis.com)
- f. Operating conditions -10 °C to 50 °C (14 °F to 122 °F) Humidity 10–85% RH (non-condensing)

## B. Type II

1. Manufacturer AXIS Q6114-E PTZ
2. Camera
  - a. Image sensor 1/3" Progressive Scan CMOS
  - b. Lens 4.3–129 mm, F1.6–4.7 Horizontal field of view: 58.3°–2.1° Vertical field of view: 34.9°–1.3° Autofocus, auto-iris
  - c. Day and night Automatically removable infrared-cut filter
  - d. Minimum illumination Color: 0.15 lux at 30 IRE F1.6 B/W: 0.008 lux at 30 IRE F1.6 Color: 0.18 lux at 50 IRE F1.6 B/W: 0.001 lux at 50 IRE F1.6
  - e. Shutter time 1/10000 s to 1 s
  - f. Pan/Tilt/Zoom
    - 1) Pan: 360° endless, 0.05°–700°/s
    - 2) Tilt: +20 to -90°, 0.05°–500°/s
    - 3) Zoom: 30x Optical, 12x Digital, Total 360x zoom Nadir flip, 256 preset positions, Tour recording, Guard tour, Control queue, On-screen directional indicator, Set new pan 0°, Adjustable zoom speed, Speed Dry
3. Video
  - a. Video compression H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles Motion JPEG
  - b. Resolutions 1280x720 (HDTV 720p) to 320x180
  - c. Frame rate Up to 25/30 or 50/60 fps (50/60 Hz) in all resolutions and H.264
  - d. Video streaming Multiple, individually configurable streams in H.264 and Motion JPEG Axis' Zipstream technology in H.264 Controllable frame rate and bandwidth VBR/MBR H.264
  - e. Image settings Compression, Color, Brightness, Sharpness, White balance, Exposure control, Exposure zones, Rotation, Backlight compensation, Fine tuning of behavior at low light, Electronic Image Stabilization (EIS), Defogging, Manual shutter time, Text and image overlay, Image freeze on PTZ WDR – Dynamic Capture: 130 dB Highlight compensation 32 individual 3D privacy masks
4. General
  - a. Casing IK08, IP66- and NEMA 4X-rated Metal casing (aluminum), Polycarbonate (PC) clear dome with Sharpdome technology, PVC free Sustainability PVC free
  - b. Memory 1 GB RAM, 256 MB Flash
  - c. Power
    - 1) Axis High PoE midspan 1–port: 100–240 V AC, max 74 W
    - 2) Camera consumption: typical 10 W, max 51 W

- 3) Axis PoE+ midspan 1-port: 100–240 V AC, max 37 W IEEE 802.3at Type 2 Class 4
- 4) Camera consumption: typical 10 W, max 25 W
- d. Connectors
  - 1) RJ45 10BASE-T/100BASE-TX PoE
  - 2) RJ45 Push-pull Connector (IP66)
- e. Storage Support for SD/SDHC/SDXC card Support for recording to dedicated network-attached storage (NAS)
- f. Operating conditions
  - 1) With 30 W midspan: -20 °C to 50 °C (4 °F to 122 °F)
  - 2) With 60 W midspan: -50 °C to 50 °C (-58 °F to 122 °F)
  - 3) Maximum temperature (intermittent): 60 °C (140 °F)
  - 4) Arctic Temperature Control: Start-up as low as -40 °C (-40 °F)
  - 5) Humidity 10–100% RH (condensing)
- g. Accessories
  - 1) Axis T91L61 wall mount

#### C. Type III

- 1. Same as 2.02.B above except with different accessories as listed below.
- 2. Accessories
  - a. Axis T98A18-VE Media Converter Cabinet A w/power supply & cabinet lock
  - b. Axis T91L61 wall mount
  - c. Axis T95A67 pole bracket

#### D. CATV CABLE

- 1. General
  - a. Comply with CEC 820, Sections 49, 50, 51 and 53 where applicable.
  - b. RG-6 cables shall be 18 gauge copper covered steel center conductor within gas expanded polyethylene dielectric. Additional jacket and shielding requirements are outlined below.
  - c. Approved equal manufacturers and assemblies shall have no less the electrical and attenuation characteristics than those specified below.
- 2. Outdoor, underground
  - a. Drawing Reference: RG6FOP and RG11FOP
  - b. Construction: Bonded foil, 60% braid, non-bonded tape, 40% braid, flooded for underground, PE jacket.
  - c. Manufacturer
    - 1) Series 6: CommScope F6SSEF, Times Fiber T6Q-FVB or approved equal.



## **PART 3 -EXECUTION**

### **3.01 INSTALLATION**

- A. Work shall be installed as shown on the Drawings in accordance with the manufacturer's diagrams and recommendations, except where otherwise indicated.
- B. Contractor shall provide initial setup and programming for all devices and software installed under this Section for a complete and operational system. System interfaces shall be coordinated with Owner, where appropriate.
- C. All cable runs shall comply with the requirements of this Division and shall be continuous between devices and equipment.

### **3.02 FIELD QUALITY CONTROL**

- A. The Contractor shall demonstrate the system functionality to manufacturer's specifications and requirements after completion of installation.
- B. The Engineer or Owner may order any changes, adjustments or further tests deemed necessary to assure that the system and its components are complete and operational in accordance with the Specifications.

### **3.03 ADJUSTING**

- A. Calibrate and adjust all equipment to manufacturer's standards in place and under dynamic field operating conditions per industry standards.

### **3.04 DEMONSTRATION**

- A. The Contractor shall properly instruct the Owner to the operational procedures of the system.
- B. Within the first 30 days from system startup, the equipment supplier shall provide no less than eight (8) hours for instruction and training.

## **END OF SECTION**

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## **SECTION 311000**

### **SITE CLEARING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

##### **1.3 DEFINITIONS**

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings and as indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain City's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 1. Use sufficiently detailed photographs or video recordings.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

#### 1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

## 1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from City and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed trafficways if required by City or authorities having jurisdiction.
- B. Improvements if applicable on Adjoining Property: Authority for performing site clearing indicated on property adjoining City's property will be obtained by City before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by City.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on City's premises as indicated by City.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
  - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## **PART 3 - EXECUTION**

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.

- B. Verify that trees, shrubs, and other vegetation to remain have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to City.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

### 3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.4 EXISTING UTILITIES

- A. City will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
  - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Arrange with utility companies to shut off indicated utilities.
  - 2. City will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by City or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify City not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without City's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 24 inches below exposed subgrade.
  - 3. Use only hand methods or air spade for grubbing within protection zones.
  - 4. Chip removed tree branches and legally dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.
  - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  - 1. Limit height of topsoil stockpiles to 72 inches.
  - 2. Do not stockpile topsoil within protection zones.
  - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

### 3.7 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than size acceptable in drawings in dimension. Do not include excavated or crushed rock.
  1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

### 3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
  2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

### 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off City's property.
- B. Burning tree, shrub, and other vegetation waste is not permitted.
- C. Separate recyclable materials produced during site clearing per authorities having jurisdiction from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

## END OF SECTION



## **SECTION 312000**

### **EARTH MOVING**

#### **PART 1 - GENERAL**

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for footings.
3. Excavating and backfilling for buildings and structures.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

- B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

##### 1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by City. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by City. Unauthorized excavation, as well as remedial work directed by City, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, pool, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

#### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

- a. Personnel and equipment needed to make progress and avoid delays.
- b. Coordination of Work with utility locator service.
- c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
- d. Extent of trenching by hand or with air spade.
- e. Field quality control.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
  1. Controlled low-strength material, including design mixture.
  2. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
  1. Warning Tape: 12 inches long; of each color.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site soil material proposed for fill and backfill as follows:
  1. Classification according to ASTM D2487.
  2. Laboratory compaction curve according to ASTM D698.
- C. Seismic survey report from seismic survey agency.
- D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

## 1.7 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

## 1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
  1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from City and other authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by City or other authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining 's property will be obtained by City before award of Contract.

1. Do not proceed with work on adjoining property until directed by City.
- C. Utility Locator Service: Notify utility locator service "Call Before You Dig" for area where Project is located before beginning earth-moving operations.  
Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls", Section 311000 "Site Clearing", Section 015639 "Temporary Tree and Plant Protection" are in place.
- D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- E. The following practices are prohibited within protection zones:
  1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Foot traffic.
  4. Erection of sheds or structures.
  5. Impoundment of water.
  6. Excavation or other digging unless otherwise indicated.
  7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## **PART 2 - PRODUCTS**

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.
  1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C33/C33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

## 2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
  - 1. Portland Cement: ASTM C150/C150M, Type I Type II or Type III.
  - 2. Fly Ash: ASTM C618, Class C or F.
  - 3. Normal-Weight Aggregate: ASTM C33/C33M, nominal maximum aggregate size.
  - 4. Foaming Agent: ASTM C869/C869M.
  - 5. Water: ASTM C94/C94M.
  - 6. Air-Entraining Admixture: ASTM C260/C260M.
- B. Produce low-density, controlled low-strength material with the following physical properties:
  - 1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C138/C138M.
  - 2. Compressive Strength: 80 psi, when tested according to ASTM C495/C495M.
- C. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C495/C495M.

## 2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
  2. Yellow: Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water systems.
  5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
  2. Yellow: Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water systems.
  5. Green: Sewer systems.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### **3.2 DEWATERING**

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

### 3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by City. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
  - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
    - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
  - 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
    - a. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

### 3.4 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
  - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
  - 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: As indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
  - 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
  - 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
  - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
  - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
  - 3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.7 SUBGRADE INSPECTION

- A. Notify City when excavations have reached required subgrade.



- B. If City determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by City, without additional compensation.

### 3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by City.
  - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by City.

### 3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for Record Documents.
  - 3. Testing and inspecting underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring, bracing, and sheeting.
  - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, or ice.

### 3.11 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Initial Backfill:
  - 1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
    - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
  - 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- F. Final Backfill:
  - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
  - 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use satisfactory soil material.
  - 3. Under steps and ramps, use engineered fill.
  - 4. Under building slabs, use engineered fill.
  - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

### 3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
  - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
  - 2. Walks: Plus or minus 1 inch.
  - 3. Pavements: Plus or minus 1/2 inch.

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

### 3.16 FIELD QUALITY CONTROL

- A. Special Inspections: City will engage a qualified special inspector to perform the following special inspections:
  - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
  - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
  - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: City will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by City.
- E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

### 3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by City; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off City's property.
- B. Transport surplus satisfactory soil to designated storage areas on City's property. Stockpile or spread soil as directed by City.
  - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off City's property.

**END OF SECTION**

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**SECTION 312316**  
**TRENCHING, BACKFILLING, AND COMPACTING**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. This section includes furnishing all labor, material, equipment, tools and services required for trenching, backfilling and compacting for all underground utilities and appurtenances.

1.02 REFERENCED STANDARDS

- A. American Standard Testing Materials (ASTM)
1. C33, Standard Specification for Concrete Aggregates
  2. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  3. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
  4. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.
  5. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
  6. D422, Standard Test for Particle Size Analysis of Soils.
  7. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  8. D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  9. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  10. D2844, Standard Test Method for Resistance *R*-Value and Expansion Pressure of Compacted Soils
  11. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
  12. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
  13. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  14. D6024, Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application.
- B. State of California, Department of Transportation (Caltrans)
1. California Test 216, Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates.
  2. California Test 226, Determination of Moisture Content by Oven Drying.
  3. California Test 227, Evaluating Cleanness of Coarse Aggregate.
  4. California Test 231, Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates by the Area Concept Utilizing Nuclear Gages.

### 1.03 SUBMITTALS

#### A. Trench Excavation Plan

1. Methods and sequencing of excavation.
2. Numbers, types, and sizes of equipment proposed to perform excavations.
3. Excavation slopes, sheeting/shoring method, and ground improvement.
4. Contractor Calculations: For excavation support and protection system. Include deflection analysis of the shoring/support system. Analysis shall be signed and sealed by a professional civil or structural engineer currently licensed by the State of California responsible for their preparation.
5. Excavation support system design (required if excavations exceed depth of 5 feet). Prior to shoring system installation, contractor shall submit detailed recommendations for monitoring of shoring system deflection during and after installation. Submittal shall be provided by qualified Geotechnical Engineer.
6. Proposed locations for stockpile of excess excavated material.
7. Proposed spoil disposal sites with written authorization from the property owner or facility manager accepting the spoil material.

#### B. Backfill Compaction Plan

1. Proposed backfill material including origin and test reports that show materials provided meet the Specifications.
2. Proposed methods and sequencing of placement including spreading, moisture conditioning, lift thickness and compaction.
3. Proposed compaction equipment including catalog and manufacturer's data sheets.

### 1.04 DEFINITIONS

- A. Cover: The depth of material placed in the trench cross section between the top of the pipe and the existing ground or finished grade, whichever elevation is lower. The minimum total depth of cover above the top of the water pipe shall be 36 inches.
- B. Crushed Rock: Material placed in the trench cross section between the prepared trench bottom and the bottom of the pipe.
- C. Imported Material: Any material located from sources offsite.
- D. Lift: Loose layer of material spread but not compacted.
- E. Native Backfill: Backfill from the top of the pipe bedding zone to the subgrade of paved areas or to the top of the finished grade in unpaved areas. Where topsoil is placed in unpaved areas, backfill shall be to the bottom of the topsoil zone.
- F. Optimum Moisture Content: The optimum moisture content of a specified material is determined by California Test Method 216 or 231 (wet density) to obtain the maximum dry density of that material when compacted. Field moisture content shall be determined on the basis of the fraction passing the  $\frac{3}{4}$  inch sieve.
- G. Pipe Bedding Zone: The area in the trench cross section from the bottom of the pipe to above the pipe. The minimum total depth of the pipe bedding zone is shown on the Plans.
- H. Prepared Trench Bottom: Graded and smooth trench bottom prior to installation of crushed rock material. Unsuitable materials below pipe bedding shall be removed and replaced with suitable materials.



- I. Relative Compaction: Tests for compaction shall be made in accordance with California Test Method 216 or 231, wet density.
- J. Relative Density: A measure of the density of the cohesionless soil after compaction. Maximum and minimum density shall be determined in the laboratory per ASTM D4253, D4254.
- K. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Well-Graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

1.05 JOB CONDITIONS

- A. Maintain and protect excavated materials to minimize inconvenience to the public and neighboring property owners and businesses.
- B. If encountered, remove and dispose of unsuitable and/or hazardous materials to an approved disposal site. The Contractor is responsible for compliance with all laws and regulations regarding disposal of unsuitable and/or hazardous materials.

**PART 2 – PRODUCTS**

2.01 MATERIALS

- A. Only suitable materials defined in these specifications may be used as fill or backfill.
- B. Unsuitable materials shall not be used for the Work.
- C. Suitable Materials:

1. Crushed Rock:

- a. Pervious Material consisting of washed coarse crush aggregate conforming to the following gradation:

Sieve Size	1 inch	3/4 inch	1/2 inch	3/8 inch	#4	#8
Percent Passing	100	90-100	65-85	20-55	0-15	0-5

2. Pipe Bedding Zone: Contractor may use one of the following suitable materials for the Pipe Bedding Zone.

- a. Native backfill or imported sand conforming to the following gradation and characteristics:

Sieve Size	Pipe Type	3/4 inch	3/8 inch	#4	#30	#200
Percent Passing	PVC	100	90-100	65-85	20-55	0-15
	Others	100	100	70-100	20-100	0-15

Pipe Type	Sand Equivalent (ASTM D2419)	Dry Density (ASTM D1556)	Resistance Value (ASTM D2844)	Coefficient of Permeability
PVC	30 (minimum)	-	78 (minimum)	1.4 in / hr
Others	30 (minimum)	80 lb / cu ft (min.)	-	1.4 in / hr

- b. Controlled Density Fill (CDF) conforming to the following mix design for one cubic yard and material requirements:

Description	Design Criteria & Quantity	Material Standards & Requirements
-------------	----------------------------	-----------------------------------

Compressive Strength	25 – 100 psi at 28 days	Unconfined (ASTM C39)
Cement	50 – 100 lbs	Type I or II Portland (ASTM C150)
Fly Ash	200 – 500 lbs	Class C or F (ASTM C618)
Water	325 – 600 lbs	Potable – free of oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product
Aggregate	2000 – 3500 lbs	See gradation below (ASTM C33)
Entrained Air	20% Maximum	-
Slump	7 in Minimum	ASTM C143

#### Aggregate Gradation for CDF

Sieve Size	3/8 inch	#4	#8	#16	#30	#50	#100
Percent Passing	100	95-100	80-100	50-85	5-60	5-30	0-10

- c. Class II Aggregate Base material shall conform to grading and quality requirements in the State Standard Specifications for 3/4 inch maximum aggregate.
- 3. Native Backfill: if required, material shall be tested prior to use and conform to the gradation and quality requirements in Part 2.01 C.2.a.
- 4. Subgrade: material shall conform to the gradation and quality requirements in Part 2.01 C.2.c.
- D. Unsuitable Materials:
  - 1. Soils which, when classified under ASTM D2487 fall in the classifications of Pt, OH, CH, MH, or OL.
  - 2. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
  - 3. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils.
  - 4. Topsoil, except as required for topsoil replacement in agricultural and easement areas.
  - 5. Saturated native materials which are over optimum moisture content shall be considered “unsuitable” because they are too wet for proper compaction. If the Contractor chooses at no cost to the City to dry wetted materials or mix native materials with suitable imported backfill material, the Engineer may allow the use of the material.

### PART 3 – EXECUTION

#### 3.01 TESTING

- A. Contractor shall contact the City Construction Inspector for the project to schedule 48 hours prior to test, a third party inspection & testing lab to perform following tests on all imported materials from each source and native materials intended for backfill/bedding:
  - 1. Gradation, (ASTM C136 or D422), every 600 cy or material change.
  - 2. Moisture – Dry Density Relationship at three different compaction efforts, ASTM D1557, ASTM D698 and 26,400 ft-lb/ft<sup>3</sup> at every material change.

Results shall be displayed in a family of Dry Density -Moisture Content curves, and in Maximum Dry Density – Compacted Effort curve.

3. Plasticity Index of Soils, (ASTM 4318), every 1,000 cy or material change.
4. Sand Equivalent Value of Soils and Fine Aggregate, (ASTM D 2419), every 1,000 cy or material change.
5. Laboratory Maximum Density, (ASTM D4253), each source.
6. One in-place field density and moisture test at every two vertical feet of trench and shaft backfill, and at maximum every 500-FT along trench.
7. Atterburg Limits, (ASTM D4318), every 600 cy or material change.
8. Organic Content, (ASTM D2974), every 5,000 cy or material change.
9. Chloride, Sulfate, Resistivity, and pH, every 600 cy or material change.

### 3.02 INSTALLATION

- A. The quantity of materials for trench excavation and fill shall be as required by the Contract Drawings.
- B. The bottom of the trench shall be proof rolled and compacted prior to placement of any material.
- C. Crushed rock shall be installed to a minimum relative compaction of 75 percent.
- D. Pipe bedding zone material shall be installed to a minimum relative compaction of 90 percent.
- E. Subgrade material shall be installed to a minimum relative compaction of 95 percent.

### 3.03 MEASUREMENT AND PAYMENT

- A. Full compensation for conforming to the provisions in this section shall be included in the prices paid for the various contract items of work involved and no additional compensation shall be allowed.

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## SECTION 315000

### EXCAVATION SUPPORT AND PROTECTION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference if required by the City.
  - 1. Review coordination for interruption, shutoff, capping, and continuation of utility services.
  - 2. Review proposed excavations.
  - 3. Review proposed equipment.
  - 4. Review monitoring of excavation support and protection system.
  - 5. Review coordination with waterproofing.
  - 6. Review abandonment or removal of excavation support and protection system.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
  - 1. Include plans, elevations, sections, and details.

2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

#### 1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by City or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  1. Notify City no fewer than two (2) days in advance of proposed interruption of utility.
  2. Do not proceed with interruption of utility without City's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. The City is not responsible for interpretations or conclusions drawn from the data.
  1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
  2. The geotechnical report is included elsewhere in Project documents.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Provide design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
  - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
  - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
  - 4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

### 2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
  - 1. Corners: Site-fabricated mechanical interlock or roll-formed corner shape with continuous interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches.
- E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- F. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- G. Tiebacks: Steel bars, ASTM A 722/A 722M.
- H. Tiebacks: Steel strand, ASTM A 416/A 416M.
- I. Clean Washed River Cobble: available from MRM Stone or approved equal. Contact Shane Fernandes, P: (209) 599-0566
  - 1. Color shall be: Tan shades
  - 2. Size shall be: 50% 2 inch, 50% 4 inch

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
  - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from City and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

### 3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install walls horizontally at locations indicated on Drawings and secure to soldier piles.

### 3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

### 3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.



- B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
  - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
  - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by City.
  - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
  - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.6 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify the City if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

### 3.7 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
  - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
  - 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
  - 3. Repair or replace, as approved by City, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

**END OF SECTION**

**SECTION 321216**  
**ASPHALT PAVING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 REFERENCED STANDARDS

- A. State of California, Department of Transportation (Caltrans) Standard Specifications (latest publication)
  - 1. Section 26 “Aggregate Bases”
  - 2. Section 37 “Bituminous Seals”
  - 3. Section 39 “Asphalt Concrete”
  - 4. Section 92 “Asphalts”
  - 5. Section 93 “Liquid Asphalts”
  - 6. Section 94 “Asphaltic Emulsions”

1.3 SUBMITTALS

- A. Asphalt Concrete Mix Design
- B. Certificate of Compliance
  - 1. Asphalt Concrete
  - 2. Aggregate Base
  - 3. Paint Binder (Tack Coat)
  - 4. Seal Coat (Fog Seal)

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Asphalt Concrete shall be Type A, ¾” Maximum, Medium per Section 39 of the State Standards.
- B. Aggregate Base shall be Class 2, ¾” maximum aggregate, per Section 26 of the State Standards.

- C. Paint Binder (Tack Coat) shall be Emulsified Asphalt, Grade SS-1 per Section 94 of the State Standards.
- D. Seal Coat shall be in conformance with Section 37 “Bituminous Seals” of the State Standards.

## 2.2 ASPHALT MIX DESIGN CRITERIA

- A. Asphalt Concrete shall be steam-refined asphalt, PG 64-10 per Section 92 of the State Standards.

## PART 3 - EXECUTION

### 3.1 TEMPORARY PAVEMENT

- A. Temporary pavement (or cut back) shall be removed before placement of permanent paving.
- B. Temporary pavement shall be installed and maintained wherever excavation is made through the pavement, sidewalk, or driveway. The temporary trench pavement shall be placed and compacted with a vibratory plate or steel drum roller to grade immediately following trench backfill. Wheel rolling will not be allowed.
- C. Temporary bituminous surfacing (cut back) shall be placed and mechanically compacted immediately above the trench following compaction.
- D. Temporary trench pavement shall be at least 2 inches thick in traffic areas and maintained to the grade of the adjacent pavement by the Contractor until permanent pavement is placed. Material, which is placed by the Contractor for convenience, shall be at no additional cost to the City.

### 3.2 PERMANENT PAVEMENT

- A. Preparation
  - 1. Permanent paving shall be placed on undisturbed previously inspected and compacted aggregate base or CDF. Re-compaction shall be required for any disturbed base or surface.
  - 2. All existing pavement edges along trench sides shall be cut to straight lines. Any existing pavement areas damaged, or otherwise broken and unsound to provide a smooth edge for new adjoining pavement shall be cut to straight lines and no additional compensation will be allowed.
- B. Placement
  - 1. Prime Coat: NOT REQUIRED.
  - 2. Paint Binder:
    - a. Prior to replacing the finished permanent pavement surfacing, a paint binder shall be sprayed on all vertical asphalt and concrete surfaces on the boundary of trench to be paved. Paint Binder shall be placed at a maximum rate of 0.10 gallons per square yard or as directed by the Engineer.
    - b. Paint binder shall be applied between lifts of asphalt. If the previous surface is not clean and the engineer determines excessive dust is evident, the surface must be

cleaned prior to application and to the satisfaction of the Engineer. Application shall conform to Section 39 of the State Standards.

3. Final paving above the trench section shall be placed as soon as practical after its backfill and compaction. Extension may be granted by the City due to weather conditions. In the event permanent paving is not done promptly, the City will consider this as incomplete work and will take necessary action in accordance with the prevailing City ordinances and policies.
4. Asphalt concrete lifts shall not exceed 0.25 foot, but no less than 0.15 foot. Compaction of asphalt concrete shall conform to Section 39 of the State Standards.
5. The finished surface of the permanent pavement shall be flush with the existing surface and shall conform to the grade and crown of the adjacent pavement. Immediately after the new paving is compacted, all joints between new and original asphalt pavement shall be painted with hot asphalt or asphalt emulsion and be covered with dry paving sand before the asphalt solidifies.
6. The surface smoothness of the replaced pavement shall be such that when a 12 foot straightedge is laid across the patched area between the edges of the old surfacing and the surface of the new pavement, the new pavement shall not deviate from the straightedge more than 1/4 inch. If the finished surface of the asphalt concrete does not meet the specified surface tolerances, it shall be brought within tolerance by either abrasive grinding or removal and replacement. The method will be selected by the Engineer and the corrective work shall be at the Contractor's expense.

C. Surface Treatments

1. The pavement section extending past the outside edge of a sawcut shall be grinded and overlaid new pavement.
2. A paint binder is required on all grinded surfaces (horizontal and vertical) prior to overlay of new permanent pavement. The binder shall be applied as specified in this Section, Part 3.02 B Trench Restoration.
3. Paving shall be as specified in Section 39 of the State Standard Specification and these specifications.
4. Grind existing asphalt pavement at the locations and to the dimensions shown on the plans and as directed by the Engineer.
5. Pavement grinding shall conform to the provisions of Section 42, Groove and Grind Pavement, of the State Standard Specifications

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**SECTION 321313**  
**CONCRETE PAVING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Concrete Paving including the Following:

- 1. Alley approach.
- 2. Curbs and gutters.
- 3. Flatwork.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for general applications of concrete.
- 2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
  - a. Concrete mixture design.
  - b. Quality control of concrete materials and concrete paving construction practices.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- C. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
- D. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.
- B. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Fiber reinforcement.
  - 4. Admixtures.
  - 5. Curing compounds.
  - 6. Applied finish materials.
  - 7. Bonding agent or epoxy adhesive.
  - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
  - 1. Aggregates.
- D. Field quality-control reports.

## 1.7 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.



- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
  - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by City and not less than 60 inches by 60 inches.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless City specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

## 1.9 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms[, **steel reinforcement**,] and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## **PART 2 - PRODUCTS**

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

### 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

### 2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from galvanized-steel wire into flat sheets.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.
- E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
- G. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- H. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.
- I. Tie Bars: ASTM A615/A615M, Grade 60; deformed.
- J. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

- K. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- L. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- M. Zinc Repair Material: ASTM A780/A780M.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C150/C150M, gray portland cement.
  - 2. Fly Ash: ASTM C618.
  - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
  - 4. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blast-furnace slag cement.
- B. Normal-Weight Aggregates: ASTM C33/C33M, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
  - 1. Aggregate Sizes: 3/4 to 1 inch nominal.
  - 2. Aggregate Source, Shape, and Color: as indicated on Drawings.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Retarding Admixture: ASTM C494/C494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Color: As selected by City from manufacturer's full range.
- G. Water: Potable and complying with ASTM C94/C94M.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.

## 2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements.
- E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

- F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
  - 1. Color: As selected by City from manufacturer's full range.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
  - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
  - 1. Fly Ash or Pozzolan: 25 percent.
  - 2. Slag Cement: 50 percent.
  - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete as required for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- F. Concrete Mixtures: Normal-weight concrete.
  - 1. Compressive Strength (28 Days): As indicated on Drawings.
  - 2. Maximum W/C Ratio at Point of Placement: 0.45.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
  2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Provide tie bars at sides of paving strips where indicated.
  - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 20 feet unless otherwise indicated on Drawings.
  2. Extend joint fillers full width and depth of joint.
  3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
    - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
    - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
  3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.



- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing as follows:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  1. Elevation: 3/4 inch.
  2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  3. Surface: Gap below 10-feet-long; unlevelled straightedge not to exceed 1/2 inch.
  4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
  5. Lateral Alignment and Spacing of Dowels: 1 inch.
  6. Vertical Alignment of Dowels: 1/4 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: City will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
  1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to City, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by City but will not be used as sole basis for approval or rejection of concrete.

- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by City.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

### 3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by City.
- B. Drill test cores, where directed by City, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

### **END OF SECTION**

## SECTION 321373

### CONCRETE PAVING JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Cold-applied joint sealants.
  2. Hot-applied joint sealants.
  3. Joint-sealant backer materials.
  4. Primers.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
1. Concrete pavement joint sealants.
  2. Joint-sealant backer materials.
- B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.
- C. Samples for Verification: Actual sample of finished products for each kind and color of joint sealant required.
1. Size: Joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Paving-Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For Installer and testing agency.

## 1.5 QUALITY ASSURANCE

### A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.6 PRECONSTRUCTION TESTING

- ### A. Preconstruction Testing: Performed by a qualified testing agency.

## 1.7 FIELD CONDITIONS

### A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## **PART 2 - PRODUCTS**

## 2.1 SOURCE LIMITATIONS

- ### A. Obtain joint sealants from single manufacturer for each sealant type.

## 2.2 JOINT SEALANTS, GENERAL

- ### A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

## 2.3 COLD-APPLIED JOINT SEALANTS

- ### A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.
- ### B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.
- ### C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

- D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
- E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.

#### 2.4 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant, Type I: ASTM D6690.
- B. Hot-Applied, Single-Component Joint Sealant, Type I or Type II: ASTM D6690.

#### 2.5 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

#### 2.6 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of joint-sealant backer materials.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
  - 3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
  - 1. Place joint sealants so they fully contact joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Non-sag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
  - 1. Remove excess joint sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.



- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

### 3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

### 3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joints within concrete paving:
  - 1. Joint Location:
    - a. Expansion and isolation joints in concrete paving.
    - b. Contraction joints in concrete paving.
    - c. Other joints as indicated.
  - 2. Joint Sealant: Single-component, nonsag, silicone joint sealant.
  - 3. Joint-Sealant Color: To be chosen by City from manufacturer's standard colors.
- B. Joints within concrete paving and between concrete and asphalt paving:
  - 1. Joint Location:
    - a. Joints between concrete and asphalt paving.
    - b. Joints between concrete curbs and asphalt paving.
    - c. Other joints as indicated.
  - 2. Joint Sealant: Hot-applied, single-component joint sealant.
  - 3. Joint-Sealant Color: To be chosen by City from manufacturer's standard colors.

**END OF SECTION**

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## SECTION 323119

### DECORATIVE METAL FENCES AND GATES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

###### A. Section Includes:

1. Decorative metal fences.
2. Swing gates.
3. Metal debris panels.

###### B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete post concrete fill.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For fencing and gates.

1. Include plans, elevations, sections, gate locations, post spacing, and mounting attachment details, and grounding details.

- C. Samples: For each fence material and for each color specified.

1. Provide Samples 12 inches in length for linear materials.
2. Provide Samples 12 inches square for bar grating and sheet or plate materials.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

- B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Include 10-foot length of fence complying with requirements.
  - 2. Include 10-foot length of debris panels mounted to fence mock-up.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

### 2.2 DECORATIVE STEEL FENCES

- A. Decorative Steel Fences: Fences made from steel tubing bars and shapes.
- B. Posts: Square steel tubing. As indicated on drawings.
- C. Post Caps: as indicated on drawings.
- D. Rails:
  - 1. Steel Tube Rails: Square steel tubing size as indicated on drawings Insert dimensions with 1/8-inch wall thickness.
- E. Pickets: Size as indicated on drawings.
  - 1. Extend pickets beyond top rail as indicated and match ends to existing.
  - 2. Picket Spacing: 4 inches on center, maximum.
  - 3. Treillage: Provide iron castings of pattern indicated between each pair of pickets.
- F. Infill: Custom design as indicated on Drawings.
- G. Fasteners: Stainless-steel carriage bolts and tamperproof nuts.
- H. Fabrication: Assemble fences into sections by welding pickets to rails.
  - 1. Fabricate sections with clips welded to rails for field fastening to posts.

2. Drill posts and clips for fasteners before finishing to maximum extent possible.
- I. Fabrication: Fabricate bar grating infill into sections of size indicated.
    1. Fabricate rails with clips welded to rails for field fastening to posts.
    2. Drill posts, clips, and bar grating for fasteners before finishing to maximum extent possible.
  - J. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
  - K. Finish for Bar Grating Infill: Powder coating.

### 2.3 SWING GATES

- A. Gate Configuration: As indicated.
- B. Gate Frame Height: As indicated.
- C. Gate Opening Width: As indicated.
- D. Steel Frames and Bracing: Fabricate members from square steel tubing as indicated. with 1/8-inch wall thickness.
- E. Frame Corner Construction: Welded.
- F. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- G. Infill: Comply with requirements for adjacent fence.
- H. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
- I. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide. Provide center gate stops and cane bolts for pairs of gates as requested by City.
- J. Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.
- K. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
  1. Function: 39 - Full surface, triple weight, antifriction bearing.
  2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- L. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
  1. Mounting Channel: Bent-plate channel formed from 1/8-inch-thick, steel plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch beyond push pad surface.

- M. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2-inch- diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.
- N. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
- O. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- P. Metallic-Coated-Steel Finish: High-performance coating.
- Q. Steel Finish: High-performance coating.

## 2.4 STEEL AND IRON

- A. Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- C. Tubing: ASTM A500/A500M, cold-formed steel tubing.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions.
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

## 2.6 GROUNDING MATERIALS

- A. Comply with requirements of Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Grounding Conductors: Size as indicated on Drawings. Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
  - 1. Material above Finished Grade: Copper.

2. Material on or below Finished Grade: Copper.
  3. Bonding Jumpers: Braided copper tape, 1-5/8 inch wide and 1/16 inch thick, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Grounding Connectors and Grounding Rods: Comply with UL 467.
1. Connectors for Below-Grade Use: Exothermic-welded type.
  2. Grounding Rods: Copper-clad steel.
    - a. Size: 5/8 by 96 inches.

## 2.7 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning." SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Powder Coating: Immediately after cleaning, apply manufacturer's standard two-coat minimum finish consisting of epoxy primer and TGIC polyester topcoat to a minimum total dry film thickness of not less than 8 mils. Comply with coating manufacturer's written instructions.
  1. Color and Gloss: As indicated on drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by City.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
  1. Construction layout and field engineering as indicated by City.

### 3.3 DECORATIVE FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.

- B. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.
- C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.
- D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Finish and slope top surface to drain water away from post.
    - b. Concealed Concrete: Top 2 inches below grade as indicated on Drawings to allow covering with surface material. Slope top surface of concrete to drain water away from post.
  - 3. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.
- B. All pool fence perimeter gates shall open outward as indicated on Drawings.
- C. All pool fence perimeter gates shall have panic hardware installed per AHJ and as indicated on Drawings.

### 3.5 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:
  - 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
    - a. Gates and Other Fence Openings: Ground fence on each side of opening.
      - 1) Bond metal gates to gate posts.
      - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.



- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
  - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify City promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
  - 3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

### 3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout

entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

- B. Lubricate hardware and other moving parts.
- C. Ensure all panic hardware installed on gates meets applicable codes by AHJ.

### 3.8 DEMONSTRATION

- A. Train City's personnel to adjust, operate, and maintain gates.

**END OF SECTION**

**SECTION 323300**  
**SITE FURNISHINGS**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pedestal showers.
2. Drinking fountains.
3. Backed benches.
4. Backless benches.
5. Standard picnic tables.
6. Accessible picnic tables.
7. Trash & recycle receptacles.
8. Columbia Pool entry sign.
9. Steel shade structures.
10. Bike racks.
11. Flagpole.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing pipe sleeves cast installing anchor bolts cast in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers approved by manufacturer.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Detailed Shop Drawings: For each type of equipment.
  - 1. Include plans, elevations, sections, attachment and footing details as a single submittal.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of site equipment.
- B. Material Certificates: For shop finishes.
- C. Field quality control reports.
- D. Sample Warranty: For manufacturer's special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.
- B. Parts list: Provide a list of parts for each site furnishing.
- C. Contact information: Provide installation contractor and manufacturer name, phone, email, and address for repairs and servicing.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Trash Receptacle Inner Containers: Two full-size units for each size indicated.
  - 2. Anchors: Two fastener sets for bike racks.

### **PART 2 - PRODUCTS**

#### 2.1 PEDESTAL SHOWERS

- A. Basis of Design Product: Subject to compliance with requirements, provide pedestal showers from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.
  - 2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.2 DRINKING FOUNTAIN

- A. Basis of Design Product: Subject to compliance with requirements, provide drinking fountain from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.
  - 2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.3 BACKED BENCHES

- A. Basis of Design Product: Subject to compliance with requirements, provide backed benches from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.
  - 2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.4 BACKLESS BENCHES

- A. Basis of Design Product: Subject to compliance with requirements, provide backless benches from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.
  - 2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.5 STANDARD PICNIC TABLES

- A. Basis of Design Product: Subject to compliance with requirements, provide standard picnic tables from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.
  - 2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.6 ACCESSIBLE PICNIC TABLES

- A. Basis of Design Product: Subject to compliance with requirements, provide accessible picnic tables from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.
  - 2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.7 TRASH & RECYCLING RECEPTACLES

- A. Basis of Design Product: Subject to compliance with requirements, provide trash & recycling receptacles from the following company:
  - 1. Manufacturer: As indicated on Drawings or approved equal.

2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.8 COLUMBIA POOL ENTRY SIGN

- A. Basis of Design Product: Subject to compliance with requirements, provide Columbia Pool entry sign from the following company:
  1. Manufacturer: As indicated on Drawings or approved equal.
  2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.9 STEEL SHADE STRUCTURES

- A. Basis of Design Product: Subject to compliance with requirements, provide steel shade structures from the following company:
  1. Manufacturer: As indicated on Drawings or approved equal.
  2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.10 BIKE RACKS

- A. Basis of Design Product: Subject to compliance with requirements, provide bike racks from the following company:
  1. Manufacturer: As indicated on Drawings or approved equal.
  2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.11 FLAGPOLE

- A. Basis of Design Product: Subject to compliance with requirements, provide flagpole from the following company:
  1. Manufacturer: As indicated on Drawings or approved equal.
  2. Color: As indicated on Drawings or chosen by City from manufacturer's standard selections.

## 2.12 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:
  1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B211.
  2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B221.
  3. Structural Pipe and Tube: ASTM B429/B429M.
  4. Sheet and Plate: ASTM B209.
  5. Castings: ASTM B26/B26M.
- B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A36/A36M.
  2. Steel Pipe: Standard-weight steel pipe complying with ASTM A53/A53M, or electric-resistance-welded pipe complying with ASTM A135/A135M.
  3. Tubing: Cold-formed steel tubing complying with ASTM A500/A500M.
  4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A513/A513M, or steel tubing fabricated from steel complying with ASTM A1011/A1011M and complying with dimensional tolerances in ASTM A500/A500M; zinc coated internally and externally.
  5. Sheet: Commercial steel sheet complying with ASTM A1011/A1011M.
- C. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.
1. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; where available from manufacturer.
- D. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M; recommended in writing by manufacturer, for exterior applications.
- E. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
  2. Hot-Dip Galvanizing: According to ASTM A123/A123M, ASTM A153/A153M, or ASTM A924/A924M.

## 2.13 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

## 2.14 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.15 ALUMINUM FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## 2.16 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

## 2.17 IRON FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## 2.18 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run directional finishes with long dimension of each piece.
  - 2. Directional Satin Finish: ASTM A480/A480M, No 4.
  - 3. Dull Satin Finish: ASTM A480/A480M, No. 6.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.



- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored positioned at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

**END OF SECTION**

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**SECTION 328400**  
**PLANTING IRRIGATION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Piping, and fittings.
  2. Valves.
  3. Automatic control valves.
  4. Sprinklers.
  5. Quick couplers.
  6. Drip irrigation specialties.
  7. Controllers.
  8. Boxes for automatic control valves.

1.2 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. ET Controllers: EvapoTranspiration Controllers. Irrigation controllers, which use some method of weather-based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET, broadcasting of ET measurements, or use of on-site sensors to track ET.
- D. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Zoning Chart: Indicate each irrigation zone and its control valve.

- B. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers controllers and automatic control valves to include in operation and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installers: Entity that employs a Certified Irrigation Technician – Landscape installer qualified by the Irrigation Association.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support piping to prevent sagging and bending.

#### 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by City or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify City no fewer than two days in advance of proposed interruption of water service.
  - 2. Do not proceed with interruption of water service without City's written permission.

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Irrigation Zone Control: Automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions, such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
  - 1. Irrigation Main Piping: As indicated on Drawings.
  - 2. Circuit Piping: As indicated on Drawings.

## 2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: ASTM D1785, PVC 1120 compound, Schedule 40.
  - 1. PVC Socket Fittings: ASTM D2466, Schedule 40.
  - 2. PVC Threaded Fittings: ASTM D2464, Schedule 80.
  - 3. PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- C. PVC Pipe, Pressure Rated: ASTM D2241, PVC 1120 compound, SDR 21.
  - 1. PVC Socket Fittings: ASTM D2467, Schedule 80.
  - 2. PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

## 2.3 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.

## 2.4 MANUAL VALVES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products or approved equal.
- B. Plastic Ball Valves:
  - 1. Description: As indicated on drawings or approved equal.
- C. Bronze Gate Valves:
  - 1. Description: As indicated on drawings or approved equal.

## 2.5 AUTOMATIC REMOTE-CONTROL VALVES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products or approved equal.
- B. Plastic, Automatic Control Valves:
  - 1. Description: As indicated on drawings.
  - 2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24 V ac solenoid.

## 2.6 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

- B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
  - 1. Description: As indicated on drawings or approved equal.
- C. Plastic, Pop-up Spray Sprinklers:
  - 1. Description: As indicated on drawings or approved equal.

## 2.7 QUICK COUPLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products or approved equal.
  - 1. As indicated on Drawings.
  - 2. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key. Locking-Top Option: Vandal-resistant locking feature. Include two matching key(s).
    - a. Locking-Top Option: Vandal-resistant locking feature. Include two matching key(s).

## 2.8 DRIP IRRIGATION SPECIALTIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products or approved equal.
  - 1. Description: As indicated on drawings or approved equal.
  - 2. Low flow point source emitters: As indicated on Drawings.
  - 3. Root watering system (RWS) model: As indicated on Drawings.

## 2.9 CONTROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products or approved equal.
  - 1. Manufacturer: As indicated on Drawings or approved equal.
- B. Description:
  - 1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 1 to XX minutes. Include switch for manual or automatic operation of each station.
  - 2. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and two matching keys.
    - a. Body Material: Molded plastic.
    - b. Mounting: Surface type for wall.
  - 3. Control Transformer: 24 V secondary, with primary fuse.

4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
  - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
  - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
  - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
5. Smart Controllers: Use ET, tested in accordance with IA SWAT Climatological Based Controllers 8th Draft Testing Protocol and compliant with ASHRAE 189.1.
6. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
  - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
  - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
  - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

## 2.10 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products or approved equal.
- B. Plastic Boxes:
  1. Description: As indicated on Drawings.
    - a. Size: As required for valves and service.
    - b. Shape: Round and Rectangular.
    - c. Sidewall Material: PE, ABS, or FRP.
    - d. Cover Material: PE, ABS, or FRP.
    - 1) Lettering: "CITY STD."
- C. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 1 inch maximum.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Provide minimum cover over top of underground piping according to the following:
  - 1. Irrigation Main Piping: Minimum depth of 18 inches below finished grade.
  - 2. Circuit Piping: 12 inches.
  - 3. Sleeves: 24 inches.

### 3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain City's approval before excavation.

### 3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install underground thermoplastic piping in accordance with ASTM D2774 and ASTM F690.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- L. Install piping in sleeves under parking lots, roadways, and sidewalks.
- M. Install sleeves made of Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.



- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings in accordance with ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings in accordance with ASTM D2855.
  - 3. PVC Nonpressure Piping: Join in accordance with ASTM D2855.

### 3.5 VALVE INSTALLATION

- A. Throttling Valves: Install in underground piping in boxes for automatic control valves.

### 3.6 INSTALLATION OF SPRINKLERS

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

### 3.7 INSTALLATION OF DRIP IRRIGATION SPECIALTIES

- A. Install as indicated on Drawings and per manufacturer's recommendations.

### 3.8 AUTOMATIC IRRIGATION CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting, Interior: Install relocated existing controller on interior wall.
  - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.

- B. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

### 3.9 CONNECTIONS

- A. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- B. Connect wiring between controllers and automatic control valves.

### 3.10 IDENTIFICATION

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
  - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

### 3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service with Test Assistance: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Irrigation system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.12 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that controllers are installed and connected in accordance with the Contract Documents.
  - 3. Verify that electrical wiring installation complies with manufacturer's submittal.

