SPECIAL PROVISIONS

FOR

CITY OF SAN LUIS OBISPO

1106 Walnut Fencing Improvements

Specification No. 2000577-02

November 2024

PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

919 Palm Street
San Luis Obispo, CA 93401
(805) 781-7200

1106 Walnut Fencing Improvements

Specification No. 2000577-02

Approval Date: November 12, 2024

<<Engineer of Record Stamp>>

<<Signature Date>>

Signature and Date

TABLE OF CONTENTS

NOTICE TO BIDDERS
BID SUBMISSION

Sealed bids will be received by the City of San Luis Obispo at the Public Works Administration Office located at 919 Palm Street, San Luis Obispo, California 93401, until

11:00 a.m. on December 12, 2024

at which time they will be publicly opened and read aloud. Public bid opening may also be viewed via Microsoft Teams video conference and conference call. In person attendance of the bid opening will be permitted in adherence to social distancing measures. Use the following link:

or join by phone with this number: (209)645-4165 with Conference ID:XXXXXXXX

Submit bid in a sealed envelope plainly marked:

1106 Walnut Fencing Improvements, Specification No. 2000577-02

Any bid received after the time and date specified will not be considered and will be returned to the bidder unopened. Bids received by Fax or Email will not be considered.

By submission of bid you agree to comply with all instruction and requirements in this notice and the contract documents.

All bids must be submitted on the Bid Item List form(s) provided and submitted with all other Bid Forms included in these Special Provisions.

Each bid must be accompanied by either a:

1. certified check
2. cashier's check
3. bidder's bond

made payable to the City of San Luis Obispo for an amount equal to ten percent of the bid amount as a guaranty. Guaranty will be forfeited to the City San Luis Obispo if the bidder, to whom the contract is awarded, fails to enter into the contract.

The City of San Luis Obispo reserves the right to accept or reject any or all bids or waive any informality in a bid.

All bids are to be compared based on the City Engineer's estimate of the quantities of work to be done, as shown on the Bid Item List.

Bids will only be accepted from bidders that are licensed in compliance with the provisions of Chapter 9, Division III of Business and Professions Code.

The award of the contract, if awarded, will be to the lowest responsive bid submitted by a responsible contractor whose bid complies with the requirements prescribed. If the contract is awarded, the contract will be awarded within 60 calendar days after the opening of the bids.

Failure to raise defects in the notice to bidders or bid forms prior to bid opening constitute a waiver of those defects.

BID DOCUMENTS

A copy of the plans and special provisions may be downloaded, free of charge, from the City's website at:

www.slocity.org/government/department-directory/public-works/public-works-bids-proposals

No printed copies are available for purchase at the City office.

Standard Specifications and Engineering Standards referenced in the Special Provisions may be downloaded, free of charge, from the City's website at:

www.slocity.org/government/department-directory/public-works/documents-online/construction-documents

You are responsible to obtain all issued addenda prior to bid opening. Addenda will be available to download at the City's website listed above or at the office of the City Engineer.

Contact the project manager, Sandra Golonka at 805-781-7239 the Public Works Department at (805) 781-7200 prior to bid opening to verify the number of addenda issued.

PROJECT INFORMATION

In general, the project consists of site improvements for the construction of a new fence, security pickets on existing fencing and a security gate.

The project estimated construction cost is $470,000.

Contract time is established as 60 working days.

The fixed liquidated damages amount is established at $500 per day for failure to complete the work within the contract time.

In compliance with section 1773 of the Labor Code, the State of California Department of Industrial Relations has established prevailing hourly wage rates for each type of workman. Current wage rates may be obtained from the Division of Labor at:

https://www.dir.ca.gov/oprl/DPreWageDetermination.htm

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

There will be a **MANDATORY** walkthrough on **November 27, 2025, at 11 am**. Prime contractors wishing to submit a bid proposal are required to attend and sign in at the meeting. Bidders must meet City Staff at 1106 Walnut Street in San Luis Obispo, California.

QUALIFICATIONS

You must possess a valid Class A or B Contractor's License at the time of the bid opening.

You and any subcontractors required to pay prevailing wage must be registered with the Department of Industrial Relations pursuant to Section 1725.5 of the Labor Code.

You must have experience constructing projects similar to the work specified for this project. Provide three similar reference projects completed as either the prime or subcontractor. All referenced projects must have been completed within the last five years from this project's bid opening date.

One of the three reference projects must have been completed under contract with a city, county, state or federal government agency as the prime contractor.

Two of the three referenced projects must include construction of a security fence.

One of the referenced projects must be for a fence with an electrical gate.

Failure to provide reference projects as specified in this section and as required on the qualification form is cause to reject a bid as being non-responsive.

The City reserves the right to reject any bid based on non-responsiveness if a bidder fails to provide a bid that complies with all bidding instructions.

The City reserves the right to reject a responsive bid based on the non-responsibility of the bidder if the Director of Public Works or Designee finds, after providing notice and a hearing to the bidder, that the bidder lacks the

1. knowledge
2. experience,

3. or is otherwise not responsible as defined in Section 3.24 of the San Luis Obispo Municipal Code to complete the project in the best interest of the City.

Rejected bidders may appeal this determination. Appeal must comply with the requirements in this Notice to Bidders.

It is the City of San Luis Obispo's intent to award the contract to the lowest responsive bid submitted by a responsible bidder. If in the bidder's opinion the contract has been or may be improperly awarded, the bidder may protest the contract award.

Protests must be filed no later than five working days after either:
1. bid opening date
2. notification of rejected bid.

Protest must be in writing and received by the project manager located at:
919 Palm Street
San Luis Obispo, CA 93401.

Valid protests must contain the following information:
1. the reasons for the protest
2. any supporting documentation
3. the ruling expected by the City to remedy the protest.

Any protest not containing all required information will be deemed invalid and rejected.

The City will consider additional documentation or other supporting information regarding the protest if submitted in compliance to the specified time limits. Anything submitted after the specified time limit will be rejected and not be considered.

The Director of Public Works or Designee may request additional information to be submitted within three days of the request, unless otherwise specified, and will notify the protester of ruling within ten days of determination.

If the protester is not satisfied with ruling, the protester may appeal the ruling to the City Council in compliance with Chapter 1.20 of the City of San Luis Obispo Municipal Code.

Pursuant to the Public Records Act (Government Code, § 6250, et seq.), the City will make public records available upon request.

AWARD

The lowest bidder will be determined using the TOTAL PROJECT BID.

As a condition to executing a contract with the City, two bonds each equal to one hundred percent of the total contract price are required in compliance with Section 3-1.05 of the Standard Specifications.

You may substitute securities for moneys withheld under the contract in compliance with the provisions of the Public Contract Code, Section 10263.

ACCOMMODATION

If any accommodations are needed to participate in the bid process, please contact Allie Genard at (805) 781-7200 or by Telecommunications Device for the Deaf at (805) 781-7107. Requests should be made as early as possible in the bidding process to allow time for accommodation.

BID FORMS

All bid forms must be completed and submitted with your bid. Failure to submit these forms and required bid bond is cause to reject the bid as nonresponsive. Staple all bid forms together.

THE UNDERSIGNED, agrees that they have carefully examined:

1. the location of the proposed work
2. the plans and specifications
3. read the accompanying instructions to bidders

and propose to furnish all:

1. materials
2. labor

to complete all the required work satisfactorily in compliance with

3. plans
4. specifications
5. special provisions

for the prices set forth in the bid item list:

BID ITEM LIST FOR 1106 WALNUT FENCING IMPROVEMENTS, SPECIFICATION NO. 2000577-02

Item No.	$SS_{(1)}$	Item Description	Unit of Measure	Estimated Quantity	Item Price (in figures)	Total (in figures)
1	15	Demolition of Existing Improvements	LS	1	---	
2	15	Clear and Grub	LS	1	---	
3	5	Construction Surveying	LS	1	---	
4	99	Construction Fencing	LS	1	---	
5	7	OSHA Compliance for Trenching	LS	1	---	
6	99	Gate Operator and Sensors	LS	1	---	
7	17	Grading	LS	1	---	
8	73,90	Concrete Curb and Gutter	LF	7		
9	73,90	Concrete Curb	LF	28		
10	73.90	Curb at Rolling Gate	LF	55		
11	73,90	Mow Curb	LF	92		
12	84	Curb Paint Red	LF	14		
13	20	Bike Rack	EA	1		
14	80	7’ Decorative Picket Fence	LF	16		
15	80	8’ Decorative Picket Fence	LF	57		
16	80	6’ Decorative Picket Fence	LF	66		

Item No.	SS(1)	Item Description	Unit of Measure	Estimated Quantity	Item Price (in figures)	Total (in figures)
17	80	4’ Decorative Picket Fence	LF	131		
18	80	3’ Decorative Picket Fence	LF	72		
19	80	2’ Decorative Picket Fence	LF	186		
20	80	Decorative Picket Gate	EA	1		
21	80	Decorative Rolling Gate	EA	1		
22	20	CMU Wall and Pilasters Foundation	LS	1	---	
23	80	Razor Wire and Brackets	LF	110		
24 (S)	86	Electrical and Communication Improvements	LS	1	---	
25	73,90	Asphalt	SF	180		
26	73,90	Concrete	SF	75		
27	20	Decorative Rock Mulch	SF	627		
28	86	Install Conduit	LS	1	---	
29 (S)	99	EV Charger	EA	1		
30 (S)	99	ChargePoint Compliance	LS	1	---	
31 (S)	99	ChargePoint Coordination/Start-up	LS	1	---	
32	20	Planting – Shrub Area	SF	295		
33	20	Sod Replacement	SF	600		
34	20	Irrigation	LS	1	---	
Total Project Bid = (Base Bid)					**$**	
Company Name:						

(1) refers to section in the Standard Specifications, with modifications in the Special Provisions, that describe required work.
(S) Specialty item per Section 5-1.13A SUBCONTRACTING, General of the Standard Specifications.
(F) final pay item per Section 9-1.02A

LIST OF SUBCONTRACTORS

Pursuant to Section 4100 of the Public Contracts Code and section 2-1.33C of the standard specifications, the Bidder is required to furnish the following information for each Subcontractor performing more than 1/2 percent (0.5%) of the total base bid. Do not list alternative subcontractors for the same work. Subcontracting must not total more than fifty percent (50%) of the submitted bid except as allowed in section 5-1.13 of the standard specifications.

For Streets & Highways projects, subcontractors performing less than ten thousand dollars ($10,000) worth of work need not be mentioned. **Subcontractors required to pay prevailing wage, must be registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 to be listed.**

NOTE: If there are no subcontractors, write "NONE" and submit with bid.

Name Under Which Subcontractor is Licensed	License Number	**DIR Public Works Registration Number**	Address and Phone Number of Office, Mill or Shop	Specific Description of Subcontract	% of Total Base Bid

Attach additional sheets as needed.

PUBLIC CONTRACT CODE SECTION 10285.1 STATEMENT

In compliance with Public Contract Code Section 10285.1 (Chapter 376, Stats. 1985), the bidder hereby declares under penalty of perjury under the laws of the State of California that the bidder, or any subcontractor to be engaged by the bidder, **has ____, has not ____** been convicted within the preceding three years of any offenses referred to in that section, including any charge of fraud, bribery, collusion, conspiracy, or any other act in violation of any state or federal antitrust law in connection with the bidding upon, award of, or performance of, any public works contract, as defined in Public Contract Code Section 1101, with any public entity, as defined in Public Contract Code Section 1100, including the Regents of the University of California or the Trustees of the California State University. The term "bidder" is understood to include any partner, member, officer, director, responsible managing officer, or responsible managing employee thereof, as referred to in Section 10285.1.

NOTE: The bidder must place a check mark after "has" or "has not" in one of the blank spaces provided. The above Statement is part of the Bid. Signing this Bid on the signature portion constitute signature of this Statement. Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

PUBLIC CONTRACT CODE SECTION 10162 QUESTIONNAIRE

In compliance with Public Contract Code Section 10162, the Bidder must complete, under penalty of perjury, the following questionnaire:

Has the bidder, any officer of the bidder, or any employee of the bidder who has a proprietary interest in the bidder, ever been disqualified, removed, or otherwise prevented from bidding on, or completing a federal, state, or local government project because of a violation of law or a safety regulation?

_____ Yes _____ No

If the answer is yes, attach a letter explaining the circumstances

PUBLIC CONTRACT CODE SECTION 10232 STATEMENT

In compliance with Public Contract Code Section 10232, you hereby state under penalty of perjury, that no more than one final unappealable finding of contempt of court by a federal court has been issued against you within the immediately preceding two-year period because of your failure to comply with an order of a federal court which orders you to comply with an order of the National Labor Relations Board.

LABOR CODE SECTION 1725.5 STATEMENTS

The bidder has delinquent liability to an employee or the state for any assessment of back wages or related damages, interest, fines, or penalties pursuant to any final judgment, order, or determination by a court or any federal, state, or local administrative agency, including a confirmed arbitration award. Any judgment, order, or determination that is

under appeal is excluded, provided that the contractor has secured the payment of any amount eventually found due through a bond or other appropriate means.

_____ Yes _____ No

The bidder is currently debarred under Section 1777.1 or under any other federal or state law providing for the debarment of contractors from public works.

_____ Yes _____ No

NOTE: The above Statements and Questionnaire are part of the Bid. Signing this Bid on the signature portion constitute signature of this Statement and Questionnaire. Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

NON-COLLUSION DECLARATION

I, _____, declare that

I am _____ of_____,

the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone refrained from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

Executed on _____, 20_____, in _____

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

_____

(Signature and Title of Declarant)

(SEAL)

Subscribed and sworn to before me
this _____day of _____, 20_____

_____

Notary Public

Company Name:_____

BIDDER ACKNOWLEDGEMENTS

By signing below, the bidder acknowledges and confirms that this bid is based on the information contained in all contract documents, including the notice to bidders, plans, specifications, special provisions, and addendum number(s) _____. **(Note: You are responsible to verify the number of addenda prior to the bid opening.)**

The undersigned further agrees that in case of default in executing the required contract, with necessary bonds, within eight days, (not including Saturdays, Sundays, and legal holidays), after having received a mailed notice that the contract is ready for signature, the proceeds of the check or bond accompanying his bid will become the property of the City of San Luis Obispo.

Licensed in accordance with an act providing for the registration of contractors, License No._____, Expiration Date _____.

The above statement is made under penalty of perjury, and any bid not containing this information "will be considered non-responsive and will be rejected" by the City.

Signature of Bidder _____

_____
(Print Name and Title of Bidder)

DIR– Public Works Registration No: _____

Business Name (DBA): _____

Owner/Legal Name: _____

Indicate One: ☐Sole-proprietor ☐ Partnership ☐Corporation

List Partners/Corporate Officers: _____
Name Title

_____
Name Title

_____
Name Title

Business Address _____

Street Address _____

Mailing Address _____

City, State, Zip Code _____

Phone Number _____

Fax Number _____

Email Address _____

Date _____

QUALIFICATIONS

Failure to furnish complete reference information **ON THIS FORM**, as specified in this project's Notice to Bidders and indicated below, is cause to reject the bid. Additional information may be attached but is not a substitute for this form.

Reference Number 1

Customer Name & Contact Individual	
Telephone & Email	
Project Name (Site Address):	
Is this similar to the project being bid and did this project include security fencing construction activity? Yes □ No □	Describe the services provided and how this project is similar to that which is being bid:
Was this contract for a public agency? Yes □ No □	Date project completed:

Reference Number 2

Customer Name & Contact Individual	
Telephone & Email	
Project Name (Site Address):	
Is this similar to the project being bid and did this project include security fencing construction activity? Yes □ No □	Describe the services provided and how this project is similar to that which is being bid:
Was this contract for a public agency? Yes □ No □	Date project completed:

Reference Number 3

Customer Name & Contact Individual	
Telephone & Email	
Project Name (Site Address):	
Is this similar to the project being bid and did this project include electric security fencing construction activity? Yes □ No □	Describe the services provided and how this project is similar to that which is being bid:
Was this contract for a public agency? Yes □ No □	Date project completed:

ATTACH BIDDER'S BOND TO ACCOMPANY BID

Know all men by these presents:

That we _____, AS PRINCIPAL, and

_____, AS SURETY, are held and firmly bound unto the City of San Luis Obispo in the sum of:

_____ Dollars (_____) to be paid to said City or its certain attorney, its successors and assigns; for which payment, well and truly to be made, we bind ourselves, our heirs, executors and administrators, successors or assigns, jointly and severally, firmly by these presents:

THE CONDITION OF THIS OBLIGATION IS SUCH, that if the certain bid of the above

bounden _____

to construct _____
(insert name of street and limits to be improved or project)

dated _____ is accepted by the City of San Luis Obispo, and if the above

bounden _____, his heirs, executors, administrators, successors, and assigns shall duly enter into and execute a contract for such construction and shall execute and deliver the two bonds described within ten (10) days (not including Saturdays, Sundays, or legal holidays) after the above bounden,

_____, has received notice by and from the said City of San Luis Obispo that said contract is ready for execution, then this obligation shall become null and void; otherwise, it shall be and remain in full force and virtue.

IN WITNESS WHEREOF, we hereunto set our hands and seals this ___ day of _____, 20____.

Bidder Principal:

_____

Signature Date
Title:

Surety:

_____

_____

_____

Bidder's signature is not required to be notarized. Surety's signature must be notarized.
Equivalent form may be substituted
(Rev. 6-30-14)

SPECIAL PROVISIONS

ORGANIZATION

Special provisions are under headings that correspond with the main section heading of the Standard Specifications. Each special provision begins with a revision clause that describes or introduces a revision to the Standard Specifications. Any paragraph added or deleted by a revision clause does not change the paragraph number of the Standard Specifications for any other reference to a paragraph of the Standard Specifications.

DIVISION I GENERAL PROVISIONS

1 GENERAL

Add to Section 1-1.01 GENERAL:

The work must be done in compliance with the City of San Luis Obispo, Department of Public Works:

1. 1106 Walnut Fencing Improvements Special Provisions
2. City of San Luis Obispo Standard Specifications and Engineering Standards – 2020 edition
3. State of California, Department of Transportation Standard Specifications and Standard Plans – 2015 edition

In case of conflict between documents, governing ranking must comply with section 5-1.02 of the City of San Luis Obispo's Standard Specifications. All work must conform to these Special Provisions and appendices, project plans, and the most current Building Codes. In the event of a conflict, the more stringent requirement shall apply.

Failure to comply with the provisions of these sections is a material breach of contract:

1. Sections 5 through 8 of the Standard Specifications
2. Section 12 through 15 of the Standard Specifications
3. Section 77-1 of the Standard Specifications
4. Section 81 of the Standard Specifications
5. authorized working hours
6. OSHA compliance

3 CONTRACT AWARD AND EXECUTION

Add Section 3-1.18B CONTRACT EXECUTION, Building Permit

3-1.18B Building Permit

The contractor must obtain a no-fee building permit from the Community Development Department. All requirements of the building permit shall be applied to the project. The contractor is responsible for coordinating inspection with the building division for the project. Request for the inspection must be scheduled 72 hours in advance of the required inspection.

4 SCOPE OF WORK

Add to Section 4-1.03 WORK DESCRIPTION:

Comply with the provisions of Sections 5,7,15,17,20,49,73,80,84,86,90,99 for general, material, construction, and payment specifics. Refer to these Special Provisions including Appendix B Supplemental Technical Specifications for modifications to the above Sections.

5 CONTROL OF WORK

Replace Section 5-1.32 AREAS FOR USE with:

Contractor shall be allowed to use area for parking, staging, and construction within the property limits.

Contractor shall install and maintain temporary rigid 6' minimum high chain link or other rigid work site construction fencing throughout the project.

Contractor will not be allowed the use of the 1106 Walnut toilet facilities. During construction, the contractor shall secure and maintain portable sanitary facilities in acceptable condition from the beginning of work until completion.

8 PROSECUTION AND PROGRESS

Add to Section 8-1.3 PRECONSTRUCTION CONFERENCE:

Provide a level 1 schedule of values for all lump sum bid items.

9 PAYMENT

Add to Section 9-1.01 GENERAL:

Work as specified in these specifications and as shown on the Plans for which no separate payment is provided for in the Bid Item List will be considered a subsidiary obligation of the Contractor and the cost thereof shall be included in the applicable Contract prices for the item to which the work applies.

The following additional Bid Item descriptions are included for those atypical bid items not fully covered in the Standard Specifications:

BID ITEM 29 – EV CHARGER - Payment for this lump sum bid item shall be made on a percentage basis based on the lump sum amount of the bid item. Work shall include purchase and installation of the EV charger per plans in compliance with ChargePoint Site Design Guide (Appendix E) provided, completed by a certified ChargerPoint Installer. Installer must provide a ChargePoint certificate. This bid item shall include all the necessary labor, tools, materials, and equipment required to do all the work.

BID ITEM 30 – CHARGERPOINT COMPLIANCE - Payment for this lump sum bid item shall be made on a percentage basis based on the lump sum amount of the bid item.

Work shall include coordination with ChargePoint to ensure timely delivery of charger and related hardware. Installation must be performed in accordance with the ChargePoint Installation Guide (Appendix E). This bid item shall include all the necessary labor, tools, materials, and equipment required to do all the work.

BID ITEM 30 – CHARGERPOINT COORDINATION AND COMMISSIONING - Payment for this lump sum bid item shall be made on a percentage basis based on the lump sum amount of the bid item. Work shall include coordination with ChargePoint's technical team for system integration, confirmation of charger connectivity, and coordination with the commissioning of the ChargerPoint EV chargers. Contractor shall comply with and provide the ChargePoint Construction Sign Off Form (Appendix F) to the City prior to scheduling ChargePoint for commissioning. This bid item shall include all the necessary labor, tools, materials, and equipment required to do all the work.

Add to Section 9-1.02A MEASUREMENT, General:

Unless otherwise specified, payment for items of work identified in the Bid Item List shall be as specified in the City of San Luis Obispo Standard Specifications, Caltrans 2015, and as directed by the Engineer. The contract unit prices paid for each bid item shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work and no additional payment will be made.

Add to Section 9-1.03 PAYMENT SCOPE:

Any item of work that does not have separate bid item is considered included in the project cost of work and no additional compensation will be paid.

DIVISION III EARTHWORK AND LANDSCAPE

20 LANDSCAPE AND IRRIGATION

Add to Section 20-5.03A(3)(c) INERT GROUND COVERS AND MULCHES, General-Summary:

Mulch to be applied to all planting areas as shown in plans. Mulch in planting areas shall be 3" depth rock mulch. Contractor shall provide sample for approval. Mulch shall be free of weed seeds or substances injurious to plant growth. Materials: 3/8" California Gold gravel mulch, Central Coast Landscape Products, or approved equal.

DIVISION V SURFACING AND PAVEMENTS

39 ASPHALT CONCRETE

Replace Section 39-1.01A GENERAL, Summary:

Hot Mix Asphalt (HMA) shall be Type A, ½" maximum aggregate.

DIVISION VIII MISCELLANEOUS CONSTRUCTION

73 CONCRETE CURBS AND SIDEWALKS

Add to Section 73-1.01 GENERAL:

Concrete removal must be per Section 73-1.03A and City Standard Detail 4910.

77 LOCAL INFRASTRUCTURE

Add to Section 77-1.03B TRENCH CONSTRUCTION, General with:

The contractor shall anticipate the minimum of one water service, one gas service and one sewer lateral for each property. The sewer lateral locations are unknown and the repair of the sewer laterals shall be factored into the payment for the mainline being installed. Water and gas services will be marked by Underground Service Alert or USA.

DIVISION X ELECTRICAL WORK

86 ELECTRICAL

Add to Section 86-1.01 GENERAL:

For construction specifications of electrical items, the Electrical Plans shall take precedent over the State Standard Specifications. Refer to Electrical Sheets of the Plan Set and to Technical Specifications included in Appendix B.

DIVISION XII BUILDING CONSTRUCTION

99 BUILDING CONSTRUCTION

Add to Section 99-1.01 GENERAL:

See Appendix B for Technical Specifications for the project.
See Appendix C for City Communication Cabling Standards for the Project.
See Appendix D for Structural Calculations
See Appendix E for ChargePoint Site Design Guide
See Appendix F for ChargePoint Construction Sign Off Form

DIVISION XIII APPENDICES

Add to Section 100-1.01 APPENDICES:

Refer to Appendix B: Technical Specifications for the project.
Refer to Appendix C: City Communication Cabling Standards for the Project.
Refer to Appendix D: Structural Calculations
Refer to Appendix E: ChargePoint Site Design Guide
Refer to Appendix F: ChargePoint Construction Sign Off Form

APPENDIX A - FORM OF AGREEMENT

THIS AGREEMENT, made on _____, by and between the City of San Luis Obispo, a municipal corporation and charter city, San Luis Obispo County, California (hereinafter called the Owner) and COMPANY NAME (hereinafter called the Contractor).

WITNESSETH:

That the Owner and the Contractor for the consideration stated herein agree as follows:

ARTICLE 1, SCOPE OF WORK: The Contractor shall perform everything required to be performed, shall provide and furnish all of the labor, materials, necessary tools, expendable equipment, and all utility and transportation services required to complete all the work of construction of

NAME OF PROJECT, SPEC NO.

in strict compliance with the plans and specifications therefor, including any and all Addenda, adopted by the Owner, in strict compliance with the Contract Documents hereinafter enumerated.

It is agreed that said labor, materials, tools, equipment, and services shall be furnished and said work performed and completed under the direction and supervision and subject to the approval of the Owner or its authorized representatives.

ARTICLE II, CONTRACT PRICE: The Owner shall pay the Contractor as full consideration for the faithful performance of this Contract, subject to any additions or deductions as provided in the Contract Documents, the contract prices as follows:

Item No.	Item	Unit of Measure	Estimated Quantity	Item Price (in figures)	Total (in figures)
1.					
2.					
3.					

BID TOTAL: $ .00

Payments are to be made to the Contractor in compliance with and subject to the provisions embodied in the documents made a part of this Contract.

Should any dispute arise respecting the true value of any work omitted, or of any extra work which the Contractor may be required to do, or respecting the size of any payment to the Contractor, during the performance of this Contract, said dispute shall be decided by the Owner and its decision shall be final, and conclusive.

ARTICLE III, COMPONENT PARTS OF THIS CONTRACT: The Contract consists of the following documents, all of which are as fully a part thereof as if herein set out in full, and if not attached, as if hereto attached:

1. Notice to Bidders and Information for Bidders
2. Standard Specifications and Engineering Standards
3. Special Provisions, any Addenda, Plans and Contract Change Orders
4. Caltrans Standard Specifications and Standard Plans 2015
5. Accepted Bid and Bid Bond
6. List of Subcontractors
7. Public Contract Code Sections 10285.1 Statement
8. Public Contract Code Section 10162 Questionnaire
9. Public Contract Code Section 10232 Statement
10. Labor Code Section 1725.5 Statements
11. Bidder Acknowledgements
12. Qualifications
13. Non-collusion Declaration
14. Agreement and Bonds
15. Insurance Requirements and Forms

ARTICLE IV INDEMNIFICATION: The Contractor shall indemnify, defend with legal counsel approved by City, and hold harmless City, its officers, officials, employees and volunteers from and against all liability, loss, damage, expense, cost (including without limitation reasonable legal counsel fees, expert fees and all other costs and fees of litigation) of every nature arising out of or in connection with the Contractor's negligence, recklessness or willful misconduct in the performance of work hereunder or its failure to comply with any of its obligations contained in this Agreement, except such loss or damage which is caused by the sole or active negligence or willful misconduct of the City. Should conflict of interest principles preclude a single legal counsel from representing both the City and the Contractor, or should the City otherwise find the Contractor's legal counsel unacceptable, then the Contractor shall reimburse the City its costs of defense, including without limitation reasonable legal counsel fees, expert fees and all other costs and fees of litigation. The Contractor shall promptly pay any final judgment rendered against the City (and its officers, officials, employees and volunteers) with respect to claims determined by a trier of fact to have been the result of the Contractor's negligent, reckless or wrongful performance. It is expressly understood and agreed that the foregoing provisions are intended to be as broad and inclusive as is permitted by the law of the State of California and will survive termination of this Agreement.

The Contractor obligations under this section apply regardless of whether such claim, charge, damage, demand, action, proceeding, loss, stop notice, cost, expense, judgment, civil fine or penalty, or liability was caused in part or contributed to by an Indemnitee. However, without affecting the rights of the City under any provision of this agreement, the Contractor shall not be required to indemnify and hold harmless the City for liability attributable to the active negligence of City, provided such active negligence is determined by agreement between the parties or by the findings of a court of competent jurisdiction. In

instances where the City is shown to have been actively negligent and where the City's active negligence accounts for only a percentage of the liability involved, the obligation of the Contractor will be for that entire portion or percentage of liability not attributable to the active negligence of the City.

ARTICLE V. It is further expressly agreed by and between the parties hereto that should there be any conflict between the terms of this instrument and the bid of said Contractor, then this instrument shall control and nothing herein shall be considered as an acceptance of the said terms of said bid conflicting herewith.

IN WITNESS WHEREOF, the parties to these presents have hereunto set their hands this year and date first above written.

CITY OF SAN LUIS OBISPO
A Municipal Corporation

_____
Whitney McDonald,
Interim City Manager

APPROVED AS TO FORM

_____
J. Christine Dietrick
City Attorney

CONTRACTOR:

Name of Company

By:_____
Name of CAO/President
Its: CAO/PRESIDENT

(2nd signature required if Corporation):

By:_____
Name of Corporate Officer

Its: _____

APPENDIX B – TECHNICAL SPECIFICATIONS

Table of Contents

Section 01 2500
Substitutions

PART 1 - GENERAL

1.01 "Or Equal" Substitutions

A. Requests for substitution of materials shall be completed in accordance with City of San Luis Obispo Standard Specifications Section 6-1.05.
   1. One Product Specified: Unless the Specifications state that no substitution is permitted, whenever in the Contract Documents any specific article, device, equipment, product, material, fixture, patented process, form, method, or type of construction is indicated or specified by name, make, trade name, or catalog number, with or without the words “or equal”, such specification shall be deemed to be used for the purpose of facilitating description of material, process, or article desired and shall be deemed to be followed by the words “or equal”. Contractor may, unless otherwise stated, offer any material, process, or article, which shall be substantially equal or better in every respect to that so indicated or specified and will completely accomplish the purpose of the Contract Documents.
   2. Two or More Products Specified: When two or more acceptable products are specified for an item of the Work, the choice will be up to the Contractor. Contractor shall utilize the same product throughout the Project. If a timely substitution request as set forth in Section 1.02.A. is not provided and an “or equal” substitution is requested, the Owner may consider the substitution only if the product specified is no longer commercially available.
      a. The burden of proof as to the equality of any material, process or article shall rest with the Contractor, and the Contractor shall submit all data substantiating a request for an “or equal” substitution item as provided in Section 3400 of the Public Contract Code, Specification Section 01 3300 and other specific sections of the specifications prior to Award of Contract.

1.02 Request for Substitutions

A. Substitute Request Form: Requests for substitutions of products, materials, or processes other than those specified must be made on the Substitution Request form attached. Requests must be submitted fourteen (14) calendar days prior to the date of the Bid Opening to be considered. An addendum will be issued seven (7) calendar days prior to Bid Opening, identifying all equipment and materials deemed equivalent to those specified and approved by the Architect.

B. Substitution Request Content: A substitution request must constitute a representation that the subcontractor/general contractor:
   1. Has investigated proposed product and determined that it is equal in quality and serviceability of the specified item.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other work, which may be required for the work to be complete with no additional cost to General Contractor / Owner.
   4. Will be acceptable in consideration of the required design and artistic effect.
   5. Will require no excessive or more expensive maintenance including adequacy and availability of replacement parts.

6. Waives claims for additional costs or time extension, which may subsequently become apparent.
7. Will reimburse Owner for review or redesign services by the Architect and re-approval fees by authorities, agencies, or the Owner.

C. Substitution Submittal Procedure:
1. Contractor shall furnish four (4) copies of the requested information sufficient to determine whether the proposed substitution is equivalent including, but not limited to, all drawings, specifications, samples, performance data, calculations, and other information as may be required to assist the Architect and the Owner in determining whether the proposed substitution is acceptable.
2. The final decision shall be the Owner's. Owner may condition its approval of the substitution upon delivery to Owner of an extended warranty or other assurances of adequate performance of the substitution.
3. If the Substitution is Permitted: The Contractor shall be solely and directly responsible for fitting approved substituted material and equipment into the available space in a manner acceptable to the Owner and for the proper operation of the substituted equipment with all other equipment with which it may be associated. The Contractor shall bear all costs of meeting the above requirements for presenting a proposed substitution, and if the substitution is accepted, the Contractor must bear all costs involved including costs of Construction Manager's, Architect's, and Engineer's services required in adapting the substituted material or equipment to the installation to the complete satisfaction of the Owner.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

End of Section 01 2500

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Section 01 3300
Submittals

PART 1 - GENERAL

1.01 Submittals

A. Submittals shall be provided in accordance with City of San Luis Obispo Standard Specification Section 5-1.23.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

End of Section 01 3300

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Section 01 4000
Quality Control

PART 1 - GENERAL

1.01 Quality Control

A. Quality Control shall be completed in accordance with City of San Luis Obispo Engineering Standards and Standard Specifications and Caltrans Standard Specifications. See Section 5 for Control of Work and Appendix J for the City's Quality Assurance Program.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

3.01 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

END OF SECTION 01 4000

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Section 03 1000
Concrete Forming and Accessories

PART 1 GENERAL

1.01 Section Includes

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Installation of items to be embedded in concrete, such as anchor bolts, inserts, embeds, and sleeves.

C. Openings for other work.

D. Form accessories.

E. Form stripping.

1.02 Related Requirements

A. Section 03 2000 - Concrete Reinforcing.

B. Section 03 3000 - Cast-in-Place Concrete.

1.03 Reference Standards

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

C. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

D. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

E. PS 1 - Structural Plywood; 2023.

1.04 Submittals

A. See Section 01 3300 - Submittals, for submittal procedures.

B. Product Data: Provide data on void form materials and installation requirements.

C. Keep an accurate record of the dates of removal of forms, form shores and reshores, and furnish copies to the SEOR.

1.05 Quality Assurance

A. Comply with the pertinent provisions of 01 4000 - Quality Requirements

B. Construct forms according to ACI PRC-347, "Guide to Formwork for Concrete," and conforming to tolerances of ACI SPEC-117, "Specifications for Tolerances for Concrete Construction"

1.06 Delivery, Storage, and Handling

A. Comply with pertinent provisions of 01 6000 - Product Requirements delivering materials in a timely manner to ensure uninterrupted progress.

B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 PRODUCTS

2.01 Formwork - General

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with relevant portions of ACI CODE-318, ACI PRC-347, and ACI SPEC-301.

2.02 Wood Form Materials

A. Softwood Plywood: PS 1, B-B Medium or High Density Concrete Form Overlay, Class I, grade marked, not mill oiled.

B. Lumber: DF species; WCLIB Construction grade or better, WWPA No. 1 grade or better; with grade stamp clearly visible.

2.03 Formwork Accessories

A. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
   1. Composition: Colorless, reactive, water-based or solvent-based compound.
   2. Do not use materials containing diesel oil or petroleum-based compounds.
   3. VOC Content: In compliance with applicable local, State, and federal regulations.

PART 3 EXECUTION

3.01 Examination

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 Earth Forms

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete. Sides of all footings and grade beams shall be formed, unless the member detail provides at least 3" clear cover to reinforcement and indicates the member is cast against earth. Remove formwork prior to backfilling operations.

3.03 Erection - Formwork

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.

B. Rigidly construct forms to prevent mortar leakage, sagging, displacement or bulging between studs. Use clean, sound, approved form material, coated with specified materials only, not oil. Provide backing on all plywood joints.

C. Coat forms with the specified resin coating, not form oil. Construct forms to exact shapes, sizes, lines and dimensions required to obtain level, plumb, and straight surfaces. Provide openings, offsets, keys, reglets, anchorages, recesses, moldings, chamfers, blocking, screeds, drips, bulkheads, and all other required features. Make forms easily removable without hammering or prying against concrete. Space forms apart with metal spreaders. Construct forms to accurate alignment, locations and grades, and provide against sagging, leakage of concrete mortar, or displacement occuring during and after placing of concrete. Coordinate installation of inserts and anchors in forms according to shop drawings and requirements for work of other sections.

D. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

E. Corners and angles: Provide 3/4" x 3/4" beveled chamfer strips for all exposed concrete corners and angles square unless indicated otherwise.

F. Reglets and Rebates: Form required reglets and rebates to receive frames, flashing and other equipment. Obtain required dimensions, details, and precise positions for work to be installed under other sections and form concrete accordingly.

G. Form Joints: Align joints and make watertight. Keep form joints to a minimum. Fill joints to produce smooth surfaces, intersections, and arises. Use polymer foam or equivalent fillers at joints and where forms abut or overlap existing concrete to prevent leakage of mortar.

H. Recesses, Drips, and Profiles: Provide smooth milled wood or pre-formed rubber or plastic shapes of types shown and required.

I. Cleanouts and Cleaning: Provide Temporary openings in all wall forms and other vertical forms for cleaning and inspection. Clean forms and surfaces to receive concrete prior to placing.

J. Re-Use: Clean and Recondition form material before re-use.

3.04 Application - Form Release Agent

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 Inserts, Embedded Parts, and Openings

A. All necessary pipe sleeves, anchors, or other required inserts shall be accurately installed as part of the work of other sections, according to Specification Section 03 30 00, Section 1.3.B for submittal requirements related to this scope.

B. Obtain approval before framing openings in structural members that are not indicated on drawings.

C. Provide formed openings where required for items to be embedded in passing through concrete work.

D. Locate and set in place items that will be cast directly into concrete.

E. Conduits or pipes:
1. Locate so as not to reduce strength of the concrete
2. Do not place pipes, other than conduits, in a slab 4-1/2" thick or less in any case. Conduit buried in a concrete slab shall not have an outside dimension greater than 1/3 the slab thickness nor be placed below the bottom reinforcing or over the top reinforcement.
3. Sleeves: Pipe sleeves may pass through the slab or walls if not exposed to rusting or other deterioration and are of uncoated or galvanized iron or steel. Provide sleeves of diameter large enough to pass any hub or coupling on pipe, including any insulation.
4. Conduits may be embedded in walls only if the outside diameter does not exceed 1/3 the wall thickness, are spaced no closer than 3 diameters on centers and not impair the strength of the structure.
5. Clusters of Conduits
    a. Clusters of conduits embedded in a concrete slab shall not exceed 6 conduits per cluster and each conduit per cluster shall be spaced as per the above requirements. Conduit clusters exceeding this requirement shall be reviewed and approved by the Structural Engineer of Record prior to installation of the conduits.
    b. If more than one conduit cluster is required in a specific area of the slab, routing and spacing of the clusters shall be reviewed and approved by the structural engineer of record prior to installation of the conduits.

c. At no time shall the quantity and routing of clusters of conduits impair the strength of the concrete construction.

F. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

G. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

H. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.

I. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

J. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 Form Cleaning

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

3.07 Formwork Tolerances

A. Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.

B. Deflection: Limit Deflection of forming surfaces from concrete pressure to L/240.

C. Finish Lines: Position formwork to maintain hardened concrete finish lines within following permissible deviations.

1. Variation from Plumb:
   - In 10'-0" 1/4 inch
   - In any story or 20'-0" 3/8 inch
   - In 40'-0" or more 3/4 inch
2. Variation from Level or Grades Indicated
   - In 10'-0" 1/4 inch
   - In any story or 20'-0" 3/8 inch
   - In 40'-0" or more 3/4 inch
3. Cross-Sectional Dimensions
   a. Minus 1/4 inch
   b. Plus 1/2 inch

3.08 Field Quality Control

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.09 Form Removal

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and all superimposed loads as determined by testing field cured cylinders, but not sooner than specified in ACI PRC-347 Section 3.6.2.3. Load supporting forms may be removed when concrete has attained 75 percent of required 28 day compressive strength, but no sooner than 3 days, provided construction is reshored. Vertical formwork for cast in place concrete walls may be removed no sooner than 1 day following concrete placement, provided that the contractor can demonstrate that no sloughing or sagging of concrete will occur.
   1. Reshore structural members as specified per ACI PRC-347.
   2. Remove formwork progressively so unbalanced loads are not imposed on the structure.
   3. Avoid damage to concrete surfaces during removal.
   4. Remove formwork in same sequence as concrete placement to achieve similar concrete surface coloration.

END OF SECTION 03 1000

Section 03 2000
Concrete Reinforcing

PART 1 GENERAL

1.01 Section Includes

A. Reinforcing Steel for Concrete Foundations

B. Reinforcing Steel for Concrete Slabs on Grade

C. Supports and accessories for steel reinforcement.

1.02 Related Requirements

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 3000 - Cast-in-Place Concrete.

1.03 Reference Standards

A. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

B. ACI 315 - Manual of Standard practice for Detailing Reinforced Concrete Structures; 2011.

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

D. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

F. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).

G. CRSI (DA4) - Manual of Standard Practice; 2023.

H. CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.04 Quality Assurance

A. Comply with the pertinent provisions of 01 4000 - Quality Requirements

B. Perform work of this section in accordance with ACI SPEC-301.

1.05 DELIVERY STORAGE AND HANDLING

A. Comply with pertinent provisions of 01 6000 - Product Requirements delivering materials in a timely manner to ensure uninterrupted progress.

B. Bundle bars, tag with identification, and transport and store so as not to damage any material. Use metal tags indicating size, length and other marking shown on placement drawings. Maintain tags after bundles are broken

C. Avoid exposure to dirt, moisture or conditions harmful to reinforcement.

1.06 EXTRA MATERIAL

A. Provide an allowance of an additional 10% of the total reinforcing steel tonnage in addition to the quantities shown on the drawings. This additional steel shall be installed in sizes and locations as directed by the structural engineer.

PART 2 PRODUCTS

2.01 Reinforcement

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Deformed billet-steel bars.
   2. Unfinished.
   3. Only to be used for conditions where bars will not be welded.

B. Reinforcing Steel: ASTM A706/A706M, Grade 60 (60,000 psi) deformed low-alloy steel bars.
   1. Unfinished.
   2. Used in all cases where welding of bars is required.

C. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.

D. Reinforcement Accessories:
   1. Tie Wire: ASTM A1064/A1064M , Annealed copper bearing steel, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Standard manufactured products shall conform to the Concrete Reinforcing Institute, "Manual of Stand Practice," latest edition.
   3. Use dense precast concrete supports with embedded wire ties for reinforcement placed on grade. Elsewhere, use wire bar supports.

E. Welding electrodes: AWS D1.4/D1.4M, Table 5.1 and 5.3, low hydrogen electrodes, E8018 for Grade 60 Steel.

2.02 Fabrication

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Bending and Forming
   1. Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials
   2. Do not heat reinforcement for bending
   3. Bend bars No. 6 size and larger in the shop only.
   4. Bars with unscheduled kinks or bends are subject to rejection.

PART 3 EXECUTION

3.01 Placement

A. Before placing bars, and again before concrete is placed, clean bars of loose rust and/or mill scale, dirt, oil, or any other coating that may be deleterious or could reduce bond with the concrete.

B. Securing in place:
   1. Accurately place bars and wire tie in precise position where bars cross.
   2. Bend ends of wire ties away from the forms.
   3. Wire tie bars to the corners of ties and stirrups.
   4. Support bars according to the Concrete Reinforcing Steel Institute (CRSI) "Placing Reinforcing Bars," using approved accessories and chairs.
   5. Place precast concrete cubes with embedded wire ties to supporting reinforcing steel bars in concrete placed on grade and in footings.
   6. Take adequate precautions to ensure that reinforcing bar position and spacing is maintained during concrete placement.

C. Maintain concrete cover around reinforcing as follows:
   1. Refer to Drawings for cover requirements

D. Splices:
   1. Do not splice reinforcing bars at the points of maximum stress except where indicated.
   2. Lap splices as shown or required to develop the full strength or stress of the bars.
   3. Stagger splices in horizontal wall bars at least 48" longitudinally in alternate bars and opposite faces.

3.02 Field Quality Control

A. Comply with all pertinent provisions of Division 01 Section 01 40 00 "Quality Requirements".

B. Supervision: Perform Work to this Section under supervision of a capable superintendent.

C. An independent testing agency, as specified in 01 4000 - Quality Requirements, shall inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION 03 2000

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Section 03 3000
Cast-in-Place Concrete

PART 1 - GENERAL

1.01 Section Includes

A. Section Includes cast-in-place concrete, concrete materials, mixture design, placement procedures and finishes for the following:

B. Joint devices associated with concrete work.

C. Miscellaneous concrete elements, including equipment pads and footings.

D. Concrete curing.

E. Concrete Foundations

1.02 Related Requirements

A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03 2000 - Concrete Reinforcing.

C. Section 32 1313 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 Reference Standards

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI 315 - Details and Detailing of Concrete Reinforcement; 1999.

C. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

D. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

E. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

F. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

H. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2022.

I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.

K. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete; 2020.

L. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete; 2020.

M. ASTM C88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate; 2018.

N. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

O. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

P. ASTM C117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing; 2017.

Q. ASTM C131/C131M - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine; 2020.

R. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

S. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

T. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

U. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.

V. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

W. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

X. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

Y. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

Z. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

AA. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

BB. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.

CC. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2024.

DD. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

EE. ASTM D75 - Standard Practice for Sampling Aggregates; 2019.

FF. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate; 2022.

GG. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.

1.04 Submittals

A. See Section 01 3300 - Submittals for submittal procedures.

B. Product Data: Comply with the pertinent provisions of Section 01 6000 - Product Requirements Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. Material Certificates: For Each of the following, signed by the manufacturer(s)
      a. Cementitious materials
      b. Admixtures
      c. Curing compounds
      d. Non-shrink grout
   2. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with the requirements:
      a. Aggregates

C. Mix Design: Submit proposed concrete mix design(s). For each concrete mixture:
   1. Inidcate Intended Locations for use
   2. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
   3. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
      a. Mixes shall be based on existing approved compressive strength test data for concrete mixes in accordance with ACI 318 Section 5.3.1.1 and requirements below:
         1) Strength Requirements: Design mixes for structural concrete for minimum 28-day compressive strengths required by Drawings and Specifications. The trial batch strength for each mix shall exceed indicated or specified strength by 750 psi or a lesser amount based on the standard deviations of strength test records according to ACI 318.
         2) Normal Weight Concrete Mix Design: Design all mixes for workability and durability of concrete. Control the mixes in accordance with the CBC, ACI 318 Section 5.2, ACI 211.1, and ACI CODE-318 Chapter 4, Building Code

Requirements for Reinforced Concrete. Make adjustments in cement content required for concrete strengths at Contractor's expense and do not exceed 0.50 (or as indicated on concrete general notes of approved plans) absolute water-cement or cement plus fly ash or slag ratio by weight. Do not use calcium chloride or any admix containing such material. Admixtures containing a material releasing nitrates in solution are limited to 0.06 percent by weight for the chloride ion.
Design the mixes with 1" maximum size, except maximum 1-1/2" size for foundations as submitted by the contractor and approved by the Structural Engineer of Record.

3) ACI 318 Section 5.3.1.1 with test records. Where a testing laboratory acceptable to the enforcement agency has records of compressive strength tests, a standard deviation shall be established. Test records from which a standard deviation is calculated shall:
   (a) Represent materials, quality control procedures and conditions similar to those expected, and changes in materials and proportions within the test records shall not have been more restricted than those for proposed work.
   (b) Represent concrete produced to meet a specified strength or strengths f' c within 1,000 psi of that specified for proposed work.
   (c) Must consist of at least 30 consecutive tests or two groups of consecutive tests totaling at least 30 tests as defined in ACI 318 Section 5.3.1.1, except as provided in ACI 318 Section 5.3.1.2.

4. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Test Reports: Submit report for each test or series of tests specified.

E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

F. Delivery Tickets: With each transit truck provide delivery ticket, signed by an authorized representative from the batch plan, containing all information required by ASTM C94/C94M , as well as time batched, type of brand of cement, cement content, maximum size of aggregate and total water content.

1.05 Quality Assurance

A. Comply with the pertinent provisions of 01 4000 - Quality Control

B. Qualifications
1. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance. Adequate numbers of trained and experienced personnell shall be used.
2. Manufacturer Qualifications: The production facility supplying hydraulic cement concrete shall have a current Certification of Ready Mixed Concrete Production Facilities from the National Ready Mixed Concrete Association, or equivalent.
3. Concrete Testing and Inspection Services: The owner shall engage a qualified Independent Testing Agency to perform evaluation test and special inspections per Structural Notes on Drawings and as required per the code. Personnel conducting test

shallbe qualified as ACI Concrete Field Testing Technician, Grade 1 according to ACI CP-1 or an equivalent program.

C. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.

D. Follow recommendations of ACI PRC-305 when concreting during hot weather.

E. Follow recommendations of ACI PRC-306 when concreting during cold weather.

F. Source Quality Control: Refer to the following paragraphs for specific procedures. Concrete materials which, by previous tests or actual service, have shown conformance may be used without testing when so approved by SEOR. Testing laboratory shall perform the following conformance testing

1. Cementitious Material Test: The concrete supplier shall furnish to the enforcement agency certification from the cement manufacturer that the cement proposed for use on the project has been manufactured and tested in compliance with the requirements of ACI 318 Section 3.2.1 and the ASTM standards listed in the materials section of this Specification.
2. Aggregates for Normal Weight Concrete: Test the aggregate before and after concrete mix is designed and whenever character of aggregate varies or source of material is changed in accordance with ASTM C33/C33M and CBC. Include a sieve analysis. Obtain samples of aggregates at the dry batching or ready-mix concrete plant in accordance with ASTM D75 and perform tests for the properties listed in the following table:

Physical Properties		
Physical Properties, units	Test Method	Minimum Values
Sieve analysis	ASTM C136/C136M	Loss after 5 cycles not more than 8 percent of coarse aggregate, nor more than 10 percent of fine aggregate
Organic impurities	ASTM C40	Fine aggregate not darker than reference standard color
Soundness	ASTM C88	
Abrasion	ASTM C131/C131M	Weight loss not more than 10.5 percent after 100 revolutions, 42 percent after 500 revolutions
Deleterious materials	ASTM C33/C33M A STM C330/C330M	
Materials finer than No. 200 sieve	ASTM C117	Not over 1 percent for gravel, 1.5 percent for crushed aggregate
Reactivity potential	ASTM C227, C289, C342	Ratio of silica released to reduction in alkalinity not to exceed 1.0.
Sand equivalent	ASTM D2419	California sand equivalent values operating range not below 71 percent

G. Compliance with Regulations: All materials shall comply with the current rules and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous substances in construction products.

H. Allowable Tolerances: Construct concrete conforming to the tolerances specified in ACI 117, as applicable, unless exceeded by the requirements of regulatory agenciesor otherwise indicated or specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01 6000 - Product Requirements.

B. Ready-mix concrete shall be mixed and delivered in accordance with ASTM C94/C94M . Each batch of concrete delivered to the Project site shall be accompanied by a time slip bearing departure time and signature of batch plant supervisor. Concrete shall be placed within 90 minutes after start of mixing. Concrete which has developed initial set shall not be used. Concrete which has partially hardened shall not be used. Deliver all materials in timely manner to ensure uninterrupted progress of the work.

C. Deliver, store and handle all cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.

1.07 JOB CONDITIONS

A. Cold Weather Requirements:
   1. Follow recommendations of ACI 306R A when concreting during cold weather.
   2. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Surfaces, in which concrete is to come in contact with, shall be free from frost or ice. No frozen materials or materials containing ice shall be furnished.
   3. When placing concrete during freezing or near-freezing weather the mix shall have a temperature of at least 50 degrees F., but not more than 90 degrees F. when cement is added. Concrete shall be maintained at a temperature of at least 50 degrees F. for at least 72 hours after placing or until it has thoroughly hydrated. When necessary, concrete materials shall be heated before mixing. Special precautions shall be provided for protection of transit-mixed concrete.

B. Hot Weather Requirements:
   1. Follow recommendations of ACI 305R when concreting during hot weather.
   2. During hot weather, proper attention shall be provided for ingredients, production methods, handling, placing, protection and curing, to prevent excessive concrete temperatures or water evaporation which could impair required strength or durability.

PART 2 PRODUCTS

2.01 Formwork

A. Comply with requirements of Section 03 1000.

2.02 Reinforcement Materials

A. Comply with requirements of Section 03 2000.

2.03 Concrete Materials

A. Cement:ASTM C595/C595M or ASTM C150/C150M, Type II - Moderate Portland type, low alkali. Provide Type V where concrete is in contact with soil corrosive to concrete.

B. Concrete aggregate is to be well graded (in Zone 2) per the Coarseness Factor Method.

C. Water: Water shall be potable and free from deleterious matter or shall otherwise satisfy the requirements of ASTM C1602/C1602M.
   1. Acquire aggregates for entire project from same source.

D. Pozzolan: ASTM C618, Class F or N Fly Ash (Class C Not permitted) subject to the conditions of the CBC, containing two percent or less carbon. Fly ash shall not be used in excess of 25 percent by weight of total cement quantity for structural concrete. Where fly ash replacement is 25% or higher, maximum water-cement ratio shall be 0.45. Fly ash need not be included in lightweight concrete mix designs.

E. Ground Granulated Blast Furnace Slag: ASTM C989/C989M Slag shall not be used in excess of 25 percent by weight of total cement quantity for structural concrete.
   1. Slag shall not be used in concrete to be polished.

F. Fly Ash: ASTM C618, Class C or F.

G. Water: Clean, potable and not detrimental to concrete, complying with ASTM C94/C94M and ASTM C1602/C1602M

2.04 Admixtures

A. Admixtures to be used in concrete shall be subject to prior approval by the Structural Engineer. Where more than one admixture is used, they shall be compatible. Use of admixtures shall be consistent throughout Work.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260/C260M.

D. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
   1. Only one brand. When used, are subject to approval of Structural Engineer of Record, and must reduce the mixing water at least 10 percent without entraining air in excess of 2 percent by volume. If the water reducing agent entrains more than 2 percent air, the water reduction shall be at least 12 percent, but in no case shall the water reducing agent entrain air in excess of 4 percent.

E. Water Reducing Admixture: ASTM C494/C494M Type A.

1. Only one brand. When used, are subject to approval of Structural Engineer of Record, and must reduce the mixing water at least 10 percent without entraining air in excess of 2 percent by volume. If the water reducing agent entrains more than 2 percent air, the water reduction shall be at least 12 percent, but in no case shall the water reducing agent entrain air in excess of 4 percent.

2.05 Accessory Materials

A. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   2. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
   3. Non-gas-forming and free of oxidizing catalysts and inorganic accelerators, used as dry or damp pack, or mixed to a 20-second flow (CRC-C 611), without segregation or bleeding at any temperature between 45 degrees F and 100 degrees F.
   4. Low-Slump, Dry Pack Products:
      a. Drypack: Field mixture of I part Portland cement to 2 parts fine aggregate mixed to a damp consistency such that a ball molded in the hands will stick together and hold its shape. In lieu of field mixing, Contractor may use factory mixed drypack material, such as Master Builders "Set Grout." f'c shall be equal to 5,000 psi.

B. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, nonmetallic aggregate, and activator.

2.06 Bonding and Jointing Products

A. Bonding Agent: "Weld-Crete," manufactured by Larsen Products Co., P.O. Box 2127, Rockville, MD 20852, Master Builders "Concresive," or equal.

B. Construction Joint Materials: "Key-Kold" or "Kwik-Joint," of profiles indicated.

C. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.

D. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D 1751 and ASTM D1752.

2.07 FINISHING AND CURING MATERIALS

A. Finishing Aids: Liquid applied at time of concrete finish to increase hydrolysis and improve workability and finish.
   1. Products:
      a. Hydrocrete: HydroCrete or HydroGrind :www.hydro-crete.com/
      b. Wagman Metal Products: G3 Finish Aid: www.wagmanmetal.com
      c. Penetron; Peneseal FH-PS: www.penetron.com/#sle.
      d. Solomon Colors; Solomon Colors Lythic Day1: www.solomoncolors.com/#sle.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

1. Application: Use at exterior flatwork.
2. Product dissipates within 4 to 6 weeks.

C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
   1. Application: Use at interior slabs.
   2. Comply with ASTM C309 standards for water retention.
   3. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested in accordance with ASTM C39/C39M.
   4. VOC Content: Zero.

D. Moisture-Retaining Sheet: ASTM C171.
   1. Curing paper, regular.
   2. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

2.08 CONCRETE MIXING

A. Furnish ready-mixed concrete from an approved commercial off-site plant. Conform to ASTM C 94, except materials, testing, and mix designs as specified herein. Use transit mixer trucks equipped with automatic devices for recording number of revolutions of drum. Comply with CBC Section, 1905.

B. Admixtures: All approved admixtures shall be introduced into the concrete at the batch plant. Field additions are not acceptable.

C. Slump: Adjust quantity of water so concrete at point and time of placing does not exceed the slumps per plans when tested according to ASTM C143. Use the minimum water necessary for workability required by part of structure being cast.

D. For compressive strength, density, fly ash or slag content, slump, and water-cement ratio, refer to the general notes in the plans.

2.09 Mixing

A. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 Examination

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 GENERAL

A. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the inspector at least 24 hours before placing concrete; do not place concrete until inspected by

the inspector.

B. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the SEOR.

3.03 Preparation

A. Earth Subgrade: Dampen 24 hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness and remove loose material.

B. Verify that forms are clean and free of rust before applying release agent.

C. Reglets and Rebates:
1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.

D. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed , but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

E. Screeds Over Vapor Barrier: Use weighted pad or cradle type screeds and do not drive stakes through the vapor barrier. Check with an instrument level, transit, or laser.

F. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

G. Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.

H. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability.

I. Gravel Fill: Recompact disturbed gravel and bring to correct elevation.

J. All concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

3.04 Placing Concrete

A. Sheet Vapor Retarders:
1. Place, protect, and repair sheet vapor retarder according to ASTM E1643, section 03 0516 - Underslab Vapor Barrier, and manufacturer’s written instructions.

B. Conveying and Placing:
   1. Do not place concrete until reinforcing steel and forms or decks have been approved by the Inspector and other authorities having jurisdiction. Concrete shall be placed only under direct observation of the inspector. Do not place concrete outside of regular working hours, unless the inspector has been notified at least 48 hours in advance.
   2. Comply with CBC Sections 1905.9 and 1905.10.
   3. Concrete shall be conveyed from mixer to location of final placement by methods, which will prevent separation or loss of materials. Place concrete in horizontal layers not more than 18" thick within 90 minutes after water is first added to the batch.
   4. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 5-feet for concealed concrete or over 3-feet for exposed concrete.
   5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
   6. Concrete shall be thoroughly consolidated during placement, and shall be worked around reinforcement and embedded fixtures with mechanical vibrators.
   7. Where new concrete is placed against or on old or existing concrete, apply bonding agent to surface of old concrete prior to placement of new concrete.

C. Compaction and Screeding:
   1. Compacting: Compact each layer of the concrete as placed with mechanical vibrators or equivalent equipment. Transmit vibration directly to concrete and in no case through the forms unless approved. Accomplish thorough compaction. Supplement by rodding or spading by hand adjacent to forms. Compact concrete into corners and angles of forms and around reinforcement and embedded fixtures. Recompact deep sections with congestion due to reinforcing steel as required.
   2. Operation of Vibrators: Do not horizontally transport concrete in forms with vibrators nor allow vibrators to contact forms or reinforcing. Push vibrators vertically into the preceding layers that are still plastic and slowly withdraw, producing maximum obtainable density in concrete without creating voids or segregation. In no case disturb concrete that has partially set. Vibrate at intervals not exceeding two-thirds the effective visible vibration diameter of the submerged vibrator. Avoid excessive vibration that causes segregation.
   3. Concrete must be vibrated at all headers, junction boxes and duct to insure that the concrete completely fills underneath the duct system. Care must be taken not to over vibrate. Shrinkage and temperature reinforcement above the duct systems shall be in accordance with ACI 318. Care shall be taken during concrete placement and, in particular, during concrete vibration, to prevent rising of top reinforcement within the slab. Contractors placing the concrete shall carefully hand finish a minimum of 24" [610mm] adjacent to junction box access openings so that the top of finished concrete and junction box access openings are flush with each other.
   4. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.

5. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.
6. Where concrete is to recieve polished finish:
   a. Screed with a vibratory straightedge and strike off at correct elevations.
   b. Do not leave the vibratory screed at any one location while the vibrator is running; move it continuously across the slab.
   c. Do not use a highway straightedge or bump cutter on the concrete surface during finishing operations.

D. Floating and Troweling:
1. After concrete has been placed, struck off, consolidated, and restraightened, concrete shall not be worked further until ready for floating. Restraightening operation is best accomplished by use of 8 foot to 10 foot wide bull float. Power floating operations shall begin when the water sheen has disappeared, and when the mix has stiffened sufficiently to permit proper operation of power-driven float.
2. Consolidate surface with power-driven floats. Hand floating with wood or cork faced floats shall be used in locations inaccessible to power driven machine. Surface shall be restraightened at this stage with ten foot highway straightedge applied at not less than two different angles.
3. High spots shall be cut down and low spots filled during this procedure to produce planes checking true under straightedge in any direction. Uniformly slope surfaces to drains where occurs.
4. Restraightening operation shall be followed by final float pass to uniform, smooth, granular texture.
5. Where concrete is to recieve polished finish:
   a. Machine-trowel the slab edges and as close as possible to walls and columns. Minimize hand-finishing.
   b. The troweled surface shall be free of trowel marks, burn marks, and mottling.
   c. Do not trowel over adjacent hardened concrete surfaces. Inspect trowel machines prior to each pass and remove any accumulated mortar.

E. Joints: Comply with CBC Section 1906.4. Locate joints in concrete only where shown or approved and obtain prior approval for points of stoppage of any pour. Clean and roughen surface of construction joints by removing entire surface and exposing 1/4" of clean coarse aggregate solidly embedded in mortar matrix by chipping, use of an approved retarder agent, or equal. Water and keep hardened concrete wet for not less than 24 hours before placing the next lift or abutting concrete. Cover the horizontal surfaces of existing or previously placed and hardened concrete with a 2" thick layer of fresh concrete of required mix less 50 percent of coarse aggregate just before balance of concrete is placed.

F. Vertical Elements: Stop placement of concrete in walls and columns 1 1/2" below bottom of beams or supported slabs. Stop placement at sills and heads of wall openings in the same manner. Allow concrete in vertical elements to be in place at least 2 hours and until vertical settlement has ceased before placing concrete for floor framing.

G. Correction of Segregation: Before placing next layer of concrete, and at the top of each placement for vertical elements, remove all concrete containing excess water or fine aggregate, or showing deficiency of coarse aggregate, and fill the space with compacted concrete of correct proportions. Comply with CBC Section, 1906.4.

H. Filling, Leveling and Patching:
   1. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.
   2. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.

I. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.05 Slab Jointing

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.06 Curing and Protection

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. All curing shall be per CBC Section 1905.11. Keep forms containing concrete in a wet condition until removed. Keep concrete continuously moist for not less than 7 days after placement. Keep concrete above 50ºF and moist with a fine fog water spray until protected by curing media.

D. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing. Use the water curing method, curing sheet material, or a clear liquid membrane-forming curing compound except as otherwise specified.

E. During times of dry or excessive winds, high ambient temperature, low humidity, or other ambient conditions causing rapid drying, use specified evaporation retardant and finishing aid material according to the manufacturers instructions and cure concrete with a fine fog spray of

water, or equal, applied both during and after finishing and continued until final curing operations are started.

F. Within 24 hours after finishing, exterior slabs and paving, and interior slabs to receive cement topping or mortar setting beds, shall be covered with sand to a depth of 2 inches and kept thoroughly wet for 7 days.
   1. Instead of sand covering, exterior walks and paving where no other surface treatment is specified, may be cured with clear liquid curing compound immediately installed in accordance with manufacturer's directions.
   2. At areas to recieve polished concrete finish, silcate curing compounds are prohibited.

3.07 GROUTING AND DRYPACKING

A. Install as indicated or required. Where grouting and drypacking is part of the work of other sections, it shall conform to the following requirements, as applicable.

B. Drypacking: Mix materials thoroughly with minimum amount of water. Install drypack by forcing and rodding to fill voids and provide complete bearing under plates. Finish exposed surfaces smooth and cure with damp burlap or liquid curing compound.

C. Non-Shrink Grouting:
   1. Mixing: Mix the approved non-shrink grout material with sufficient water per manufacturers recommendations.
   2. Application: Surfaces to receive the non-shrink grout shall be clean, and shall be moistened thoroughly immediately before placing the mortar. Before grouting, surfaces to be in contact shall be roughened and cleaned thoroughly, all loose particles shall be removed and the surface flushed thoroughly with neat cement grout immediately before the grouting mortar is placed. Place fluid grout from one side only and puddle, chain, or pump for complete filling of voids; do not remove the dams or forms until grout attains initial set. Finish exposed surfaces smooth, and cure as recommended by grout manufacturer.

3.08 Field Quality Control

A. Comply with pertinent provisions of Section 01 4000 - Quality Control.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Testing/Evaluation of Concrete: Conform to CBC and ACI. Testing Laboratory shall perform following tests. Samples for testing shall be obtained in accordance with AASTM C172/C172M, and shall be taken from as close to point of placement as possible.
   1. Compressive Strength Tests: Cast one set of three or more cylinders from each days placing and each 50 cubic yards, or fraction thereof, or not less than once for each 2,000 square feet of surface area for slabs and walls, of each strength of structural concrete. Date cylinders, assign record number, and tag showing the location from which sample was taken. Also record slump test result of sample. Do not make more than two series of tests from any one location or batch of concrete.
   2. Test Cylinders: Samples will be made in accordance with ASTM C172/C172M . Cast cylinders according to ASTM C31/C31M ; 24 hours later, store cylinders under moist curing conditions at about 70 F. Test according to ASTM C39/C39M at 7 and 28 day ages.

The remaining cylinder shall be kept in reserve in case tests are unsatisfactory.

D. Core Tests: Comply with CBC and ACI. If tests show that compressive strength of any concrete falls below required minimum at 28 day age, additional curing and testing of concrete which unsatisfactory test reports represent may be directed. Testing Laboratory shall take and test drilled cores as directed in accordance with ASTM C42. Contractor shall refill core holes with drypack concrete of the same compressive strength required for cored concrete. If core tests results are unsatisfactory, Contractor shall furnish required labor, equipment, and weights, and the Testing Laboratory shall conduct load testing on involved parts of building or structure as directed. Contractor shall bear additional curing and test costs, including Testing Laboratory costs, for concrete not meeting required compressive strength at 28 day age even if testing demonstrates that concrete has eventually attained required minimum compressive strength, and all costs for required corrections or removals and replacements as directed and required for approved construction.

E. Level of Floors: Continuously monitor concrete placing to maintain level floor by use of an instrument level, transit, or laser.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.10 Protection

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 03 3000

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Section 04 2000
Unit Masonry

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Mortar and grout.

C. Installation of Reinforcement

D. Placement of anchor bolts, assemblies and embeds

E. Grouting of plates and embeds

F. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.

B. Section 03 3000 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.

C. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.

B. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.

C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

D. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

H. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

I. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

J. ASTN C1019 - Standard Test Method for Sampling and Testing Grout, 2016

K. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023b.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittals for submittal procedures.

B. Mix Designs and test results:
   1. One of the following for each mortar mix
      a. Mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C270, or
      b. Mix designs and mortar tests performed in accordance with the property specification of ASTM C270
   2. One of the following for each grout mix
      a. Mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C476, or
      b. Mix designs and grout strength tests performed in accordance with the property specification of ASTM C476, or
      c. Compressive strength tests performed in accordance with ASTM C1019, and slump flow and Visual Stability Index (VSI) as determined by ASTM C1611/C1611M.

C. Material Certificates- Material certificates for the following, certifying that each material is in compliance.
   1. Anchors, ties, fasteners, and metal accessories
   2. Masonry Units
   3. Mortar and grout materials
   4. Self-Consolidating grout

D. Construction Procedures
   1. Cold weather construction procedures
   2. Hot weather construction procedures

E. Samples of cured dry mortar showing finish color.

F. Cured sealant colors for control joints.

G. Control Joint Filler, 12" pieces of each size and type.

1.05 QUALITY ASSURANCE

A. Comply with the pertinent provisions of 01 4000 "Quality Requirements."

B. Comply with provisions of the following codes and standards except where exceeded by requirements of the contract documents.
   1. California Building Code (CBC), 2022

2. ACI 530/530.1/ERTA, Building Code Requirements for Masonry Structures, 2016

C. Inspections:
   1. General: Structural verifications inspections and test shall be performed in accordance with the following codes and standards:
      a. California Building Code (CBC), 2022
      b. ACI 530/530.1/ERTA, Building Code Requirements for Masonry Structures, 2016
   2. Owner Requirements:
      a. The owner or owner's agent shall employ one or more approved agencies to perform inspections during construction as required by code and shown in the contract documents and specifications
   3. Special Inspection
      a. Qualifications: The special inspector(s) shall provide written documentation to the building official demonstrating his or her competence and relevant experience or training. The experience or training shall be considered relevant when the documented experience or training is related in complexity to the same type of special inspection activities for projects of similar complexity and material quantities.
      b. Special Inspection Report Requirements
         1) The special inspector shall keep record of inspections
         2) The special inspector shall furnish inspection reports to the building official and to the Architect and Engineer of Record.
         3) Reports shall indicate that work inspected was or was not completed in conformance to approved construction documents.
         4) Discrepancies shall be brought to the immediate attention of the contractor for correction
         5) If not corrected discrepancies shall be brought to the attention of the building official, and the Architect and Engineer of Record prior to completion of that phase of work.
         6) A final report documenting the special inspections and correction of any discrepancies noted shall be submitted to the building official.
   4. Contractor Requirements
      a. Special inspection is in addition to the contractor's quality control inspections and testing. The contractor's quality control inspections and testing shall occur prior to special inspection and reports shall be available to the special inspector.
      b. The contractor will notify, in writing, the owner or owner's agent at least 48 hours in advance of special inspection required.
      c. The contractor shall ensure that the work for which special inspection is required remains accessible and exposed for special inspection purposes until completion of the required special inspection.
      d. Any contractor responsible for the construction of the main wind and/or seismic force resisting system shall submit a written statement of responsibility to the building official and owner prior to commencement of work on the system or component. The statement of responsibility shall contain acknowledgement and awareness of the special inspection requirements.
   5. Inspections Required per Drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means of that will prevent mechanical damage and contamination by other materials.

B. Do not use damaged masonry units, damaged components of structure, damaged packaged materials,

C. Protect cementitious materials for mortar and grout from precipitation and groundwater

D. Do not use masonry materials that are contaminated

E. Store different aggregates separately

F. Protect reinforcement, ties and metal accessories from permanent distortions and store them off the ground.

1.07 PROJECT CONDITIONS

A. Masonry Protection - Cover top of unfinished masonry work to protect it from moisture intrusion

B. Hot Weather Construction - Implement approved hot weather procedures and comply with the following:
   1. Preparation When the ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F with a wind velocity greater than 8 mph:
      a. Preparation When the ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F with a wind velocity greater than 8 mph:
         1) Maintain sand piles in a damp, loose condition
         2) Provide necessary conditions and equipment to produce mortar having a temperature below 120°F
   2. Construction — While masonry work is in progress
      a. When the ambient air temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph:
         1) Maintain temperature of mortar and grout below 120°F.
         2) Flush mixer, mortar transport container, and mortar boards with cool water before they come into contact with mortar ingredients or mortar.
         3) Maintain mortar consistency by retempering with cool water.
         4) Use mortar within 2 hr of initial mixing.
   3. Protection — When the mean daily temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
   2. Load-Bearing Units: ASTM C90, medium weight.
      a. Hollow block, as indicated.
      b. Exposed Faces: Manufacturer's standard color and texture.

1) Split Face, Color: 60B568A
c. Manufacturers:
1) Air Vol Block LLC Precision Concrete Masonry Units; or approved equal

2.02 MORTAR AND GROUT MATERIALS

A. Mortar
1. Provide mortar conforming to the following parameters
a. Conform to ASTM C270
b. Comply with Section 2103.2 of the 2022 CBC
c. Type S Mortar
d. 2,000 psi minimum 28 day compressive strength
e. Manufacturer:
1) Air Vol Block LLC, 1 Suburban RD, San Luis Obispo CA 93401, 805-543-1314; or approved equal
2) Mortar Color: 5663B
(a) Provide lime-proof, inorganic compounds, which shall not exceed 15% by weight of the cement, unless otherwise directed by manufacturer.
(b) Carbon black shall not exceed 3% by weight of the cement.
(c) Color to be factory blended for full color saturation of mortar joint and to be factory packaged for unitized jobsite mixing at a ratio of one unit of color per sack of cementitious material (Portland cement, lime, or masonry cement).

B. Grout
1. Provide grout conforming to the following parameters
a. Conform to ASTM C476
b. Comply with Section 2103.3 of the 2022 CBC
c. 2,000 psi minimum 28 day compressive strength. Determine compressive strength of grout in accordance with ASTM C1019.
d. Do not use admixtures unless accepted by the Engineer of Record. Field addition of admixtures is not permitted in self-consolidating grout.

C. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
1. Hydrated Lime: ASTM C207, Type S.
2. Grout Aggregate: ASTM C404.

D. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.

2.03 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; uncoated finish.

2.04 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 MORTAR AND GROUT MIXING

A. Mortar
1. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar. Maintain workability of mortar by remixing or retempering. Discard mortar which has begun to stiffen or is not used within 2-1/2 hours after initial mixing.
2. Limit the weight of mineral oxide or carbon black pigments added to project-site prepared mortar to the following maximum percentages by weight of cement:
   a. Pigmented portland cement-lime mortar
      1) Mineral oxide pigment = 10 percent
      2) Carbon black pigment = 2 percent
   b. Pigmented mortar cement mortar
      1) Mineral oxide pigment = 5 percent
      2) Carbon black pigment = 1 percent
   c. Pigmented masonry cement mortar
      1) Mineral oxide pigment = 5 percent
      2) Carbon black pigment = 1 percent

      Do not add mineral oxide or carbon black pigment to preblended colored mortar or colored cement.
3. Do not use admixtures containing more than 0.2 percent chloride ions

B. Grout
1. Except for self-consolidating grout, mix grout in accordance with the requirements of ASTM C476.
2. Unless otherwise required, mix grout other than self-consolidating grout to a consistency that has a slump between 8 and 11 inches.
3. Proportioning of self-consolidating grout at the project site is not permitted. Do not add water at the project site except in accordance with the self-consolidating grout manufacturer's recommendations.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.
1. Include verification that foundations are constructed within a level alignment tolerance of +/- 1/2 inch.

B. Verify that related items provided under other sections are properly sized and located.
   1. Include verification that reinforcing dowels are positioned in accordance with the project drawings.

C. If stated conditions are not met notify the Engineer of Record.

3.02 PREPARATION

A. Clean reinforcement and shanks of anchor bolts by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed. Reinforcement with rust, mill scale, or both are acceptable without cleaning or brushing provided that the dimensions, of a cleaned sample are not less than required by the ASTM specification governing the reinforcement.

B. Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.

C. Wetting Masonry units
   1. Concrete Masonry - Unless otherwise required, do not wet concrete masonry before laying. Wet cutting is permitted.

D. Debris - Construct grout spaces free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

E. Reinforcement - Place reinforcement and ties in grout spaces prior to grouting

F. Cleanouts - Provide cleanouts in the bottom course of masonry for each grout pour when grout pour exceeds 5 ft 4 in.
   1. Construct cleanouts so that the space to be grouted can be cleaned and inspected. In solid grouted masonry, space cleanout horizontally a maximum of 32 inches on center.
   2. Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimension shall be 3 in.
   3. After cleaning, close cleanouts with closures braced to resist grout pressure.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running. Unless Otherwise required on the drawings
   2. Coursing: One unit and one mortar joint to equal 8 inches.

3.04 PLACING AND BONDING

A. Placing mortar units

1. Mortar joints at foundations - In the starting course on the foundations and other supporting members, construct bed joints so that the bed joint thickness is a least /1/4 inch and not more than:
   a. 1-1/4" when the first course of masonry is solid grouted and supported by a concrete foundation.
2. Bed and head joints - Unless otherwise required construct 3/8 in thick bed and head joints except at foundation. Construct joints that also conform to the following
   a. Fill holes not specified in exposed and below grade masonry with mortar.
   b. Unless otherwise required, tool joint with a round jointer when the mortar is thumbprint hard.
   c. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be grouted.
3. Hollow units - Place hollow units so:
   a. Face shells of bed joints are fully mortared
   b. Webs are fully mortared in:
      1) all courses of piers, columns and pilasters;
      2) when necessary to confine grout or insulation.
   c. Head joints are mortared, a minimum distance from each face equal to the face shell thickness of the unit.
   d. Vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with the project drawings.
4. Open units with beveled ends - Fully grout open-end units with beveled ends. Head joints of open-end units with beveled ends need not be mortared. At the beveled ends, form a grout key that permits grout within 5/8 inch of the face of the unit to prevent leakage of grout.
5. All Units
   a. Place clean units while the mortar is soft and plastic. Remove and re-lay in fresh mortar any unit disturbed to the extent that the initial bond is broken after initial positioning.
   b. Cut exposed edges or faces of masonry units smooth, or position so that exposed faces or edges are unaltered manufactured surfaces.
   c. When the bearing of a masonry wythe on its support is less than two-thirds of the wythe thickness, notify the Architect and Engineer of Record.

B. Embedded items an accessories - Install embedded items and accessories as follows:
   1. Construct chases as masonry units are laid
   2. Install pipes and conduits passing horizontally through masonry partitions.
   3. Place pipes and conduits passing horizontally through piers, pilasters, or columns
   4. Place horizontal pipes and conduits in and parallel to plane of walls
   5. Install secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.
   6. Install movement joints.
   7. Aluminum - Do not embed aluminum conduits pipes and accessories in masonry, grout or mortar unless they are effectively coated or isolated to prevent chemical reaction between aluminum and cement or electrolytic action between aluminum and steel.

C. Bracing of masonry - Design, provide and install bracing that will assure stability of masonry during construction.

D. Site tolerances - Erect masonry within the following tolerances from the specified dimensions.

1. Dimension of elements
   a. In cross section or elevation (-1/4 in., +1/2 in.)
   b. Mortar joint thickness
      bed joints between masonry courses (+ 1/8 in)
      bed joint between flashing and masonry (-1/2 in., +1/8 in.)
      head (-1/4 in., +3/8 in.)
   c. Grout space or cavity width, except for masonry walls passing framed construction (-1/4 in., +3/8 in.)
2. Elements
   a. Variation from level
      bed joints (+/- 1/4 in. in 10 ft, +/- 1/2 in. maximum)
      top surface of load bearing walls (+/- 1/4 in. in 10 ft, +/- 1/2 in. maximum)
   b. Variation from plumb (+/- 1/4 in. in 10 ft, +/- 3/8 in. in 20 ft,+/- 1/2 in. maximum)
   c. True to a line (+/- 1/4 in. in 10 ft, +/- 3/8 in. in 20 ft,+/- 1/2 in. maximum)
   d. Alignment of columns and walls (bottom versus top) (+/- 1/2 in. for load bearing walls and columns., +/- 3/4 in. for non-load bearing walls)
3. Location of elements
   a. Indicated in plan (+/- 1/2 in. in 20 ft, +/- 3/4 in. maximum)
   b. Indicated in elevation (+/- 1/4 in. in story height +/- 3/4 in. maximum)
   c. If the above conditions cannot be met due to previous construction, notify the Architect and Engineer of Record.
   d. Reinforcement, tie, and anchor installation

3.05 REINFORCEMENT, TIE AND ANCHOR INSTALLATION

A. Basic requirements - Place reinforcement, wall ties and anchors in accordance with the sizes, types, and locations indicated on the Project Drawings and as specified. Do not place dissimilar metals in contact with each other.

B. Reinforcement
   1. Support reinforcement to prevent displacement caused by construction loads or by placement of grout or mortar, beyond the allowable tolerances.
   2. Completely embed reinforcing bars in grout in accordance with the Section entititled grout placement.
   3. Maintain clear distance between reinforcing bards and the interior of masonry unity or formed surface of at least 1/4 inch for fine grout and 1/2 inch for coarse grout, except where cross webs of hollow units are used as supports for horizontal reinforcement.
   4. Place reinforcing bars maintining the following minimum cover:
      a. Masonry face exposed to earth or weather 2 in for bars larger than No. 5, 1-12/ in. for No. 5 bars or smaller.
      b. Masonry not exposed to earth or weather 1-1/2 in.
   5. Maintain minimum clear distance between parallel bars of the nominal bar size or 1 in., whichever is greater.
   6. In columns and pilasters, maintain minimum clear distance between vertical bars of one and one-half times the nominal bar size or 1-1/2 in., whichever is greater.
   7. Splice only where indicated on the Project Drawings, unless otherwise acceptable. When splicing by welding, provide welds in conformance with the provisions of AWS D1.4.
   8. Do not bend reinforcement after it is embedded in grout or mortar without approval from the Engineer of Record.

9. Noncontact lap splices - Postion bars spliced by noncontact lap splices no farther apart transversely than one-fift the specified length of lap nor more than 8 in.
10. Joint reinforcement
    a. Place joint reinforcement so that longitudinal wires are embedded in mortar with a minimum cover of 1/2 in. when not exposed to weather or earth; or 5/8 in. when exposed to weather or earth.
    b. Provide minimum 6 in. lap splice for joint reinforcement.
    c. Ensure that all ends of longitudinal wires of joint reinforcement at laps are embedded in mortar or grout.
11. Placement tolerances
    a. Place reinforcing bars in walls and flexural elements within a tolerance of +/- 1/2 in. when the distance from the centerline of reinforcing bars to the opposite face of masonry, d, is equal to 8 in. or less, +/- 1in. for d equal to 24 in. or less but greater than 8 in., and 1-1/4 in. for d greater than 24 in.
    b. Place vertical bars within:
        1) 2 in. of the required location along the length of the wall when the wall segment length exceeds 24 in.
        2) 1 in. of the required location along the length of the wall when the wall segment length does not exceed 24 in
        3) If it is necessary to move bars more than one bar diameter or a distance exceeding the tolerance stated above to avoid interference with other reinforcing steel, conduits, or embedded items notify the Engineer of Record.
        4) Foundation dowels that interfere with unit webs are permitted to be be bent to a maximum of 1 in. horizontally for every 6 in. of vertical height.

C. Anchor bolts
1. Embed headed and bent-bar anchor bolts larger than 1/4 in. diameter in grout that is placed in accordance with Section 3.06A and Section 3.06B. Anchor bolts of 1/4 in.diameter or less are permitted to be placed in grout or mortar bed joints that have a specified thickness of at least 1/2 in. thickness.
2. For anchor bolts placed in the top of grouted cells and bond beams, maintain a clear distance between the bolt and the face of masonry unit of at least 1/4 in. when using fine grout and 1/2 in. when using coarse grout.
3. For anchor bolts placed throught the face shell of a hollow masonry unit, drill a hole that is tight-fitting to the bolt or provide minimum clear distance that conforms to Section 3.05D.2 around the bolt and through the face of the shell. For the portion of the bolt that is within the grouted cell, maintain a clear distance between the bolt and the face of masonry unit and between the head or bent leg of the bolt and the formed surface of grout of at least 1/4 in. when using fine grout and at least 1/2 in when using coarse grout.
4. Place anchor bolt with a clear distance between parallel anchor bolts not less than the nominal diameter of the anchor bolt, nor less than 1 in.

3.06 GROUT PLACEMENT

A. Placing time - Place grout wihin 1-1/2 hr from introducing water in the mixture and prior to initial set.
1. Discard site-mixed grout that does not meet the specified slump without adding water after initial mixing.
2. For ready-mixed grout:
    a. Addition of water is permitted at the time of discharge to adjust slump.

b. Discard ready mixed grout that does not meet the specified slump without adding water, other than the water that was added at the time of discharge.
The time limit is waived as long as the ready mixed grout meets the specified slump.

B. Confinement - Confine grout to the areas indicated on the project drawings. Use material to confine grout that permits bond between masonry units and mortar.

C. Grout pour height - Do not exceed the maximum grout pour height given in the Table below

Grout Type (1)	Maximum grout pour height, ft	Minimum clear width of grout space, in (2,3)	Minimum clear grout space dimensions for grouting cells of hollow units, in x in (3,4,5)
Fine	1	3/4	1-1/2x2
Fine	5.33	2	2x3
Fine	12.67	2-1/2	2-1/2x3
Fine	24	3	3x3
Coarse	1	3/4	1-1/2x3
Coarse	5.33	2	2-1/2x3
Coarse	12.67	2-1/2	3x3
Coarse	24	3	3x4

1. Fine and course grouts are defined by ASTM C476.
2. For grouting between masonry wythes.
3. Minimum clear width of grout space and minimum clear grout space dimension are the net dimension of the space determined by subtracting masonry protrusions and the diameters of horizontal bars from the as-built cross section of the grout space. Select grout type and maximum grout pour height based on minimum clear space.
4. Area of vertical reinforcement shall not exceed 6 percent of the area of the grout space.

D. Grout lift height
1. For grout conforming to Section 2.02B
   a. Where the following conditions are met, place grout in lifts not exceeding 12 ft 8 in.
      1) The masonry has cured at least 4 hours
      2) The grout slump is maintained between 10 and 11 in.
      3) No intermediate reinforced bond beams are placed between the top and the bottom of the pour height
   b. When conditions 1 and 2 are met but there are intermediate bond beams within the grout pour, limit the grout lift height to the bottom of the lowest bond beam that is more than 5 ft. 4 in. above the bottom of the lift, but do not exceed a grout lift height of 12 ft. 8 in.
   c. When the conditions of 1 or 2 are not met, place grout in lifts not excedding 5 ft. 4 in.
2. For self-consolidating grout conforming to Section 2.02B:
   a. When placed in masonry that has cured for at least 4 hours, place in lifts not exceeding the grout pour height.
   b. When placed in masonry that has not cured for at least 4 hours, place in lifts not exceeding 5 ft. 4 in. or the grout pour height, whichever is less.

E. Consolidation
1. Consolidate grout at the time of placement.

a. Consolidate grout pours 12 in. or less in height by mechanical vibration or by puddling.
b. Consolidate pours exceeding 12 in in height by mechanical vibration, and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

2. Consolidation or reconsolidation is note required for self-consolidating grout.

F. Grout key - When grouting, form grout keys between grout pours. Form grout keys between grout lifts when the first lift is permitted to set prior to placement of the subsequent lift.
1. Form a grout key by terminating the grout a minimum of 1-1/2 in. below a mortar joint.
2. Do not form grout keys within beams.
3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.
4. Alternate grout placement - Place masonry units and grout using construction procedures employed in the accepted grout demonstration panel.

G. Lap splices minimum 24 bar diameters.

H. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

I. Place and consolidate grout fill without displacing reinforcing.

3.07 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Verify f'm and f'AAC in accordance with Section 1.05

C. Sample and test grout as required in Section 1.04 and 1.05.

3.09 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

E. Remove debris

F. Do not damage the masonry

3.10 PROTECTION

A. Protect adjacent construction and in place masonry against damage.

B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 04 2000

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Section 32 3119
Decorative Metal Fences and Gates

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative steel fences.

B. Decorative steel gate.

C. Decorative steel rolling gate.

D. Automatic gate operators complete with safety devices, keypad, card reader, and remote operation

E. Pedestal for gate operator with housing for operators.

F. Detection loops in pavement.

G. Concertina wire and attachments.

H. Coordination with Electrical drawings.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 04 2000 - Unit Masonry

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

D. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

E. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2002 (Reapproved 2017).

F. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008, with Editorial Revision (2017).

G. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.

H. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

I. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test; 2023.

J. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction; 2020.

K. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016 (Reapproved 2023).

L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

O. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

P. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittals, for submittal procedures.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings:
   1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Manufacturer's Warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.07 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Provide five year manufacturer warranty for rolling gate operator.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Metal Fences and Gates:
   1. Ameristar Perimeter Security, USA: www.ameristarperimeter.com/#sle; or approved equal.

B. Automatic Gate Operators:
   1. LiftMaster: www.liftmaster.com; or approved equal.
   2. HySecurity; hysecurity.com; or approved equal.
   3. Maximum Controls: max.us.com; or approved equal.

C. Concertina Wire
   1. https://www.concertina-wire.org/concertina-wire/concertina-wire.html; or approved equal.
   2. https://razorfencing.com/razor-wire; or approved equal.

2.02 FENCES

A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:

B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
   1. Total Coating Thickness: 2 mils, minimum.
   2. Color: Black.

C. Steel: ASTM A653/A653M; tensile strength 45,000 psi, minimum.
   1. Hot-dip galvanized; ASTM A653/A653M, G60.
   2. 62 percent recycled steel, minimum.

2.03 HEAVY INDUSTRIAL STEEL ORNAMENTAL FENCE SYSTEM

A. Provide fence meeting requirements for Industrial class as defined by ASTM F2408.

B. Fence Panels: Aegis II Invinciple; height per plans

1. Panel Style: Two rail.
2. Attach panels to posts with manufacturer's standard panel brackets.

C. Posts: Steel tube.
1. Size: 2-1/2 inches square by 12 gauge, 0.109 inch, with manufacturer's standard cap.
2. Post Cap: Flush plate.

D. Rails: Manufacturer's standard, double-wall steel channel 1-3/4 inch square by 12 gauge, 0.1094 inch with prepunched picket holes.
1. Picket Retaining Rods: 0.125 inch galvanized steel.
2. Picket-to-Rail Intersection Seals: PVC grommets.

E. Pickets: Steel tube.
1. Spacing: 3-3/4 inch clear.
2. Size: 1 inch square by 14 gauge, .0747 inch.
3. Style: Invincible.
4. Finial: Spear point.

F. Flexibility: Capable of following variable slope of up to 1:2.

2.04 STEEL ROLL GATE SYSTEM

A. Provide fence components meeting requirements for Industrial class as defined by ASTM F2408.

B. Gate system shall comply with all safety requirements of ASTM F2200.

C. PassPort II Industrial Ornamental design style: Invincible.
1. Panel Style: Two rail.
2. Panel Strength: Capable of supporting 600 pound load applied at midspan without deflection.
3. Attach panels to posts with manufacturer's standard panel brackets.

D. Posts: Steel tube.
1. Size: 4 inches square by 11 gauge, 0.1196 inch, with manufacturer's standard cap.
2. Post Cap: Flush plate.

E. Top rail, uprights, and diagonal rails: 2" square by 12 Ga.

F. Bottom rail: 2"x4"x11 Ga.
1. Picket Retaining Rods: 1/8 inch galvanized steel.
2. Picket-to-Rail Intersection Seals: PVC grommets.

G. Pickets: Steel tube.
1. Spacing: 4.175 inch on center.
2. Size: 1 inch square by 14 gauge, 0.0747 inch
3. Invincible style gates over 18’ long shall have pickets face-welded to 2” x 2” angle iron to form panels equal in length to the gate frame bay width.
4. Style: Pickets with finial extend above top rail.
5. Finial: Spear point.

H. Flexibility: Capable of following variable slope of up to 1:4.

I. Mesh: 2" mesh safety screening shall cover the entire gate and an equal portion of fence parallel to the gate in the open posiiton up to a height of over 6 feet from ground elevation.

J. Color: Black.

2.05 Automatic Gate Operators

A. Rolling Gates: Prewired, pedestal-mounted gate operator for horizontal roller gates, per ASTM F2200 and UL 325.
   1. Operating type: Roller chain.
   2. Control Functions: Open, Pause, Close.
   3. Maximum Open/Close Time: 30 seconds.
   4. Access: Card, Keypad, and Remote.
   5. Maximum gate weight: 1,500 pounds (560 kilograms).
   6. Horsepower Rating: Suitable for connected load.
   7. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
      a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
      b. Secondary Device: Provide electric sensing edge with wireless edge kit or non-monitored safety edge as an option along with continuous-constant control device.
   8. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
      a. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   9. Products:
      a. LiftMaster IHSL24UL (Basis of Design)
      b. Or approved equal.

2.06 ACCESSORIES

A. Keypad Mounting Supports: Where not factory installed, provide mounting supports for keypad installation.
   1. Products:
      a. PedestalPro, www.pedestalpro.com
         1) Furnished by owner. Contractor to install pedestal footing and anchors to receive pedestal.

B. Keypad Housing:
   1. Material: Steel
   2. Finish: Powder Coated
   3. Color: Black
   4. Size: As required for components - keypad and card reader minimum

2.07 Concertina Wire

A. Product: Concertina Razor Wire
   1. Type: Cross Razor Wire
   2. Material: Stainless Steel
   3. Size: 12" Diameter

B. Accessories:
   1. Mounting brackets and clips per manufacturer's installation requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set fence posts in accordance with the manufacturer recommended spacing.

C. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
   1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.

D. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From Indicated Position: 1 inch.

C. Minimum Distance from Property Line: 6 inches.

3.05 CLEANING

A. Leave immediate work area neat at end of work day.

B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

C. Clean fence with mild household detergent and clean water rinse well.

D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.

E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 3119

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Section 32 3313
Site Bicycle Racks

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.

D. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2022a.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittals for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Racks:
   1. Peak Racks; www.peakracks.com/#sle; or approved equal.
   2. Substitutions: See Section 01 2500

2.02 BICYCLE RACKS

A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Model: 5-Bike Single-Sided Rack
      a. Finish/Color: Hot Dipped Galvanized - Gray
      b. Add Hardware: Surface Mount to Concrete
         1) Capacity: Seven bicycles.
         2) Accessories: In-ground grout cover.

B. Materials:

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle racks.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

C. Do not begin installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings.

C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 3313

APPENDIX C – CITY COMMUNICATION CABLING STANDARDS

SECTION 17010
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 GENERAL

1.1 SUMMARY:

A. Section includes, but is not necessarily limited to:
   1. Common standards and procedures for the Communications Work.
   2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Communications Systems. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

B. Provisions of this Section apply to Communications Work, including the following Sections:
   1. Section 17026 - Grounding and Bonding for Communications Systems
   2. Section 17029 - Hangers and Supports for Communications Systems
   3. Section 17033 - Conduits and Backboxes for Communications Systems
   4. Section 17036 - Cable Trays for Communications Systems
   5. Section 17039 - Surface Raceways for Communications Systems
   6. Section 17053 - Identification for Communications Systems
   7. Section 17100 - Structured Cabling, Basic Materials and Methods
   8. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures
   9. Section 17119 - Communications Termination Blocks and Patch Panels
   10. Section 17123 - Communications Cable Management
   11. Section 17126 - Communications rack Mounted Power Protection and Power Strips
   12. Section 17130 - Communications Indoor Backbone Cabling
   13. Section 17150 - Communications Horizontal Cabling

1.2 REFERENCES:

A. Usage: In accordance with Section 01110 – Summary of Work.

B. American National Standards Institute (ANSI)
   1. ANSI/TIA/EIA-568-B.1-200l, Commercial Building Telecommunications Cabling Standard – Part l: General Requirements
   2. ANSI/TIA/EIA-568-B.2-200l, Commercial Building Telecommunications Cabling Standard - Part2: Balanced Twisted Pair Cabling Components
   3. ANSI/TIA/EIA-568-B.3-2000, Optical Fiber Cabling Components Standard
   4. ANSI/TIAIEIA-606-A-2002, Administration Standard for Commercial Telecommunications Infrastructure

1.3 DEFINITIONS

A. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.
   1. ADA Americans With Disabilities Act
   2. AFC Above Finished Ceiling
   3. AFF Above Finished Floor

4. BDF Building Distribution Facility
5. BICSI Building Industry Consulting Service International
6. BLDG Building
7. CAT Category
8. CD Campus Distributor
9. CL Centerline
10. DIY Division
11. (E) Existing
12. EF Entrance Facility
13. ER Equipment Room
14. FBO Furnished By Owner
15. FD Floor Distributor
16. HR Home Run
17. ID Inside Diameter
18. LAN Local Area Network
19. MAX Maximum
20. (N) New
21. NIC Not In Contract
22. OD Outside Diameter
23. OFE Owner Furnished Equipment
24. PSRH Project Standard Receptacle Height
25. PSSH Project Standard Switch Height
26. TR Telecommunications Room
27. TVP Typical
28. UON Unless Otherwise Noted.

B. Reference to Named Products.
   1. Selected Item: Item so noted was selected based on comparative testing of similar products. Procedure for determination of equivalence is noted in the specification for the item(s).
   2. System Design Basis: Item so noted interacts with other system items to produce total system function. Substitution of this item may require coordinated substitution of other system items.
   3. Design Basis: Item so noted was used as basis for system drawings to establish features, size, etc. Use of specified equivalents may require adjustment of physical layout or wiring, but does not affect system function. No preference is implied.

1.4 SUBMITTALS

A. Comply with Section 01300 - Administrative Requirements and the following:
   1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.
   2. Submit 8 ½ "x 11" items bound in volumes and drawings in edge bound sets. Submit all drawings on sheets of the same size.

3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
4. Progress Schedule: Comply with 01300 - Administrative Requirements.