### 3.13 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

### 3.14 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

### 3.15 DEMONSTRATION

- A. Train City's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

### 3.16 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
- C. Underground Irrigation Main Piping:
  - 1. NPS 4 and Smaller:
    - a. Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.
- D. Circuit Piping as indicated on Drawings shall be the following:
  - 1. NPS 2 and Smaller:
    - a. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
- E. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
  - a.

**END OF SECTION**

**SECTION 329200**  
**TURF AND GRASSES**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Sodding.
  - 2. Turf renovation.
- B. Related Requirements:
  - 1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See drawing designations and latest soils report for planting soils recommendations.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- G. Surface soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by City for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
  - 1. Experience: Five projects of similar size and design within the past seven years.
  - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 3. Pesticide Applicator: State licensed, commercial.
  - 4. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
  - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  - 2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from City. A minimum of three representative

samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

3. Report suitability of tested soil for turf growth.
  - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
  - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
  1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk materials with appropriate certificates.

## 1.9 PROJECT CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
  1. Spring Planting.
  2. Fall Planting.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

## **PART 2 - PRODUCTS**

### **2.1 TURFGRASS SOD**

- A. Turfgrass Sod: Approved, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as indicated on Drawings, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

### **2.2 FERTILIZERS**

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition:
    - a. 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
    - b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition:
    - a. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
    - b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

### **2.3 ORGANIC SOIL AMENDMENTS**

- A. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5-10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  - 1. Organic Matter Content: 50 to 60 percent of dry weight.
  - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.



## 2.4 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by City and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  - 1. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to soils analysis amendment recommendations from soil laboratory.
- B. Placing Planting Soil:

1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain City's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### 3.5 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
  1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
  2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf affected by construction.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off City's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

- I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
  - 1. Soil Amendment(s): applied according to soils report recommendations.
  - 2. Initial Fertilizer: applied according to manufacturer's recommendations and per soils report recommendations.
- J. Apply sod as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

### 3.6 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
  - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
  - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
  - 1. Mow turf to a height of 1-1/2 to 2 inches.
- D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
  - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

### 3.7 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by City:
  - 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

### 3.8 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with City's operations and others in proximity to the Work. Notify City before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.9 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off City's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

### 3.10 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
  - 1. Sodded Turf: 60 days from date of Substantial Completion.
    - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

### **END OF SECTION**

## SECTION 329300

### PLANTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Plants.
- 2. Tree stabilization.

- B. Related Requirements:

- 1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
- 2. Section 329200 "Turf and Grasses" for turf (lawn).

##### 1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Area: Areas to be planted.

- G. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- H. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- I. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- J. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- K. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

#### 1.4 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly clean and repair damage caused by planting operations.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples for Verification: For each of the following:
  - 1. Compost Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  - 1. Manufacturer's certified analysis of standard products.
  - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- B. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- C. Sample Warranty: For special warranty.

## 1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by City for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
  - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 2. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
  - 1. Notify City of sources of planting materials seven days in advance of delivery to site.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  - 1. Shade and protect plants from the wind when stored outside.
  - 2. Plants requiring shade shall be stored in a shady/filtered light location or under a temporary sunscreen.
  - 3. Do not store plants on paved surfaces (i.e. (Asphalt, concrete, etc.)
  - 4. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chops, shredded bark, peat moss, or other similar mulching material.
  - 5. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.
  - 6. Do not remove container-grown stock from containers before time of planting.
  - 7. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.



### 1.11 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
  - 1. Spring Planting.
  - 2. Fall Planting.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

### 1.12 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by City.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Trees, Shrubs, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  - 3. Include the following remedial actions as a minimum:
    - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.

### 1.13 MAINTENANCE SERVICE

- A. Initial Maintenance Service (Establishment) for Plants: Provide maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance

immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Establishment Period: Thirty (30) days from date of planting completion.
- B. Maintenance Service for Plants: Provide maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after establishment period is completed, but not prior to final construction punch list for entire project.
1. Maintenance Period Sixty (60) days.

## **PART 2 - PRODUCTS**

### **2.1 PLANT MATERIAL**

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

### **2.2 FERTILIZERS**

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast and slow release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  1. Composition: 1 lb./1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium, in amounts recommended in soil reports from a qualified soil-testing laboratory.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorous, and potassium in the following composition:
  1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium, in amounts recommended in soil reports from a qualified soil-testing laboratory.
- D. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
  1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

## 2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  1. Type: Ground or shredded bark.
  2. Size Range: 2 inches maximum, 1/2 inch minimum.
  3. Color: As indicated on Drawings.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  1. Organic Matter Content: 50 to 60 percent of dry weight.
  2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

## 2.4 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

## 2.5 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
  - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
  - 2. Flexible Ties: As indicated on Drawings.

## 2.6 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWP A U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.
- B. Root Barrier: Root control fabric 24 inches high (deep), as indicated on Drawings.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
  - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by City and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain City's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by City. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. Finish Grading: Grade planting areas to a smooth uniform surface plan with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- B. Before planting, obtain City's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- C. Soil Preparation: As indicated on Drawings.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
  1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  2. Excavate approximately three times as wide as ball diameter for container-grown stock.
  3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  6. Maintain supervision of excavations during working hours.
  7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify City if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
  1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify City if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

### 3.5 TREE, SHRUB, AND GROWDCOVER PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
  - 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
  - 2. Carefully remove root ball from container without damaging root ball or plant.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: As indicated on Drawings.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### 3.6 TREE, SHRUB, AND GROWDCOVER PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Do not apply pruning paint to wounds.

### 3.7 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
  - 1. Upright Staking and Tying:
    - a. Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

### 3.8 INSTALLATION OF ROOT BARRIER

- A. Install root barrier where trees are planted within distance indicated on Drawings from paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.
- B. Align root barrier vertically, and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.
- C. Install root barrier continuously for a distance as indicated on Drawings in each direction from the tree trunk, for a total distance as indicated on Drawings per tree. If trees are spaced closer, use a single continuous piece of root barrier.
  1. Position top of root barrier as indicated on Drawings and according to manufacturer's written recommendations.
  2. Do not distort or bend root barrier during construction activities.
  3. Do not install root barrier surrounding the root ball of tree.

### 3.9 PLACING SOIL IN PLANTERS

- A. Fill planter with planting soil as indicated on Drawings. Place soil in lightly compacted layers to an elevation as indicated on Drawings below top of planter, allowing natural settlement.

### 3.10 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and grasses as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes as indicated on Drawings to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.11 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

### 3.12 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### 3.13 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with City's operations and others in proximity to the Work. Notify City before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.14 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by City.
  1. Submit details of proposed pruning and repairs.
  2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
  3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by City.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.



1. Provide new trees of same size as those being replaced for each tree of 6 inches or smaller in caliper size.
2. Provide one new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
3. Species of Replacement Trees: Same species being replaced.

### 3.15 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off City's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

### 3.16 MAINTENANCE SERVICE

- A. Maintenance Service Planting: Provide maintenance by skilled employees of landscape Installer. Maintain as required per section 3.12 above. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
  1. Maintenance Period: 90 days from date of planting completion.

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## SECTION 331100

### WATER UTILITY DISTRIBUTION PIPING AND APPURTENANCES

#### PART 1 – GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 33 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This section includes furnishing all labor, material, equipment, tools and services required for pipe systems.
- B. The contractor shall comply with the City of Turlock Standard Specifications, except as modified or appended herein.

##### 1.3 SUBMITTALS

- A. Submittals shall be submitted in accordance with the Submittal Procedures section.
- B. Prior to commencement of work, the contractor shall submit in full compliance with all aspects of this section, including but not limited to:
  - 1. Material data
  - 2. Fittings
  - 3. Thrust restraint
  - 4. Valves
  - 5. Fire Hydrants
  - 6. Accessories
  - 7. Appurtenances
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Instructions: Provide manufacturer's installation instructions for pipe, hydrants and valves.
- E. Field Test Reports: Provide results for unofficial hydrostatic and bacteriological tests. City will perform official hydrostatic and bacteriological tests.
- F. Project Record Documents: Refer to General Provisions, Section 5-12 for Record Drawings requirements.

#### PART 2 – PRODUCTS

##### 2.1 MATERIALS

- A. All materials and components used for improvement to City of Turlock Water System shall comply with the latest American Water Works Association (AWWA) Standards including amendments, the National Sanitation Foundation International (NSF International) listings for Water Treatment and Distribution Systems including annexations, and be constructed from "No Lead" materials.
- B. Water Main Pipe

1. Polyvinyl Chloride Pipe (PVC)
  - a. PVC pipe shall conform to AWWA C900 or C905 for all pipes except for diameters larger than 12 inches shall be C905. All pipes shall be Class 150 or 200 for use in municipal water systems and fire protection lines.
  - b. Rubber rings shall conform to manufacturer's recommendations.
  - c. All PVC pipe shall be 20-foot laying lengths and shall have cast iron outside diameter (CIOD).
  - d. The color of the pipe shall be blue to match Under Ground Service Alert color code.
  - e. PVC pipe joints shall have elastomeric-gasket bell ends or couplings. The bell ends shall be integral thickened bell end or integral sleeve-reinforced bell end. The bell end joints shall have a minimum wall thickness of the bell or sleeve-reinforced bell, equal at all points to the Standard Dimension Ratio (SDR) requirements for the pipe. The minimum wall thickness in the ring groove and bell-entry sections shall be equal to or exceed the minimum wall thickness of the pipe barrel.
  - f. Deflection in pipe joints shall not exceed 80 percent of the manufacture's published allowable deflection.
  - g. Acceptable PVC pipe manufacturers are to be Pacific Western, John Mansville, Certainteed or equal.

C. Water Main Fittings

1. Bends, tees and other fittings shall be Ductile Iron, Class 150, for use with Cast Iron Pipe and Ductile Iron Pipe.
2. Steel pipe fittings must be flanged, fusion-bonded and epoxy coated, inside and outside
3. Flanges for steel pipe fittings shall be Class D.
4. Flange Fittings must conform to the AWWA Standard C110.
5. Mechanical Fittings must conform to the AWWA Standard C111.
6. All couplings shall be cement mortar lined in accordance with AWWA C104, and shall be furnished with rubber ring seal joints designed to be used with Class 150 or 200 PVC Pipe, C900 or C905.
7. Steel pipe fittings (for above ground use only) must conform to AWWA Standard C205, C207 and C213.
8. All fittings for use with connection to PVC pipe must use mechanical joints unless a valve is shown adjacent in which case the fitting joint must be flanged.
9. All fittings required to maintain proposed alignment shall conform to these standards, whether or not they are specifically described by the Contract Documents.
10. Contractor shall supply all fittings shown or noted on the plans and fittings not shown or noted on the plans that may be required to maintain proposed alignment.

D. Thrust Blocking

1. Reaction or thrust blocking shall be constructed at bends, tees, dead ends and where changes in pipe diameter occur. Blocking shall be placed between undisturbed ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be that required by the City of Turlock Standard Details. The blocking shall be placed so that the joints of the pipe and fittings will be accessible for repair.

2. Prior to pouring concrete for thrust blocks, the ground must be properly moistened to prevent the ground from absorbing moisture from the concrete.
3. Concrete shall be minor concrete in accordance with Section 90 of Caltrans Specifications.
4. Crosses shall be blocked in place and then cradled with concrete in lieu of a thrust block.
5. All fittings in contact with concrete thrust blocks must be wrapped with a minimum of 6-mil polyethylene plastic. Water main pipe shall not be in direct contact with thrust block.
6. Backfill may be placed on thrust blocks only after the surface has set sufficiently to resist the weight of the backfill. However, newly placed concrete shall be allowed to cure a minimum of 24 hours prior to compacting of backfill. All concrete for thrust blocks shall be placed in the presence of the Engineer.
7. All wood forms and materials used for forming thrust blocks and not suitable for backfill must be removed prior to backfilling. In addition, thrust blocks and other material used for testing and not shown on the plans, must be removed by the contractor.

E. Restrained Pipe and Fittings:

1. Restrained pipe shall be used in areas requiring the use of fittings for vertical bends. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles compatible with ANSI/AWWA C110/A21.10.
2. The restrained flange adapter or mechanical joint restraint shall consist of a plurality of individual actuated gripping wedges to maximize restrain capability. Torque limiting actuating screws shall be used to ensure proper initial set of gripping wedges.
3. The restrained flange adapter shall be capable of deflection during assembly, or allow lengths of pipe to be field cut and a minimum of 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
4. The restrained flange adapter and mechanical joint restraint coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
5. Restrained flange adapter manufacturer and model: EBAA, Inc. Series 2100 Megaflange, or equal.
6. Mechanical joint restraint manufacturer and model: EBAA, Inc. Series 1100 Megalug, or equal.

F. Water Main Valves and Valve Boxes

1. All valves shown adjacent to fittings shall have one mechanical joint and one flange joint. The flange joint will bolt to the fitting.
2. All gate valves shall be the rubber-seated, tight-closing type conforming to AWWA Standard C509. Valves shall open left and be equipped with a 2-inch AWWA operating nut.
  - a. Muller R/S,
  - b. Clow Model R/S,
  - c. Waterous Series 500 R/S,
  - d. Kennedy Ken-Seal R/S,
  - e. Stockham R/W,
  - f. MandH R/S
  - g. American AVK R/S, or equal

3. All butterfly valves shall conform to AWWA Standard C509. Butterfly valves may be installed on main runs only. Valves shall open left and be equipped with a 2-inch AWWA operating nut.
  4. Valve boxes shall be a traffic valve box and lid rated for H-20 traffic loads. The minimum inside diameter of the concrete box shall be 10-3/8 inches. The overall depth of the concrete box shall be a minimum of 12 inches. The valve box lid shall be cast iron.
    - a. Valve cover lids must be labeled "WATER."
    - b. An acceptable valve box manufacturer and product is Christy Concrete Products – G05TBOX "Traffic Valve Box" and G05CT "Cast Iron" lid, or equal.
    - c. Materials to be used for extensions below valve box to valve operating nut shall be 8-inch PVC pipe.
  5. All valves shall be Mueller resilient seat gate valve, American Darling compression resilient seat valve, M & H 3067 AWWA resilient seat gate valve, Kennedy resilient seat gate valve, AVK resilient seat gate valve, or Clow resilient seat gate valve or equal, and shall be the rubber-seated, tight-closing type conforming AWWA C509. Valves shall open left and be equipped with a 2-inch AWWA operating nut. Dresser "450" butterfly valve conforming AWWA C504, or equal, may be installed on main runs only.
  6. Valve boxes shall be Christy G5 with Christy Cast Iron cover or equal. The following materials may be used for extensions: Concrete or 8 inch Polyvinyl Chloride Pipe. All valve boxes shall be installed to finished grade as per the City of Turlock Standard Detail.
- G. Tracer Wire
1. All mains shall include copper tracer wire, #12 in size. The tracer wire shall be connected to all valves and fittings as shown in City of Turlock Standard Drawings.

## **PART 3 – EXECUTION**

### **3.1 WORK SEQUENCE**

- A. Contractor shall submit for approval a work sequence schedule delineating work phasing.
- B. Each group shall maintain and limit shutdowns of the water distribution system to 6-hour durations or as otherwise determined by the City.
- C. Construction activities shall be scheduled in such a manner to limit construction period and site disruption at each to a maximum of 60 working days.
- D. Once excavation and other construction activities begin at a site, all work including permanent trench pavement restoration or native soil backfill and compaction, and installation of water services shall be completed at that site within 30 working days to the satisfaction of the Engineer.
- E. Potholing existing utility locations shall be the first operation within each phase.

### **3.2 INSTALLATION**

- A. Water mains shall be installed in accordance with the Contract Document and AWWA standards for pipe installation.
- B. Handling of Pipes and Appurtenances

1. Proper implements, tools, equipment and facilities satisfactory to the City Engineer shall be provided and used by the Contractor for the safe and efficient execution of the work.
2. All pipe, fittings, valves, hydrants and appurtenances shall be lowered into the trench in such a manner as to prevent damage to pipe fittings.
3. Under no circumstance shall pipe or accessories be dropped or dumped into the trench. Special care shall be exercised so that the coating on pipe, valves and fittings will not be damaged. If such damage should occur, the coating shall be repaired to the satisfaction of the City Engineer. Chain slings will not be permitted.
4. Pipe loaded on trucks or stacked one upon another shall be supported on wooden blocking.
5. Pipe handled sideways shall not be skidded or rolled against pipe already on the ground.
6. All foreign matter or dirt shall be removed from the interior of pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying.
7. All pipe and accessories shall be inspected for defects prior to lowering into trench. Any defective, damaged or unsound pipe or accessory shall be repaired or replaced at the Contractors' expense.

C. Laying Pipe

1. The Contractor shall field verify by potholing, the size, depth and alignment of all existing water mains and services shown on the Improvement Plans or marked in the field by the Underground Service Alert (USA) markings prior to construction. The Contractor shall also field verify by potholing, the size, depth and alignment of all other existing utility crossings shown on the Improvement Plans or marked in the field by the Underground Service Alert (USA) markings prior to construction. If any existing utility is not exactly as shown on the Improvement Plans or otherwise omitted, the Contractor shall notify the City Engineer before proceeding with the installation of any new work until instructions for how to proceed are issued by the City Engineer.
2. Pipe and appurtenances must be installed in accordance with these City of Turlock Standards and per the manufacturer's recommendations. Uniform bearing shall be provided under the full length of the barrel of the pipe. Bell holes shall be provided at each joint, but shall be no larger than necessary for joint assembly.
3. All water mains and services shall be installed to the alignment, elevation and slope as shown on the Improvement Plans. When curved alignment is shown on the plans the maximum deflection at any joint shall not exceed 80 percent of the manufacturer's recommendation for the type of pipe and joint being used.
4. When work is stopped at the end of the work day, the open ends of all water mains shall be closed with watertight blind flange. The blind flange shall not be removed unless the trench is dry.

D. Thrust Blocks

1. Thrust Blocks shall be cast-in-place concrete between undisturbed ground and the fitting to be anchored. The thrust block area for bearing against the soil shall be determined by City of Turlock Standard Details.
2. Prior to pouring concrete for thrust blocks, the ground must be properly moistened to prevent the ground from absorbing moisture from the concrete.

3. All concrete for thrust blocks shall be placed in the presence of the Engineer. Thrust blocking shall be placed so the joints of the pipe and fittings are accessible for future repair.
  4. The thrust block shall extend from the fitting to undisturbed soil, shall be kept clear of the joints, and shall be of such bearing area as to assure adequate resistance to the force to be encountered. In lieu of the above, movement may be prevented by the use of pipe collars and stainless steel rods and other joint restraint devices. When straps are used to secure thrust blocks, they shall be stainless steel.
  5. Backfill may be placed, but not compacted, on thrust blocks after the concrete surface has cured sufficiently to resist the weight of the backfill. Concrete shall be allowed to cure a minimum of 24 hours prior to compaction of backfill. All wood forms and foreign materials used for forming thrust blocks and not suitable for backfill must be removed prior to backfilling.
- E. Valves
1. Valves shall be set plumb and properly fitted to the adjacent sections of the main.
  2. A valve box shall be installed flush to final grade over each valve.
- F. Tracer Wire
1. Tracer (locating) wire shall be laid on top of all pipe listed below and connected at valves per the Standard Details. Tracer tape shall also be installed on:
    - a. All Water mains (PVC and Ductile Iron)
    - b. Fire hydrant runs
    - c. Service lines at
      - i. all dead end streets,
      - ii. services not perpendicular to the water main
- G. Installation of 4-inch and Larger Water Service Pipe
1. Water services shall be installed to the same specifications for water mains and any referenced standards therein.
- H. Connections to Water Mains
1. The Contractor will make all connections to “existing” and “active” water mains and services with a City Water Operations representative present at the time of connection.
    - a. “Existing” water mains means any water main or service 1/2-inch and larger installed previously by another contractor. Existing water mains are part of the current water system and deliver water to customers.
    - b. “Active” water mains means any new water main or service 1/2-inch and larger installed by a previous contractor or the current Contractor. Active water mains have been hydrostatically pressure tested, disinfected with passing negative bacteriological test results and flushed. Active mains are considered part of the current water system but may not yet deliver water to customers.
  2. Temporary Connections for Construction
    - a. Only one temporary connection, including a construction water meter, is allowed for each project. Any remaining connections will be installed by the City upon acceptance of the water mains and before the street or trench is paved. If permanent pavement has been installed, permanent pavement replacement will be completed by the Contractor.



- b. The temporary connection between an existing or active water main and a new water main requires the installation of a new, unused Reduced Pressure backflow prevention device (RP).
- c. The RP must be installed above ground with the proper air gap provided. If the RP is located within a public street or an access road to a developing subdivision site, the RP must be located behind the curb or future curb adjacent to the tie-in point. The RP must be visible for inspection at any time.
- d. The RP device requires a minimum of 3 inspections by the City of Turlock Water Division Cross Connection Specialist:
  - i. Proper configuration and installation per Construction Documents
  - ii. Testing for proper functioning
  - iii. Proper removal once all the newly installed water mains have successfully passed the hydrostatic pressure test, been disinfected with passing negative bacteriological results and flushed.
- e. The Contractor shall install the water main within 6 inches vertically and within 10 feet horizontally from the point of connection to the existing system for all other points of connection (other than the initial temporary connection provided). Water main installation shall not terminate within 5 feet in any direction of any existing utilities and structures.
- f. Temporary connections shall be scheduled at times designated by the City of Turlock Water Division to ensure the least inconvenience to all water users.
- g. No connection (other than the initial temporary connection) shall be made until the new water has been successfully pressure tested, disinfected and flushed per these specifications.
- h. The Contractor is responsible for protecting the existing system from all physical damage and possible contamination during construction.
- i. Temporary Connection from Existing Fire Hydrant
  - i. Prior to connecting to a Fire Hydrant for water use during construction, the Contractor shall obtain a City of Turlock Hydrant Use permit from the City of Turlock Finance Division.
  - ii. The permit shall be taken to the City of Turlock City Hall: 156 S Broadway #150, Turlock, CA. The City Water Division will issue a Hydrant Meter designate a single hydrant for water use during construction.
  - iii. The Contractor will install a Reduced Pressure Principle Backflow Assembly, per Standard Detail #661, after the Hydrant Meter.
  - iv. The hydrant assembly shall be protected at times through the use of traffic delineators (cones), barricades, caution tape and other devices accepted by the City of Turlock.
  - v. The hydrant meter and backflow prevention device must be inspected and tested by the City of Turlock Cross Connection Specialist before use.
  - vi. Three (3) inspections shall be coordinated with the Construction Inspector and conducted by the City's Cross-Connection Specialist. Prior to backfilling the RBPB device, the Contractor shall contact the Construction Inspector for the Project to coordinate inspection with the Cross-Connection Specialist for

proper installation inspection as per Standard Detail #610D. The RPBP device shall be tested for proper operation. The City may accept the water main after all tests have been completed. The Contractor shall properly remove the RPBP device during the inspection of the Cross-Connection Specialist.

- vii. Only one temporary connection, including a water meter, will be allowed for this project during construction. Any remaining connections will be installed by the City before the street is paved and after all pipes have been tested, disinfected and flushed. If pavement has been installed, pavement replacement will be done by the Contractor. The installation of the temporary connection shall be scheduled by the Contractor with the Construction Inspector for the Project.
- j. The Contractor shall install the water main within 6 inches vertically and within 10 feet horizontally from the point of connection to the existing system. Water main installation shall not terminate within 5 feet of any existing utilities and structures.
- k. Connections shall be scheduled at times as designated by the City and in such a manner as to ensure the least inconvenience to all water users.
- l. No connection shall be made until the new work has been tested and disinfected as specified hereinafter. The Contractor shall be responsible for safeguarding the existing system from all damage and possible contamination in the performance of the work. The Contractor shall furnish the pipe and materials necessary for the City of Turlock Water Operations staff to make the final connection to the existing system.

#### I. Hydrostatic Pressure Testing

- 1. After the pipe trench has been backfilled and compacted with 12 inches over the top of the pipe, each section of the pipe to be tested shall be slowly filled with water from the existing system through an accepted temporary backflow prevention assembly and all air shall be expelled from the pipe. Any temporary pipe, fittings, valves, couplings and other materials needed to fill the pipes with water shall be supplied and installed by the Contractor.
- 2. All new, previously untested, fire hydrants, curb stop valves at service locations and blow-offs at dead ends must be opened to purge any air at those high points in the new system.
- 3. The Contractor shall furnish and install any thrust blocks, temporary caps or plugs, and other necessary materials needed to maintain pressures in sections of pipes being tested.
- 4. Partially opened valves will create turbulence through the valve and increase air bubbles in the system. To reduce all air in the new pipe, any inline valve(s) used to control the flow of water into the new section of pipe to be tested must be opened completely before closing the hydrants or blow-offs.
- 5. After the system has been filled with water and all air expelled, all valves at the ends of the section to be tested shall be fully closed. The new main and any new hydrants and services (including any meter idler or meter unit) must be pressurized at system pressure for a period of not less than 24 hours.
- 6. After the 24-hour pressure equalization period, additional water may be needed to complete the hydrostatic pressure test.
- 7. The hydrostatic pressure test requires all mains, hydrants and services (including any meter idler or meter unit) to be pressurized to a minimum gauge pressure of

150 psi or the system pressure plus 50 psi, whichever pressure is greater. The hydrostatic pressure test shall be for a minimum of 2 hours. The pump, gauge and all necessary apparatuses or equipment for the test shall be supplied and installed by the Contractor.

8. During the test, all exposed pipe, fittings, valves, hydrants, and joints will be carefully examined. Any cracked or defective material shall be removed and replaced by the Contractor to the satisfaction of the City Engineer. The test shall be repeated until no defects remain.
9. The pipes in the section being tested will not be accepted if total leakage exceeds the allowable leakage. If leaks are detected, the Contractor shall permanently stop all leaks. All pipes, joints and/or appurtenances which prove defective shall be replaced and the mains on which such defect or defects occur shall be tested again to determine final acceptability of the installation.
10. The formula to be used for allowable leakage of water during a hydrostatic pressure test is:

$$L = \frac{SD\sqrt{P}}{148,000}$$

*L* = testing allowable leakage, in gallons per hour

*S* = length of pipe tested, in feet

*D* = nominal diameter of pipe, in inches

*P* = average test pressure during hydrostatic pressure test, in psi (gauge)

11. Allowable leakage per 1000 linear feet at 150 psi gauge pressure of water main is:

<b>Water Main Size</b>	<b>Allowable Leakage (gallons per hour)</b>
6-inch	0.50
8-inch	0.66
10-inch	0.83
12-inch	0.99
14-inch	1.16
16-inch	1.32
18-inch	1.49
20-inch	1.66
24-inch	1.99

#### J. Disinfection

1. Water mains shall be hydrostatically pressure tested prior to any disinfection. Water mains shall be disinfected in accordance with the Contract Documents and AWWA standards for disinfecting water mains. The Contractor must use one of the following 3 methods to disinfect all new water mains and appurtenances.
  - a. Tablet Method (average chlorine dose of 25 mg/L),
  - b. Continuous-Feed Method (24-hr average chlorine dose of 10 mg/L), or
  - c. Slug Method (3-hr exposure chlorine dose of a minimum 50 mg/L)
2. The Tablet Method consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed. This method may be used only if the pipes and appurtenances are kept clean and dry during construction. This procedure must not be used on solvent-welded plastic or on screwed joint steel pipe because of

the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

- a. When using calcium hypochlorite granules, the granules shall be placed during construction at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals.
- b. The minimum quantity of calcium hypochlorite granules required in ounces (oz) or grams (g) for commonly used pipe sizes are:

Water Main Size	Calcium Hypochlorite Granules	
	1.7 oz	48 g
4-inch	1.7 oz	48 g
6-inch	3.8 oz	108 g
8-inch	6.7 oz	190 g
10-inch	10.5 oz	298 g
12-inch	15.1 oz	428 g
14-inch or larger	D <sup>2</sup> x 15.1	D <sup>2</sup> x 428 g

- c. When using calcium hypochlorite tablets, 5-gram tablets shall be placed during construction in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. The number of 5-g tablets required for each pipe section shall be equal to 0.0012 times the inside pipe diameter (in inches) squared times the length of the pipe section being disinfected (in feet) (0.0012 x d<sup>2</sup> x L) rounded to the next higher integer. The tablets shall be attached by a food-grade adhesive. There shall be adhesive only on the broadside of the tablet attached to the inside surface of the pipe. Attach tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is lowered into place in the trench, the position of the tablets shall be marked on the outside section of the pipe to indicate that the pipe has been installed with the tablets at the top.
- d. The minimum quantity of calcium hypochlorite 5-gram tablets required for commonly used pipe sizes are:

Water Main Size	Calcium Hypochlorite 5-gram Tablets	
	13-ft & less	20-ft
Pipe Section Length	13-ft & less	20-ft
4-inch	1	1
6-inch	1	1
8-inch	1	2
10-inch	2	3
12-inch	3	4
16-inch	4	7

- e. For filling and disinfection contact with the use of the Tablet Method (granules or tablets), the main shall be filled with water at a rate to ensure that the water within the main will flow at a velocity no greater than 1 foot per second (fps). Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 41 degrees Fahrenheit, the water shall remain in the pipe for at least 48 hours.

- f. The City of Turlock Water Division will collect and analyze all samples. A detectable amount of “free” chlorine residual should be found at each sampling point after the 24-hour (or 48-hour, when required) period.
- 3. The Continuous-Feed Method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove air pockets, flushing the main to remove particulates and re-filling the main with chlorinated potable water. The potable water shall be chlorinated so that after a 24-hour contact period in the main there will be a “free” chlorine residual of not less than 10 milligrams per liter (mg/L).
  - a. When using calcium hypochlorite granules in conjunction with the continuous-feed method, the granules shall be placed during construction in pipe sections as specified for the Tablet Method. The purpose of this procedure is to provide a strong chlorine concentration in the first flow of flushing water that flows down the main.
  - b. Preliminary flushing shall be complete before the main is chlorinated, unless granules are used. Preliminary flushing shall be used to eliminate air pockets and remove particulates. The maximum flushing velocity must not exceed 2.5 feet per second. Flushing is not substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity and pigging of the main may be required.
  - c. Flushing for disinfection purposes shall be completed after the preliminary flushing. The water to be used for flushing must be from a temporary, backflow-protected connection to the existing distribution system. The water flow shall be at a constant, measured rate into the newly installed water main through the use of a calibrated and tested flow meter.
  - d. At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of the AWWA Manual M12 “Simplified Procedures for Water Examination”.

K. Final Flushing

- 1. After the applicable retention period for disinfection, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the “free” chlorine concentration in the water leaving the main is between a minimum of 0.4 mg/L and a maximum of 0.8 mg/L. In all cases, the minimum residual concentration shall be no lower than the existing distribution system or 0.4 mg/L, whichever is the greater minimum.
- 2. All heavily chlorinated water must be de-chlorinated utilizing a neutralizing chemical applied to the water to be wasted to thoroughly neutralize the residual chlorine. Disposing of de-chlorinated water to the ground surface, the positive storm drainage system or the sanitary sewer system must be preapproved by permit, issued by the City of Turlock Environmental Regulatory Compliance Administrator before disposal.

**END OF SECTION**

## SECTION 333313

### SANITARY SEWERAGE UTILITIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, City of Turlock Standard Specifications, State of California Standard Specifications, Standard Specifications for Public Work Construction (the “Greenbook”), and American Society for Testing and Materials (ASTM) apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings
  - 2. Pipe liners
  - 3. Pipe encasements
  - 4. Manholes
  - 5. Manhole liners
  - 6. Grout

##### 1.03 DEFINITIONS

- A. Owner: City of Turlock, Utilities Department

##### 1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. All pipe and fittings for each type specified on Plans
  - 2. Pipe liner products
  - 3. Pipe Encasement products
  - 4. Manhole liner products
- B. Shop Drawings:
  - 1. For manholes: Include plans, elevations, sections, details, calculations, and frames and covers.
  - 2. For structures: Include plans, elevations, sections, details, calculations, and covers/hatches.

3. For manhole liners: Include plans and details (shop drawings, see section below).
4. For sheet liners: Include plans and details (shop drawings, see section below).

- C. Cast-in-Place Concrete Design Mixtures: For each concrete mixture. Also, submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Precast Concrete Design Mixtures: For each precast concrete mixture. Include compressive strength and water absorption tests.
- E. Manhole Liner submittals:

The following shall be submitted to the City for approval prior to the start of procurement of materials or manufacture:

1. Liner schedule
2. Material Certifications
3. Test results
4. Material samples
5. Proposed details for installation of liner at seams, terminations, corners, openings, pipe penetrations, etc., and the type of factory and field welds and attachments.

- F. Structural Calculations for manholes and structures wet signed by a California Engineer.

#### 1.05 INFORMATIONAL SUBMITTALS

- A. Product Certificates:

1. For each type of pipe and fitting, from manufacturer.
2. Testing results for all pipe liner products, from manufacturer.
3. Testing results for all manhole liner products, from manufacturer.

- B. Concrete Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials
2. Admixtures
3. Steel reinforcement and accessories
4. Fiber reinforcement
5. Curing compounds

- C. Concrete Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates

- D. Concrete Field Quality-Control Reports



1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe damage and to prevent entrance of dirt, debris, and moisture.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Do not store plastic pipe and fittings in direct sunlight.
- D. Support pipes to prevent sagging and bending.
- E. Handle manholes according to manufacturer's written rigging instructions.

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by City or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify City no fewer than two working days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without City's written permission.

**PART 2 - PRODUCTS**

2.01 GRAVITY SEWER PIPE

- A. Material: Pipe material shall be in accordance with Section 16 of the City of Turlock Standard Specifications.

2.02 MANHOLES

- A. Standard Manholes:
  - 1. Manholes shall be in accordance with the City of Turlock Standard Specifications.
  - 2. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints, except that Portland cement shall be Type II modified cement. Manhole base, riser and cone shall have a minimum compressive strength of 4,000 psi at 28 days. Base section shall be cast-in-place. All manhole structures to be designed for the higher of the following loads: 100 year flood water elevation 73 ft, or H2O loading with water level at structure rim elevation.
  - 3. Diameter: As indicated on Plans and details.

4. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
5. Sections: Minimum thickness for floor slab, walls, and base section as indicated on Plans and details; Base shall be cast-in-place with integral floor, benches, and channels (see "Concrete" section below).
6. Riser Sections: minimum thickness per plans and details, of length to provide depth indicated. Riser rings shall not exceed 12" in height including manhole frame and cover.
7. Transition Sections: Reducer cone or transition slab per plans and details.
8. Top Section: Concentric-cone, or flat-slab-top type as indicated on plans; with top of cone of size that matches grade rings.
9. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
10. Adjusting Rings: Interlocking rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole, frame, and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, total thickness per Plans and details, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
12. Liner: All manholes shall include lining in compliance with the City of Turlock Standard Specifications.

B. Manhole Frames and Covers:

1. Description: Sewer manhole frames and covers shall be South Bay Foundry SBF A-515 with 624 cover or approved equal, in accordance with the City of Turlock Standard Specifications and Standard Detail S-5.

2.03 CONCRETE

A. General: Cast-in-place concrete complying with Section 90 of the State of California Standard Specifications, and the following:

1. Cement: ASTM C 150, Type II
2. Fine Aggregate: ASTM C 33, sand
3. Coarse Aggregate: ASTM C 33, crushed gravel
4. Water: Potable

B. Portland Cement Design Mix: 4000 psi minimum compressive strength at 28 days, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum compressive strength at 28 days, with 0.45

maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
  - a. Invert Slope: As indicated on Plans.
2. Benches: Concrete, sloped to drain into channel.
  - a. Slope: 8 percent

D. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to Section 90 of the State of California Specifications.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

## 2.04 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

## 2.05 PVC SHEET LINER

A. General

### 1. Summary

- a. This section covers the supply, installation, and repair of a PVC sheet liner in the following areas:
  - i. All new manholes.
- b. The plastic liner shall be either PVC or HDPE as specified in Part 2.05 or Part 2.06.
- c. The liner must be continuous and free of pinholes both across the joints and in the liner itself.
- d. All work for and in connection with the installation and repair of the lining of the concrete, and the field sealing and welding joints, will be done in strict conformity with all applicable specifications, instructions, and recommendations of the lining manufacturer.

2. Quality Assurance

- a. Referenced Standards:
  - i. Standard Specifications for Public Works Construction, 2015, "Green Book".

3. Submittals

- a. Shop Drawings:
  - i. See General Provisions.
  - ii. Liner schedule.
  - iii. Material certifications.
  - iv. Test results.
  - v. Material samples.
  - vi. Proposed details for installation of liner at seams, terminations, corners, openings, pipe penetrations, etc., and the type of factory and field welds and attachments.
- b. Fabrication and/or installation of the lining shall not commence until the shop drawings and materials submittals have been reviewed and accepted by Engineer.

4. Measurement and Payment

- a. All items in this specification shall be paid as specified in the General Provisions.

B. Products

1. Acceptable Manufacturers

- a. PVC Liner (in accordance with The City of Turlock Standard Specifications Section 16).
  - i. Ameron T-Lock as manufactured by Ameron Protective Linings Division, Brea, California.
  - ii. Poly-Tee, by Poly-Tee Incorporated.
  - iii. Bekaplast PVC lining system as manufactured by Atlas Minerals and Chemicals, Inc.
  - iv. Or equal.

2. Material

- a. Liner.
  - i. Material used in the liner and in all joint, corner, and welding strips to be a manufactured poly (vinyl chloride), specially compounded to remain flexible.

- ii. Poly (vinyl chloride) resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation.
- iii. Copolymer resins will not be permitted.
- iv. Physical properties:
  - Plastic liner plate sheets, joint, corner, and welding strips to have the following physical properties when tested at 77 Deg F  $\pm$  5 Deg F.

<b>PROPERTY</b>	<b>ASTM TEST METHOD</b>	<b>INITIAL</b>	<b>AFTER CHEMICAL EXPOSURE TEST (a)</b>
Tensile Strength	D-412-Die B	2200 psi min	2100 psi min
Elongation at break	D-412-Die B Instantaneous	200% min	200% min
Shore durometer - Type D	1 Second D2240	50-60	$\pm$ 5% with respect to initial test results
Shore durometer - Type D	10 Seconds D2240	35-50	$\pm$ 5% with respect to initial test results
Weight change	(b)		+/- 1.5% with respect to initial test results

(a) Chemical Exposure Test Requirement listed below.

(b) Specimens shall be 1 IN x 3 IN sample sheet thickness, taken from sheet and strip at any time prior to final acceptance of the Work.

- (1) Liner plate locking extensions embedded in concrete to withstand a pull test of at least 100 pounds per linear IN, applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test is to be conducted at a temperature of 70 to 80 Deg F inclusive.
- (2) All plastic liner plate sheets, include locking extensions, all joint, corner, and welding strips shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material. The Engineer may authorize the repair of such defects by approved methods.
- (3) The lining to have impact resistance, be flexible, and have an elongation sufficient to bridge up to 1/4 IN settling cracks, which may occur in the structure or pipe or in the joint after installation, without damage to the lining.
- (4) The lining shall be capable of being repaired at any time during the life of the pipe or structure. Damage to the liner shall not require complete replacement of liner.

Manufacturer shall provide repair procedures to the City of Turlock to protect structure upon future damage to liner.

- v. Chemical Resistance:
  - After conditioning to constant weight at 110 Deg F, tensile specimens and weight change specimens to be exposed to the following solutions for a period of 112 days at 77 Deg F  $\pm$  5 Deg F.
    - (1) At 28-day intervals, tensile specimens and weight change specimens to be removed from each of the chemical solutions and tested. If any specimen fails to meet the 112-day requirements before completion of the 112-day exposure, the material will be subject to rejection.

CHEMICAL SOLUTION	CONCENTRATION
Sulfuric Acid	20%
Sodium Hydroxide	5%
Ammonium Hydroxide	5%*
Nitric Acid	1%*
Ferric Chloride	1%
Sodium Hypochlorite	1%
Soap	0.1%
Detergent (linear alky benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

\* Volumetric percentages of concentrated C.P. grade reagents.

- vi. Details and dimensions of basic size sheets (4 FT widths):
  - Liner sheets with integral locking extensions to be a minimum of 0.065 IN thickness.
  - Locking extensions (T-shaped) of the same material as that of the liner to be integrally extruded with the sheet.
  - Locking extensions to be approximately 2.5 IN apart and shall be at least 0.375 IN high.
  - Sheets to have a nominal width of 48 IN and a length of not more than 24 FT, except that longer lengths may be supplied on special order.
    - (1) Lengths specified shall include a tolerance at a ratio of  $\pm$  1/4 IN for each 100 IN.

- Sheets not used for shop fabrication into larger sheets to be shop tested for pinholes using an electrical spark tester set at 20,000 volts minimum.
- vii. Sheets and Accessories:
- Linings to be supplied as fabricated by shop welding the basic size sheets together.
    - (1) Shop welds to be made by lapping sheets of a minimum of 1/2 IN and applying heat and pressure to the lap to produce a continuous welded joint. Welding strips shall be approximately 1 IN wide with a minimum width of 7/8 IN. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be nominal 0.94 IN
    - (2) Tensile strength measured across shop-welded joints measured in accordance with ASTM D412 to be at least 2200 psi.
  - Sheets that are strapped on forms to have a transverse strap channels cut in the locking extensions so that the strapping can be placed into perpendicular to the locking extensions.
    - (1) Channels to be not less than 3/4 IN wide and not more than 1 IN wide and to be cut so that a maximum 3/16 IN of the base of the locking extensions remains in the base of the strap channel.
    - (2) Strap channels to be provided at intervals of not less than 15 IN nor more than 20 IN center-to-center.
    - (3) Strap channels will not be cut through the final two locking extensions on each edge of the sheet.
- viii. Corrosion Resistance:
- Joint and welding straps shall have the same corrosion resistance as the sheet lining material. (The joint and welding strips shall be applied by thermal welding methods in the field.)
- b. Installation Products:
- i. Cleaners: Cleaners used in the installation of the liner shall be as recommended by the manufacturer of the liner. Cleaners shall be nonflammable and shall be water soluble or water dispersible and shall not be detrimental to the plastic liner.
- c. Product Delivery, Storage, and Handling.
- i. In accordance with manufacturer's recommendations.

## C. Installation

### 1. General

- a. Installation of the lining, including preheating of sheets in cold weather and the welding of all joints, to be done in accordance with the recommendations of the manufacturer.
- b. Coverage of the lining to be not less than the minimum shown on the plans and specifications.
- c. The lining to be held snugly in place against inner forms by means of steel banding straps or by other means recommended by the manufacturer.
  - i. Banding straps must be located in the precut strap channels to prevent crushing or tilting of the locking extension.
- d. If banding straps are used, a steel channel, angle, or bar may be inserted along the edge locking extension of each liner sheet for cast-in-place structures.
  - i. Banding straps must be located in the precut strap channels to prevent crushing or tilting of the locking extensions.
- e. Concrete poured against lining to be vibrated, spaded, or compacted in a careful manner to protect the lining and produce a dense, homogenous concrete, securely anchoring the locking extensions into the concrete.
- f. In removing forms, care should be taken to protect the lining from damage.
  - i. Sharp instruments not to be used to pry forms from lined surfaces.
  - ii. When forms are removed, any nails that remain in the lining to be pulled, without tearing the lining, and the resulting holes clearly marked.
  - iii. Form tie holes to be marked before ties are broken off and all areas of serious abrasion or damage shall be marked.
- g. All nail and tie holes and all cut, torn, and abraded areas in the lining to be patched.
  - i. Patches made entirely with welding strip to be fused to the liner over the entire patch area.
  - ii. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive.
  - iii. All edges must be covered with welding strip fused to the patch and the sound lining adjoining the damaged area.
- h. Hot joint compounds, such as coal tar, not to be poured or applied to the lining.
- i. Contractor to take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.

## 2. Application to Concrete Structures - Special Requirements

- a. Linear sheets to be closely fitted and properly secured to the inner forms.



- i. Sheets to be cut to fit curved and warped surfaces using a minimum number of separate pieces.
    - ii. If liner joints are to be Type C-3 joints, the adjacent sheets to be butted with not more than 1/4 IN opening between the sheets.
    - iii. A 2-IN-wide water-resistant tape or welding strip to be welded on the back of butt joints to prevent wet concrete from flowing around edges.
  - b. Unless otherwise shown on the plans, the lining will be returned at least 3 IN at the surfaces of contact between the concrete structure and items not of concrete (including access frames, or cast iron pipes).
    - i. The same procedure will be followed at joints where the type of protective lining is changed or the new work is built to join existing unlined concrete.
    - ii. At each return, the return liner will be sealed to the item in contact with the plastic-lined concrete using Amer-Plate 19Y adhesive system, or equal.
- 3. Joints in Lining for Concrete Structures

- a. Lining at joints will be free of all mortar and other foreign material and will be clean and dry before joints are made.
- b. Field joints in the lining will be of the following described types, used as prescribed:
  - i. Type C-1: The joint will be made with a separate 4-IN joint strip and two welding strips.
    - The 4-IN joint strip will be centered over the joint, heat-sealed to the liner then welded along each edge to adjacent sheets with 1-IN-wide welding strip.
    - The width of the space between adjacent sheets will not exceed 2 IN.
    - The 4-IN joint strip will lap over each sheet a minimum of 0.5 IN. It may be used at any transverse or longitudinal joint.
  - ii. Type C-2: The joint will be made by lapping sheets not less than 0.5 IN.
    - One 1 IN welding strip is required.
    - The upstream sheet will overlap the one downstream.
    - The lap will be heat-sealed into place prior to welding.
  - iii. Type C-3: The joint will be made by applying 2 IN wide waterproof tape or 1 IN wide welding strip on the back of the butt joint or by

some other method approved by the engineer to prevent wet concrete from getting under the sheet.

- After the forms have been stripped, a 1 IN welding strip will be applied over the face of the sheet.
- c. All welding is to be in strict conformance with the specifications of the lining manufacturer.

#### 4. Testing and Repairing Damaged Surfaces

- a. After installation, all surfaces covered with lining, including welds, will be tested with an approved electrical holiday detector [Tinker & Rasor Model No. AP-W (or equal) with power pack] with the instrument set to provide 15,000 to 20,000 volts.
  - i. All welds shall be physically tested by a nondestructive probing method.
    - All patches over holes, or repairs to the liner wherever damage has occurred.
- b. Each transverse welding strip which extends to a lower edge of the liner will be tested by the manufacturer's representative.
  - i. The welding strips will extend 2 IN below the liner to provide a tab.
  - ii. A 10-pound pull will be applied to each tab.
  - iii. The force will be applied normal to the face of the structure by means of a spring balance.
  - iv. Liner adjoining the welding strip will be held against the concrete during application of the force.
  - v. The 10-pound pull will be maintained if a weld failure develops, until no further separation occurs.
  - vi. Defective welds will be retested after repairs have been made.
  - vii. Tabs shall be trimmed away neatly by the installer of the liner after the welding strip has passed inspection.

#### 5. Lining Manufacturer Representative

- a. A representative of the lining manufacturer shall visit the jobsite on three separate occasions as follows:
  - i. During lift station construction, taking this opportunity to train the welders.
  - ii. Once after the welding has begun.
  - iii. When the welding is complete.
    - Charges for these visits should be obtained by the Contractor from the lining manufacturer and these charges shall be included in the Contractor's bid.

- b. A representative of the lining manufacturer shall be responsible for providing and documenting testing of the liner.
- c. The weld specimen will be tested by the manufacturer's representative as follows:
  - i. Each welding strip tab, tested separately, shall be subjected to a 45 N (10-pound) pull normal to the face of the liner with the liner secured firmly in place. There shall be no separation between the welding strip and liner.
  - ii. Three test specimens shall be cut from the welded sample and tested in tension across the welds.
    - If none of these specimens fail when tested, the weld will be considered as satisfactory.
    - If one specimen fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory.
    - If two of three specimens fail, the welder will be considered to be an unqualified welder and shall be disqualified.

## 6. Welder Qualification Testing

- a. Each PVC liner welder shall pass a manufacturer accepted qualification welding test before doing any welding. Requalification may be required at any time deemed necessary by the Engineer and shall consist of the following:
  - i. Two pieces of liner, at least 15 IN long and 9 IN wide shall be lapped 1-1/2 IN and held in a vertical position.
  - ii. A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner. Each end of the welding strip shall extend at least 2 IN beyond the liner to provide tabs.

## 2.06 HDPE SHEET LINER

### A. General

#### 1. Summary

- a. This section covers the supply, installation, and repair of a HDPE sheet liner in the following areas:
  - i. All new manholes.
- b. The plastic liner shall be either PVC or HDPE as specified in Part 2.05 or Part 2.06.

- c. The liner must be continuous and free of pinholes both across the joints and in the liner itself.
- d. All work for and in connection with the installation and repair of the lining of the concrete, and the field sealing and welding joints, will be done in strict conformity with all applicable specifications, instructions, and recommendations of the lining manufacturer.

## 2. Quality Assurance

### a. Referenced Standards:

#### i. American Society for Testing and Materials (ASTM):

- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique.
- D 1603 Test Method for Carbon Black in Olefin Plastics.
- D 5199 Standard Test Method for Measuring Nominal thickness of Geotextiles and Geomembranes.
- D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
- D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
- D 1204 Standard test Method for Linear Dimensions Changes of Nongrid thermoplastic Sheeting or Film at elevated Temperature.
- D 696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C With a Vitreous Silica Dilatometer.
- D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- D 570 Standard Test Method for Water Absorption of Plastics
- E 96 Standard Test Method for Water Vapor Transmission of Material.

## 3. Submittals

### a. Shop Drawings:

- i. See General Provisions.
- ii. Liner schedule.
- iii. Material certifications.
- iv. Test results.
- v. Material samples.
- vi. Proposed details for installation of liner at seams, terminations, corners, openings, pipe penetrations, etc., and the type of factory and field welds and attachments.

- b. Fabrication and/or installation of the lining shall not commence until the shop drawings and materials submittals have been reviewed and accepted by Engineer:

#### 4. Qualifications

- a. The HDPE liner specified in this section shall be furnished by a manufacturer who is fully experienced, reputable and qualified in the manufacturing of the materials. The manufacturer must at least 10 years of manufacturing experience.
- b. The HDPE liner and all raw materials and components shall be manufactured or produced in the United States of America.
- c. Locking devices must be extruded to the sheet as a one step process.

#### 5. Measurement and Payment

- a. All items in this specification shall be paid as specified in the General Provisions.

### B. Products

#### 1. Acceptable Manufacturers

##### a. HDPE Liner

- i. GSE Studliner as manufactured by GSE Lining Technology, Inc.

#### 2. Roll dimensions

- a. Concrete protection product shall be produced in rolls that are 8.0 FT (2.4 m) in width and a thickness range of 80 mils (2.0 mm) to 200 mils (5.0 mm) in thickness. Roll lengths vary according to thickness.
- b. Locking studs of the same material as that of the liner shall be integrally extruded with the sheet. Stud spacing shall be on approximate 1.25 IN (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).

#### 3. Materials

- a. The material used in the embedment liner and in all welding strips shall be made from 97-98 percent virgin high density polyethylene and 1.5-3 percent carbon black or pigmentation for the purpose of an otherwise specified color.
- b. Plasticizer shall not be added to the resin formulation.
- c. Concrete protection product and welding strips shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges and be manufactured in the United States of America.

- d. All HDPE cap strips and patches shall be made from coextruded conductive HDPE to facilitate spark testing, have good impact resistance and have an elongation sufficient to bridge up to ¼ IN settling cracks.
- e. Cap strips shall be approximately 6 IN wide or greater and shall be equivalent to that of the liner.
- f. Material shall maintain a repairable state through its lifecycle by methods approved and recommended by the manufacturer.
- g. Concrete protection product shall have the following physical properties:

TESTED PROPERTY	TESTED METHOD	FREQUENCY	NOMINAL VALUE			
Thickness, mm (mil) Density, g/cm <sup>3</sup>	ASTM D 5199	Every 5 <sup>th</sup> roll 1/100,000 ft <sup>2</sup>	2.00 (80)	3.00 (120)	4.00 (160)	5.00 (200)
	ASTM D 1505		0.94	0.94	0.94	0.94
Tensile Properties (each direction) Strength at Yield, lb/in <sup>2</sup> (MPa) Elongation at Break, %	ASTM D 6693, Type IV Dumbbell G.L. = 2.0 IN (50 mm)	1/100,000 ft <sup>2</sup>	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500
Stud Pull-Out Strength <sup>1</sup> , lb/ft <sup>2</sup> (kN/m <sup>2</sup> )		1/product	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)
Carbon Black Content/Pigment Content, % Black (carbon) Gray (pigment)	ASTM D 1603*/421 8 ASTM D 5630, Modified	1/100,000 ft <sup>2</sup>	2-3 1.5-2.5	2-3 1.52.5	2-3 1.5-2.5	2-3 1.5-2.5
Carbon Black Dispersion <sup>2</sup>	ASTM D 5596	1/100,00 ft <sup>2</sup>	Note 2	Note 2	Note 2	Note 2
Notched Constant Tensile Load, hours	ASTM D 5397	1/formulation	1,000	1,000	1,000	1,000
Coefficient of Linear Thermal Expansion, per °C	ASTM D 696	1/product	1 .20E-04	1 .20E-04	1 .20E-04	1 .20E-04
Low Temperature Brittleness, °C	ASTM D 746	1/product	-77	-77	-77	-77
Dimensional Stability, % (each direction)	ASTM D 1204	1/product	±1.0	±1.0	±1.0	±1.0
Water Absorption, %	ASTM D 570	1/product	0.1	0.1	0.1	0.1
Water Vapor Transmission, (g/m <sup>2</sup> /day)	ASTM E 96	1/product	<0.01	<0.01	<0.01	<0.01

TESTED PROPERTY	TESTED METHOD	FREQUENCY	NOMINAL VALUE			
Roll Width, ft (m)			8 (2.44)	8 (2.44)	8 (2.44)	8 (2.44)
Roll Length, ft (m)			246 (74.97)	213 (64.91)	196 (59.73)	196 (59.73)
Roll Area, ft <sup>2</sup> (m <sup>2</sup> )			1,968 (182.83)	1,704 (158.30)	1,558 (145.67)	1,568 (145.67)

NOTES:

- (1) Concrete must have compressive strength of at least 5,000 lb/in<sup>2</sup> (34,500 kPa).
- (2) Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. Nor more than 1 view from category 3.

C. Raw Resin shall have the following properties:

PROPERTY	TEST METHOD	VALUE	TESTING FREQUENCY
Density, g/cm <sup>3</sup>	ASTM D 1505	0.932	1/resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	≤ 1.0	1/resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/formulation

1. Material Supply

- a. Concrete protection product shall be supplied in roll form, sheets, pre-fabricated tubes or panels.
- b. Cap strips shall be supplied in 6 IN widths or greater.

2. Material Handling and Storage

- a. Materials are to be handled as to prevent damage.
- b. The on-site storage location for geomembrane material, provided by the Contractor to protect the liner from punctures abrasions and excessive dirt and moisture. Storage area should have the following characteristics:
  - i. Level (no wooden pallets).
  - ii. Smooth.
  - iii. Dry.
  - iv. Protected from theft and vandalism.

D. Installation

1. General

- a. Installation of the lining, including preheating of sheets in cold weather and the welding of all joints, to be done in accordance with the recommendations of the manufacturer.
  - b. Coverage of the lining to be not less than the minimum shown on the plans and specifications.
  - c. The lining to be held snugly in place against inner forms by means of steel banding straps or by other means recommended by the manufacturer.
    - i. Banding straps must be located in the precut strap channels to prevent crushing or tilting of the locking extension.
  - d. If banding straps are used, a steel channel, angle, or bar may be inserted along the edge locking extension of each liner sheet for cast-in-place structures.
    - i. Banding straps must be located in the precut strap channels to prevent crushing or tilting of the locking extensions.
  - e. Concrete poured against lining to be vibrated, spaded, or compacted in a careful manner to protect the lining and produce a dense, homogenous concrete, securely anchoring the locking extensions into the concrete.
  - f. In removing forms, care should be taken to protect the lining from damage.
    - i. Sharp instruments not to be used to pry forms from lined surfaces.
    - ii. When forms are removed, any nails that remain in the lining to be pulled, without tearing the lining, and the resulting holes clearly marked.
    - iii. Form tie holes to be marked before ties are broken off and all areas of serious abrasion or damage shall be marked.
  - g. All nail and tie holes and all cut, torn, and abraded areas in the lining to be patched.
    - i. Patches made entirely with welding strip to be fused to the liner over the entire patch area.
    - ii. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive.
    - iii. All edges must be covered with welding strip fused to the patch and the sound lining adjoining the damaged area.
  - h. Hot joint compounds, such as coal tar, not to be poured or applied to the lining.
  - i. Contractor to take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.
- Permanent Pavement

## 2. Lining Manufacturer Representative



- a. A representative of the lining manufacturer shall visit the jobsite on three separate occasions as follows:
  - i. During lift station construction, taking this opportunity to train the welders.
  - ii. Once after the welding has begun.
  - iii. When the welding is complete.
    - Charges for these visits should be obtained by the Contractor from the lining manufacturer and these charges shall be included in the Contractor's bid.
- b. A representative of the lining manufacturer shall be responsible for providing and documenting testing of the liner.
- c. The weld specimen will be tested by the manufacturer's representative as follows:
  - i. Each welding strip tab, tested separately, shall be subjected to a 45 N (10-pound) pull normal to the face of the liner with the liner secured firmly in place. There shall be no separation between the welding strip and liner.
  - ii. Three test specimens shall be cut from the welded sample and tested in tension across the welds.
    - If none of these specimens fail when tested, the weld will be considered as satisfactory.
    - If one specimen fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory.
    - If two of three specimens fail, the welder will be considered to be an unqualified welder and shall be disqualified.

### 3. Testing

- a. After installation, all surfaces covered with lining, including welds, will be tested with an approved electrical holiday detector [Tinker & Rasor Model No. AP-W (or equal) with power pack] with the instrument set to provide 15,000 to 20,000 volts.
  - i. All welds shall be physically tested by a nondestructive probing method.
    - All patches over holes, or repairs to the liner wherever damage has occurred.
- b. Each transverse welding strip which extends to a lower edge of the liner will be tested by the manufacturer's representative.

- i. The welding strips will extend 2 IN below the liner to provide a tab.
- ii. A 10-pound pull will be applied to each tab.
- iii. The force will be applied normal to the face of the structure by means of a spring balance.
- iv. Liner adjoining the welding strip will be held against the concrete during application of the force.
- v. The 10-pound pull will be maintained if a weld failure develops, until no further separation occurs.
- vi. Defective welds will be retested after repairs have been made.
- vii. Tabs shall be trimmed away neatly by the installer of the liner after the welding strip has passed inspection.

#### 4. Welder Qualification Testing

- a. Each HDPE liner welder shall pass a manufacturer accepted qualification welding test before doing any welding. Requalification may be required at any time deemed necessary by the Engineer and shall consist of the following:
  - i. Two pieces of liner, at least 15 IN long and 9 IN wide shall be lapped 1-1/2 IN and held in a vertical position.
  - ii. A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner. Each end of the welding strip shall extend at least 2 IN beyond the liner to provide tabs.

### **PART 3 – EXECUTION**

#### 3.01 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 02 Section 312316 "Trenching, Backfilling, and Compacting."

#### 3.02 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout takes into account design considerations. Install piping as indicated on Plans.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install piping free of sags and bends.
- D. Install manholes for changes in direction unless fittings are indicated.

- E. Install gravity-flow, nonpressure, piping according to the following:
  - 1. Install piping pitched down in direction of flow, at slope indicated on Plans.
  - 2. Ensure piping has 42-inches minimum cover when subject to any loading.
  - 3. Install ductile-iron, gravity sewer piping according to ASTM A 746 and applicable standards for pressure piping in the section below.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
- G. Sanitary sewer pipe installation shall comply with the City of Turlock Standard Specifications.

### 3.03 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure piping according to the following:
  - 1. Join gravity sewer piping according to AWWA C600 for push-on joints.
- B. Ream ends of pipes and tubes and remove burrs.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Sanitary sewer pipe joint installation shall comply with the City of Turlock Standard Specifications.

### 3.04 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. All manhole bases shall be cast-in-place per City of Turlock Standard Specifications.
- E. Set tops of frames and covers as shown on the plans and details.
- F. All manhole installations shall comply with the City of Turlock Standard Specifications.

### 3.05 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to the City of Turlock Standard Specifications.

### 3.06 CONNECTIONS

#### A. Make connections to manholes.

1. Protect existing piping and manholes to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
2. All connections shall comply with the City of Turlock Standard Specifications.

### 3.07 MANHOLE LINER INSTALLATION

#### A. General

##### 1. Summary

###### a. Section Includes:

- i. Methods of installing epoxy lining system for existing manholes.

##### 2. Quality Assurance

###### a. Referenced Standards:

- i. Drawings and general provisions of the Contract, including General and Supplementary Conditions, City of Turlock Standard Specifications, State of California Standard Specifications, Standard Specifications for Public Work Construction (the "Greenbook"), and American Society for Testing and Materials (ASTM) apply to this Section. Section 26 "Aggregate Bases"

##### 3. Definitions

- a. Owner: City of Turlock

##### 4. Measurement and Payment

- a. All items in this specification shall be paid as specified in the General Provision.

#### B. Products

##### 1. Materials

- a. Manhole liner

##### 2. Shop Drawings

- a. Plan and details.

### 3. Submittals

- a. The following shall be submitted to the City for approval prior to the start of procurement of materials or manufacture:
  - i. Liner schedule
  - ii. Material Certifications
  - iii. Test results
  - iv. Material samples
  - v. Proposed details for installation of liner at seams, terminations, corners, openings, pipe penetrations, etc., and the type of factory and field welds and attachments.

### C. Execution

#### 1. Installation and Application

- a. Lining Material shall consist of solvent free, high-build epoxy resin capable of spray application to 125mils (3mm) minimum thickness in one continuous coat.
- b. Existing surface to be prepared per liner specifications.
- c. Lining material shall be applied to all prepared surfaces from 1 inch (25mm) below the low-flow water level to the base of the ring and cover unless otherwise specified in the Special Provisions. Termination points of the lining to the existing subsurface shall be keyed into the subsurface by mechanically scoring a minimum ¼ inch x ¼ inch (6mm x 6mm) keyway. Epoxy shall be applied to a thickness of 125 mils (3mm). Lining material shall be uniform in color, fully cured, free of holidays, surface imperfections, blisters and sags and adequately adhered to the subsurface.
- d. The set or cured lining materials shall be tested as described below:
  - i. The party performing the following tests shall be as specified in the Special Provisions. If the testing party is to be selected by the Contractor, the name of the testing party and information on the testing instruments to be used for adhesion testing and its calibration shall be submitted to the Engineer.
  - ii. Spark Test. The cured lining system shall be spark tested for holidays with the high voltage holiday detector instrument specified by the coating manufacturer or as specified in the Special Provisions. The voltage shall be set at a minimum of 15,000 volts. For thicknesses greater than 150 mils (4mm), the voltage shall be set at 100 volts per 1 mil (25µm) of thickness of the applied lining material. Identified holidays shall be marked without contaminating

the lining surface and repaired in accordance with Liner Repairs listed below.

- iii. Mil Gauge Test. During installation, a mil gauge shall be used to verify that the minimum thickness of the lining meets and /or exceeds the minimum thickness specified herein or specified in the Special Provisions.
- iv. Adhesion Testing. Adhesion testing shall be performed on a minimum of 1 structure or 15 percent of all rehabilitated structures, whichever is greater, or as shown on the Plans and/or specified in the Special Provisions. Adhesion testing shall be conducted after the liner system has cured in accordance with the manufacturer's specifications. Adhesion testing shall be in accordance with ASTM D4541 as modified herein.

A minimum of one  $\frac{3}{4}$  inch (19mm) dolly shall be affixed to the lined surface of the host structure at the upper section or cone area, the midsection, and at the bottom, unless otherwise specified in the Special Provisions. Each testing location shall be identified by the Engineer. The adhesive used to attach the dollies to the liner shall be rapid setting with tensile strength in excess of the liner material and permitted to cure in accordance with manufacturer's specifications. The lining material and dollies shall be prepared to receive the adhesive in accordance with the manufacturer's specifications. Prior to the pull test, the tester shall utilize a scoring device to cut through the coating until the substrate is reached. Failure due to the improper dolly adhesive or scoring will require retesting. The pull tests in each area shall meet or exceed 200 psi (1,400kPa) and shall include substrate adhered to the back of the dolly or no visual signs of coating material in the test hole. Pull tests with results between a minimum 150 psi (1,000kPa) and 200 psi (1,400kPa) may be acceptable if more than 50 percent of the substrate adhered to the back of the dolly. A test result may be disregarded, as determined by the Engineer, if there is a valid nonstatistical reason as specified in Sections 8.4 and 8.5 of ASTM D4541. If any test fails, a minimum of 3 additional locations in the section of the failure shall be tested, as directed by the Engineer. If any of the retests fail, all loosely adhered or unadhered liner in the failed area, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. If a host structure fails the adhesion test, one additional host structure or 10 percent of the initial number of host structures selected for testing shall be tested as directed by the Engineer or as specified in the Special Provisions.

- v. Liner Repairs. Holidays, uncured lining material, blisters, surface imperfections and damage to the liner resulting from the adhesion test shall be repaired to a point 1 inch (25mm) minimum beyond the

limits of the damaged area. The repair shall be 125 mils (3mm) thick or the minimum thickness specified in the Special Provisions. Holidays shall be primed and recoated with the same lining system to a minimum additional thickness of 30 mils (750µm) unless otherwise specified by the liner manufacturer or approved by the Engineer. Blisters, uncured lining and surface imperfections shall be completely removed and the areas recoated with appropriate lining material to 1 inch (25mm) minimum beyond the repair areas at a minimum thickness of 100 mils (500µm). Additional spark testing shall be performed after repairs are completed.

- e. Performance Requirements. The lining system shall meet or exceed the following specifications

	<b>Epoxy Liner</b>
Tensile Strength ASTM D638, Type IV, psi (Mpa) (min)	3,000 (21)
Elongation at Break, % ASTM D638, Type IV	0.9
Wear Resistance, mg. wt. Loss Taber abrasion, ASTM D4060	115 <sup>1</sup>
Hardness, shore D, Durometer ASTM D2240	80
Weight Change <sup>2</sup>	±1.5%

- 1. Abrasive wheel No. CS-17, maximum value.
- 2. Tested in conformance with Chemical Resistance (Pickle Jar) Test.

### 3.08 IDENTIFICATION

- A. Materials and their installation are specified in Division 02 Section "Excavation." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
  - 1. Use detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

### 3.09 FIELD QUALITY CONTROL - UTILITY SYSTEM

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:
  - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
  - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
  - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
  - f. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - g. Gates with leakage rates out of conformance with the specifications.
  - h. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects. All testing shall comply with the City of Turlock Standard Specifications and the following requirements. All tests shall be completed at the contractor's expense.

1. Do not enclose, cover, place permanent resurfacing, or put into service before inspection and approval.
2. Test completed piping systems according to requirements listed in the City of Turlock Standard Specifications. This standard includes leakage tests, low pressure air tests, and televised inspection. Additional testing specified in these project specifications shall be completed in accordance with the applicable standards.
3. Schedule tests and inspections with at least 24 hours advance notice to the City of Turlock, Utilities Department.
4. All testing shall be completed under supervision of a representative from the City of Turlock Utilities Department.
5. Submit separate report for each test.
6. Prior to testing, all sewer lines shall be cleaned and flushed by methods specified in the City of Turlock Standard Specifications.
7. Following completion of each gate installation, the gates shall be operated through at least two complete open/close cycles. Gates shall be checked by contractor and verified to meet leakage rate requirements specified.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping, valves, or gates using new materials, and repeat testing until leakage is within allowances specified.



### 3.11 FIELD QUALITY CONTROL - CONCRETE

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
  - 1. Verification of use of required design mixture.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to Section 90 "Portland Cement Concrete" of the State Of California Specifications shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least one composite sample for each 100 to 150 cu. yd. or fraction thereof of each concrete mixture placed each day.
  - 2. Slump: According to State Specifications and the following; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 3. Compression Test Specimens: In Accordance with Section 90 of the State of California Specifications and California Test 539 and 540.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
  - 4. Compressive-Strength Tests: In Accordance with Section 90 of the State of California Specifications and California Test 521; test one laboratory-cured cylinder at 7 days, test one laboratory-cured cylinder at 14 days, test two laboratory-cured cylinders at 28 days, and hold one cylinder.
  - 5. Test results shall be reported in writing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for 7, 14, and 28-day tests.
  - 6. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - 7. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### 3.12 CLEANING AND CCTV INSPECTION OF SEWERS

- A. General
  - 1. Description

a. Scope:

- i. The Contractor shall perform Closed Circuit Television (CCTV) inspections of the project pipelines above the flow line and, where possible, record any defects discovered below the flow line. The Contractor shall perform CCTV inspections of sewer mains and lateral connections prior to pipe bursting and CIPP lining, to verify and identify existing pipeline conditions and lateral locations. The Contractor shall perform CCTV inspection of new and rehabilitated sewer mains and laterals. The Contractor shall clean sewer mains prior to pipe rehabilitation, as necessary for closed circuit television (CCTV) inspections, and cleaning of sewer main and laterals after replacement or rehabilitation.

b. Requirements

- i. The Contractor shall inspect the sewer interior using a color CCTV and document the inspection on a digital recorder. All inspection video shall be submitted in MPEG file format (.mpg) and saved on USB hard drive for submittal. Files submitted on proprietary software are not permitted. Each inspected sewer reach, manhole to manhole, should have an associated MPEG file. Electronic PDF (.pdf) files of each inspection log and digital photographs (.jpg) files shall accompany the video inspections for each sewer reach (manhole to manhole and including laterals) inspected. The nature of the pre-rehabilitation inspections shall be to verify condition of the existing sewers, locating and logging defects such as obstacles and breaks that would prevent pipe bursting activities, and to provide a permanent record of the existing sewer and lateral condition as it relates to line dimensions, material, changes and connections.

2. Quality Assurance

- a. Contractor's Qualifications: The Contractor shall have a minimum of three (3) years of experience in such work necessary to successfully meet this specification and provide references for five (5) sewer inspection projects involving remote CCTV pan and tilt inspection.
- b. The Contractor shall have all operators who are responsible for locating and logging defects into the data collection software successfully trained and certified through National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP).
- c. The nature of the post-rehabilitation inspections will be to verify condition of the new sewer and to provide a permanent record of the new sewer and lateral conditions and lateral connection locations.

3. Submittals

- a. The following submittals shall be provided in accordance with the City of Turlock General Provisions Section 5.02 – Submittals:
- i. Submit resumes and project references for the field personnel who will be employed for this project, including the NASSCO PACP Certification number for each operator.
  - ii. Manufacturer's product literature for all video equipment including but not limited to cabling, camera, monitor, footage counter, video titling device, and recorder.
  - iii. Written documentation for arrangements of legal disposal of all liquids and materials removed from pipelines and manholes during cleaning.
  - iv. Contractor shall submit a written procedure indicating cleaning methods, cleaning equipment to be used, and describing all procedures. A cleaning schedule shall be submitted in writing for approval a minimum of seven (7) days before cleaning is to start. Cleaning shall not begin until submitted plan is approved by the City Weight tickets for hauling and disposing of materials.
  - v. The Contractor shall provide to The City of Turlock pre-installation and post-installation videotapes and suitable log for each sewer line. All CCTV inspection shall utilize USB hard drives for documentation, with each sewer reach inspection recorded as an individual movie file (.mpeg, .mpg). Unedited recordings and an electronic PDF (.pdf) file of each inspection log shall be provided to the City of Turlock five (5) working days prior to sewer replacement and within three (3) working days after the sewer installation. If post-rehabilitation inspection recordings are not submitted within three working days of the rehabilitation, the City may, at their discretion, suspend any further rehabilitation until the post-rehabilitation recordings are submitted. As a result of this suspension, no additional working days will be added to the contract, nor will any adjustment be made for increase in cost.
  - vi. A log shall be submitted with each recording. The log shall identify the sewer line by manhole numbers, street location, and plan sheet number. The log shall include the cleaning date, inspection date, location, distance, length, and depth of water for any sags, and any repairs necessary. The post installation log shall also include the inspection date, location, and distance of all reconnected side sewers, debris, as well as any other defects in the new sewer including, but not limited to, gouges, cracks, bumps, or bulges. A sample form will be required prior to any inspection for review and acceptance.

All forms and documentation of piping defects and information databases shall be in compliance with NASSCO formats and record keeping.

vii. Pre-rehabilitation inspection log: Submitted with each pre-rehabilitation video recording. The log shall identify the sewer line by manhole numbers, street location, and plan sheet number. The log shall include:

- The cleaning and inspection dates.
- Location and alignment length.
- Location of all laterals.
- Pipeline sags: length and depth
- Grade breaks: type and location
- Documentation and detailed description of defects and any repairs necessary prior to rehabilitation, including distance from nearest manhole and conformance to cleaning requirements.

viii. Post-rehabilitation inspection log: Submitted with each post-rehabilitation video recording. The log shall identify the sewer line by manhole numbers, street location, and plan sheet number. The log shall include:

- The inspection dates.
- Location and alignment length.
- Location and description of all debris in the sewer.
- Defects in the liner, including, but not limited to, gouges, cracks, bumps, wrinkles, or bulges.
- Defects in the pipe installed by open-cut method, including, but not limited to sags, offset joints, or cracks.
- Location and inspection of lateral reinstatements, and connection to manholes.

#### 4. Previous Inspection Video Recording And Reports

- a. Video recordings and reports of the sewers are available for review at the City of Turlock. The City makes no express or implied guarantee as to the accuracy or the completeness of the information contained on the video recordings. The Contractor must make their own judgment as to the condition of the sewers and the quantity of cleaning necessary and must not rely on the description provided on the video recordings.

### B. Products

#### 1. Sewer Main CCTV Camera

- a. The camera(s) shall be operative in 100 percent humidity/submerged conditions. The CCTV camera equipment shall provide a view of the pipe ahead of the equipment and of features to the side and rear of the equipment through turning and rotation of the lens. The camera shall be capable of tilting at right angles along the axis of the pipe while panning the camera lens through a full circle about the circumference of the pipe. The lights on the camera shall also be capable of panning 90-degrees to the axis of the pipe. If the equipment proves to be unsatisfactory, it shall be replaced with adequate equipment. The camera unit shall have sufficient quantities of line and video cable to inspect sewers with access as far apart as 800 feet.
- b. The CCTV camera, electronic systems and monitor shall provide an image that meets the following specifications:
  - i. The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five stages.
  - ii. With the monitor control correctly adjusted, the six colors - Yellow, Cyan, Green, Magenta, Red, and Blue, plus Black and White, shall be clearly resolved with the primary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no color tint.
  - iii. The picture shall show no convergence or divergence over the whole of the picture. The monitor shall be at least 13 inches diagonally across the picture tube.
  - iv. The live picture on the CCTV monitor shall be capable of registering a minimum of 500 lines horizontal resolution and be a clear, stable image with no interference.
- c. Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus picture of the entire inside periphery of the sewers and laterals for all conditions except submergence. Under ideal conditions (no fog in the sewer) the camera lighting shall allow a clear picture up to five pipe diameter lengths away for the entire periphery of the sewer. The lighting shall provide uniform light free from shadows or hot spots.
- d. Camera focal distance shall be remotely adjustable through a range of 6 inches to infinity.
- e. The monitor and software shall also be able to capture and save screen images of typical sewer details and all defects. Screen image files shall be named using upstream manhole number and footage and submitted on DVD following last paragraph, 3.12 C 8, this section.

## 2. Lateral Camera

- a. Lateral cameras shall be self-righting color. Monitor resolution shall be as specified in paragraph 3.12 B 1. The lateral camera may be pushed from cleanouts to the sewer main using sewer rods or inserted from the main pipeline using a “lateral launched” camera. Maximum rate of travel shall be 30 feet per minute when recording.

### 3. Video Recordings

- a. The video and audio recordings of the sewer inspections shall be made using digital video equipment. The digital recording equipment shall capture sewer inspection on DVD with each sewer reach inspection recorded as an individual movie file (.mpeg, .mpg). The files shall be named according to Upstream/Downstream manhole numbers or per requirements established elsewhere in the Contract Documents.
- b. The audio portion of the composite video shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of the oral report. Audio shall be recorded by the operating technician on the inspection video as the sewer is inspected and shall include the sewer location, identification of beginning and terminating manholes including location (address or cross streets), inspection direction, length of inspection, side sewer identification, flow information, complete descriptions of the sewer line conditions as they are encountered, description of the rehabilitation work, reason for termination, and other relevant commentary to the inspections. In addition, the audio reports shall include the distance traveled on the specific run, a description of abnormal conditions in the sewer and side sewer connections as they are encountered, explanations for pausing, backing up, or stopping the survey, and the final measured center to center distances between consecutive manholes. Audio dubbing after the inspection is prohibited.
- c. The reaches shall be inspected from upstream to downstream, wherever possible. The images recorded on the CCTV video shall be the same images that are required to be displayed on the CCTV monitor. The footage counter shall be zeroed at the beginning of each inspection and at each intermediate manhole along the inspection run. The video recorder shall be paused if the camera progress is stopped for a period longer than 30 seconds due to breakdown of the equipment, or any purpose other than analyzing conditions of the sewer. The operator shall document the delay on the recording when progress resumes.
- d. The equipment used for the inspection must provide for simultaneous monitoring of the in-sewer inspection by the City of Turlock. Equipment that does not allow for out of sewer observation of the inspection will not be allowed.
- e. Typed labels shall be attached to the face of each CD or DVD. The typed index labels shall include the following information:

- i. Content (CCTV)
  - ii. Contractor name
  - iii. Type of survey (CCTV)
  - iv. Project name
  - v. Reaches included (from Manhole Number ## to Manhole Number ##)
  - vi. Date of survey
  - vii. Work order number (if applicable)
  - viii. Sheet numbers in plans
- f. The inspection video shall be delivered on a medium that is not re-recordable. Contractor shall maintain a copy of all inspection documentation (electronic information, databases, and logs) for the duration of the work and warranty period.

#### 4. Cleaning Equipment

##### a. General

- i. All equipment specified in this section shall be in good working condition and manufactured or fabricated to withstand the severity of the work covered under this section.

##### b. High Velocity Hydraulic Equipment

- i. The equipment shall be truck mounted. Water jet cleaning equipment shall include a water tank, auxiliary engine, pumps, and hydraulically driven hose reel. Nozzles shall be capable of producing a jet stream angle of 15 to 45 degrees from the horizontal and shall be able to produce flows from fine spray to a solid stream. The Contractor shall also provide a high velocity water gun with sufficient discharge and pressure for washing and scouring of manhole interiors.

##### c. Balling

- i. Hydraulic cleaning of sanitary sewers shall be through high pressure balling. Ball shall be a heavy rubber ball such as “Wayne Ball” manufactured by Sidu Company, Long Beach, California, or approved equal.

##### d. Root Removal

- i. If root removal is necessary for the inspection, the Contractor shall employ sewer-cleaning equipment to cut all roots encountered back to the pipe surface.

##### e. Debris Removal

- i. Sludge, dirt, sand, rocks, grease, and other solids or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing materials from manhole section to manhole section will not be permitted.
- ii. Trucks hauling solids or semi-solids from the site shall be watertight so that no leakage or spillage will occur. Under no circumstances shall sewerage or solids be dumped onto the ground surface, streets, in the sewer system, catch basins, or storm drains. Material must be disposed of legally and arrangements for disposal shall be made by the Contractor prior to the start of the project. Clear water, with no solids, soil, debris or turbidity may be discharged back to the sewer. The Contractor shall be responsible for paying all disposal costs and fees.

5. Product Data

- a. The Contractor shall provide the following information:
  - i. TV inspection reports as specified in Reports, 333313-3.12 C 8 shall be submitted each week covering the previous week's work.

C. Execution

1. General

- a. The CCTV camera shall be positioned as close to the springline as possible while maintaining the required equipment stability. If the flow levels are above the spring line, then the vertical position of the camera shall be just above the free water surface. The Contractor shall also attach a 1-inch gauge in front of the camera to visually monitor for vertical sagging along the main pipeline. The Contractor shall inspect and document all manholes encountered during the inspection activities. The camera shall pan the periphery of the manhole from casting to invert. Inspections shall be conducted during low flow periods to increase the viewable sidewall area of the pipe.
- b. The speed that the camera or survey unit is conveyed through the sewer while performing general inspections shall be uniform and shall be limited to a maximum of 30-feet per minute. The survey unit shall be slowed, stopped, or backed-up to perform detailed inspections of significant features. The camera shall be stopped at all defects, changes in material, water level, size, side connections, manholes, junctions, or other unusual areas. When stopped at the defect or feature, the operator shall pan the camera to the area and along the circumference of the pipe. The operator shall also record audio of the type of defect or feature, clock position, footage, extent or other pertinent data. Still photographs or screen captures shall be taken at all



defects and general line condition photographs shall be taken at least every 200 feet.

- c. During period of camera advancement along the reach, the operator shall pan to view the flow line conditions along both sides of the pipe and the crown at regular intervals. This may be done while the camera is moving forward as long as the recorded picture quality is not adversely affected. When viewing the flow line area, the camera shall be returned to the forward position providing a full view of the pipe before panning to view the opposite side of the sewer or the crown conditions.
- d. At the Contractor's discretion or direction of the City of Turlock, the camera shall be stopped or backed up (when conditions allow) to view and analyze conditions that appear to be unusual or uncommon for a sound sewer. The lens and lighting shall be readjusted, if need be, in order to ensure a clear, distinct, and properly lighted feature. The video recorder shall be paused if the camera progress is stopped for a period longer than 30 seconds due to breakdown of the equipment, or any purpose other than analyzing conditions of the sewer. The operator shall document the delay on the recording when progress resumes.
- e. The Contractor shall be responsible for all traffic control measures required during periods of sewer inspection.

## 2. Linear Measurement

- a. The Contractor shall measure the camera progress along the full length of each reach. The length counter shall be zeroed at the beginning of each inspection, and at any intermediate manhole. In the case of resuming an inspection at an intermediate point along the pipeline, the length counter shall start at the last point recorded. The Contractor shall ensure that the counter starts to register immediately when camera progress starts. The device shall be observable at ground level. Markings on the cable, instruments requiring observation inside a manhole, or correction of the length for the depth of the manhole are not acceptable.
- b. Prior to commencing inspections, the Contractor shall demonstrate compliance with the linear measurement tolerance specified below:
  - i. The equipment shall measure the location of the camera unit in 1-foot increments from the beginning (upstream end) of each continuous section. This footage location must be displayed on the CCTV monitor and recorded.
  - ii. The accuracy of the measured location shall be within + 0.5% of the actual length of the sewer reach being surveyed, or 1 foot, whichever is greater.

### 3. CCTV Monitor Display

- a. The images displayed on the CCTV monitors shall be a view of the pipe above the water surface as seen by the CCTV camera as the unit is conveyed through the sewer.
- b. The camera lighting shall be fixed in intensity prior to commencing the survey and the white balance set to the color temperature emitted. In order to ensure color constancy, ideally no variation in illumination shall take place during the survey.

### 4. Data Displays

- a. The CCTV images shall include an initial data display that identifies the sewer reach being surveyed and a survey status display that provides continuously updated information on the location of the survey unit as the survey is being performed. These data displays shall be in alphanumeric form. The size and position of the data shall not interfere with the main subject of the monitor picture.
- b. The on-screen display should be white during inspections where the background behind the display is dark and, conversely, black where the background is light.
- c. At the beginning of each reach of sewer being inspected, the following information shall be electronically generated and displayed on the CCTV monitors as well as included in the audio track:
  - i. Date of survey
  - ii. Project name/location
  - iii. Manhole number to manhole number (in order of inspection)
  - iv. Direction of survey (upstream or downstream)
  - v. Time of start of survey.
- d. During inspections, the following information shall be electronically generated, automatically updated, and displayed on the CCTV monitors:
  - i. Survey unit location in the sewer line in feet and tenths of feet from adjusted zero
  - ii. Sewer diameter
  - iii. Manhole reference numbers (upstream and downstream manholes in order of survey direction).

### 5. Manhole Numbering, Inspection Forms and Defect Codes

- a. The Contractor shall use The City of Turlock's manhole numbering system and reference manhole numbers as identified on the Contract Documents when performing the inspections for this project. The entire manhole number must be used when referring to an upstream/downstream manhole for a pipe

reach. Defect codes shall conform to those specified in the NASSCO PACP specification.

6. Cleaning

a. General

- i. Cleaning of sewer lines prior to CCTV inspection is the responsibility of the Contractor and shall be completed as necessary to ensure that no blockages exist. The term 'clean' in this specification is defined as the removal of all accumulations including sludge, dirt, sand, rocks, asphalt, concrete, grease, roots, and any other solid or semisolid material in the pipe down to the parent material with 100 percent debris removal. It will be the Contractor's responsibility to make as many cleaning passes as necessary to meet the above definition of 'clean.' Acceptance of the cleaning, as determined by the Construction Manager, shall be based upon the subsequent CCTV inspection of the line.
- ii. If the camera cannot pass the entire sewer reach from its starting direction, the reach shall be inspected as much as possible from both upstream and downstream directions. If the pipe can not be fully inspected from either the upstream and downstream manholes the Contractor shall notify the Construction Manager. Such notification shall be written and include manhole to manhole reach numbers and the reason why inspection cannot be completed.
- iii. Selection of equipment shall be based on field condition such as access to manholes, quantity of debris, size of sewer. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewers and manholes.
- iv. The Contractor shall use a basket in the downstream manhole of the cleaning operation and capture all debris. At the City of Turlock option, the Construction Manager may photo document the contents of the debris in the basket.
- v. If any Contractor equipment becomes stuck in the sewer, the Contractor shall be responsible for all costs associated with extracting the equipment from the sewer.
- vi. Any damages to public or private property resulting from Contractor activities shall be repaired by the Contractor at no cost to the City of Turlock.

b. Cleaning of Existing Sewer Mains Prior Rehabilitation by CIPP or SPR

- i. Contractor cleaning shall remove all sludge, rocks, debris, roots, grease accumulations and obstructions from the sewer main as necessary for the rehabilitation as required by the CIPP or SPR manufacturer. Debris from cleaning operations shall be captured in the downstream manhole in accordance with the provisions of this Section. Additional sewer cleaning activities shall be in compliance with Section 02319, Sewer Rehabilitation Using Machine Spiral-Wound PVC Liner Method, or Section 02320, Sewer Rehabilitation Using Cured-in-Place pipe Method.
  - c. Cleaning of New or Replaced Sewer Main:
    - i. The contractor shall clean all new sewer mains and laterals after all backfilling, and before testing, CCTV inspection and final pavement placement.
- 7. Site Restoration
  - a. After televising a reach or reaches in an area, the work site shall be cleaned and restored to pre-work conditions.
- 8. Report
  - a. Two copies of the pre-rehabilitation and post-installation (4 copies total) inspection videos in sequential order from upstream manhole to downstream manhole saved in mpeg format on USB hard drives; electronic version (.jpg) of still photographs saved on a USB hard drive; a digital Microsoft Access database conforming to the NASSCO PACP database standard populated with all inspection and defect information; and hard copies and electronic pdf files of the inspection logs shall be submitted to the City of Turlock for review and approval. Electronic information submittals that do not conform to the specifications shall be re-recorded in the field at the Contractor's expense. Original CCTV video and re-recorded runs shall be edited to provide a record with all inspections in sequential order from upstream to downstream. Electronic information not in sequential order are unacceptable.
  - b. The TV inspection report shall include video recordings, pictures and any City of Turlock required inspection forms and defect codes. Contractor shall provide equal documentation on both the videos and forms. Contractor shall maintain a copy of all report material. The Contractor shall provide comments as necessary to fully describe the existing condition of the sewer, both through the voice over on the videos and on the inspection forms. Photographs shall further document both typical sewer features, and defects. The photographs shall be copied to a USB hard drive and submitted to the City along with the videos and logs.

**END OF SECTION**

## SECTION 334100

### STORM UTILITY DRAINAGE PIPING

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 17, "Storm Drain Collection System" of the City of Turlock Standard Specifications, latest edition.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings
  - 2. Nonpressure transition couplings
  - 3. Expansion joints and deflection fittings
  - 4. Drains
  - 5. Encasement for piping
  - 6. Manholes
  - 7. Catch basins
  - 8. Stormwater inlets

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
  - 2. Stormwater inlets: Include plans, elevations, sections, details, frames, covers, and grates.
  - 3. French Drain system: Include plans, elevations, sections, details, risers, stubs, assembly, and pipe storage.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle stormwater inlets according to manufacturer's written rigging instructions.

## 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by City or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify The City no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without City's written permission.

## **PART 2 PRODUCTS**

### 2.1 PIPE AND FITTINGS

- A. Pipe and fittings shall be SDR26 PVC or HDPE and shall comply with the requirements of Section 64 "Plastic Pipe" of the Caltrans Standard Specifications and City of Turlock Standard Specifications.

### 2.2 DRAINS

- A. Drains shall comply with the requirements of Section 70 "Miscellaneous Drainage Facilities", of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

### 2.3 MANHOLES

- A. Manholes shall comply with the requirements of Section 51 "Concrete Structures", Section 70 "Miscellaneous Drainage Facilities", and Section 75 "Miscellaneous Metal" of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

### 2.4 CONCRETE

- A. Concrete shall comply with the requirements of Section 51 "Concrete Structures", of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

### 2.5 STORMWATER INLETS

- A. Stormwater inlets shall comply with the requirements of Section 51, "Concrete Structures," Section 70, "Miscellaneous Drainage Facilities", Section 75, "Miscellaneous Metal", and Section 90, "Concrete" of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

## **PART 3 EXECUTION**

### 3.1 EARTHWORK

- A. Earthwork shall comply with the City of Turlock Standard Specifications.