B. Manufacturer's Product Data:
1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:
2. Data sheet for each item in each Communications Section, including all accessories, clearly marked for proposed product.
3. Material Safety Data Sheet, where applies.
4. List of Materials Schedule. For each item, include:
   a. Referencing Specification Section
   b. Referencing Paragraph
   c. Referencing Drawing, if specified only on plans
   d. Manufacturer
   e. Model number
   f. Listing, including name of Nationally Recognized Testing Laboratory.
   g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted.
      i. Example:

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	UL Listed/ ETL Verified
17010	2.03C		XYZ	123	Y
17150	2.07Al		AAA	34-56	Y
		T4.2	ZZY	456	Y

1.5 QUALITY ASSURANCE

A. Procedures: In accordance with Section 01400 - Quality Requirements.

B. Contractor may design data and voice cabling and subcontract the installation to another contractor or perform both design and installation. In either case, all contractors must meet the qualifications for any portion of the work they perform.

C. Qualifications for contractors who perform DESIGN work:
1. Any person who designs any data or voice cabling for this project must be a BICSI Registered Communication Distribution Designer (RCDD®) and a full-time employee of Contractor. Two (2) copies of RCDD certification(s) must be submitted during the pre-construction meeting.
2. Any person who designs any data or voice cabling for this project shall be thoroughly familiar with the cabling methods set forth in the latest release of the BICSI Telecommunications Distribution Methods Manuals (TDMM), latest edition.
3. Contractor shall submit two (2) copies of documentation of at least five (5) years experience in design of structured cabling systems during the pre-construction meeting.
4. Contractor shall submit two (2) copies of a written list of completed projects equivalent in size and complexity to this project, with a reference name, title,

company, address, and telephone number for each during the pre-construction meeting.

D. Qualifications for contractors who perform INSTALLATION work:
   1. Contractor must have at least one person acting as project manager/engineer for this project who is both a BICSI RCDD and a full-time employee of Contractor. Two (2) copies of RCDD certification(s) must be submitted during the pre-construction meeting.
   2. Contractor shall be thoroughly familiar with the cabling methods set forth in the BICSI TDMM, latest edition, and unless otherwise specified, shall supervise the installation in accordance with the recommendations and practices outlined in the BICSI TDMM, latest edition.
   3. Contractor shall be an approved Ortronics Certified Installer or Berk-Tek Certified OASIS Integrator. The Telecommunications contractor is responsible for workmanship and installation practices in accordance with the Ortronics CI/CIP Program and Berk-Tek OASIS Program.
   4. Contractor shall submit during the pre-construction meeting two (2) copies of documentation of at least five (5) years experience in installation and maintenance of structured cabling systems.
   5. Contractor shall submit during the pre-construction meeting two (2) copies of a written list of completed projects equivalent in size and complexity to this project, with a reference name, title, company, address, and telephone number for each.
   6. During the pre-construction-meeting, Contractor shall submit two (2) copies of a written list of qualified technicians assigned to this project, including relevant manufacturer training programs and years of related experience completed by each. At least 30 percent of the copper installation and termination crew must be certified by Berk-Tek and Ortronics or by BICSI at the Technician level. At least 20 percent of the optical fiber installation and termination crew must be certified by Berk-Tek and Ortronics or other industry-recognized organizations in optical fiber installation and testing.

E. Structured Cabling System shall qualify for an Ortronics NetClear GT2 25-year manufacturer warranty. Contractor shall responsible for the following:
   1. Register project for warranty PRIOR to the start of installation in conformance with Ortronics warranty requirements.
   2. Submit final Bill of Materials and certified test results to Ortronics within (5) business days of completing installation and certification testing.
   3. Deliver warranty confirmation letter and certificate to Owner's representative.

F. Test Plan
   1. Provide a complete and detailed test plan for the Telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories ten (10) business days prior to the proposed test date. Include procedures for certification, validation, and testing.

G. Designated Supervisor

1. Provide a designated supervisor present and in responsible charge in the fabrication shop and on the project site during all phases of installation and testing of the Work of this section. This supervisor shall be the same individual throughout the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of Contractor intervene.

H. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.
   1. A complete set of the latest stamped, actioned submittals of record.

I. Test Equipment
   1. Requirements:
      a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Certification Testing of the Work of this section.
      b. Maintain test equipment at the job site while testing is in progress from installation of equipment racks until Owner Acceptance of this Work; thereafter remove all of this test equipment from the job site.
      c. Unless otherwise indicated, test equipment shall remain property of Contractor.
      d. Provide all required test cables and adapters.
         a. Provide equipment with traceable calibration, with calibration date not greater than one (1) year prior to the date of the use of the equipment to perform the specified testing.
   2. Equipment: Specified in individual Sections.

J. Standard Products
   1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.
      a. Alternative Qualifications. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.
   2. Material and Equipment Manufacturing Date.
      a. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 REGULATORY REQUIREMENTS

A. Regulations Applicable: Including but not limited to those defined in Section 01110 - Summary of Work.
   1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.
   2. Safety Agency Listing: All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.
   3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Owner's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.7 DELIVERY. STORAGE, AND HANDLING

A. Procedures:
   1. In accordance with Section 01600 - Product Requirements and as specified in the individual sections of Division 17.

B. General
   1. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for Telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

1.9 SEQUENCING

A. Comply with Section 01110 - Summary of Work, 01300 - Administrative Requirements, and the following:
   1. Sequence.
      a. Within (10) days of issuance of the Notice to Proceed, Owner’s Representative will provide the Contractor copies of the Contract Drawings showing station outlets with final Owner assigned backbone cable and horizontal jack and cable ID numbers.
      b. Reproduceables, as applies:
         i. 1 set of reproducible bond.
         ii. CAD files: 1 set
      c. Contractor shall use drawings provided in executing the work of the Project.

1.10 OPERATING AND MAINTENANCE DATA

A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the Telecommunications cabling and pathway system.

1. Submit operations and maintenance data in accordance with Section 01770 - Closeout Procedures and as specified herein not later than 2 months prior to the date of beneficial occupancy.

1.11 PROJECT RECORD DOCUMENTS

A. Comply with Section 01770 - Closeout Procedures, and the following:
   1. Record Drawings
      a. CAD.
         i. Use a Computer Aided Drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, latest version at time of bid.
      b. Except where prohibited by Contract, Owner's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, latest version at time of bid, for use by the Contractor in preparing Record Drawings.
      c. CD copy of Record Drawings: Provide 2 separate disc copies of each drawing file in the format noted above. Submit of CD-R disk.

1.12 WARRANTY SERVICE

A. In addition to provisions of 01780 - Warranties, provide the following:
   1. Response Time: Provide a qualified technician familiar with the work at the Project Site within 24 hours after receipt of a notice of malfunction. Provide the Owner's Representative with telephone number attended 8 hours a day, 5 days a week, to be called in the event of a malfunction.

B. Provide all additional Warranties as defined in each Communication Systems Section.

1.13 ACCEPTANCE REVIEW AND TESTING PROCEDURES

A. Complete all Work of this section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the Owner's Representative in writing that the Work of these Sections is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing. The Owner's Representative will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These procedures may be performed at any hour of the day or night as required by the Owner's Representative to comply with the project schedule and avoid conflict with residents. Provide all specified personnel and equipment at any time without claim for additional cost or time.

B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this section. Provide quantity of technicians as required to comply with project schedule.

C. In Addition, provide:
   1. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare cable and connectors and specified tooling for application.
   2. Ladders, scaffolding and/or lifts as required to access high devices.
   3. All test equipment.

4. Complete set of latest stamped, actioned submittals of record for reference.
5. Complete set of manufacturer test reports.
6. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
    a. Demonstrate: Complete operation of all systems and equipment, including portable equipment.
    b. Adjust: As directed by the Owner's Representative.
    c. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the Owner's Representative.

D. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the Owner's Representative, in place of the Work of this section which is incomplete or found not in conformance with the Contract Documents as of ten (10) business days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this section. Thereafter, remove such temporary equipment.

1.14 CLOSEOUT

A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, re-test and re-submit certification test report(s). Notify the Owner's Representative of completion of Punch List.

B. Portable Equipment: Furnish all portable equipment and spares to the Owner's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.

C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit manuals.

D. Project Record Documents: Submit print and digital copies. Digital files shall be in CAD system shall produce files in AutoCAD® .DWG format, latest version at time of bid.

E. Keys: If applicable, replace construction locks with permanent locks. Provide five (5) sets of keys to the Owner's Representative.

F. Training: Conduct specified training.

G. Warranty: Submit Contractor and Manufacturer Warranties dated to run from date of Acceptance of the Work of this section.

PART 2 PRODUCTS

2.1 GENERAL

A. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.

B. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.

C. Products shall be made by manufacturers regularly engaged in the production of such products.

D. Provide quantity as shown on Contract Drawings, or as otherwise indicated.
E. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this section as if specified in full herein.
F. Unless recycled content is specified, provide new materials.
G. Provide the manufacturer's latest design/model, permanently labeled with the manufacturer's name, model number and serial number.
H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.
I. Components:
    1. UL or third party certified. Cabling and interconnecting hardware and components for Telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.
    2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.
        a. The label or listing by the specified organization will be acceptable evidence of compliance.
        b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Owner's Representative.
        c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
J. Enclosures:
    1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.
    2. Make bolted connections with self-locking devices.
K. Finishes: Any item or component of the Work of this section which is visible shall comply with the following:
    1. Finishes noted or scheduled on the Contract Drawings take precedence.
    2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.
    3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the Owner's Representative.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine existing conditions before starting work. Document conflicts in writing and submit to Owner’s Representative in a timely manner for resolution.

3.2 WIRING CLASSIFICATION AND RELATED

A. Audio Signal Wiring Classification:
   1. Type A-1: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.
   2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.
   3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.

B. Video and Related Signal Wiring Classification:
   1. Type V-1: Baseband and composite video wiring I volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.
   2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
   3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.
   4. Type V-4: MATV system wiring 0.1 to 1000 microVolts peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.

C. Control Signal Wiring Classifications:
   1. Type C-1: DC control wiring 0 to 50 volts.
   2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
   3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

D. Additional Wiring Classifications:
   1. Type M-1: DC power wiring 0 to 48 volts.
   2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.
   3. Wiring Combinations.

E. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Drawings.
   1. Types A-1, C-1, and M-1.
   2. Types A-2, C-1, C-2, and M-1, runs less than 20 feet.
   3. Types A-2, C-1, and M-1.
   4. Types A-3, C-1, C-2, and M-1.
   5. Types A-2, V-1, and V-3.
   6. Types V-1, V-2, V-3, and C-1.
   7. Types M-2 and C-3.

3.3 PREPARATION

A. Prepare and sequence the work to minimize disruption to each room environment and existing communications systems.

B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

3.4 REPAIR AND RESTORATION

A. Where working in spaces occupied by the Owner, return to their original positions any furniture or articles relocated to perform the work.

3.5 CLEANING

A. Where working in spaces occupied by the Owner:
   1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.

2. All scrap material in work area shall be picked up and removed from the building at the end of each day. See also Section 01770 - Closeout Procedures for additional requirements.
3. All dust resulting from work performed shall be vacuumed up daily.
4. All scrap material shall be removed from site and disposed of in an authorized disposal site. Refer to Section 01565 - Site Waste Management Program.

END OF SECTION

SECTION 17026
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Section includes grounding and bonding of Communications Work, including but not limited to:
   1. Communications Race
   2. Cable Runway
   3. Cable Shields
   4. Protector Fields
   5. Communications cabinets and enclosures.

1.2 RELATED WORK UNDER OTHER SECTIONS

A. Section 07840 - Firestopping
B. Section 16400 - Service and Distribution System
C. Section 17010 - Common Work Results for Communications
D. Section 17029 - Hangers and Supports for Communications Systems
E. Section 17033 - Conduits and Backboxes for Communications Systems
F. Section 17036 - Cable Trays for Communications Systems Communications Systems
G. Section 17100 - Structured Cabling, Basic Materials and Methods
H. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures
I. Section 17119 - Communications Termination Blocks and Patch Panels
J. Section 17123 - Communications Cable Management
K. Section 17150 - Communications Horizontal Cabling

1.3 SYSTEM DESCRIPTION

A. Provide telecommunications system grounding conductor as described herein and indicate on drawings.
B. Except as otherwise indicated, the complete communications installation including the, metallic conduits and raceways, cable trays, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.
C. Resistance:
   1. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-A-2002, whichever is more restrictive.

1.4 REFERENCES

A. American National Standards Institute (ANSI)
   1. ANSI/TIAIEIA-606-A-2002 Administration Standard for Commercial Telecommunications Infrastructure
   2. ANSI-J-STD-607-A-2002 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
   3. Underwriters Laboratories (UL)
   4. UL 467 (1993); R 2004 Grounding and Bonding Equipment

1.5 SUBMITTALS

A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 Common Work Results for Communications.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
   1. Ground Rod:
      a. High strength high carbon steel, with electrolytically bonded jacket of copper on surface.
      b. UL spec. 467
      c. ANSI C-33.8-10n.
      d. Manufacturer:
         i. Allied Bolt
         ii. Inwesco 12A60
         iii. Blackburn
         iv. Cooper Power Systems
         v. Weaver.
         vi. Erico "Cadweld" Products, Inc.
         vii. ITT Blackburn.
         viii. Or equal.
   2. Ground Wells:
      a. Christy Concrete Products, Inc.
      b. Forni Corp.
      c. Or equal.
   3. Ground Bushings, Connectors, Jumpers and Bus:
      a. O-Z/Gedney.
      b. Thomas & Betts Corp.
      c. Or equal.
   4. Compression Connector Lug
      a. Panduit
      b. B-Line SB-479 Series
      c. Thomas & Betts
      d. Or equal.
   5. Telecommunications Ground Bus Bar
      a. CPI
      b. B-Line
      c. Panduit
      d. Or equal.
   6. Bonding Ribbon:
      a. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.
      b. Manufacturer:
         i. Inwesco 12A55
         ii. Corning Cable Systems

iii. Preformed Line Products.
iv. Or equal.

7. Bonding Ribbon Clamp:
   a. Soft lead
   b. 1/16 inch thick
   c. Bolt hole for attachment
   d. Manufacturer:
      i. Inwesco 12A56
      ii. Corning Cable Systems
      iii. Preformed Line Products.
      iv. Or equal.
8. Fargo Clamp:
   a. Cast copper, silver plated, furnished with copper bolt.
   b. RUS Listed
   c. Manufacturer:
      i. Allied Bolt
      ii. Inwesco 12A57
      iii. Corning Cable Systems
      iv. or equal.
9. Ground Inserts:
   a. Cast Bronze w 1/4 Copper Rod.
   b. Provide minimum one each maintenance hole or vault.
   c. Manufacturer:
      i. Inwesco 12H69
      ii. Or equal by vault or manhole manufacturer.
      iii. Or equal.

2.2 GROUND CONDUCTORS

A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green. Where continuous colorcoded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with NEC.

B. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 A WG or smaller and stranded conductors for #8 A WG or larger.

2.3 COMPRESSION CONNECTOR LUG

A. Description
   1. Connector lug with compression connection to conductor.
   2. Copper alloy body.
   3. Provide lug size to match conductor being terminated.
   4. Provide 2 hole pattern lugs.
   5. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.

2.4 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.5 CONNECTIONS TO PIPE

A. For cable to pipe: UL listed bolted connection complying with CEC requirements.

2.6 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
   1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
   2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground" or equal.

2.7 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

A. Where required by the drawing or specified herein.

PART 3 EXECUTION

3.1 GENERAL

A. Provide Grounding and Bonding according to the most restrictive requirements of:
   1. ANSI-J-STD-607-A.
   2. California Electrical Code Article 250 and references therein.
   3. California Electrical Code Article 800.

B. In the event of conflicting requirements, National Electrical Code requirements shall prevail.

C. Point of Connection
   1. Under Work of this Section, make connections to Communications Ground Busbars provided under Work of Section 16061 Grounding.
   2. Mechanical Connections

D. Make connections bare metal to bare metal.
   1. Where required, remove paint to bare metal, make grounding or bonding connection, and touch up paint.
   2. Torque threaded fasteners to manufacturer's recommended values.

E. Compression Connections
   1. Make compression connections with the lug or fitting manufacturer's recommended tooling, with the tooling set to the recommended force and stroke.

F. Communications Raceways and Sleeves
   1. Bond metallic raceway and sleeves to the Communications Ground Busbar at the Communications Room that serves the related Communications Receptacle.
   2. Where a metallic raceway connects 2 or more Communications Rooms, bond to the Communications Ground Busbar at each.

G. Cable Tray and Cable Runway

1. Coordinate with the Work of Section 17033 - Communications Raceways, Boxes and Fittings, paragraph Cable Runway.
2. Provide manufacturer's bonding clips, plates or jumpers as required to comply with the UL Classified conditions for use as an equipment grounding conductor.
3. Bond the Cable Runway to the Communications Ground Busbar at the Communications Room served.

H. Cable Shields
1. Comply with California Electrical Code Article 800.

I. Protector Fields
1. Comply with California Electrical Code Article 800.

J. Communications cabinets and enclosures
1. Bond to the Communications Ground Busbar at the Communications Room.

K. Emergency/Information Telephone enclosures
1. Bond as detailed on Communications Drawings.

L. Communications Broadband Systems
1. Comply with California Electrical Code Article 820.
2. Ground Broadband passives as shown on Communications Drawings.

3.2 LABELING

A. Provide labeling according to the requirements of:
1. ANSI/TIA/EIA-606-A.
2. Section 17053 Identification for Communications Systems.

END OF SECTION

SECTION 1702
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of communications supports and cable hook system as described in this specification, including but not limited to:
   1. Strut Supports
   2. Cable Hooks (J-Hooks)
   3. Beam Clamps
   4. Concrete Fasteners
   5. Touch-Up Materials
   6. Conduit Supports
   7. Equipment Supports
   8. Fastening Hardware

B. Related work: 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. Section 03300 - Cast-in-place Concrete. Concrete equipment pads.
   2. Division 5: Metals. Hangers for electrical equipment.
   3. Section 09260 - Gypsum Board Assemblies, Section 09510 - Acoustical Ceilings, Section 09512 - Manufactured Wood Ceilings, and Section 09520- Textile Ceiling System. Slack Fixture support wires.
   4. Section 17010 - Common Work Results for Communications
   5. Section 17026 - Grounding and Bonding for Communications Systems
   6. Section 17033 - Conduits and Backboxes for Communications Systems
   7. Section 17036 - Cable Trays for Communications Systems
   8. Section 17053 - Identification for Communications Systems
   9. Section 17100 - Structured Cabling, Basic Materials and Methods
   10. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures
   11. Section 17123 - Communications Cable Management
   12. Section 17150 - Communications Horizontal Cabling

1.2 SYSTEM DESCRIPTION

A. Provide devices specified in this Section and related Sections for support of communications equipment specified for this Project.

B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.3 REFERENCES

A. American Society For Testing and Materials (ASTM)

1. ASTM AI23/AI23M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM AI53/AI53M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM B633-98el Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
4. ASTM A653/A653M-04a Standard Specification for Steel Sheet, ZincCoated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the HotDip Process.

B. American National Standards Institute (ANSI)
1. ANSI/TIA/EIA-568-B.l-2001, Commercial Building Telecommunications Cabling Standard – Part l: General Requirement.
2. ANSI/TIA/EIA-568-B.2-2001, Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components.
3. ANSI/TIA/EIA-568-B.3;-2000, Optical Fiber Cabling Components Standard.
4. ANSI/ TIA/ EIA 569-B-2003, Commercial Building Standard for Telecommunications Pathways and Spaces.

C. National Fire Protection Association
1. NFPA 70, National Electrical Code

1.4 SUBMITTALS

A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.5 UALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Cable hooks shall be listed and labeled by Underwriters Laboratories (UL) as required.

C. Cable hooks shall have the manufacturers name and part number stamped in the part itself for identification.

PART 2 PRODUCTS

2.1 SUPPORTING DE ICES

A. General
1. Supports to be sized to suit load and selected to match mounting conditions.

B. Manufacturers
2. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
   a. Concrete fasteners:
      i. Phillips Red-Head
      ii. Remington
      iii. Ramset
      iv. Hilti
      v. Simpson Strong-Tie
      vi. Or Equal

b. Concrete inserts and construction channel:
   i. Unistrut Corp.
   ii. GS Metals Globe Strut
   iii. Thomas & Betts Kindorf Corp.
   iv. Or Equal
c. Conduit Straps:
   i. O-Z/Gedney
   ii. Erico Caddy Fastening Products
   iii. Thomas & Betts Kindorf Corp.
   iv. Or Equal
d. Beam Clamps
   i. Cooper B-Line
   ii. SuperStrut
   iii. Unistrut
   iv. Or Equal
e. Aircraft Cable Sway Braces
   i. Mason Industries
   ii. M.W. Sausse/ ibrex
   iii. Loos & Company, Inc.
   iv. Or Equal

C. Concrete Fasteners
   1. Provide expansion- type concrete anchors.
   2. Provide powder driven concrete fasteners with washers. Obtain approval from Owner's Representative prior to use.

D. Concrete Inserts
   1. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of inch to inch diameter thread for rod support.

E. Aircraft cable sway braces
   1. Steel rope sized to meet load.

F. Construction Channel
   1. Construction:
      a. 1-5/8 square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 on center in the base of the channel.
      b. 10 foot sections.
   2. All supporting materials by same manufacturer.

G. Beam Clamps
   1. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.

H. Conduit Straps
   1. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
      a. Use malleable strap with spacers for exterior and wet locations.
      b. Use steel strap without spacers for interior locations.

2. Steel channel conduit strap for support from construction channel.
3. Steel conduit hanger for pendant support with threaded rod.
4. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

I. Threaded rods, couplings, screws, and nuts:
1. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

J. Miscellaneous Parts
1. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM Al23 or A153.

K. Paint/Tape for Touch-up:
1. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing "Galambra", or equal.

2.2 CABLE HANGERS

A. Ceiling Hung J-Hooks
1. Drawing Reference(s):
   a. WMJ
   b. ACJ
2. Features/Functions/Construction
   a. Specifically intended to carry the load of up to 50 communications cables without applying excess forces to cables at bottom of bundle.
   b. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8 cable bearing surface.
   c. Integral hanger rod attachment hardware at top.
   d. Load rated for application.
   e. Incorporates smooth 90-degree radiused edges to prevent snagging cable jackets on installation.
   f. Designed so the mounting hardware is recessed to prevent cable damage.
   g. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.
   h. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
   i. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.
   j. Finishes:
      i. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
      ii. Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.
3. Manufacturer
   a. Cooper B-Line series BCH21, BCH32, BCH64

b. Erico/Caddy CableCat
c. Or Equal

PART 3 EXECUTION

3.1 GENERAL

A. The Owner's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the Owner.

3.2 EXAMINATION

A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.3 PREPARATION

A. Coordinate size, shape and location of concrete pads required for equipment installation with Base Building General Contractor Coordinate size, shape and location of concrete pads required for equipment installation with Base Building General Contractor.
B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
C. Where shown on the Drawings or Specifications, install freestanding communications equipment on concrete pads.

3.4 INSTALLATION

A. Furnish and install supporting devices as noted throughout the Communications Systems work.
B. Communications device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using pre-cast inserts, expansion anchors, preset inserts or beam clamps.
D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.
E. Use expansion anchors or preset inserts in solid masonry walls.
F. Use self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.
G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.
H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
I. Do not drill structural steel members unless first approved in writing by the Owner's Representative.
J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
K. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.

L. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.5 ERECTION OF METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.6 WOOD SUPPORTS

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.7 ANCHORAGE

A. As part of the equipment submittals, cot' all provide anchorage calculations for floor and wall mounted communications equipment so that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, Table 23P, Part II and with Section 2312 "Earthquake Regulations" and of the "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

1. The contractor shall recommend the method of anchoring the equipment to the mounting surface and shall provide the Contractor with the assembly dimensions, weights and approximate centers of gravity.
2. All floor mounted, free standing electrical equipment such as racks and cabinets, etc. shall be securely fastened to the floor structure.

3. DISTRIBUTION PATHWAY IA CEILING HUNG CABLE HOOKS J HOOKS

A. oid, Plenum or Suspended Ceiling Exposed Cable Installation. Where drawings specifically show or permit use of exposed cable installation in voids, conform to the most restrictive requirements of Code TIA-569-B and this Section.

B. Provide support for all cabling. Do not place or attach direct grid, concealed spline grid, flexible or rigid ductwork, H AC registers, sprinkler piping or fixtures, light fixtures or building structure. Conform to the California Electric Code.

C. Placement:

1. All pathways created by ceiling hung cable hooks shall be reviewed by The Owner s Representative prior to installation.
2. Ceiling hung cable hooks and cabling supported by same shall not obscure access to access doors, hatches, air dampers, valves, filter sections, A boxes, cable trays, junction boxes, pull boxes or similar areas of access required by other trades.
3. All ceiling hung cable hooks shall be mounted close enough together such that upon completion of the station cable installation a minimum amount of cable droop occurs between adjacent rings. The distance between supporting rings shall not exceed 48 in wood frame construction, 60 in concrete construction, or as required by the current edition of TIA-569-B.
4. Refer to the separation requirements listed in Section 17150 - Communications Horizontal Cabling for minimum distances from electrical power and other electro-magnetic sources.

D. Follow manufacturer's recommendations for allowable fill capacity for each size of cable hook.
   1. Cable hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.
   2. Spring steel cable hooks shall be capable of supporting a minimum of 100 pounds with a safety factor of 3 where extra strength is required.
   3. Where aggregate cable bundle supported by ceiling hung cable hooks exceeds either the rated cable or weight load limit of the ceiling hung cable hook system, provide ceiling basket tray - Type CTW - as specified in Section 17036 Cable Trays for Communications Systems.

END OF SECTION

SECTION 17033
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Provide telecommunications pathways in accordance with EIA TIA/EIA-569-B, as specified in this Section and as shown on the plans. Provide system furniture pathways in accordance with UL 1286. Provision of all low voltage Communications Systems Pathway and Electronic Security and Safety System Pathway, including:
   1. Rigid steel conduit and fittings.
   2. P C insulated rigid steel conduit and fittings
   3. Intermediate metal conduit and fittings
   4. Electrical metallic tubing and fittings.
   5. Flexible metallic conduit and fittings.
   6. Liquidtight flexible metallic conduit and fittings.
   7. Miscellaneous conduit fittings and products.
   8. Junction Boxes
   9. Floor Boxes
   10. Hinged cover enclosures.
   11. Pullboxes and Terminal Cabinets.

B. At Hazardous Occupancies, installation conforms to the requirements of California Electric Code for Class and Division rating of spaces.

1.2 RELATED WORK IN OTHER SECTIONS

A. Related work: 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. Section 01730 - Cutting and Patching.
   2. Section 07600 - Flashing and Sheet Metal.
   3. Section 09900 - Paints and Coatings. Exposed conduit and other devices.
   4. Section 17010 - Common Work Results for Communications.
   5. Section 17026 - Grounding and Bonding for Communications Systems.
   6. Section 17029 - Hangers and Supports for Communications Systems.
   7. Section 17036 - Cable Trays for Communications Systems.
   8. Section 17100 - Structured Cabling, Basic Materials and Methods.
   9. Section 17150 - Communications Horizontal Cabling.

1.3 REFERENCES

A. Usage: In accordance with Section 01110 - Summary of Work.
   1. American National Standards Institute (ANSI).
      a. ANSI C80.l 1994 Rigid Steel Conduit - Zinc Coated.
      b. ANSI C80.3 1991 Electrical Metallic Tubing - Zinc Coated.
   2. National Electrical Manufacturers Association (NEMA).
      a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 olts Maximum).

b. NEMA FB 1 (ANSIINEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable.
e. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems.
f. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
g. NEMA RN 1-1998 Polyvinyl Chloride (P C) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
h. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct.
i. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
j. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.

3. Underwriters Laboratories, Inc. (UL).
a. UL 1 2000 Flexible Metal Conduit.
b. UL 6 2004 Electrical Rigid Metal Conduit – Steel.
c. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment.
d. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit.
e. UL 514A 1991 (R 2004) Metallic Outlet Boxes.
f. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings.
g. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
h. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid P C Conduit.
i. UL 797 1993 (R 2004) Electrical Metallic Tubing – Steel.
j. UL 1242 1983 (R1993) (Bul. 1993) Intermediate Metal Conduit.
k. UL 1286(1999; R 2001, Bul. 2002) Office Furnishings.
l. UL 1479 Fire Tests of Through Penetration Firestops.
m. UL Fire Resistance Directories.

1.4 SUBMITTALS

A. Conform to the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.5 UALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
B. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the Owner's Representative.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide the following types of conduit systems listed by their commonly used generic name.

2.2 RACEWAY

A. Manufacturers:
   1. Raceway:
      a. Allied Tube and Conduit Co.
      b. Triangle PWC, Inc.
      c. Western Tube and Conduit Corp.
      d. Spring City Electrical Manufacturing Co.
      e. Occidental Coating Co. (OCAL).
      f. Alflex Corp.
      g. American Flexible Metal Conduit Co.
      h. Anaconda.
      i. Or equal.
   2. Fittings:
      a. Appleton Electric Co.
      b. OZ/Gedney.
      c. Thomas & Betts Corp.
      d. Spring City Electrical Manufacturing Co.
      e. Occidental Coating Co. (OCAL).
      f. Carlon.
      g. Or equal.

B. Rigid Steel Conduit.
   1. Drawing and Spec Reference: RSC.
   2. Construction:
      a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.
      b. Standard threaded couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.
      c. Three piece couplings: Electroplated, cast malleable iron.
      d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.
      e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.

f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.
g. All fittings and connectors shall be threaded.

C. Coated Rigid Steel Conduit:
1. Drawing and Spec Reference: CRSC.
2. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.l and NEMA RN-l with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
3. Fittings:
   a. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory P C coated with an insulating jacket equivalent to that of the coated material.
   b. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2" beyond fitting, whichever is less.
4. Performance:
   a. Tensile Strength: 3500 psi.
5. Approvals:
   a. NEMA RNI (Type 40 - 40 mils thick).
   b. CalTrans Type 2
6. Manufacturers:
   a. Plastibond by RobRoy Industries.
   b. Occal-40 by Occidental Coating Company.
   c. KorKap by Plastic Applicators.
   d. Ocal-Blue.
   e. Or equal.

D. Intermediate Metal Conduit.
1. Drawing Reference: IMC.
2. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.
3. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

E. Electrical Metallic Tubing.
1. Drawing and Spec Reference: EMT.
2. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.
3. Set screw type couplings: Electroplated, steel or cast malleable iron, UL listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

4. Set screw type connectors: Electroplated steel or cast malleable iron UL listed concrete tight with male hub and insulated plastic throat, 150 degree C temperature rated. Setscrew shall be same as for couplings.
5. Raintight couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.
6. Raintight connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

F. Flexible Conduit:
1. Drawing Reference: FLE
2. Construction:
   a. Flexible steel, zinc coated on both inside and outside by hot-dipping process.
   b. Interlocking spirally wound continuous steel strip.
   c. 3/4" minimum size.
3. Fittings: Connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.
4. Approvals:
   a. UL 1

G. Liquidtight Flexible Metallic Conduit:
1. Drawing Reference: Liquidtight
2. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtightjacket of polyvinyl chloride (P C) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
3. Fittings: Connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "0" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.3 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

A. General
1. UL 514B.
2. Listed in UL Electrical Construction Materials List.

B. Conduit Fittings, Insulated Throat Grounding Bushings
1. Description
   a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.
   b. UL Listed for use with copper conductors.
   c. Thermoplastic insulated liner for 105 degrees Celsius.
   d. Body of malleable iron, zinc plated; or die cast zinc.
2. Manufacturer

a. Thomas & Betts (Steel City) BG-801 Series
b. O-Z/Gedney
c. Or equal.

C. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with P C sleeve, neoprene sealing grommets and P C coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and P C sleeve.

D. Watertight cable sealing bushings: One piece, compression molded sealing ring with P C coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

E. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.

F. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75- inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.

1. Manufacturer:
   a. OZ/Gedney Type D
   b. Steel City Type EDF
   c. Or equal.

G. Fire rated penetration seals:

1. UL classified.
2. Conduit penetrations in fire rated separation shall be sealed with a UL classified assembly consisting of fill, void or cavity materials.
3. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.
4. Penetrations of rated floors shall be sealed with an assembly having both F and T ratings at least equal to rating of the floor.
5. Penetrations of rated walls shall be sealed with an assembly having an F rating at least equal to the rating of the wall.

H. Standard products not herein specified:

1. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.
2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

I. Hazardous area fittings: UL listed for the application.

2.4 JUNCTION AND DE ICE BOXES

A. Junction and Device Boxes

1. Drawing References: As shown on Symbol Schedule
2. Construction:
   a. Concealed/Flush Mounted:
   b. One or two piece welded knockout boxes.
   c. UL 514A, cadmium or zinc-coated 1.25 oz/sq. ft., if ferrous metal.
   d. Pressed sheet steel, for indoor locations.
   e. UL 514C approved if non-metallic.
   f. At hollow masonry, tile walls and plaster walls, provide with device rings as required.
   g. Surface mounted:
      i. Exterior – Conform to the Junction and/or PullBox construction scheduled on the Plans. Where construction not otherwise scheduled or noted on the plans, conform to the following:
         (1) Cast iron or aluminum with threaded hubs and mounting lugs.
         (2) Gasketed cover with spring lid.
      ii. Concrete floor embedded:
         (1) Cast iron concrete pour boxes with screwed brass cover, unless otherwise noted.
         (2) Cadmium plated screw cover attachment at least 6 on center.
   h. If size not otherwise noted, at least 4S (4" square) by 2-1/8" deep, or Code minimum size, whichever is larger.
      i. Wherever 4S is indicated, contractor may at their option substitute 4-11/16" square boxes while maintaining the minimum depth required by these specifications and the drawings.
   i. Provide complete with approved type of connectors and required accessories, including attachment lugs or hangers. Provide raised device covers as required to accept scheduled device.
3. Approvals.
   a. UL 514A
4. Manufacturers:
   a. Interior:
      i. Steel City.
      ii. Bowers.
      iii. Or equal.
   b. Exterior, exposed with cover of same construction.
      i. Appleton
      ii. Pyle-National
      iii. Or equal.
   c. Other conditions:
      i. Any meeting approvals and requirements.

B. Locking Wall Boxes

2. Drawing References: L WB3, L WB4.
3. Features/Functions/Construction.
    a. Locking hinged steel cover.
    b. Accepts 3 or 4 gang plate inserts.
    c. 2-1/8" minimum depth behind plate insert.
    d. Protects contents from tampering when closed.
    e. Lid incorporates push-to-open retention latch.
    f. Lid folds down 180 degrees, out of way during use.
    g. Size.
        i. LWB3: NEMA 3 gang capacity.
        ii. LWB4: NEMA 4 gang capacity.
    h. Finish:
        i. Submit White or Prime options for selection by the Architect.
4. Manufacturers
    a. FSR Inc.
        i. LWB3: WB-3G with 3 gang Bowers backbox.
        ii. L WB4: WB-4G with 4 gang Bowers backbox.
    b. Custom by C.W. Cole.
    c. Or equal.

2.5 CABINETS AND ENCLOSURES

A. Terminal Cabinets.
1. Drawing Reference: As Scheduled.
2. Construction:
    a. Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.
    b. Interior dimensions not less than those scheduled.
    c. Finish: Manufacturer's standard gray baked enamel finish.
    d. Covers: Trim fitted, continuous hinged steel door, flush catch-lockable and keyed to match. Screw fastened doors not acceptable.
        i. Door face to be not less than 95 of panel interior dimensions.
    e. Provide with 3/4" fire retardant treated ply backboard.
3. Mounting:
    a. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.
    b. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.
    c. Interior Applications:
        i. NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.
    d. Exterior Applications:
        i. NEMA 250 Type - As Scheduled, not less than NEMA 3R.
4. Manufacturers:
    a. B-Line Electrical Enclosures.

b. Circle AW Products.
c. Hammond.
d. Henessey.
e. Hoffman.
f. Myers Electric Products.
g. Rittal.
h. Or equal.

2.6 FLOOR BOXES, POKE THROUGHS AND MONUMENTS

A. Floor Box High Capacity, 3 Compartment
A. Plan Reference: FC4, FW4, FR4
2. Features
a. UL Listed
b. Box
i. Size at least 10 inches by 12 inches by 6 inches deep.
ii. Three compartments, with voltage barriers, with standard electrical plate mounting brackets for at least:
(1) One single gang.
(2) One 2 gang.
(3) One 4 gang.
c. Knockouts concentric, combination 1 inch and 1.25 inch.
d. Cover for carpet finish.
e. Cover size approximately 10.5 inches by 12.5 inches.
f. At least 11 gage steel.
g. Carpet flange of mitered brass or aluminum edging.
i. Option of brass or aluminum to be selected by the Architect.
ii. Option of 0.25 inch or 0.5 inch flange height to be selected by the Contracting Officer.
h. Within cover, provide a lift-off, full-access door, open area approximately 6.5 inches by 8 inches.
i. Within the lift-off, full-access door, provide a hinged, fold-back cable exit port.
j. Open area approximately 2 inches by 2 inches.
k. Flush in closed position.
3. Applications:
a. FC4: Concrete floor systems. Provide "pour pan" protection at slab on grade conditions.
b. FR4: Raised Floor Conditions.
c. FW4: Wooden Floor Conditions.
4. Approvals:
a. UL 514A scrub water.
5. Manufacturers:
a. FSR Inc.
i. FC4: FL-500P-(cover flange code)-4. Supply larger boxes where scheduled and indicated plates and jacks require it.

Provide manufacturer's "Pour Pan" FL-GRD2 or FL-GRD4 to protect from moisture at installations at grade level.

ii. FW4, FR4: FL-540P-(cover flange code)-4. Supply larger boxes where scheduled and indicated plates and jacks require it.

b. RCI Systems, Inc.

i. FC4: FB-2600. Supply larger boxes where scheduled and indicated plates and jacks require it. Provide manufacturer's "Pour Pan" to protect from moisture at installations at grade level.

c. Wiremold/Walker RFB-ll.

d. Or equal.

B. Electrified Furniture Monuments.

1. Plan Reference: EFM
2. Construction:
   a. Above slab box construction.
      i. Die-cast aluminum with satin finish.
      ii. Four-piece assembly consisting of base plate, three-sided housing, and removable faceplates.
      iii. Equipped with faceplate that accepts modular jacks specified in Section 17150.
   b. Manufacturers:
      i. Wiremold 525RT
      ii. Or equal.

2.7 TABLETOP BOXES

A. Presenter Desk Network Interface.

1. Drawing Reference: PDN.
2. Construction/Features/Function.
   a. Steel Enclosure with flip-up lid - refer to detail on plans.
   b. Installs flush in Presenter Desktop or Conference Table.
3. Approvals
   a. UL Spill Rating
4. Accommodates Keystone standard network jack.
5. Convenience power receptacle.
6. Manufacturer:
   a. Mockett PCSS.
   b. Wiremold.
   c. Or equal.

PART 3 EXECUTION

3.1 CONDUIT APPLICATION

A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Exterior, Exposed:

a. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
b. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.

2. Interior, Exposed, Wet and Damp Locations:
   a. Type RSC.
   b. At interior locations over 8 feet above finished floor, EMT acceptable.
3. Interior, Hazardous Locations.
   a. Type RSC
   b. Type IMC, where permitted by the CEC.
4. Interior, exposed or concealed, dry locations:
   a. RSC, if subject to physical abuse.
   b. EMT, if not subject to physical abuse.
5. Interior, concealed, damp locations, including in masonry walls.
   a. RSC
6. Embedded in Concrete.
   a. RSC or rigid non-metallic conduit.
   b. P C Type DB-120.
7. Transition from walls to open plan furniture systems:
   a. Liquidtight.

3.2 GENERAL RE UIREMENTS

A. Refer to the manufacturer's instructions and conform thereto.
B. Distribution Pathway via EMT Raceway:
   1. The EMT conduit is to be installed meeting the NEC handbook Article 348 Installation Specifications.
   2. Provide escutcheon plates for all through wall conduit stubs.
   3. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.
   4. All conduit which passes through fire walls shall be sealed with fire stop putty after all station wire has been installed.

3.3 MOUNTING AND INSTALLATION DE ICE BOXES

A. Conform to the more restrictive of NEMA OS 3-2002 and the following.
B. Provide backboxes at all communications systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.
C. The distance between pull boxes shall not exceed 150 feet or more than two 90 degree bends.
D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4" from frame. erify placement with Owner's Representative details to ensure that box clears all trim, etc.
E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.

F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.

G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.

H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.

I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.

J. Install wiring jacks and outlet devices after wiring work is complete.

3.4 TERMINAL CABINETS, JUNCTION BOXES AND PULL BOXES

A. General

1. Thoroughly examine site conditions for acceptance of cabinets and enclosures installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment.

C. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with standards referenced in Section 17029.

D. "Train" interior wiring, bundle and clamp using specified plastic wire wraps. Separate power and signal wiring.

E. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.

F. Terminate conduit in cabinet with lock nut and grounding bushing.

G. Cleaning

1. Touch-up paint any marks, blemishes or other finish damage suffered during installation.
2. acuum clean cabinet on completion of installation.

3.5 SUPPORT

A. Provide supports for raceways as specified in Section 17029 - Hangers and Supports for Communications Systems.

B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of the this Section and Section 17029 - Hangers and Supports for Communications Systems. Fasten all hangers from the building structural system.

C. Provide supports and mounting attachments per the most restrictive of Code and the following.

Raceway Size (inches)	No of cables in run	Location	Support Spacing (feet)	
			RSC	EMT
Horizontal Runs				
1/2, 3/4	1-2	Flat Ceiling Wall Runs	5	5
1/2, 3/4	1-2	Where access limited to building	7	7

		structure		
1/2, 3/4	3≥	Any location	7	7
1≥	1-2	Flat ceiling or wall	6	6
1≥	1-2	Where access limited to building structure	10	10
1≥	3≥	Any locations	10	10
Any	Any	Concealed	10	10
ertical Runs				
1/2, 3/4	Any	Exposed	7	7
1, 1-1/4	Any	Exposed	8	8
1-1/2 ≥	Any	Exposed	10	10

D. Install no more than one coupling or device between supports.

E. Conduit support.

1. As specified in Section 17029 - Hangers and Supports for Communications Systems.

F. The Owner's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the Owner.

3.6 PENETRATIONS

A. Gypsum Wall Board Penetrations: Provide circular penetrations maximum 1/8" inch larger than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.

B. Install UL listed fire-stop system whenever a raceway penetrates a firewall in conformance with the manufacturer's directions, the published systems assembly requirements, CBC Section 709 and 710 and CEC 300-21, whichever is the most restrictive. At cable tray penetrations, provide pillow type removable fire stop per CBC Section 709 and 710, the published systems assembly requirements and the manufacturer's directions, whichever is the most restrictive.

C. All communications systems conduit openings in walls and floors are the responsibility of the Contractor. Install sleeves shown on the drawings when the concrete is poured. Any openings required after the concrete has set maybe core drilled.

3.7 RACEWAY INSTALLATION, GENERAL

A. Raceway runs are shown schematically. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar generally not indicated. Provide where designated.

1. Install exposed conduit and raceway parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours. Level and square conduit and raceway runs.

2. Raceway runs shall be mechanically and electrically continuous between all each equipment rack and utility demarcation point, receptacle and/or surface raceway strip, as applies.
3. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box, or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.
4. Bends.
   a. All bends or elbows shall have a minimum radius as follows:

Conduit Size	Min. Radius (Inches)
	8
1	12
1-1/4	18
2	24
2-1/2	24
3	30
3-1/2	30
4	30
5	36
6	42

   b. Use factory elbows or machine bends for conduit bends 1-1/4" and larger.
5. Make bends and offsets so the inside diameter is not effectively reduced. Make bends in parallel or banked runs from the same center line so that the bends are parallel.
6. Install at least one (1) 3/8", 200 pound strength nylon pull cord in all empty raceways.
7. Raceways crossing building expansion joints or in straight runs exceeding 1 00 feet shall be provided with UL listed expansion fittings.
8. Install conduit seals and drains to prevent accumulated moisture in conduits from entering Communications System enclosures.

B. Do not install conduit in concrete slabs unless specifically directed by Owner's Representative. Embedded conduits in concrete slab walls, and columns shall be installed in center third between upper and lower layers of reinforcing steel as directed by the Owner's Representative. Space conduits 8" on center except at cabinet locations where slab thickness shall be increased as directed by the Owner's Representative.

C. All conduits to be kept 12" away from steam or hot water lines. Install horizontal conduit and raceway runs below water and steam piping.

D. Conduit dropping down to equipment shall be as straight as possible without any offsets, parallel or perpendicular to walls, ceilings and other building features.

E. Conduit installed on any equipment shall be run symmetrical with the equipment and in such a manner as to:
   1. not to be exposed to damage;

2. not interfere with access to components of the equipment that will interfere with maintenance operation or;
3. not to be in a manner that the Owner deems detrimental to its operation.

F. Whenever an installation such as that listed occurs, the Contractor shall make all necessary changes at no additional cost to the Owner.

G. All cut ends of conduit, scratches, tool marks, etc. on any metallic raceway installed in the ground or on the exterior of the building shall be treated with two coats of specified Touch Up Paint/Tape.

H. Exposed conduit and metallic surface raceway installed in finished spaces shall be painted to match surrounding surfaces using paint and methods directed by the Owner's Representative.

I. All raceways stubbing up into equipment or racks shall be sealed. Raceways with conductors shall be plugged with duct-seal. Spare raceways shall be capped. Prevent foreign matter from entering conduit and raceway; use temporary closure protection. Replace conduits containing concrete, varnish or other foreign material.

J. Complete installation of conduit and raceway runs before starting installation of cables/wires within conduit and raceway.

K. Use specified conduit and raceway fittings that are of types compatible with the associated conduit and raceway and suitable for the use and location. Join and terminate conduit and raceway with fittings designed and approved for the purpose of the conduit and raceway system and make up tight.

L. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed.

M. Horizontal conduit or EMT runs, where required and permitted, shall be installed as close to ceiling or ceiling beams as practical.

N. Conduit and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.

O. Conduit and EMT shall not be run through beams, purlins or columns except where permission is granted by Owner's Representative in writing.

P. Bond installed metallic raceway in accordance with the requirements of the CEC.

3. RACEWAY FOR ACCESS CONTROL AND INTRUSION DETECTION SYSTEMS

A. Refer to general requirements herein above.

B. Access control and intrusion detection systems shall be installed in entirely in raceway, including:
   1. Rough- in for the field devices as detailed and scheduled on the plans.
   2. Pull cabinets located at regular intervals in the building, sized to accommodate the access control and intrusion detection cabling.
      a. Size raceway between pull cabinets to accommodate fill of field devices.
      b. Provide two separate raceway systems.
         i. one for power cabling, including power for door locks and field devices.

ii. one for Access Control and Intrusion Detection System field devices, including card readers, motion detectors, glass break sensors, request-to-exit sensors and similar.

(1) For Owner's Security contractor provided card readers, assume a 0.26 inch diameter cable is required from the serving IDF or BD to each door scheduled to receive a card reader.

3. Gutter at backboard of BD and IDF to terminate the raceway arriving from the pull cabinets and directly from the field devices.
4. Terminal cabinets at backboard of BD and IDF to enclose the TB15's used to terminate the field wiring installed under the work of this contract.

3. HA ARDOUS LOCATIONS

A. Use rigid steel conduit only.

B. Install UL listed sealing fittings that prevent passage of explosive vapors in accordance with the manufacturers written instructions. Locate fittings at suitable, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces.

C. Install raceway sealing fittings at the following points and elsewhere as indicated:
1. Where conduits enter or leave hazardous locations.

3.10 REUSE OF EXISTING CONDUIT

A. Existing conduit is to be used as a pathway only where so shown on the drawings.

B. Prior to beginning work involving the use of an existing conduit, the Contractor shall consult with the Owner's Representative in order to establish whether or not the conduit contains active service.

C. If no active service exists within the conduit, all cable is to be removed, and work is to proceed.

D. If active service does exist within the conduit and it has been determined that service needs to be disrupted, then work on that conduit shall not proceed until a schedule of service outage has been established by Owner's Representative. Once given permission to proceed, the Contractor shall within the time period of one (l) working day; remove the old cable, install, terminate and test the new cables, and notify the Owner's Representative the work using the specific conduit has been completed.

E. Conduit preparation procedure:
1. Remove existing Wires and Cables (if any).
2. Run a mandrel Y2" smaller than the inside diameter of the conduit through the conduit receiving new wires and cables.
3. If the specified size mandrel will not pass through the existing conduit, start with a smaller size mandrel and increase mandrel size until the specified sized mandrel will pass.
4. Run a wire brush and clean rag with an outside diameter 1/8" larger than the inside of the conduit through the conduit receiving new wires and cables.
5. Repeat above until conduit is clean and materials detrimental to the wire and cables to be installed no longer exit conduit with the clean rag.

3.11 STATION CABLE PATHWAY INSTALLATION

A. Cut In Boxes and Station Outlet Boxes.

1. Unless otherwise noted on the plans, all cut in boxes and surface station outlet boxes are to be installed at a height of 36" A.F.F. (above finished floor) to center, except for those intended to be used for telephone wall jacks. Those plates or boxes that are to be used for telephone wall jacks shall be installed at a height of 54 A.F.F. to center.
2. All station outlets shall be installed so that their edges are parallel to the vertical and horizontal edges of the surface on which they are mounted.

END OF SECTION

SECTION 17036
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK
A. Cable Trays for Communications Cabling.
   1. Cable Trays
   2. Cable Runways
   3. Basket Tray

B. Cable Tray Support

1.2 RELATED WORK UNDER OTHER SECTIONS
A. Section 17010 - Common Work Results for Communications.
B. Section 17026 - Grounding and Bonding for Communications Systems.
C. Section 17029 - Hangers and Supports for Communications Systems.
D. Section 17033 - Conduits and Backboxes for Communications Systems.
E. Section 17053 - Identification for Communications Systems.
F. Section 17100 - Structured Cabling, Basic Materials and Methods.
G. Section 17150 - Communications Horizontal Cabling.

1.3 REFERENCES
A. Usage: In accordance with Section 01110 - Summary of Work.
   1. National Electrical Manufacturers Association (NEMA).
      a. NEMA FG 1 1-1998 Fiberglass Cable Tray Systems.
      b. NEMA E 1 1-1998 Metal Cable Tray Systems.
      c. NEMA E 2 2001 Metal Cable Tray Installation Guidelines.

1.4 SUBMITTALS
A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 Common Work Results for Communications.

1.5 DELI ERY, STORAGE AND HANDLING
A. Procedures: In accordance with Section 01600 - Product Requirements.

1.6 SE UENCING
A. Not Used.

PART 2 PRODUCTS

2.1 CABLE TRAY, CABLE RUNWAY AND BASKET TRAY
A. Cable Tray
   1. Drawing and spec reference: CTxx-yy, where "xx" denotes nominal width of cable runway in inches and "yy" denotes nominal depth.
   2. Construction:
      a. Steel or aluminum.
      b. Rungs 9" on center, unless otherwise noted.
      c. UL Classified splice kits.
   3. Approvals:

a. ASTMA513.
b. California Electrical Code, Article 318.
c. NEMA El Class 12C minimum, or to suit indicated cable and raceway loads, whichever is greater.

4. Manufacturers:
a. B-Line Cable Tray Systems Ladder Type Cable Tray.
b. Globe Tray.
c. PW Industries.
d. Or equal.

B. Cable Runway
1. Drawing and spec reference: CR , where " " denotes nominal width of cable runway in inches.
2. Construction:
a. Solid Steel Side Bar per ASTM A-36 or Tubular Steel Side Bar per ASTM A-513.
b. 1.5" x 0.375 minimum tubular side stringers.
c. UL Classified splice kits.
d. Designed to support at least 100 pounds per foot load with a Safe Working Load deflection of or less.
3. Finish: Telco gray powder coat or gold on zinc plating.
4. Approvals:
a. ASTM A513
b. UL Classified as an equipment grounding conductor.
c. California Electrical Code, Article 318
5. Manufacturers:
a. B-Line Telecom-Saunders SB-17.
b. Chatsworth Products Inc. 11275 series.
c. PW Industries.
d. Or equal.

C. Cable Tray, Open Wire Frame
1. Drawing and spec reference(s): CTWxx-y, where xx denotes the tray width and y the depth of the tray, in inches.
2. Construction.
a. Welded wire mesh with continuous safety edge wire lip.
b. Mesh forms grid at nominally 2" by 4".
c. Carbon Steel.
d. Electroplated zinc galvanized.
e. All bends, seams and joints field fabricated from basic straight section pieces and splice components as supplied by the manufacturer.
f. Where supported from ceiling, supported at both sides in trapeze arrangement - centerline support not acceptable.
g. Provides pathway complying with EIA/TIA-569B and NEMA Publications El & E2.
h. Meets requirements of California Electrical Code, Article 318.

3. Approvals:
   a. NEMA Publications El & E2.
4. Manufacturers:
   a. B-Line Wire Basket Runway.
   b. Cablofil.
   c. G.S. Metals Corp.
   d. Or equal.

D. Cable Tray, Fiberglass
1. Drawing and spec reference(s): CTFxx-y, where xx denotes the tray width and y the depth of the tray, in inches.
2. Construction
   a. Non-metallic, Non-conductive, Fiberglass Construction, suitable for continuous exterior exposure in a marine environment.
   b. Deep structural C-form side channels.
   c. Ladder rungs at 9" O.C., UON
   d. All bends, seams and joints field fabricated from basic straight section pieces and splice components as supplied by the manufacturer.
3. Approvals:
   a. UL Listed as a system.
   b. ASTMA568.
   c. NEMA Publication FGl.
   d. NEMA 12C.
   e. California Electrical Code, Article 318.3.
   f. Meets ASTM E-84 smoke density rating; Polyester 680, inyl Ester 1025.
   g. Class 1 Flame Rating and self-extinguishing requirements of ASTM D-635.
4. Manufacturers:
   a. Enduro Composite Systems.
   b. Robroy.
   c. PW Industries.
   d. Or equal.

PART 3 EXECUTION

3.1 C T A

A. Unless otherwise noted, communications cable tray installations shall conform to the following:
1. Type CT - Within Communications Rooms (including Telecomm Building (ADF), BDF and IDF spaces).
2. Type CTW - Horizontal station cabling outside of the communications rooms where shown on plans or where more than 100 cables are supported, whichever is greater.

3. Type CR - Wherever vertical transitions from ceiling or floor sleeves are required within the Communications Room.

3.2 I

A. Provide all required supports, fittings and accessories for a complete system as described in NEMA E-2, by Code, manufacturer recommendation or as shown on the plans, whichever is most restrictive.

B. Bond sections to one another and to building ground.

C. Access Clearance. Maintain access for use by Owner's personnel to tray as described below. Coordinate installation with work of structural, mechanical, plumbing/fire protection and electrical trades to maintain required access.

1. Unless shown otherwise on the plans, provide a clear access of at least 24" wide along one side of each tray for use by Owner's personnel.
2. Unless shown otherwise on the plans, installation to maintain at least 12" vertical clearance over the top of each tray for use by Owner's personnel.

3.3 S

A. Support in accordance with the most restrictive of the following:

1. Contractor's engineered means of engineered support submitted in accordance with the requirements of 17010 - Common Work Results for Communications and Section 17029 - Hangers and Supports for Communications Systems.
2. California Building Code, including but not limited to requirements of olume 2, Chapter 16, Division *N,* Section 1632 and Table 16-0.
3. Metallic Cable Tray: NEMA E 2-2001, or latest edition.
4. Fiberglass Cable Tray: NEMA FG-I-1998, or latest edition.

B. Provide lateral sway bracing as required by Code.

END OF SECTION

SECTION 17053
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Provide all labor, materials, tools, and equipment required for permanent intelligible labeling on, or adjacent to, all cabling, connectors, innerduct, faceplates, jacks, receptacles, controls, fuses, circuit breakers, patching jacks, and racks.

B. This section includes minimum requirements for the following:
   1. Labeling Communications Cabling
   2. Labeling Closet Hardware
   3. Labeling Work Stations
   4. Labeling Pathways, Spaces, Grounding and Bonding.

C. Refer to detailed plans for additional requirements.

D. Clearly and distinctly indicate the function of the item.

E. Coordinate with Record Drawings

1.2 REFERENCES

A. Usage: In accordance with Section 01110 – Summary of Work.

B. American Society for Testing and Materials (ASTM)
   1. ASTM D 709(2001) Laminated Thermosetting Materials

C. Electronic Industries Alliance (EIA)
   1. EIA TIA/EIA-606-A(2002) Administration Standard for Commercial Telecommunications Infrastructure (ANSI/TIA/EIA-606)

D. Underwriters Laboratories (UL)
   1. UL 969 (1995: R 2001) Marking and Labeling Systems

1.3 UALITY ASSURANCE

A. Identification and administration work specified herein shall comply with the applicable requirements of:
   1. ANSI/TIA/EIA-606-A Administration Standards.
   2. ANSI/TIA/EIA-569B Pathway and Spaces
   3. ANSI/TIA/EIA-568B Telecommunications Cabling Standard
   4. BICSI Telecommunications Distribution Methods Manual
   5. UL 969 (1995; R 2001) Marking and Labeling Systems.

1.4 SUBMITTALS

A. Conform with the requirements of Section 01300 – Administrative Requirements and Section 17010 – Common Work Results for Communications.

1.5 DELI ERY, STORAGE, AND HANDLING

A. Procedures: In accordance with Section 01600 – Product Requirements.

1.6 SE UENCING

A. Not Used.

PART 2 PRODUCTS

2.1 COMMUNICATIONS CABLING LABELS, INTERIOR

A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.

C. Provide vinyl substrate with a white printing area and black print. If cable jackets are white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.

D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.

E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.

F. Manufacturers:

1. Cable Type – Silver Satin
   a. Brady TLS2200 labels – PTL-31-427
   b. Brady laser printable labels – LAT-18-361, LAT-53-361
   c. Or equal.
2. Cable Type – 4 pair UTP
   a. Brady TLS2200 labels – PTL-31-427
   b. Brady laser printable labels – LAT-18-361, LAT-53-361
   c. Or equal.
3. Cable Type – 4 Pair STP
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady laser printable labels – LAT-19-361
   c. Or equal.
4. Cable Type – 25 pair copper
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady laser printable labels – LAT-19-361
   c. Or equal.
5. Cable Type – 50 pair copper
   a. Brady TLS200 labels – PTL-33-427
   b. Or equal.
6. Cable Type – 100 pair copper
   a. Brady TLS2200 labels – PTL-34-427
   b. Or equal.
7. Cable Type – 6-12 strand fiber
   a. Brady TLS2200 labels – PTL-21-427
   b. Or equal.
8. Cable Type – RG-6 Coax
   a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
   b. Brady laser printable labels – LAT-18-361, LAT-53-361
   c. Or equal.
9. Cable Type – RG-59 Coax
   a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
   b. Brady laser printable labels – LAT-18-361, LAT-53-361

10. Cable Bundles
    a. Brady TLS2200 labels – PTL-12-109
    b. Or equal.

2.2 COMMUNICATIONS CABLE LABELS, OUTSIDE PLANT

A. Cable Tags in Manholes, Handholes, and aults
   1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
      a. The tags shall be polyethylene.
      b. The tags shall be machine printed – handwritten tags are not acceptable.
   2. Polyethylene Cable Tags
      a. Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are .08 inch thick (minimum), non-corrosive, non-conductive, resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F.
      b. Provide .05 inch (minimum) thick black polyethylene tag holder.
      c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
      d. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background.
      e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tag s orientation.
   3. Manufacturers:
      a. Brady
      b. Or equal.

2.3 CLOSET HARDWARE LABELS

A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
C. Where insert type labels are used provide clear plastic cover over label.
D. Manufacturer:
   1. Copper Patch Panels
      a. 6 port group
         i. Ortronics OR-70700408
         ii. Or equal.
      b. Patch Panel Name Label
         i. Brady
         ii. Or equal.

2.4 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
C. Manufacturers:

1. Brady Corporation
   a. TLS2200 labels
      i. PTL-20-422, Size 2.0 x 1.0
      ii. PTL-22-422, Size 3.0 x 1.0
      iii. PTL-37-422, Size 3.0 x 1.9
      iv. PTL-23-422, Size 4.0 x 1.0
      v. PTL-38-422, Size 4.0 x 1.0
   b. Laser printable labels
      i. LAT-13-747, Size 1.875 x 0.833
      ii. LAT-24-747, Size 1.75 x 1.0
      iii. LAT-32-747, Size 3.0 x 0.9
      iv. LAT-33-747, Size 2.0 x 1.437
      v. LAT-34-747, Size 3.0 x 1.437
   c. Continuous tape for TLS2200
      i. PTL-8-422, Size 0.5 , white polyester
      ii. PTL-8-430, Size 0.5 , clear polyester
      iii. PTL-8-439, Size 0.5 , white vinyl
      iv. PTL-42-439, Size 1.0 , white vinyl
      v. PTL-43-439, Size 1.9 , white vinyl
2. Or equal.

2.5 WORKSTATION LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
C. Where insert type labels are used provide clear plastic cover over label.
D. Manufacturers:
   1. Ortronics OR-70400411
   2. Or equal.

2.6 NAMEPLATES

A. Field Fabricated Nameplates
   1. Features/Function/Construction
      a. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
      b. Comply with ASTM D 709.
      c. Each nameplate inscription shall identify the function and, when applicable, the position.
      d. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core.
      e. Surface shall be matte finish.
      f. Corners shall be square.
      g. Accurately align lettering and engrave into the core.
      h. Minimum size of nameplates shall be 1 x 2.5 .
      i. Lettering shall be a minimum of 0.25 inch high normal block style.

PART 3 EXECUTION

3.1 GENERAL

A. Apply labeling to clean surfaces free of oil, dust, solvents, or loose material.
B. Apply after Project painting in area of application is complete.
C. Apply to locations where labeling will not be damaged, covered over, or in the way of the infrastructure or system.
D. Apply labeling right side up, parallel to major edges of surfaces to which it is applied. When no line is evident, apply parallel to the floor line. Correct conditions of labeling applied out of true.
E. Protect installed labeling from damage.
F. Replace labeling that is defaced, illegible or peeling off the surface to which it is applied.

3.2 IDENTIFICATION LABELING

A. The Owner will provide the Contractor copies of the Contract Drawings showing station outlets with Owner assigned data & voice jack ID numbers. Label all installed work according to this master set.
B. Workstation faceplates
   1. Workstation faceplates shall be labeled according to the format *fs-n*, where:

      f numeric character(s) identifying the floor of the building occupied by the BDF

      s alpha character(s) uniquely identifying the BDF on floor *f*, or the building area in which the BDF is located

      n three numeric characters designating the port on a patch panel on which a four-pair horizontal cable is terminated in the BDF

      E_____: Faceplate with cables terminating on the 6th ports of each patch panel in the second BDF on the first floor is identified as:

      1B-006

   2. The cover plate areas directly above and beneath the jacks are the labeling areas. In the top area, using the specified means, label the faceplate number assigned on the contract documents.
C. Pathways
   1. Pathways shall be marked at each endpoint and at all intermediate pull or junction boxes. In the case of partitioned pathways (i.e. innerduct) each partition shall have a unique identifier.
   2. Use adhesive type labels as specified in the Products portion of this section.
D. Labels shall be affixed at the entry to all telecommunications rooms and spaces (including entrance facilities, communication equipment rooms, communication equipment spaces and work areas).

1. Use adhesive type labels for all communications space labeling as specified in the Products portion of this section.
2. Affix labels to entrance doors – coordinate location with Owner s Representative.

E. Cables

1. Horizontal, Building Backbone, and Campus Backbone cables shall be marked within 12 of each endpoint or to innerduct in which the cable is installed.
2. Except where installed in innderduct or conduit, all backbone fiber optic cable shall have affixed to the outer jacket, labels of a bright color that contain at least the legend FIBER OPTIC CABLE. These labels must be affixed at intervals no greater than 10 ft.
3. Within every manhole, vault, or pullbox and within 4 ft of the entrance into a building every backbone cable s assigned identifier shall be affixed to either the cable s outer jacket or to an innerduct in which the cable is installed.
4. Any cable installed in conduit shall be labeled at all intermediate pull or junction boxes.
5. Use adhesive type labels as specified in the Products portion of this section.
6. Affix labels to cables – marking cables is not permitted.
7. Where cable is fully encased in innerduct, label the outside of the innerduct with the cable label and, where the contents are fiber optic cabling, the FIBER OPTIC CABLE label.
8. Horizontal cables shall be labeled according to the format fs-an, where:

   f numeric character(s) identifying the floor of the building occupied by the BDF

   s alpha character(s) uniquely identifying the BDF on floor *f*, or the building area in which the BDF is located

   a one or two alpha characters uniquely identifying a single patch panel or a group of patch panels with sequentially numbered ports

   n three numeric characters designating the port on a patch panel on which a four-pair horizontal cable is terminated in the BDF

   E: 9th cable terminating on the first patch panel in the 3rd BDF on the 8th floor is identified as:

   8C-A009

9. A unique building backbone pair or optical fiber identifier shall be used to identify each single copper pair or each single optical fiber in a backbone cable between two BDFs in one building, and shall have a format fs_1/fs_2-*n.d*, where:

   fs_1/fs_2-*n* a building backbone cable identifier

d two to four numeric characters identifying a single copper pair or a single optical fiber

E: Building backbone fiber connecting BDFs 1A and 2A within a building

Cable 1, Pair 1 1A/2A-1.1,2
Cable 1, Pair 2 1A/2A-1.3,4
Cable 1, Pair 3 1A/2A-1.5,6

10. A unique campus backbone pair or optical fiber identifier shall be assigned to each pair or optical fiber in a backbone cable connecting BDFs in different buildings, and it shall have the format b_1-fs_1 / b_2-fs_2 -n.d, where:

b_1-fs_1 / b_2-fs_2 -n campus backbone cable identifier
d two to four numeric characters identifying a single copper pair or a single optical fiber

E: Campus backbone fiber Cables 1 and 2 connecting Building SLO101, BDF 1A, and Building SLO108, BDF 1B

Cable 1, Pair 1 SL0101-1A / SL0108-1B -1.1,2
Cable 1, Pair 2 SL0101-1A / SL0108-1B -1.3,4

Cable 2, Pair 1 SL0101-1A / SL0108-1B -2.1,2
Cable 2, Pair 2 SL0101-1A / SL0108-1B -2.3,4

F. Patch Panels

1. Fiber patch panels shall be marked using adhesive labels indicating the identifiers of all fibers installed to them.
2. If not shown on the contract documents, Owner s Representative will provide specific fiber ID information.
3. Category rated patch panels shall be labeled according to the format fs-a, where:

f numeric character(s) identifying the floor of the building occupied by the BDF

s alpha character(s) uniquely identifying the BDF on floor *f*, or the building area in which the BDF is located

a one or two alpha characters uniquely identifying a single patch panel or a group of patch panels with sequentially numbered ports

E: First patch panel in the first BDF of the first floor is identified as:

1A-A

G. 66 Blocks

1. Each cable termination position on 66 blocks shall be labeled with number designators.
   a. All backbone copper cable termination blocks shall be labeled with both the pair count of every 5th pair and the cable s assigned identifier.

H. Grounding and Bonding

1. The Telecommunications Main Grounding Busbar (TMGB) shall be labeled as such with an adhesive type label affixed reading TMGB.
2. The Telecommunications Grounding Busbar (TGB) within a BDF shall be labeled as such with an adhesive type label affixed which follows the format TGB-*fs*, where:

   TGB Telecommunications Grounding Busbar

   f numeric character(s) identifying the floor of the building occupied by the BDF

   s alpha character(s) uniquely identifying the BDF on floor *f*, or the building area in which the BDF is located

3. The conductor connecting the TMGB to the building ground shall be labeled at each end with an adhesive label affixed in a visible location as close as practicable to the bonding point at each end of the conductor. The label shall follow the format BC-TMGB, where:

   BC Bonding Conductor

   TMGB Telecommunications Main Grounding Busbar

   f numeric character(s) identifying the floor of the building occupied by the BDF

   s alpha character(s) uniquely identifying the BDF on floor *f*, or the building area in which the BDF is located

4. The conductor connecting the TGB within a BDF to the building ground shall be labeled at each end with an adhesive label affixed in a visible location as close as practicable to the bonding point at each end

of the conductor. The label shall follow the format BC-TGB-*fs*, where:

BC Bonding Conductor

TGB Telecommunications Grounding Busbar

f numeric character(s) identifying the floor of the building occupied by the BDF

s alpha character(s) uniquely identifying the BDF on floor *f*, or the building area in which the BDF is located

I. Firestops

1. Each firestop shall be labeled at each location where firestopping is installed, on each side of the penetrated fire barrier, within 12 inches of the firestopping material.
2. Firestops shall be labeled according to the format FS-fn, where:

FS Firestop

f numeric character(s) identifying the floor of the building occupied by the BDF

n = three numeric characters designating firestop sequential number.

END OF SECTION

SECTION 17100
STRUCTURED CABLING, BASIC MATERIALS METHODS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This Section defines commons means and methods for the work of the following Sections:
   1. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures.
   2. Section 17119 - Communications Termination Blocks and Patch Panels.
   3. Section 17123 - Communications Cable Management.
   4. Section 17150 - Communications Horizontal Cabling.

B. Related work specified in other Sections.
   1. Section 16080 - Electrical Commissioning.
   2. Section 16261 - Static Uninterruptible Power Supply.
   3. Section 16620 - Fire Alarm System.
   4. Section 17054 - EMCS - Communications Devices.

1.2 RELATED DOCUMENTS

A. Section 17010 - Common Work Results for Communications applies to the work of this Section.

1.3 REERENCES

A. Usage: In accordance with Section 01110 - Summary of Work.

B. In addition to the requirements of Section 17010 - Common Work Results for Communications, conform to the applicable portions of the following standards agencies:
   1. American Society for Testing and Materials (ASTM).
      a. ASTM A228/A228M-02 Steel Wire, Music Spring uality.
   2. Bellcore.
      a. TR-NWT-000253Intermediate Reach, 1,OC3.
   3. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA)Telecommunications Industry Association/Electronic Industries Association (TIA/EIA).
      a. TIA/EIA-455-B Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (ANSI/TIA/EIA-455-B-98) Oct. 1998.
      b. TIA/EIA-455-1-BFOTPl - Cable Flexing for Fiber Optic Interconnecting Devices (ANSI/TIA/EIA-455-1B-98) Oct. 1998.
      c. TIA/EIA-455-2-CFOTP2 - Impact Test Measurements for Fiber Optic Devices (ANSI/TIA/EIA0455-2C-98) Jul. 1998.
      d. TIA/EIA-455-3-AFOTP3 - Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components (May 1989).

e. TIA/EIA-455-5-CFOTP5 - Humidity Test Procedure for Fiber Optic Components (ANSI/TIA/EIA-455-5C-2002).
f. TIA/EIA-455-7FOTP7 - Numerical Aperture of Step-Index Multimode Optical Fibers by Output Far-Field Radiation Pattern Measurement (ANSI/TIA/EIA-455-7-92) Dec. 1992.
g. TIA/EIA-455-11-BFOTP11 - ibration Test Procedure for Fiber Optic Components and Cables (ANSI/TIA/EIA-455-11B-94) Jut. 1994.
h. TIA/EIA-455-13-AFOTP13 - isual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies (ANSI/TIA/EIA-455-13A-02).
i. TIA/EIA-455-20-BFOTP20 - IEC60793-1-26 Optical Fibers - 1-46: Measurement Methods and Test Procedures - Monitoring of Changes in Optical Transmittance (ANSI/TIA/EIA-455-20-B-2004).
j. EIA TIA-455-21-A(2) FOTP-21 (r2002) - Mating Durability of Fiber Optic Interconnecting Devices.
k. TIA/EIA-455-25-CFOTP25 - Impact Testing of Optical Fiber Cables and Cable Assemblies (ANSI/TIA/EIA-455-25C-2002).
l. TIA/EIA-455-31-CFOTP31 - Proof Testing Optical Fibers by Tension (ANSI/TIA/EIA-455-31C-95) (R04).
m. TIA-455-33BFOTP33 -Optical Fiber Cable Tensile Loading and Bending Test 2005.
n. TIA/EIA-455-34-AFOTP34 - Interconnection Device Insertion Loss Test (ANSI/TIA/EIA-455-34A-99).
o. TIA/EIA-455-37-AFOTP37 - Low or High Temperature Bend Test for Fiber Optic Cable (ANSI/TIA/EIA-455-37A-93) (R-2002).
p. TIA/EIA-455-38FOTP38 - Measurement of Fiber Strain in Cables Under Tensile Load (ANSI/TIA/EIA-455-38-95) Nov. 1995.
q. TIA/EIA-455-39-BFOTP39 - Fiber Optic Cable Water Wicking Test (ANSI/TIA/EIA-45 5- 39B-03).
r. TIA/EIA-455-41-AFOTP41 - Compressive Loading Resistance of Fiber Optic Cables (ANSI/TIA/EIA-455-41A-01).
s. TIA/EIA-455-42-AFOTP42 - Optical Crosstalk in Fiber Optic Components (ANSI/TIA/EIA-455-42-A-1989) (R2001).
t. TIA/EIA-455-43-AFOTP43 - Output Near-Field Radiation Pattern Measurement of Optical Waveguide Fibers (ANSI/TIA/EIA-455-43A-99) Oct. 1999).
u. TIA/EIA-455-54-BFOTP54 - Mode Scrambler Requirements for Overfilled Launching Conditions to Multimode Fibers (ANSI/TIA/EIA-455-54B-98) (R2001).
v. TIA/EIA-455-56-BFOTP56 -Test Method for Evaluating Fungus Resistance of Optical Fiber and Cable (ANSI/TIA/EIA-455-56B-95) (R2004).

w. TIA/EIA-455-57-BFOTP57 - Preparation and Examination of Optical Fiber Endface for Testing Purposes (ANSI/TIA/EIA-455-57B-96) (R2000).
x. TIA/EIA-455-64FOTP64 - Procedure for Measuring Radiation-Induced Attenuation in Optical Fibers and Optical Cables (ANSI/TIA/EIA-455-64-97) (R2002).
y. TIA/EIA-455-67AFOTP67 - IEC 60793-1-51 Optical Fibers Part 1-51: Measurement Methods and Test Procedures - Dry Heat (ANSI/TIA-455-67 -A-2003).
z. TIA/EIA-455-72FOTP72 - Procedure for Measuring Temperature and Humidity Cycling Aging Effects on Optical Characteristics of Optical Fibers (ANSI/TIA/EIA-455-72-97) (R2001).
aa. TIA/EIA-455-73FOTP73 - Procedure for Measuring Temperature and Humidity Cycling Aging Effects on Mechanical Characteristics of Optical Fibers. (ANSI/TIA/EIA-455-73-97) (R2001).
ab. TIA/EIA-455-74AFOTP74 - IEC 60793-1-53 Optical Fibers Part 1-53: Measurement Methods and Test Procedures - Water Immersion.
ac. TIA/EIA-455-78-BFOTP-78 - IEC 60793-1-40 Optical Fibers Part 140: Measurement Methods and Text Procedures – Attenuation.
ad. TIA/EIA-455-80-CFOTP80 - IEC 60793-1-53 Optical Fibers Part 1-44: Measurement Methods and Test Procedures - Cut-off.
ae. TIA/EIA-455-84-BFOTP84 - Jacket Self-Adhesion (Blocking) Test for Fiber Optic Cable (ANSI/TIA/EIA-455-84B-98) (R 2003).
af. TIA/EIA-455-85-AFOTP85 - Fiber Optic Cable Twist Test (ANSI/TIA/EIA-455-85A-92) (R99) May. 1999.
ag. TIA/EIA-455-86FOTP86 - Fiber Optic Cable Jacket Shrinkage (ANSI/TIA/EIA-455-86-83) (R 90) (R99) May. 1999.
ah. TIA/EIA-455-87-BFOTP87 - Fiber Optic Cable Knot Test (ANSI/TIA/EIA-455-87B-93) (R99) May. 1999.
ai. TIA/EIA-455-88FOTP88 - Fiber Optic Cable Bend Test Jun. 2001.
aj. TIA/EIA-455-89-BFOTP89 - Optical Fiber Cable Jacket Elongation and Tensile Strength (ANSI/TIA/EIA-455-89B-98) (R 2003).
ak. TIA/EIA-455-91FOTP9l - Fiber Optic Cable Twist-Bend Test (ANSI/TIA/EIA-455-9l-86) (R 2003).
al. TIA/EIA-455-95-AFOTP95 - Absolute Optical Power Test for Optical Fibers and Cables (ANSI/TIA/EIA-455-95-A-2000) Apr. 2000.
am. TIA/EIA-455-l 00-AFOTP100 - Gas Leakage Test for Gas-Blocked Fiber Optic Cables (ANSI/TIA/EIA-455-l00A-89) (R99) May. 1999.
an. TIA/EIA-455-l04-AFOTP104 - Fiber Optic Cable Cyclic Flexing Test (ANSI/TIA/EIA-455-l04A-93)(R2000) Jul. 2000.
ao. TIA/EIA-455-1 07-AFOTP 1 07 - Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set (ANSI/TIA/EIA-455-107A-99) Feb. 1999.

ap. TIA/EIA-455-111FOTP111 - Procedure for the Measurement of Optical Fiber Curl (ANSI/TIA/EIA-455-111-2000) Jul. 2000.

aq. TIA/EIA-455-113FOTP113 - Polarization-Mode Dispersion Measurement of Single-Mode Optical Fibers by the Fixed Analyzer Method (ANSI/TIA/EIA-455-113-96) (R 2001).

ar. TIA/EIA-455-122AFOTP122 - Polarization-Mode Dispersion Measurement for Single-Mode Optical Fibers by Stokes Parameter Evaluation (ANSI/TIA/-455-122-A-02).

as. TIA/EIA-455-123FOTP123 - Measurement of Optical Fiber Ribbon Dimensions (ANSI/TIA/EIA-455-123-2000) Jun. 2000.

at. TIA/EIA-455-124AFOTP124 - Polarization-Mode Dispersion Measurement for Single-Mode Optical Fibers by Interferometry (ANSI/TIA/EIA-455-124-A-04).

au. TIA/EIA-455-126FOTP126 - Spectral Characterization of LEDs (ANSI/TIA/EIA-455-126-2000) Feb. 2000.

av. TIA/EIA-455-128FOTP128 - Procedures for Determining Threshold Current of Semiconductor Lasers (ANSI/TIA/EIA-455-128-96) (R 2003).

aw. TIA/EIA-455-129FOTP129 - Procedures for Applying Human Body Model Electrostatic Discharge Stress to Package Optoelectronic Components (ANSI/TIA/EIA-455-129-96) (R 2003).

ax. TIA/EIA -4 5 5-131 FOTP 131 - Measurement of Optical Fiber Ribbon Residual Twist (ANSI/TIA/EIA-455-131-97) (R2000) Oct. 2000.

ay. TIA/EIA-455-132-AFOTP132 - Measurement of the Effective Area of Single-Mode Optical Fiber (ANSI/TIA/EIA-455-132-2001) Jun. 2001.

az. TIA/EIA-455-133AFOTP133 IEC-60793-1-22 Optical Fibers - Part 1-22: Measurement Methods and Test Procedures - Length (ANSI/TIA-455-133-A-03).

ba. TIA/EIA-455-134FOTP134 - Measurement of Connector Ferrule Hole Inside Diameter (ANSI/TIA/EIA-455-134-96) (R 2002).

bb. TIA/EIA-455-135FOTP135 - Measurement of Connector Ferrule Inside and Outside Diameter Circular Runout (ANSI/TIA/EIA-455-135-96) (R 2002).

bc. TIA/EIA-455-141FOTP141 - Twist Test for Optical Fiber Ribbons (ANSIITIA/EIA-455-141-1999) Oct. 1999.

bd. TIA/EIA-455-157FOTP157 - Measurement of Polarization Dependent (PDL) of Single-mode Fiber Optic Components (ANSI/TIA/EIA-455-157-2000) May. 2000.

be. TIA/EIA-455-158FOTP158 - Measurement of Breakaway Frictional Force in Fiber Optic Connector Alignment Sleeves (ANSI/TIA/EIA-455-158-97) (R 2001).

bf. TIA/EIA-455-160AFOTPI60 - IEC 60793-1-50 Optical Fibers - Part 1-50: Measurement Methods and Test Procedures - Damp Heat (Steady State) (ANSI/TIA-455-160-A-03).

bg. TIA/EIA-455-162-AFOTPI62 - Fiber Optic Cable Temperature-Humidity Cycling (ANSIITIAIEIA-455-162A-99) Aug. 1999.

bh. TIA/EIA-455-175-BFOTPI75 - IEC 60793-1-42 Optical Fibers Part 1-42: Measurement Methods and Test Procedures - Chromatic Dispersion (ANSI/TIA-455-175-B-03).

bi. TIA/EIA-455-176AFOTPI76 - IEC 60793-1-20 Optical Fibers Part 1-20: Measurement Methods and Test Procedures - Fiber Geometry (ANSI/TIA-455-176-A-03).

bj. TIA/EIA-455-177-BFOTPI77 - IEC 60793-1-43 Optical Fibers Part 1-43: Measurement Methods and Test Procedures - Numerical Aperture (ANSI/TIA-455-177-B-03).

bk. TIA/EIA-455-178-BFOTPI78 - IEC 60793-1-32 Optical Fibers Part 1-32: Measurement Methods and Test Procedures - Coating Stripability (ANSI/TIA-455-178-B-03).

bl. TIA/EIA-455-180-AFOTPI80 - Measurement of the Optical Transfer Coefficients of a Passive Branching Device (Coupler) (ANSI/TIA/EIA-455-180-A-99) Dec. 1999.

bm. TIA/EIA-455-181FOTPI81 - Lightning Damage Susceptibility Test for Fiber Optic Cables with Metallic Components (ANSI/TIA/EIA - 455-181-92) (2001) Jul. 2001.

bn. TIA/EIA-455-183FOTPI83 - Hydrogen Effects on Optical Fiber Cable (ANSI/TIA/EIA-455-183-2000) Jul. 2000.

bo. TIA/EIA-455-184FOTPI84 - Coupling Proof Overload Test for Fiber Optic Interconnecting Devices (ANSI/TIA/EIA-455-184-91) (R95) (R99) Oct. 1999.

bp. TIA/EIA-455-185FOTPI85 - Strength of Coupling Mechanism for Fiber Optic Interconnecting Devices (ANSI/TIA/EIA-455-185-91) (R95) (R99) Oct. 1999.

bq. TIA/EIA-455-186FOTPI86 - Gauge Retention Force Measurement for Fiber Optic Components (ANSI/TIA/EIA-455-186-91) (R 2004).

br. TIA/EIA-455-187FOTPI87 - Engagement and Separation Force Measurement of Fiber Optic Connector Sets (ANSI/TIA/EIA-455-187-91) (R 2004).

bs. TIA/EIA-455-191-BFOTPI91 - IEC 60793-1-45 Optical Fibers Part 1-45: Measurement Methods and Test Procedures - Mode Field Diameter (ANSI/TIA-455-191-B-2003).

bt. TIAIEIA-455-192FOTPI92 - H-Parameter Test Method for Polarization- Maintaining Optical Fiber (ANSIfTIAIEIA-455-192-99) May. 1999.

bu. TIA/EIA-455-193FOTPI93 - Polarization Crosstalk Method for Polarization-Maintaining Optical Fiber and Components (ANSI/TIA/EIA-455-193-99) May. 1999.

bv. TIA/EIA-455-194FOTPI94 - Measurement of Fiber Pushback in Optical Connectors (ANSI/TIA/EIA-455-194-2000) Jan. 2000.

bw. TIA/EIA/455-195AFOTPI95 - IEC 60793-1-21 Optical Fibers - Part 1-21: Measurement Methods and test Procedures - Coating Geometry (ANSI/TIA-455-195-A-2003).

bx. TIA/EIA-455-197rOTPI97 - Differential Group Delay Measurement of Single-mode Components and Devices by the Differential Phase Shift Method (ANSI/TIA/EIA-455-197-2000) Jul. 2000.

by. TIA/EIA-455-201FOTP201 - Return Loss of Commercial Polarization - Maintaining Fiber or Polarizing Fiber Pigtailed Devices and Cable Assemblies Aug. 2001.

bz. TIA/EIA-455-203FOTP203 - Launched Power Distribution Measurement Procedure for Graded-Index Multimode Fiber Transmitters (ANSI/TIA/EIA-455-203-2001) Jun. 2001.

ca. TIA/EIA-455-204FOTP204 - Measurement of Bandwidth on Multimode Fiber (ANSI/TIA/EIA-455-204-2000) Dec. 2000.

cb. TIA/EIA-4920000-B Generic Specification for Optical Waveguide Fibers (ANSI/TIA/EIA-4920000-B-97) (R2002).

cc. TIA/EIA-492AOOO-A Sectional Specification for Class Ia Multimode, Graded-Index Optical Waveguide Fibers (ANSI/TIA/EIA-492AOOO-A-97) (R 2002).

cd. TIA/EIA-492AAAA-A Detail Specification for 62.5-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (ANSI/TIA/EIA-492AAAA-A-98) (R 2002).

ce. TIA/EIA-492AAAB Detail Specification for 50-urn Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (ANSI/TIA/EIA-492AAAB-98) (R 2002).

cf. TIA/EIA-492COOO Sectional Specification for Class I a DispersionUnshifted Single-Mode Optical Fibers (ANSI/TIA/EIA-492COOO-98) (R 2002).

cg. TIA/EIA-492CAAA Detail Specification for Class I a Dispersion-Unshifted Single-Mode Optical Fibers (ANSI/TIA/EIA-492CAAA-98) May 1998 (R 2002).

ch. TIA/EIA-492CAAB Detail Specification for Class I a Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak (ANSI/TIA/EIA-492CAAB-2000) Sep.2000.

ci. TIA/EIA-492EOOO Sectional Specification for Class I d NonzeroDispersion Single-Mode Optical Fibers for the 1550 nm Window (ANSI/TIA/EIA-492EOOO-96) (R 2002).

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ck. EIA/TIA-526-14A OFSTP-14 - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant (1998) (R 2003).

cl. TIA-559 Single-Mode Fiber Optic System Transmission Design Mar. 1989 (R 2002).
cm. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements (ANSI/TIA/EIA-568-B.1-2001).
cn. TIA/EIA-568-B.l-1 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 1 - Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius (ANSI/TIA/EIA-568-B.I-I-2001).
co. TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components (ANSI/TIA/EIA-568-B.2-2001).
cp. TIA/EIA-568-B.3 Optical Fiber Cabling Components Standard (ANSI/TIA/EIA -568- B.3-2000).
cq. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces.
cr. EIA TIA/EIA-604-2-A-2003 FOCIS 2 Fiber Optic Connector Intermateability Standard, Type Fiber Jack Connector.
cs. EIA TIA/EIA-604-3A(2000) FOCIS 3 Fiber Optic Connector Intermateability Standard - Standard Type SC.
ct. EIA TIA/EIA-604-12(2000) FOCIS 12 Fiber Optic Connector Intermateability Standard Type MT-RJ.
cu. EIA TIA/EIA-606-A(2002) Administration Standard for the Telecommunications Infrastructure (ANSI/TIA/EIA-606).

4. Federal Communications Commission (FCC).
   a. The Code of Federal Regulations, Title 47, Telecommunications, Chapter 1 - FCC Part 68 (1982 issue or latest revision) (47 CFR 68).
5. Institute of Electrical and Electronic Engineers.
   a. IEEE 383-2003 Standard for ualifying Class IE Electric Cables and Field Splices for Nuclear Power Generating Stations.
   b. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms.
6. Insulated Cable Engineers Association (ICEA).
   a. ICEA S-56-434 (1983, 5th Ed.) Polyolefin Insulated Communication Cables for Outdoor Use.
   b. ICEA S-83-596(2001) Fiber Optic Premises Distribution Cable.
   c. ICEA S-90-661(2002) Category 3,5 and 5e Individually Unshielded Twisted Pair Indoor Cables With or Without Overall Shield for use in General Purpose and LAN Communications Wiring Systems - Technical Requirements.
7. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA).
   a. NEMA WC 63.1(2000) Twisted Pair Premise oice and Data Communications Cables.
8. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA).

a. NFPA 70 National Electrical Code.

9. Underwriters Laboratories, Inc. (UL).
   a. UL 444(2002; Bul. 2002, 2003) Communications Cables.
   b. UL 910(1998) Flame-Propagation and Smoke-Density alues for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.
   c. UL 1286(1999; R 2004) Office Furnishings.
   d. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords. Oct. 2001.
   e. UL 1666(2000; R 2002) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed ertically in Shafts.
   f. UL 1863(2000; R 2004) Communications Circuit Accessories.

1.4 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in:
   1. ANSI/TIA/EIA-568-B.l.
   2. ANSI/TIA/EIA-568-B.2,
   3. ANSI/TIA/EIA-568-B.3,
   4. ANSI/TIA/EIA-569-B,
   5. ANSI/TIA/EIA-606-A,
   6. IEEE Std 100 and
   7. this Section.

B. Campus Distributor (CD) - A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

C. Building Distribution Facility (BDF) - A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

D. Floor Distributor (FD) - A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

E. Telecommunications Room (TR) - An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

F. Entrance Facility (EF) - An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

G. Equipment Room (ER) - A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

H. Open Cabling - Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

I. Open Office - A floor space division provided by furniture, movable partitions, or other means instead of by building walls.

J. Pathway - A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.5 SUBMITTALS

A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.6 DELI ERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01600 - Product Requirements, Section 17010 - Common Work Results for Communications Systems and the following:

B. Shipping Conditions:

1. All cable shall be shipped on reels or manufacturer supplied "handy boxes".
2. The diameter of the drum shall be at least 13 times the diameter of the cable.
3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.
4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.
5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.
6. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.

C. Storage:

1. Retain factory cable protection until installation. Supplement with heavy gauge plastic sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.
2. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.
3. Protect cable reels from physical damage from site construction vehicles or from settling into the soil.
4. Equipment, other than cable, to be delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 SE UENCING

A. Not Used.

1. PERFORMANCE STANDARDS

A. Telephone (oice) Copper Cabling Plant:

1. Suitable for direct connection to the Public Switched Network in accordance with rules set forth by FCC Part 68, California Public Utilities Commission, and other Authorities Having Jurisdiction.
2. Category 3 as defined in TIA/EIA-568-B.2 paragraph 4.4.

B. Horizontal (Station) Copper Cabling – Permanent Link.

Category 6, as defined in ANSI/TIA/EIA-568-B.2-1, Chapter 7 (*a n ans ss n n s*), with the test measurements performed in accordance with ANSI/TIA/EIA-568-B.2-1, Annex A (*a n f d as n d s*

n a) using a Level III field tester, as defined in ANSI/TIA/EIA-568-B.2-1, Annex B (*s ns n s n a*). Cabling shall meet or exceed the requirements stated therein.

C. Fiber Optic Cabling
   1. Optical Budget, any end to end link not to exceed the sum of the following:
      a. Optical fiber loss (attenuation).
      b. Splice loss.
      c. Connector loss.
   2. Optical fiber loss shall be the optical fiber specified cable performance, pro-rated for total link distance.
      a. Fiber Loss, Multimode, not to exceed:
         i. At 850 nanometers, 3.0 dB per Kilometer.
         ii. At 1300 nanometers, 1.0 dB per Kilometer.
      b. Fiber Loss, Single mode, Outside Plant Cable, not to exceed:
         i. At 1310 nanometers, 0.35 dB per Kilometer.
         ii. At 1550 nanometers, 0.25 dB per Kilometer.
      c. Fiber Loss, Single mode, Campus Backbone Cable, not to exceed:
         i. At 1310 nanometers, 0.4 dB per Kilometer.
         ii. At 1550 nanometers, 0.3 dB per Kilometer.
   3. Splice Loss.
      a. Multimode.
         i. 0.15 dB for each fusion splice.
      b. Single Mode.
         i. 0.06 dB for each fusion splice.
   4. Connector Loss
      a. Multimode.
         i. 0.75 dB for each mated pair of type SC Connector.
      b. Single Mode.
         i. 0.75 dB for each mated pair of type SC, Ultra Physical Contact Connector.
         ii. 0.30 dB for each mated pair of type SC, Angled Physical Contact Connector.

1. TESTING

A. GENERAL
   1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.
   2. Test each end-to-end cable link.
   3. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and Owner's Representative approved, forms; and in electronic format approved by the Owner's Representative.
   4. Provide machine-generated data on an appropriate disk media (CD-ROM CD-R format) to be transferred to the Owner's computers.

a. 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.

5. Provide registered testing software used for the actual tests to the Owner for review of test data.

B. Test Equipment:

1. Provide in conformance with the applicable requirements of 17010 Common Work Results for Communications.
2. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:
   a. Level III Category Category 6 Cable Tester – Agilent, Fluke, or equal.
   b. Outside Plant oice Cabling Plant tester - capable of detecting shorts, opens, reversals, mis-wiring and crosstwists. (Siemon STM-8, Fluke or equal).
   c. Tone Test Sets.
   d. Optical power meter (HP, Corning Cable Systems, Fluke or equal). Site portable communications systems (walkie-talkie, cell phone or similar).
   e. Site portable communications systems (walkie-talkie, cell phone or similar).
   f. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

C. Station Wiring, General.

1. Test station wire only after all pairs of station wire in an 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. 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 re-tested.

D. Inside Category 6 Cabling.

1. Using the listed Category 6 cable test set, test 100 of cabling and submit report on the parameters specified for Category 6 cabling in this Section. Report whether tested link passes or fails the Category 6 standards in Part 2 of this Section.
2. Note exceptions to required Category 6 standards. Remedy and retest.

E. Telephone: Outside Plant, Inside Riser Wire:

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 less than 100 of cable pairs pass testing, the cable shall be deemed unacceptable and shall be replaced. Contractor shall replace, terminate and test new cable at no additional cost to the Owner.

2. Test procedures:
   a. TEST #1 – Continuity:
      i. Meter set for 20 ohm full scale ohm reading. Each pair shall be shorted at one end and the loop resistance value read at the other.
      ii. 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:
      i. 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.
   c. RE UIREMENT: Reading for each tip conductor in pair of approximately one-half the loop resistance value from Test #1.
3. Test Report:
   a. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions found, as well as corrective action taken to correct any found opens, shorts, or transpositions.

F. Fiber Optic Cabling.
1. Perform fiber optic cable testing on all installed fiber optic cabling. Submit test results. Notify Owner's Representative in writing at least 48 hours in advance that fiber optic cable testing shall commence. Submit calibration certification for testing equipment to be used.
2. Submit test report no later than five (5) business days after the cables are tested.
3. Test and submit optical power loss test results on each fiber, in each cable, and in both directions under final installation conditions. Submit with the following information:
   a. Date of test.
   b. Name of test personnel.
   c. Fiber cable type and part number.
   d. Cable Length
   e. Fiber strand number, buffer tube color, and strand color.
   f. T location.
   g. R location.
   h. Optical Light Source manufacturer, model and serial number.
   i. Optical Power Meter manufacturer, model and serial number.
   j. Reference standard, with allowable values for cable attenuation, connector loss, and splice loss.
   k. Allowable loss for the link under test, calculated as the sum of cable attenuation plus connector loss plus splice loss.

l. T wavelength(s).
m. Attenuation in dB at the T wavelength(s).

4. Acceptance Tests.
   a. Power Meter Attenuation Test.
      i. Perform on all fiber cabling segments.
      ii. Method: Perform the following measured attenuation tests using the method B of ANSIlEIAffIA-526-14A for multimode strands and ANSIlEIA/TIA-526-7 for singlemode strands. Measure the attenuation of the fiber optic network inclusive of all splices and patch points called for on the Drawings.
      iii. Measure attenuation between all the coupling points (when applicable) using the insertion method.
      iv. Perform a reference measurement in dBm to determine the injection power level of the stabilized source. Reference cable shall have the same core diameter as strands under test. Connect the optical source directly to the optical power level meter using 2 reference cables and a coupler.
      v. Connect the optical source to the strand under test using I of the 2 reference cables attached to the strand's terminal coupler.
      vi. Connect the optical power level meter to the other end of the strand under test through its terminating coupler using the other reference cable.
      vii. Obtain the measured attenuation (in dB) by subtracting the reference level (dBm) from the received level (dBm).
         (1) Periodically during the acceptance tests, check and document the reference level.
      viii. Test each fiber link for overall attenuation from end-to-end in both directions.
      ix. Perform the attenuation acceptance test at the 850 nm wavelength for multi-mode and 1310 nm for single-mode.
   b. OTDR Distance and Attenuation Assessments.
      i. Perform acceptance testing of all reels of fiber optic cable prior to installation.
      ii. Perform in accordance with the requirements of:
         (1) ANSI/EIA/TIA-568-B.l.
         (2) ANSI/EIA/TIA-568- B.3.
         (3) TIA/EIA-455-59-A.
      iii. Test and submit strip charts and/or tracer recordings on all strands in each tube in every cable in one direction. Submit with the following information:
         (1) Date of test.
         (2) Name of test personnel.
         (3) Test wavelength.