### 3.2 PIPING INSTALLATION

- A. Pipe and Fittings shall comply with the requirements of Section 64 "Plastic Pipe", of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

### 3.3 DRAIN INSTALLATION

- A. Drain installation shall comply with the requirements of Section 51, “Concrete Structures,” Section 70, “Miscellaneous Drainage Facilities”, Section 75, “Miscellaneous Metal”, and Section 90, “Concrete” of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

### 3.4 MANHOLE INSTALLATION

- A. Manhole installation shall comply with the requirements of Section 51, “Concrete Structures,” Section 70, “Miscellaneous Drainage Facilities”, Section 75, “Miscellaneous Metal”, and Section 90, “Concrete” of the Caltrans Standard Specifications and the City of Turlock Standard Specifications.

### 3.5 STORMWATER INLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

### 3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

### 3.7 IDENTIFICATION

- A. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
  - 1. Use warning tape or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.8 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.

- e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- 4. Reinspect and repeat procedure until results are satisfactory.
  
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  - 4. Submit separate report for each test.
  - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    - b. Option: Test plastic piping according to ASTM F 1417.
    - c. Option: Test concrete piping according to ASTM C 924.
  
- C. Leaks and loss in test pressure constitute defects that must be repaired.
  
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.9 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

### END OF SECTION



## APPENDIX B: STRUCTURAL CALCULATIONS



**LA COSTA  
ENGINEERING**

2226 FARADAY AVENUE  
CARLSBAD, CALIFORNIA 92008  
TEL 760-931-0290 FAX 438-5251  
marty\_montgomery@yahoo.com

CIVIL • STRUCTURAL  
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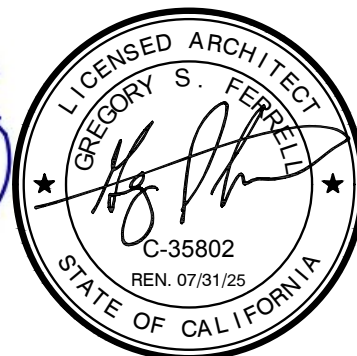
**STRUCTURAL CALCULATIONS AND DETAILS  
FOR  
SWIMMING POOL DESIGN**

PROJECT: COLUMBIA POOL IMPROVEMENTS  
600 COLUMBIA STREET  
TURLOCK, CALIFORNIA 95380

ENGINEER: MARTELL B. MONTGOMERY  
R.C.E. 50344 EXP. 6-30-25

DATE: AUGUST 7, 2023

DESIGN LOADS: CBC 2022



## **STRUCTURAL CALCULATION – INDEX**

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16-17	Pool Floor Slab Design
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# **SWIMMING POOL DESIGN**



# LA COSTA ENGINEERING

2226 FARADAY AVENUE  
CARLSBAD, CALIFORNIA 92008  
TEL 760-931-0290 FAX 438-5251  
marty\_montgomery@yahoo.com

CIVIL • STRUCTURAL  
MECHANICAL • PETROLEUM

CLIENT AQUATIC DESIGN GROUP

JOB COLUMBIA POOL IMPROVEMENTS

CALCULATED BY MBM DATE 8/7/23

SCALE \_\_\_\_\_

## POOL DESIGN CRITERIA:

LATERAL SOIL LOADS AND PRESUMPTIVE LOAD-BEARING VALUES  
PER CBC 2022 TABLES 1610.1, 1806.2.

### DRAINED CONDITIONS:

SOIL CLASSIFICATION:	SM
ACTIVE PRESSURE: Pa	45 pcf
AT-REST PRESSURE: Po	60 pcf
APPROX. SOIL UNIT WT.: $\gamma$	120 pcf
PASSIVE PRESSURE: Pp	150 pcf
BEARING PRESSURE: Ps	1500 psf
COEFF. OF FRICTION: $\mu$	0.25

SEISMIC PRESSURE:  $\Delta P_{AE}$ 

11
----

 H<sup>2</sup>

(for walls > 6'-0",  $\Delta P_{AE} = 1/2 \gamma H^2 \Delta K_{AE}$ )  
 $\Delta K_{AE} = 3/4 k_h$

where  $PGA_M = 0.374$  and  $k_h = 2/3 PGA_M = 0.249$

### SURCHARGE @ DECK:

$q_{DL} = (6"/12)(150 \text{ pcf}) = 75 \text{ psf}$  (factored up when  $P_o > \gamma$ )  
 $q_{LL} = 60 \text{ psf}$

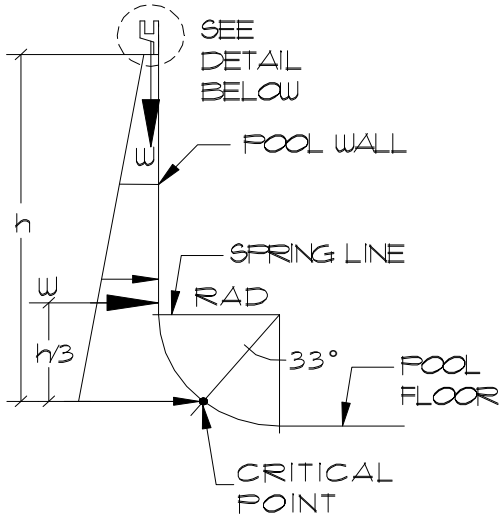
LATERAL SURCHARGE:  $w = 1'$   
 $\phi = 22.5^\circ \sim 2:1 \text{ SLOPE}$   
 $k_a = \text{TAN}^2(45^\circ - 22.5^\circ/2) = 0.45$   
 $\sim 0.5$

$k_a q w = (0.5)q(1') = 0.5q$   
 $= 0.5(75 \text{ psf}) = 37.5 \text{ plf DL}$   
 $= 0.5(100 \text{ psf}) = 50 \text{ plf LL}$

**NOTE:** HYDROSTATIC PRESSURE RELIEF VALUES ARE PROVIDED IN POOL FLOOR SLABS TO ESTABLISH A "DRAINED CONDITION" IN THE PRESENCE OF A GROUND WATER TABLE, A PERCHED GROUND WATER CONDITION, OR POOR SITE DRAINAGE.

**POOL WALL DESIGN METHOD: (RIM FLOW GUTTER)**

**MECHANICS: AT-REST CONDITION, CANTILEVER WALL, POOL EMPTY**



**MOMENT:**

$\gamma = P_o =$  AT-REST SOIL PRESSURE

$P = \gamma h = P_o h$

$W = Ph/2 = P_o h^2/2$

$M = P_o h^2/2 * h/3 = P_o h^3/6$

STRENGTH DESIGN:  $1.2D + 1.6(L+H)$   
 WHERE D = DEAD LOAD, L = LIVE LOAD  
 AND H = LOAD DUE TO  
 LATERAL EARTH PRESSURE OR  
 GROUND WATER PRESSURE.

$P_{SURCHARGE} = k_a q w$

$M_{SURCHARGE} = k_a q w h^2/2$

**WHERE:**

w=WIDTH OF WALL

$\phi$ =ANG. INTERNAL FRICTION

$k_a = \text{TAN}^2(45 - \phi/2)$



**BY INSPECTION:**

**WALL DESIGN** GOVERNS POOL DESIGN

**SLIDING** RESISTED BY POOL FLOOR

**OVERTURNING** RESISTED BY:

- (1) CONSIDERABLE LENGTH AND WIDTH OF POOL FLOOR WRT POOL WALL.
- (2) EFFECTS OF EQUAL AND OPPOSITE MOMENTS AT EA. END.
- (3) COMPLETE CONTINUITY OF WALL-FLOOR-WALL SYSTEM.

## POOL WALL DESIGN METHOD

### CRITICAL POINT COORDINATES:

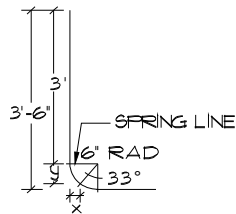
INTERSECTION POINT IN COVE WHERE DESIGN OF WALL MEETS FLOOR SLAB DESIGN. DETERMINES EFFECTIVE WALL HT.

$\phi=33^\circ$  TO CRITICAL POINT

$$x=R-R(\sin 33^\circ)$$

$$y=R(\cos 33^\circ)$$

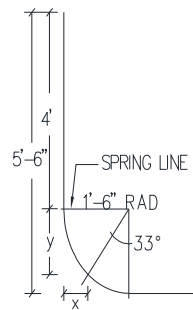
### 3'-6" WALL:



$$x=0.5'-0.5'(\sin 33^\circ)=0.23'$$

$$y=0.5'(\cos 33^\circ)=0.42'$$

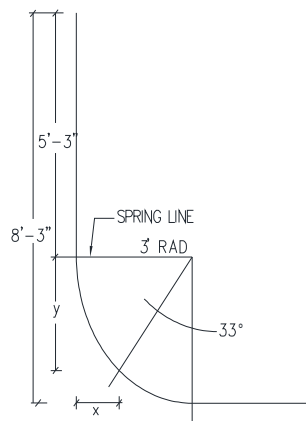
### 5'-6" WALL:



$$x=1.5'-1.5'(\sin 33^\circ)=0.68'$$

$$y=1.5'(\cos 33^\circ)=1.26'$$

### 8'-3" WALL:



$$x=3'-3'(\sin 33^\circ)=1.37'$$

$$y=3'(\cos 33^\circ)=2.52'$$

**SWIMMING POOL WALL DESIGN:**  
ACI 318-19

**RIM FLOW POOL**

**@ 3'-6" DEPTH:**

h = 3.42 ft (WATER DEPTH TO CRITICAL PT.)  
 $P_o = 60$  pcf

**MOMENT:**  $M_{UL} = 1.6(60 \text{ pcf})(3.42')^3/6 + 1.2(37.5 \text{ psf})(3.42')^2/2 + 1.6(50 \text{ psf})(3.42')^2/2 = 1371 \text{ lb-ft}$   
 (NEGLECT RESISTING MOMENT)

**TRY:**

b = 12 in  
 t = 6 in  
 $d_s = 3$  in  
 $f'_c = 4000$  psi  
 $f_y = 60000$  psi  
 $\phi = 0.9$

**Check Reinforcement Ratio of Wall at the chosen depth of reinforcement:**

$M_u = 1371 \text{ lb-ft}$   
 $1.37 \text{ kip-ft}$

$\rho_{min} = 200/f_y = 0.0033$

$\rho_{max} = 0.75[(0.85f'_c/f_y) * 0.85(87000/(87000+f_y))]$

$\rho_{max} = 0.0214$

From:  $\omega = \rho f_y / f'_c =$

$\phi k_n = \phi [f'_c \omega (1 - 0.59\omega)] =$

$bd^2/12000 = M_u / \phi k_n$

**Set Quadratic equation:**

$0.59\phi(f_y^2/f'_c)\rho^2 + (-\phi f_y)\rho + (M_u * 12000/bd^2) = 0$

$a = 0.59\phi(f_y^2/f'_c) = 477900$

$b = -\phi f_y = -54000$

$c = 12000 * M_u / bd^2 = 152.34$

$\rho = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a = 0.0029$

Is  $\rho_{min} < \rho < \rho_{max}$  ? No

Is  $\rho < \rho_{min}$  ? Yes, Use  $\rho_{min}$

**Use  $d_s = 3$  in**



**Design reinforcement:**

Flexural reinforcement:

$$\begin{aligned} \rho &= 0.0033 && \text{(If } \rho < \rho_{\min}, \text{ Set } \rho = \rho_{\min}) \\ A_s = \rho b d &= 0.12 \text{ in}^2 \\ \text{Try \#4 @ 12" o.c.: } A_s &= 0.20 \text{ in}^2 > 0.12 \text{ in}^2 && \text{GOVERNS VERT.} \end{aligned}$$

Determine the minimum flexural reinforcement per ACI 318-19, 9.6.1.2:

$$\begin{aligned} A_{s\min} = 200b_w d / f_y &= 0.12 \text{ in}^2 \\ \text{Try \#4 @ 12" o.c.: } A_s &= 0.20 \text{ in}^2 \geq 0.12 \text{ in}^2 \end{aligned}$$

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$$\begin{aligned} A_s = 0.0018b \cdot h &= 0.13 \text{ in}^2 \\ \text{Max. spacing} = 5h \text{ or } 18" &= 15" \text{ o.c.} \\ \text{Try \#4 @ 12" o.c.: } A_s &= 0.20 \text{ in}^2 > 0.13 \text{ in}^2 && \text{GOVERNS HORIZ.} \end{aligned}$$

**Design:**

<p><b>USE <math>t=6"</math>, <math>d_s=3"</math>, #4 @ 12" o.c. VERT. #4 @ 12" o.c. HORIZ.</b></p>
--

**SWIMMING POOL WALL DESIGN:**  
**ACI 318-19**

**RIM FLOW POOL**

**@ 5'-6" DEPTH:**

h = 5.26 ft (WATER DEPTH TO CRITICAL PT.)  
 $P_o = \boxed{60}$  pcf

**MOMENT:**  $M_{UL} = 1.6(60 \text{ pcf})(5.26')^3/6 + 1.2(37.5 \text{ psf})(5.26')^2/2 + 1.6(50 \text{ psf})(5.26')^2/2 = 4058 \text{ lb-ft}$   
 (NEGLECT RESISTING MOMENT)

**TRY:**

b =  $\boxed{12}$  in  
 t =  $\boxed{7}$  in  
 $d_s = \boxed{4}$  in  
 $f'_c = \boxed{4000}$  psi  
 $f_y = \boxed{60000}$  psi  
 $\phi = \boxed{0.9}$

**Check Reinforcement Ratio of Wall at the chosen depth of reinforcement:**

$M_u = 4058 \text{ lb-ft}$   
 $4.06 \text{ kip-ft}$

$\rho_{min} = 200/f_y = 0.0033$

$\rho_{max} = 0.75[(0.85f'_c/f_y) * 0.85 * (87000 / (87000 + f_y))]$

$\rho_{max} = 0.0214$

From:  $\omega = \rho f_y / f'_c =$

$\phi k_n = \phi [f'_c \omega (1 - 0.59\omega)] =$

$bd^2 / 12000 = M_u / \phi k_n$

Set Quadratic equation:

$0.59 * \phi * (f_y^2 / f'_c) * \rho^2 + (-\phi f_y) * \rho + (M_u * 12000 / bd^2) = 0$

a =  $0.59 * \phi * (f_y^2 / f'_c) = 477900$

b =  $-\phi * f_y = -54000$

c =  $12000 * M_u / bd^2 = 253.61$

$\rho = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a = 0.0049$

Is  $\rho_{min} < \rho < \rho_{max}$  ? Yes, Use  $\rho$

**Use  $d_s = 4 \text{ in}$**

**Design reinforcement:**

Flexural reinforcement:

$$\rho = 0.0049$$

$$A_s = \rho b d = 0.24 \text{ in}^2$$

**Try #4 @ 8" o.c.:  $A_s = 0.30 \text{ in}^2 > 0.24 \text{ in}^2$  GOVERNS VERT.**

Determine the minimum flexural reinforcement per ACI 318-19, 9.6.1.2:

$$A_{smin} = 200 b_w d / f_y = 0.16 \text{ in}^2$$

**Try #4 @ 8" o.c.:  $A_s = 0.30 \text{ in}^2 \geq 0.16 \text{ in}^2$**

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$$A_s = 0.0018 b h = 0.15 \text{ in}^2$$

Max. spacing = 5h or 18": 18 " o.c.

**Try #4 @ 12" o.c.:  $A_s = 0.20 \text{ in}^2 > 0.15 \text{ in}^2$  GOVERNS HORIZ.**

**Design:**

<p><b>USE <math>t=7"</math>, <math>d_s=4"</math>, #4 @ 8" o.c. VERT. #4 @ 12" o.c. HORIZ.</b></p>
---

**SWIMMING POOL WALL DESIGN:**  
**ACI 318-19**

**RIM FLOW POOL**

**@ 8'-3" DEPTH:**

h = 7.77 ft (WATER DEPTH TO CRITICAL PT.)  
 $P_o = \boxed{60}$  pcf

**MOMENT:** Comparative Evaluation per Lew, Sitar - 2010 SEAOC Seismic Earth Pressures:

**CASE 1: AT-REST PRESSURE**

$M_{UL} = 1.6(\mathbf{60 \text{ pcf}})(7.77')^3/6 + 1.2(37.5 \text{ psf})(7.77')^2/2 + 1.6(50 \text{ psf})(7.77')^2/2 =$  11279 lb-ft  
**GOVERNS**

**CASE 2: ACTIVE + SEISMIC PRESSURE**

$M_{UL} = 1.6(\mathbf{45 \text{ pcf}})(7.77')^3/6 + 1.0(\mathbf{11})(7.77')^3/6 + 1.2(37.5 \text{ psf})(7.77')^2/2 + 1.6(50 \text{ psf})(7.77')^2/2 =$  10262 lb-ft

(NEGLECT RESISTING MOMENT)

**TRY:**

b =  $\boxed{12}$  in  
t =  $\boxed{10}$  in  
 $d_s = \boxed{7}$  in  
 $f'_c = \boxed{4000}$  psi  
 $f_y = \boxed{60000}$  psi  
 $\phi = \boxed{0.9}$

**Check Reinforcement Ratio of Wall at the chosen depth of reinforcement:**

$M_u = 11279 \text{ lb-ft}$   
11.28 kip-ft

$\rho_{min} = 200/f_y = 0.0033$

$\rho_{max} = 0.75[(0.85*f'_c/f_y)*0.85*(87000/(87000+f_y))]$

$\rho_{max} = 0.0214$

From:  $\omega = \rho f_y / f'_c =$

$\phi k_n = \phi [f'_c \omega (1 - 0.59\omega)] =$

$bd^2/12000 = M_u / \phi k_n$

Set Quadratic equation:

$0.59*\phi*(f_y^2/f'_c)*\rho^2 + (-\phi f_y)*\rho + (M_u*12000/bd^2) = 0$

a =  $0.59*\phi*(f_y^2/f'_c) =$  477900

b =  $-\phi*f_y =$  -54000

c =  $12000*M_u/bd^2 =$  230.18

$\rho = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a = 0.0044$

Is  $\rho_{min} < \rho < \rho_{max}$  ? Yes, Use  $\rho$

**Use  $d_s = 7$  in**

**Design reinforcement:**

Flexural reinforcement:

$$\rho = 0.0044$$

$$A_s = \rho b d = 0.37 \text{ in}^2$$

**Try #4 @ 6" o.c.:  $A_s = 0.40 \text{ in}^2 \geq 0.37 \text{ in}^2$  GOVERNS VERT.**

Determine the minimum flexural reinforcement per ACI 318-19, 9.6.1.2:

$$A_{smin} = 200 b_w d / f_y = 0.28 \text{ in}^2$$

**Try #4 @ 6" o.c.:  $A_s = 0.40 \text{ in}^2 \geq 0.28 \text{ in}^2$**

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$$A_s = 0.0018 b^* h = 0.22 \text{ in}^2$$

Max. spacing = 5h or 18": 18 " o.c.

**Try #4 @ 8" o.c.:  $A_s = 0.30 \text{ in}^2 > 0.22 \text{ in}^2$  GOVERNS HORIZ.**

**Design:**

<b>USE <math>t=10"</math>, <math>d_s=7"</math>, #4 @ 6" o.c. VERT. #4 @ 8" o.c. HORIZ.</b>
--

## REINFORCEMENT TABLE

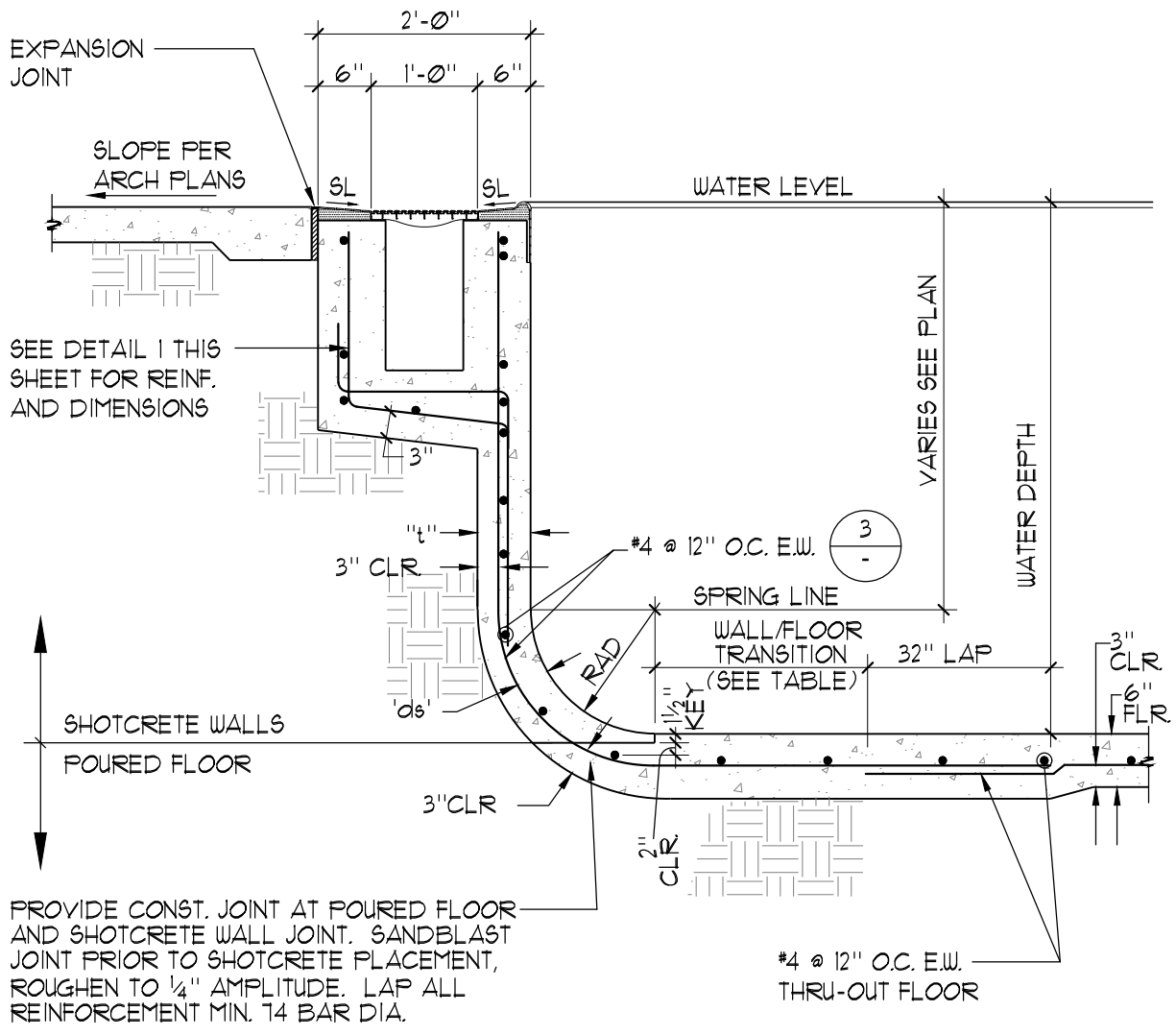
WATER DEPTH	"t"	"ds"	RADIUS	VERTICAL REINF.	HORIZONTAL REINF.	TRANSITION TO FLOOR REINF. BEYOND END RADIUS
0'-0" TO 3'-6"	6"	3"	0" TO 6"	#4 @ 12" O.C.	#4 @ 12" O.C.	24"
3'-7" TO 5'-6"	7"	4"	6" TO 18"	#4 @ 8" O.C.	#4 @ 12" O.C.	24"
5'-7" TO 8'-3"	10"	7"	18" TO 36"	#4 @ 6" O.C.	#4 @ 8" O.C.	24"

### CONCRETE NOTES:

- ① THE MINIMUM ULTIMATE COMPRESSIVE STRENGTH AT 28 DAYS WITH A 0.40-0.50 WATER/CEMENT RATIO  
 POOL = 4000 PSI  
 SLAB-ON-GRADE = 4000 PSI
- ② CONTINUOUS INSPECTION BY AN APPROVED INSPECTOR IS REQUIRED OF ALL CONCRETE PLACEMENT.
- ③ ALL CEMENT USED SHALL CONFORM TO A.S.T.M. C-150 TYPE II
- ④ FINE AND COARSE AGGREGATE SHALL CONFORM TO A.S.T.M. C-33. MAXIMUM SIZE OF AGGREGATE TO BE 1".
- ⑤ CONCRETE MIX DESIGNS SHALL BE BASED UPON ACI 318
- ⑥ CONCRETE SHALL BE TESTED AND INSPECTED PER SECTION CBC 1705.3 AND ACI 318
- ⑦ REMOVAL OF FORMS SHALL COMPLY WITH ACI 318
- ⑧ ALL REINFORCING SHALL BE ASTM A-615, GRADE 60, UNLESS OTHERWISE NOTED. LAPS SHALL BE 64 BAR DIA.

### SHOTCRETE NOTES:

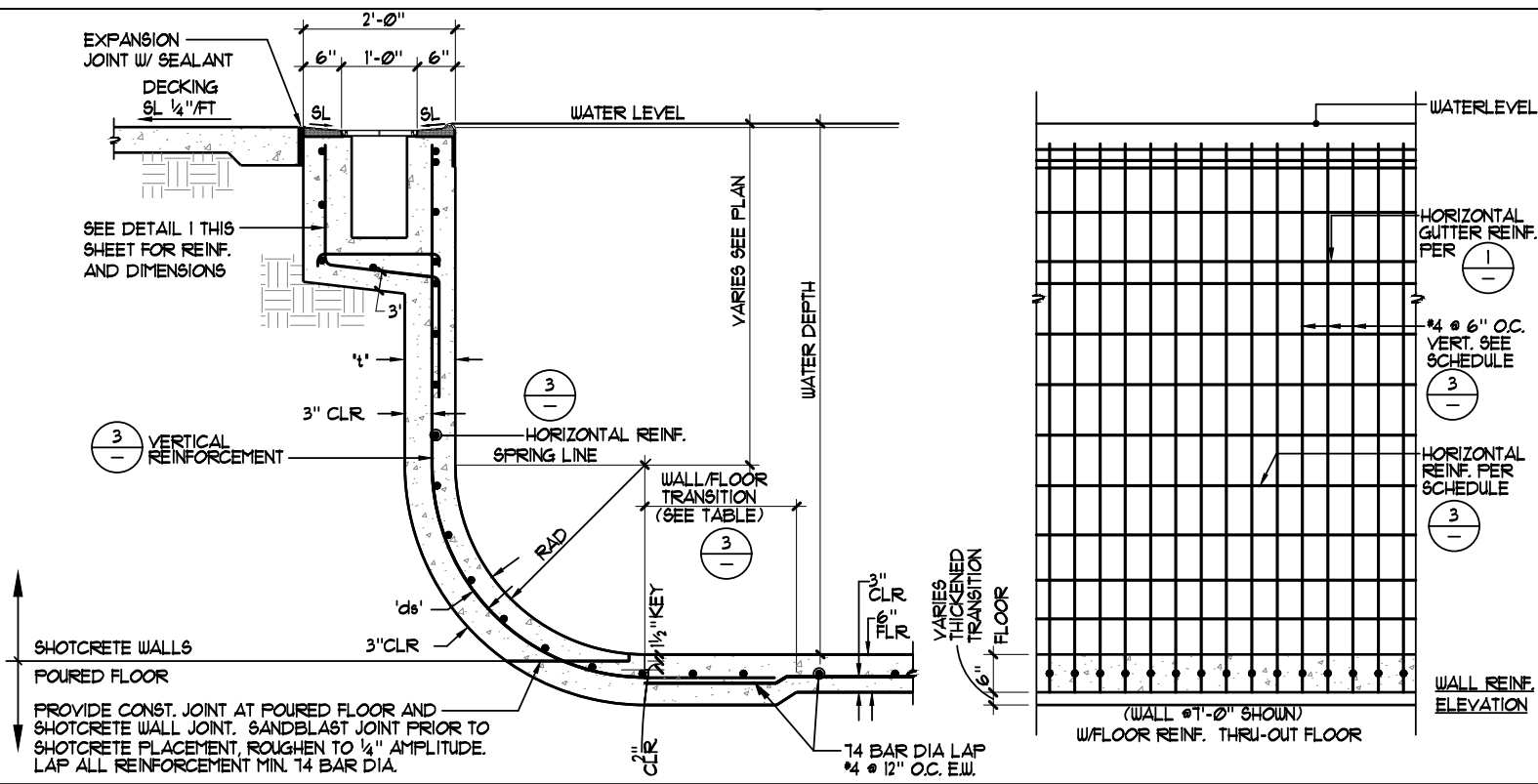
- ① SHOTCRETE SHALL BE WET-MIX AND HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS. SHOTCRETE MATERIAL SHALL HAVE A WATER/CEMENT RATIO OF 0.40-0.50. SHOTCRETE MATERIALS MIXTURE DESIGN PROPORTIONING, PLACEMENT, CURING, AND TESTING SHALL BE PER ACI 318
- ② CONTINUOUS INSPECTION BY AN APPROVED INSPECTOR IS REQUIRED OF ALL SHOTCRETE PLACEMENT PER ACI-318.
- ③ ALL CEMENT USED SHALL CONFORM TO A.S.T.M. C-150 TYPE II
- ④ FINE AND COARSE AGGREGATE SHALL CONFORM TO A.S.T.M. C-33. MAXIMUM SIZE OF AGGREGATE TO BE 3/8".
- ⑤ SHOTCRETE SHALL BE TESTED AND INSPECTED PER CBC 1705.3 AND ACI 318.
- ⑥ ANCHOR BOLTS, ANCHORS, DOWELS, INSERTS, ETC. SHALL BE SECURELY TIED IN PLACE PRIOR TO PLACING OF SHOTCRETE.
- ⑦ ALL REINFORCEMENT WITHIN SHOTCRETE SHALL MAINTAIN THE LESSER OF 6 BAR DIA. AND 2 1/2" CLEAR NON-CONTACT SPLICES.
- ⑧ THE FILM OF LAITANCE WHICH FORMS ON THE SURFACE OF THE SHOTCRETE SHALL BE REMOVED WITHIN APPROXIMATELY TWO HOURS AFTER APPLICATION BY BRUSHING WITH A STIFF BROOM. IF THIS IS NOT REMOVED WITHIN TWO HOURS, IT SHALL BE REMOVED BY THOROUGH WIRE BRUSHING OR SAND BLASTING. CONSTRUCTION JOINTS OVER EIGHT HOURS OLD SHALL BE THOROUGHLY CLEANED WITH AIR AND WATER PRIOR TO RECEIVING SHOTCRETE.
- ⑨ ALL REINFORCING SHALL BE ASTM A-615, GRADE 60, UNLESS OTHERWISE NOTED. LAP SPLICES SHALL BE 64 BAR DIA. NON-CONTACT LAP SPLICES SHALL HAVE CLEAR SPACING BETWEEN BARS THE GREATER OF 6 BAR DIA AND 2 1/2". REINFORCING SHALL CONFORM TO ACI 318.



4

POOL WALL 0'-0" TO 5'-6"

3/4" = 1'-0"



**POOL WALL 5'-7" TO 8'-3"**

3/4"=1'-0"

PROVIDE CONST. JOINT AT POURED FLOOR AND SHOTCRETE WALL JOINT. SANDBLAST JOINT PRIOR TO SHOTCRETE PLACEMENT, ROUGHEN TO 1/4" AMPLITUDE. LAP ALL REINFORCEMENT MIN. 14 BAR DIA.



## POOL FLOOR FOUNDATION SLAB DESIGN:

CBC 2022, ACI 318-19

WATER DEPTH	SLAB (t)	$W_{H2O}$	$W_{SLAB}$	$W_{TOT}$
3'-6"	6"	218 psf	75 psf	293 psf
5'-6"	6"	343 psf	75 psf	418 psf
8'-3"	6"	515 psf	75 psf	590 psf

### ASSUMPTIONS:

- 1) FULL POOL, WATER = 62.4 pcf
- 2) CONCRETE WT = 150 pcf

$$P_s = 1500 \text{ psf} > 590 \text{ psf} \quad \text{OK}$$

### 1) Slab Foundation Data:

H= 6 in (Design reinf./ft.)  
b= 12 in (Design reinf./ft.)  
Rebar cover: 3 in

### 2) Determine the shrinkage and temperature reinforcement:

Perimeter:  $A_s = 0.0018b^*h = 0.065 \text{ in}^2$  24.4.3.2  
Try #4 @12" o.c.:  $0.20 \text{ in}^2 > 0.065 \text{ in}^2$  **OK**

Horiz:  $A_s = 0.0018b^*h = 0.065 \text{ in}^2$  24.4.3.2  
Try #4 @12" o.c.:  $0.20 \text{ in}^2 > 0.065 \text{ in}^2$  **OK**  
Max spacing = 18" or  $5^*h = 18 \text{ " o.c.}$  24.4.3.3

Design: **Construct 6" CONC. POOL FOUNDATION SLAB w/ #4 @12" o.c., ea. way at mid-depth.**

## CHECK REBAR SPLICE DEVELOPMENT LENGTH:

CBC 2022, ACI 318-19

$$f'_c = 4000 \text{ psi}$$

$$f_y = 60000 \text{ psi}$$

$$25.4.2.3: \quad l_d = \left[ \frac{f_y \Psi_t \Psi_e \Psi_g}{25 \lambda \sqrt{f'_c}} \right] d_b$$

$$25.4.2.4: \quad l_d = \left[ \frac{3 f_y}{40 \lambda \sqrt{f'_c}} * \frac{\Psi_t \Psi_e \Psi_s \Psi_g}{\left( \frac{c_b + k_{tr}}{d_b} \right)} \right] d_b$$

### FOR #4 REBAR:

$$\begin{aligned} d_b &= 0.5" & \lambda &= 1.0 \text{ (NORMAL WT. CONC.)} \\ & & \Psi_s &= 0.8 \text{ (#6 OR SMALLER)} \\ & & \Psi_e &= 1.0 \text{ (UNCOATED BARS)} \\ & & \Psi_g &= 1.0 \text{ (GRADE 60 REINFORCING BARS)} \\ \text{SET } \left( \frac{c_b + k_{tr}}{d_b} \right) &= 2.5 & \Psi_t &= 1.3 \text{ (>12" CONC. BELOW HORIZ. REINF.)} \end{aligned}$$

$$l_d = \left[ \frac{(60,000)(1.3)(1)(1)}{25(1)\sqrt{4000}} \right] (0.5) = 24.7 \text{ in} \quad \textbf{GOVERNS}$$

$$l_d = \left[ \frac{3(60,000)}{40(1)\sqrt{4000}} * \frac{(1.3)(1)(0.8)(1)}{(2.5)} \right] (0.5) = 14.8 \text{ in}$$

$$\text{CLASS B SPLICE} = 1.3(24.7") = \textbf{32 in = 64 BAR DIA.}$$

### FOR #5 REBAR:

$$\begin{aligned} d_b &= 0.625" & \lambda &= 1.0 \text{ (NORMAL WT. CONC.)} \\ & & \Psi_s &= 0.8 \text{ (#6 OR SMALLER)} \\ & & \Psi_e &= 1.0 \text{ (UNCOATED BARS)} \\ \text{SET } \left( \frac{c_b + k_{tr}}{d_b} \right) &= 2.5 & \Psi_g &= 1.0 \text{ (GRADE 60 REINFORCING BARS)} \\ & & \Psi_t &= 1.3 \text{ (>12" CONC. BELOW HORIZ. REINF.)} \end{aligned}$$

$$l_d = \left[ \frac{(60,000)(1.3)(1)(1)}{25(1)\sqrt{4000}} \right] (0.625) = 30.8 \text{ in} \quad \textbf{GOVERNS}$$

$$l_d = \left[ \frac{3(60,000)}{40(1)\sqrt{4000}} * \frac{(1.3)(1)(0.8)(1)}{(2.5)} \right] (0.625) = 18.5 \text{ in}$$

$$\text{CLASS B SPLICE} = 1.3(30.8") = \textbf{40 in = 64 BAR DIA.}$$

<b>FOR #4 REBAR: USE MIN. 32" LAP SPLICE</b>
<b>FOR #5 REBAR: USE MIN. 40" LAP SPLICE</b>

# POOL SURGE CHAMBER

## RESTRAINED WALL DESIGN:

### PER SOILS RPT:

AT-REST PRESSURE	$P_o =$	60 pcf
PASSIVE PRESSURE	$P_p =$	150 pcf
COEFF. OF FRICTION	$\mu =$	0.25
ALLOW. BEARING PRESS.	$P_s =$	1500 psf
SOIL UNIT WT	$\gamma_s =$	120 pcf

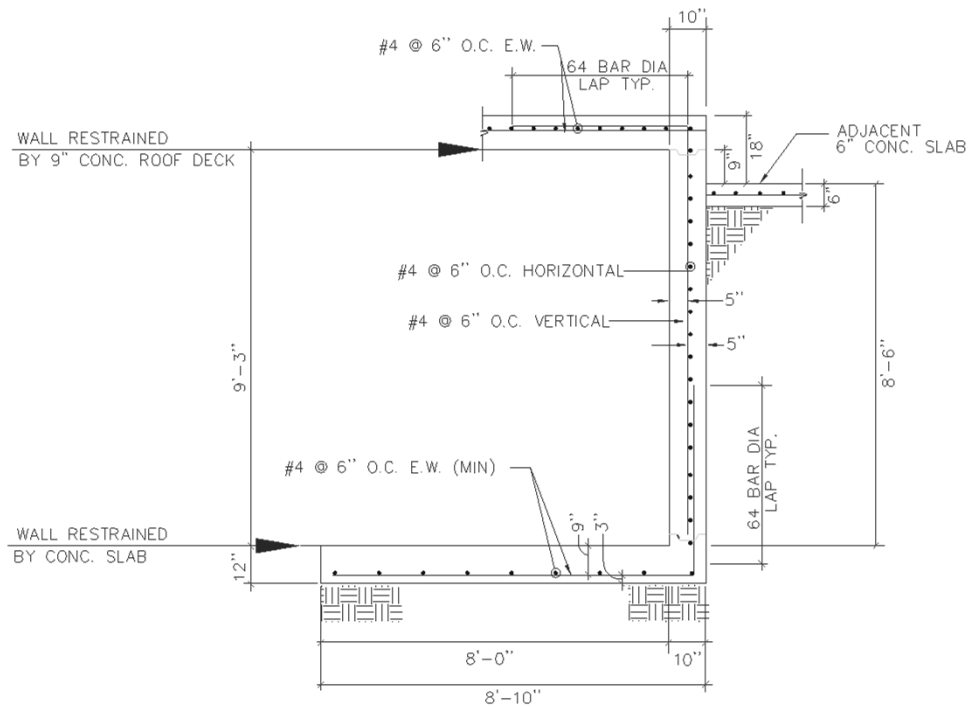
### CONDITIONS:

EMPTY CHAMBER

CONC. ROOF DL =  $(0.75')(1')(150 \text{ pcf})(8'/2 + 10''/12) = 544 \text{ lb}$

CONC. ROOF LL =  $(100 \text{ psf})(1')(8'/2 + 10''/12) = 483 \text{ lb}$

STEM:



Stem Design:

USE  $t=10''$ ,  $d_s=5''$ , #4 @ 6" o.c. VERTICAL  
#4 @ 6" o.c., HORIZ.

## Restrained Retaining Wall

Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** Surge Chamber, Restrained Wall: At-Rest Pressure Condition

### Code Reference

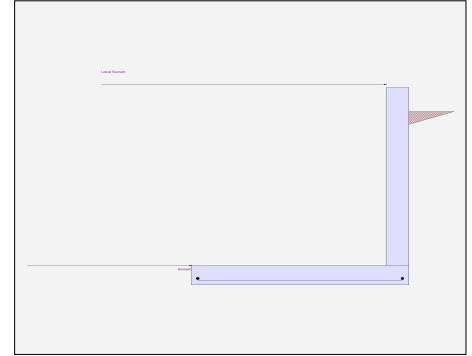
Calculations per IBC 2021 1807.3, ASCE 7-16

#### Criteria

Retained Height	=	8.0 ft
Wall height above soil	=	1.250 ft
Total Wall Height	=	9.250 ft
Top Support Height	=	9.250 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	in

#### Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	60.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	150.0 psf/ft
Soil Density	=	120.0 pcf
Footing  Soil Frictior	=	0.250 psf
Soil height to ignore for passive pressure	=	in



#### Surcharge Loads

Surcharge Over Heel	=	175.0 psf
>>>Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	544.0 lbs
Axial Live Load	=	483.0 lbs
Axial Load Eccentricity	=	in

#### Earth Pressure Seismic Load

#### Uniform Lateral Load Applied to Stem

Lateral Load	=	#/ft
...Height to Top	=	ft
...Height to Bottom	=	ft
Load Type	=	Earth (H) (Service Level)
Wind on Exposed Stem	=	0.00 psf (Strength Level)
Wind acts left-to-right toward retention side.		
$K_h$ Soil Density Multiplier	=	0.2 g

#### Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3
Added seismic per unit area	=	0.0 psf

### Design Summary

Total Bearing Load	=	3,508.25 lbs
...resultant ecc.	=	-29.871 in
Soil Pressure @ Toe	=	0.0 psf OK
Soil Pressure @ Heel	=	1,213.47 psf OK
Allowable	=	psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	0.0 psf
ACI Factored @ Heel	=	1,522.99 psf
Footing Shear @ Toe	=	10.350 psi OK
Footing Shear @ Heel	=	0.0 psi OK
Allowable	=	94.868 psi
Reaction at Top	=	855.22 lbs
Reaction at Bottom	=	2,361.28 lbs

#### Sliding Calcs

Lateral Sliding Force	=	2,361.28 lbs
-----------------------	---	--------------

### Concrete Stem Construction

Thickness	=	10.00 in
Wall Weight	=	125.0 psf
Stem is FREE to rotate at top of footing		

	@ Top Support	Mmax Between Top & Base	@ Base of Wall
	Stem OK	Stem OK	Stem OK
Design Height Above Ftg	= 9.250 ft	3.975 ft	0.00 ft
Rebar Size	= # 4	# 4	# 4
Rebar Spacing	= 6.00 in	6.00 in	6.00 in
Rebar Placed at	= Center	Center	Center
Rebar Depth 'd'	= 5.0 in	5.0 in	5.0 in
<b>Design Data</b>			
fb/FB + fa/Fa	=	0.596	
Moment.....Actual	=	0.0 ft-#	0.0 ft-#
Moment.....Allowable	=	8,469.0 ft-#	8,469.0 ft-#
Shear Force @ this height	=	1,369.95 lbs	2,822.05 lbs
Shear.....Actual	=	22.832 psi	47.034 psi
Shear.....Allowable	=	71.420 psi	71.420 psi

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

## Restrained Retaining Wall

Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

### DESCRIPTION: Surge Chamber, Restrained Wall: At-Rest Pressure Condition

#### Footing Strengths & Dimensions

Toe Width	=	8.0 ft
Heel Width	=	0.8333
Total Footing Width	=	8.833
Footing Thickness	=	12.0 in
Key Width	=	in
Key Depth	=	in
Key Distance from Toe	=	ft
f'c =	4,000.0 psi	Fy = 60000 psi
Footing Concrete Density	=	150 pcf
Min. As %	=	0.0018
Cover @ Top	= 2 in	@ Btm.= 3 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	0.0	1,522.99 psf
Mu' : Upward	=	5,320.66	ft-#
Mu' : Downward	=	5,760.0	ft-#
Mu: Design	=	-439	0 ft-#
Actual 1-Way Shear	=	10.350	psi
Allow 1-Way Shear	=	94.868	0.0 psi

#### Other Acceptable Sizes & Spacings:

Toe: # 4 @ 6.00 in	-or-	#4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.00 in
Heel: None Spec'd	-or-	phiMn = phi * 5 * lambda * sqrt(fc) * Sm
Key: # 0 @ 0.00 in	-or-	No key defined
Min footing T&S reinf Area		2.29 in2
Min footing T&S reinf Area per foot		0.26 in2 /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 9.26 in		#4@ 18.52 in
#5@ 14.35 in		#5@ 28.70 in
#6@ 20.37 in		#6@ 40.74 in

### Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

#### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

Surcharge Over Heel	=	0.0lbs	8.833 ft	0.0ft-#
Axial Dead Load on Stem	=	1,027.0lbs	8.417 ft	8,643.92ft-#
Soil Over Toe	=	0.0lbs	0.0 ft	0.0ft-#
Adjacent Footing Load	=	0.0lbs	0.0 ft	0.0ft-#
Surcharge Over Toe	=	0.0lbs	0.0 ft	0.0ft-#
Stem Weight	=	1,156.25lbs	8.417 ft	9,731.77ft-#
Soil Over Heel	=	0.0lbs	8.833 ft	0.0ft-#
Footing Weight	=	1,325.0lbs	4.417 ft	5,852.08ft-#
<b>Total Vertical Force</b>	=	<b>3,508.25lbs</b>	<b>Moment =</b>	<b>24,227.8ft-#</b>

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

## Restrained Retaining Wall

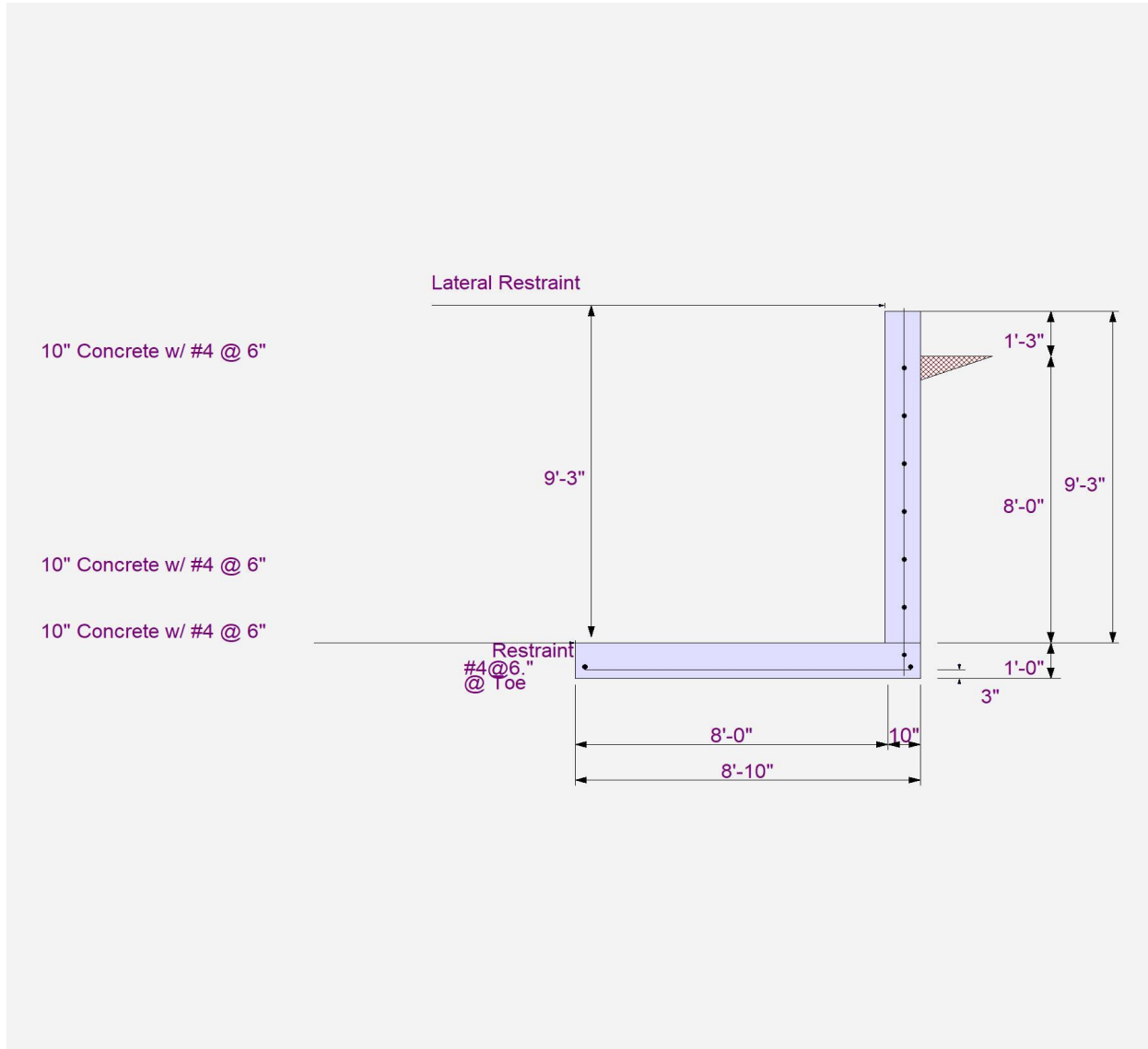
Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** Surge Chamber, Restrained Wall: At-Rest Pressure Condition



## Restrained Retaining Wall

Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** Surge Chamber, Restrained Wall: At-Rest Pressure Condition



## Restrained Retaining Wall

Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** Surge Chamber, Restrained Wall: Active + Seismic Pressure Condition

### Code Reference

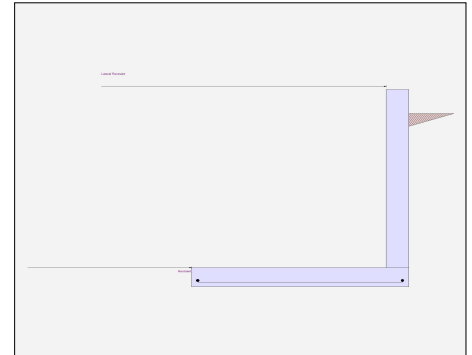
Calculations per IBC 2021 1807.3, ASCE 7-16

#### Criteria

Retained Height	=	8.0 ft
Wall height above soil	=	1.250 ft
Total Wall Height	=	9.250 ft
Top Support Height	=	9.250 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	in

#### Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	45.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	150.0 psf/ft
Soil Density	=	120.0 pcf
Footing  Soil Frictior	=	0.250 psf
Soil height to ignore for passive pressure	=	in



#### Surcharge Loads

Surcharge Over Heel	=	175.0 psf
>>>Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	544.0 lbs
Axial Live Load	=	483.0 lbs
Axial Load Eccentricity	=	in

#### Earth Pressure Seismic Load

#### Uniform Lateral Load Applied to Stem

Lateral Load	=	#/ft
...Height to Top	=	ft
...Height to Bottom	=	ft
Load Type	=	Earth (H) (Service Level)
Wind on Exposed Stem	=	0.00 psf (Strength Level)
Wind acts left-to-right toward retention side.		

#### Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3

$K_h$  Soil Density Multiplier = 0.2490 g Added seismic per unit area = 188.244 psf

### Design Summary

Total Bearing Load	=	3,508.25 lbs
...resultant ecc.	=	-29.871 in
Soil Pressure @ Toe	=	0.0 psf OK
Soil Pressure @ Heel	=	1,213.47 psf OK
Allowable	=	psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	0.0 psf
ACI Factored @ Heel	=	1,522.99 psf
Footing Shear @ Toe	=	10.350 psi OK
Footing Shear @ Heel	=	0.0 psi OK
Allowable	=	94.868 psi
<b>Reaction at Top</b>	=	1,292.39 lbs
<b>Reaction at Bottom</b>	=	2,625.69 lbs

### Concrete Stem Construction

Thickness	=	10.00 in
Wall Weight	=	125.0 psf
Stem is FREE to rotate at top of footing		

	@ Top Support	Mmax Between Top & Base	@ Base of Wall
<b>Design Height Above Ftg</b>	Stem OK = 9.250 ft	Stem OK = 4.198 ft	Stem OK = 0.00 ft
Rebar Size	# 4	# 4	# 4
Rebar Spacing	6.00 in	6.00 in	6.00 in
Rebar Placed at	Center	Center	Center
Rebar Depth 'd'	5.0 in	5.0 in	5.0 in
<b>Design Data</b>			
fb/FB + fa/Fa	=	0.771	
Moment.....Actual	=	0.0 ft-#	0.0 ft-#
Moment.....Allowable	=	8,469.0 ft-#	8,469.0 ft-#
Shear Force @ this height	=	1,957.78 lbs	3,337.58 lbs
Shear.....Actual	=	32.630 psi	55.626 psi
Shear.....Allowable	=	71.420 psi	71.420 psi

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



## Restrained Retaining Wall

Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

### DESCRIPTION: Surge Chamber, Restrained Wall: Active + Seismic Pressure Condition

#### Footing Strengths & Dimensions

Toe Width	=	8.0 ft
Heel Width	=	0.8333
Total Footing Width	=	8.833
Footing Thickness	=	12.0 in
Key Width	=	in
Key Depth	=	in
Key Distance from Toe	=	ft
f'c =	4,000.0 psi	Fy = 60000 psi
Footing Concrete Density	=	150 pcf
Min. As %	=	0.0018
Cover @ Top	= 2 in	@ Btm.= 3 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	0.0	1,522.99 psf
Mu' : Upward	=	5,320.66	ft-#
Mu' : Downward	=	5,760.0	ft-#
Mu: Design	=	-439	0 ft-#
Actual 1-Way Shear	=	10.350	psi
Allow 1-Way Shear	=	94.868	0.0 psi

#### Other Acceptable Sizes & Spacings:

Toe: # 4 @ 6.00 in	-or-	#4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.0 in
Heel: None Spec'd	-or-	phiMn = phi * 5 * lambda * sqrt(fc) * Sm
Key: # 0 @ 0.00 in	-or-	No key defined
Min footing T&S reinf Area		2.29 in2
Min footing T&S reinf Area per foot		0.26 in2 /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 9.26 in		#4@ 18.52 in
#5@ 14.35 in		#5@ 28.70 in
#6@ 20.37 in		#6@ 40.74 in

### Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

#### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

Surcharge Over Heel	=	0.0lbs	8.833 ft	0.0ft-#
Axial Dead Load on Stem	=	1,027.0lbs	8.417 ft	8,643.92ft-#
Soil Over Toe	=	0.0lbs	0.0 ft	0.0ft-#
Adjacent Footing Load	=	0.0lbs	0.0 ft	0.0ft-#
Surcharge Over Toe	=	0.0lbs	0.0 ft	0.0ft-#
Stem Weight	=	1,156.25lbs	8.417 ft	9,731.77ft-#
Soil Over Heel	=	0.0lbs	8.833 ft	0.0ft-#
Footing Weight	=	1,325.0lbs	4.417 ft	5,852.08ft-#
<b>Total Vertical Force</b>	=	3,508.25lbs	Moment =	24,227.8ft-#

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

## Restrained Retaining Wall

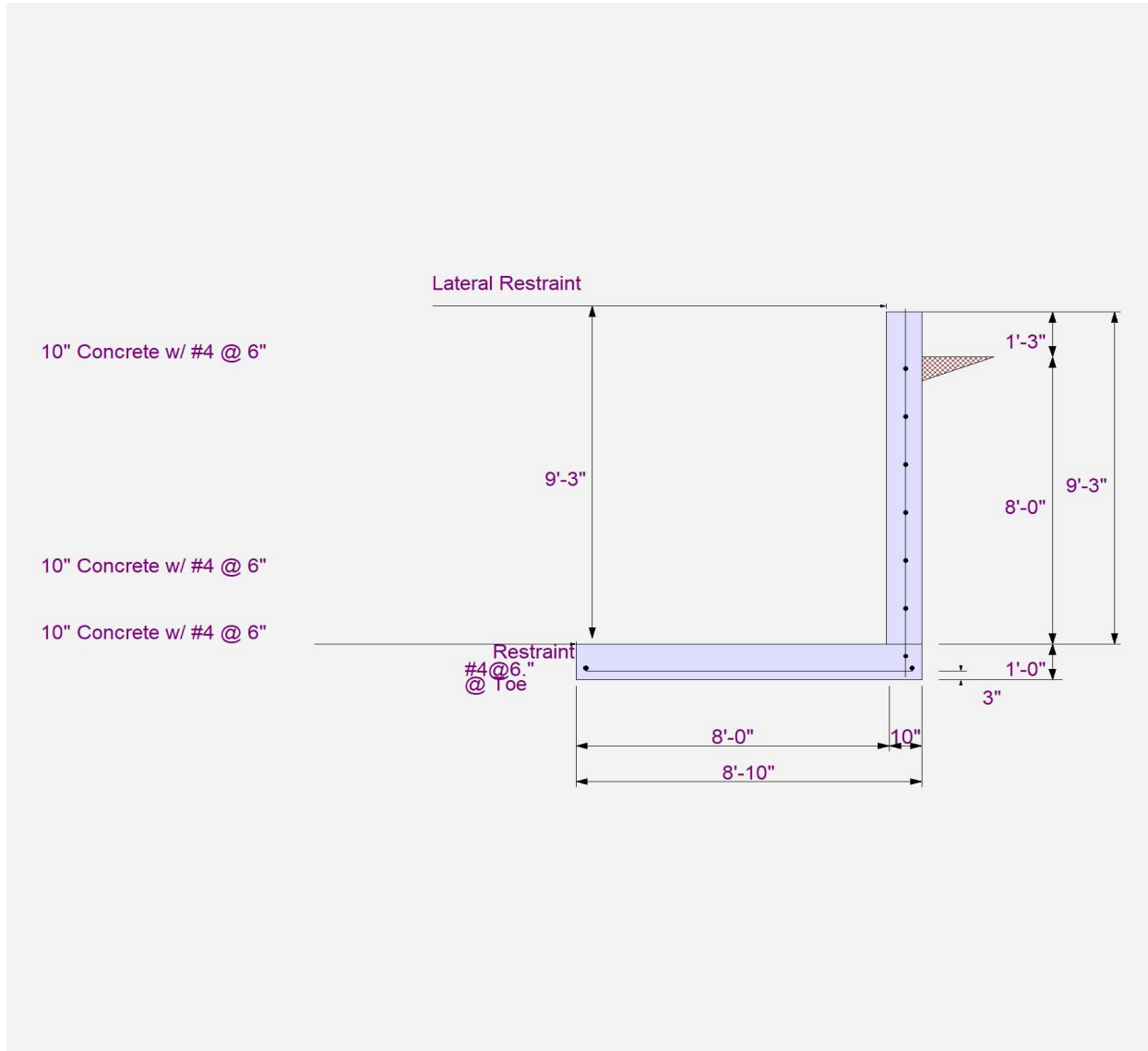
Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** Surge Chamber, Restrained Wall: Active + Seismic Pressure Condition



## Restrained Retaining Wall

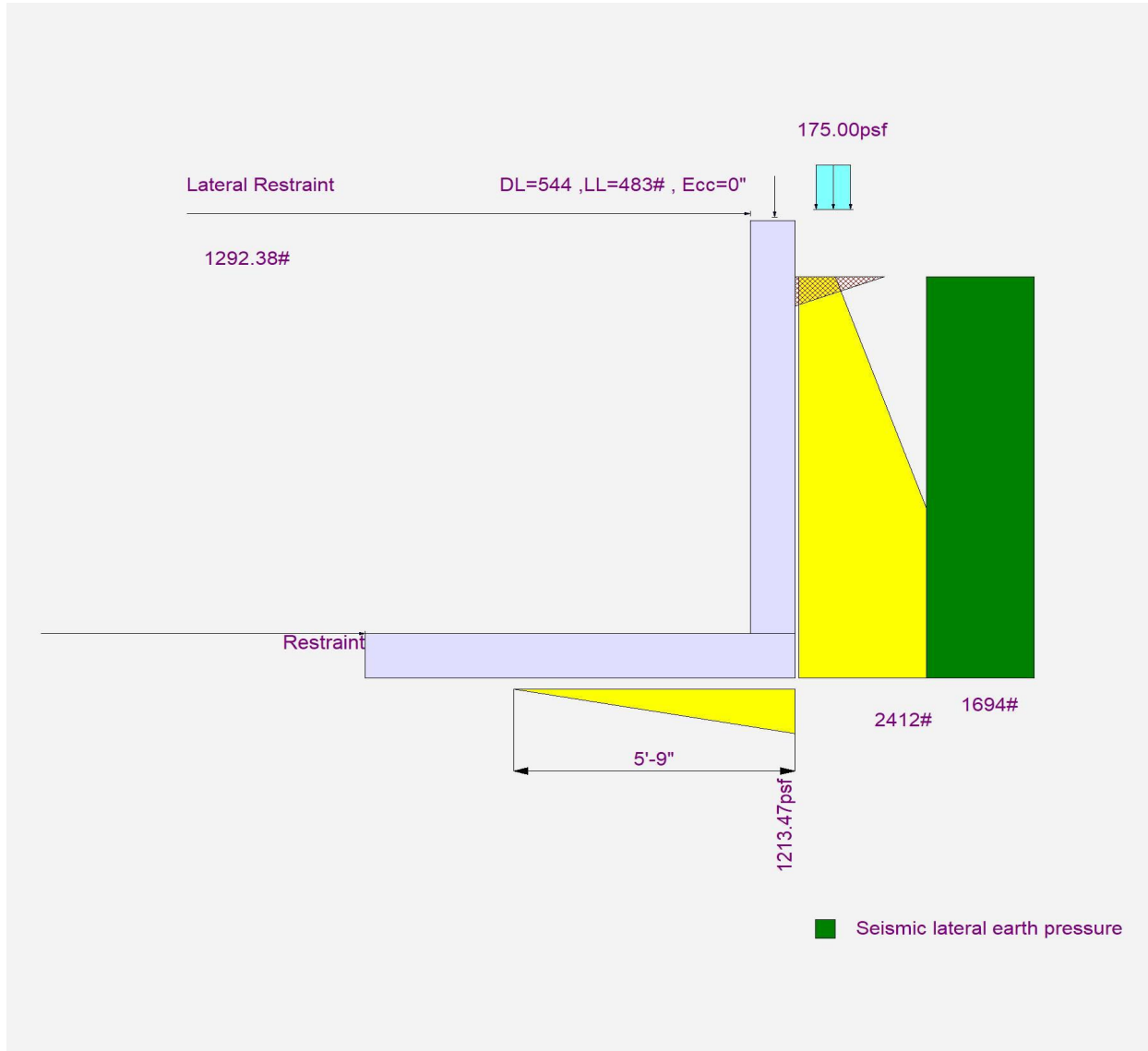
Project File: Columbia Pool.ec6

LIC# : KW-06019364, Build:20.23.05.25

LA COSTA ENGINEERING

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** Surge Chamber, Restrained Wall: Active + Seismic Pressure Condition



## SURGE CHAMBER FLOOR SLAB DESIGN:

2022 CBC, ACI 318-19

WATER DEPTH	SLAB (t)	$W_{H2O}$	$W_{SLAB}$	$W_{TOT}$
8'-6"	12"	530 psf	150 psf	680 psf

### ASSUMPTIONS:

- 1) FULL POOL, WATER = 62.4 pcf
- 2) CONCRETE WT = 150 pcf

$$P_s = 1500 \text{ psf} > 680 \text{ psf} \quad \text{OK}$$

**USE MIN. 12" CONC. SLAB W/ #4 @ 6" O.C. EA. WAY**

### 1) Slab Foundation Data:

H=	12 in (Design reinf./ft.)
b=	12 in (Design reinf./ft.)
Rebar cover:	3 in

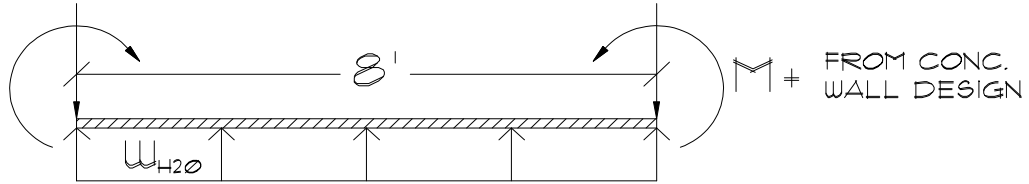
### 2) Determine the shrinkage and temperature reinforcement:

Transverse: $A_s = 0.0018b \cdot h =$	0.19 in <sup>2</sup>		
Try #4 @ 6" o.c.:	0.40 in <sup>2</sup> >	0.19 in <sup>2</sup>	<b>OK</b>
Horizontal: $A_s = 0.0018b \cdot h =$	0.19 in <sup>2</sup>		
Try #4 @ 6" o.c.:	0.40 in <sup>2</sup> >	0.19 in <sup>2</sup>	<b>OK</b>
Max spacing = 18" or 5*h =	18 " o.c.		

Design: **Construct 12" CONC. SLAB w/ #4 @6" o.c., ea. way, 3" from bot.**

## SURGE CHAMBER FLOOR DESIGN

FBD:



$$W_{\text{INCIDENTAL PERCHED GROUNDWATER}} = (62.4 \text{ pcf})(1')(1') = 62.4 \text{ plf}$$

$$M_{uc} = 1.6(62.4 \text{ plf})(8')^2/8 = 799 \text{ lb-ft}$$

M+ FROM WALL GOVERNS

USE FOOTING/SLAB DESIGN FROM  
RESTRAINED WALL CALCS.

**USE  $t=12"$ ,  $d_s=3"$ , MIN. #4 @ 6" o.c. EA. WAY**

## CHECK REBAR SPLICE DEVELOPMENT LENGTH:

CBC 2022, ACI 318-19

$$f'_c = 4000 \text{ psi}$$

$$f_y = 60000 \text{ psi}$$

$$25.4.2.3: \quad l_d = \left[ \frac{f_y \Psi_t \Psi_e \Psi_g}{25 \lambda \sqrt{f'_c}} \right] d_b$$

$$25.4.2.4: \quad l_d = \left[ \frac{3 f_y}{40 \lambda \sqrt{f'_c}} * \frac{\Psi_t \Psi_e \Psi_s \Psi_g}{\left( \frac{c_b + k_{tr}}{d_b} \right)} \right] d_b$$

### FOR #4 REBAR:

$$\begin{aligned} d_b &= 0.5" & \lambda &= 1.0 \text{ (NORMAL WT. CONC.)} \\ & & \Psi_s &= 0.8 \text{ (#6 OR SMALLER)} \\ & & \Psi_e &= 1.0 \text{ (UNCOATED BARS)} \\ & & \Psi_g &= 1.0 \text{ (GRADE 60 REINFORCING BARS)} \\ \text{SET } \left( \frac{c_b + k_{tr}}{d_b} \right) &= 2.5 & \Psi_t &= 1.3 \text{ (>12" CONC. BELOW HORIZ. REINF.)} \end{aligned}$$

$$l_d = \left[ \frac{(60,000)(1.3)(1)(1)}{25(1)\sqrt{4000}} \right] (0.5) = 24.7 \text{ in} \quad \textbf{GOVERNS}$$

$$l_d = \left[ \frac{3(60,000)}{40(1)\sqrt{4000}} * \frac{(1.3)(1)(0.8)(1)}{(2.5)} \right] (0.5) = 14.8 \text{ in}$$

$$\text{CLASS B SPLICE} = 1.3(24.7") = \textbf{32 in = 64 BAR DIA.}$$

### FOR #5 REBAR:

$$\begin{aligned} d_b &= 0.625" & \lambda &= 1.0 \text{ (NORMAL WT. CONC.)} \\ & & \Psi_s &= 0.8 \text{ (#6 OR SMALLER)} \\ & & \Psi_e &= 1.0 \text{ (UNCOATED BARS)} \\ \text{SET } \left( \frac{c_b + k_{tr}}{d_b} \right) &= 2.5 & \Psi_g &= 1.0 \text{ (GRADE 60 REINFORCING BARS)} \\ & & \Psi_t &= 1.3 \text{ (>12" CONC. BELOW HORIZ. REINF.)} \end{aligned}$$

$$l_d = \left[ \frac{(60,000)(1.3)(1)(1)}{25(1)\sqrt{4000}} \right] (0.625) = 30.8 \text{ in} \quad \textbf{GOVERNS}$$

$$l_d = \left[ \frac{3(60,000)}{40(1)\sqrt{4000}} * \frac{(1.3)(1)(0.8)(1)}{(2.5)} \right] (0.625) = 18.5 \text{ in}$$

$$\text{CLASS B SPLICE} = 1.3(30.8") = \textbf{40 in = 64 BAR DIA.}$$

<b>FOR #4 REBAR: USE MIN. 32" LAP SPLICE</b>
<b>FOR #5 REBAR: USE MIN. 40" LAP SPLICE</b>

# Surge Chamber Roof Longitudinal Reinforcement Design

ACI 318-19

Max. Span: 8 ft

**1) Estimate the thickness of slab:**

Try t= 9 in

assume cover: 4.25 in

assume No. 4 bars: 0.25 in

d = t - (cover + r) = 4.5 in

Check minimum depth requirement:

simply supported: l/20= 4.8 in Table 7.3.1.1

< Slab thickness: Deflection calcs are not required

**2) Compute the trial factored loads:**

Live Load: LL = 100 psf

Dead Load:

Element:	W <sub>d</sub>	unit
Slab:	125	psf
Earth:	0	psf
Pavers:	0	psf
Misc:	12.5	psf
<b>DL = Total:</b>	<b>137.5</b>	<b>psf</b>

Factored Load:  $w_u = 1.2*DL + 1.6*LL = 325$  psf

Load per 1 ft strip:  $w_u = 1 \text{ ft} * \text{factored load} = 325$  plf

**3) Check the thickness required for moment:**

$M_u = 2.6$  kip-ft/ft

$b = 12$  in

$f_y = 60000$  psi

$f'_c = 4000$  psi

$\rho_{min} = 200/f_y = 0.00333$

$\rho_{max} = 0.75[(0.85*f'_c/f_y) * 0.85*(87000/(87000+f_y))]$

$\rho_{max} = 0.02138$

$\phi = 0.9$

From:  $\omega = \rho f_y / f'_c =$

$\phi k_n = \phi [f'_c \omega (1 - 0.59\omega)] =$

$bd^2 / 12000 = M_u / \phi k_n$

Set Quadratic equation:

$(fy^2/fc) * \phi * \rho^2 + (-\phi fy) * \rho + (Mu * 12000 / bd^2) = 0$

$a = 0.59 * \phi * (fy^2 / fc) = 477900$

$b = -\phi * fy = -54000$

$c = 12000 * Mu / bd^2 = 128.40$

$\rho = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a = 0.0024$

Is  $\rho_{min} < \rho < \rho_{max}$  ? No

Is  $\rho_{min} < \rho$  ? Yes, Use  $\rho_{min}$

**Use total slab depth of 9 in**

**4) Check if thickness is adequate for shear:**

$V_u =$	1300 lbs/ft	
$V_c = [2\lambda\sqrt{f'_c} + N_u/6A_g]b_wd =$	6831 lbs/ft	Table 22.5.5.1 where $N_u/6A_g = 0$ (No axial load)
		$\lambda_s = \sqrt{2/(1+d/10)} =$ 1.17 $\leq$ 1.0
$V_n = V_c =$	6831 lbs/ft	(22.5.1.1) Ignore $V_s$
$\phi V_n =$	5123 lbs/ft	
Is $\phi V_n > V_u$ ?	Yes	
$\phi V_c = 0.75[2\lambda\sqrt{f'_c} + N_u/6A_g]b_wd =$	5123 lbs/ft	
For Slabs: Is $V_u < \phi V_c$ ?	YES, additional shear reinforcement is NOT required	

**5) Design reinforcement:**

Flexural reinforcement:

$\rho =$	0.0033	(If $\rho < \rho_{min}$ , Set $\rho = \rho_{min}$ )
$A_s = \rho bd =$	0.18 in <sup>2</sup>	
Try #4 @ 6" o.c.: $A_s =$	0.40 in <sup>2</sup>	$> 0.18$ in <sup>2</sup> GOVERNS VERT.

Determine the minimum flexural reinforcement per ACI 318-19, 7.6.1.1:

$A_{smin} = 0.0018bh =$	0.19 in <sup>2</sup>	
Max. spacing = 3h or 18":	18 " o.c.	7.7.2.3
Try #4 @ 6" o.c.: $A_s =$	0.40 in <sup>2</sup>	$\geq 0.19$ in <sup>2</sup> GOVERNS HORIZ.

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$A_s = 0.0018b*h =$	0.19 in <sup>2</sup>	
Max. spacing = 5h or 18":	18 " o.c.	24.4.3.3
Try #4 @ 6" o.c.: $A_s =$	0.40 in <sup>2</sup>	$> 0.19$ in <sup>2</sup>

Design:

**Provide #4 @ 6" o.c. each at center of 9" deep slab as flexural, shrinkage and temperature reinforcement.**



## Surge Chamber Roof Beam Longitudinal Reinforcement Design at Manhole

ACI 318-19

Span: 8 ft

**1) Estimate the thickness of slab:**

Try d= 9 in  
 assume cover: 4.25 in  
 assume No. 4 bars: r= 0.25 in  
 d = t - (cover +r) = 4.5 in

Check minimum depth requirement:

simply supported: l/20= 4.8 in Table 7.3.1.1

> actual depth: deflection calcs are not required

**2) Compute the trial factored loads:**

Live Load: LL = 100 psf

Dead Load:

Element:	W <sub>d</sub>	unit
Slab:	112.5	psf
Earth:	0	psf
Pavers:	0	psf
Misc:	12.5	psf
<b>Total:</b>	<b>125</b>	<b>psf</b>

DL =

Factored Load: w<sub>u</sub> = 1.2\*DL + 1.6\*LL = 310 psf

Load per 3.67 ft strip: w<sub>u</sub> = 3.67 ft \* factored load = 1138 plf

**3) Check the thickness required for moment:**

M<sub>u</sub> = 9.1016 kip-ft/ft

b = 12 in

f<sub>y</sub> = 60000 psi

f<sub>c</sub>' = 4000 psi

ρ<sub>min</sub> = 200/f<sub>y</sub> = 0.00333

ρ<sub>max</sub> = 0.75[(0.85\*f<sub>c</sub>'/f<sub>y</sub>)\*0.85\*(87000/(87000+f<sub>y</sub>))]

ρ<sub>max</sub> = 0.02138

φ = 0.9

From: ω = ρf<sub>y</sub>/f<sub>c</sub>' =

φk<sub>n</sub> = φ[f<sub>c</sub>'ω(1-0.59ω)] =

bd<sup>2</sup>/12000 = M<sub>u</sub>/φk<sub>n</sub>

Set Quadratic equation:

(f<sub>y</sub><sup>2</sup>/f<sub>c</sub>')\*φ\*ρ<sup>2</sup> + (-φf<sub>y</sub>)\*ρ + (M<sub>u</sub>\*12000/bd<sup>2</sup>) = 0

a = 0.59\*φ\*(f<sub>y</sub><sup>2</sup>/f<sub>c</sub>') = 477900

b = -φ\*f<sub>y</sub> = -54000

c = 12000\*M<sub>u</sub>/bd<sup>2</sup> = 449.461728

ρ = [-b +/-√(b<sup>2</sup> - 4ac)]/2a = 0.00905

Is ρ<sub>min</sub> < ρ < ρ<sub>max</sub> ? Yes, Use ρ

Is ρ < ρ<sub>min</sub> ? No

<b>Use total slab depth of 9 in</b>
-------------------------------------

**4) Check if thickness is adequate for shear in roof slab beam:**

$$V_u = 4551 \text{ lbs/ft}$$
$$V_c = [2\lambda\sqrt{f'_c} + N_u/6A_g]b_wd = 6831 \text{ lbs/ft} \quad \text{Table 22.5.5.1 where } N_u/6A_g = 0 \text{ (No axial load)}$$
$$\lambda_s = v[2/(1+d/10)] = 1.17 \leq 1.0$$

$$\phi V_c = 5123 \text{ lbs/ft}$$

For Slabs:

Is  $\phi V_c > V_u$  ?

OK no additional shear reinforcement is required

7.6.3.1

**5) Design reinforcement:**

Flexural reinforcement:

$$A_s = \rho b d = 0.49 \text{ in}^2$$
$$\rho = 0.0090$$

**Try (3)- #4:  $A_s = 0.60 \text{ in}^2 > 0.49 \text{ in}^2$  GOVERNS**

Determine the minimum flexural reinforcement per ACI 318-19, 7.6.1.1:

$$A_{smin} = 0.0018bh = 0.19 \text{ in}^2$$
$$\text{Max. spacing} = 3h \text{ or } 18": 18 \text{ " o.c. } \quad 7.7.2.3$$

**Try (3)- #4:  $A_s = 0.60 \text{ in}^2 \geq 0.19 \text{ in}^2$**

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$$A_s = 0.0018b^*h = 0.19 \text{ in}^2$$
$$\text{Max. spacing} = 5h \text{ or } 18": 18 \text{ " o.c. } \quad 24.4.3.3$$

**Try (3)- #4:  $A_s = 0.60 \text{ in}^2 > 0.19 \text{ in}^2$**

Design:

**Provide (3) - #4 @ center of beam for flexural reinforcement.**

**ACCESS LADDER CONNECTION DESIGN:**

2022 CBC, ACI 318-19

(Pump Pit/Surge Chamber Concrete Walls)

**ASSUME:**

- 1) 1 PERSON STANDING ON 1 RUNG, W=300 lb
- 2) DISTANCE FROM WALL TO PERSON CENTER OF MASS,  $d_p = 1.25$  FT.
- 3) WALL CONNECTION BRACKET INTERVAL,  $d_{cb} = 4.25$  FT MAX.

**Load Comb:** 1.2D + 1.6L:

**Shear:** For 4 wall brackets in shear,  $V_u = 1.6(300 \text{ lb})/4 =$  **120 lb/bracket**

**Tension:** For pryout on 1 upper bracket,  $T_u = 1.6(300 \text{ lb}/2)(1.25')/(4.25') =$  **71 lb/bracket**

**TRY HILTI KWIK BOLT-TZ2, ESR-4266, w/ 1/2"  $\phi$  SS x 3-1/4" EMBED. FOR ATTACHMENT OF LADDER BRACKETS TO SURGE CHAMBER CONCRETE WALL**

SEE ATTACHED HILTI ANCHORAGE REPORT:

www.hilti.com

Company: La Costa Engineering  
 Address: 2226 Faraday Ave., Carlsbad, CA 92008  
 Phone | Fax: 7609310290 |  
 Design: Surge Chamber/Pump Pit Tank Ladder - Concrete -  
 Fastening point: Access Ladder Connection to side of 10" Conc. Wall

Page: 1  
 Specifier: Martell Montgomery  
 E-Mail: marty\_montgomery@yahoo.com  
 Date: 8/8/2023

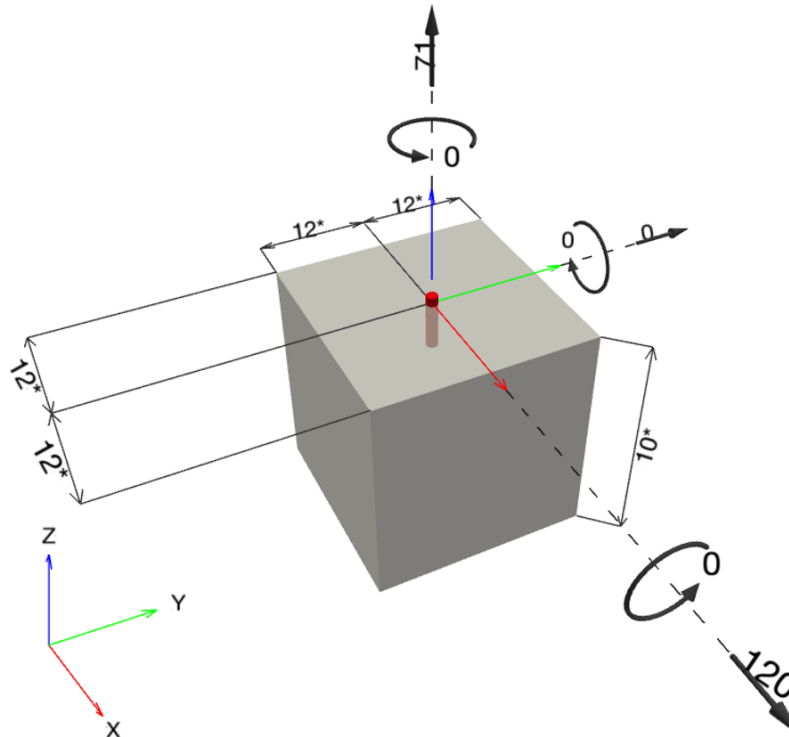
**Specifier's comments:**

**1 Input data**

**Anchor type and diameter:** Kwik Bolt TZ2 - SS 304 1/2 (2) hnom1  
 Item number: 2210260 KB-TZ2 1/2x3 3/4 SS304  
 Effective embedment depth:  $h_{ef,act} = 2.000$  in.,  $h_{nom} = 2.500$  in.  
 Material: AISI 304  
 Evaluation Service Report: ESR-4266  
 Issued | Valid: 12/17/2021 | 12/1/2023  
 Proof: Design Method ACI 318-14 / Mech  
 Stand-off installation:  
 Profile:  
 Base material: cracked concrete, 4000,  $f'_c = 4,000$  psi;  $h = 10.000$  in.  
**Installation:** hammer drilled hole, **Installation condition: Dry**  
 Reinforcement: tension: condition B, shear: condition B; no supplemental splitting reinforcement present  
 edge reinforcement: none or < No. 4 bar



**Geometry [in.] & Loading [lb, in.lb]**





# Hilti PROFIS Engineering 3.0.87

www.hilti.com

Company:	La Costa Engineering	Page:	2
Address:	2226 Faraday Ave., Carlsbad, CA 92008	Specifier:	Martell Montgomery
Phone   Fax:	7609310290	E-Mail:	marty_montgomery@yahoo.com
Design:	Surge Chamber/Pump Pit Tank Ladder - Concrete -	Date:	8/8/2023
Fastening point:	Access Ladder Connection to side of 10" Conc. Wall		

## 1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 71; V <sub>x</sub> = 120; V <sub>y</sub> = 0; M <sub>x</sub> = 0; M <sub>y</sub> = 0; M <sub>z</sub> = 0;	no	6

## 2 Load case/Resulting anchor forces

### Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	71	120	120	0

max. concrete compressive strain: - [%]  
max. concrete compressive stress: - [psi]  
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]  
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

	Load N <sub>ua</sub> [lb]	Capacity $\phi$ N <sub>n</sub> [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	71	8,906	1	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	71	1,977	4	OK

\* highest loaded anchor    \*\*anchor group (anchors in tension)



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Design:	Surge Chamber/Pump Pit Tank Ladder - Concrete -	Date:	8/8/2023
Fastening point:	Access Ladder Connection to side of 10" Conc. Wall		

### 3.1 Steel Strength

$N_{sa}$  = ESR value refer to ICC-ES ESR-4266  
 $\phi N_{sa} \geq N_{ua}$  ACI 318-14 Table 17.3.1.1

#### Variables

$A_{se,N}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.10	120,404

#### Calculations

$N_{sa}$ [lb]
11,875

#### Results

$N_{sa}$ [lb]	$\phi_{steel}$	$\phi N_{sa}$ [lb]	$N_{ua}$ [lb]
11,875	0.750	8,906	71

### 3.2 Concrete Breakout Failure

$N_{cb} = \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$  ACI 318-14 Eq. (17.4.2.1a)  
 $\phi N_{cb} \geq N_{ua}$  ACI 318-14 Table 17.3.1.1  
 $A_{Nc}$  see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)  
 $A_{Nc0} = 9 h_{ef}^2$  ACI 318-14 Eq. (17.4.2.1c)  
 $\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$  ACI 318-14 Eq. (17.4.2.5b)  
 $\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$  ACI 318-14 Eq. (17.4.2.7b)  
 $N_b = k_c \lambda_a \sqrt{f_c} h_{ef}^{1.5}$  ACI 318-14 Eq. (17.4.2.2a)

#### Variables

$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f_c$ [psi]
2.000	12.000	1.000	6.000	17	1.000	4,000

#### Calculations

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [lb]
36.00	36.00	1.000	1.000	3,041

#### Results

$N_{cb}$ [lb]	$\phi_{concrete}$	$\phi N_{cb}$ [lb]	$N_{ua}$ [lb]
3,041	0.650	1,977	71



# Hilti PROFIS Engineering 3.0.87

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Company:	La Costa Engineering	Page:	4
Address:	2226 Faraday Ave., Carlsbad, CA 92008	Specifier:	Martell Montgomery
Phone   Fax:	7609310290	E-Mail:	marty_montgomery@yahoo.com
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Fastening point:	Access Ladder Connection to side of 10" Conc. Wall		

## 4 Shear load

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	120	5,426	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	120	2,129	6	OK
Concrete edge failure in direction x+**	120	5,973	3	OK

\* highest loaded anchor    \*\*anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa}$  = ESR value      refer to ICC-ES ESR-4266  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-14 Table 17.3.1.1

#### Variables

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.10	120,404

#### Calculations

$V_{sa}$ [lb]
8,348

#### Results

$V_{sa}$ [lb]	$\phi_{steel}$	$\phi V_{sa}$ [lb]	$V_{ua}$ [lb]
8,348	0.650	5,426	120



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Design:	Surge Chamber/Pump Pit Tank Ladder - Concrete -	Date:	8/8/2023
Fastening point:	Access Ladder Connection to side of 10" Conc. Wall		

**4.2 Pryout Strength**

$$V_{cp} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b \right] \quad \text{ACI 318-14 Eq. (17.5.3.1a)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

$A_{Nc}$  see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-14 Eq. (17.4.2.1c)}$$

$$\Psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.5b)}$$

$$\Psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.4.2.7b)}$$

$$N_b = k_c \lambda_a \sqrt{f_c} h_{ef}^{1.5} \quad \text{ACI 318-14 Eq. (17.4.2.2a)}$$

**Variables**

$k_{cp}$	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\Psi_{c,N}$
1	2.000	12.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f_c$ [psi]
6.000	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,N}$	$\Psi_{cp,N}$	$N_b$ [lb]
36.00	36.00	1.000	1.000	3,041

**Results**

$V_{cp}$ [lb]	$\phi_{concrete}$	$\phi V_{cp}$ [lb]	$V_{ua}$ [lb]
3,041	0.700	2,129	120





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**4.3 Concrete edge failure in direction x+**

$$V_{cb} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-14 Eq. (17.5.2.1a)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-14 Table 17.3.1.1}$$

$$A_{Vc} \text{ see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-14 Eq. (17.5.2.1c)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.6b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-14 Eq. (17.5.2.8)}$$

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-14 Eq. (17.5.2.2a)}$$

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]	$l_e$ [in.]
8.000	12.000	1.000	10.000	2.000
$\lambda_a$	$d_a$ [in.]	$f_c$ [psi]	$\Psi_{parallel,V}$	
1.000	0.500	4,000	1.000	

**Calculations**

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
240.00	288.00	1.000	1.095	9,347

**Results**

$V_{cb}$ [lb]	$\phi_{concrete}$	$\phi V_{cb}$ [lb]	$V_{ua}$ [lb]
8,532	0.700	5,973	120

**5 Combined tension and shear loads**

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{N,V}$ [%]	Status
0.036	0.056	5/3	2	OK

$$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} \leq 1$$



## Hilti PROFIS Engineering 3.0.87

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### 6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-14, Section 17.8.1.

**Fastening meets the design criteria!**



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### 7 Installation data

Profile: -  
Hole diameter in the fixture: -  
Plate thickness (input): -

Drilling method: Hammer drilled  
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - SS 304 1/2 (2) hnom1  
Item number: 2210260 KB-TZ2 1/2x3 3/4 SS304  
Maximum installation torque: 481 in.lb  
Hole diameter in the base material: 0.500 in.  
Hole depth in the base material: 2.750 in.  
Minimum thickness of the base material: 4.000 in.