(4) Pulse duration(s) and scale range(s).
(5) Index of refraction.
(6) Fiber cable type and part number.
(7) Fiber tube and/or fiber strand number.
(8) Direction of test.
(9) Overall distance.
(10) Attenuation in dB.

PART 2 PRODUCTS

2.1 COMMUNICATIONS CABLES AND RELATED

A. General:
1. Cabling shall be UL listed for the application and shall comply with EIA TIA/EIA-568-B.l, TIA/EIA-568-B.2, TIA/EIA-568-B.3 and NFPA 70.
2. Ship cable on reels and/or in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.
3. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
   a. In plenum spaces, provide type CMP or OFNP cabling.
   b. In riser spaces, provide type CMR or OFNR cabling.
   c. Under outside plant cabling conditions, provide type CM or OFN cabling.

PART 3 EXECUTION

3.1 GENERAL

A. All system cabling and terminations be installed in accordance with the manufacturer's instructions and as shown.
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 ANSI C2 and NFPA 70.
C. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
D. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
E. 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 harnesses of different classes cross, or where hinged panels are to be interconnected.
F. Correct unacceptable wiring conditions including but not limited to:
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. Ungrommeted, unbushed, or uninsulated wire or cable entries.
6. Deformation or improper radius of wire or cable.

3.2 SPLICING

A. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
   1. At designated splices, maintain conductor color code across all splices.
      a. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
      b. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

3.3 PULLING IN

A. erify that all raceway has been de-burred and properly joined, coupled, terminated, and bushed prior to installation of cables. erify that all raceway is 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 for minimum permissible radius and maximum permissible deformation.

C. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

3.4 SUPPORT

A. 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 or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

B. Separation. Conform to the following table 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 Electromagnetic Field sources, including but not limited to motors, transformers and copiers.

Separation of Telecommunications Cabling and Pathways from 480 or Lower Power Lines

Condition	Minimum Separation Distance		
	2k A	2-5k A	5k A
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	5 in.	12 in.	24 in.
Unshielded power lines in proximity to a grounded metal conduit pathway	2.5 in.	6 in.	12 in.
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway	N/A	3 in.	6 in.

C. Support: Provide support for all cabling. Conform to the restrictions of the National Electric Code and Section 17029.

END OF SECTION

SECTION 17116
COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES

PART 1 GENERAL

1.1 SCOPE OF WORK
A. Communications racks and cabinets.
B. Communications Rack Mounted Power Protection and Power Strips.

1.2 RELATED WORK IN OTHER SECTIONS
A. Section 17026 - Grounding and Bonding for Communications Systems.
B. Section 17033 - Conduits and Backboxes for Communications Systems.
C. Section 17036 - Cable Trays for Communications Systems.
D. Section 17126 - Communications Rack Mounted Power Protection and Power Strips.
E. Section 17150 - Communications Horizontal Cabling.

1.3 REFERENCES
A. American National Standards Institute (ANSI).
   1. EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment (ANSI/EIA/310-D).
   2. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (ANSIIJ-STD-607-A-2002).
B. International Conference of Building Officials (lCBO).
   1. AC156 ICBO ES Acceptance Criteria for Seismic ualification Testing of Nonstructural Components (Jul. 2004).
C. Telecordia Technologies.
   1. Network Equipment Building System (NEBS) GR-63-CORE (Seismic Zone 4).

1.4 SUBMITTALS
A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.5 DELI ERY, STORAGE AND HANDLING
A. Procedures: In accordance with Section 01600 - Product Requirements and Section 17100 - Structured Cabling, Basic Materials and Methods.

1.6 SE UENCING
A. Not used.

PART 2 PRODUCTS

2.1 GENERAL
A. Keys.
   1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided for similar usage within a system identically.

2.2 E UIPMENT ENCLOSURE SYSTEMS
A. General:

1. Provide enclosure systems including, but not limited to enclosures, cabinets, cases and related panels and accessories as specified herein. Provide size and quantity as shown on drawings or scheduled.
2. Provide color as shown on drawings. If no color is shown on drawings, submit manufacturer's standard color chips for selection.
3. Provide enclosure systems conforming to the UBC/CBC, latest edition, for seismic design.
4. Equipment Enclosures: Each rack provided with frame angles tapped 10-32, ANSI/EIA 310-D Universal Spaced.

B. Relay Rack
   1. Drawing Reference(s).
      a. R15.
      b. R15S.
   2. Construction.
      a. Two wide vertical side channels tapped with EIA mounting holes on both sides, 3 EIA channel construction.
      b. Full 19" wide EIA Frame fits standard equipment forms - assemblies with non-standard opening widths not permitted.
      c. Two (2) Base Angles.
      d. Two (2) Top angles.
      e. 7 ft Tall.
      f. 44 EIA Rack Units minimum.
      g. Horizontal and vertical cable management unless otherwise indicated on plans.
   3. Manufacturers:
      a. CPI 46353-703
      b. Or equal.

C. Equipment Rack, Zone 4, Front, Rear and Side Access.
   1. Drawing References: R22.
   2. Construction:
      a. Manufacturer tested Zone 4 assembly, rated for at least 900 pounds of uniformly distributed load.
      b. ertical Height (Min): 44RU.
      c. Depth: 36" minimum.
      d. No front or rear door.
      e. Fully Adjustable 19" Mounting Rails, DIN Slot on EIA spacing standard.
      f. Full height receptacle strip, at least two (2) circuits, 20A, unless otherwise noted, as specified in Section 17126.
      g. Provide each rack with the following accessory shelves:
         i. One (1) Exhaust Fan Panel, top or rear doors, at least 200 CFM.
      h. Gangable. Racks have been designed such that they are suitable for installation either as a single, standalone unit, or in a row of identical racks (gangable).

i. Single rack installation. Provide side panels at both sides.
ii. Multirack installation in a row. Bolt racks together using means provided by manufacturer. Omit side panels except at ends of row of racks - provide at ends of rows of racks.

3. Manufacturers. Provide manufacturer's accessories or 3rd party accessories as specified elsewhere in this Section for other specified elements. Coordinate selected shelves, fans and similar with rack submitted for finish and mounting means:
   a. Middle Atlantic/DataTel MRK4436PRO with MRK-Z4 Base angles, MW4 FT-FC top w/4 fans.
   b. Or equal.

2.3 RACK PANELS AND ACCESSORIES

A. Rack Mounting Screws:
   1. Screws 10-32; length as required for at least 1/4" excess when fully seated; oval head with black plastic non marring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square- Tip or Torx drive. Slotted screws are not acceptable.

PART 3 EXECUTION

3.1 MOUNTING

A. Unless otherwise noted, all floor supported equipment racks shall be bolted to the structure in accordance with the requirements of the CBC, the UBC and the contractors approved structural engineering submittal demonstrating the method to be used to conform to these requirements.
B. Rows of identical racks shall be bolted together, in addition to being bolted to the floor, and bonded to form a single electrical ground plane.
C. Wall mounted equipment racks and cabinets shall similarly be bolted to structural members in accordance with the requirements of the CBC, the UBC and the contractors approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

3.2 E UIPMENT ENCLOSURE RACK AND E UIPMENT BACKBOARD FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.
B. Provide permanent labels for all equipment and devices.
C. Floor racks to be bolted floor unless otherwise indicated.
D. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
E. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.
F. Where wiring of mixed types are called for on the plans, maintain separation of wiring classifications as specified in the individual sections of the Communications

Work. Separately dress, route and land microphone, audio line level and data cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level, data and control cables on the left side of the equipment enclosure, as viewed from the rear.

G. Provide vertical wire management of cabling within the rack independent of the adjustable EIA mounting rails. ertical wiring management provided by the contractor within the rack shall not prevent such rails from being moved as required by the Owner.

H. Dress and support cabling at a minimum of 24 inch on center.

I. Access shall not require demounting or de-energizing of equipment or cabling. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

J. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

K. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

L. At audio and video jack fields, provide service loop to permit removal of jack fields from rack sufficient to conveniently access all jack contacts for routine cleaning and maintenance. Organize the service loop and harness such that reasonable reconnection of jacks and jack normals is possible without cutting apart the harness.

M. Coordinate the design and execution of wire harnessing of multi-bay audio and video rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multi-pin connectors and related interconnect systems as specified elsewhere herein.

3.3 SIGNAL GROUNDING BONDING PROCEDURES

A. Comply with National Electrical Code and the California Electric Code. Bond equipment racks to ground in accordance with the California Electric Code and ANSI/EIA/TIA 607 and Section 17026.

B. Unless otherwise noted maintain a unipoint ground scheme.

C. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

END OF SECTION

SECTION 1711
COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 GENERAL

1.1 SCOPE OF WORK
A. This Section defines material standards for:
   1. Copper Termination Assemblies, including:
      a. Rack and cabinet mounted copper patch panels.
      b. Backboard, rack and cabinet mounted terminal blocks.
   2. Fiber Termination Assemblies, including:
      a. Fiber connectors.
      b. Rack and cabinet mounted fiber patch panels.
      c. Backboard mounted fiber terminal boxes.
   3. Hybrid Copper/Fiber Termination Assemblies.

1.2 RELATED WORK UNDER OTHER SECTIONS
A. Section 17010 – Common Work Results for Communications.
B. Section 17026 - Grounding and Bonding for Communications Systems.
C. Section 17100 - Structured Cabling, Basic Materials and Methods.
D. Section 17113 - Communications Entrance Protection.
E. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures.
F. Section 17123 - Communications Cable Management.
G. Section 17130 - Communications Interior Backbone Cabling.
H. Section 17140 - Communications Outside Plant Backbone Cabling.
I. Section 17150 – Communications Horizontal Cabling.

1.3 REFERENCES
A. ELECTRONIC INDUSTRIES ALLIANCE (EIA).
   1. EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment (ANSI/EIA/310- D).

1.4 SUBMITTALS
A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.5 DELI ERY, STORAGE AND HANDLING
A. Procedures: In accordance with Section 01600 - Product Requirements and Section 17100 - Structured Cabling, Basic Materials and Methods.

1.6 SE UENCING
A. Not used.

PART 2 PRODUCTS

2.1 COPPER CABLE TERMINATION DE ICES AND RELATED
A. Category 5e oice Termination Block.
   1. Drawing reference(s):
      a. 66TB6 6 pair

b. 66TB25 25 pair
c. 66TB50 50 pair
d. 66TB100 100 pair
e. 66TB300 300 pair
f. 66TB600 600 pair

2. General: Insulation displacement connector blocks consisting of oxygen free mechanical fastening system arranged in a flame-retardant molded plastic fastened to a mounting bracket.
3. Features/Functions:
   a. "66" type terminals.
4. Construction/Implementation.
   a. Provide complete with stand-off mounting bracket.
   b. Provide cable management D-rings at the bottom of and between each column of blocks.
5. Manufacturer:
   a. Siemon S66M1-50
   b. Or equal.

B. Category 5e oice Termination Block with Pre-wired RJ21 (50 Pin) connector.
1. Drawing reference(s):
   a. 66PWTB100 100 pair
   b. 66PWTB200 200 pair
   c. 66PWTB300 300 pair
   d. 66PWTB600 600 pair
2. Features/Functions:
   a. 66 type terminal block with pre-wired RJ21 connector for 25 pairs on each side of block.
   b. Meets or exceeds Category 5e performance.
3. Manufacturers:
   a. Siemon S66M2-5W
   b. Or equal.

C. Data and oice Icons
1. Icons shall be provided for all patch panel ports.
2. Manufacturer:
   a. Icons for Patch Panel A shall be ORANGE, Ortronics P/N OR-40323200 (package of 100) or equal.
   b. Icons for Patch Panel B shall be ORANGE, Ortronics P/N OR-40323200 (package of 100) or equal.
   c. Icons for Patch Panel C shall be ORANGE, Ortronics P/N OR-40323200 (package of 100) or equal.
   d. Icons for Patch Panel D shall be BLUE, Ortronics P/N OR-40326100 (package of 100) or equal.

D. Category 6 Data and oice Patch Panels, Rack Mounted.
1. This section applies to patch panels used to distribute BOTH data and voice connections. See paragraph 2.1.E for specifications for patch panels used to distribute voice only

2. Drawing Reference: C6PP, where refers to port count.
3. Functions/Features:
   a. Shall meet or exceed the current TIA/EIA 568-B.1, B.2 and proposed ISO/IEC 11801-B defined ohm copper cable channel specifications.
   b. 19" EIA rack mountable.
   c. 24 ports per EIA rack unit (1.75").
   d. Arranged in groups of six (6) ports on steel panel.
   e. Ports shall be factory numbered, 1 through 96, 1 through 48, and 1 through 24
   f. Jacks on front.
   g. Terminations on rear.
   h. Holder for port identifier designation strips on front.
   i. Integral cable management bar at rear.
4. Manufacturer:
   a. Ortronics Clarity Category 6 96-port, 8-position, 8-conductor, high-density modular to 110 patch panel, P/N OR-PHD66U96.
   b. Ortronics Clarity Category 6 48-port, 8-position, 8-conductor, high-density modular to 110 patch panel, P/N OR-PHD66U48.
   c. Ortronics Clarity Category 6 24-port, 8-position, 8-conductor, high-density modular to 110 patch panel, P/N OR-PHD66U24.
   d. Or equal.

E. Category 5e oice Patch Panels, Rack Mounted.
1. This section applies to patch panels used to distribute voice connections ONLY. See paragraph 2.1.D for specifications for patch panels used to distribute data and voice connections.
2. Drawing Reference: C5ePP, where refers to port count.
3. Functions/Features:
   a. Shall meet or exceed the current TIA/EIA 568-B.1, B.2 and proposed ISO/IEC 11801-B defined ohm copper cable channel specifications.
   b. 19" EIA rack mountable.
   c. 24 ports per EIA rack unit (1.75").
   d. Arranged in groups of six (6) ports on steel panel.
   e. Ports shall be factory numbered, 1 through 96, 1 through 48, and 1 through 24
   f. Jacks on front.
   g. Terminations on rear.
   h. Holder for port identifier designation strips on front.
   i. Integral cable management bar at rear.
4. Manufacturer:
   a. Ortronics Clarity Category 5e 96-port, 8-position, 8-conductor, high-density modular to 110 patch panel, P/N OR-PHD5E6U96.
   b. Ortronics Clarity Category 5e 48-port, 8-position, 8-conductor, high-density modular to 110 patch panel, P/N OR-PHD5E6U48.

c. Ortronics Clarity Category 5e 24-port, 8-position, 8-conductor, high-density modular to 110 patch panel, P/N OR-PHD5E6U24.
d. Or equal.

F. oice Termination Frames
1. All voice backbone termination blocks and stand-off brackets shall be mounted on an approved termination frame unless otherwise specified on the drawings.
a. Homaco 200-pair voice termination frame P/N 50M-201-R19 Wall/Rack Module.
b. Homaco 400-pair voice termination frame P/N 50M-201-D19 Wall/Rack Module.
c. Homaco 600-pair voice termination frames P/N 50M-201-T19 Wall/Rack Module.
d. Or equal.

2.2 FIBER CABLE TERMINATION DE ICES AND RELATED

A. Fiber Optic Connectors and Related:
1. General.
a. Connectors to comply with:
i. EIA/TIA-4750000-C.
ii. EIA/TIA-604-3A.
2. Connectors:
a. SC, unless otherwise noted or scheduled.
b. Connector performance per TIA/EIA – 568B.3 and the following:
i. Insertion Loss:
(1) Multimode:
a. Less than or equal to 0.75 dB per mated pair.
(2) Single mode, UPC
a. Less than or equal to 0.75 dB per mated pair.
(3) Single mode, APC
a. Less than or equal to 0.30 dB per mated pair.
ii. Return Loss:
(1) Single mode, Ultra Polish, greater than or equal to 55 dB.
(2) Single mode, Angled Physical Contact, greater than or equal to 65 dB.
iii. Manufacturer:
(1) Connector.
a. Berk-Tek/Nexans
b. Or equal.

B. Fiber Optic Pigtails, Fusion Splicing
1. Fiber optic terminations shall be performed using fusion spliced factory pigtails with SC connectors unless otherwise specified on the drawings.
2. Pigtails for fusion spliced terminations of 50/125 micron multimode fiber:

a. Manufacturer:
   i. 1-fiber pigtails 2 meter, SC connector, Ortronics P/N OR-626PF9FR-FZ002M or equal.
   ii. 6-fiber pigtails 2 meter, SC connector, Ortronics P/N OR-626SF4ZR-FZ002M or equal.
   iii. 12-fiber pigtails 2 meter, SC connector, Ortronics P/N OR-626TF4ZR-FZ002M or equal.

3. Pigtails for fusion spliced terminations of 8.3/125 micron singlemode fiber:
   a. Manufacturer:
      i. 1-fiber pigtails 2 meter, SC connector, Ortronics P/N OR-626PC9FR-RZ002M or equal.
      ii. 6-fiber pigtails 2 meter, SC connector, Ortronics P/N OR-626SC4ZR-RZ002M or equal.
      iii. 12-fiber pigtails 2 meter, SC connector, Ortronics P/N OR-626TC4ZR-RZ002M or equal.

C. Heat Shrink Sleeves
1. All splices shall utilize heat shrink sleeves for splice protection.
   a. 60 mm heat shrink sleeves shall be used in all 12 inch splice trays.
   b. 40 mm heat shrink sleeves are acceptable in 6 inch splice trays where 60 mm heat shrink sleeves either will not fit or are not recommended by the splice tray manufacturer.
   c. Manufacturer:
      i. Heat shrink sleeves for splices in surface mount fiber patch/splice cabinets Ortronics P/N OR-20500043 or equal.
      ii. Heat shrink sleeves for splices in rack mount fiber splice cabinets Ortronics P/N OR-20500130 or equal.

D. Splice Trays
1. All finished splices (with heat shrink sleeve in place) shall be mounted and stored within splice trays compatible with the splice enclosure being used. All slack in 250- and 900-micron coated fibers shall be carefully coiled and stored inside the tray.
2. Manufacturer:
   a. Splice trays for fusion splices in surface mount fiber patch/splice enclosures Ortronics P/N OR-62600003 or equal.
   b. Splice trays for fusion splices in rack mount fiber splice enclosures Ortronics P/N OR-61500016 or equal.

E. Fiber Optic Adapter Panels
1. Manufacturer:
   a. Adapter panels for multi mode fiber terminations in surface mount or rack mount patch or patch/splice cabinets 6-SC duplex (12 fibers), metal adapters, phosphor-bronze alignment sleeves, Ortronics P/N OR-615SCDSM6 or equal.
   b. Adapter panels for single mode fiber terminations in surface mount or rack mount patch or patch/splice cabinets 6-SC duplex (12 fibers),

blue adapters, ceramic alignment sleeves, Ortronics P/N OR-615SCDSM6C or equal.

F. Fiber Patch Enclosure, Wall Mount
   1. Drawing Reference: FPEW, where refers to the fiber patch panel count.
   2. Features/Functions:
      a. Provides a location for packaging fiber optic cables with direct terminations.
      b. Two compartments, separated by a partition loaded with fiber optic adapter panels.
         i. Left side typically for storing incoming cable slack and connecting terminated fibers.
         ii. Right side typically for patching rack-mounted network equipment.
      c. Suitable for indoor use.
      d. Constructed of 0.125 inch minimum thick aluminum or powder coated steel.
      e. Cable can be inserted/removed laterally via removable mending plate or similar.
      f. Interior cable storage rings or spools.
      g. Tamper-proof hardware - separate locking sections for cable terminations and patch panel access.
      h. Provides strain relief for entrance cables.
   3. Manufacturer:
      a. Patch enclosures for up to 24 fibers Ortronics P/N OR-615SMFC-L -12P or equal.
      b. Patch enclosures for up to 48 fibers Ortronics P/N OR-615SMFC-24P or equal.
      c. Patch enclosures for up to 96 fibers Ortronics P/N OR-615SMFC-48P or equal.

G. Fiber Patch/Splice Enclosure, Wall Mount
   1. Drawing Reference: FPSEW, where refers to the fiber patch panel count.
   2. Features/Functions:
      a. Provides a location for splicing and packaging fiber optic cables.
      b. Two compartments, separated by a partition loaded with fiber optic adapter panels.
         i. Left side typically for storing incoming cable slack and splice trays and connecting terminated fibers.
         ii. Right side typically for patching rack-mounted network equipment.
      c. Suitable for indoor use.
      d. Constructed of 0.125 inch minimum thick aluminum or powder coated steel.

e. Cable can be inserted/removed laterally via removable mending plate or similar.
f. Interior cable storage rings or spools.
g. Threaded stud or similar anchoring point for stacking and securing splice trays.
h. Tamper-proof hardware - separate locking sections for cable terminations and patch panel access.
i. Provides strain relief for entrance cables.

3. Manufacturer:
a. Patch/splice enclosures for up to 48 fibers Ortronics P/N OR-615SMFC-24P/S or equal.
b. Patch/splice enclosures for up to 96 fibers Ortronics P/N OR-615SMFC-48P/S or equal.

H. Fiber Patch Enclosure, Rack Mount

1. Drawing Reference: FPER, where refers to the fiber patch panel count.
2. Features/Functions:
a. 19" EIA rack mount.
b. Provides a location for packaging fiber optic cables with direct terminations.
c. Two compartments, separated by a partition loaded with fiber optic adapter panels.
i. Rear (larger) side typically for storing incoming cable slack and connecting terminated fibers.
ii. Front (smaller) side typically for patching rack-mounted network equipment.
d. Suitable for indoor use.
e. Constructed of 0.125 inch minimum thick aluminum or powder coated steel.
f. Cable can be inserted/removed laterally via removable mending plate or similar.
g. Interior cable storage rings or spools.
h. Tamper-proof hardware - separate locking sections for cable terminations and patch panel access.
i. Provides strain relief for entrance cables.
j. Suitable for reentry, if required for future maintenance or modification, without damage to the cable or terminated fibers.
3. Manufacturer:
a. Patch enclosures for up to 36 fibers Ortronics P/N OR-615MMC-18P-00 or equal.
b. Patch enclosures for up to 72 fibers Ortronics P/N OR-615MMC-36P-00 or equal.
c. Patch enclosures for up to 144 fibers Ortronics P/N OR-615MMC-72P-00 or equal.

I. Fiber Splice Enclosure, Rack Mount

1. Drawing Reference: FSER, where refers to the fiber splice count.
2. Features/Functions:
   a. 19" EIA rack mount.
   b. Provides a location for packaging fusion spliced fiber optic cables.
   c. Suitable for indoor use.
   d. Constructed of 0.125 inch minimum thick aluminum or powder coated steel.
   e. Interior cable storage rings or spools.
   f. Provides strain relief for entrance cables.
   g. Integral threaded stud or steel wire frame for organizing and securing splice trays
   h. Suitable for reentry, if required for future maintenance or modification, without damage to the cable or terminated fibers.
3. Manufacturer:
   a. Splice enclosures for up to 48 fibers Ortronics P/N OR-615MMC-48S-00 or equal.
   b. Splice enclosures for up to 96 fibers Ortronics P/N OR-615MMC-96S-00 or equal.

PART 3 EXECUTION

3.1 **R S 17130 C I B C R R O P C W EF A BDF .**

3.2 **R S 17100 S C , B M A M .**

3.3 **R S 17150 C H C .**

END OF SECTION

SECTION 17123
COMMUNICATIONS CABLE MANAGEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Section includes provision of cable management for cabling installed under the work of this Project as well as for Owner furnished patch cords at equipment racks.

B. Scope includes:

1. Innerduct.
   a. Interior.
   b. Outside Plant.
2. Cable End Spillway.
3. Backboard Cable Management.
4. Patch Panel Cable Management at racks and cabinets.

1.2 RELATED WORK IN OTHER SECTIONS

A. Section 17033 - Conduits and Backboxes for Communications Systems.
B. Section 17036 - Cable Trays for Communications Systems.
C. Section 17039 - Surface Raceways for Communications Systems.
D. Section 17053 - Identification for Communications Systems.
E. Section 17100 - Structured Cabling, Basic Materials and Methods.
F. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures.
G. Section 17119 - Communications Termination Blocks and Patch Panels.
H. Section 17150 - Communications Horizontal Cabling.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM D2239-03 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

B. Underwriters Laboratories (UL).

1. UL 910 Test for Flame-Propagation and Smoke-Density alues for Electrical and Optical-Fiber Cables used in Spaces Transporting Environmental Air (Nov. 1998).

1.4 SUBMITTALS

A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.5 DELI ERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 01600 - Product Requirements and Section 17100 - Structured Cab ling, Basic Materials and Methods.

1.6 SE UENCING

A. Not used.

PART 2 PRODUCTS

2.1 CONDUIT CABLE MANAGEMENT

A. Conduit End Waterfall Spillway.
   1. Drawing Reference: CEW.
   2. Features/Functions:
      a. Spillway fastens to end of EMT conduit, provides radius sweep, open on top, solid from below.
      b. Maintains proper bend radii for fiber/cable.
      c. Provides tie points for fire pillow retention.
      d. Supports up to 100 lbs. of hanging fiber/cable.
      e. Clamp for securing to EMT.
      f. Self-fastening tie down system for supporting cabling.
   3. Construction:
      a. Fire Retardant ABS.
   4. Manufacturers:
      a. Bejed BJ-2049 Spillway.
      b. Or equal (no known equal).

2.2 HORI ONTAL PATCH PANEL CABLE MANAGEMENT

A. Patch Panel Cable Management, Rack Mounted, Snap Cover.
   1. Drawing References:
      a. 1 RU: RMWM1C
      b. 2 RU: RMWM2C
      c. 3 RU: RMWM3C
   2. Construction.
      a. EIA 19 or 23" Rack Mount, as required.
      b. Continuous flexible system of fingers and slots.
      c. De-burred to avoid snagging patch cord jacket.
      d. Snap Cover.
   3. Manufacturer, EIA 19 rack mount:
      a. 1 RU CPI 30139-719 or equal.
      b. 2 RU CPI 30130-719 or equal.
      c. 3 RU CPI 30131-719 or equal.
   4. Manufacturer, EIA 23 rack mount:
      a. 1 RU CPI 30139-723 or equal.
      b. 2 RU CPI 30130-723 or equal.
      c. 3 RU CPI 30131-723 or equal.

2.3 ERTICAL CABLE MANAGEMENT

A. Cable Management, ertical, latches.
   1. Drawing References:
      a. Single-Sided Narrow: CMSSNC
      b. Single-Sided Wide: CMSSWC
      c. Double-Sided Narrow: CMDSNC
      d. Double-Sided Wide: CMDCWC
   2. Construction.
      a. Bolts to racks specified in Section 17116.
      b. De-burred and supplied with protective edge guards to avoid snagging patch cord jacket.

c. System of latches to retain cables.
d. Manufacturer:
i. Single-Sided Narrow CPI 11730-703 or equal.
ii. Single-Sided Wide CPI 11374-703 or equal.
iii. Double-Sided Narrow CPI 12096-703 or equal.
iv. Double-Sided Wide CPI 11729-703 or equal.

2.4 BACKBOARD CABLE MANAGEMENT

A. Fiber Management Ring, Preformed Loop.
1. Drawing Reference: FMR
2. Construction:
a. 24 inch diameter steel ring stores fiber slack using elco fasteners at regular intervals around ring.
b. Screw fastens to backboard at BDF or IDF.
3. Manufacturer:
a. Leviton 48900-0FR.
b. Or equal (no known equal).

B. Wire Management Rings, Wall/Ceiling Mounted:
1. Drawing References/Functions Features:
a. WMRB - Bridle Ring Type, Threaded Lag Screw.
b. WMRC - Closed Ring, U shaped assembly with two screw holes at ends.
c. WMRO - Open, Re-enterable Split Ring permitting cables to be inserted midspan, two screw holes at ends.
d. WMP - Steel back board with 4 inch deep min, 8 inch wide vertical wire management rings, front enterable. Provide trough at bottom of each column of WMP.
e. WMP T - Narrow, steel back board with 4 inch deep min, 3 inch wide vertical wire management rings, front enterable.
2. Provide as required to support indicated cable bundle and location.
3. Provide type WMRB at wood frame construction for cable hung from underside of ceiling, unless otherwise noted.
4. Manufacturers:
a. WMRB:
i. B-Line Fasteners, BR Series.
ii. Senior Industries.
iii. T&B
iv. Or equal.
b. WMRC:
i. AllenTel
ii. Chatworth Products Wall Mount Closed D Ring.
iii. Senior Industries.
iv. Or equal.
c. WMRO:
i. AllenTel.
ii. Chatworth Products Wall Mount Open Ring.

iii. Commscope/Systimax, Inc.
iv. Siemon.
v. Or equal.

d. WMP:
i. Siemon S188- to match adjacent terminal blocks with S188-WD.
ii. Ortronics OR-806003194 or OR-806003196 to match terminal blocks.
iii. By any manufacturer listed for 110TB under Section 17119 – Communications Termination Blocks and Patch Panels.
iv. Or equal.

e. WMP T:
i. Siemon SI10M-WM- to match adjacent terminal blocks.
ii. By any manufacturer of listed for 110TB under Section 17119Communications Termination Blocks and Patch Panels.
iii. Or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Refer to Section 17130 Communications Indoor Backbone Cabling for requirements for cable routing within IDF's, and BDF's.

3.2 INNERDUCT INSTALLATION

A. Schedule of Application.
1. Underground.
a. At 4" ducts and inside maintenance holes and vaults, place fiber cabling and 50 pair and smaller copper telephone cabling inside WMID.
b. Omit WMID at conduits smaller than 4 .
c. At tray conditions in utility tunnel and at backboard, cable runway and tray conditions at communications closets, protect fiber cabling with ID Innerduct.
d. Retention/Sealing of ducts at conduit entrances.
2. At plenum tray conditions, provide IDP.
3. At 4" and larger interior conduits, provide WMID. Provide plenum rated WMID at plenum ceiling conditions.

3.3 CONDUIT END WATERFALL

A. Fasten securely to conduit end wherever cabling will exit conduit 18" or more above the cable tray to prevent damage due to cabling due to weight of cable bearing on a conduit end.
B. Secure cabling with integral cable restraint system.

END OF SECTION

SECTION 17126
COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 1 GENERAL

1.1 SCOPE OF WORK
A. Section includes provision of power strips at racks and cabinets installed under the work of this Project.

1.2 RELATED WORK IN OTHER SECTIONS
A. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures.

1.3 REFERENCES
A. ELECTRONIC INDUSTRIES ALLIANCE (EIA).
   1. EIA-31 0-D (l992) Cabinets, Racks, Panels, and Associated Equipment (ANSIIEIA/31 0- D).

1.4 SUBMITTALS
A. Conform with the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.5 DELI ERY, STORAGE AND HANDLING
A. Procedures: In accordance with Section 01600 - Product Requirements and Section 17100 - Structured Cabling, Basic Materials and Methods.

1.6 SE UENCING
A. Not used.

PART 2 PRODUCTS

2.1 E UIPMENT ENCLOSURE PWER, PROTECTION AND SIGNAL GROUNDING
A. Comply with applicable Codes. Provide UL Listed devices suitable for commercial use. Provide all junction boxes, raceway, fittings, wire, supports and fastenings as required for complete installation. Unless otherwise noted, provide receptacles of NEMA 5-15R configuration.

B. Full Height Receptacle Strip, One (1) Circuit, 15A.
   1. Features/Construction:
      a. Not less than 70" Long.
      b. Not less than eleven (11) 15A receptacles.
      c. Integral circuit breaker.
      d. NEMA 5-15P plug on 6' cord.
      e. UL Listed Assembly.
      f. Provide mounting hardware as necessary to attach to rack interior.
   2. Manufacturers:
      a. Middle Atlantic/Datatel.
      b. Or equal.

C. Full Height Receptacle Strip, One (1) Circuit, 20A.

1. Features/Construction:
   a. Not less than 70" Long.
   b. Not less than eleven (11) 15A receptacles.
   c. Integral circuit breaker.
   d. NEMA 5-20P plug on 6' cord.
   e. UL Listed Assembly.
   f. Provide mounting hardware as necessary to attach to rack interior.
2. Manufacturers:
   a. Midde Atlantic PD-1020C-NS.
   b. Or equal.

PART 3 EXECUTION

3.1 CONFORM WITH THE RE UIREMENTS OF SECTION 17116 AND THE FOLLOWING

A. Mounting:
   1. Mechanically fasten strips to the rack/cabinet being served using strip or rack being served.
   2. Mount strip so that it does not impede user access to:
      a. ertical wire management integral to the racks.
      b. Front and rear movement of adjustable EIA mounting rails supplied with the rack or cabinet.
      c. Mounting of Owner furnished EIA rack mountable equipment within the served rack.
   3. Unless otherwise noted, the strip to be mounted to derive power from electrical receptacles mounted to the cable tray above the rack or drop box receptacles beneath the floor. Mount strip so that the power cord reaches the provided receptacles without:
      a. Causing tension on the power cord.
      b. Putting it in direct contact with signal cabling.
      c. Putting it in contact with sharp edges.
      d. Lacing it to parts intended to be movable, including, but not limited to:
         i. Slide out drawers and shelving.
         ii. Rack mounted for Owner furnished servers on pullout rails.
         iii. EIA adjustable mounting rails.

END OF SECTION

SECTION 17130
COMMUNICATIONS INDOOR BACKBONE CABLING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Work of this Section includes:
   1. Indoor Copper Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.
   2. Indoor Optical Fiber Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.
   3. Terminate fiber on patch panels as specified in Section 17119.
   4. Terminate copper cabling on terminal blocks as specified in Section 17119. Provide terminal block, high pair count copper connector cabling and rack mounted patch panels to permit Owner's telephone contractor to cross connect the entrance and riser cabling to individual station ports using Owner furnished patch cords.
   5. For all cabling:
      a. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 17100.
      b. Label cables, jacks, plates and patch panels as specified in Section 17053.
      c. Document on Record Documents as described in Section 17010.

B. Related work in other Sections.
   1. Section 17026 - Grounding and Bonding for Communications Systems.
   2. Section 17029 - Hangers and Supports for Communications Systems.
   3. Section 17033 - Conduits and Backboxes for Communications Systems.
   4. Section 17036 - Cable Trays for Communications Systems.
   5. Section 17053 - Identification for Communications Systems.
   6. Section 17100 - Structured Cabling, Basic Materials and Methods.
   7. Section 17116 - Communications Cabinets, Racks, Frames and Enclosures.
   8. Section 17119 - Communications Termination Blocks and Patch Panels.
   9. Section 17123 - Communications Cable Management.
   10. Section 17126 - Communications Rack Mounted Power Protection and Power Strips.
   11. Section 17150 - Communications Horizontal Cabling.

1.2 REERENCES

A. Refer to Section 17100 - Structured Cabling, Basic Materials and Methods.

1.3 SUBMITTALS

A. Conform to the requirements of Section 01300 - Administrative Requirements and Section 17010 - Common Work Results for Communications.

1.4 DELI ERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 01600 - Product Requirements and Section 17100 - Structured Cabling, Basic Materials and Methods.

1.5 SE UENCING

A. Not used.

PART 2 PRODUCTS

2.1 COPPER BACKBONE CABLING

A. General:
   1. Each conductor shall be a minimum of 22 or 24 AWG.
   2. Complies with:
      a. ICEA S-90-661.
      b. EIA TIA/EIA-568-B.1.
      c. EIA TIA/EIA-568-B.2.
      d. NEMA WC 63.1
      e. UL444.
   3. Solid conductor 100 ohm multipair UTP (Unshielded twisted pair), formed into 25 pair binder groups covered with a gray thermoplastic jacket.
   4. Imprinted with:
      a. Manufacturers name or identifier.
      b. Flammability rating.
      c. Gauge of conductor.
      d. Transmission performance rating (category designation).
      e. At regular intervals not to exceed 2 feet.
   5. The word "FEET" or the abbreviation "FT" shall appear after each length marking.
   6. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
      a. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.
      b. Meets EIA/TIA Category 3.
      c. USOC color code.
      d. NEC Type CM or CMG.
   7. Color coding shall comply with industry standards for 25 pair cables.

B. Inside Distribution Wire, Horizontal.
   1. Drawing Reference ** pro T-IDW, where ** refers to required pair count.
   2. Construction:
      a. 2 to 600 pair count voice pair cabling in overall jacket.
      b. Meets EIA/TIA Category.
      c. USOC color code.
      d. NEC Type CM or CMG.
      e. Nominal Outside Diameter, not to exceed the following:
      f.

Pair County	Outside Diameter (inches)
6 pr.	0.23
12 pr.	0.25
25 pr.	0.34
50 pr.	0.47
100 pr.	0.64
200 pr.	0.97
300 pr.	1.07
400 pr.	1.30
600 pr.	1.50

3. Manufacturer:
   a. Superior/Essex.
   b. General Cable.
   c. Or equal.

C. Inside Distribution Wire, Riser.
1. Drawing Reference ** pr. T-IDW-R, where ** refers to required pair count.
2. Construction:
   a. 25 to 600 pair count voice pair cabling in overall jacket.
   b. P C jacket.
   c. USOC color code.
   d. NEC Type CMR.
   e. Meets EIA/TIA Category 3.
   f. Nominal Outside Diameter, not to exceed the following:

P C	**O D , :**
25 pr.	0.54
50 pr.	0.70
100 pr.	0.86
200 pr.	1.20
300 pr.	1.30
400 pr.	1.50
600 pr.	1.90

3. Manufacturer:
   a. Superior/Essex.
   b. General Cable.
   c. Or equal.

D. Inside Distribution Wire, Plenum.
1. Drawing Reference ** pro T-IDW-P, where ** refers to required pair count.
2. Construction:
   a. 25 to 600 pair count voice pair cabling in overall jacket.
   b. Plenum rated jacket.
   c. USOC color code.
   d. NEC Type CMP.
   e. Meets EIA/TIA Category 3.
   f. Nominal Outside Diameter, not to exceed the following:

P C	**O D**

25 pr.	0.54
50 pr.	0.70
100 pr.	0.86
200 pr.	1.20
300 pr.	1.30
400 pr.	1.50
600 pr.	1.90

3. Manufacturer:
   a. Superior/Essex.
   b. General Cable.
   c. Or equal.

2.2 FIBER OPTIC COMMUNICATIONS CABLING AND RELATED

A. General Requirements:

1. Fiber count per cable to comply with minimum counts indicated on the plans. Plans indicate specific cable counts providing quantities of multimode and single mode fiber strands.
2. uantities are minimum quantities. At Contractor's option, provide a greater number. Where a greater number are provided, terminate, test, label and document all strands on fiber patch panels and/or terminal boxes as indicated as if quantity provided were called out for on the plans.
3. Where contract documents call for individual single mode and multimode cables, Contractor may substitute a hybrid cable with the same or greater strand count of each type.
4. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
   a. Provide nonconductive optical fiber general purpose cable (OFN or OFNG), nonconductive optical fiber plenum cable (OFNP), and nonconductive optical fiber riser cable (OFNR) rated cable in accordance with NFPA 70 and UL 910.
   b. Type OFNP or OFNR may be substituted for type OFN or OFNG and type OFNP may be substituted for type OFNR in accordance with NFPA 70.
5. Fiber media shall, at minimum, meet the following performance standards:
   a. ANSI/EIA/TIA 568-B.l.
   b. ANSI/EIA/TIA 568-B.3.
6. Fiber media shall, at minimum, meet the following construction standards:
   a. ICEA S-87-640.
   b. ICEA S-83-596.
   c. All dielectric, unless otherwise noted.
7. The cable cordage jacket, fiber, unit, and group color shall be in accordance with EIA TIAIEIA-598-B.
   a. Colors shall be across specified storage/installation temperature range.
   b. Means of providing conforming colors shall not degrade performance of cable.

8. Jacket:
   a. Free of splits, holes or blisters.
   b. Marked and listed in conformance with California Electric Code 770.
   c. Conform with:
      i. UL 1666 and
      ii. NFPA 70.
   d. Heavy duty construction, Fiberglass Epoxy Rod/Kevlar strength member(s).
   e. Each fiber to be 100 attenuation tested by the Manufacturer prior to shipping. Manufacturer's test to be affixed to shipping reel.
   f. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches. Hybrid fiber optic cable marking shall comply with EIA TIAIEIA-598-B.
9. Performance:
   a. Temperature Sensitivity:
      i. Storage: -40C degrees to 70C degrees.
      ii. Installation: -30C degrees to 70C degrees.
   b. ariance:
      i. Multimode.
   c. Specified attenuation is maximum allowed over entire operating range of cable.
      i. Single mode:
         (1) Average change, not more than 0.05 dB/km at 1550 -40C degrees to 70C degrees.
      ii. Maximum change not more than 0.15 dB/km at 1550 nm.

B. Fiber, Multimode - General.
1. Meeting EIA/TIA 568B.3 and EIA TIAIEIA-492AAAB, multimode, 50/125-urn diameter, 0.275 numerical aperture.
2. Construction:
   a. Multimode fiber strands.
   b. Core Diameter: 50.0 /- 3.0 m per TIA/EIA -455-176.
   c. Cladding Diameter: 125 /- 2.0 / m per TIA/EIA-455-176.
   d. Numerical Aperture:0.200 /- 0.015 per TIA/EIA-455-177.
   e. Core to Cladding Offset $\leq$ 3.0 /µm.
   f. Coating Diameter: 245 /- 10 / m per TIA/EIA-455-173 or 163.
   g. Core and Cladding Non-Circularity.
   h. Core: $\leq$ 5.0% per TIA/EIA -455-176.
   i. Cladding: $\leq$ 2.0% per TIA/EIA-455-176.
   j. Graded Index.
   k. Effective Group Index of refraction:
      i. 1.49 at 850 nm.
      ii. 1.49 at 1300 nm.
   l. Coating to be mechanically strippable, dual layered, U -cured acrylate applied by the fiber manufacturer.

3. Each fiber to be 100 proof-tested by the manufacturer to sustain 100 kpsi load minimum per TIA/EIA-455-31.
4. Performance:
   a. Bandwidth:
      i. Laser source, per TIA/EIA-492AAAC and draft IEC 60793-210 for type Al a.2, ensured by DMD performance specifications for sources meeting launch conditions specified in 10 Gigabit Ethernet (IEEE 802.3ae), OIF OC-192/STM-64 SR-4-04, and draft 10 Gigabit Fiber Channel (Tll.2 10GFC).
      (1) 850 nm: 950 MHz at 1 km.
      (2) 1300 nm: 500 MHz at 1km.
   b. Overfilled Launch/LED, per TIA/EIA-455-204.
      i. 850 nm: 700 MHz at 1 km.
      ii. 1300 nm: 500 MHz at 1km.
   c. Chromatic Dispersion:
      i. Minimum Zero Dispersion Wavelength: 1297 nm per TIA/EIA-455-168 or 175.
      ii. Maximum Zero Dispersion Wavelength: 1320 nm per TIA/EIA-455-168 or 175.
      iii. Maximum Zero Dispersion Slope: 0.101 ps/nm2^{e}km per TIA/EIA-455-168 or 175.
   d. Differential Mode Delay (DMD), ps/m, per DMD test methods TIA/EIA-455-220 and IEC 60793-1-49.
      i. 850 nm: .70.
      ii. 1300 nm: .88.
   e. Attenuation:
      i. 850 nm: ≤ 3.0 dB/km.
      ii. 1300 nm: ≤ 1.0 dB/km.
      iii. Max attenuation point discontinuity: 0.25 dB at any design wavelength.
      iv. Bending Attenuation induced 1550 run, with 100 turns on 75mm dia mandrel: 0.50 dB.
      v. Attenuation Difference at 1380 nm, ≤ attenuation at 1300 nm 3.0 dB/km.
      vi. Water Immersion: Induced attenuation, 23 degrees C water immersion: ≤ 0.1 dB/km.
   f. Manufacturers:
      i. Berk-Tek.
      ii. Or equal.

C. Fiber, Single Mode – General.
1. Meeting EIA/TIA 568B.3 and EIA TIA/EIA-492CAAA, single-mode, 8/125-m diameter, 0.10 numerical aperture.
2. Construction:
   a. Single mode fiber strands.

b. Mode field diameter: 9.3 /- 0.5 m at 1310 nm (measured per Petermann II) 10.5 /- 1.0 m at 1550 nm.
c. Core Diameter: 8.3 m.
d. Numerical Aperture: 0.11.
e. Cladding Diameter: 125 /- 1.0 m.
f. Cloating Diameter: 245 /- 10 m.
g. Cladding Non-Circularity: ≤ 1.0%.
h. Core to Cladding Offset: ≤ 0.8 µm.
i. Cabled Cutoff Wavelength (ccf): <1260 nm.
j. Coating to be mechanically strippable, dual layered, U -cured acrylate applied by the fiber manufacturer.
k. Each fiber to be 100 proof-tested by the manufacturer to sustain 100 kpsi load minimum.

3. Performance:
   a. Chromatic Dispersion:
      i. Minimum Zero Dispersion Wavelength: 1301.5 run.
      ii. Maximum Zero Dispersion Wavelength: 1321.5 nm.
      iii. Maximum Zero Dispersion Slope: 0.092 ps/nm2 per km.
   b. Dispersion:
      i. ≤ 3.2 ps/(nm^{e}km) from 1285 run to 1330 nm.
      ii. 18 ps/(nm^{e}km) at 1550 nm.
      iii. Polarization Mode Dispersion: ≤ 0.5 ps/ SQRT km.
   c. Attenuation:
      i. Point Discontinuity: ≤ 0.10 dB at 1310 nm or 1550 nm.
      ii. Water peak attenuation at 1383 /- 3 nm: ≤ 2.1 dB/km.
      iii. Bending Attenuation induced 1550 nm, with 100 turns on 75mm dia mandrel 0.10 dB.
      iv. Water Immersion: Induced attenuation, 23 degrees C water immersion: ≤ 0.05 dB/km.
   d. Manufacturer:
      i. Berk-Tek.
      ii. Or equal.

D. Fiber Optic Cable, Inside Distribution, Breakout Cable:
1. Drawing References:
   a. FOM-IDW Multimode, where indicates fiber count.
   b. FOS-IDW Single Mode, where indicates fiber count.
   c. FOH-IDW Hybrid, where indicates total fiber count. Ratio of Single mode to Multimode within overall count is 1:1, unless otherwise noted.
2. Fiber: Refer to:
   a. FIBER, MUL TIMODE, GENERAL, and
   b. FIBER, SINGLE MODE, GENERAL, as applies.
3. Application: In-building Distribution. Breakout Cable Applications.
4. Approvals: Where used outside conduit, OFN, OFNP, OFNR per NEC 770-51, as applies.

5. Construction:
   a. Refer additionally to Fiber Cable Construction, General, and elsewhere herein.
   b. Suitable and approved for indoor use.
   c. Tight buffer.
   d. At least one ripcord to facilitate sheath removal.
   e. Breakout style construction, with individual jacket per fiber with overall outside jacket.
   f. Maximum Cable Diameter:
      i. 2 Fibers: .236
      ii. 4 Fibers: .285
      iii. 6 Fibers: .363
      iv. 8 Fibers: .437
      v. 10 Fibers: .473
      vi. 12 Fibers: .506
   g. Performance:
      i. Maximum attenuation per EIA/TIA-455-61.
      ii. Multimode.
         (1) 850 nm: $\leq$ 3.5 dB/km.
         (2) 1300 nm: $\leq$ 1.5 dB/km.
      iii. Single mode.
         (1) 1300 nm: $\leq$ 1.0 dB/km.
         (2) 1550 nm: $\leq$ 1.0 dB/km.
   h. Minimum bend radius:
      i. During installation: 20 times cable outside diameter.
      ii. After installation: 10 times cable outside diameter.
   i. Maximum Safe Longitudinal Load:
      i. At installation:
         (1) 2 Fibers: 150lbs.
         (2) 4 Fibers: 290 lbs.
         (3) 6 Fibers: 380lbs.
         (4) 8 Fibers: 480lbs.
         (5) 10-12 Fibers: 575 lbs.
      ii. Long term application:
         (1) 2 Fibers: 25 lbs.
         (2) 4 Fibers: 90lbs.
         (3) 6 Fibers: 115 lbs.
         (4) 8 Fibers: 145lbs.
         (5) 10-12 Fibers: 75lbs.
      iii. Crush resistance: 250lb/inch.
      iv. Impact Resistance: 3.6 ft-lbs., 10 impacts.
      v. Flex, Twist/Bend 1000 cycles, 22 lbs., 10 x O.D. radius.
   j. Manufacturer, subject to above:
      i. Berk-Tek.
      ii. Or equal.