Hilti KB-TZ2 stud anchor with 2.5 in embedment, 1/2 (2) hnom1, Stainless steel, installation per ESR-4266

#### 7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> <li>• Suitable Rotary Hammer</li> <li>• Properly sized drill bit</li> </ul>	<ul style="list-style-type: none"> <li>• Manual blow-out pump</li> </ul>	<ul style="list-style-type: none"> <li>• Torque controlled cordless impact tool</li> <li>• Torque wrench</li> <li>• Hammer</li> </ul>

#### Coordinates Anchor in.

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	0.000	0.000	12.000	12.000	12.000	12.000



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## 8 Remarks; Your Cooperation Duties

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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

# **POOL DECK ACCESSORIES**

## **ANCHORAGE CALCULATIONS**



**2) Check the thickness required for moment:**

Internal Moment:  $M_u = 56898 \text{ lb-in}$   
 $= 4.741 \text{ kip-ft}$   
 $b = 7.11 \text{ in}$   
 $f_y = 60000 \text{ psi}$   
 $f_c' = 4000 \text{ psi}$   
 $\rho_{min} = 200/f_y = 0.00333$   
 $\rho_{max} = 0.75[(0.85*f_c'/f_y) * 0.85*(87000/(87000+f_y))]$   
 $\rho_{max} = 0.02138$   
 $\phi = 0.9$   
 $\rho = 0.0031$   
 $\omega = \rho f_y / f_c' = 0.050$   
 $\phi k_n = \phi [f_c' \omega (1 - 0.59 \omega)] = 175$   
 $bd^2/12000 = M_u / \phi k_n$   
 $d = \sqrt{(M_u * 12000 / \phi * k_n * b)} = 6.77 \text{ in}$   
 Use  $d = 9 \text{ in}$       **Use 12" Min. Slab**  
 Is  $\rho_{min} < \rho < \rho_{max}$ ? NO, Use  $\rho_{min}$

**Adjacent Slab thickness:      12 in Min.    OK to resist anchor internal moment**

**3) Design Flexural Reinforcement:**

$A_s = M_u * 12000 / \phi f_y j d$   
 For a first trial assume that  $j d = 0.925 d$   
 therefore,  $A_s = 0.13 \text{ in}^2/\text{ft}$   
 and  $a = A_s * f_y / 0.85 f_c' = 0.186 \text{ in}$   
 and  $j d = d - a/2 = 8.91 \text{ in}$   
 recompute  $A_s$  using new  $j d$ :  $A_s = 0.024949 * M_u = 0.12 \text{ in}^2/\text{ft}$   
**Try #4 bars @ 12" o.c.:      0.20 in<sup>2</sup>/ft > 0.12 in<sup>2</sup>/ft      OK**

Determine the minimum flexural reinforcement per ACI 318-19, 7.6.1.1:

$A_{smin} = 0.0018bh = 0.26 \text{ in}^2/\text{ft}$  (For 12" Max. Slab)  
 Max. spacing = 3h or 18":      18 " o.c.      7.7.2.3

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$A_{s(min)} = 0.0018bh = 0.26 \text{ in}^2/\text{ft}$  (For 12" Max. Slab)  
 Set 50% reinforcing for front face:      0.13 in<sup>2</sup>/ft/face      Per R24.4.3.2  
 Max. spacing = 5h or 18":      18 " o.c.      24.4.3.3  
**Try #4 bars @ 12" o.c., top & bot.:      0.20 in<sup>2</sup>/ft > 0.13 in<sup>2</sup>/ft      OK**

**Provide #4 bars at 12" o.c. ea. way, top & bot., for flexural reinforcement in 12" min. slab, 4000 psi conc.**

**Concrete Breakout Strength in Shear (ACI 318-19, 17.7.2):**

**Case 1:** Required Shear at Anchor:  $V_u = M_u / (2/3 d_{sa}) = 13832 \text{ lb}$

$$V_n = V_{cb} = A_{Vc} / A_{Vco} \psi_{ed,V} \psi_{c,V} \psi_{h,V} V_b$$

$f'_c =$	4000 psi	
$c_{a1} =$	7 in	
$h_a =$	12 in	<b>Use 12" Min. Slab</b>
$d_o =$	2.37 in $\emptyset$	
$l_e = d_{sa} =$	6.17 in	

IF  $c_{a2} > c_{a1}$ :

$\psi_{ed,V} =$	1.0	
$\psi_{c,V} =$	1.0	cracked concrete without supplementary reinforcement
$\psi_{h,V} = \sqrt{(1.5 c_{a1} / h_a)} = \sqrt{((1.5)(24) / 9)} =$	2.0	

$$A_{Vco} = 4.5 (c'_{a1})^2 = 220.5 \text{ in}^2$$

IF  $h_a < 1.5 c_{a1}$ :

$$A_{Vc} = 2 (1.5 c_{a1}) h_a = 252 \text{ in}^2$$

$$V_b = 7 (l_e / d_o)^{0.2} \sqrt{d_o} \sqrt{f'_c} (c'_{a1})^{1.5} = 15285 \text{ lb}$$

$$V_n = V_{cb} = A_{Vc} / A_{Vco} \psi_{ed,V} \psi_{c,V} \psi_{h,V} V_b = \mathbf{34936 \text{ lb}} \quad \mathbf{GOVERNS}$$

$$\phi = 0.75$$

$$\phi V_n = 26202 \text{ lb}$$

**IS  $\phi V_n > V_u$  ?    26202 lb    >    13832 lb    YES**

**USE BRONZE STANCHION SOCKET ANCHOR,  $d = 6.17"$**   
**USE 12" MIN. SLAB, 4000 PSI CONCRETE w/ MIN. 7"**  
**EDGE DISTANCE FROM CL ANCHOR IN ANY DIRECTION**

**Resultant Max. Concrete Stress from Anchor:**

Assume bearing on 1/3 of perimeter:

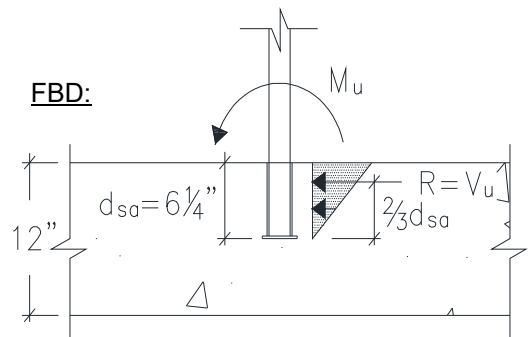
$$L_c = \pi d_o / 3 = 2.485 \text{ in}$$

$$V_u / L_c = 5566 \text{ lb/in.}$$

acting at  $2/3 d_{sa}$

Max. stress on concrete:

$$\sigma = (V_u / L_c) / (d_{sa} / 2) = \mathbf{1804 \text{ psi}} \quad \text{acting at end of stress cone}$$



Nominal Bearing Strength of concrete:

$$B_n = \phi 0.85 f'_c = \mathbf{2210 \text{ psi}} \quad \text{Table 21.2.1 14.5.6.1}$$

**Is  $B_n > \sigma$  ?    YES**



## Bronze Stanchion Anchor Stresses:

### Anchor Sleeve Analysis

Note: Bearing load is at maximum at top & bot. of sleeve

$$\begin{aligned}l_e=d_{sa} &= 6.17 \text{ in} \\d_o &= 2.37 \text{ in } \emptyset \\M_u &= 4.74 \text{ kip-ft} = 4741 \text{ lb-ft}\end{aligned}$$

$$T=C= M_u/l_e = 9222 \text{ lb}$$

### Check Bearing in Sleeve Side Wall

$$C= 9222 \text{ lb Resultant}$$

<i>Bronze Property Values</i>	
Bearing Bronze C93200 (SAE 660)	<i>psi</i>
Ultimate Tensile Strength	35000
Yield Strength	20000

$$\begin{aligned}\phi &= 0.75 \\ \text{Bearing length on 1/3 of perimeter, } L_c &= 2.48 \text{ in} \\ \text{Bronze Anchor thickness, } t &= 0.17 \text{ in} \\ \text{Project Area of Bearing, } A_{pb} &= 0.42 \text{ in}^2 \\ R_n = \phi 1.8 F_y A_{pb} &= 11392 \text{ lb} \quad \text{J7-1}\end{aligned}$$

Is  $R_n > C$  ?                      **YES      Bronze Stanchion Anchor OK**

### Check Shear in Bronze Stanchion Anchor Base Plate Lip

Note: Shear in base plate lip only occurs in uplift.  
No design loads can cause uplift except for code minimum  
LL = 200 lb in any direction.

$$\begin{aligned}T_u = 1.6LL &= 320 \text{ lb} \\d_o &= 2.37 \text{ in } \emptyset \\ \text{Base plate lip distance, } d &= 0.25 \text{ in} \\ \text{Base Plate Lip mid circumference, } d_o + d &= 2.62 \text{ in } \emptyset \\ \text{Base plate lip thickness, } t &= 0.125 \text{ in} \\ A_v = \pi(d_o + 2d)t &= 1.03 \text{ in}^2 \\ \phi &= 0.9 \\ V_n = \phi 0.6 F_y A_v &= 11112 \text{ lb} \quad \text{G2-1}\end{aligned}$$

Is  $V_n > T_u$  ?                      **YES      Bronze Stanchion Anchor OK**

### BILL OF MATERIALS

ITEM NO.	PART #	QTY.	DESCRIPTION	MATERIAL
1	23638	1	STANCHION ANCHOR 1.90"	BRONZE
2	36450	1	LID & KEY 6" BRONZE ANCHOR	YELLOW BRASS (SAE #41)

C87500

**DENSITY**

.299 LB/IN<sup>3</sup>

**HARDNESS BRINELL**

134

**TENSILE STRENGTH YIELD**

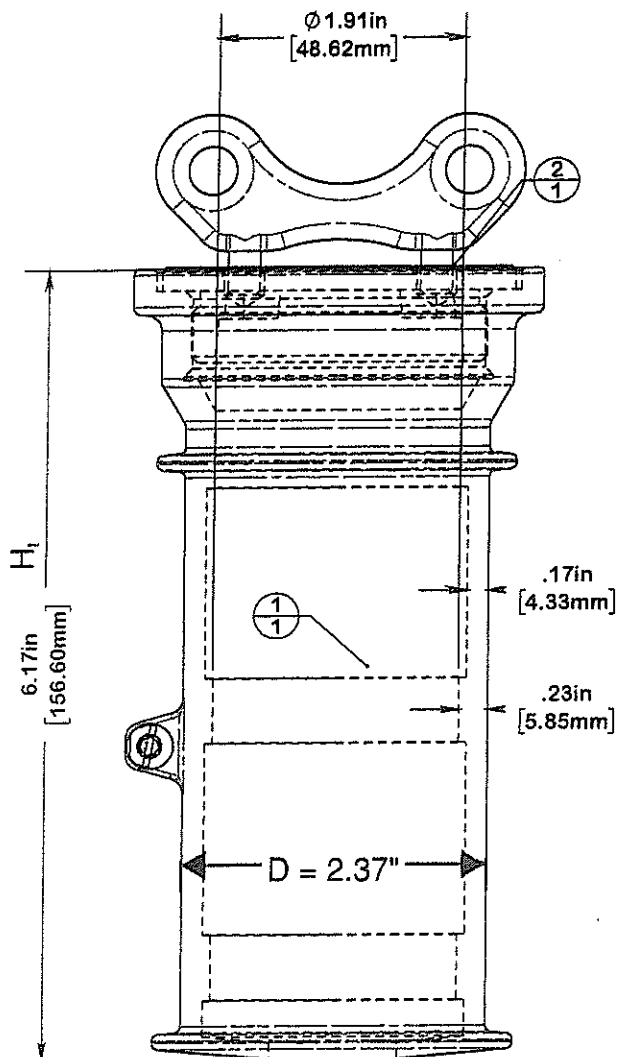
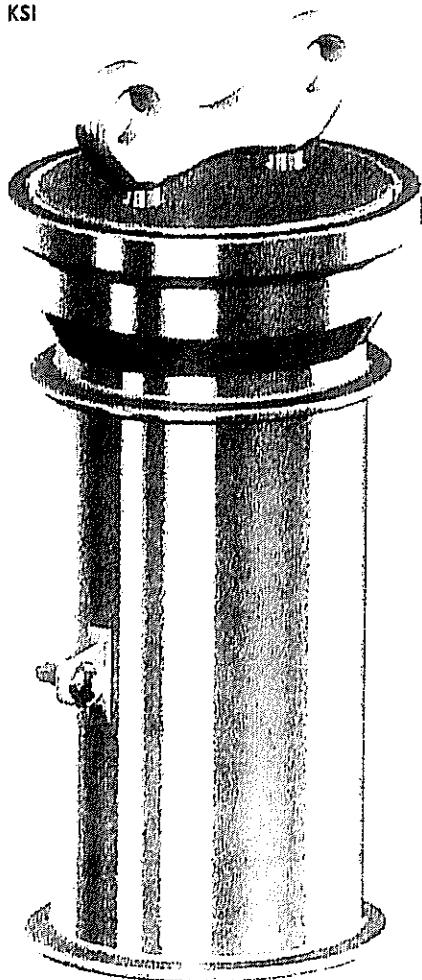
29700 PSI

**ELONGATION AT BREAK**

21%

**MODULUS OF ELASTICITY**

15400 KSI



*NOTE:*

*⚠ DIMENSIONS VARY WITH SPECIFIC APPLICATIONS. SPECIFICATIONS ARE NOMINAL AND ARE SUBJECT TO CHANGE. PLEASE CONTACT SPECTRUM AQUATICS FOR CUSTOM APPLICATIONS*

**SPECTRUM**  
Aquatics

A "CORE" Company

7100 Spectrum Lane  
Missoula, Montana 59808  
800.791.8056

www.spectrumaquatics.com

## ENGINEERING DATA

PRODUCT	STANCHION ANCHOR 1.90" - LID AND KEY			
MODEL #	35021	CATALOG #:	23638	REVISION: A
MATERIAL:	SEE BILL OF MATERIALS			
FINISH #:	NONE			

## GRABRAIL WEDGE ANCHOR DESIGN

2022 CBC, ACI 318-19

<u>Case 1:</u>	P = 200 lb acting at any point along rail	h =	35 in	<b>GOVERNS</b>
<u>Case 2:</u>	P = 300 lb person/ 2 anchors - horizontal load	h =	35 in	
<u>Case 3:</u>	P = 300 lb person/ 2 anchors - vertical load	L =	27 in	

$$\begin{aligned} P &= 200 \text{ lb} \\ h &= 35 \text{ in} \\ d_{wa} &= 4.13 \text{ in} \\ h_{eff} &= h + d_{wa}/2 = 37.07 \text{ in} \\ \text{Load Comb: } &1.2D + 1.6L \\ M_u &= 1.6P/h_{eff} = 11861 \text{ lb-in} \end{aligned}$$

### Check Slab Internal Bending Stresses due to Moment Transfer from Anchor:

#### 1) Estimate the thickness of slab:

$$\begin{aligned} \text{Try: } t &= 6 \text{ in (9" for coverage at anchor location)} \\ \text{assume cover:} & 2.8125 \text{ in} \\ r &= 0.1875 \text{ in \#3 bars} \\ A_{st} &= 0.22 \text{ in}^2 \text{ (assume 2-\#3 bars, ea. way, 1 ea. side of anchor)} \\ d = t - (\text{cover} + r) &= 3 \text{ in} \\ d_o &= 2.22 \text{ in } \emptyset \\ b = 3d_o &= 6.66 \text{ in} \\ \rho = A_{st}/bd &= 0.0110 \end{aligned}$$

#### 2) Check the thickness required for moment:

$$\begin{aligned} \text{Internal Moment: } M_u &= 11861 \text{ lb-in} \\ &= 0.988 \text{ kip-ft} \\ b &= 6.66 \text{ in} \\ f_y &= 60000 \text{ psi} \\ f_c' &= 4000 \text{ psi} \\ \rho_{min} = 200/f_y &= 0.00333 \\ \rho_{max} = 0.75[(0.85*f_c'/f_y) * 0.85*(87000/(87000+f_y))] & \\ \rho_{max} &= 0.02138 \\ \phi &= 0.9 \\ \rho &= 0.0110 \\ \omega = \rho f_y / f_c' &= 0.165 \\ \phi k_n = \phi [f_c' \omega (1 - 0.59\omega)] &= 537 \\ bd^2/12000 = M_u / \phi k_n & \\ d = \sqrt{(M_u * 12000 / \phi * k_n * b)} &= 1.82 \text{ in} \\ \text{Use } d &= 3 \text{ in} \quad \mathbf{6" Slab OK} \\ \text{Is } \rho_{min} < \rho < \rho_{max} ? & \text{ YES} \end{aligned}$$

<b>Adjacent Slab thickness:</b>	<b>6 in</b>	<b>OK to resist handrail internal moment</b>
---------------------------------	-------------	--

**3) Design Flexural Reinforcement:**

$$A_s = M_u * 12000 / \phi f_y j d$$

For a first trial assume that  $j d = 0.925 d$

$$\text{therefore, } A_s = 0.08 \text{ in}^2/\text{ft}$$

$$\text{and } a = A_s * f_y / 0.85 f_c' = 0.116 \text{ in}$$

$$\text{and } j d = d - a/2 = 2.94 \text{ in}$$

$$\text{recompute } A_s \text{ using new } j d: A_s = 0.07554 * M_u = 0.07 \text{ in}^2/\text{ft}$$

Determine the minimum flexural reinforcement per ACI 318-19, Sec. 7.6.1:

$$A_{s(\min)} = 0.0018 b h = 0.13 \text{ in}^2/\text{ft} \quad (\text{For 6" Slab})$$

$$\text{Max. spacing} = 3h \text{ or } 18": 18 \text{ " o.c. } 7.7.2.3$$

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$$A_{s(\min)} = 0.0018 b h = 0.13 \text{ in}^2/\text{ft} \quad (\text{For 6" Slab})$$

$$\text{Max. spacing} = 5h \text{ or } 18": 18 \text{ " o.c. } 24.4.3.3$$

$$\text{Try 2-#3 bars, 1 at ea. side of anchor: } 0.22 \text{ in}^2/\text{ft} > 0.13 \text{ in}^2/\text{ft} \quad \text{OK}$$

**Provide 2- #3 bars, 1 at ea. side of stanchion anchor & ea. way for supplemental reinforcement.**

**Concrete Breakout Strength in Shear (Per ACI 318-19, 17.7.2):**

$$\text{Required Shear at Anchor: } V_u = M_u / (2/3 d_{WA}) = 4308 \text{ lb}$$

$$V_n = V_{cb} = A_{Vc} / A_{Vco} \psi_{ed,V} \psi_{c,V} \psi_{h,V} V_b$$

$$f_c' = 4000 \text{ psi}$$

$$c_{a1} = 4 \text{ in}$$

$$h_a = 9 \text{ in min. conc. section}$$

$$d_o = 2.22 \text{ in } \emptyset$$

$$l_e = d_{WA} = 4.13 \text{ in}$$

IF  $c_{a2} > c_{a1}$ :

$$\psi_{ed,V} = 1.0$$

$$\psi_{c,V} = 1.0 \quad \text{cracked concrete without}$$

$$\psi_{h,V} = \sqrt{1.5 c_{a1} / h_a} = 1.0 \quad \text{supplementary reinforcement}$$

$$A_{Vco} = 4.5 (c'_{a1})^2 = 72 \text{ in}^2$$

IF  $h_a < 1.5 c_{a1}$ :

$$A_{Vc} = 2 (1.5 c_{a1}) h_a = 108 \text{ in}^2$$

$$V_b = 7 (l_e / d_o)^{0.2} \sqrt{d_o} \sqrt{f_c'} (c'_{a1})^{1.5} = 5975 \text{ lb}$$

$$V_n = V_{cb} = 8962 \text{ lb} \quad \text{GOVERNS}$$

$$\phi = 0.75$$

$$\phi V_n = 6722 \text{ lb}$$

$$\text{IS } \phi V_n > V_u ? \quad 6722 \text{ lb} > 4308 \text{ lb} \quad \text{YES}$$

**USE BRONZE WEDGE ANCHOR,  $l_e = 4.13"$   
 USE 9" MIN. THICK, 4000 PSI CONCRETE w/ MIN.  
 4 in. EDGE DISTANCE FROM ANCHOR TO POOL FACE.**

**Resultant Max. Concrete Stress from Anchor:**

Assume bearing on 1/3 of perimeter:  $L_c = \pi d_o / 3 = 2.328 \text{ in}$   
 $V_u / L_c = 1850 \text{ lb/in.}$  acting at  $2/3 d_{sa}$

Max. stress on concrete:  
 $\sigma = (V_u / L_c) / (d_{wa} / 2) = \mathbf{896 \text{ psi}}$  acting at end of stress cone

Nominal Bearing Strength of concrete:  $\phi = 0.65$  Table 21.2.1  
 $B_n = \phi 0.85 f'_c = \mathbf{2210 \text{ psi}}$  14.5.6.1

Is  $B_n > \sigma$  ? **YES**

**Bronze Wedge Anchor Stresses:**

**Wedge Anchor Sleeve Analysis** Note: Bearing load is at maximum at top & bot. of wedge anchor

$d = 2/3 d_{wa} = 2.75 \text{ in}$   
 $d_o = 2.22 \text{ in } \emptyset$   
 $M_u = 0.99 \text{ k-ft} = 988 \text{ lb-ft}$   
 $T = C = M_u / d = 4308 \text{ lb}$

**Check Bearing in Sleeve Side Wall**

$C = 4308 \text{ lb Resultant}$

<i>Bronze Property Values</i>	
Bearing Bronze C93200 (SAE 660)	<i>psi</i>
Ultimate Tensile Strength	35000
Yield Strength	20000

$\phi = 0.75$   
 Bearing length on 1/3 of perimeter,  $L = 2.32 \text{ in}$   
 Bronze Anchor thickness,  $t = 0.13 \text{ in}$   
 Project Area of Bearing,  $A_{pb} = 0.30 \text{ in}^2$

$R_n = \phi 1.8 F_y A_{pb} = 8160 \text{ lb}$  J7-1

Is  $R_n > C$  ? **YES Bronze Stanchion Anchor OK**

### Check Shear in Bronze Wedge Anchor Base Plate Extension Tabs

Note: Shear in base plate extension tabs only occurs in uplift.  
No design loads can cause uplift except for code minimum  
LL = 200 lb in any direction.

$T_u=1.6LL =$	320 lb	
$d_o=$	2.37 in $\emptyset$	
Base plate extension tab distance, $l=$	0.44 in	
Base plate extension tab thickness, $t=$	0.13 in	
$A_v=4lt=$	0.23 in <sup>2</sup>	
$\phi=$	0.9	
$V_n=\phi 0.6F_yA_v =$	2471 lb	G2-1

Is  $V_n > T_u$  ?

**YES Bronze Wedge Anchor OK**

C87500

DENSITY

.299 LB/IN<sup>3</sup>

HARDNESS BRINELL

134

TENSILE STRENGTH YIELD

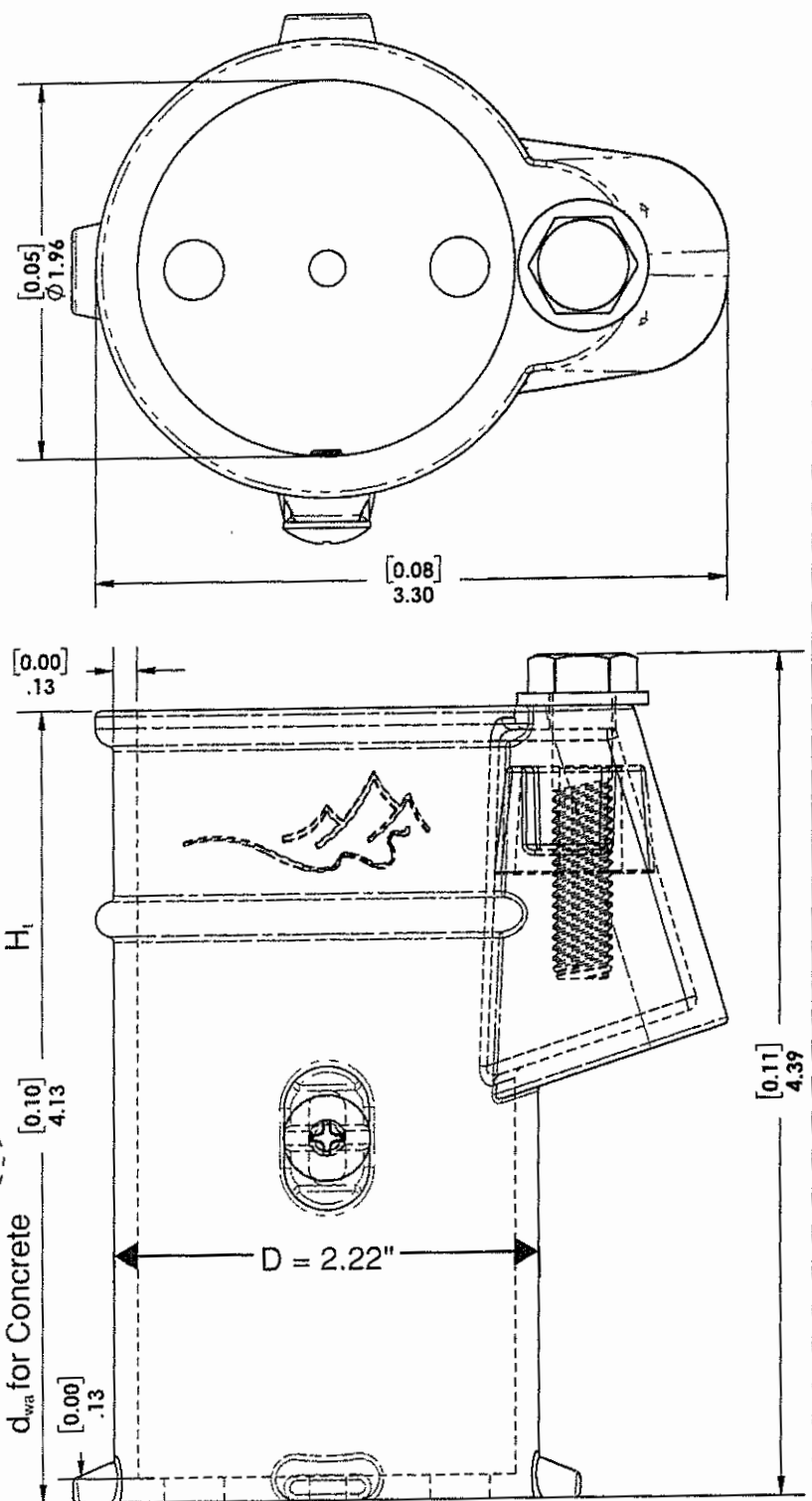
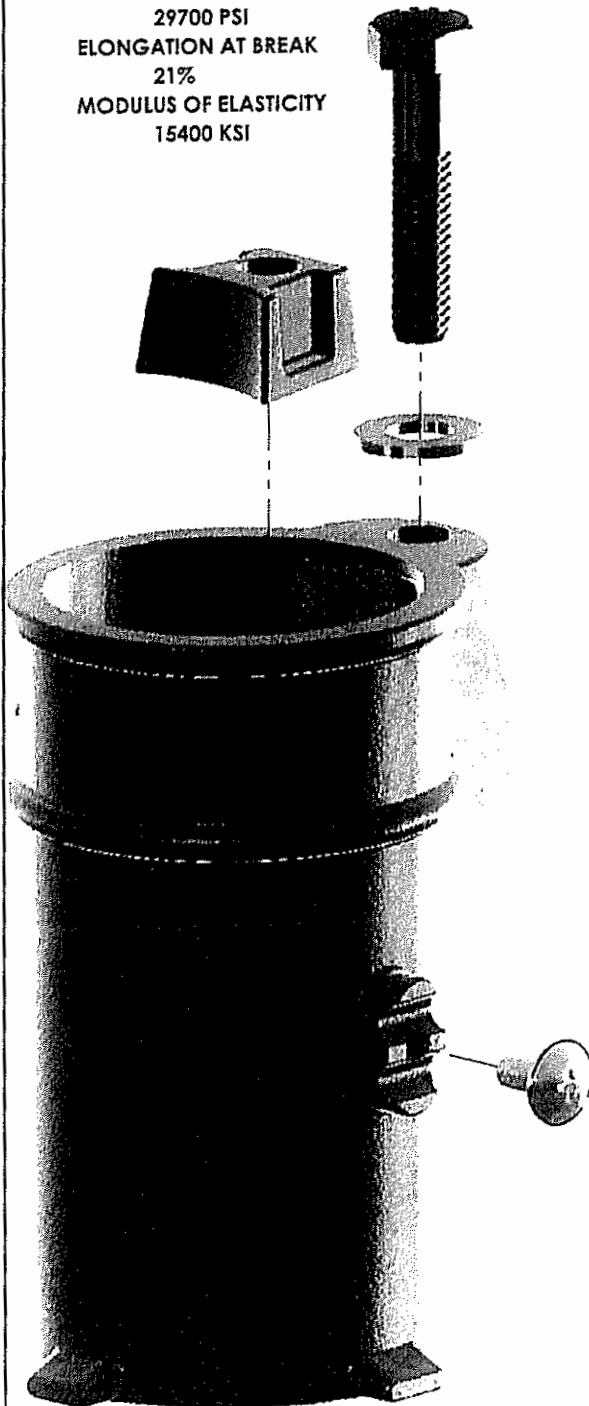
29700 PSI

ELONGATION AT BREAK

21%

MODULUS OF ELASTICITY

15400 KSI



NOTE:

 DIMENSIONS VARY WITH SPECIFIC APPLICATIONS. SPECIFICATIONS ARE NOMINAL AND ARE SUBJECT TO CHANGE. PLEASE CONTACT SPECTRUM AQUATICS FOR CUSTOM APPLICATIONS.

**SPECTRUM**  
*Aquatics*  
 A LA CORE Company

ENGINEERING DATA

PRODUCT:	ANCHOR WEDGE 1.90"x4.00"
PRODUCT #:	24010
MATERIAL:	CDA C87500
REVISION:	B Wednesday, November 01, 2017 12:51:44 PM

## HANDRAIL WEDGE ANCHOR DESIGN

2022 CBC, ACI 318-19

Case 1: P = 200 lb acting at any point along rail

**GOVERNS**

Case 2: P = 50 lb/ft(6 ft/2 anchors) = 150 lb

$$\begin{aligned} P &= 200 \text{ lb} \\ h &= 34 \text{ in} \\ d_{wa} &= 4.13 \text{ in} \\ h_{eff} &= h + d_{wa}/2 = 36.07 \text{ in} \\ \text{Load Comb: } &1.2D + 1.6L \\ M_u &= 1.6P/h_{eff} = 11541 \text{ lb-in} \end{aligned}$$

### Check Slab Internal Bending Stresses due to Moment Transfer from Anchor:

#### 1) Estimate the thickness of slab:

$$\begin{aligned} \text{Try: } t &= 6 \text{ in (9" for coverage at anchor location)} \\ \text{assume cover: } &2.8125 \text{ in} \\ r &= 0.1875 \text{ in} \\ A_{st} &= 0.22 \text{ in}^2 \text{ (assume 2-}\#3 \text{ bars, ea. way, 1 ea. side of anchor)} \\ d &= t - (\text{cover} + r) = 3 \text{ in} \\ d_o &= 2.22 \text{ in } \emptyset \\ b &= 3d_o = 6.66 \text{ in} \\ \rho &= A_{st}/bd = 0.0110 \end{aligned}$$

#### 2) Check the thickness required for moment:

$$\begin{aligned} \text{Internal Moment: } M_u &= 11541 \text{ lb-in} \\ &= 0.962 \text{ kip-ft} \\ b &= 6.66 \text{ in} \\ f_y &= 60000 \text{ psi} \\ f_c' &= 4000 \text{ psi} \\ \rho_{min} &= 200/f_y = 0.00333 \\ \rho_{max} &= 0.75[(0.85*f_c'/f_y) * 0.85 * (87000/(87000+f_y))] \\ \rho_{max} &= 0.02138 \\ \phi &= 0.9 \\ \rho &= 0.0110 \\ \omega &= \rho f_y / f_c' = 0.165 \\ \phi k_n &= \phi [f_c' \omega (1 - 0.59\omega)] = 537 \\ bd^2/12000 &= M_u / \phi k_n \\ d &= \sqrt{(M_u * 12000 / \phi * k_n * b)} = 1.80 \text{ in} \\ \text{Use } d &= 3 \text{ in} \\ \text{Is } \rho_{min} < \rho < \rho_{max} &? \text{ YES} \end{aligned}$$

**6" Slab OK**

<b>Adjacent Slab thickness:</b>	<b>6 in</b>	<b>OK to resist handrail internal moment</b>
---------------------------------	-------------	--



**3) Design Flexural Reinforcement:**  $A_s = M_u * 12000 / \phi f_y j d$

For a first trial assume that  $j d = 0.925 d$

therefore,  $A_s = 0.08 \text{ in}^2/\text{ft}$

and  $a = A_s * f_y / 0.85 f_c' = 0.113 \text{ in}$

and  $j d = d - a/2 = 2.94 \text{ in}$

recompute  $A_s$  using new  $j d$ :  $A_s = 0.0755 * M_u = 0.07 \text{ in}^2/\text{ft}$

Determine the minimum flexural reinforcement per ACI 318-19, Sec. 7.6.1:

$A_{s(\text{min})} = 0.0018 b h = 0.13 \text{ in}^2/\text{ft}$  (For 6" Slab)

Max. spacing =  $3h$  or  $18"$ :  $18 \text{ " o.c.}$  7.7.2.3

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$A_{s(\text{min})} = 0.0018 b h = 0.13 \text{ in}^2/\text{ft}$  (For 6" Slab)

Max. spacing =  $5h$  or  $18"$ :  $18 \text{ " o.c.}$  24.4.3.3

Try 2-#3 bars, 1 at ea. side of anchor:  $0.22 \text{ in}^2/\text{ft} > 0.13 \text{ in}^2/\text{ft}$  OK

Check adj. slab reinf., #4@12" o.c.:  $0.20 \text{ in}^2/\text{ft} > 0.13 \text{ in}^2/\text{ft}$  OK

**Provide 2- #3 bars, 1 at ea. side of stanchion anchor & ea. way supplemental reinforcement at upper anchor location only. Provide #4 @ 12" o.c. for flexural reinforcement in adjacent slab area. Provide double mat #4 @ 12" o.c. for flexural reinforcement in stair location at lower anchor location.**

**Concrete Breakout Strength in Shear (Per ACI 318-19, 17.7.2):**

Required Shear at Anchor:  $V_u = M_u / (2/3 d_{wa}) = 4192 \text{ lb}$

$V_n = V_{cb} = A_{vc} / A_{vco} \psi_{ed,v} \psi_{c,v} \psi_{h,v} V_b$

$f_c' = 4000 \text{ psi}$

$c_{a1} = 6 \text{ in}$

$h_a = 9 \text{ in}$  (deepened slab section at anchor)

$d_o = 2.22 \text{ in}$

$l_e = d_{wa} = 4.13 \text{ in}$

IF  $c_{a2} > c_{a1}$ :

$\psi_{ed,v} = 1.0$

$\psi_{c,v} = 1.0$  cracked concrete without

$\psi_{h,v} = \sqrt{1.5 c_{a1} / h_a} = 1.0$  supplementary reinforcement

$A_{vco} = 4.5 (c'_{a1})^2 = 162 \text{ in}^2$

IF  $h_a < 1.5 c_{a1}$ :

$A_{vc} = 2 (1.5 c_{a1}) h_a = 162 \text{ in}^2$

$V_b = 7 (l_e / d_o)^{0.2} v (d_o) \sqrt{f_c'} (c'_{a1})^{1.5} = 10976 \text{ lb}$

$V_n = V_{cb} = 10976 \text{ lb}$  GOVERNS

$\phi = 0.75$

$\phi V_n = 8232 \text{ lb}$

IS  $\phi V_n > V_u$ ?  $8232 \text{ lb} > 4192 \text{ lb}$  YES

**USE BRONZE WEDGE ANCHOR,  $l_e = 4.13"$   
USE 9" THICKENED SLAB, 4000 PSI CONCRETE w/ MIN.  
6 in. EDGE DISTANCE FROM ANCHOR IN ANY DIRECTION**

### Resultant Max. Concrete Stress from Anchor:

Assume bearing on 1/3 of perimeter:  $L_c = \pi d_o / 3 = 2.328 \text{ in}$   
 $V_u / L_c = 1801 \text{ lb/in.}$  acting at  $2/3 d_{sa}$

Max. stress on concrete:  
 $\sigma = (V_u / L_c) / (d_{wa} / 2) = 872 \text{ psi}$  acting at end of stress cone

Nominal Bearing Strength of concrete:  $\phi = 0.65$  Table 21.2.1  
 $B_n = \phi 0.85 f'_c = 2210 \text{ psi}$  14.5.6.1

Is  $B_n > \sigma$  ? **YES**

### Bronze Wedge Anchor Stresses:

Wedge Anchor Sleeve Analysis Note: Bearing load is at maximum at top & bot. of wedge anchor

$d = 2/3 d_{wa} = 2.75 \text{ in}$   
 $d_o = 2.22 \text{ in } \emptyset$   
 $M_u = 0.96 \text{ k-ft} = 962 \text{ lb-ft}$   
 $T = C = M_u / d = 4192 \text{ lb}$

### Check Bearing in Sleeve Side Wall

$C = 4192 \text{ lb Resultant}$

<i>Bronze Property Values</i>	
Bearing Bronze C93200 (SAE 660)	<i>psi</i>
Ultimate Tensile Strength	35000
Yield Strength	20000

$\phi = 0.75$   
Bearing length on 1/3 of perimeter,  $l = 2.32 \text{ in}$   
Bronze Anchor thickness,  $t = 0.13 \text{ in}$   
Project Area of Bearing,  $A_{pb} = 0.30 \text{ in}^2$   
 $R_n = \phi 1.8 F_y A_{pb} = 8160 \text{ lb}$  J7-1

Is  $R_n > C$  ? **YES Bronze Stanchion Anchor OK**

### Check Shear in Bronze Wedge Anchor Base Plate Extension Tabs

Note: Shear in base plate extension tabs only occurs in uplift.  
No design loads can cause uplift except for code minimum  
LL = 200 lb in any direction.

$$\begin{aligned}T_u &= 1.6LL = 320 \text{ lb} \\d_o &= 2.22 \text{ in } \emptyset \\ \text{Base plate extension tab distance, } l &= 0.44 \text{ in} \\ \text{Base plate extension tab thickness, } t &= 0.13 \text{ in} \\ A_v &= 4lt = 0.23 \text{ in}^2 \\ \phi &= 0.9 \\ V_n &= \phi 0.6F_y A_v = 2471 \text{ lb} \quad \text{G2-1}\end{aligned}$$

Is  $V_n > T_u$  ?                      **YES    Bronze Wedge Anchor OK**

### Check Flexural Strength of Stainless Steel Handrail Post:

Try 1-1/2" 304SS Pipe:

$$\begin{aligned}\text{Pipe O.D.} &= 1.9 \text{ in} \\ \text{Pipe I.D.} &= 1.61 \text{ in} \\ t &= 0.145 \text{ in} \\ Z &= 0.4476 \text{ in}^3\end{aligned}$$

<i>Steel Property Values</i>	
304L Stainless Steel	<i>psi</i>
Ultimate Tensile Strength	70000
Yield Strength	25000
Modulus of Elasticity	$20 \times 10^6$

$$M_u = Ph_{\text{eff}} = 7213 \text{ lb-in}$$

$$\phi M_n = \phi F_y Z = 10071 \text{ lb-in} \quad \text{where } \phi = 0.9$$

Is  $\phi M_n > M_u$  ?                      **YES, SS Handrail Post OK**

C87500

DENSITY

.299 LB/IN<sup>3</sup>

HARDNESS BRINELL

134

TENSILE STRENGTH YIELD

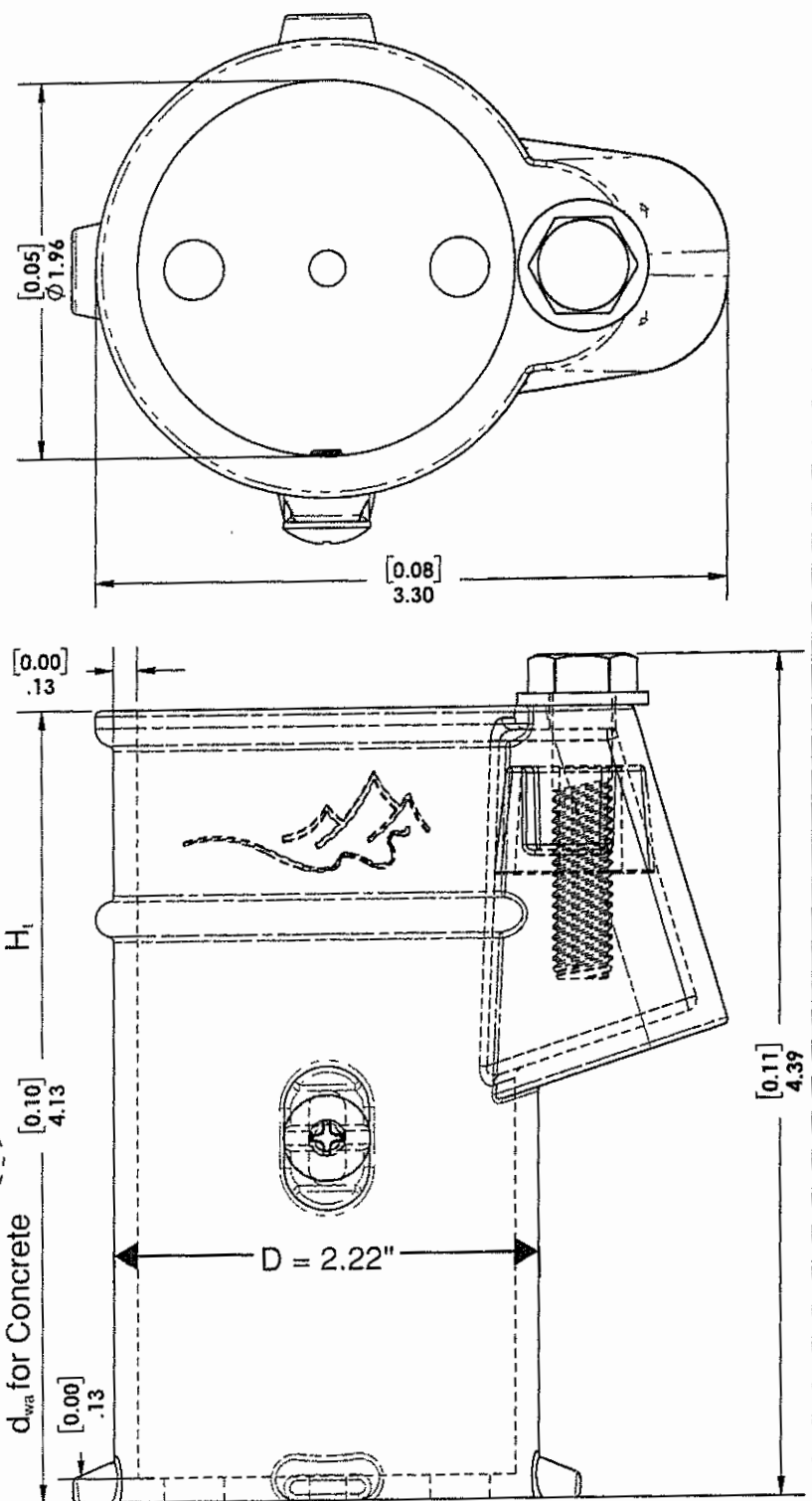
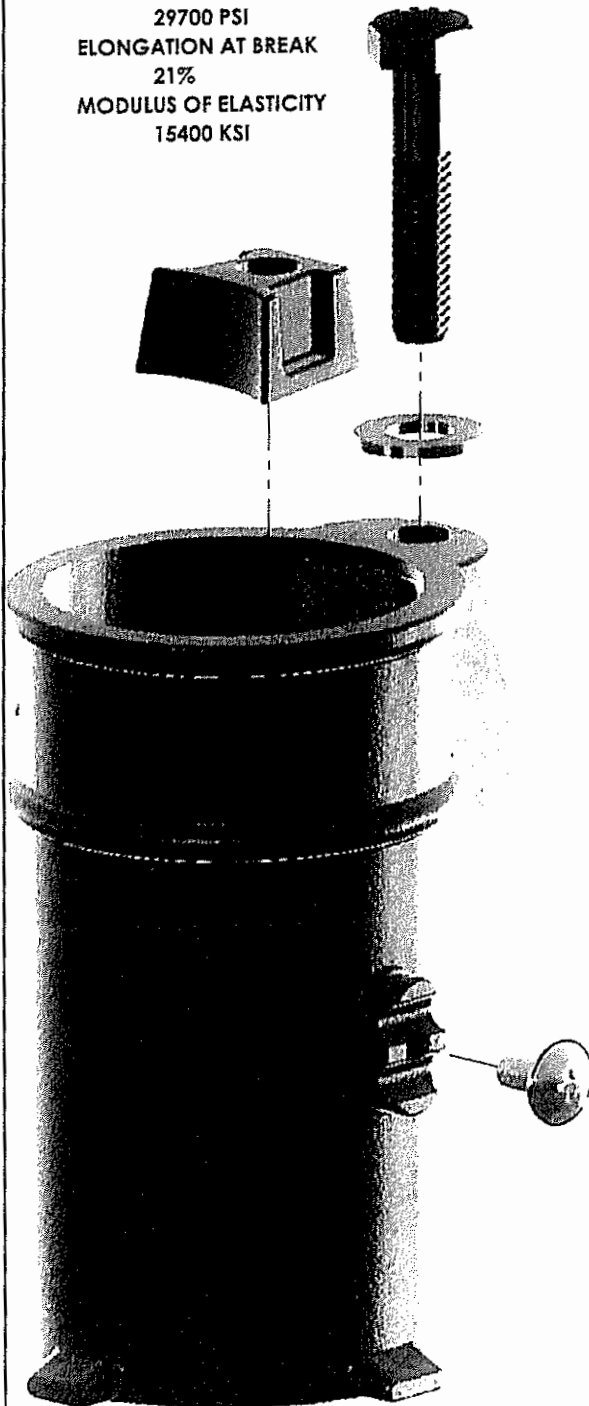
29700 PSI

ELONGATION AT BREAK

21%

MODULUS OF ELASTICITY

15400 KSI



NOTE:

⚠ DIMENSIONS VARY WITH SPECIFIC APPLICATIONS. SPECIFICATIONS ARE NOMINAL AND ARE SUBJECT TO CHANGE. PLEASE CONTACT SPECTRUM AQUATICS FOR CUSTOM APPLICATIONS.

**SPECTRUM**  
*Aquatics*  
 A LA CORE Company

ENGINEERING DATA

PRODUCT:	ANCHOR WEDGE 1.90"x4.00"
PRODUCT #:	24010
MATERIAL:	CDA C87500
REVISION:	B Wednesday, November 01, 2017 12:51:44 PM

# **POOL MECHANICAL EQUIPMENT**

## **ANCHORAGE CALCULATIONS**

## SEISMIC LOADS ON EQUIPMENT

### DESIGN METHOD PER CBC 2022, ASCE 7-16, 13.3.1

$$F_p = \frac{0.4a_p S_{DS} W_p (1+2z/h)}{R_p/I_p} \quad 13.3-1 \text{ (ASCE 7-16)}$$

Site Class: D  
 Per ASCE7 Hazards Report:  $S_S = 0.682$   
 $S_1 = 0.268$   
 $S_{DS} = 0.570$   
 $S_{D1} = 0.369$

Per Table 13.6-1	
$a_p =$	1.0
$R_p =$	2.5
$I_p =$	1.0
$\Omega_o =$	2

$z = 0$  ft  
 $h = 6.58$  ft (Varies 1.5' to 6.58')

$$= \frac{(0.4)(1.0)(0.570)W_p(1+2*0/6.58')}{(2.5/1.0)} = 0.09 W_p$$

SHALL NOT EXCEED:

$$F_p = 1.6S_{DS}I_pW_p = (1.6)(0.570)(1.0)W_p = 0.91 W_p$$

SHALL NOT BE LESS THAN:

$$F_p = 0.3S_{DS}I_pW_p = (0.3)(0.570)(1.0)W_p = 0.17 W_p$$

**GOVERNS**

<b>USE <math>F_p = 0.17 W_p</math></b>
--

LOAD COMB: ASCE 7-16, 2.3.6

6.:  $1.2D + E_v + E_{mh}$

7.:  $0.9D - E_v + E_{mh}$  (USE FOR UPLIFT FORCE)

NOTE 1: ANCHORAGE DESIGN SHALL INCLUDE A  
 CONCURRENT VERT. COMPONENT OF  $E_v = +/- 0.2S_{DS}W_p$  12.4-4a

NOTE 2: ALL CONCRETE ANCHOR LOADS ARE INCREASED BY  $\Omega_o = 2$   
 TO SATISFY ACI 318-19, 17.10.5.3 (d) AND 17.10.6.3 (c)  
 IN ALL HILTI ANCHORAGE REPORTS.

### Check for Exception #2, 11.4.8 for Site-Specific Ground Motion Analysis

Bldg Fundamental Period:  $T = C_t h_n^x$  12.8-7

$T = 0.08$  s

$T_L = 8$  s Fig. 22-14

$T_s = S_{D1}/S_{DS} = 0.65$  s

$1.5T_s = 0.97$  s

Is  $T < 1.5T_s$ ? YES, Exception Satisfied

Table 12.8-2:	
$C_t =$	0.02
$h_n =$	6.58 ft
$x =$	0.75

## SEISMIC LOADS ON WALL MOUNTED EQUIPMENT

### DESIGN METHOD PER CBC 2022, ASCE 7-16, 13.3.1

$$F_p = \frac{0.4a_p S_{DS} W_p (1+2z/h)}{R_p/I_p} \quad 13.3-1 \text{ (ASCE 7-16)}$$

Per ASCE 7 Hazards Report:

$$S_S = 0.682$$

$$S_1 = 0.268$$

$$S_{DS} = 0.570$$

$$S_{D1} = 0.369$$

Per Table 13.6-1	
$a_p =$	1.0
$R_p =$	2.5
$I_p =$	1.0
$\Omega_o =$	2

$$z = 5 \text{ ft}$$

$$h = 5 \text{ ft (Varies up to 5')}$$

$$= \frac{(0.4)(1.0)(0.570)W_p(1+2*5'/5')}{(2.5/1.0)} = 0.27 W_p$$

**GOVERNS**

SHALL NOT EXCEED:

$$F_p = 1.6S_{DS}I_p W_p = (1.6)(0.570)(1.0)W_p = 0.91 W_p$$

SHALL NOT BE LESS THAN:

$$F_p = 0.3S_{DS}I_p W_p = (0.3)(0.570)(1.0)W_p = 0.17 W_p$$

<b>USE <math>F_p = 0.27 W_p</math></b>
--

### LOAD COMB: ASCE 7-16, 2.3.6

6.:  $1.2D + E_v + E_{mh}$

7.:  $0.9D - E_v + E_{mh}$  (USE FOR UPLIFT FORCE)

NOTE 1: ANCHORAGE DESIGN SHALL INCLUDE A  
CONCURRENT VERT. COMPONENT OF  $E_v = +/- 0.2S_{DS}W_p$  12.4-4a

NOTE 2: ALL CONCRETE ANCHOR LOADS ARE INCREASED BY  $\Omega_o = 2$   
TO SATISFY ACI 318-19, 17.10.5.3 (d) AND 17.10.6.3 (c)  
IN ALL HILTI ANCHORAGE REPORTS.

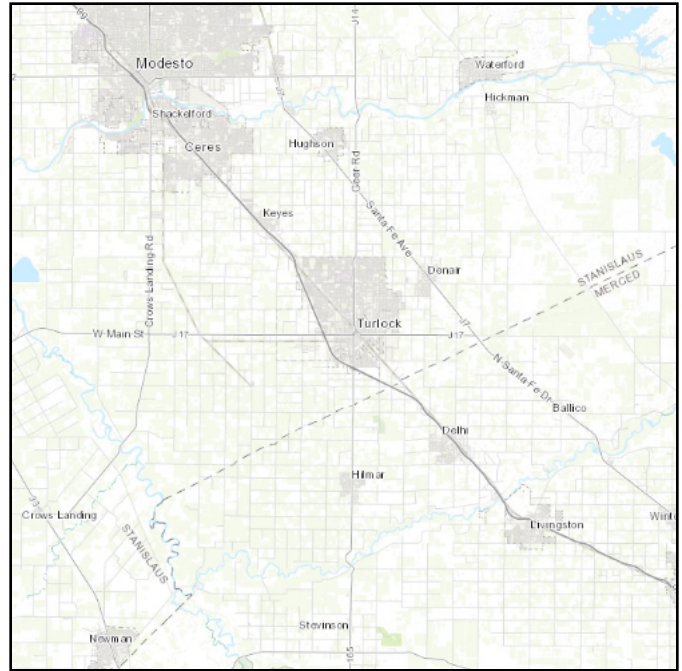
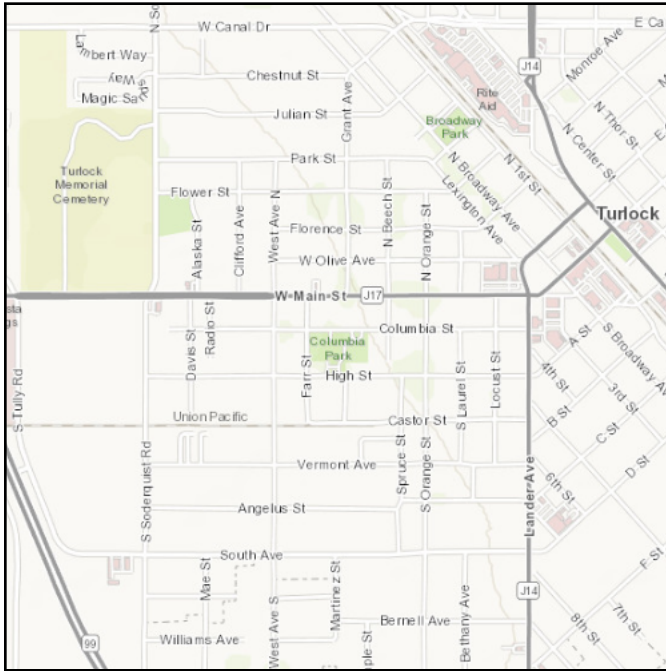


# ASCE 7 Hazards Report

**Address:**  
600 Columbia St  
Turlock, California  
95380

**Standard:** ASCE/SEI 7-16  
**Risk Category:** II  
**Soil Class:** D - Default (see Section 11.4.3)

**Latitude:** 37.49158  
**Longitude:** -120.855749  
**Elevation:** 99.4702055616554 ft (NAVD 88)





**Site Soil Class:** D - Default (see Section 11.4.3)

**Results:**

$S_s$ :	0.682	$S_{D1}$ :	N/A
$S_1$ :	0.268	$T_L$ :	12
$F_a$ :	1.255	PGA :	0.284
$F_v$ :	N/A	PGA <sub>M</sub> :	0.374
$S_{MS}$ :	0.855	$F_{PGA}$ :	1.316
$S_{M1}$ :	N/A	$I_e$ :	1
$S_{DS}$ :	0.57	$C_v$ :	1.141

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

**Data Accessed:** Tue Aug 08 2023

**Date Source:** [USGS Seismic Design Maps](#)

## PUMP ANCHORAGE:

*Seismic Load Effects including Overstrength*

$$E_m = E_{mh} \pm E_v \quad 12.4-5,6$$

$$E_{mh} = \Omega_o Q_E \quad 12.4-7$$

$$1.0E_m = 1.0E_{mh} = \Omega_o V$$

$$\Omega_o V = 0.17 \Omega_o W \quad W = \boxed{600} \text{ lb}$$

$$\Omega_o V = 205 \text{ lb}$$

$$M_{seis} = (V)(18"/12) = 308 \text{ lb-ft}$$

$$M_{resis} = (0.90)[(W)(7"/2)/12] - (0.2)(0.570)(W)(7"/2)/12 = 138 \text{ lb-ft}$$

$$T = (M_{seis} - M_{resis})/(7"/12) = 292 \text{ lb}$$

### Determine Load to Anchor in Tension

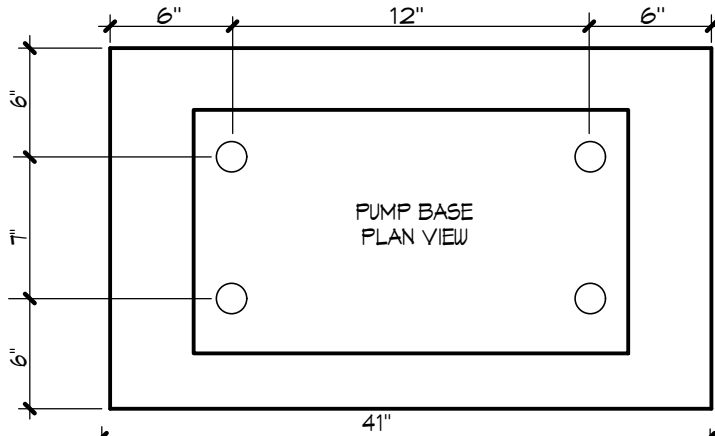
$$T_u = T_{BOLT} = T/2 = \underline{146 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.5.3 (d)}$$

### Determine Load to Anchor in Shear

$$V_u = V_{BOLT} = V/4 = \underline{51 \text{ lb}} \quad \text{(ALL 4 BOLTS FUNCTION IN SHEAR)} \\ \text{USE ACI 318-19, 17.10.6.3 (c)}$$

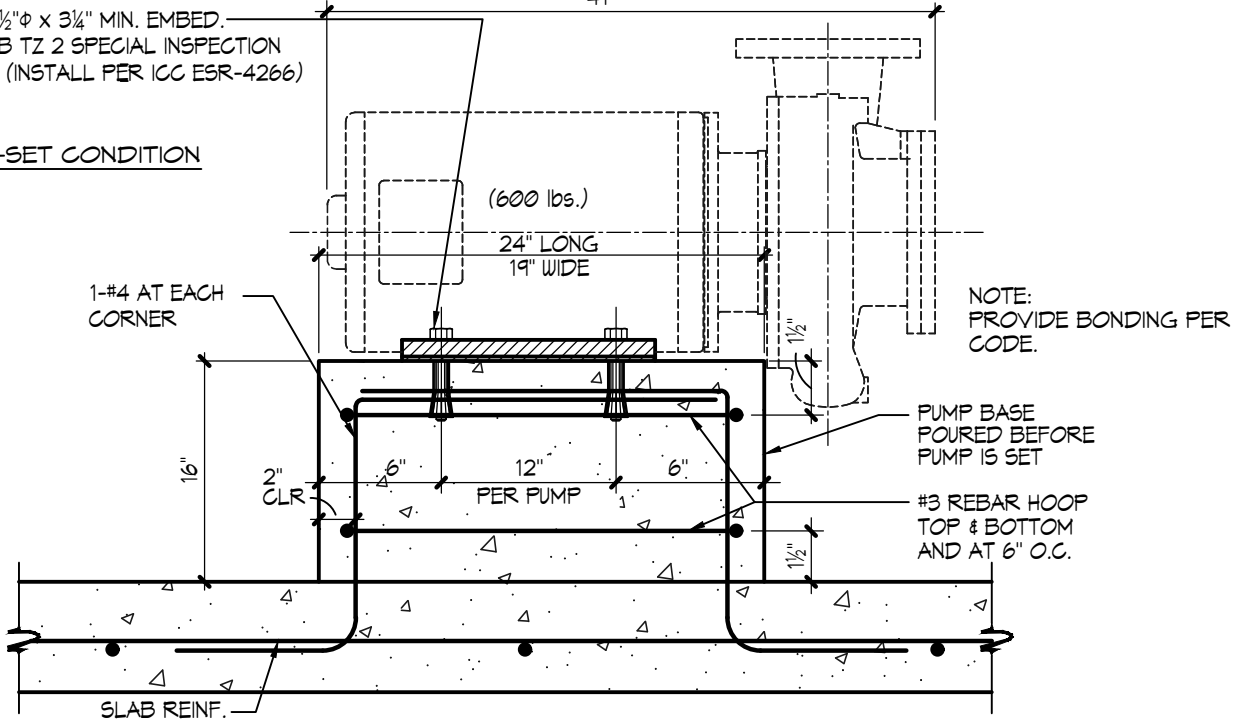
## TRY HILTI KWIK BOLT KB-TZ2 1/2" $\phi$ SS x 3 1/4" EMBED:

SEE ATTACHED HILTI ANCHORAGE REPORT



FOUR (4)- $\frac{1}{2}$ " $\phi$  x  $\frac{3}{4}$ " MIN. EMBED.  
SS HILTI KB TZ 2 SPECIAL INSPECTION  
REQUIRED (INSTALL PER ICC ESR-4266)

POST-SET CONDITION



**PUMP ANCHORAGE**

NO SCALE

www.hilti.com

Company: La Costa Engineering  
 Address: 2226 Faraday Ave., Carlsbad, CA 92008  
 Phone | Fax: 7609310290 |  
 Design: Pump Anchorage - Concrete - Aug 7, 2023  
 Fastening point: Mechanical Bldg. Conc. Floor

Page: 1  
 Specifier: Martell Montgomery  
 E-Mail: marty\_montgomery@yahoo.com  
 Date: 8/9/2023

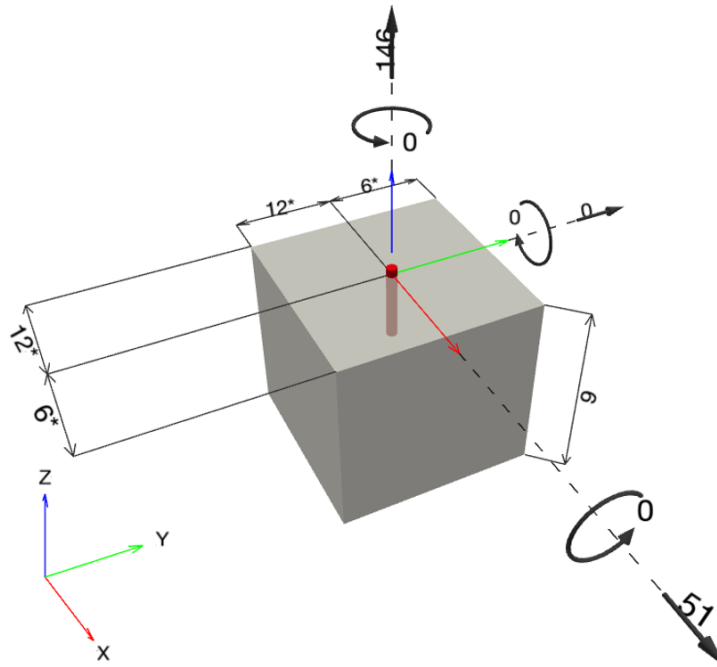
**Specifier's comments:**

**1 Input data**

**Anchor type and diameter:** Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3  
 Item number: 2210261 KB-TZ2 1/2x4 1/2 SS304  
 Effective embedment depth:  $h_{ef,act} = 3.250$  in.,  $h_{nom} = 3.750$  in.  
 Material: AISI 304  
 Evaluation Service Report: ESR-4266  
 Issued | Valid: 12/17/2021 | 12/1/2023  
 Proof: Design Method ACI 318-19 / Mech  
 Stand-off installation:  
 Profile:  
 Base material: cracked concrete, 4000,  $f'_c = 4,000$  psi;  $h = 9.000$  in.  
**Installation:** hammer drilled hole, Installation condition: Dry  
 Reinforcement: tension: not present, shear: not present; no supplemental splitting reinforcement present  
 edge reinforcement: none or < No. 4 bar  
 Seismic loads (cat. C, D, E, or F) Tension load: yes (17.10.5.3 (d))  
 Shear load: yes (17.10.6.3 (c))



**Geometry [in.] & Loading [lb, in.lb]**





# Hilti PROFIS Engineering 3.0.87

www.hilti.com

Company:	La Costa Engineering	Page:	2
Address:	2226 Faraday Ave., Carlsbad, CA 92008	Specifier:	Martell Montgomery
Phone   Fax:	7609310290	E-Mail:	marty_montgomery@yahoo.com
Design:	Pump Anchorage - Concrete - Aug 7, 2023	Date:	8/9/2023
Fastening point:	Mechanical Bldg. Conc. Floor		

## 1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 146; V <sub>x</sub> = 51; V <sub>y</sub> = 0; M <sub>x</sub> = 0; M <sub>y</sub> = 0; M <sub>z</sub> = 0;	yes	5

## 2 Load case/Resulting anchor forces

### Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	146	51	51	0

max. concrete compressive strain: - [%]  
max. concrete compressive stress: - [psi]  
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]  
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

	Load N <sub>ua</sub> [lb]	Capacity $\phi$ N <sub>n</sub> [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	146	8,906	2	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	146	3,071	5	OK

\* highest loaded anchor    \*\*anchor group (anchors in tension)



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Phone   Fax:	7609310290	E-Mail:	marty_montgomery@yahoo.com
Design:	Pump Anchorage - Concrete - Aug 7, 2023	Date:	8/9/2023
Fastening point:	Mechanical Bldg. Conc. Floor		

### 3.1 Steel Strength

$N_{sa}$  = ESR value refer to ICC-ES ESR-4266  
 $\phi N_{sa} \geq N_{ua}$  ACI 318-19 Table 17.5.2

#### Variables

$A_{se,N}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.10	120,404

#### Calculations

$N_{sa}$ [lb]
11,875

#### Results

$N_{sa}$ [lb]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi N_{sa}$ [lb]	$N_{ua}$ [lb]
11,875	0.750	1.000	8,906	146

### 3.2 Concrete Breakout Failure

$N_{cb} = \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$  ACI 318-19 Eq. (17.6.2.1a)

$\phi N_{cb} \geq N_{ua}$  ACI 318-19 Table 17.5.2

$A_{Nc}$  see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$  ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$  ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$  ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$  ACI 318-19 Eq. (17.6.2.2.1)

#### Variables

$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
3.250	6.000	1.000	8.000	17	1.000	4,000

#### Calculations

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [lb]
95.06	95.06	1.000	1.000	6,299

#### Results

$N_{cb}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi N_{cb}$ [lb]	$N_{ua}$ [lb]
6,299	0.650	0.750	1.000	3,071	146



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Design:	Pump Anchorage - Concrete - Aug 7, 2023	Date:	8/9/2023
Fastening point:	Mechanical Bldg. Conc. Floor		

## 4 Shear load

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	51	5,426	1	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	51	8,819	1	OK
Concrete edge failure in direction x+**	51	3,512	2	OK

\* highest loaded anchor    \*\*anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa,eq}$  = ESR value      refer to ICC-ES ESR-4266  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-19 Table 17.5.2

#### Variables

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]	$\alpha_{v,seis}$
0.10	120,404	1.000

#### Calculations

$V_{sa,eq}$ [lb]
8,348

#### Results

$V_{sa,eq}$ [lb]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi V_{sa,eq}$ [lb]	$V_{ua}$ [lb]
8,348	0.650	1.000	5,426	51



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**4.2 Pryout Strength**

$$V_{cp} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b \right] \quad \text{ACI 318-19 Eq. (17.7.3.1a)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\Psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\Psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

**Variables**

$k_{cp}$	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\Psi_{c,N}$
2	3.250	6.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
8.000	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,N}$	$\Psi_{cp,N}$	$N_b$ [lb]
95.06	95.06	1.000	1.000	6,299

**Results**

$V_{cp}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cp}$ [lb]	$V_{ua}$ [lb]
12,599	0.700	1.000	1.000	8,819	51





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**4.3 Concrete edge failure in direction x+**

$$V_{cb} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1a)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Vc} \text{ see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1a)}$$

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]	$l_e$ [in.]
6.000	6.000	1.000	9.000	3.250
$\lambda_a$	$d_a$ [in.]	$f_c$ [psi]	$\Psi_{parallel,V}$	
1.000	0.500	4,000	1.000	

**Calculations**

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
135.00	162.00	0.900	1.000	6,690

**Results**

$V_{cb}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cb}$ [lb]	$V_{ua}$ [lb]
5,017	0.700	1.000	1.000	3,512	51

**5 Combined tension and shear loads, per ACI 318-19 section 17.8**

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{N,V}$ [%]	Status
0.048	0.015	5/3	1	OK

$$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} \leq 1$$



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## 6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by  $\omega_0$ .
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

## Fastening meets the design criteria!



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Fastening point:	Mechanical Bldg. Conc. Floor		

### 7 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3

Item number: 2210261 KB-TZ2 1/2x4 1/2 SS304

Maximum installation torque: 481 in.lb

Hole diameter in the base material: 0.500 in.

Hole depth in the base material: 4.250 in.

Minimum thickness of the base material: 5.500 in.

Hilti KB-TZ2 stud anchor with 3.75 in embedment, 1/2 (3 1/4 ) hnom3, Stainless steel, installation per ESR-4266

#### 7.1 Recommended accessories

**Drilling**

- Suitable Rotary Hammer
- Properly sized drill bit

**Cleaning**

- Manual blow-out pump

**Setting**

- Torque controlled cordless impact tool
- Torque wrench
- Hammer

#### Coordinates Anchor in.

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	0.000	0.000	12.000	6.000	12.000	6.000



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## 8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

**FILTER ANCHORAGE:**

*Seismic Load Effects including Overstrength*

$$E_m = E_{mh} +/- E_v \quad 12.4-5,6$$

$$E_{mh} = \Omega_o Q_E \quad 12.4-7$$

$$1.0E_m = 1.0E_{mh} = \Omega_o V$$

$$\Omega_o V = 0.17 \Omega_o W \quad W = \boxed{8155} \text{ lb}$$

$$\Omega_o V = 2789 \text{ lb}$$

$$M_{seis} = (V)(28.75"/12) = 6682 \text{ lb-ft} \quad h_{cg} = (57.50"/2) = 28.75"$$

$$M_{resis} = (0.90)[(W)(30"/2)/12] - (0.2)(0.570)(W)(30"/2)/12 = 8012 \text{ lb-ft}$$

$$T = (M_{seis} - M_{resis})/(30"/12) = 0 \text{ lb}$$

**Determine Load to Anchor in Tension**

$$T_u = T_{BOLT} = T/2 = \underline{0 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.5.3 (d)}$$

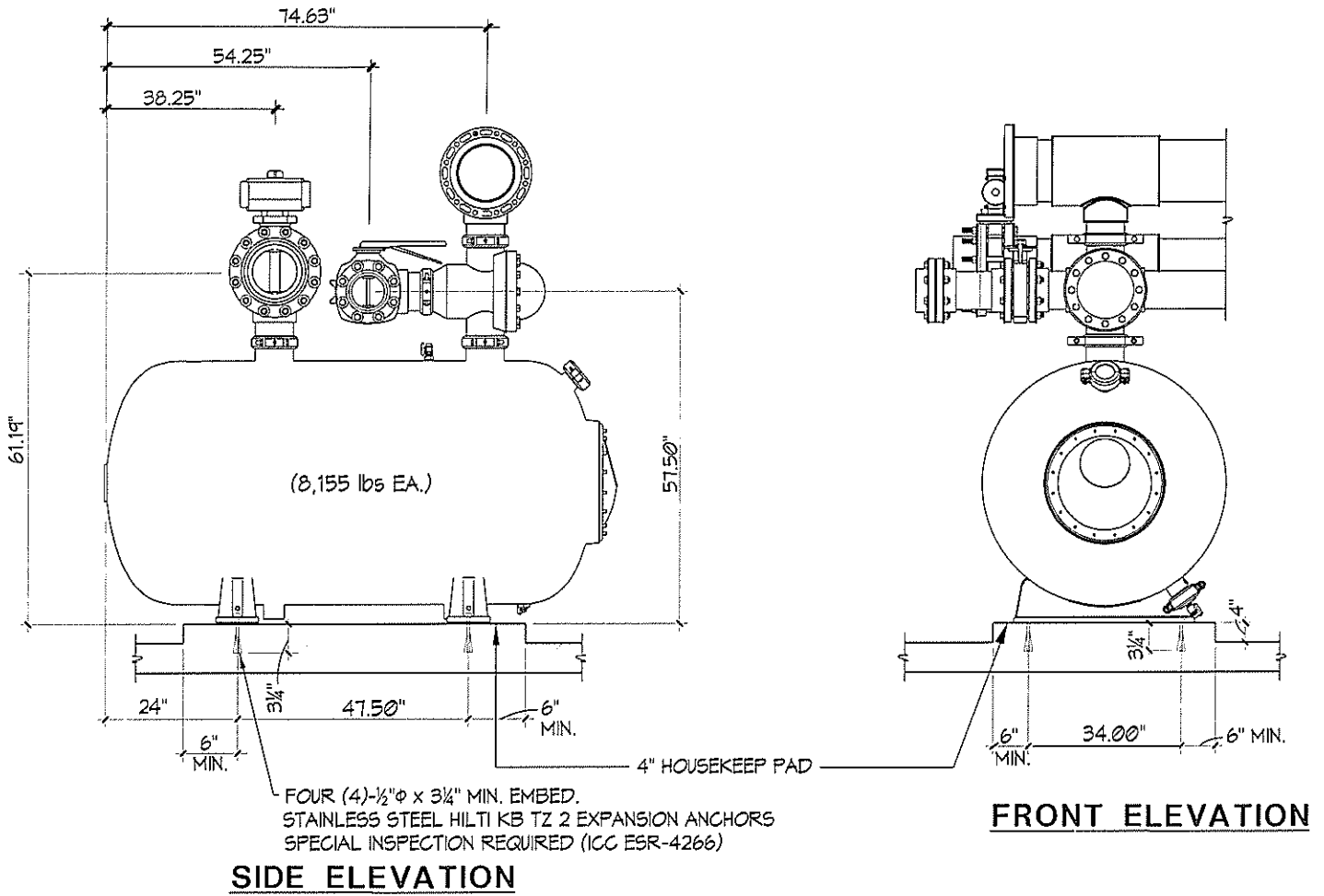
**Determine Load to Anchor in Shear**

$$V_u = V_{BOLT} = V/4 = \underline{697 \text{ lb}} \quad \text{(ALL 4 BOLTS FUNCTION IN SHEAR)}$$

USE ACI 318-19, 17.10.6.3 (c)

**TRY HILTI KWIK BOLT KB-TZ2 1/2" Ø SS x 3 1/4" EMBED:**

SEE ATTACHED HILTI ANCHORAGE REPORT



**FILTER ANCHORAGE**



NO SCALE

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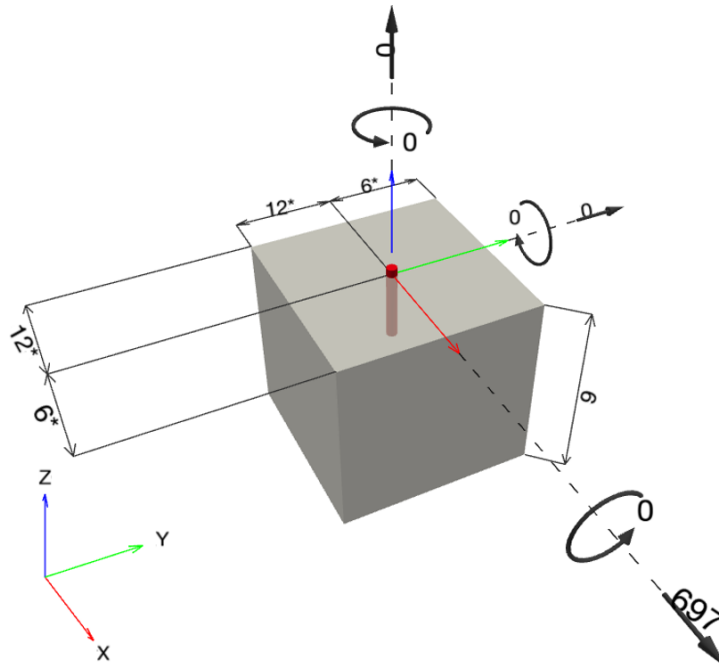
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Fastening point:	Mechanical Bldg. Conc. Floor		

**Specifier's comments:**

**1 Input data**

<b>Anchor type and diameter:</b>	<b>Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3</b>	 
Item number:	2210261 KB-TZ2 1/2x4 1/2 SS304	
Effective embedment depth:	$h_{ef,act} = 3.250$ in., $h_{nom} = 3.750$ in.	
Material:	AISI 304	
Evaluation Service Report:	ESR-4266	
Issued   Valid:	12/17/2021   12/1/2023	
Proof:	Design Method ACI 318-19 / Mech	
Stand-off installation:		
Profile:		
Base material:	cracked concrete, 4000, $f'_c = 4,000$ psi; $h = 9.000$ in.	
<b>Installation:</b>	<b>hammer drilled hole, Installation condition: Dry</b>	
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar	
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d)) Shear load: yes (17.10.6.3 (c))	

**Geometry [in.] & Loading [lb, in.lb]**





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Fastening point:	Mechanical Bldg. Conc. Floor		

## 1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0; V <sub>x</sub> = 697; V <sub>y</sub> = 0; M <sub>x</sub> = 0; M <sub>y</sub> = 0; M <sub>z</sub> = 0;	yes	20

## 2 Load case/Resulting anchor forces

### Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	697	697	0

max. concrete compressive strain: - [%]  
max. concrete compressive stress: - [psi]  
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]  
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

	Load N <sub>ua</sub> [lb]	Capacity $\phi$ N <sub>n</sub> [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A

\* highest loaded anchor    \*\*anchor group (anchors in tension)





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**4 Shear load**

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_v = V_{ua}/\phi V_n$	Status
Steel Strength*	697	5,426	13	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	697	8,819	8	OK
Concrete edge failure in direction x+**	697	3,512	20	OK

\* highest loaded anchor    \*\*anchor group (relevant anchors)

**4.1 Steel Strength**

$V_{sa,eq}$  = ESR value      refer to ICC-ES ESR-4266  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-19 Table 17.5.2

**Variables**

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]	$\alpha_{v,seis}$
0.10	120,404	1.000

**Calculations**

$V_{sa,eq}$ [lb]
8,348

**Results**

$V_{sa,eq}$ [lb]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi V_{sa,eq}$ [lb]	$V_{ua}$ [lb]
8,348	0.650	1.000	5,426	697

Input data and results must be checked for conformity with the existing conditions and for plausibility!  
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**4.2 Pryout Strength**

$$V_{cp} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b \right] \quad \text{ACI 318-19 Eq. (17.7.3.1a)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\Psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\Psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

**Variables**

$k_{cp}$	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\Psi_{c,N}$
2	3.250	6.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
8.000	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,N}$	$\Psi_{cp,N}$	$N_b$ [lb]
95.06	95.06	1.000	1.000	6,299

**Results**

$V_{cp}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cp}$ [lb]	$V_{ua}$ [lb]
12,599	0.700	1.000	1.000	8,819	697



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Phone   Fax:	7609310290	E-Mail:	marty_montgomery@yahoo.com
Design:	Filter Anchorage - Concrete - Aug 7, 2023	Date:	8/9/2023
Fastening point:	Mechanical Bldg. Conc. Floor		

**4.3 Concrete edge failure in direction x+**

$$V_{cb} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1a)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$A_{Vc}$  see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1a)}$$

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]	$l_e$ [in.]
6.000	6.000	1.000	9.000	3.250
$\lambda_a$	$d_a$ [in.]	$f_c$ [psi]	$\Psi_{parallel,V}$	
1.000	0.500	4,000	1.000	

**Calculations**

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
135.00	162.00	0.900	1.000	6,690

**Results**

$V_{cb}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cb}$ [lb]	$V_{ua}$ [lb]
5,017	0.700	1.000	1.000	3,512	697



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## 5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by  $\omega_0$ .
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

## Fastening meets the design criteria!



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Fastening point:	Mechanical Bldg. Conc. Floor		

## 6 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3

Item number: 2210261 KB-TZ2 1/2x4 1/2 SS304

Maximum installation torque: 481 in.lb

Hole diameter in the base material: 0.500 in.

Hole depth in the base material: 4.250 in.

Minimum thickness of the base material: 5.500 in.

Hilti KB-TZ2 stud anchor with 3.75 in embedment, 1/2 (3 1/4 ) hnom3, Stainless steel, installation per ESR-4266

### 6.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> <li>• Suitable Rotary Hammer</li> <li>• Properly sized drill bit</li> </ul>	<ul style="list-style-type: none"> <li>• Manual blow-out pump</li> </ul>	<ul style="list-style-type: none"> <li>• Torque controlled cordless impact tool</li> <li>• Torque wrench</li> <li>• Hammer</li> </ul>

### Coordinates Anchor in.

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	0.000	0.000	12.000	6.000	12.000	6.000



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## 7 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

**HEATER ANCHORAGE:**

*Seismic Load Effects including Overstrength*

$$E_m = E_{mh} \pm E_v \quad 12.4-5,6$$

$$E_{mh} = \Omega_o Q_E \quad 12.4-7$$

$$1.0E_m = 1.0E_{mh} = \Omega_o V \quad 3397 \text{ lb HEATER/ } 3097 \text{ lb HEATER}$$

$$\Omega_o V = 0.17 \Omega_o W \quad 200 \text{ lb FLUE AND PIPING}$$

$$\Omega_o V = 1230 \text{ lb} \quad W = \boxed{3597} \text{ lb TOTAL}$$

$$M_{seis} = (V)(79"/2)/12 = 4049 \text{ lb-ft}$$

$$M_{resis} = (0.90)[(W_{heater})(33"/2)/12 - (0.2)(0.570)(W_{heater})(33"/2)/12] = 3671 \text{ lb-ft}$$

$$M_u = M_{seis} - M_{resis} = 378 \text{ lb-ft}$$

**TENSION FROM SEISMIC FORCE APPLIED TO C.G.**

NOT DUE TO GEOMETRY WRT HEATER,  
APPLY ENTIRE TENSILE LOAD  
TO ONE SIDE OF SKID.  
(2- BOLTS/SIDE OF SKID)

**Determine Load to Anchor in Tension**

$$M_u / 2 \text{ Skid Mount Connections} = 189 \text{ lb-ft}$$

$$T_u = T_{BOLT} = M_u / (33"/12) = \underline{69 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.5.3 (d)}$$

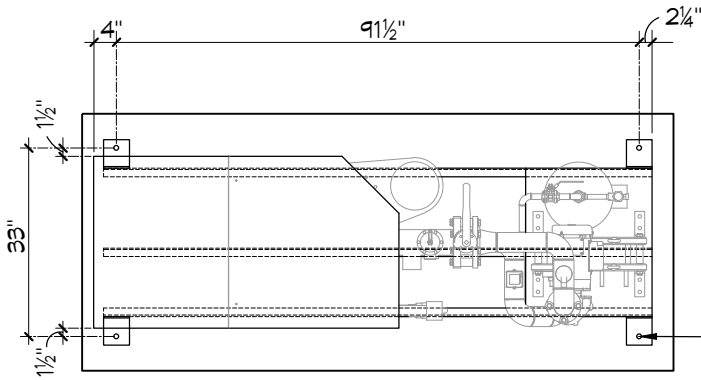
**Determine Load to Anchor in Shear**

(ALL 4 BOLTS FUNCTION IN SHEAR)

$$V_u = V_{BOLT} = V/4 = \underline{308 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.6.3 (c)}$$

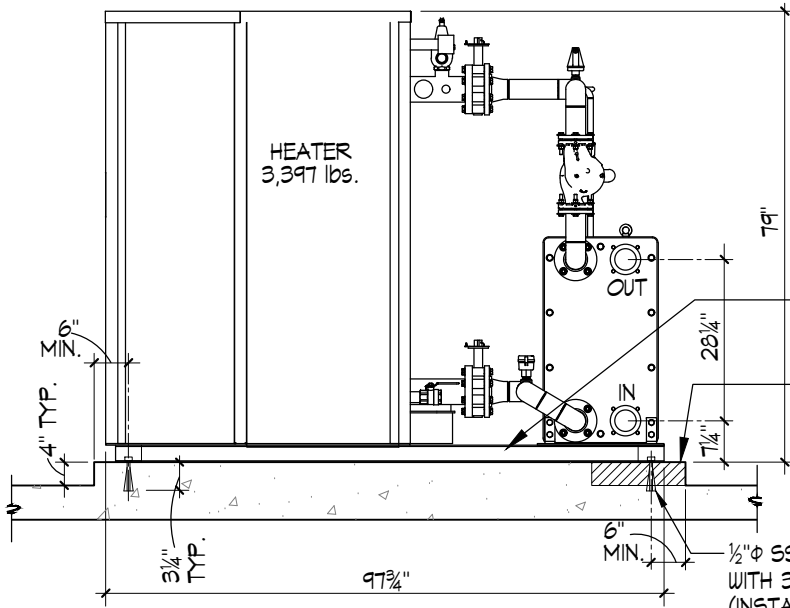
**TRY HILTI KWIK BOLT KB-TZ2 1/2" Ø SS x 3 1/4" EMBED:**

SEE ATTACHED HILTI ANCHORAGE REPORT



**PLAN VIEW**

1/2" φ SS HILTI KB-TZ 2  
WITH 3 1/4" MIN. EMBED  
(INSTALL PER ESR  
ICC ESR-4266).



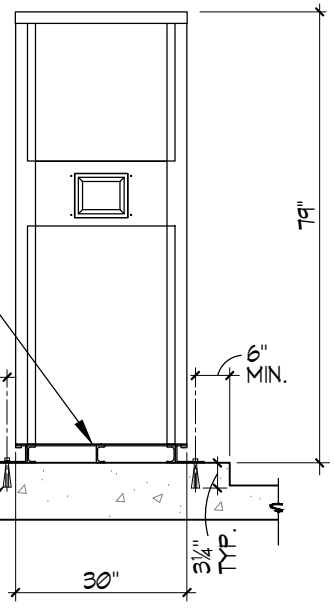
**SIDE VIEW**

SKID MOUNTED  
ON STEEL FRAME

ENLARGED EQ.  
PAD



1/2" φ SS HILTI KB-TZ 2  
WITH 3 1/4" MIN. EMBED  
(INSTALL PER ESR  
ICC ESR-4266).



**FRONT VIEW**

**HEATER ANCHORAGE**

1/2" = 1'-0"



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 Address: 2226 Faraday Ave., Carlsbad, CA 92008  
 Phone | Fax: 7609310290 |  
 Design: Heater Anchorage - Concrete - Aug 7, 2023  
 Fastening point: Mechanical Bldg. Conc. Floor

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 Specifier: Martell Montgomery  
 E-Mail: marty\_montgomery@yahoo.com  
 Date: 8/9/2023

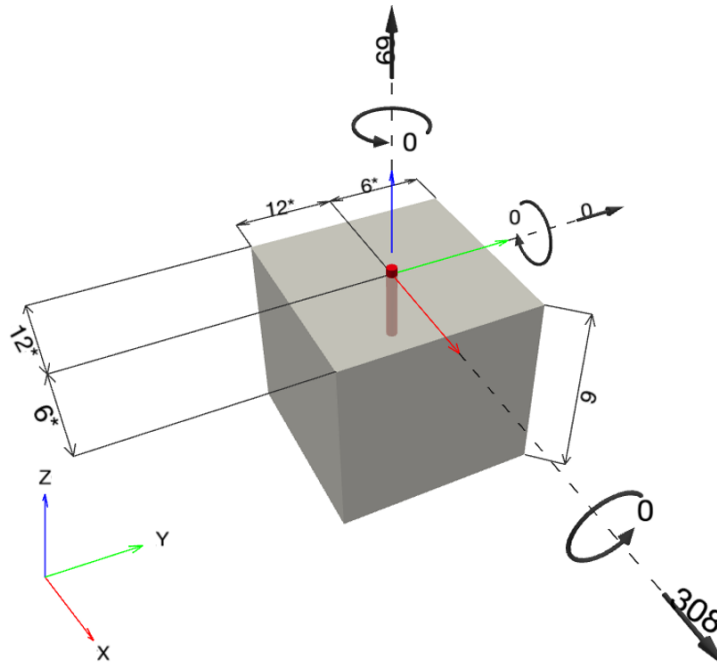
**Specifier's comments:**

**1 Input data**

**Anchor type and diameter:** Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3  
 Item number: 2210261 KB-TZ2 1/2x4 1/2 SS304  
 Effective embedment depth:  $h_{ef,act} = 3.250$  in.,  $h_{nom} = 3.750$  in.  
 Material: AISI 304  
 Evaluation Service Report: ESR-4266  
 Issued | Valid: 12/17/2021 | 12/1/2023  
 Proof: Design Method ACI 318-19 / Mech  
 Stand-off installation:  
 Profile:  
 Base material: cracked concrete, 4000,  $f'_c = 4,000$  psi;  $h = 9.000$  in.  
**Installation:** hammer drilled hole, Installation condition: Dry  
 Reinforcement: tension: not present, shear: not present; no supplemental splitting reinforcement present  
 edge reinforcement: none or < No. 4 bar  
 Seismic loads (cat. C, D, E, or F) Tension load: yes (17.10.5.3 (d))  
 Shear load: yes (17.10.6.3 (c))



**Geometry [in.] & Loading [lb, in.lb]**





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Design:	Heater Anchorage - Concrete - Aug 7, 2023	Date:	8/9/2023
Fastening point:	Mechanical Bldg. Conc. Floor		

## 1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 69; V <sub>x</sub> = 308; V <sub>y</sub> = 0; M <sub>x</sub> = 0; M <sub>y</sub> = 0; M <sub>z</sub> = 0;	yes	9

## 2 Load case/Resulting anchor forces

### Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	69	308	308	0

max. concrete compressive strain: - [%]  
max. concrete compressive stress: - [psi]  
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]  
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

	Load N <sub>ua</sub> [lb]	Capacity $\phi$ N <sub>n</sub> [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	69	8,906	1	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	69	3,071	3	OK

\* highest loaded anchor    \*\*anchor group (anchors in tension)



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Fastening point:	Mechanical Bldg. Conc. Floor		

**3.1 Steel Strength**

$N_{sa}$  = ESR value refer to ICC-ES ESR-4266  
 $\phi N_{sa} \geq N_{ua}$  ACI 318-19 Table 17.5.2

**Variables**

$A_{se,N}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.10	120,404

**Calculations**

$N_{sa}$ [lb]
11,875

**Results**

$N_{sa}$ [lb]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi N_{sa}$ [lb]	$N_{ua}$ [lb]
11,875	0.750	1.000	8,906	69

**3.2 Concrete Breakout Failure**

$N_{cb} = \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$  ACI 318-19 Eq. (17.6.2.1a)

$\phi N_{cb} \geq N_{ua}$  ACI 318-19 Table 17.5.2

$A_{Nc}$  see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$  ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$  ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$  ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$  ACI 318-19 Eq. (17.6.2.2.1)

**Variables**

$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
3.250	6.000	1.000	8.000	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [lb]
95.06	95.06	1.000	1.000	6,299

**Results**

$N_{cb}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi N_{cb}$ [lb]	$N_{ua}$ [lb]
6,299	0.650	0.750	1.000	3,071	69



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Fastening point:	Mechanical Bldg. Conc. Floor		

## 4 Shear load

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	308	5,426	6	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	308	8,819	4	OK
Concrete edge failure in direction x+**	308	3,512	9	OK

\* highest loaded anchor    \*\*anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa,eq}$  = ESR value      refer to ICC-ES ESR-4266  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-19 Table 17.5.2

#### Variables

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]	$\alpha_{v,seis}$
0.10	120,404	1.000

#### Calculations

$V_{sa,eq}$ [lb]
8,348

#### Results

$V_{sa,eq}$ [lb]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi V_{sa,eq}$ [lb]	$V_{ua}$ [lb]
8,348	0.650	1.000	5,426	308



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**4.2 Pryout Strength**

$$V_{cp} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b \right] \quad \text{ACI 318-19 Eq. (17.7.3.1a)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\Psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\Psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

**Variables**

$k_{cp}$	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\Psi_{c,N}$
2	3.250	6.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
8.000	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,N}$	$\Psi_{cp,N}$	$N_b$ [lb]
95.06	95.06	1.000	1.000	6,299

**Results**

$V_{cp}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cp}$ [lb]	$V_{ua}$ [lb]
12,599	0.700	1.000	1.000	8,819	308



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**4.3 Concrete edge failure in direction x+**

$$V_{cb} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1a)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Vc} \text{ see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1a)}$$

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]	$l_e$ [in.]
6.000	6.000	1.000	9.000	3.250
$\lambda_a$	$d_a$ [in.]	$f_c$ [psi]	$\Psi_{parallel,V}$	
1.000	0.500	4,000	1.000	

**Calculations**

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
135.00	162.00	0.900	1.000	6,690

**Results**

$V_{cb}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cb}$ [lb]	$V_{ua}$ [lb]
5,017	0.700	1.000	1.000	3,512	308

**5 Combined tension and shear loads, per ACI 318-19 section 17.8**

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{N,V}$ [%]	Status
0.022	0.088	5/3	2	OK

$$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} \leq 1$$



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Fastening point:	Mechanical Bldg. Conc. Floor		

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## 6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by  $\omega_0$ .
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

## Fastening meets the design criteria!



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Company: La Costa Engineering  
 Address: 2226 Faraday Ave., Carlsbad, CA 92008  
 Phone | Fax: 7609310290 |  
 Design: Heater Anchorage - Concrete - Aug 7, 2023  
 Fastening point: Mechanical Bldg. Conc. Floor

Page: 8  
 Specifier: Martell Montgomery  
 E-Mail: marty\_montgomery@yahoo.com  
 Date: 8/9/2023

### 7 Installation data

Profile: -  
 Hole diameter in the fixture: -  
 Plate thickness (input): -

Drilling method: Hammer drilled  
 Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3  
 Item number: 2210261 KB-TZ2 1/2x4 1/2 SS304  
 Maximum installation torque: 481 in.lb  
 Hole diameter in the base material: 0.500 in.  
 Hole depth in the base material: 4.250 in.  
 Minimum thickness of the base material: 5.500 in.