E. Fiber Optic Cable, Riser:
1. Drawing References:
a. FOM-R Multimode, where indicates fiber count.
b. FOS-R Single mode, where indicates fiber count.
c. FOH-R Hybrid, where indicates total fiber count. Ratio of Single mode to Multimode within overall count is 1:1, unless otherwise noted.
2. Fiber: Refer to:
a. FIBER, MUL TIMODE, GENERAL, and
b. FIBER, SINGLE MODE, GENERAL, as applies.
3. Application: Intra-building distribution in building risers and below building crawl space.
4. Listing: Meeting NEC/CEC OFNR, Listing by nationally recognized testing agency.
a. Construction:
i. Refer additionally to Fiber Cable Construction, General, and elsewhere herein.
ii. Jacket: Subject to listing and rating for vertical riser cable.
iii. Tight Buffer construction only, "Core Lock" not required.
iv. Otherwise as for FO -OP, except for construction affecting listing.
b. Dimensions, not to exceed the following:
i. 1 to 4 Fibers: 0.20".
ii. 5 to 12 Fibers: 0.28 .
iii. 12 to 24 Fibers: 0.50 .
iv. 25 to 60 Fibers: 0.80 .
v. 61 to 108 Fibers: 0.90 .
vi. 109 to 144 Fibers: 1.10 .
c. Performance:
i. As for FO -OP.
d. Manufacturer:
i. Berk-Tek.
ii. Or equal.

F. Fiber Optic Cable, Plenum:
1. Drawing References:
a. FOM-P Multimode, where indicates fiber count.
b. FOS-P Single mode, where indicates fiber count.
c. FOH-P Hybrid, where indicates total fiber count. Ratio of Single mode to Multimode within overall count is 1:1, unless otherwise noted.
2. Fiber: Refer to
a. FIBER, MULTIMODE, GENERAL, and
b. FIBER, SINGLE MODE, GENERAL, as applies.
c. Application: Intra-building distribution in building plenum and duct space.

3. Listing: Meeting NEC OFNP, Listing by nationally recognized testing agency.
4. Construction:
   a. Refer additionally to Fiber Cable Construction, General, and elsewhere herein.
   b. Jacket: Subject to listing and rating for plenum cable.
   c. Tight Buffer construction only, Core Lock not required.
   d. Otherwise as for FO -OP, except for construction affecting listing.
5. Dimensions, not to exceed the following:
   a. 1 to 4 Fibers: 0.20 .
   b. 5 to 12 Fibers: 0.28 .
   c. 12 to 24 Fibers: 0.50 .
   d. 25 to 60 Fibers: 0.80 .
   e. 61 to 108 Fibers: 0.90 .
   f. 109 to 144 Fibers: 1.10 .
6. Performance:
   a. As for FO -OP.
7. Manufacturer:
   a. Berk-Tek
   b. Or equal.

G. Fiber Optic Cable, Outside Plant, Riser and Inside, Constrained Diameter:
1. Drawing References:
   a. FOM-OPR Multimode, where indicates fiber count.
   b. FOS-OPR Single mode, where indicates fiber count.
   c. FOH-OPR Hybrid, where indicates total fiber. Ratio of Single mode to Multimode within overall count is 1:1, unless otherwise noted.
2. Fiber and Application:
   a. Inter-building and intra-building distribution in building risers, below building crawl space, manholes and site conduit.
   b. Specifically suitable for continuous splice free entry into building from OSP interior past without distance limits due to construction and/or cable diameter.
3. Listing: UL OFNR. Meeting NEC OFNR.
4. Construction:
   a. Refer additionally to Fiber able Construction, General, and elsewhere herein.
   b. Suitable and approved for wet location. Meets requirements for FO -OP where installed in those locations.
   c. As for FO -R with not to exceed dimensional constraint, as follows:

F C	**O C D .**
2	0.18
4	0.20
6	0.22
8	0.24

10	0.26
12	0.28
14	0.28
16	0.28
18	0.28
24	0.31
30	0.35
36	0.35
48	0.41
60	0.43
72	0.47
84	0.51
96	0.55
108	0.55
120	0.59
132	0.61
144	0.63
156	0.71

5. Performance:
   a. As for FO -R.
6. Manufacturer:
   a. Berk-Tek.
   b. Or equal.

PART 3 EXECUTION

3.1 FIBER OPTIC CABLING PRACTICE

A. Service Loop.
   1. At IDF's and BDF's, at both ends of cables, provide at least 30 feet of fiber in excess of that required to reach the patch panel by a dressed route. Form into a storage loop and fix in place as directed by the Owner's Representative.
   2. At the Telecomm Building, provide at least 30 feet of fiber in excess of that required to reach the patch panel by a dressed route. Form into a storage loop and fix in place in the cable vault (outside of the machine room) as directed by the Owner's Representative.

B. Splicing.
   1. Interior: Provide fusion splices.
   2. Exterior: Do not splice at exterior unless splicing is indicated on Plans. In such circumstances, provide fusion splices.

C. Termination Methods.
   1. Review proposed breakout procedure with the Owner's Representative before beginning this work.
   2. Use full cable breakout method. Display both connectorized and non-connectorized fibers entering a patch panel.

3. Remove sheath so that no more than 4 inches of unstripped cable enters the panel.
4. Strip back a sufficient amount of cable so that fiber strands wrap at least one full wrap, circle or figure eight, inside the panel with the connectorized ends attached to the most distant bulkhead connectors.
5. Group together the fibers from each binder group with 0.125 inch nylon spiral wrap. (Commscope/Systimax, Panduit, Corning Cable Systems SAN-DT25-06, or equal.)

D. Outside Plant.
1. Obtain allowable pulling tension for underground fiber cable from the manufacturer. Use pulling equipment with tension gauges to verify that cable pulls do not exceed allowable pulling tension.
2. Loose Tube, Gel Filled Cabling - No flow of filling when tested in accordance with FOTP-81.

E. Loose Tube Breakout.
1. Install breakout tubing over the full exposed length of the fiber strands.
2. Install buffer tubing on all strands, including those not being connectorized as part of this Contract.
3. Reinforce and protect the junction of the cable sheath and buffer tubing using a method approved by the Owner's Representative before beginning this work.

3.2 COPPER BACKBONE TIE CABLE INSTALLATION AND TERMINATION

A. General:
1. Backbone cable(s) shall be installed in conduit system unless otherwise noted.

B. Sequencing:
1. If the installation of a tie cable requires the disconnection and removal of any existing cable(s) carrying active service prior to installation.
   a. Notify the Owner's Representative no less than 5 working days in advance of when this work is to be performed.
2. When this work is performed, the newly installed cables must be installed, tested and passed in one 24 hour period beginning when the active service on the existing cable is interrupted.

C. Installation of Tie Cable:
1. All tie cable between terminal blocks at IDF rooms shall be continuous, unspliced runs.
2. Termination of oice or Shared Use Tie Cable:
   a. Cable shall be terminated on 66 Type punch blocks system in the following order:
      i. Terminate pairs and groups in order top to bottom and then left to right according to insulation or binder color as listed below.
      ii. Mate is the first wire of the pair to be terminated, Wire is the second.
   b. Comply with the following table:

G N	P	M	B	W
1		White	Blue	
2		White	Orange	
3		White	Green	
4		White	Brown	
5		White	Slate	
6		Red	Blue	
7		Red	Orange	
8		Red	Green	
9		Red	Brown	
10		Red	Slate	
11		Black	Blue	
12		Black	Orange	
13		Black	Green	
14		Black	Brown	
15		Black	Slate	
16		Yellow	Blue	
17		Yellow	Orange	
18		Yellow	Green	
19		Yellow	Brown	
20		Yellow	Slate	
21		iolet	Blue	
22		iolet	Orange	
23		iolet	Green	
24		iolet	Brown	
25		iolet	Slate	

3. Cables containing pair counts of 50 or greater shall be terminated as follows:
   a. Columns of punch blocks stacked 2 high shall be mounted on the backboard.
   b. Beginning at the top right of the 1st column, first the blue binder will be punched down, followed by the orange binder directly beneath it.
   c. Binder punch will continue top to bottom, and then left to right until the entire cable has been terminated.
   d. Thus a 50-pair cable requires two punch blocks.
4. Upon completing the termination of all cables within an IDF, install a clear plastic cover at each punch block.

3.3 DATA TELEPHONE IDF ROOM LAYOUT

A. General:
1. Final backboard design layout within an IDF room shall be approved by the Owner's Representative prior to work beginning on the backboard.
2. Reference the design basis layout in the plans and bring to the Owner's Representative's attention any field conditions that would prevent installation as shown on the plans. Submit for resolution in a timely manner.
3. Layout of cable around backboard:

a. All backbone cable shall be formed around the backboard before either rising or dropping vertically to the punch blocks on which they are to be terminated.
b. All backbone cable shall be organized in Wire Management Rings, Split D, Type WMRO. No tywraps or similar bindings are permitted.

4. Termination:
a. Terminate voice pairs and BDF tie cable on 66 blocks.

3.4 DATA TELEPHONE NODE AND BDF ROOM LAYOUT

A. General:
1. Final backboard and cable runway design layout within the Telecomm Building or within a BDF room shall be approved by the Owner's Representative prior to work beginning.
2. Reference the design basis layout in the plans and bring to the Owner's Representative's attention any field conditions that would prevent installation as shown on the plans. Submit for resolution in a timely manner.

B. Layout of cable around backboard:
1. All cables shall be formed around the backboard before either rising or dropping vertically to the punch blocks on which they are to be terminated.
2. All cables shall be organized in Wire Management Rings, Split D, and Type WMRO. No tywraps or similar bindings are permitted.

C. For outside plant, flooded cables entering the Telecomm Building, a BDF or an IDF functioning as a building entrance facility:
1. Transition in a splice case to non-flooded cable prior to termination on protector blocks for voice pairs, or on an unprotected 66 block for systems pairs, where such are indicated. Where systems pairs are not indicated, assume all pairs are for voice use.
2. Position the splice case on the backboard where accessible for future service. Orient parallel to floor to prevent continuous gel flow from OSP cabling. Place on cable tray only where such placement is indicated on the plans.

END OF SECTION

SECTION 17150
COMMUNICATIONS HORI ONTAL CABLING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes, but is not necessarily limited to provision of:
   1. Horizontal Station Cabling
      a. Horizontal copper station cabling, meeting TIA/EIA Category 6 standards, homerun from receptacles to indicated BDF. Terminate on rack mounted patch panels, as indicated.
   2. For all cabling:
      a. Terminate on patch panels as specified in Section 17119 – Communications Termination Blocks and Patch Panels.
      b. Test cabling to demonstrate performance meets or exceeds specified standards using test equipment and methods as specified in Section 17100 – Structured Cabling, Basic Materials and Methods.
      c. Label cables, jacks, plates and patch panels as specified in Section 17053 – Identification for Communications Systems.
      d. Document on Record Documents as described in Section 17010 – Common Work Results for Communications.

B. Related Documents:
   1. Specification Section 17010 – Common Work Results for Communications applies to this Section.

C. Related Work in Other Sections:
   1. Section 17029 – Hangers and Supports for Communications Systems
      a. J-hooks and hangers for the work of this Section.
   2. Section 17033 – Conduits and Backboxes for Communications Systems
      a. Empty raceway for the work of this Section.
   3. Section 17036 – Cable Trays for Communications Sytstems
      a. Empty tray for the work of this Section.
   4. Section 17039 – Surface Raceways for Communications Systems
      a. Empty raceway for the work of this Section.
   5. Section 17053 – Identification for Communications Systems
      a. Labeling systems and execution for the work of this Section.
   6. Section 17119 – Communications Termination Blocks and Patch Panels
      a. Specification for patch panels and blocks used by work of this Section
   7. Section 17123 – Communications Cable Management
      a. Specification for innerduct, backboard and patch cord management used by the work of this Section.

1.2 REFERENCES

A. As listed in Section 17100 – Structured Cabling, Basic Materials and Methods.

1.3 SUBMITTALS

A. Conform with the requirements of Section 01300 – Administrative Requirements and Section 17010 – Common Work Results for Communications.

1.4 DELI ERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 01600 – Product Requirements and Section 17100 – Structured Cabling, Basic Materials and Methods.

1.5 SE UENCING

A. Not Used.

PART 2 PRODUCTS

2.1 GENERAL

A. All products shall be NEW.

B. All devices shall comply with all parts of ANSI/TIA/EIA 568-B.1, B.2, B.3 Commercial Building Telecommunications Standard.

C. The wiring configuration for all telecommunications devices shall be T568-B.

D. All UTP cabling shall meet or exceed all requirements in this specification, ANSI/TIA/EIA S-80-576 that are applicable to four-pair inside wiring cable for non-plenum spaces within a building.

E. All Copper data cabling and data connectivity products shall be manufacturer-recommended end-to-end combinations (patch cords, station connectors, horizontal cabling, and patch panels). The selected combination must meet the following criteria:

1. ETL erified Components to ANSI/TIA-568-B.2-1 (Category 6)
2. ETL erified Patch Cords to ANSI/TIA-568-B.2-1 (Category 6)
3. ETL erified Communications Cables to ANSI/TIA 568-B.2-1 (Category 6).

F. Products are specified throughout this specification either by reference standard or by manufacturer and part number in order to establish quality and performance characteristics of individual products. Contractor s options for selecting each product are as follows:

1. Product specified only by reference standards: Select any product meeting standards.
2. Product specified by naming several products and/or manufacturers: Select any product and/or manufacturer named.
3. Product specified by naming several products and/or manufacturers and reference standards: Select any product meeting standards. Product and/or manufacturer names indicate products and/or manufacturers, which meet standards.
4. Product specified by naming only product: Select product specified.
5. Product specified by naming one or more products and stating or equal with the specified product: Select any product named or submit request for substitution for any product not specifically named. Product substitutions submitted prior to bid shall be handled according to procedures outlined in section 00430 – Supplements to Bid Form. Product substitutions submitted after contract award shall be handled according to procedures outlined in sections 00700 – General Requirements and 01600 – Product Requirements.

2.2 DATA AND OICE HORI ONTAL CABLE

A. Drawing Reference:
   1. Plenum rated (CMP) cables: UTP6-4P, where: cable count
   2. Riser rated (CMR) cables: UTP6-4, where: cable count

B. The horizontal cable, running to/from each data or voice port, shall be BLUE in color.

C. Manufacturer:
   1. In plenum spaces, Berk-Tek 4 pair, 24 AWG, Category 6, CMP, LanMark 1000 P/N 10032094 or equal.
   2. In spaces not noted as plenum space, Berk-Tek 4 pair, 24 AWG, Category 6, CMR, LanMark 1000 P/N 10032455 or equal.

2.3 MODULAR JACKS AND BLANK INSERTS

A. Modular Jacks
   1. Single modular inserts for data and voice ports shall be 8-position, 8-conductor, 180 , T568A/B.
   2. Manufacturer:
      a. The modular insert for data port #1 shall be DARK ORANGE, Ortronics P/N OR-TJ600-43 or equal.
      b. The modular insert for data port #2 shall be DARK ORANGE, Ortronics P/N OR-TJ600-43 or equal.
      c. The modular insert for data port #3 shall be DARK ORANGE, Ortronics P/N OR-TJ600-43 or equal.
      d. The modular insert for data/voice port #4 shall be DARK BLUE, Ortronics P/N OR-TJ600-36 or equal.

B. Blank Inserts
   1. All empty positions within a faceplates and surface mount boxes shall be filled with blank inserts.
   2. Manufacturer:
      a. Ortronics TracJack, FOG WHITE P/N OR-42100002-88 or equal.

2.4 WORK AREA FACEPLATES AND DE ICE BOXES

A. Drawing Reference:
   1. MMP4 Wall mount, single gang, 4-port faceplate
   2. MMP6 Wall mount, single gang, 6-port faceplate
   3. IRR4 Inline surface raceway, single gang, 4-port faceplate
   4. IRR6 Inline surface raceway, single gang, 6-port faceplate
   5. OMP4 System furniture, 4-port faceplate
   6. OMP6 System furniture, 6-port faceplate

B. All faceplates shall be UL listed and CSA certified.

C. All faceplates shall be constructed of high-impact, ABS plastic UL 94 -0 construction (unless otherwise specified).

D. All faceplates shall have a minimum of four (4) modular inserts.

E. Manufacturer:

1. Wall mount, single gang 4 port faceplate Ortronics TracJack Series, FOG WHITE, P/N OR-40300546 or equal.
2. Wall mount, single gang, 6 port faceplate Ortronics TracJack Series, FOG WHITE, P/N OR-40300545 or equal.
3. Inline surface raceway faceplates shall be from the same manufacturer and product series as the raceway itself. Faceplates shall be specifically designed by the manufacturer to accept the data and voice modular inserts specified in this section.
4. System furniture, 4-port faceplate Ortronics TracJack Series, BLACK, P/N OR-40300633-00 or equal.

2.5 WALL TELEPHONE FACEPLATES

A. Drawing References:
   1. Wall Mounted Telephone, Flush
   2. 630A

B. Construction, where not otherwise specified, scheduled, or indicated:
   1. Mechanically fastened to building or similar. Adhesive fastening is not acceptable.
   2. Stainless steel or high strength 94 O plastic.
   3. Mounts to single gang ring, single gang box, or surface mount box. Refer to schedule on drawings.
   4. Shall accept one (1) modular jack specified in paragraph 2.3.
   5. Face of jack is flush with surface of faceplate when mounted into faceplate.

C. Manufacturer:
   1. Ortronics OR-40300637
   2. Or equal.

2.6 DATA PATCH CORDS

A. All UTP patch cords shall be factory terminated.

B. Lengths at the workstation shall not be less than 5 ft nor more than 9 ft.

C. Lengths at the patch panel shall not be less than 3 ft nor more than 15 ft.

D. Coordinate lengths in with the owner through the construction chain of command prior to purchasing.

E. Manufacturer:
   1. 3 ft patch cords Ortronics Clarity Category 6, BLUE, P/N OR-MC603-06 or equal.
   2. 5 ft patch cords Ortronics Clarity Category 6, BLUE, P/N OR-MC605-06 or equal.
   3. 7 ft patch cords Ortronics Clarity Category 6, BLUE, P/N OR-MC607-06 or equal.
   4. 9 ft patch cords Ortronics Clarity Category 6, BLUE, P/N OR-MC609-06 or equal.
   5. 15 ft patch cords Ortronics Clarity Category 6, BLUE, P/N OR-MC615-06 or equal.

2.7 OICE PATCH CORDS

A. This section applies to patch cords used to distribute dial tone from voice backbone termination blocks to patch panels in the telecommunications Entrance Facility (EF)

and each Telecommunications Room (TR) ONLY. See paragraph 2.5 for specifications for patch cords used to distribute data connections in Telecommunications Equipment Rooms (ER), Telecommunications Rooms (TR), and work areas.

B. oice patch cords shall be single-ended, 4-pair solid cable assembly, T568B, gray jacket, 20 ft, CMR, no boot

C. Manufacturer:
   1. Siemon P/N IC5-8A-20
   2. Or equal.

2. UNSPECIFIED PRODUCTS

A. Any product not specifically addressed in this specification or on the drawings but required in order to provide a complete and functional structured cabling system shall be provided by the telecommunications contractor in a quantity and level of quality consistent with the specified items. Unspecified products shall be approved by the owner through the construction chain of command prior to installation. Product submittal requirements for specified products shall also apply to unspecified products.

PART 3 EXECUTION

3.1 GENERAL

A. All devices shall comply with ANSI/TIA/EIA 568-B., B.2, B.3 Commercial Buildings Telecommunications Standard.

B. All telecommunication outlets shall be T568B wiring configuration.

C. All products shall meet or exceed all requirements of this specification.

D. The telecommunications contractor s work shall comply with all contract documents including, but not limited to:
   1. Architectural floor plans
   2. Furniture plans
   3. Equipment layouts
   4. Electrical contract documents
   5. Telecommunications contract documents

E. The telecommunications contractor shall coordinate all work with all other trades and:
   1. Project manager
   2. General contractor
   3. Electrical contractor
   4. Owner

F. The telecommunications contractor shall refer to drawings for pathways including sleeves, conduits, cable trays and runways, and J-hook supports to be utilized for the structured cabling system.

G. The telecommunications contractor shall perform work so that progress of entire project including work of other sections is not interfered with or delayed.

H. The telecommunications contractor shall obtain detailed installation information from all manufacturers under other specification sections that affect the installation of the

structured cabling system and provide information on products furnished under this section that affect work specified in other sections.

I. The telecommunications contractor shall not disrupt existing services. Existing services shall remain operational at all times unless there is a compelling need to disrupt them. If such a compelling need is determined to exist, then the telecommunications contractor shall coordinate an outage through the construction chain of command at least 48 hours in advance.

3.2 WORKMANSHIP

A. All work shall adhere to the reference standards in Part 1 of this specification.

B. Work shall be executed in workmanlike manner and shall be neat, plumb, parallel to the building structure, perpendicular to all electronics and associated cabling and neat in appearance when completed.

C. The telecommunications contractor shall maintain maximum headroom at all times and shall not run work exposed unless noted as such on the drawings.

D. Material and equipment shall be new and installed according to manufacturer s recommended best practices so that the completed installation operates safely and efficiently.

E. The telecommunications contractor is responsible for the greater quantity and better quality where conflicts exist.

F. Any reference to telecommunications outlet shall indicate faceplate, modular insert, termination, cabling, labeling, etc.

G. All cabling shall be terminated at both ends unless otherwise noted on the drawings.

3.3 DATA AND OICE HORI ONTAL CABLE

A. Install one (1) horizontal Category 6 cable from each data and voice modular insert within faceplate to its corresponding patch panel.

B. All cables shall be labeled at both ends with the cable ID using equipment and permanent labels approved by the owner. See Section 17053 – Identification for Communications Systems for cable identification specifications.

C. All four pairs of each horizontal cable shall be terminated at both ends.

1. One end of the horizontal cable shall be terminated in an 8-position, 8-conductor modular jack at the telecommunications outlet.
2. One end of the horizontal cable shall be terminated in an 8-position, 8-conductor 110 data patch panel within the Telecommunications Room (TR).

D. Install cable in specified raceways and cable trays.

E. Cable pulling: Pulling tension: Maximum pulling tensions for 4-pair horizontal UTP cable shall not exceed 110N (25 lbf).

F. Maintain cable twist to within inch of the main point of Insulation Displacement Contact (IDC).

G. When stripping cable for termination remove only a minimum amount (i.e., as little as possible) of cable jacket insulation (not to exceed inch).

H. Additional cable slack (Service Loop) shall be provided at both ends for maintenance or future cabling system changes:

1. Telecommunications Entrance Facility (EF)/Telecommunications Rooms (TRs)/Service Loop: 10 feet (arranged in figure 8 or serpentine fashion wherever possible to avoid inductance).

2. Work Area or Wall Telephone outlet: 3 feet

I. Splices are not permitted in any horizontal cabling.

J. No horizontal cable run from modular connector to patch panel shall exceed 90 m (295 ft) including slack.

K. Horizontal cable shall run loose throughout all conduits. At no time shall any horizontal cable within a conduit be secured by zip ties, electrical, tape, hook and loop closure straps or similar bindings.

L. Cables for corresponding data and voice ports shall be terminated on separate patch panels. See Section 17053 – Identification for Communications Systems for cable identification specifications.

1. Patch panel A shall be used to terminate data port #1 for all stations.
2. Patch panel B shall be used to terminate data port #2 for all stations.
3. Patch panel C shall be used to terminate data port #3 for all stations.
4. Patch panel D shall be used to terminate data/voice port #4 for all stations.
5. Patch panel P shall be used to terminate all wall telephones.

3.4 MODULAR JACKS AND BLANK INSERTS

A. Install all data and voice modular inserts.

B. Refer to the drawings for configuration and orientation of modular inserts within each data and voice faceplate.

C. Refer to the drawings for configuration and orientation of icons.

3.5 WORK AREA AND WALL TELEPHONE FACEPLATES AND DE ICE BOXES

A. Install all faceplates and device boxes.

B. Refer to the drawings for location of work area and wall telephone faceplates and device boxes.

C. Refer to the drawings for configuration and orientation of work area and wall telephone faceplates and device boxes.

D. Coordinate exact location, configuration, and orientation of all work area and wall telephone faceplates and device boxes through the construction chain of command prior to installation.

3.6 DATA PATCH CORDS

A. The telecommunications contractor shall provide a quantity of patch cords to match 100 percent of the total quantity of data and voice ports terminated within each installed patch panel.

B. The telecommunications contractor shall provide a quantity of patch cords to match 100 percent of the total quantity of installed data modular inserts within the data/voice faceplates at the work areas.

C. The telecommunications contractor shall deliver all patch cords to Owner s Representative.

3.7 TESTING AND CERTIFICATION

A. 100 percent of horizontal data and voice cabling shall be tested and certified in accordance with Section 17160 – Communications Structured Cable Testing and Certification.

END OF SECTION

APPENDIX D – STRUCTURAL CALCULATIONS

SLO Police Department Fence

1120 Walnut St.

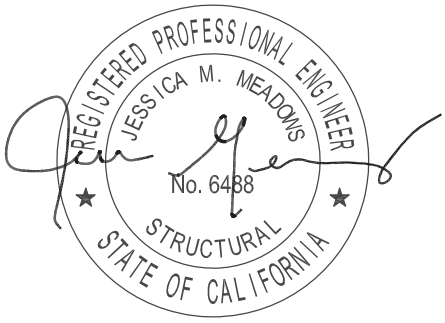
RRM Project No. 2504-05-PS23

STRUCTURAL CALCULATIONS

August 23, 2024

Prepared by: Ian Kelly, EIT

Under Direction of: Jessica Meadows, SE



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Index of Structural Calculations

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PROJECT DESIGN CRITERIA

PROJECT LOCATION:

Address: 1120 Walnut St.
San Luis Obispo, CA 93401

Latitude: N 35.2861°
Longitude: W 120.6628°

DESIGN CODES:

Notation	Code/ Standard Reference	Title
A	ASCE 7-16	Minimum Design Loads for Buildings and Other Structures
C	2022 CBC	2022 California Building Code
I	ACI 318-19	2019 Building Code Requirements for Structural Concrete
M	TMS 402/ 602-16	2016 Building Code Requirements and Specification for Masonry Structures
S	AISC 360-16	2016 Steel Construction Manual
W	2018 NDS	2018 National Design Specification for Wood Construction
SDP	2021 SDPWS	2021 Seismic Deisgn Provisions for Wind and Seismic (American Wood Council)

MATERIAL REFERENCES:

Notation	Material Reference	Title
B		Design of Wood Structures ASD/LRFD, Breyer, 6th Edition
T	TJ-4000	Weyerhaeuser Specifier's Guide

PROJECT DESCRIPTION:

The calculations herewith represent the following structures as described:

Fence Anchorage and Foundation
Configuration: Fence Post Anchorage and Foundation
Gravity System: N/A

Lateral System: N/A

Foundation System: Continous Concrete Footings Suppourting Walls and Deepend Footings for Posts and
Special Considerations: 25' Rolling Gate
Existing Wood and CMU Walls around the Perimeter

PROJECT DESIGN CRITERIA

GEOTECHNICAL PARAMETERS: CBC Ch. 18 Table 1806.2

Geotechnical Report:

Prepared by:	N/A	
Project No:	N/A	
Dated:	N/A	

Bearing Pressure:

Allowable Bearing Pressure:	1500	psf
Passive Earth Pressure:	100	psf/ft
Friction Coefficient:	0.25	
Friction + Passive:	100% Greater + 100% Lesser	

Retaining Walls:

Allowable Bearing Pressure:	N/A	psf
Passive Earth Pressure:	N/A	psf/ft
Friction Coefficient:	N/A	
Friction + Passive:	N/A	
Active Lateral Earth Pressure:	N/A	psf/ft for Level Backfill
Increase for Slope:	N/A	psf/ft per degree of incline
At Rest Lateral Earth Pressure:	N/A	psf/ft for Level Backfill
Increase for Slope:	N/A	psf/ft per degree of incline
Seismic Active Earth Pressure:	N/A	psf/ft for Level Backfill
Seismic At-Rest Earth Pressure:	N/A	psf/ft for Level Backfill

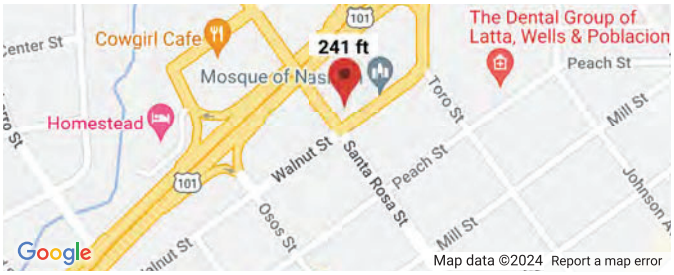
This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

Search Information

Coordinates:	35.286176023013915, -120.66280248560875
Elevation:	241 ft
Timestamp:	2024-06-25T21:43:33.357Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	IV
Site Class:	D-default



Basic Parameters

Name	Value	Description
S_S	1.064	MCE_R ground motion (period=0.2s)
S_1	0.392	MCE_R ground motion (period=1.0s)
S_{MS}	1.276	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.851	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.899	Coefficient of risk (0.2s)
CR_1	0.902	Coefficient of risk (1.0s)
PGA	0.471	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.566	Site modified peak ground acceleration
T_L	8	Long-period transition period (s)
SsRT	1.064	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.184	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	2.142	Factored deterministic acceleration value (0.2s)
S1RT	0.392	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.435	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.753	Factored deterministic acceleration value (1.0s)
PGAd	0.879	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

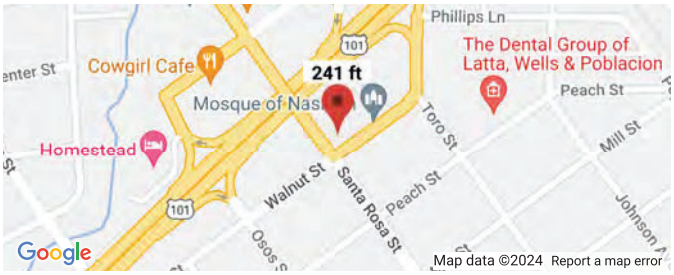
Search Information

Coordinates: 35.286176023013915, -120.66280248560875

Elevation: 241 ft

Timestamp: 2024-06-25T21:46:08.434Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year	64 mph
MRI 25-Year	70 mph
MRI 50-Year	74 mph
MRI 100-Year	78 mph
Risk Category I	86 mph
Risk Category II	91 mph
Risk Category III	98 mph
Risk Category IV	102 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

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Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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rrm design group

SHEET NO.

PROJECT NO. 2504-05-PS23

DATE 08/2024

PROJECT SLO PD

BY IPK

SUBJECT 6' Perimeter Fence – Lateral Loads

CHECKED BY MSD

8 FT FENCE GATE

WIND LOAD

FOR VELOCITY PRESSURE ON OTHER STRUCTURES, USE ASCE 7-16 EQN (29.4-1);

$q_h = 0.00256(K_Z)(K_{Zt})(K_d)(K_e)(V^2)$ PER ASCE 7-16 EQN (26.10-1)

WHERE:

EXPOSURE LEVEL	:	C	
V = BASIC WIND SPEED (3s GUST, ULTIMATE)	:	102	mph
K_Z = VELOCITY PRESSURE COEFFICIENT PER ASCE 7-16 TABLE 26.10-1	:	0.85	
K_{Zt} = TOPOGRAPHIC FACTOR PER ASCE 7-16, SECTION 26.8.2	:	1.00	
K_d = WIND DIRECTIONALITY FACTOR PER ASCE 7-16 TABLE 26.6-1	:	0.85	
K_e = GROUND ELEVATION FACTOR PER ASCE 7-16 TABLE 26.9-1	:	1.00	

qh = 0.00256(0.85)(1)(0.85)(1)(102^2) = 19.22 psf

FOR WIND ON SOLID FREESTANDING WALL, USE ASCE 7-16 EQN (29.3-1);

$F_{WIND} = q_h(G)(C_f)(A_s)$

WHERE:

G = GUST EFFECT FACTOR PER ASCE 7-16, SECTION 26.11	:	0.85
Cf = NET FORCE COEFFICIENT PER ASCE 7-16, FIG 29.4-1	:	2.064

NOTE: ASSUMED MAXIMUM ASPECT RATIO, B/s = 10.0
REDUCTION FACTOR PER NOTE 4 OF 0.8 FOR s/h = 1.0.
ON TOTAL WALL, 1.85*(0.8) = 2.06

Fwind = 19.22(0.85)(2.064)(As) = 33.72 psf x As

Fwind @ STRENGTH = 33.7 psf x As
Fwind @ SERVICE = 20.2 psf x As

WIND GOVERNS

rrm design group

SHEET NO.

PROJECT NO. 2504-05-PS23

DATE 08/2024

PROJECT SLO PD

BY IPK

SUBJECT 6' Perimeter Fence – Lateral Loads

CHECKED BY MSD

8 FT FENCE GATE (CONT.)

SEISMIC LOAD

SEISMIC BASE SHEAR, $V_{SEIS} = C_S(W)$

WHERE:

C_S = SEISMIC RESPONSE COEFFICIENT PER ASCE 7-16 SECTION 12.8.1.1

W = EFFECTIVE SEISMIC WEIGHT : 5.0 psf

$$C_S = \frac{S_{DS}}{\left(\frac{R}{I_E}\right)}$$

WHERE:

S_{DS} = SEISMIC COEFFICIENT (SITE CLASS D) : 0.851

R = RESPONSE MODIFICATION FACTOR (TABLE 15.4-2) : 1.25

I_e = SEISMIC IMPORTANCE FACTOR : 1.0

WHERE:

S_1 = SEISMIC PARAMETER @ PERIOD = 1.0sec : 0.392

S_{D1} = SPECTRAL RESPONSE ACCELERATION @ PERIOD = 1.0sec : 0.7448

T = FUNDAMENTAL PERIOD (USE T_a PER ASCE 7-16 SECTION 12.8.2.1) : $C_t(h_n^x)$

C_t = APPROXIMATE PERIOD PARAMETER PER TABLE 12.8-2 : 0.02

x = APPROXIMATE PERIOD PARAMETER PER TABLE 12.8-2 : 0.75

h_n = HEIGHT IN FEET OF HIGHEST LEVEL OF STRUCTURE : 8.00 ft

THE VALUE OF C_S SHALL BOT BE LESS THAN 0.03

C_S = 0.681 ← GOVERNS

C_{S_MAX} = 6.263 (Ta = 0.095 sec)

C_{S_MIN} = 0.037

Vseis = (0.681)(5 psf) = 3.4 psf

Vseis @ STRENGTH = 3.4 psf x As

Vseis @ SERVICE = 2.38 psf x As

rrm design group

SHEET NO.

PROJECT NO. 2504-05-PS23

DATE 08/2024

PROJECT SLO PD

BY IPK

SUBJECT 6' Perimeter Fence – Lateral Loads

CHECKED BY MSD

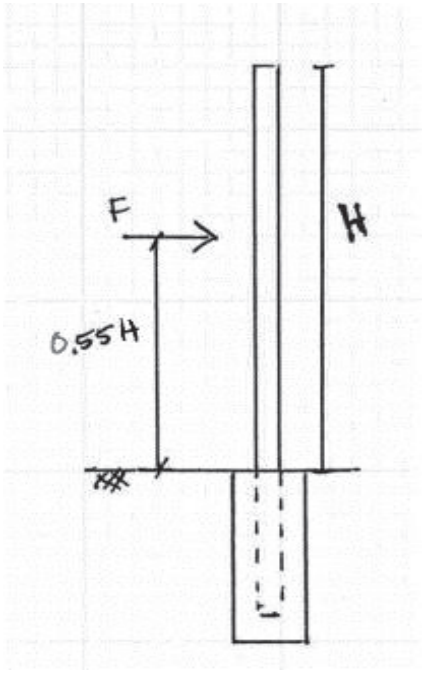
8 FT CE GATE (CONT.)

POLE FOOTING DESIGN

WIND GOVERNS
Fwind @ STRENGTH = 33.7 psf x As
Fwind @ SERVICE = 20.2 psf x As

MAX SPAN =	8	FT OC
H =	8	FT
0.55*H =	4.4	FT

As =	(8 FT) * (8 FT)	
Open Section =	0.5	50%
As =	32	FT^2
Fwind =	648	LBS @ 4.4 FT ABOVE GRADE



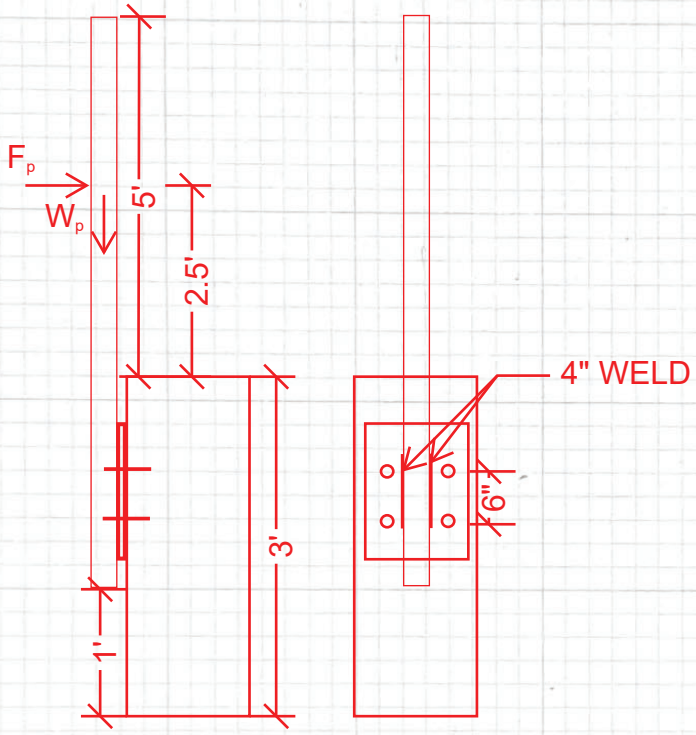
PROVIDE 1'-0" DIAMETER x 5'-0" DEEP POLE FOOTING AT 8' FENCE GATE.
SEE FOLLOWING PAGE FOR POLE FOOTING CALCULATIONS.

Project Name: SLO PD	**Date:** 06/24
Project #: 2504-05-PS23	**Scale:**
Participants:	
Topic/Subject: FENCE CONNECTION TO EXISTING WALL	

Fence Attachment to (E) CMU Wall

DETAIL 33/S-321

Scale: NTS



q = 33.7 psf *from spreadsheet*

As = 8ft x 5ft = 40ft^2

Open Section = 0.5 (50%)

As = 20ft^2

Fw = 404.4lbs

M2over = Fw x 30" = 12,132#-in

M2dead = 0.9 x 150 lbs. x 1" = 135 #-in

Tw = $\frac{12{,}132\ \#\text{-in} + 135\#\text{-in}}{6"}$ = 2044.5 lbs / 2 anchors

Tw = 1022.3 lbs / anchor
Vw = 404.4 lbs / 2 anchors = 202.2 lbs / anchor

Load Amplification from 1500 psi CMU

Tw = 1022.25/0.866 = 1180.43 lbs / anchor
Vw = 202.2/0.866 = 233.5 lbs / anchor

USE SET-3G w/ 3/8" Ø F1554 Gr. 36 w/ 3" EMBED

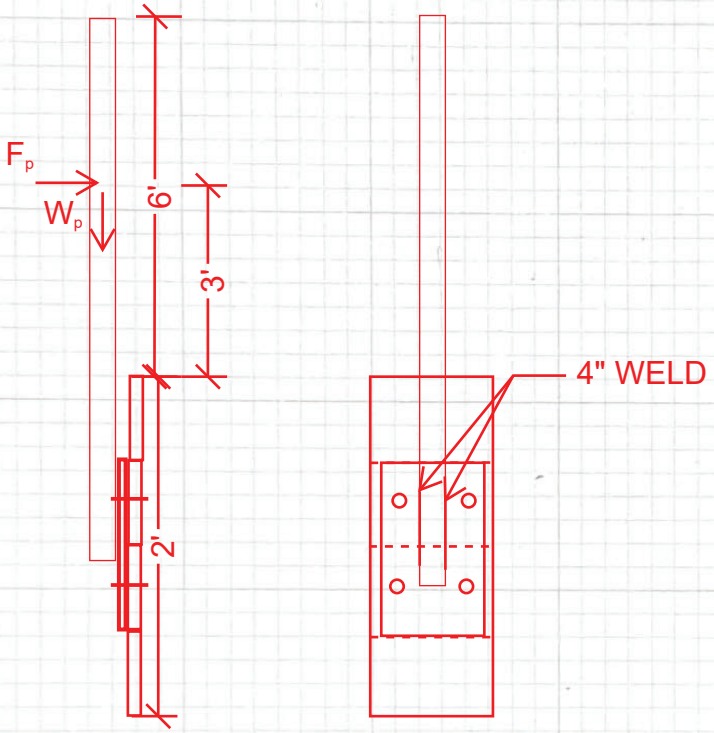
USE A36 PLATE 1'-3" x 0.75' x 0'-1/4"

Project Name: SLO PD	**Date:** 06/24
Project #: 2504-05-PS23	**Scale:**
Participants:	
Topic/Subject: FENCE CONNECTION TO EXISTING WALL	

Fence Attachment to (E) Wood Wall

DETAIL 43/S-321

Scale: NTS



q = 33.7 psf *from spreadsheet*

As = 8ft x 6ft = 48ft^2

Open Section = 0.5 (50%)

As = 24ft^2

Fw = 485.3lbs

M2over = Fw x 36" = 17,470.8#-in

M2dead = 0.9 x 150 lbs. x 1" = 135 #-in

$Tw = \frac{17{,}470.8\ \#\text{-in} + 135\#\text{-in}}{6"} = 3201$ lbs

Vw = 485.3 lbs / 2 anchors = 242.7 lbs / anchor

Z⊥' = 360 lbs * Cd = 360lbs(1.6) = 576 lbs (NDS 12B)

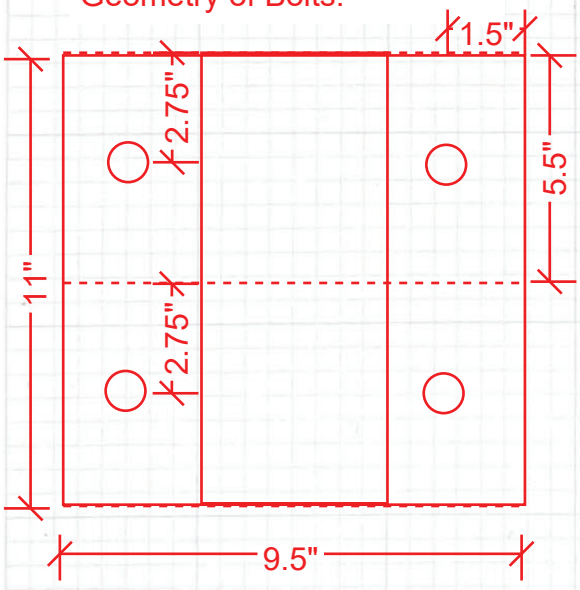
USE (4) 5/8" Ø x 1 1/2" BOLTS

CHECK PLATE FOR CRUSHING:

PER 2018 NDS CHAPTER 3.10:
Cb =1
F'c_PERP = 625 * 1 = 625 PSI
f'c = 3201 lbs / (104.5 SQ IN - 2 SQ IN) = 31.2 PSI < 625 PSI , OK

Use 0'-11" x 9.5" x 0'-1/4" A36 Steel Plate

Geometry of Bolts:



RRM Design Group
3765 S. Higuera Street
Suite 102
San Luis Obispo, CA 93405
805-597-5287

Project Title:
Engineer:
Project ID:
Project Descr:

Pole Footing Embedded in Soil

Project File: post 1 footing.ec6

DESCRIPTION: Post 1 Footing

Code References

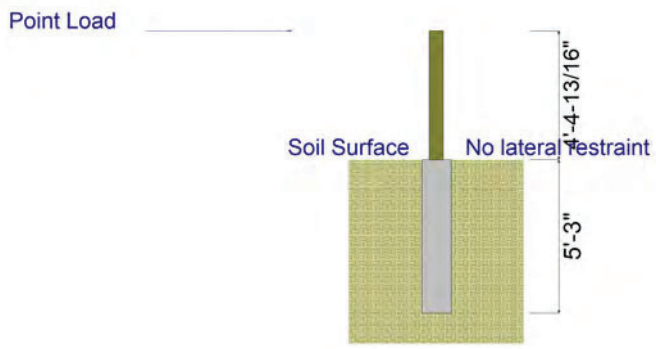
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Pole Footing Shape	Circular
Pole Footing Diameter	12.0 in
Calculate Min. Depth for Allowable Pressures	
No Lateral Restraint at Ground Surface	
Allow Passive	200.0 pcf
Max Passive	1,500.0 psf

Controlling Values

Governing Load Combination	+0.60W
Lateral Load	0.3888 k
Moment	1.711 k-ft
NO Ground Surface Restraint	
Pressures at 1/3 Depth	
Actual	**341.947** psf
Allowable	**342.810** psf
Minimum Required Depth	**5.250 ft**
Footing Base Area	0.7854 ft^2
Maximum Soil Pressure	0.0 ksf



Applied Loads

Lateral Concentrated Load (k)		Lateral Distributed Loads (kl		Vertical Load (k)	
D : Dead Load	k		k/ft		k
Lr : Roof Live	k		k/ft		k
L : Live	k		k/ft		k
S : Snow	k		k/ft		k
W : Wind	0.6480 k		k/ft		k
E : Earthquake	k		k/ft		k
H : Lateral Earth	k		k/ft		k
Load distance above ground surface	4.40 ft	TOP of Load above ground surface	ft		
		BOTTOM of Load above ground surface	ft		

Load Combination Results

Load Combination	Forces @ Ground Surface Loads - (k)	Moments - (ft-k)	Required Depth - (ft)	Pressure at 1/3 Depth Actual - (psf)	Allow - (psf)	Soil Increase Factor
	0.000	0.000	0.13	0.0	0.0	1.000
+0.60W	0.389	1.711	5.25	341.9	342.8	1.000
+0.450W	0.292	1.283	4.63	304.2	305.9	1.000

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Project Descr:

Pole Footing Embedded in Soil

Project File: post 1 footing.ec6

LIC# : KW-06017541, Build:20.23.12.07 RRM Design Group (c) ENERCALC INC 1983-2023

DESCRIPTION: Rolling Gate Post

Code References

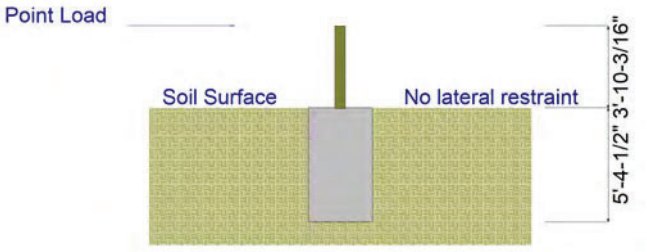
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Pole Footing Shape	Circular
Pole Footing Diameter	36.0 in
Calculate Min. Depth for Allowable Pressures	
No Lateral Restraint at Ground Surface	
Allow Passive	200.0 pcf
Max Passive	1,500.0 psf

Controlling Values

Governing Load Combination	+D+0.60W
Lateral Load	1.359 k
Moment	5.232 k-ft
NO Ground Surface Restraint	
Pressures at 1/3 Depth	
Actual	**354.829** psf
Allowable	**355.773** psf
Minimum Required Depth	**5.375 ft**
Footing Base Area	7.069 ft^2
Maximum Soil Pressure	0.2122 ksf



Applied Loads

	Lateral Concentrated Load (k)	Lateral Distributed Loads (kl	Vertical Load (k)
D : Dead Load	k	k/ft	1.50 k
Lr : Roof Live	k	k/ft	k
L : Live	k	k/ft	k
S : Snow	k	k/ft	k
W : Wind	2.265 k	k/ft	k
E : Earthquake	k	k/ft	k
H : Lateral Earth	k	k/ft	k
Load distance above ground surface	3.850 ft	TOP of Load above ground surface ft	
		BOTTOM of Load above ground surface ft	

Load Combination Results

Load Combination	Forces @ Ground Surface Loads - (k)	Moments - (ft-k)	Required Depth - (ft)	Pressure at 1/3 Depth Actual - (psf)	Allow - (psf)	Soil Increase Factor
D Only	0.000	0.000	0.13	0.0	0.0	1.000
+D+0.60W	1.359	5.232	5.38	354.8	355.8	1.000
+D+0.450W	1.019	3.924	4.75	315.7	316.4	1.000
+0.60D+0.60W	1.359	5.232	5.38	354.8	355.8	1.000
+0.60D	0.000	0.000	0.13	0.0	0.0	1.000

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Pole Footing Embedded in Soil

Project File: post 1 footing.ec6

LIC# : KW-06017541, Build:20.23.12.07 RRM Design Group (c) ENERCALC INC 1983-2023

DESCRIPTION: Fence Gate Footing

Code References

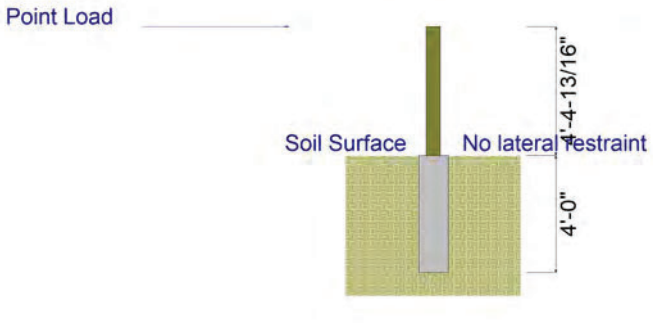
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Pole Footing Shape	Circular
Pole Footing Diameter	12.0 in
Calculate Min. Depth for Allowable Pressures	
No Lateral Restraint at Ground Surface	
Allow Passive	200.0 pcf
Max Passive	1,500.0 psf

Controlling Values

Governing Load Combination	+0.60W
Lateral Load	0.2028 k
Moment	0.8923 k-ft
NO Ground Surface Restraint	
Pressures at 1/3 Depth	
Actual	**263.557** psf
Allowable	**264.915** psf
Minimum Required Depth	**4.0 ft**
Footing Base Area	0.7854 ft^2
Maximum Soil Pressure	0.0 ksf



Applied Loads

Lateral Concentrated Load (k)		Lateral Distributed Loads (kl		Vertical Load (k)	
D : Dead Load	k		k/ft		k
Lr : Roof Live	k		k/ft		k
L : Live	k		k/ft		k
S : Snow	k		k/ft		k
W : Wind	0.3380 k		k/ft		k
E : Earthquake	k		k/ft		k
H : Lateral Earth	k		k/ft		k
Load distance above ground surface	4.40 ft	TOP of Load above ground surface	ft		
		BOTTOM of Load above ground surface	ft		

Load Combination Results

Load Combination	Forces @ Ground Surface Loads - (k)	Moments - (ft-k)	Required Depth - (ft)	Pressure at 1/3 Depth Actual - (psf)	Allow - (psf)	Soil Increase Factor
	0.000	0.000	0.13	0.0	0.0	1.000
+0.60W	0.203	0.892	4.00	263.6	264.9	1.000
+0.450W	0.152	0.669	3.63	235.7	236.7	1.000

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Project Title:
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Project ID:
Project Descr:

General Footing

Project File: post 1 footing.ec6

LIC# : KW-06017541, Build:20.23.12.07 RRM Design Group (c) ENERCALC INC 1983-2023

DESCRIPTION: CMU WALL FOOTING (Full Height),

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,155.92	ksi
Concrete Density	=	150.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.150 : 1
Min. Sliding Safety Factor	=	1.150 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	200.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

Footing base depth below soil surface	=	2.0	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

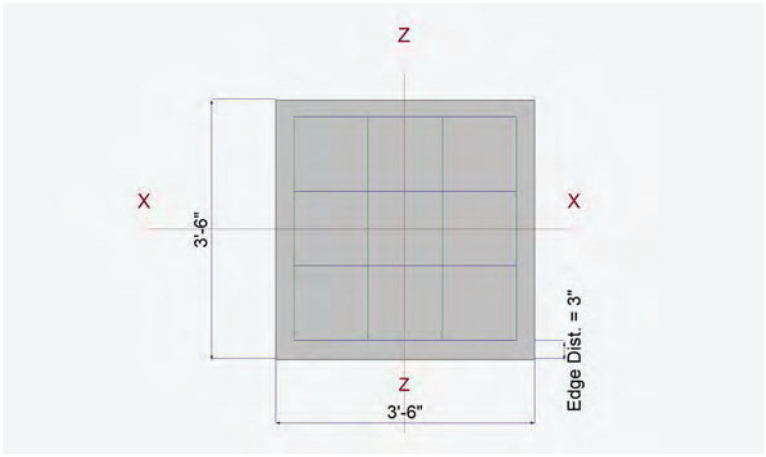
Width parallel to X-X Axis	=	3.50	ft
Length parallel to Z-Z Axis	=	3.50	ft
Footing Thickness	=	16.0	in

Pedestal dimensions...

px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in

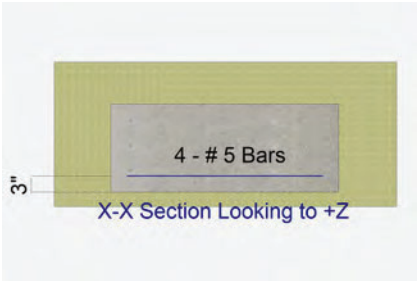


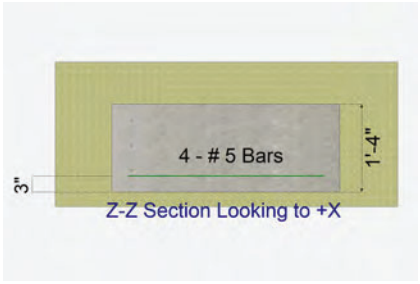
Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		4.0
Reinforcing Bar Size	=	#	5
Bars parallel to Z-Z Axis			
Number of Bars	=		4.0
Reinforcing Bar Size	=	#	5

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	1.408							k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=					2.696	3.836		k-ft
V-x	=								k
V-z	=								k

RRM Design Group
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Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: post 1 footing.ec6

DESCRIPTION: CMU WALL FOOTING (Full Height),

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.5069	Soil Bearing	0.7603 ksf	1.50 ksf	+D+0.70E about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	1.860	Overturning - Z-Z	2.685 k-ft	4.994 k-ft	+0.60D+0.70E
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.03785	Z Flexure (+X)	0.7635 k-ft/ft	20.172 k-ft/ft	+1.20D+E
PASS	0.01703	Z Flexure (-X)	0.3434 k-ft/ft	20.172 k-ft/ft	+0.90D+E
PASS	0.01222	X Flexure (+Z)	0.2464 k-ft/ft	20.172 k-ft/ft	+1.40D
PASS	0.01222	X Flexure (-Z)	0.2464 k-ft/ft	20.172 k-ft/ft	+1.40D
PASS	0.03035	1-way Shear (+X)	2.494 psi	82.158 psi	+0.90D+E
PASS	0.01509	1-way Shear (-X)	1.239 psi	82.158 psi	+1.20D+E
PASS	0.008349	1-way Shear (+Z)	0.6859 psi	82.158 psi	+1.40D
PASS	0.008349	1-way Shear (-Z)	0.6859 psi	82.158 psi	+1.40D
PASS	0.01615	2-way Punching	2.654 psi	164.317 psi	+1.40D

Top reinforcing mat required (see 'Bending' tab).

Hand check required for anchor pullout.

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.3883	0.3883	n/a	n/a	0.259
X-X, +D+0.60W	1.50	n/a	0.0	0.3883	0.3883	n/a	n/a	0.259
X-X, +D+0.70E	1.50	n/a	0.0	0.3883	0.3883	n/a	n/a	0.259
X-X, +D+0.450W	1.50	n/a	0.0	0.3883	0.3883	n/a	n/a	0.259
X-X, +D+0.5250E	1.50	n/a	0.0	0.3883	0.3883	n/a	n/a	0.259
X-X, +0.60D+0.60W	1.50	n/a	0.0	0.2330	0.2330	n/a	n/a	0.155
X-X, +0.60D+0.70E	1.50	n/a	0.0	0.2330	0.2330	n/a	n/a	0.155
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.3883	0.3883	0.259
Z-Z, +D+0.60W	1.50	4.081	n/a	n/a	n/a	0.1642	0.6124	0.408
Z-Z, +D+0.70E	1.50	6.775	n/a	n/a	n/a	0.01626	0.7603	0.507
Z-Z, +D+0.450W	1.50	3.061	n/a	n/a	n/a	0.2202	0.5564	0.371
Z-Z, +D+0.5250E	1.50	5.081	n/a	n/a	n/a	0.1093	0.6673	0.445
Z-Z, +0.60D+0.60W	1.50	6.802	n/a	n/a	n/a	0.008857	0.4571	0.305
Z-Z, +0.60D+0.70E	1.50	11.291	n/a	n/a	n/a	0.0	0.6670	0.445

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, D Only	None	0.0 k-ft	Infinity	OK
X-X, +D+0.60W	None	0.0 k-ft	Infinity	OK
X-X, +D+0.70E	None	0.0 k-ft	Infinity	OK
X-X, +D+0.450W	None	0.0 k-ft	Infinity	OK
X-X, +D+0.5250E	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.60W	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.70E	None	0.0 k-ft	Infinity	OK
Z-Z, D Only	None	0.0 k-ft	Infinity	OK
Z-Z, +D+0.60W	1.618 k-ft	8.324 k-ft	5.146	OK
Z-Z, +D+0.70E	2.685 k-ft	8.324 k-ft	3.10	OK
Z-Z, +D+0.450W	1.213 k-ft	8.324 k-ft	6.861	OK
Z-Z, +D+0.5250E	2.014 k-ft	8.324 k-ft	4.133	OK
Z-Z, +0.60D+0.60W	1.618 k-ft	4.994 k-ft	3.087	OK
Z-Z, +0.60D+0.70E	2.685 k-ft	4.994 k-ft	1.860	OK

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Project Title:
Engineer:
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Project Descr:

General Footing

Project File: post 1 footing.ec6

DESCRIPTION: CMU WALL FOOTING (Full Height),

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status

Footing Has NO Sliding

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.2464	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.40D	0.2464	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D	0.2112	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D	0.2112	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D+0.50W	0.2112	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D+0.50W	0.2112	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D+W	0.2112	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D+W	0.2112	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D+E	0.2112	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +1.20D+E	0.2112	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +0.90D+W	0.1584	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +0.90D+W	0.1584	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +0.90D+E	0.1584	+Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
X-X, +0.90D+E	0.1584	-Z	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.40D	0.2464	-X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.40D	0.2464	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D	0.2112	-X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D	0.2112	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D+0.50W	0.01865	-X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D+0.50W	0.4038	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D+W	0.1739	-X	Top	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D+W	0.5963	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D+E	0.3325	-X	Top	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +1.20D+E	0.7635	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +0.90D+W	0.2258	-X	Top	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +0.90D+W	0.5444	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +0.90D+E	0.3434	-X	Top	0.3456	ACI 7.6.1.1	0.3543	20.172	OK
Z-Z, +0.90D+E	0.7525	+X	Bottom	0.3456	ACI 7.6.1.1	0.3543	20.172	OK

One Way Shear X

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.69 psi	0.69 psi	0.69 psi	82.16 psi	0.01	OK
+1.20D	0.59 psi	0.59 psi	0.59 psi	82.16 psi	0.01	OK
+1.20D+0.50W	0.06 psi	1.24 psi	1.24 psi	82.16 psi	0.02	OK
+1.20D+W	0.71 psi	1.89 psi	1.89 psi	82.16 psi	0.02	OK
+1.20D+E	1.24 psi	2.46 psi	2.46 psi	82.16 psi	0.03	OK
+0.90D+W	0.86 psi	1.75 psi	1.75 psi	82.16 psi	0.02	OK
+0.90D+E	1.05 psi	2.49 psi	2.49 psi	82.16 psi	0.03	OK

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.69 psi	0.69 psi	0.69 psi	82.16 psi	0.01	OK
+1.20D	0.59 psi	0.59 psi	0.59 psi	82.16 psi	0.01	OK
+1.20D+0.50W	0.59 psi	0.59 psi	1.24 psi	82.16 psi	0.02	OK
+1.20D+W	0.59 psi	0.59 psi	1.89 psi	82.16 psi	0.02	OK
+1.20D+E	0.59 psi	0.59 psi	2.46 psi	82.16 psi	0.03	OK
+0.90D+W	0.44 psi	0.44 psi	1.75 psi	82.16 psi	0.02	OK
+0.90D+E	0.44 psi	0.44 psi	2.49 psi	82.16 psi	0.03	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	2.65 psi	164.32 psi	0.01615	OK
+1.20D	2.27 psi	164.32 psi	0.01384	OK
+1.20D+0.50W	2.27 psi	164.32 psi	0.01384	OK
+1.20D+W	2.27 psi	164.32 psi	0.01384	OK
+1.20D+E	2.28 psi	164.32 psi	0.01387	OK
+0.90D+W	1.71 psi	164.32 psi	0.01039	OK

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Project Title:
Engineer:
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General Footing

Project File: post 1 footing.ec6

DESCRIPTION: CMU WALL FOOTING (Full Height),

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+0.90D+E	1.78 psi	164.32 psi	0.01085	OK

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Project Title:
Engineer:
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Project Descr:

Masonry Column

Project File: post 1 footing.ec6

DESCRIPTION: CMU Pilaster

Code References

Calculations per TMS 402-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Material Properties

F'm	=	2,000.0 psi
Fr - Rupture	=	61.0 psi
Em = f'm *	=	900.0
Column Density	=	1.0 pcf
Rebar Grade	=	Grade 60
Fy - Yield	=	60000 psi
Fs - Allowable	=	32000 psi
E - Rebar	=	29,000.0 ksi

Column Data

Column width along X-X	=	15.625 in
Column depth along Y-Y	=	15.625 in
Longitudinal Bar Size	=	# 5.0
Bars per side at +Y & -Y	=	2
Bars per side at +X & -X	=	2
Cover from ties	=	3.0 in
Actual Edge to Bar Cente	=	3.6875 in

Analysis Settings

Analysis Method	=	**Strength Design**
φ factor for Strength Design	=	0.90
End Fixity Condition	=	Top Free, Bottom Fixed
Overall Column Height	=	9.333 ft
Construction Type		Solid Grouted Hollow Concrete Masor
Tie Bar Size	=	# 3
Tie Bar Spacing	=	8.0 in

Brace condition for deflection (buckling) along columns :

X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 9.333 ft, K
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 9.333 ft, K

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 15.823 lbs * Dead Load Factor
AXIAL LOADS . . .
BENDING LOADS . . .
Lat. Uniform Load creating Mx-x, W = 0.03370 k/ft
Lat. Point Load at 4.0 ft creating Mx-x, W = 0.5180 k
Lat. Point Load at 4.0 ft creating Mx-x, E = 2.740 k

DESIGN SUMMARY

Bending Check Results

PASS **Maximum Bending Stress Ratio =** **0.305** : 1
Load Combination +1.20D+E
Location of max.above base 0.000 ft
At maximum location values are . . .
Pu 0.019 k
0.9 * Pn 0.316 k
Mu-x -10.960 k-ft
0.9 * Mn-x : 35.928 k-ft

PASS **Reinforcing Area Check** *(TMS 402-16, Sec 5.3.1.3)*
As : Actual Reinforcement 1.240
Min: 0.0025 * An 0.610
Max: 0.04 * An 9.766

Dimensional Checks
Min. Side Dim. >= 8" *(TMS 402-16, Sec. 5.3.1.1(b))*
PASS Governing K * Lu / Dimension <= 3 *(TMS 402-16, Sec. 5.3.1.1(a))*

Maximum SERVICE Load Reactions . .
Top along X-X 0.000 k
Bottom along X-X 2.740 k

Maximum SERVICE Load Deflections . . .
Along x-x 0.034 in at 9.333 ft above base
for load combination : E Only

Compressive Strength 287.247 k *(TMS 402-16, Sec. 9.3.4.1.1)*
Pa = 0.80 [0.80 f'm (An - Ast) + FyAst) * [1-(h/(140*r))^2]

PASS **Check Column Ties** *(TMS 402-16, Sec 5.3.1.4)*
Min. Tie Dia. = 1/4", # 3 bar provided
Max Tie Spacing = 10.00 in, Provided = 8.00 in

Rx *4.511*
Ry *4.511*

Load Combination Results

Load Combination	Maximum Bending Stress Ratios Stress Ratio	Status	Location	Maximum Axial Load Actual	Allow	Maximum Moments Actual	Allow
+1.40D	.0000760	PASS	0.06264 ft	0.02215 k	287.118 k	0.0 k-ft	53.715 k-ft
+1.20D	.0000650	PASS	0.0 ft	0.01899 k	287.118 k	0.0 k-ft	53.715 k-ft
+1.20D+0.50W	0.0490	PASS	0.0 ft	0.01899 k	0.7195 k	1.770 k-ft	36.115 k-ft
+1.20D+W	0.09852	PASS	0.0 ft	0.01899 k	0.3160 k	3.540 k-ft	35.928 k-ft
+1.20D+E	0.3050	PASS	0.0 ft	0.01899 k	0.3160 k	10.960 k-ft	35.928 k-ft
+0.90D+W	0.09852	PASS	0.0 ft	0.01424 k	0.3160 k	3.540 k-ft	35.928 k-ft
+0.90D+E	0.3050	PASS	0.0 ft	0.01424 k	0.3160 k	10.960 k-ft	35.928 k-ft

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Masonry Column

Project File: post 1 footing.ec6

DESCRIPTION: CMU Pilaster

Maximum Reactions

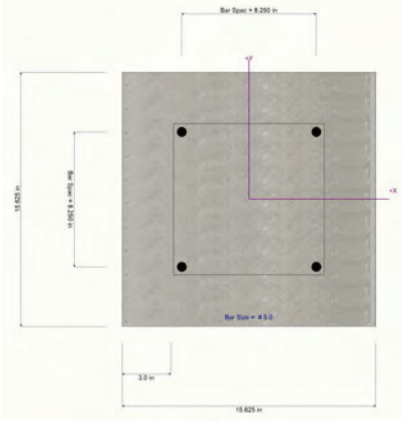
Note: Only non-zero reactions are listed.

Load Combination	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base
D Only	k	k	0.016 k
+D+0.60W	0.500 k	k	0.016 k
+D+0.70E	1.918 k	k	0.016 k
+D+0.450W	0.375 k	k	0.016 k
+D+0.5250E	1.439 k	k	0.016 k
+0.60D+0.60W	0.500 k	k	0.009 k
+0.60D+0.70E	1.918 k	k	0.009 k
W Only	0.833 k	k	k
E Only	2.740 k	k	k

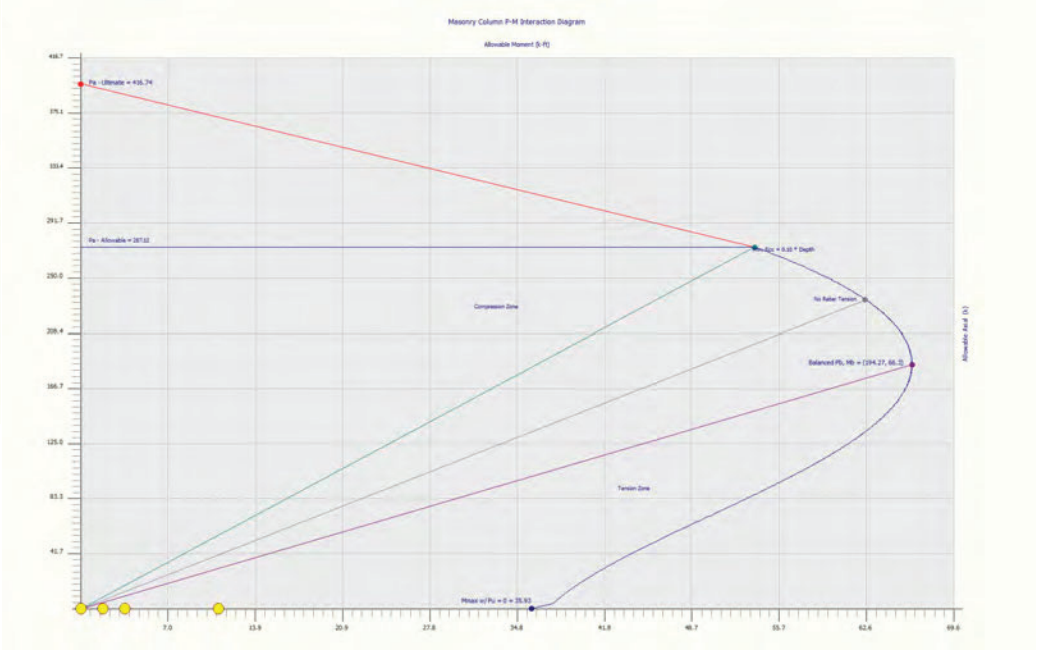
Maximum Deflections for Load Combinations

Load Combination	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft
+D+0.60W	0.0075 in	9.333 ft
+D+0.70E	0.0236 in	9.333 ft
+D+0.450W	0.0056 in	9.333 ft
+D+0.5250E	0.0177 in	9.333 ft
+0.60D+0.60W	0.0075 in	9.333 ft
+0.60D+0.70E	0.0236 in	9.333 ft
W Only	0.0125 in	9.333 ft
E Only	0.0335 in	9.270 ft

Cross Section



Interaction Diagram



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Project Title:
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Cantilevered Retaining Wall

Project File: post 1 footing.ec6

LIC# : KW-06017541, Build:20.23.12.07 RRM Design Group

DESCRIPTION: Freestanding 3' Wall (Wind)

Code Reference

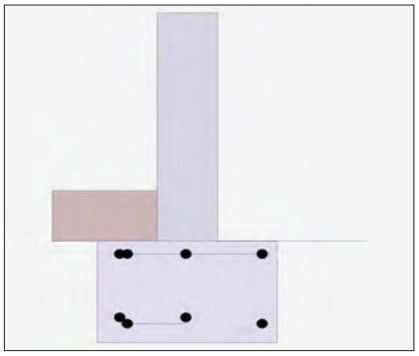
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	0.00 ft
Wall height above soil	=	3.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	33.7 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Stem Weight Seismic Load

F_p / W_p Weight Multiplier = 0.000 g

Added seismic base force 0.0 lbs

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Cantilevered Retaining Wall

Project File: post 1 footing.ec6

DESCRIPTION: Freestanding 3' Wall (Wind)

Design Summary

Wall Stability Ratios

Overturning	=	3.60	OK
Sliding	=	7.14	OK
Global Stability	=	9.37	

Total Bearing Load	=	701 lbs	
...resultant ecc.	=	3.74 in	

Eccentricity within middle third

Soil Pressure @ Toe	=	678 psf	OK
Soil Pressure @ Heel	=	23 psf	OK
Allowable	=	1,500 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	949 psf	
ACI Factored @ Heel	=	32 psf	
Footing Shear @ Toe	=	2.0 psi	OK
Footing Shear @ Heel	=	0.2 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	91.8 lbs	
less 100% Passive Force	-	375.0 lbs	
less 100% Friction Force	-	280.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing pressures.

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Masonry		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 5		
Rebar Spacing	=	16.00		
Rebar Placed at	=	Center		
Design Data				
fb/FB + fa/Fa	=	**0.068**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	161.8		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	242.6		
Moment.....Allowable	=	3,566.5		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	1.8		
Shear.....Allowable	psi =	80.5		
Anet (Masonry)	in2 =	91.50		
Wall Weight	psf =	84.0		
Rebar Depth 'd'	in =	3.81		

Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Equiv. Solid Thick.	in =	7.63
Masonry Block Type	=	
Masonry Design Method	=	SD

Concrete Data

f'c	psi =
Fy	psi =

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Cantilevered Retaining Wall

Project File: post 1 footing.ec6

DESCRIPTION: Freestanding 3' Wall (Wind)

Footing Data

Toe Width	=	0.67 ft
Heel Width	=	1.33
Total Footing Width	=	2.00
Footing Thickness	=	16.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	949		32	psf
Mu' : Upward	=	188		30	ft-#
Mu' : Downward	=	109		80	ft-#
Mu: Design	=	79	OK	50	ft-# OK
phiMn	=	19,302		20,869	ft-#
Actual 1-Way Shear	=	1.95		0.23	psi
Allow 1-Way Shear	=	82.16		82.16	psi

Toe Reinforcing = # 4 @ 6.94 in
Heel Reinforcing = # 4 @ 6.94 in
Key Reinforcing = None Spec'd

Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34.72 in, #10@ 44.09 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34.72 in, #10@ 44.09 in

Key: No key defined

Min footing T&S reinf Area 0.69 in2
Min footing T&S reinf Area per foot 0.35 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.94 in	#4@ 13.89 in
#5@ 10.76 in	#5@ 21.53 in
#6@ 15.28 in	#6@ 30.56 in

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Cantilevered Retaining Wall

Project File: post 1 footing.ec6

DESCRIPTION: Freestanding 3' Wall (Wind)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		31.1	0.44	13.8	Soil Over HL (ab. water tbl)	0.0	1.67	0.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		1.67	0.0
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=	60.7	2.83	171.9	Soil Over Toe	=	48.9	0.33	16.3
	=				Surcharge Over Toe	=			
Seismic Stem Self Wt					Stem Weight(s)	=	252.0	1.00	252.1
					Earth @ Stem Transitions	=			
					Footing Weight	=	400.0	1.00	400.0
					Key Weight	=			
					Vert. Component	=			
Total	=	91.8	**O.T.M.** =	185.7	**Total =**		700.9 lbs	**R.M.=**	668.4

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Resisting/Overturning Ratio = **3.60**
Vertical Loads used for Soil Pressure = 700.9 lbs

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.028	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

DESCRIPTION: Freestanding 3' Wall (Wind)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

K_cover=7.3125, K_spacing=16, K_diam=5.625, and K_min=5.625

Lap Splice length for #5 bar specified in this stem design segment (25.4.2.3a) =	25.00 in
Development length for #5 bar specified in this stem design segment =	12.11 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	9.59 in
As Provided =	0.2325 in2/ft
As Required =	0.0149 in2/ft

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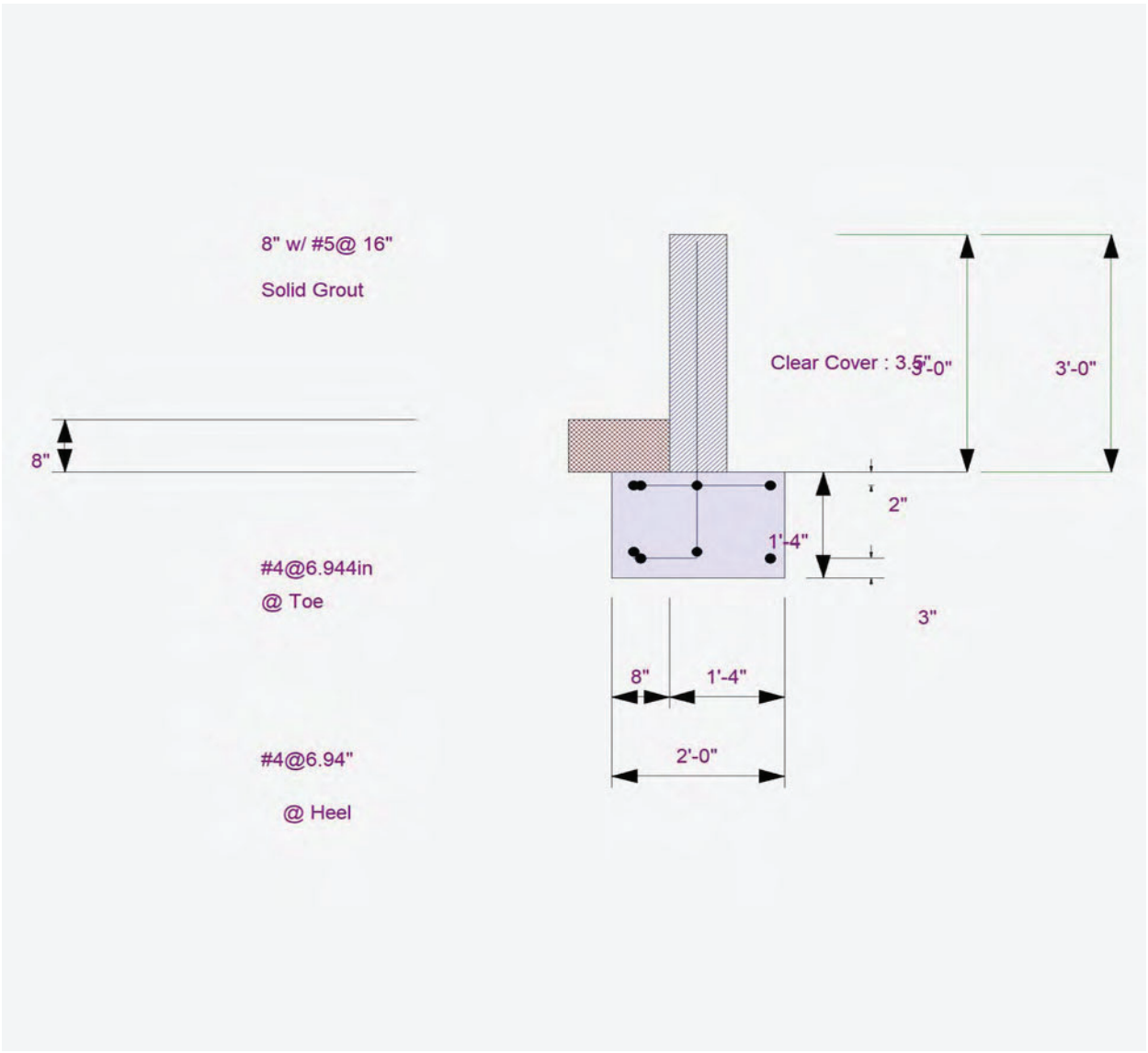
DESCRIPTION: Freestanding 3' Wall (Wind)



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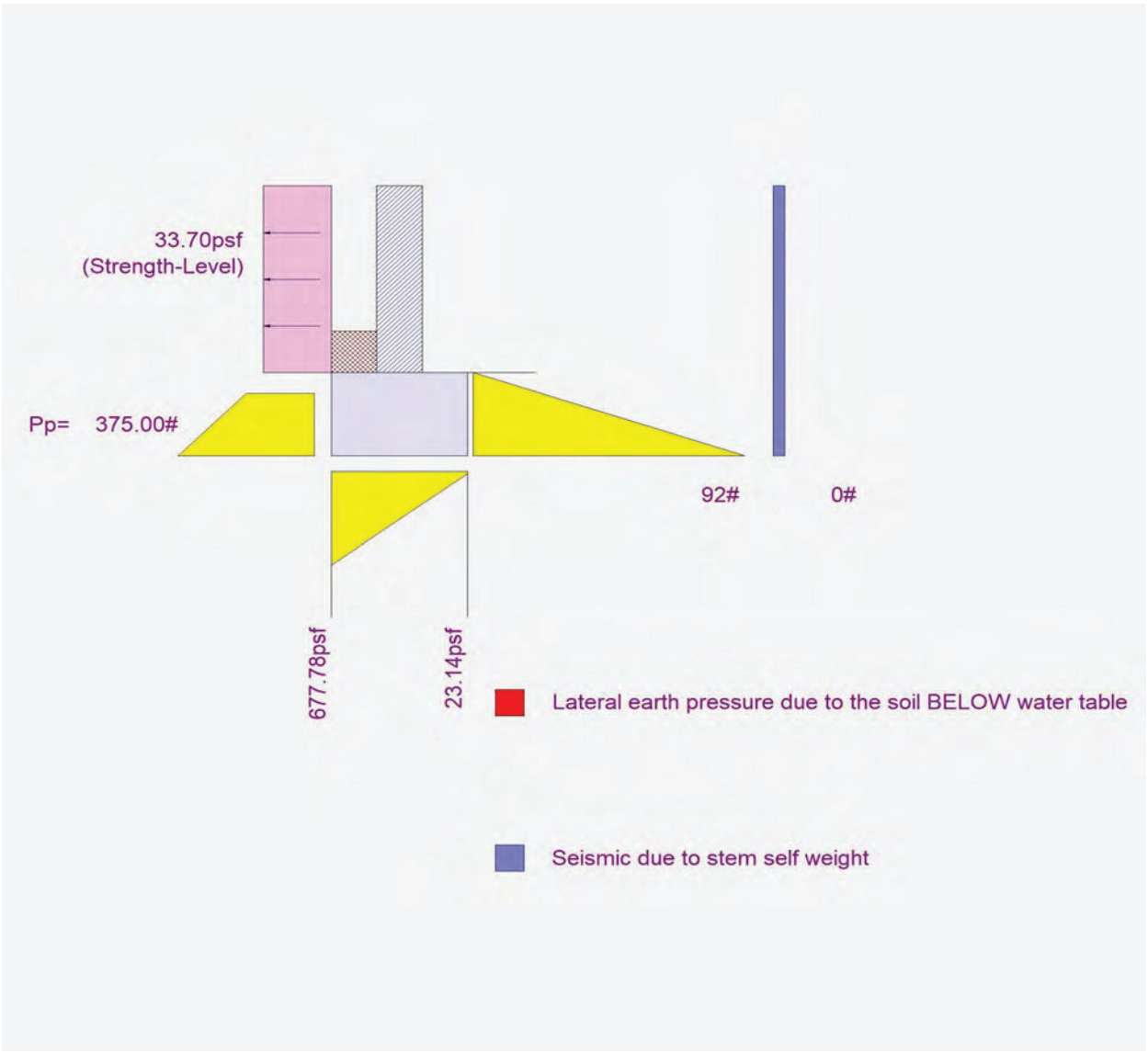
Cantilevered Retaining Wall

DESCRIPTION: Freestanding 3' Wall (Wind)



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3765 S. Higuera Street
Suite 102
San Luis Obispo, CA 93405
805-597-5287

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: post 1 footing.ec6

LIC# : KW-06017541, Build:20.23.12.07 RRM Design Group

DESCRIPTION: Freestanding 3' Wall (Seismic)

Code Reference

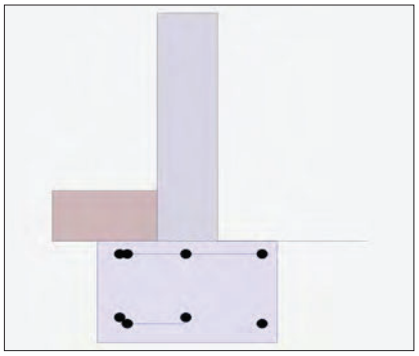
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	0.00 ft
Wall height above soil	=	3.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Stem Weight Seismic Load

F_p / W_p Weight Multiplier = 0.681 g

Added seismic base force 120.1 lbs

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DESCRIPTION: Freestanding 3' Wall (Seismic)

Design Summary

Wall Stability Ratios

Overturning	=	1.89	OK
Sliding	=	4.33	OK
Global Stability	=	9.37	

Total Bearing Load	=	701 lbs	
...resultant ecc.	=	6.62 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,042 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,459 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	3.3 psi	OK
Footing Shear @ Heel	=	1.0 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	151.2 lbs	
less 100% Passive Force	-	375.0 lbs	
less 100% Friction Force	-	280.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing pressures.

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Masonry		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 5		
Rebar Spacing	=	16.00		
Rebar Placed at	=	Center		
Design Data				
fb/FB + fa/Fa	=	**0.072**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	171.6		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	257.4		
Moment.....Allowable	=	3,566.5		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	1.9		
Shear.....Allowable	psi =	80.5		
Anet (Masonry)	in2 =	91.50		
Wall Weight	psf =	84.0		
Rebar Depth 'd'	in =	3.81		

Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Equiv. Solid Thick.	in =	7.63
Masonry Block Type	=	
Masonry Design Method	=	SD

Concrete Data

f'c	psi =
Fy	psi =

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DESCRIPTION: Freestanding 3' Wall (Seismic)

Footing Data

Toe Width	=	0.67 ft
Heel Width	=	1.33
Total Footing Width	=	2.00
Footing Thickness	=	16.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,459	0	psf
Mu' : Upward	=	271	0	ft-#
Mu' : Downward	=	109	80	ft-#
Mu: Design	=	162 OK	80	ft-# OK
phiMn	=	19,302	20,869	ft-#
Actual 1-Way Shear	=	3.29	0.99	psi
Allow 1-Way Shear	=	82.16	82.16	psi
Toe Reinforcing	=	# 4 @ 6.94 in		
Heel Reinforcing	=	# 4 @ 6.94 in		
Key Reinforcing	=	None Spec'd		
Footing Torsion, Tu	=		0.00	ft-lbs
Footing Allow. Torsion, phi Tu	=		0.00	ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34.72 in, #10@ 44.09 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34.72 in, #10@ 44.09 in

Key: No key defined

Min footing T&S reinf Area 0.69 in2
Min footing T&S reinf Area per foot 0.35 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.94 in	#4@ 13.89 in
#5@ 10.76 in	#5@ 21.53 in
#6@ 15.28 in	#6@ 30.56 in

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LIC# : KW-06017541, Build:20.23.12.07 RRM Design Group

DESCRIPTION: Freestanding 3' Wall (Seismic)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		31.1	0.44	13.8	Soil Over HL (ab. water tbl)	0.0	1.67	0.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		1.67	0.0
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	48.9	0.33	16.3
	=				Surcharge Over Toe	=		
Seismic Stem Self Wt		120.1	2.83	340.4	Stem Weight(s)	=	252.0	1.00	252.1
					Earth @ Stem Transitions	=			
Total	=	151.2	**O.T.M.** =	354.2	Footing Weight	=	400.0	1.00	400.0
					Key Weight	=			
					Vert. Component	=			
					Total =		700.9 lbs	**R.M.=**	668.4

Resisting/Overturning Ratio = **1.89**
Vertical Loads used for Soil Pressure = 700.9 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.043	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

Cantilevered Retaining Wall

DESCRIPTION: Freestanding 3' Wall (Seismic)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

K_cover=7.3125, K_spacing=16, K_diam=5.625, and K_min=5.625

Lap Splice length for #5 bar specified in this stem design segment (25.4.2.3a) =	25.00 in
Development length for #5 bar specified in this stem design segment =	12.11 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	9.59 in
As Provided =	0.2325 in2/ft
As Required =	0.0158 in2/ft

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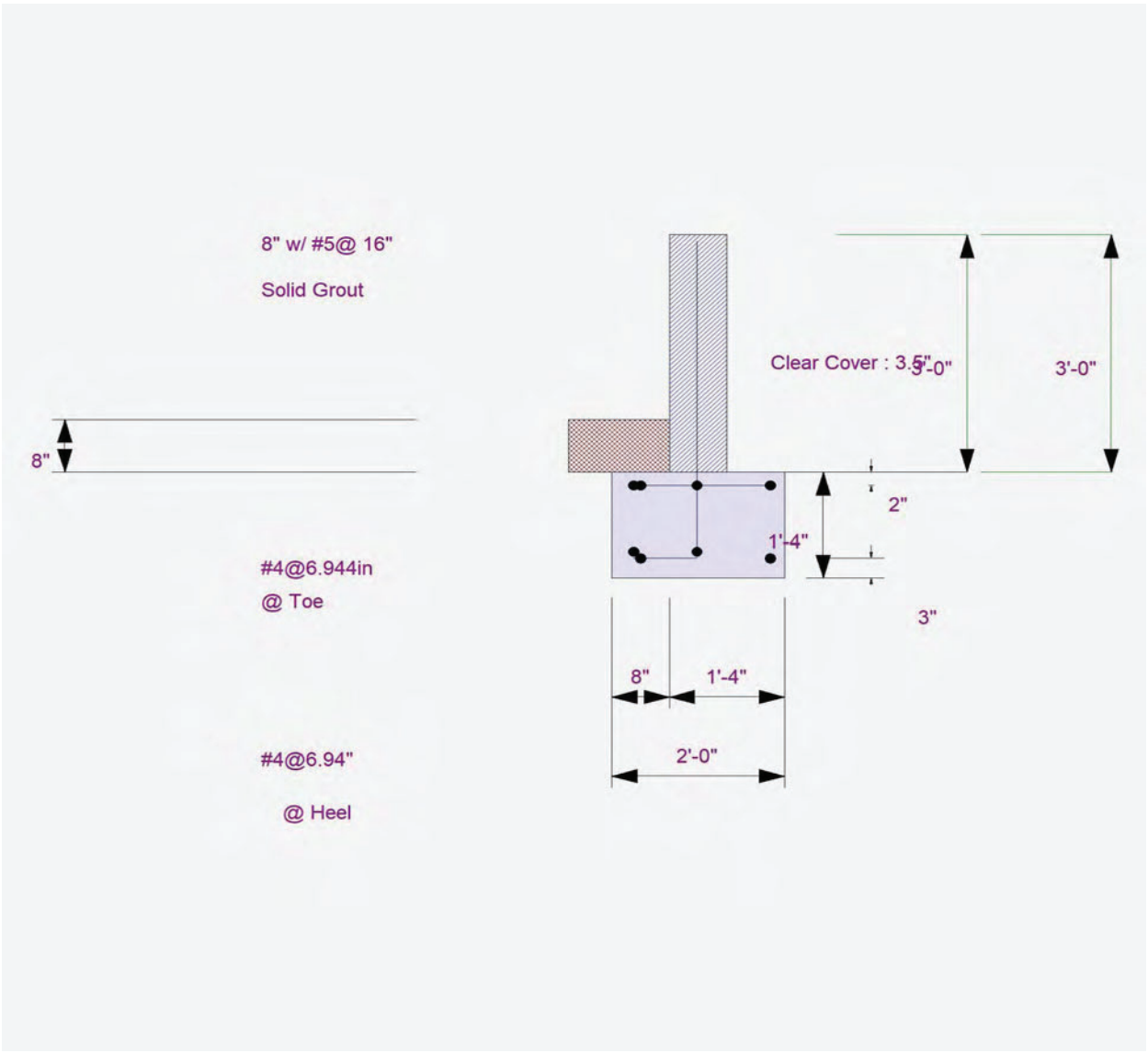

Cantilevered Retaining Wall

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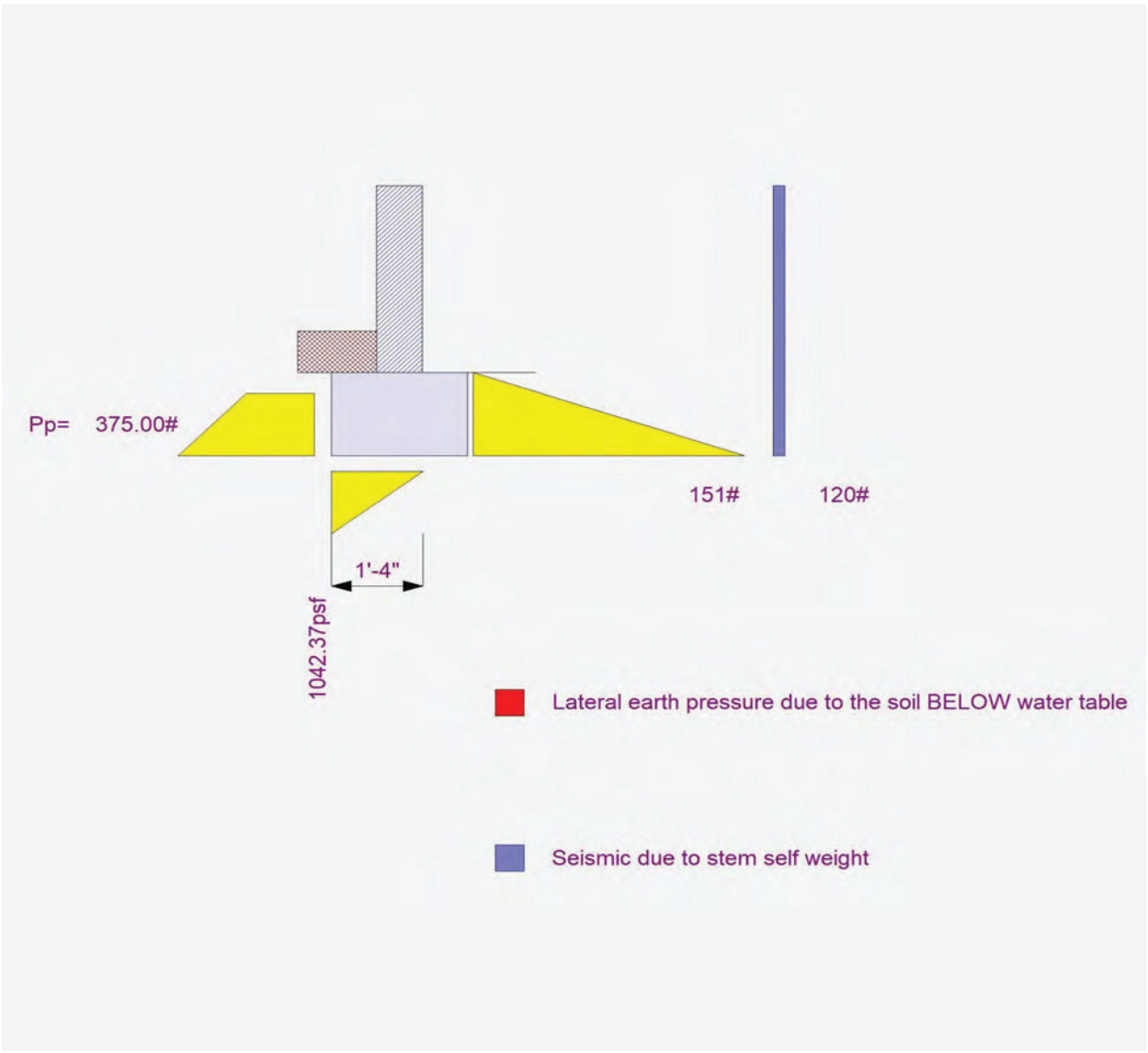


ADM

Anchor Designer Masonry

Input Data

Masonry Wall Details

Design Method	Wall Type	Nominal Thickness (in)	CMU State	Hole Condition	Anchor Location	Compression Strength (psi)
ACI 318-19 / ESR-4844	Grout Filled CMU	8	Cracked	Dry	Face	2000

Anchor

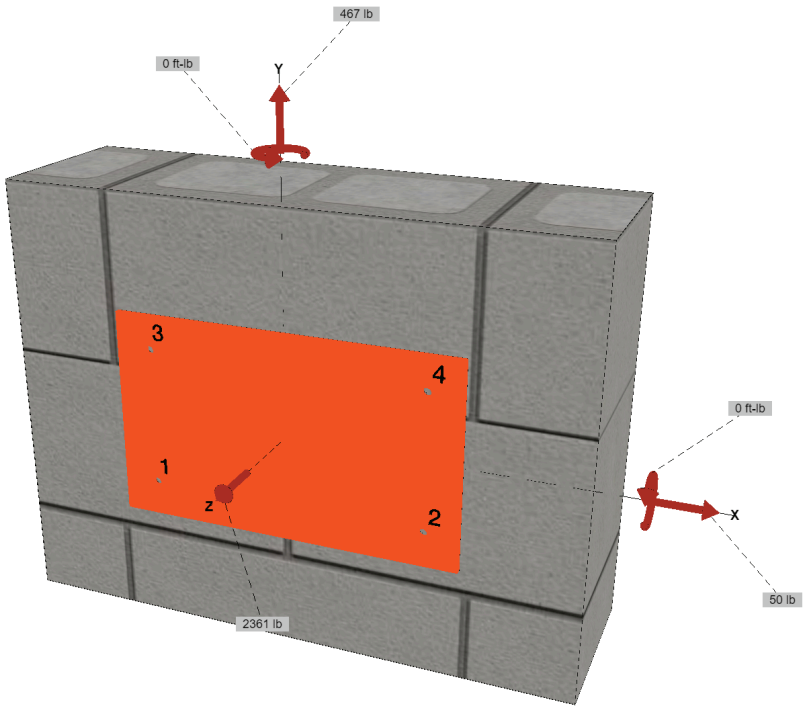
Product	Embedment Depth (in)
SET-3G w/ 3/8"Ø F1554 Gr. 36	4

Load Condition

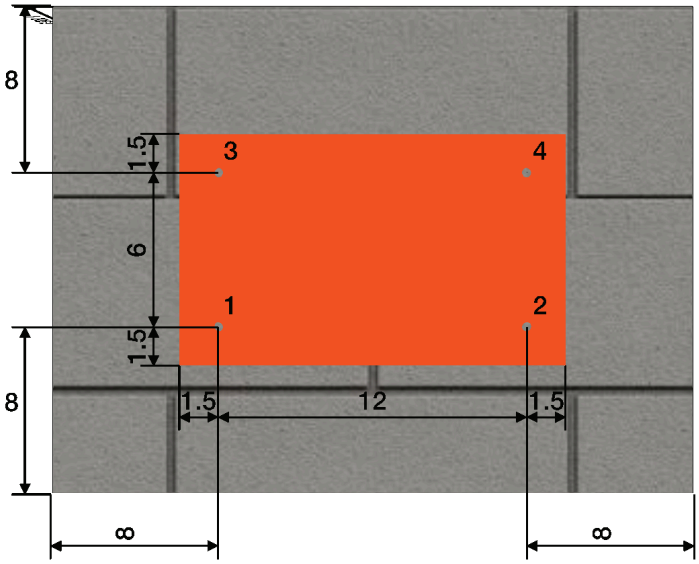
Seismic or Design Category 0.75 Reduction Factor	Sustained Tension	Apply Entire Shear Load at Front Row
No	No	No

Load

N_{ua} (lb)	V_{uax} (lb)	V_{uay} (lb)	M_{ux} (ft-lb)	M_{uy} (ft-lb)
2361	467	50	0	0


467 lb
0 ft-lb
Y
3
4
1
2
z
0 ft-lb
x
50 lb
2361 lb

Geometry



Results

Resulting Anchor Forces

Resulting Anchor Forces		
Anchor	Tension (lb)	Shear (lb)
1	590	117
2	590	117
3	590	117
4	590	117

Limit States in Tension

Tension			
Limit State Identity	Limit State Status	Demand (lb)	Capacity (lb)
Steel Strength	17.39%	590.25	3393.75
Masonry Breakout Strength	28.20%	2361.00	8371.84
Bond Strength	35.19%	2361.00	6709.39

Limit States in Shear

Shear			
Limit State Identity	Limit State Status	Demand (lb)	Capacity (lb)
Steel Strength	6.65%	117.42	1764.75
Masonry Breakout Strength Case 1x	0.00%	25.00	3058144.55
Masonry Breakout Strength Case 1y	0.01%	233.50	3059061.72
Masonry Breakout Strength Case 2x	0.00%	50.00	3058144.55
Masonry Breakout Strength Case 2y	0.02%	467.00	3059061.72
Masonry Breakout Strength Case 3cx1	0.00%	233.50	6116289.09
Masonry Breakout Strength Case 3cx2	0.00%	233.50	6116289.09
Masonry Breakout Strength Case 3cy1	0.00%	25.00	6118123.43
Masonry Breakout Strength Case 3cy2	0.00%	25.00	6118123.43
Masonry Crushing Strength	3.80%	117.42	3092.35

Shear			
Limit State Identity	Limit State Status	Demand (lb)	Capacity (lb)
Masonry Pryout Strength	3.25%	469.67	14450.99

Interaction Check

Interaction per ACI 318-19 Section 17.8 (Nua/ΦNn + Vua/ΦVn < 1.2 = Pass)			
$N_{ua}/\Phi N_n$	$V_{ua}/\Phi V_n$	$N_{ua}/\Phi N_n + V_{ua}/\Phi V_n$	Interaction Status
0.3519	0.0665	0.4184	Pass

Result

SET-3G w/ 3/8"Ø F1554 Gr. 36 with hef=4 inches *does meet* the selected design criteria.