Hilti KB-TZ2 stud anchor with 3.75 in embedment, 1/2 (3 1/4 ) hnom3, Stainless steel, installation per ESR-4266

#### 7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> <li>• Suitable Rotary Hammer</li> <li>• Properly sized drill bit</li> </ul>	<ul style="list-style-type: none"> <li>• Manual blow-out pump</li> </ul>	<ul style="list-style-type: none"> <li>• Torque controlled cordless impact tool</li> <li>• Torque wrench</li> <li>• Hammer</li> </ul>

#### Coordinates Anchor in.

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	0.000	0.000	12.000	6.000	12.000	6.000





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Fastening point:	Mechanical Bldg. Conc. Floor		

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## 8 Remarks; Your Cooperation Duties

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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

**CHLORINATION UNIT/ ACID UNIT ANCHORAGE:**

*Seismic Load Effects including Overstrength*

$$E_m = E_{mh} +/- E_v \quad 12.4-5,6$$

$$E_{mh} = \Omega_o Q_E \quad 12.4-7$$

$$1.0E_m = 1.0E_{mh} = \Omega_o V$$

$$\Omega_o V = 0.17 \Omega_o W \quad W = \boxed{672} \text{ lb TOTAL}$$

$$\Omega_o V = 230 \text{ lb}$$

$$M_{seis} = (V)(23.69"/2)/12 = 227 \text{ lb-ft}$$

$$M_{resis} = (0.90)[(W_{heater})(17"/2)/12 - (0.2)(0.570)(W_{heater})(17"/2)/12] = 374 \text{ lb-ft}$$

$$M_u = M_{seis} - M_{resis} = 0 \text{ lb-ft}$$

**TENSION FROM SEISMIC FORCE APPLIED TO C.G.**

NOTE DUE TO GEOMETRY WRT HEATER,  
APPLY ENTIRE TENSILE LOAD  
TO ONE SIDE OF SKID.  
(2- BOLTS/SIDE OF SKID)

**Determine Load to Anchor in Tension**

$$M_u / 2 \text{ Skid Mount Connections} = 0 \text{ lb-ft}$$

$$T_u = T_{BOLT} = M_u / (17"/12) = \underline{0 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.5.3 (d)}$$

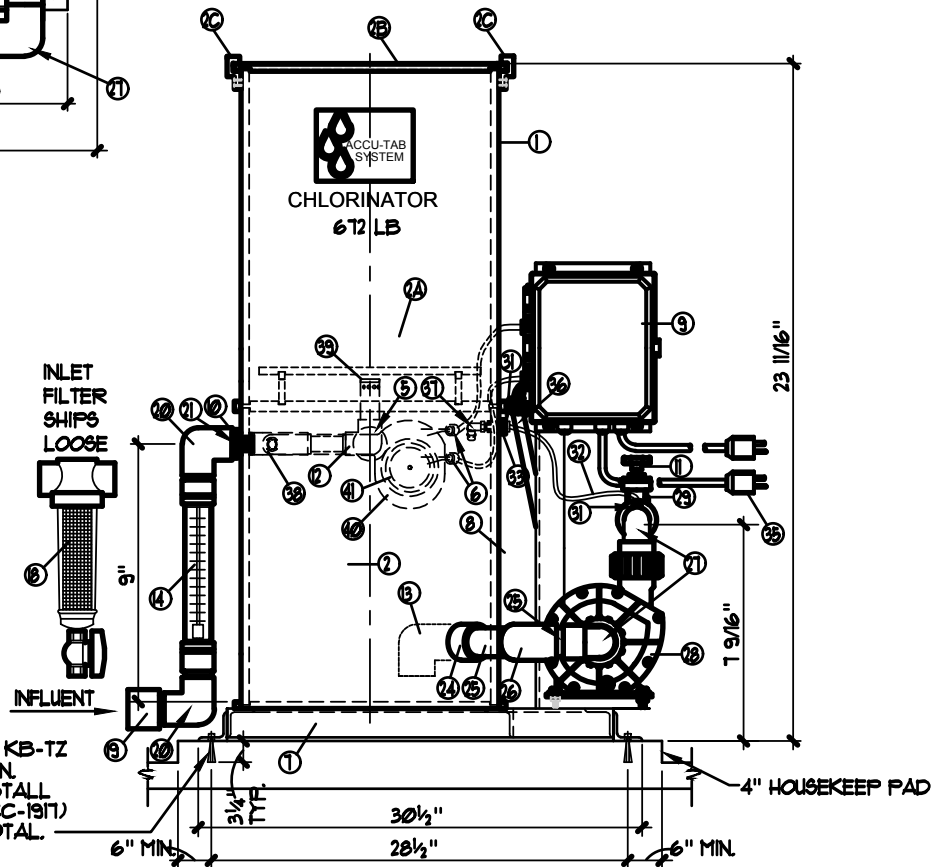
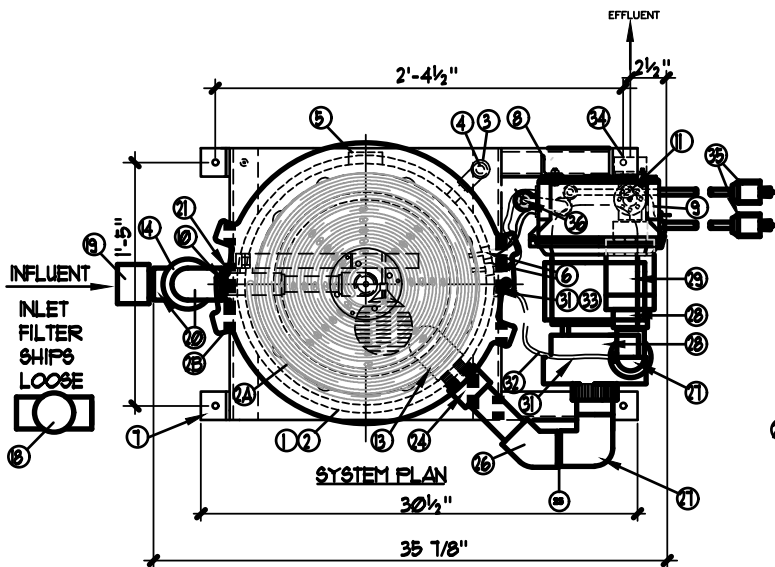
**Determine Load to Anchor in Shear**

(ALL 4 BOLTS FUNCTION IN SHEAR)

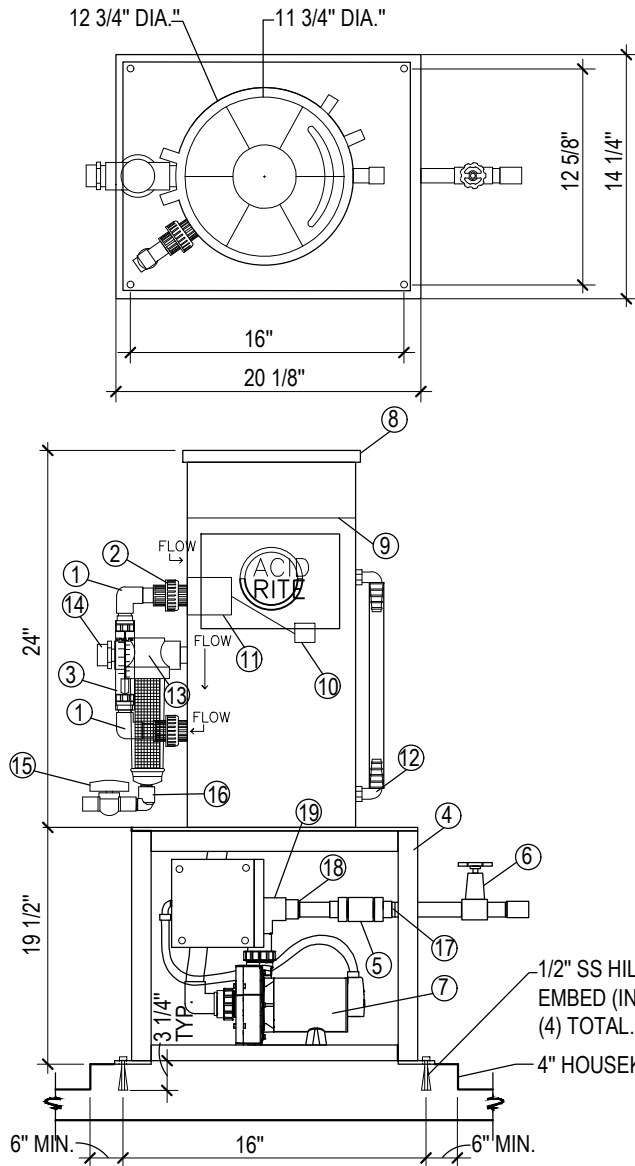
$$V_u = V_{BOLT} = V/4 = \underline{57 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.6.3 (c)}$$

**TRY HILTI KWIK BOLT KB-TZ2 1/2" Ø SS x 3 1/4" EMBED:**

SEE ATTACHED HILTI ANCHORAGE REPORT



## ACCU-TAB POWERBASE 3140 CHLORINATION SYSTEM



BILL OF MATERIAL ACID RITE 450		
ITEM	QUAN.	DESCRIPTION
1	1	1/2" 90 SCH. 40
2	2	1/2" T UNION SCH. 40
3	1	1/2" BLUE-WHITE F-400 FLOWMETER
4	AR	ALUMINUM 1/2" ANGLE
5	1	1" SPEARS FLAP CHECK VALVE
6	1	1/2" GATE VALVE
7	1	HAYWARD PAPP100 PUMP
8	1	1/2" RED HDPE LID
9	1	SIEVE PLATE
10	1	SQUARE 4x4 FLOAT
11	1	3/4" MILLER VALVE
12	2	1/2" MALE THREAD x BARB FITTING
13	1	1" RUSCO STRAINER
14	1	1" SOCKET x 3/4" FPT SCH. 40 REDUCING BUSHING
15	1	1/2" DURA THRD. x THRD. BALL VALVE
16	1	1/2" MPT x 1/2" SOCKET STREET ELBOW
17	2	SPEARS SCH. 40 PVC 1" x 1/2" REDUCING BUSHING
18	2	SPEARS SCH. 40 PVC 1 1/2" x 1" REDUCING BUSHING
19	1	SPEARS SCH. 40 PVC 1 1/2" SLIP x MALE SLIP STREET ELBOW

1/2" SS HILTI KB-TZ2 WITH 3 1/4" MIN. EMBED (INSTALL PER ESR ICC-4266) FOUR (4) TOTAL.

4" HOUSEKEEP PAD

## ACID TABLET FEEDER

NO SCALE

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Phone   Fax:	7609310290	E-Mail:	marty_montgomery@yahoo.com
Design:	Chlorination Unit Anchorage - Concrete - Aug 7, 2023	Date:	8/9/2023
Fastening point:	Mechanical Bldg. Conc. Floor		

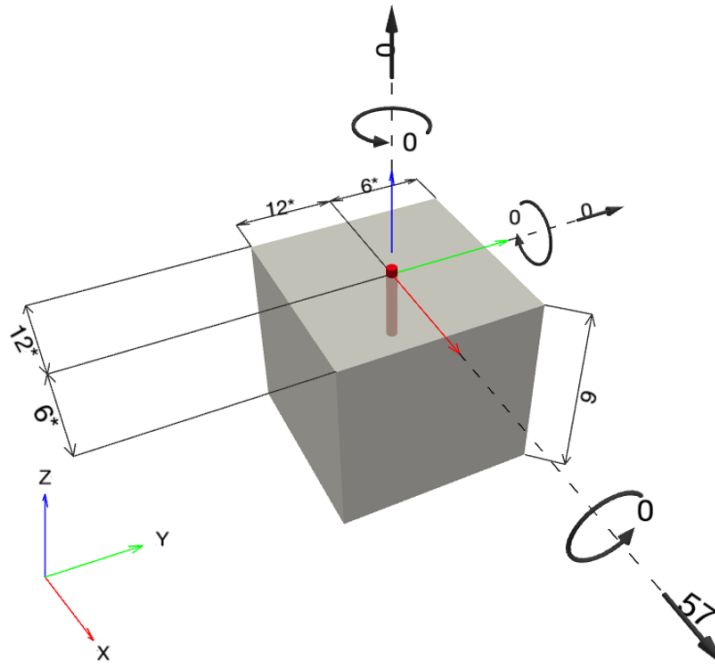
**Specifier's comments:**

**1 Input data**

<b>Anchor type and diameter:</b>	<b>Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3</b>
Item number:	2210261 KB-TZ2 1/2x4 1/2 SS304
Effective embedment depth:	$h_{ef,act} = 3.250$ in., $h_{nom} = 3.750$ in.
Material:	AISI 304
Evaluation Service Report:	ESR-4266
Issued   Valid:	12/17/2021   12/1/2023
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, $f'_c = 4,000$ psi; $h = 9.000$ in.
<b>Installation:</b>	<b>hammer drilled hole, Installation condition: Dry</b>
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))



**Geometry [in.] & Loading [lb, in.lb]**





# Hilti PROFIS Engineering 3.0.87

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## 1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 0; V <sub>x</sub> = 57; V <sub>y</sub> = 0; M <sub>x</sub> = 0; M <sub>y</sub> = 0; M <sub>z</sub> = 0;	yes	2

## 2 Load case/Resulting anchor forces

### Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	57	57	0

max. concrete compressive strain: - [%]  
max. concrete compressive stress: - [psi]  
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]  
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

	Load N <sub>ua</sub> [lb]	Capacity $\phi$ N <sub>n</sub> [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A

\* highest loaded anchor    \*\*anchor group (anchors in tension)



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## 4 Shear load

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	57	5,426	2	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	57	8,819	1	OK
Concrete edge failure in direction x+**	57	3,512	2	OK

\* highest loaded anchor    \*\*anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa,eq}$  = ESR value      refer to ICC-ES ESR-4266  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-19 Table 17.5.2

#### Variables

$A_{se,v}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]	$\alpha_{v,seis}$
0.10	120,404	1.000

#### Calculations

$V_{sa,eq}$ [lb]
8,348

#### Results

$V_{sa,eq}$ [lb]	$\phi_{steel}$	$\phi_{nonductile}$	$\phi V_{sa,eq}$ [lb]	$V_{ua}$ [lb]
8,348	0.650	1.000	5,426	57



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**4.2 Pryout Strength**

$$V_{cp} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-19 Eq. (17.7.3.1a)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-19 Eq. (17.6.2.2.1)}$$

**Variables**

$k_{cp}$	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2	3.250	6.000	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]
8.000	17	1.000	4,000

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [lb]
95.06	95.06	1.000	1.000	6,299

**Results**

$V_{cp}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cp}$ [lb]	$V_{ua}$ [lb]
12,599	0.700	1.000	1.000	8,819	57





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**4.3 Concrete edge failure in direction x+**

$$V_{cb} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1a)}$$

$$\phi V_{cb} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$A_{Vc}$  see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1a)}$$

**Variables**

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]	$l_e$ [in.]
6.000	6.000	1.000	9.000	3.250
$\lambda_a$	$d_a$ [in.]	$f_c$ [psi]	$\Psi_{parallel,V}$	
1.000	0.500	4,000	1.000	

**Calculations**

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
135.00	162.00	0.900	1.000	6,690

**Results**

$V_{cb}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi V_{cb}$ [lb]	$V_{ua}$ [lb]
5,017	0.700	1.000	1.000	3,512	57



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- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
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- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by  $\omega_0$ .
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

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## 6 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - SS 304 1/2 (3 1/4 ) hnom3

Item number: 2210261 KB-TZ2 1/2x4 1/2 SS304

Maximum installation torque: 481 in.lb

Hole diameter in the base material: 0.500 in.

Hole depth in the base material: 4.250 in.

Minimum thickness of the base material: 5.500 in.

Hilti KB-TZ2 stud anchor with 3.75 in embedment, 1/2 (3 1/4 ) hnom3, Stainless steel, installation per ESR-4266

### 6.1 Recommended accessories

#### Drilling

- Suitable Rotary Hammer
- Properly sized drill bit

#### Cleaning

- Manual blow-out pump

#### Setting

- Torque controlled cordless impact tool
- Torque wrench
- Hammer

### Coordinates Anchor in.

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	0.000	0.000	12.000	6.000	12.000	6.000



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## WALL PANEL ANCHORAGE:

Seismic Load Effects including Overstrength

$$E_m = E_{mh} \pm E_v \quad 12.4-5,6$$

$$E_{mh} = \Omega_o Q_E \quad 12.4-7$$

$$1.0E_m = 1.0E_{mh} = \Omega_o V$$

$$\Omega_o V = 0.27 \Omega_o W \quad W = \boxed{100} \text{ lb}$$

$$\Omega_o V = 55 \text{ lb}$$

$$M_{seis} = (V)(2.5"/12) = 11 \text{ lb-ft} \quad h_{cg} = (5"/2) = 2.5"$$

$$M_{resis} = (0.90)[(W)(18"/2)/12] - (0.2)(0.570)(W)(18"/2)/12 = 59 \text{ lb-ft}$$

$$T = (M_{seis} - M_{resis})/(18"/12) = 0 \text{ lb}$$

### Determine Load to Anchor in Tension

$$T_u = T_{BOLT} = T/2 = \underline{0 \text{ lb}} \quad \text{USE ACI 318-19, 17.10.5.3 (d)}$$

### Determine Load to Anchor in Shear

$$V_u = V_{BOLT} = V/4 = \underline{14 \text{ lb}} \quad \text{(ALL 4 BOLTS FUNCTION IN SHEAR)}$$

USE ACI 318-19, 17.10.6.3 (c)

## CK. (E) CMU WALL IMPACTS:

### VERTICAL IMPACTS:

None to CMU Wall. ( $W_p = 100 \text{ lb}$ )/4 = **25 lb** max shear load at single anchor. This is a very small load; the existing CMU wall can easily resist this additional vertical load.

### SEISMIC IMPACTS:

Negligible.  $(55 \text{ lb})/[(100 \text{ psf})(10 \text{ ft})(12 \text{ ft})] < 1\%$  seismic load increase exerted on the existing wall surface area.

**This is a very small additional load acting on the CMU wall.**

Seismic load  $\times \Omega = 14 \text{ lb}$  shear per anchor.

$$V_u = 25 \text{ lb} > 14 \text{ lb}$$

### VERTICAL LOADS GOVERN SEISMIC LOADS IN WALL MOUNT PANEL DESIGN

### CHECK PRYOUT FORCES DUE TO SHEAR LOADS:

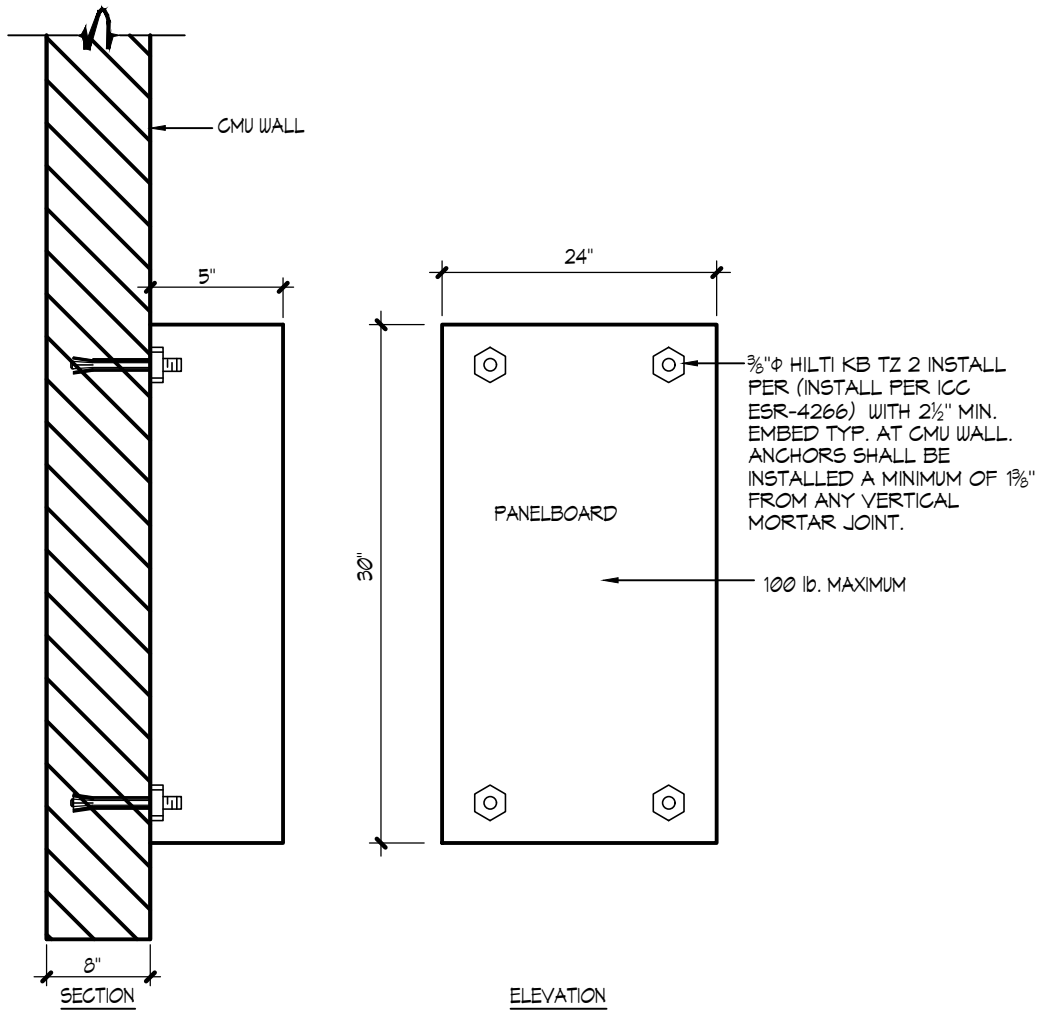
$$P_u = (25 \text{ lb})(5"/2)/(2") = 31 \text{ lb/bolt} \quad \text{USE ACI 318-19, 17.10.5.3 (d)}$$

**PRYOUT GOVERNS**

### TRY HILTI KWIK BOLT KB-TZ2 3/8" $\phi$ SS x 2 1/2" EMBED:

SEE ATTACHED HILTI ANCHORAGE REPORT

**NOTE:** Combination Shear & Tensile Loading = 2% of total anchor capacity per Hilti report



**PANELBOARD MOUNTING DETAIL**

NO SCALE

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Company: La Costa Engineering  
Address: 2226 Faraday Ave., Carlsbad, CA 92008  
Phone | Fax: 7609310290 |  
Design: Wall Panel - Masonry - Aug 7, 2023  
Fastening point: Panel Equipment Mounting to CMU Wall

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Specifier: Martell Montgomery  
E-Mail: marty\_montgomery@yahoo.com  
Date: 8/9/2023

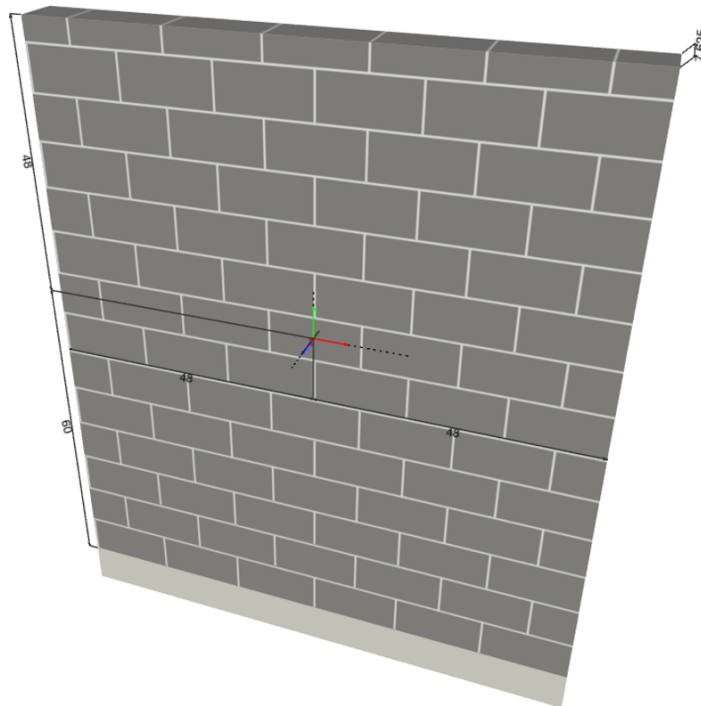
**Specifier's comments:**

**1 Input data**

**Anchor type and diameter:** Kwik Bolt TZ2 - SS 304 3/8 (2 1/2)  
Item number: 2210242 KB-TZ2 3/8x3 SS304  
Effective embedment depth:  $h_{ef} = 2.500$  in.  
Material: AISI 304  
Evaluation Service Report: ESR-4561  
Issued | Valid: 3/1/2022 | 12/1/2023  
Proof: Design Method ASD Masonry  
Stand-off installation:  
Profile:  
Base material: Grout-filled CMU, L x W x H: 16.000 in. x 8.000 in. x 8.000 in.;  
Joints: vertical: 0.375 in.; horizontal: 0.375 in.  
Base material temperature: 68 °F  
Installation: Face installation  
Seismic loads: no



**Geometry [in.]**

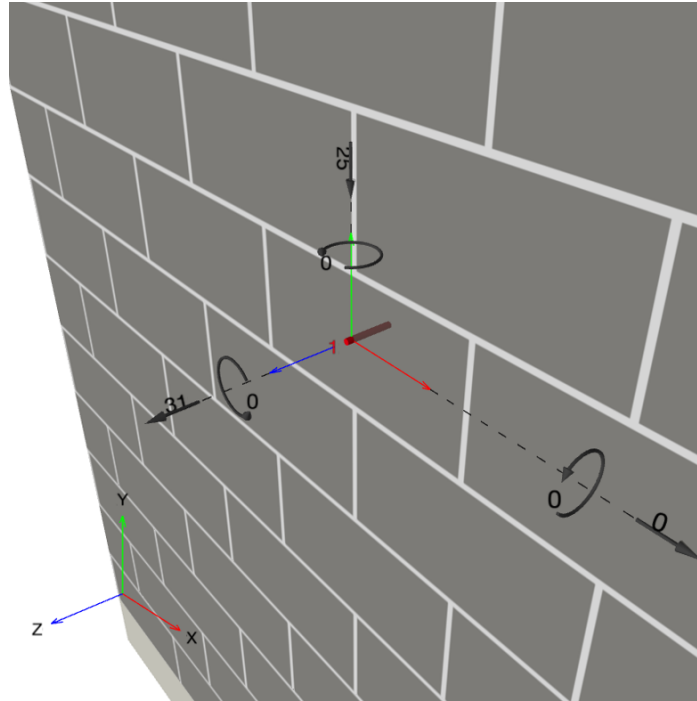




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**Geometry [in.] & Loading [lb, in.lb]**



**1.1 Design results**

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 31; V <sub>x</sub> = 0; V <sub>y</sub> = -25; M <sub>x</sub> = 0; M <sub>y</sub> = 0; M <sub>z</sub> = 0;	no	6

**2 Load case/Resulting anchor forces**

Load case: Service loads

**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	31	25	0	-25

max. compressive strain: - [%]  
 max. compressive stress: - [psi]  
 resulting tension force in (x/y)=(0.000/0.000): 0 [lb]  
 resulting compression force in (x/y)=(0.000/0.000): 0 [lb]





# Hilti PROFIS Engineering 3.0.87

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## 3 Tension load (Most utilized anchor 1)

	Load $P_s$ [lb]	Capacity $P_t$ [lb]	Utilization $\beta_p = P_s/P_t$ [%]	Status
Overall strength	31	590	6	OK

### 3.1 Overall strength

$P_{t,Base}$  = ESR Value refer to ICC-ES ESR-4561  
 $P_t = P_{t,Base} \cdot f_{red,E} \cdot f_{red,s} \cdot f_{red,Temp} \cdot f_{red,Bedjoint}$   
 $P_t \geq P_s$

#### Variables

$c_{min}$ [in.]	$c_{cr}$ [in.]	$s_{min}$ [in.]	$s_{cr}$ [in.]	Temperature [°F]
4.000	12.000	3.000	10.000	68

#### Results

$P_t$ [lb]	$P_{t,Base}$ [lb]	$P_s$ [lb]	$f_{red,E}$	$f_{red,S}$	$f_{red,Temp}$	$f_{red,Bedjoint}$
590	590	31	1.000	1.000	1.000	1.000



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### 4 Shear load (Most utilized anchor 1)

	Load $V_s$ [lb]	Capacity $V_t$ [lb]	Utilization $\beta_V = V_s/V_t$ [%]	Status
Overall strength para and perp, (Dir. x-) <sup>1</sup>	-	-	4	OK

<sup>1</sup>Shear utilization may result from parallel and perpendicular shear (see details)

#### 4.1 Overall strength parallel

$V_{t,Base,\parallel} = \text{ESR Value}$  refer to ICC-ES ESR-4561  
 $V_{t,\parallel} = V_{t,Base,\parallel} \cdot f_{red,E,\parallel} \cdot f_{red,s,\parallel} \cdot f_{red,Temp}$   
 $V_{t,\parallel} \geq V_{s,\parallel}$

Variables

$c_{min}$ [in.]	$c_{cr}$ [in.]	$s_{min}$ [in.]	$s_{cr}$ [in.]	Temperature [°F]
4.000	12.000	3.000	10.000	68

Results

$V_{t,\parallel}$ [lb]	$V_{t,Base,\parallel}$ [lb]	$V_{s,\parallel}$ [lb]	$f_{red,E,\parallel}$	$f_{red,s,\parallel}$	$f_{red,Temp}$	Utilization $\beta_{V,\parallel}$ [%]
695	695	-25	1.000	1.000	1.000	4

#### 4.2 Overall strength perpendicular

$V_{t,Base,\perp} = \text{ESR Value}$  refer to ICC-ES ESR-4561  
 $V_{t,\perp} = V_{t,Base,\perp} \cdot f_{red,E,\perp} \cdot f_{red,s,\perp} \cdot f_{red,Temp}$   
 $V_{t,\perp} \geq V_{s,\perp}$

Variables

$c_{min}$ [in.]	$c_{cr}$ [in.]	$s_{min}$ [in.]	$s_{cr}$ [in.]	Temperature [°F]
4.000	12.000	3.000	10.000	68

Results

$V_{t,\perp}$ [lb]	$V_{t,Base,\perp}$ [lb]	$V_{s,\perp}$ [lb]	$f_{red,E,\perp}$	$f_{red,s,\perp}$	$f_{red,Temp}$	Utilization $\beta_{V,\perp}$ [%]
0	695	0	0.000	0.000	1.000	0

#### 4.3 Shear interaction

$\beta_{V,\parallel} = \frac{V_{s,\parallel}}{V_{t,\parallel}}$	$\beta_{V,\perp} = \frac{V_{s,\perp}}{V_{t,\perp}}$	$\delta$	Utilization $\beta_V$ [%]	Status
0.036	0.000	1.667	4	OK

$\beta_V = \beta_{V,\parallel}^\delta + \beta_{V,\perp}^\delta \leq 1.0$



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### 5 Combined tension and shear loads (Most utilized anchor 1)

$\beta_p = \frac{P_s}{P_t}$	$\beta_{V,\parallel} = \frac{V_{s,\parallel}}{V_{t,\parallel}}$	$\beta_{V,\perp} = \frac{V_{s,\perp}}{V_{t,\perp}}$	$\alpha$	Utilization $\beta_{p,v}$ [%]	Status
0.007	0.036	0.000	1.667	2	OK

$$\beta_{p,v} = \beta_p^\alpha + \beta_{V,\parallel}^\alpha + \beta_{V,\perp}^\alpha \leq 1.0$$

### 6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- The min. sizes of the bricks, the masonry compressive strength, the type / strength of the mortar and the grout (in case of fully grouted CMU walls) has to fulfill the requirements given in the relevant ESR-approval or in the PTG.
- Only the local load transfer from the anchor(s) to the wall is considered, a further load transfer in the wall is not covered by PROFIS!
- Wall is assumed as being perfectly aligned vertically – checking required(!): Noncompliance can lead to significantly different distribution of forces and higher tension loads than those calculated by PROFIS. Masonry wall must not have any damages (neither visible nor not visible)! While installation, the positioning of the anchors needs to be maintained as in the design phase i.e. either relative to the brick or relative to the mortar joints.
- The effect of the joints on the compressive stress distribution on the plate / bricks was not taken into consideration.
- If no significant resistance is felt over the entire depth of the hole when drilling (e.g. in unfilled butt joints), the anchor should not be set at this position or the area should be assessed and reinforced. Hilti recommends the anchoring in masonry always with sieve sleeve. Anchors can only be installed without sieve sleeves in solid bricks when it is guaranteed that it has not any hole or void.
- The accessories and installation remarks listed on this report are for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- The compliance with current standards (e.g. 2018, 2015, 2012, 2009 and 2006 IBC) is the responsibility of the user.
- Drilling method (hammer, rotary) to be in accordance with the approval!
- Masonry needs to be built in a regular way in accordance with state-of the art guidelines!

## Fastening meets the design criteria!



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### 7 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Drilled in hammer mode

Anchor type and diameter: Kwik Bolt TZ2 - SS 304 3/8 (2 1/2)

Item number: 2210242 KB-TZ2 3/8x3 SS304

Maximum installation torque: 181 in.lb

Hole diameter in the base material: 0.375 in.

Hole depth in the base material: 3.250 in.

Minimum thickness of the base material: 7.625 in.

Hilti KB-TZ2 stud anchor with 2.5 in embedment, 3/8 (2 1/2), Stainless steel, installation per ESR-4561

#### Coordinates Anchor in.

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	0.000	0.000	48.000	48.000	60.000	48.000



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## 8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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## PUMP PIT GUARDRAIL ANCHORAGE DESIGN

CBC 2022, ACI 318-19

Case A: P = 200 lb acting at any point along rail      **GOVERNS**

Case B: P = 50 lb/ft along rail w/ Posts at 4'-0" o.c.

$$\begin{aligned}
 P &= 200 \text{ lb} \\
 h &= 42 \text{ in} \\
 M_u = Ph &= 700 \text{ lb-ft}
 \end{aligned}$$

### Check Pipe Bending Strength:

#### TRY 1 1/2" Std. Pipe:

$$\begin{aligned}
 f_y \text{ (psi)} &= 35000 & I \text{ (in}^4\text{)} &= 0.293 & t \text{ (in)} &= 0.135 \\
 E \text{ (psi)} &= 2.90\text{E}+07 & S \text{ (in}^3\text{)} &= 0.309 & d_o \text{ (in)} &= 1.9 \\
 F_y &= 35000 \text{ psi} & Z \text{ (in}^3\text{)} &= 0.421 & &
 \end{aligned}$$

#### Bending:

$$\begin{aligned}
 M_n = F_y Z &= 1228 \text{ lb-ft} & \Omega_b &= 1.67 \\
 M_n / \Omega_b &= 735 \text{ lb-ft} \\
 \text{Is } M_n / \Omega_b > M_u? & \quad \mathbf{735 \text{ lb-ft} > 700 \text{ lb-ft}} & & \quad \mathbf{OK}
 \end{aligned}$$

$$\begin{aligned}
 \Delta s = V * h_{\text{tube}}^3 / (3EI) &= 0.58 \text{ in} & & \quad \mathbf{OK} \\
 \Delta_{\text{MAX}} = (0.025)(3.5')(12) &= \underline{1.05 \text{ in}} > 0.58 \text{ in} & & \quad \mathbf{OK}
 \end{aligned}$$

### Check Conc. Internal Bending Stresses due to Moment Transfer from Pipe Anchorage:

$$\text{Pipe embed depth } d_o = 8 \text{ in}$$

$$h_{\text{eff}} = h + 2/3 d_o = 47.3 \text{ in}$$

#### **Use Load Comb. 1.2D + 1.6L**

$$M_{\text{uc}} = 1.6 P h_{\text{eff}} = 15147 \text{ lb-in}$$

$$V_{\text{uc}} = M_{\text{uc}} / (2/3 d_o) = 2840 \text{ lb}$$

#### **1) Assume min. Depth of Concrete Wall and Reinforcing:**

$$\text{Try: } t = 8 \text{ in}$$

$$\text{assume cover: } 3.75 \text{ in}$$

$$\text{assume \#4 bars @ 12" o.c.: } r = 0.25 \text{ in}$$

$$d = t - (\text{cover} + r) = 4 \text{ in}$$

$$b = 12 \text{ in}$$

$$\rho = A_{\text{st}} / bd = \mathbf{0.0042}$$

**2) Check the thickness required for moment:**

Internal Moment:  $M_u = 15147 \text{ lb-in}$   
 $= 1.262 \text{ kip-ft}$   
 $b = 12 \text{ in}$   
 $f_y = 60000 \text{ psi}$   
 $f'_c = 3000 \text{ psi}$   
 $\rho_{min} = 200/f_y = 0.0033$   
 $\rho_{max} = 0.75[(0.85*f'_c/f_y) * 0.85 * (87000 / (87000 + f_y))]$   
 $\rho_{max} = 0.0160351$   
 $\phi = 0.9$   
 $\rho = 0.0042$   
 $\omega = \rho f_y / f'_c = 0.321$   
 $\phi k_n = \phi [f'_c \omega (1 - 0.59\omega)] = 702$

$bd^2/12000 = M_u / \phi k_n$

Check:  $d = \sqrt{(M_u * 12000 / \phi * k_n * b)} = 1.34 \text{ in} < 4 \text{ in OK}$

Use  $t = 8 \text{ in}$

Is  $\rho_{min} < \rho < \rho_{max}$ ? YES OK

<b>Min. Conc. Wall depth:</b>	<b>8 in</b>	<b>OK to resist guardrail internal moment</b>
-------------------------------	-------------	---

**3) Design Flexural Reinforcement:**

$A_s = M_u * 12000 / \phi f_y j d$

For a first trial assume that  $j d = 0.925 d$

therefore,  $A_s = 0.04 \text{ in}^2/\text{ft}$

and  $a = A_s * f_y / 0.85 f'_c = 0.074 \text{ in}$

and  $j d = d - a/2 = 7.96 \text{ in}$

recompute  $A_s$  using new  $j d$ :  $A_s = 0.0279074 * M_u = 0.04 \text{ in}^2/\text{ft}$

Determine the minimum flexural reinforcement per ACI 318-19, 7.6.1.1:

$A_{s(min)} = 0.0018bh = 0.17 \text{ in}^2/\text{ft}$  (For 8" Wall)  
 Max. spacing = 3h or 18": 18 " o.c. 7.7.2.3

Determine the shrinkage and temperature reinforcement per ACI 318-19, 24.4.3.2:

$A_{s(min)} = 0.0018bh = 0.17 \text{ in}^2/\text{ft}$  (For 6" Slab)  
 Max. spacing = 5h or 18": 18 " o.c. 24.4.3.3

Try 2-#3 bars, 1 at ea. side of anchor:  $0.22 \text{ in}^2/\text{ft} > 0.17 \text{ in}^2/\text{ft}$  OK

Check min. wall reinf., #4@12" o.c.:  $0.20 \text{ in}^2/\text{ft} > 0.17 \text{ in}^2/\text{ft}$  OK

<b>Provide 2- #3 bars, 1 at ea. side of guard rail pipe embedment for flexural reinforcement.</b>
<b>Provide min. #4 bars at 12"o.c. ea. way for flexural reinforcement in wall, 3000 psi</b>

**Concrete Breakout Strength in Shear (ACI 318-19, 17.7.2):**

$$V_n = V_{cb} = A_{vc} / A_{vco} \psi_{ed,v} \psi_{c,v} V_b$$

$f'_c =$	3000 psi
$c_{a1} =$	3 in
$h_a =$	8 in
$d_o =$	1.9 in
$l_e = h_{ef} =$	8 in

IF  $c_{a2} > c_{a1}$ :

$$\psi_{ed,v} = 1.0$$

$$\psi_{c,v} = 1.4$$

$$A_{vco} = 4.5(c'_{a1})^2 = 40.50 \text{ in}^2$$

IF  $h_a < 1.5c_{a1}$ :

$$A_{vc} = 2(1.5c_{a1})h_a = 72 \text{ in}^2$$

$$V_b = 7(l_e/d_o)^{0.2} \sqrt{d_o} \sqrt{f'_c} (c'_{a1})^{1.5} = 3661 \text{ lb}$$

$$V_n = V_{cb} = 9112 \text{ lb} \quad \text{GOVERNS}$$

$$\phi = 0.75$$

$$\phi V_n = 6834 \text{ lb}$$

IS $\phi V_n > V_u$ ?	6834 lb	>	2840 lb	YES
-----------------------	---------	---	---------	-----

**USE  $t_{min} = 8"$  WALL, 3000 PSI CONCRETE w/ MIN. #4 @ 12" o.c. EA. WAY  
w/ MIN. 3 in EDGE DISTANCE FROM PIPE IN ANY DIRECTION**

**CK. WELDS AT HORIZONTAL TO VERTICAL PIPE RAILS:**

Case A: P = 200 lb acting at any point along rail **GOVERNS**

Case B: P = 50 lb/ft along rail w/ Posts at 4'-0" o.c.

Use 1/2 pipe dia. for weld resistance:  $L_w = \pi d / 2 = \pi(1.9") / 2 = 2.98 \text{ in}$

REQ'D STRENGTH PER INCH OF WELD:  $R_u = (200 \text{ lb} / 2.98 \text{ in}) = 67 \text{ lb/in} = 0.07 \text{ k/in}$

TRY  $w = 1/8"$   $t_e = 0.707w$ :

$$R_n = F_{nBM} A_{BM} = (0.60) F_{yPipe} = (0.60)(35 \text{ ksi})(0.135") = 2.84 \text{ k/in} \quad \text{J2-2, J4-3} \quad \text{GOVERNS}$$

$$R_n = F_{nw} A_{we} = (0.60)(70 \text{ ksi})(0.707)(1/8") = 3.71 \text{ k/in} \quad \text{J2-3}$$

$$R_n / \Omega = (2.84 / 2.0) = 1.42 \text{ k/in} \quad \text{Table J2.5, where } \Omega = 2.0$$

Is  $R_n / \Omega > R_u$  ? 1.42 k/in > 0.07 k/in **OK**

**USE MIN. 1/8" F. WELD, E70 ROD, FULL PERIMETER OF 1-1/2" STD HORIZ. PIPE RAILS TO 1-1/2" STD. VERT. PIPES AT 4'-0" O.C.**