Warnings

- Designer must exercise own judgment to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

APPENDIX E - CHARGERPOINT SITE DESIGN GUIDE

CP6000

Networked Charging Station

Site Design Guide

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

WARNING:

1. **Read and follow all warnings and instructions before servicing, installing, or operating the ChargePoint® charging station.** Install and operate only as instructed. Failure to do so may lead to death, injury, or property damage, and will void the Limited Warranty.
2. **Only use licensed professionals to install your ChargePoint charging station and adhere to all national and local building codes and standards.** Before installing the ChargePoint charging station, consult with a licensed contractor, such as a licensed electrician, and use a trained installation expert to ensure compliance with local building and electrical codes and standards, climate conditions, safety standards, and all applicable codes and ordinances. Inspect the charging station for proper installation before use.
3. **Always ground the ChargePoint charging station.** Failure to ground the charging station can lead to risk of electrocution or fire. The charging station must be connected to a grounded, metal, permanent wiring system, or an equipment grounding conductor shall be run with circuit conductors and connected to the equipment grounding terminal or lead on the Electric Vehicle Supply Equipment (EVSE). Connections to the EVSE shall comply with all applicable codes and ordinances.
4. **Install the ChargePoint charging station on a concrete pad using a ChargePoint-approved method.** Failure to install on a surface that can support the full weight of the charging station can result in death, personal injury, or property damage. Inspect the charging station for proper installation before use.
5. **This charging station is not suitable for use in Class 1 hazardous locations, such as near flammable, explosive, or combustible vapors or gases.**
6. **Supervise children near this device.**
7. **Do not put fingers into the electric vehicle connector.**
8. **Do not use this product if any cable is frayed, has broken insulation, or shows any other signs of damage.**
9. **Do not use this product if the enclosure or the electric vehicle connector is broken, cracked, open, or shows any other signs of damage.**
10. **Use only copper conductor wire rated for 90 °C (194 °F).**

IMPORTANT: Under no circumstances will compliance with the information in a ChargePoint guide such as this one relieve the user of the responsibility to comply with all applicable codes and safety standards. This document describes approved procedures. If it is not possible to perform the procedures as indicated, contact ChargePoint. **ChargePoint is not responsible for any damages that may result from custom installations or procedures not described in this document or that fail to adhere to ChargePoint recommendations.**

Product Disposal

Do not dispose of as part of unsorted domestic waste. Inquire with local authorities regarding proper disposal. Product materials are recyclable as marked.

Document Accuracy

The specifications and other information in this document were verified to be accurate and complete at the time of its publication. However, due to ongoing product improvement, this information is subject to change at any time without prior notice. For the latest information, see our documentation online at chargepoint.com/guides.

Copyright and Trademarks

Symbols

This guide and product use the following symbols:

DANGER: Risk of electric shock

WARNING: Risk of personal harm or death

CAUTION: Risk of equipment or property damage

IMPORTANT: Crucial step for installation success

Read the manual for instructions

Ground/protective earth

Illustrations Used in This Document

The illustrations used in this document are for demonstration purposes only and may not be an exact representation of the product. However, unless otherwise specified, the underlying instructions are accurate for the product.

Contents

Site Design Guidelines 1

This document describes how to design a project site for the ChargePoint® CP6000 networked charging station for electric vehicles. This includes guidelines and best practices for electrical infrastructure and capacity planning, construction, and concrete work required prior to installation of charging stations and cellular signal requirements.

Note: CP6000 charging stations are available in several configurations. The images in this guide might not match your station exactly; however, the information is applicable unless otherwise noted.

IMPORTANT: Ensure the installation complies with all applicable codes and ordinances.

Access ChargePoint documents at chargepoint.com/guides.

Document	Content	Primary Audiences
Datasheet	Full station specifications	Site designer, installer, and station owner
Site Design Guide	Civil, mechanical, and electrical guidelines to scope and construct the site	Site designer or engineer of record
Concrete Mounting Template Guide	Instructions to embed the charging station template in a concrete pad with anchor bolts and conduit placement	Site construction contractor
Construction Signoff Form	Checklists used by contractors to ensure the site is correctly completed and ready for product installation	Site construction contractor
Installation Guide	Anchoring, wiring, and powering on	Installer
Operation and Maintenance Guide	Operation and preventive maintenance information	Station owner, facility manager, and technician
Service Guide	Component replacement procedures, including optional components	Service technician
Declaration of Conformity	Statement of conformity with directives	Purchasers and public

Initial Site Guidelines

Designing electrical infrastructure to support current and future EV charging demand can help avoid costly upgrades later as EV adoption grows.

Complete an on-site evaluation to determine conduit and wiring requirements from the panel to the proposed parking spaces, as well as to measure cellular signal levels and identify suitable locations for any necessary cellular signal booster equipment.

If you have pre-existing infrastructure or are using your own preferred electrical contractor to prepare your site, a Construction Signoff Form by a ChargePoint Operations and Maintenance (O&M) partner is required to certify compliance with electrical code, and to ensure everything was prepared to ChargePoint specifications.

IMPORTANT: You must be a licensed electrician and complete online training to become a ChargePoint certified installer. If you do not complete training, you cannot access the ChargePoint network to complete installation.

Find online training at: chargepoint.com/installers

If the charging station is not installed by a ChargePoint certified installer, using a ChargePoint approved method, it is not covered under warranty and ChargePoint is not responsible for any malfunctions.

Electrical Requirements

At a minimum, each Level 2 charging station, either single or dual port, requires the following:

- A dedicated single phase electrical circuit from 40 A to 80 A
- A new circuit breaker at the electrical panel
- Conductor wiring and circuit protection sized in accordance with all applicable codes

Consequently, CP6000 charging station with two charge ports typically requires two power input circuits, one circuit per port. There may be situations where both ports share a main single circuit. If power capacity is limited at a site or to reduce costs for electrical infrastructure, consider ChargePoint Power Management options for power sharing at the circuit level, panel level, transformer, or site level.

IMPORTANT: Always check local codes to ensure compliance. You may need to adjust these instructions to comply with codes that apply at your installation location.

Additional Electrical Considerations

- CP6000 charging stations are AC electrical vehicle (EV) supply equipment and are permanently connected to AC networks.
- Evaluate existing electrical infrastructure to determine if the existing utility service and electrical panel capacity is sufficient.

- Ensure appropriate electrical wiring, over current circuit protection, and metering, if required, is in place.
- Identify costs for any necessary upgrades and/or a new dedicated electrical panel.
- ChargePoint recommends using a licensed electrician to evaluate available capacity and identify any upgrades that may be required.
- If a dedicated EV electrical panel is required, choose a panel location in close proximity to the charging stations.
- Determine raceway or conduit runs for electrical wiring from the electrical panel.

Charging Station Placement

To help minimize costs, choose station locations that are as close as possible to the available electrical infrastructure. Selecting these types of locations helps minimize long conduit and wire runs, as well as any trenching work.

WARNING: The ChargePoint charging station must be installed on a level concrete base or a flat wall rated for the weight of the station. Asphalt cannot support the full weight of the station. Failure to install the station on a suitable surface may cause the station to tip over, resulting in death, personal injury, or property damage.

Layout Considerations

- Identify station locations for EV charging spots.
- CP6000 charging stations can be installed either indoors or outdoors.
- They can be mounted on walls or in the ground (pedestal mount).
- CP6000 charging stations do not have an integrated active ventilation system.
- To help minimize costs, choose station locations that are as close as possible to the available electrical infrastructure.
- Consider locations where it will be easy to add future stations.
- Consider how easily drivers can find the stations they need to access.
- Identify suitable locations with smooth, plumb surfaces for wall mount stations or suitable floor surfaces for pedestal mount stations.
- Consider a layout to minimize electrical infrastructure costs to all proposed EV parking spaces.
- Avoid or minimize trenching requirements.
- Comply with regional accessibility laws, regulations, and ordinances. The CP6000 charging station must not block ramps or pathways and the height of the interactive display cannot exceed the maximum height as dictated by local laws.
- For stall parking, ChargePoint recommends using perpendicular parking stalls to better accommodate EVs with front and rear charge ports.

- Use dual-port pedestal mount stations where possible in open areas for adjacent parking or adjoining parking spaces.
- Consider protective bollards and wheel blocks where appropriate, especially for open tandem parking spaces.
- If the charging station has a camera, orient the camera towards the parking space.
- Use professional cellular test equipment to measure cellular signal levels to ensure adequate cellular coverage at the station installation location. To ensure adequate signal strength in underground or enclosed parking structures, cellular repeaters may be required. Use an indoor antenna located near EV parking spaces and an outdoor antenna typically located at the garage entrance ceiling or on the rooftop where cellular signals are best. See Connectivity for more details.
- When the charging stations cannot be placed close enough to the source of power to avoid undesirable line losses, consider increasing the size of the conductors. When the circuit conductors must be larger than 1/0 AWG, you must add a disconnect immediately adjacent to the station and terminate the upsized conductor at the line side lug of the disconnect. Then, connect a short length of 1/0 AWG conductor to the load side lug of the disconnect and the station. Adding disconnects close to the stations is also helpful when the circuit breakers are relatively far away.

Plan for the Future

Consider current EV charging needs and also potential future needs as EV adoption grows.

- Consider running raceway or conduit to all planned EV parking spots and pulling electrical wiring from the panel to meet current needs.
- Consider installing a dedicated electrical panel for EV charging and leveraging ChargePoint Power Management. This efficiently uses available power at a site to support more EV charging ports than would otherwise be possible.

Civil and Mechanical Design 2

Use the guidance below to design the civil and mechanical aspects of the site.

Each charging station can be installed attached to a wall or on a concrete pedestal with a Cable Management Kit (CMK). The pedestal can be mounted on a newly poured pad or an existing concrete surface.

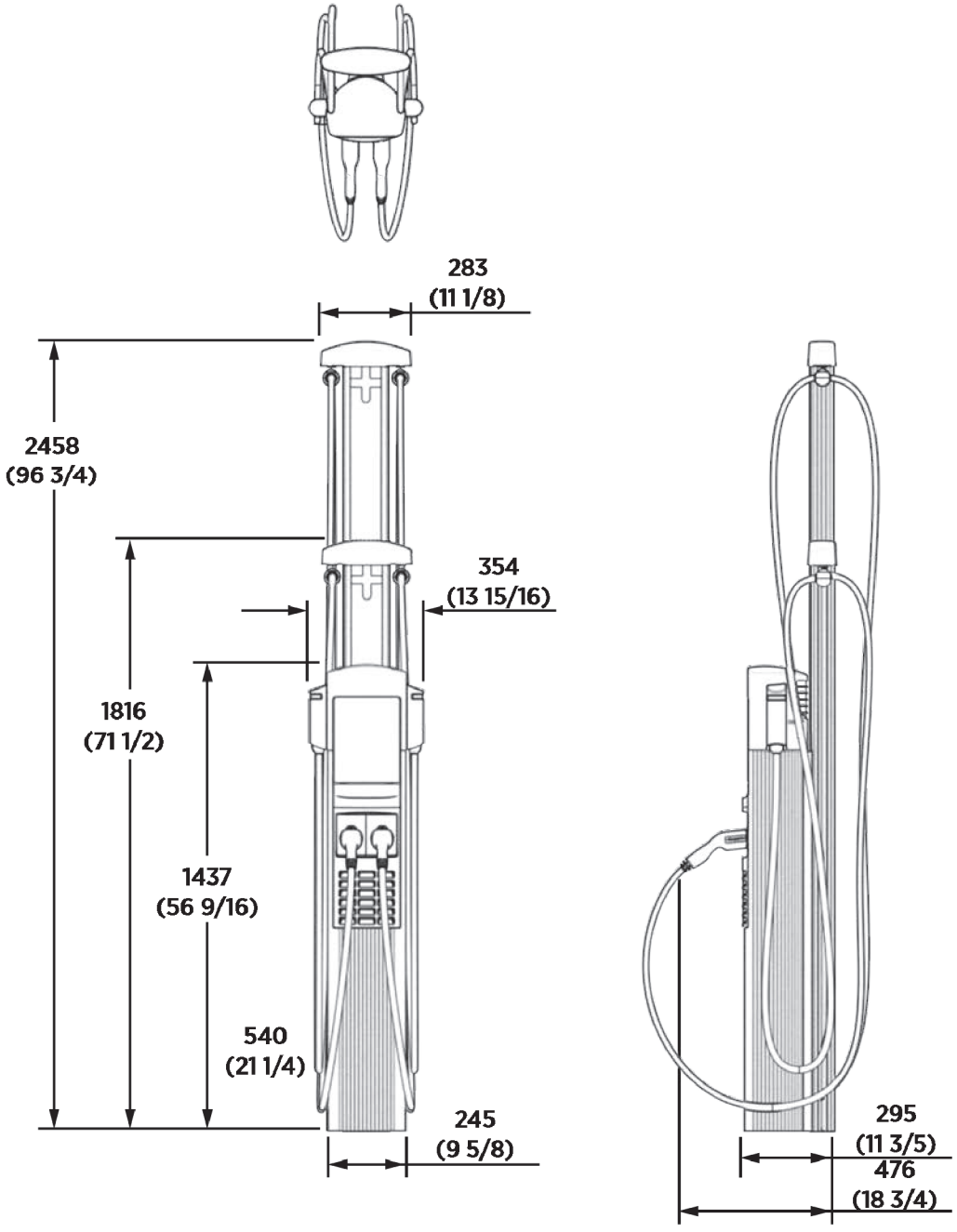
Component Dimensions and Weights

Each CP6000 charging station can be mounted on a pedestal or on a wall with a Cable Management Kit (CMK). The station is a vertical enclosure with the weights and dimensions shown below.

Station Configuration	Approximate Weight
Single port, wall	62 kg (136 lb)
Dual port, wall	68 kg (150 lb)
Single port, pedestal	71 kg (155 lb)
Dual port, pedestal	76 kg (168 lb)

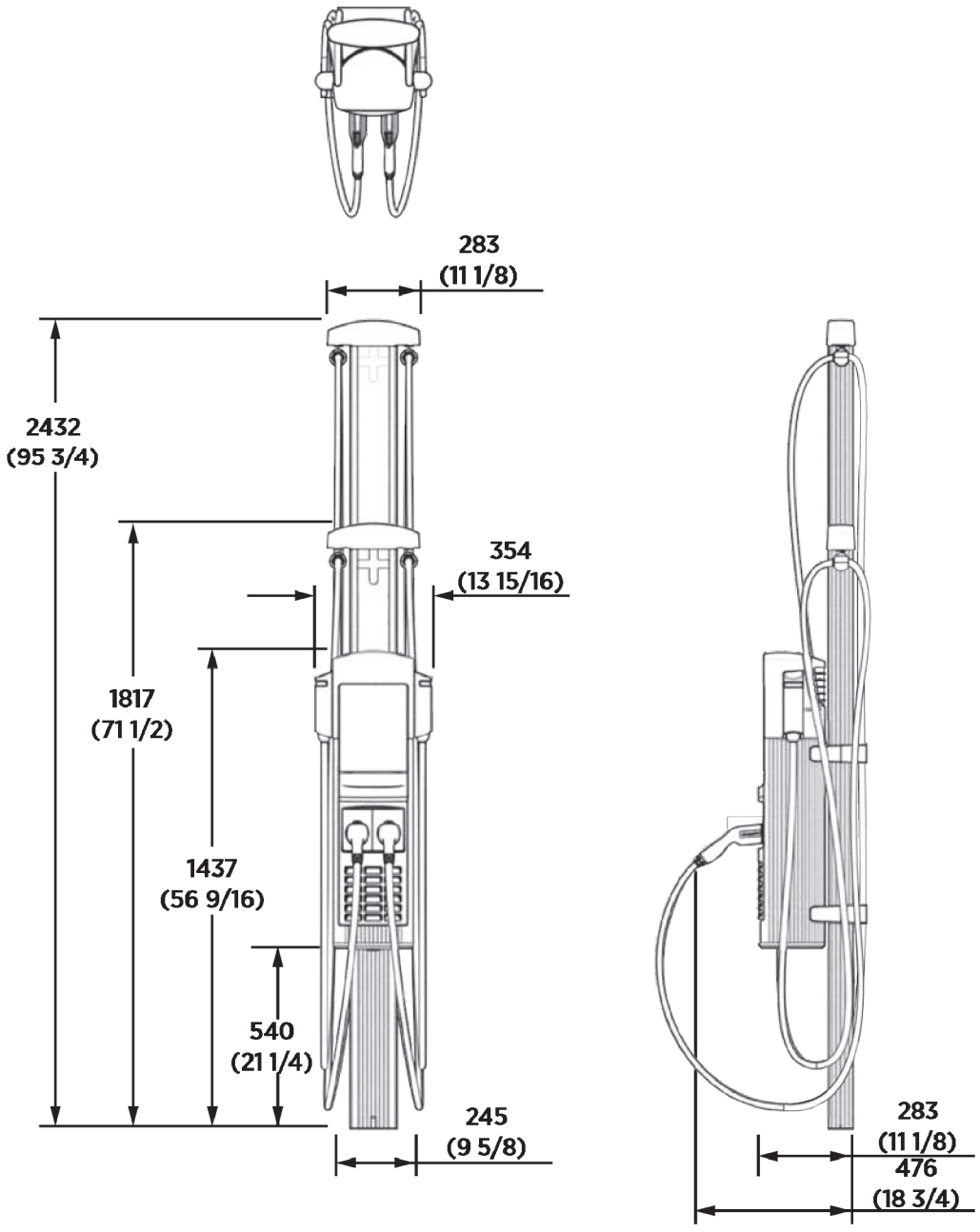
Pedestal Mount With CMK

Note: Images are not to scale. Measurements appear in metric units (mm), followed by imperial equivalents (inches).



Wall Mount With CMK

Note: Images are not to scale. Measurements appear in metric units (mm), followed by imperial equivalents (inches).



Mounting Specifications - Pedestal Mount Stations

IMPORTANT: Use a ChargePoint Concrete Mounting Template (CMT) when installing a new pedestal mount charging station or replacing an existing non-ChargePoint pedestal mount station. You do not need a CMT if you are installing a wall mount charging station or replacing an existing ChargePoint station.

The concrete pad must either be designed to be site-specific or must meet these specifications:

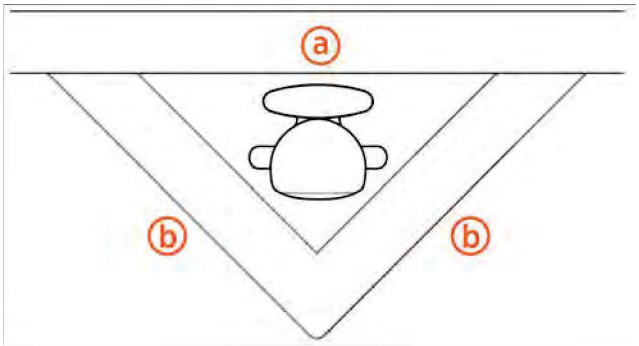
- Must not be installed in asphalt
- Mounting surface must be smooth
- Mounting surface cannot exceed a slope of 6 mm per 300 mm (0.25 in per ft)
- The concrete base must measure at least 600 mm (2 ft) on all sides
- Epoxy anchors can be used (installations in existing concrete)
- No expanding bolts are used
- Consult a civil engineer to ensure sufficient volume and strength of concrete; (installations in existing concrete)

IMPORTANT: If the existing pad does not meet the specifications above, a structural engineer must inspect and approve the pad for CP6000 charging station dimensions and weight.

Pedestal Base Designs

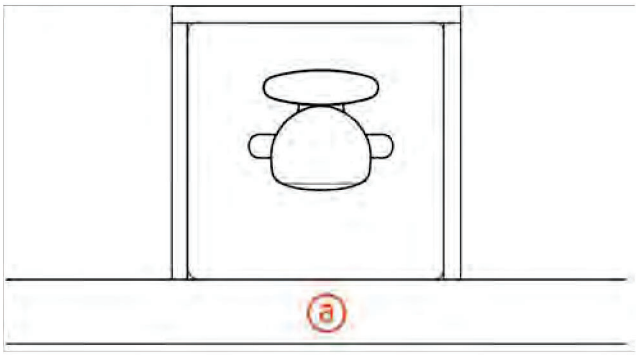
There are three basic pedestal base designs:

- In front of a curb **(a)** - Does not obstruct a pedestrian pathway or disturb landscaping.
  900 mm (3 ft) on each side **(b)**
  Area: 0.42 m^2 (4.5 ft^2)
  Volume: 0.26 m^3 (9 ft^3)



- Behind a curb **(a)** in a planter or berm
  600 mm (2 ft) on each side
  Area: 0.37 m^2 (4 ft^2)
  Volume: 0.23 m^3 (8 ft^3)

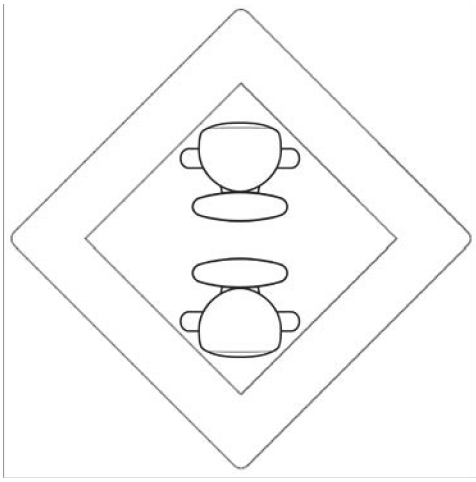
Note: Use a retaining wall as needed to prevent dirt from accumulating on the pad.



- Two stations back to back, centered between four spaces 900 mm (3 ft) on each side

  Area: 0.84 m^2 (9 ft^2)

  Volume: 0.51 m^3 (18 ft^3)

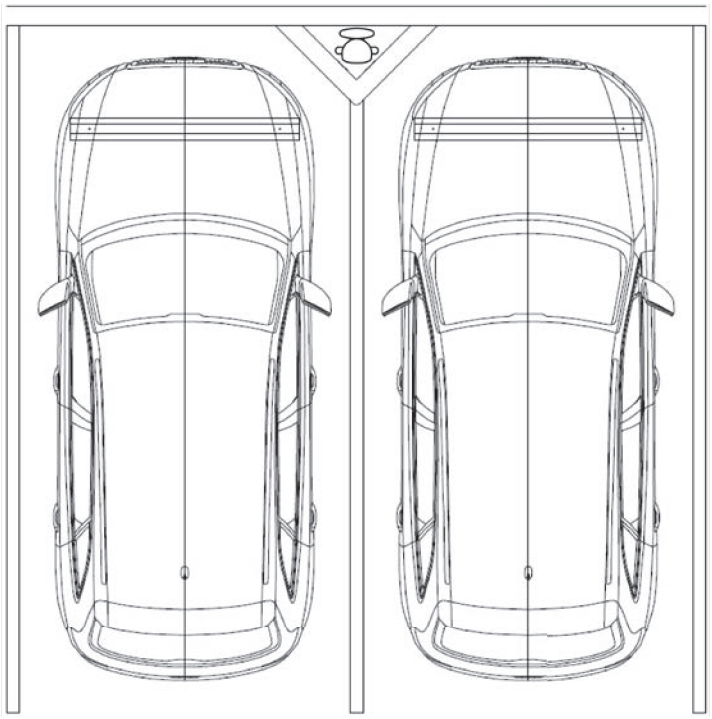


Pedestal Configurations for Different Parking Arrangements

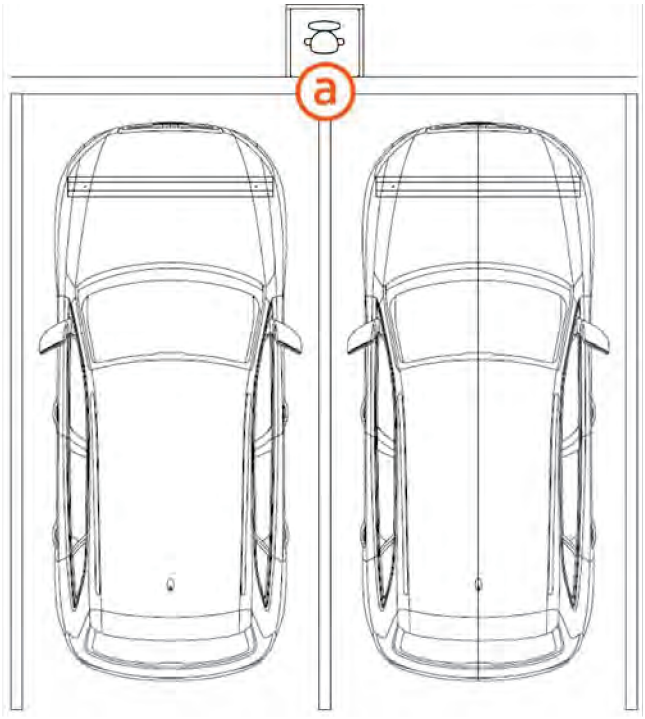
The pedestal base design can be configured in a variety of ways to serve different parking arrangements. Ensure a sufficient volume of concrete to provide anchoring for the charging station.

Note: CP6000 charging stations are available in several configurations. The images in this guide might not match your station exactly; however, the information is applicable unless otherwise noted.

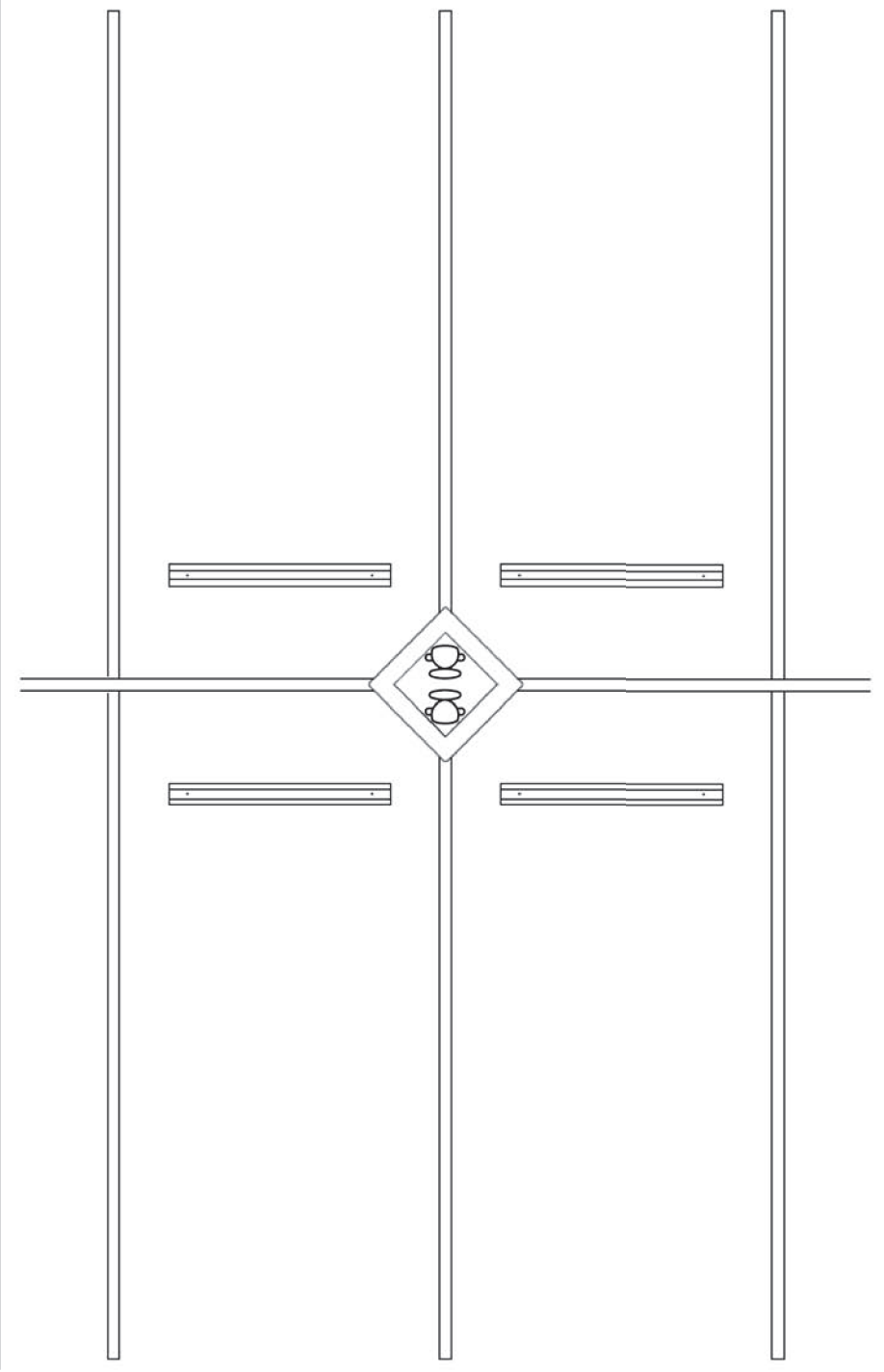
- Place the station against the curb between spaces with wheel stops 900 mm (3 ft) from the front of each stall. The base of the charging station can be flush with the parking spaces or at curb level.



- Place the station in a planter or berm between spaces with wheel stops 900 mm (3 ft) from the front of each stall or the curb **(a)**.



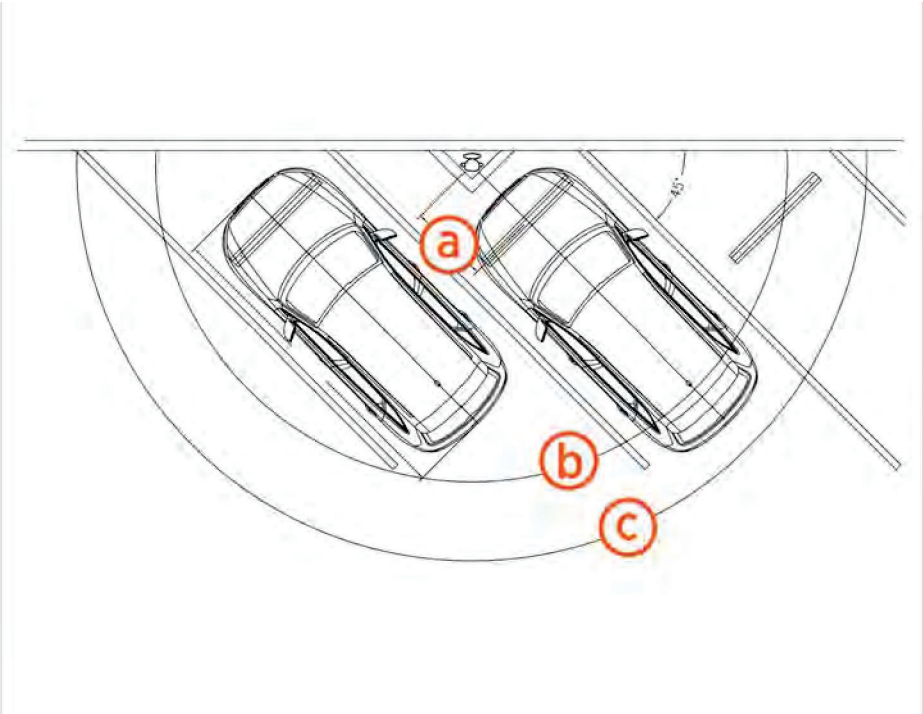
- Place two stations back to back centered on four spaces with wheel stops 900 mm (3 ft) from the front of each stall. The base of the charging station can be flush with the parking spaces or at curb level.



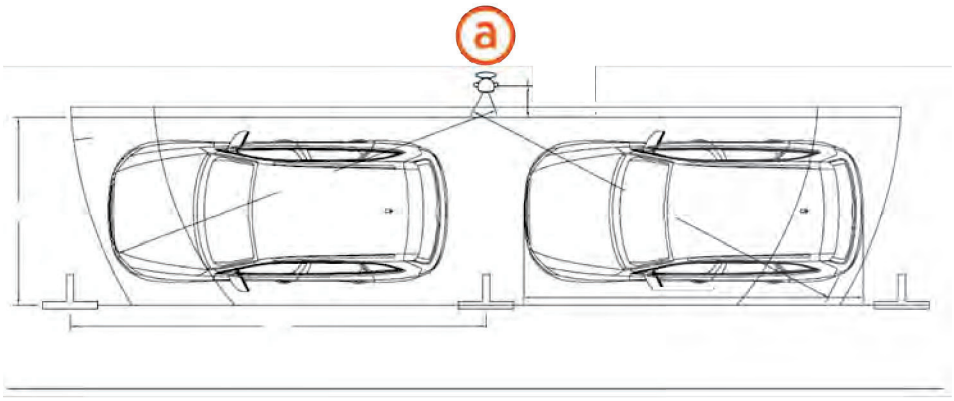
- When placing a dual holster station centered on the right space, the charging cables can reach two vehicles. Place a wheel stop 1220 mm (4 ft) **(a)** from the center of the charging station.

  Note the following details for this arrangement:

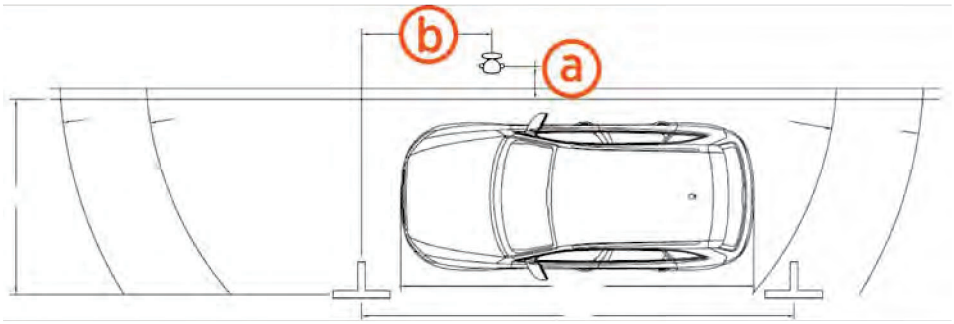
  - The arc shows the usable reach of the two charging cable lengths available: 5.5 m (18 ft) **(b)** and 7 m (23 ft) **(c)**.
  - The 7 m (23 ft) cord option is recommended for this configuration.
  - The base of the charging station can be flush with the parking spaces or at curb level.
  - Be sure to install 'EV Charging Station' signs on both spaces.



- Place a dual holster station centered between two parallel parking spaces, each 6 m (20 ft) long. Place the station **(a)** 450 mm (18 in) from the curb. A 7 m (23 ft) charging cable is recommended.



- Place a single holster station for a single parallel parking space 6 m (20 ft) long. Place the station **(a)** 450 mm (18 in) from the curb, and 1.8 m (6 ft) from the front of the parking space **(b)** This allows the cord to reach any part of the vehicle without blocking the curb side doors.

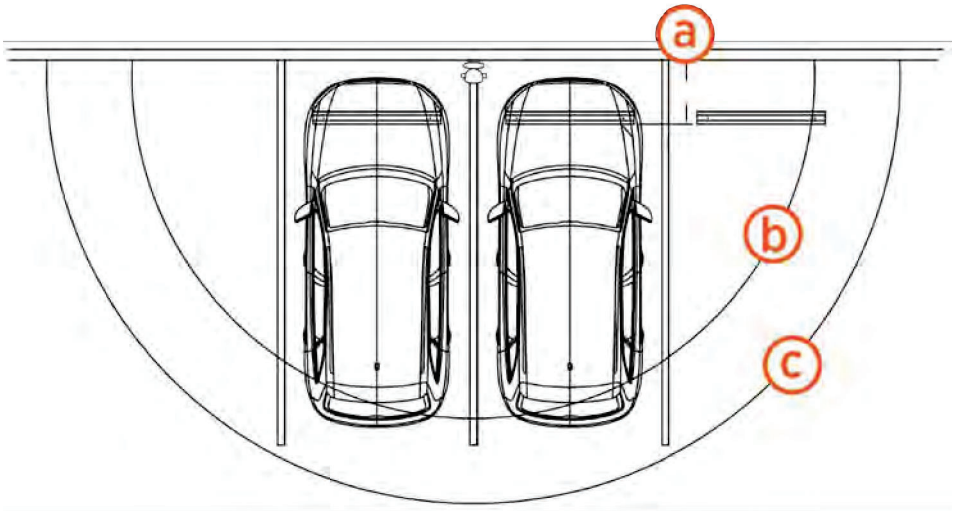


Mounting Specifications - Wall Mount Stations

For wall mounted stations:

- The wall must be smooth, stable, and plumb.
- The minimum height of the wall must be 1160 mm (45.7 in) above a finished floor.
- Place wheel stops 900 mm (3 ft) **(a)** from the wall.
- The arcs show the usable reach of two charging cable lengths available, 5.5 m (18 ft) **(b)** and 7 m (23 ft) **(c)**.

Note: Ensure the space between the wall and the charging station is clear and free of debris.



IMPORTANT: Ensure the wall supports the station. If mounting to a hollow wall, bridge at least two studs using a 41 mm (1 5/8 in) channel strut.

WARNING: If not installed correctly, the ChargePoint charging station may pose a fall hazard, leading to death, personal injury, or property damage. Always use the provided Concrete Mounting Template shown preinstalled here, or a ChargePoint-approved surface mounting solution, to install the ChargePoint charging station. Always install in accordance with applicable codes and standards using licensed professionals. Non approved installation methods are performed at the risk of the contractor and void the Limited One-Year Parts Exchange Warranty.

Drainage

Ensure any slopes, walls, or fencing at the site do not trap water around the charging station installation site. The system is only built to withstand water to the height of the conduit stub-up.

WARNING: Exposing the ChargePoint charging station to water above the height of the conduit stub-up could create an electrocution, shock, or fire hazard. Cut power to the charging station if it has been exposed to standing water and contact ChargePoint before the charging station is powered on.

Clearances

For pedestal installations, the conduit stub-up must be a minimum of 230 mm (9 in) from any obstructions to the rear. This includes other charging stations. Check applicable codes for any additional clearance requirements.

Accessibility

Comply with regional accessibility laws, regulations, and ordinances. The CP6000 charging station must not block ramps or pathways and the height of the interactive display cannot exceed the maximum height as dictated by local laws.

Signage

Refer to local and regional code to design the following elements for the site:

- Any required re-striping of parking spaces
- EV or Accessible EV signs
- EV or Accessible EV paint markings on and around the parking spaces

Electrical Design 3

The CP6000 charging stations are available with a maximum amperage of either 50 A or 80 A.

If the charging station allows a maximum of 50 A, Power Select current options include 16 A, 24 A, 32 A, 40 A, 48 A, and 50 A.

If the charging station allows a maximum of 80 A, Power Select current options include 16 A, 24 A, 32 A, 40 A, 48 A, 50 A, 56 A, 64 A, 72 A, and 80 A.

Power Share allows a dual-port station to share power from a single circuit across two ports, adjusting power depending on whether one or both are charging. Standard wiring uses an independent circuit for each port. Power Share can be used in combination with Power Select.

Refer the CP6000 datasheet at chargepoint.com/guides for information about the following:

- Electrical input
- Electrical output
- Mounting and functional interfaces
- Safety and connectivity features
- Safety and operational ratings

General Wiring Considerations

Ensure that the installation location is equipped with service wiring that supports the charging station's power requirements.

Conduit and wire size are determined based on the length of runs from the electrical panel to the station location. Service wiring must be run through conduit to comply with local electrical codes. Consult national and local codes or a project engineer to determine the grade, quality, and size of the conduit or cable.

Attach the conduit with a listed adapter. Use a sealing method that meets all applicable code requirements.

The CP6000 Concrete Mount Kit accommodates service wiring through the flare, conduit, or locally appropriate wiring method. Visit Pedestal Mount Concrete Preparation for more information.

Note: All wiring and conduit is supplied by the contractor unless otherwise indicated.

For full product specifications, refer to the CP6000 Datasheet.

Wall Mount Considerations

- CP6000 wall mounted charging stations use surface mount wiring.
- When pulling electrical wiring for wall mount stations, the conduit and wire must be brought to the location where the stations will be mounted. Flex conduit is typically used to bring the wire to the station. Wiring is brought in through knock outs in the bottom of the charging station.

Pedestal Mount Considerations

- CP6000 pedestal mounted charging stations typically require service wiring installed underground to enter through the bottom of the station.
- When pulling electrical wiring for CP6000 pedestal mount, ensure at least 1.5 m (5 ft) of wire remains above grade.

Conduit

The outside diameter of conduit must not exceed the sizes called out in the pedestal mounting template: 95 mm (3.74 in). Conduit stub-ups must measure between 152 mm (6 in) and 590 mm (23.25 in) above grade.

Conduit stub-ups must not extend higher than 600 mm above ground level.

Electrical Supply Requirements

Wiring must be sized in accordance with all applicable codes for continuous load devices. The main standard for cable size is based on IEC 60364-5-52:2009 and IEC 60364-5-54:2011. The terminal block accepts stranded or solid conductors up to 1/0 AWG (50 mm^2). The appropriate size depends upon the distance between the electrical panel and the charging station installation site and the maximum current in the circuit.

When planning multiple EV charging stations, it is best practice to separate non-continuous from continuous loads, with all branch circuits for EV charging on a dedicated electrical panel assembly with adequate circuit breakers. When sizing new electrical panels dedicated for EV charging, all branch circuits must support continuous load.

CP6000 charging stations are designed for connection to and operation on rated voltages of 208 V or 240 V (phase to phase) at 60 Hz. Source must have neutral bonded to ground to establish 120 V phase to ground.

CAUTION: CP6000 charging station is rated Over-voltage Category III and includes surge protection for absorbing transient over voltages. CP6000 charging stations are tested to IEC 61000-4-5 (4 kV) standards. In countries where extra Surge Protection Device protection is required, check the national codes for categorization and installation of the equipment.

CAUTION: Use copper conductors only.

Use new circuit breakers only.

Port Capacity	Breaker Rating
80 A /port	100 A breaker per port
48 A/port	60 A breaker per port
40 A/port	50 A breaker per port

Ensure all power and ground connections (especially those at the breaker) are clean, tight, and torqued to specification. Remove all oxide from all conductors and terminals before connecting wiring.

Be aware of these requirements before installing the charging station:

- CP6000 charging stations comply with Class B.
- The CP6000 is Class I grounded equipment and must be grounded.

Consult your electricity grid operator regarding requirements for local regulations. Depending on the desired rated power, the installation of the charging station may require registration with and approval by your electricity grid operator.

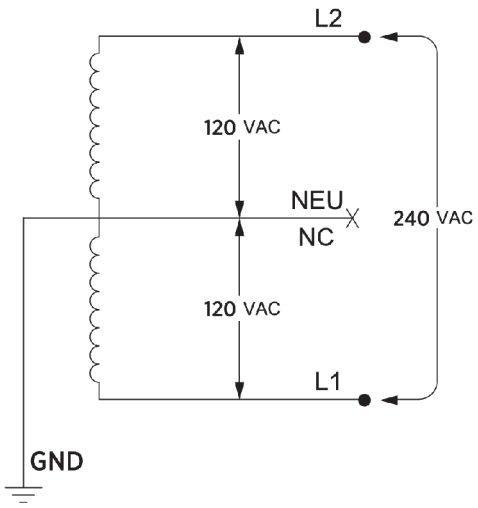
Grounding Requirements

CP6000 charging stations must be connected to a grounded, metal, permanent wiring system. An equipment-grounding conductor must be run with circuit conductors and connected to an equipment-grounding terminal on the charging station.

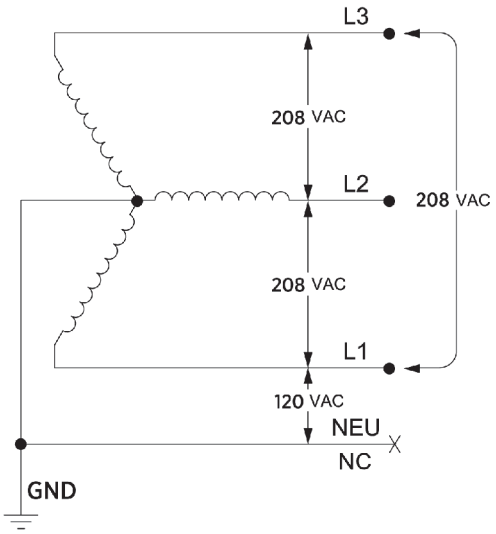
A grounding conductor that complies with applicable codes must be grounded to earth at the service equipment or, when supplied by a separate system, at the supply transformer, or may be grounded to an earth electrode. Ensure the grounding conductor complies with all applicable codes.

Connect To These Systems

- 120/240 V AC, 1Ø Bonded Neutral
  Station is connected to L1 and L2
  Neutral is not used



- 120/208 V AC, 3Ø Wye Bonded Neutral
  Station may be connected to any two lines
  Neutral is not used



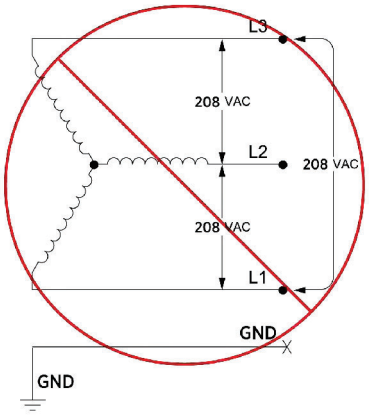
Do Not Connect to These Systems

- 208 V AC 3Ø Wye, ungrounded

  Floating Neutral

  Voltage of either line to ground is undetermined

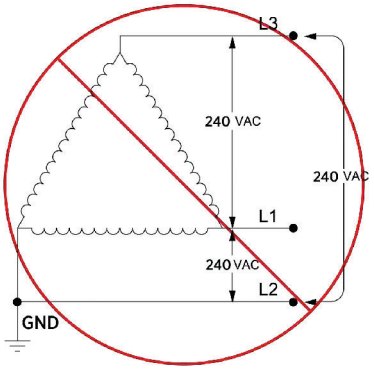
  Neutral is not grounded



- 120/240 V AC 3Ø Delta, corner-grounded

  Voltage of any line is not 120 V nominal relative to ground

- Any system where the center point of the AC power source is not grounded.



Connectivity 4

A consistently strong cellular signal is needed before installers can activate the vehicle charging station. Weak or sporadic signal can affect crucial aspects of the charging station, including:

- Accuracy in reporting
- Ability for drivers to use the mobile app
- Ability for customer support to troubleshoot problems
- Support for advanced features such as Power Management or Waitlist

A strong signal is also required for the ChargePoint Assure maintenance and management programs.

ChargePoint stations use cellular data connections to reach ChargePoint Cloud Services. This allows secure, PCI-compliant data connections without requiring any other form of internet connectivity at an install site or imposing additional network management responsibilities on a site host.

Each station has its own cellular connection.

Signal Strength and Quality

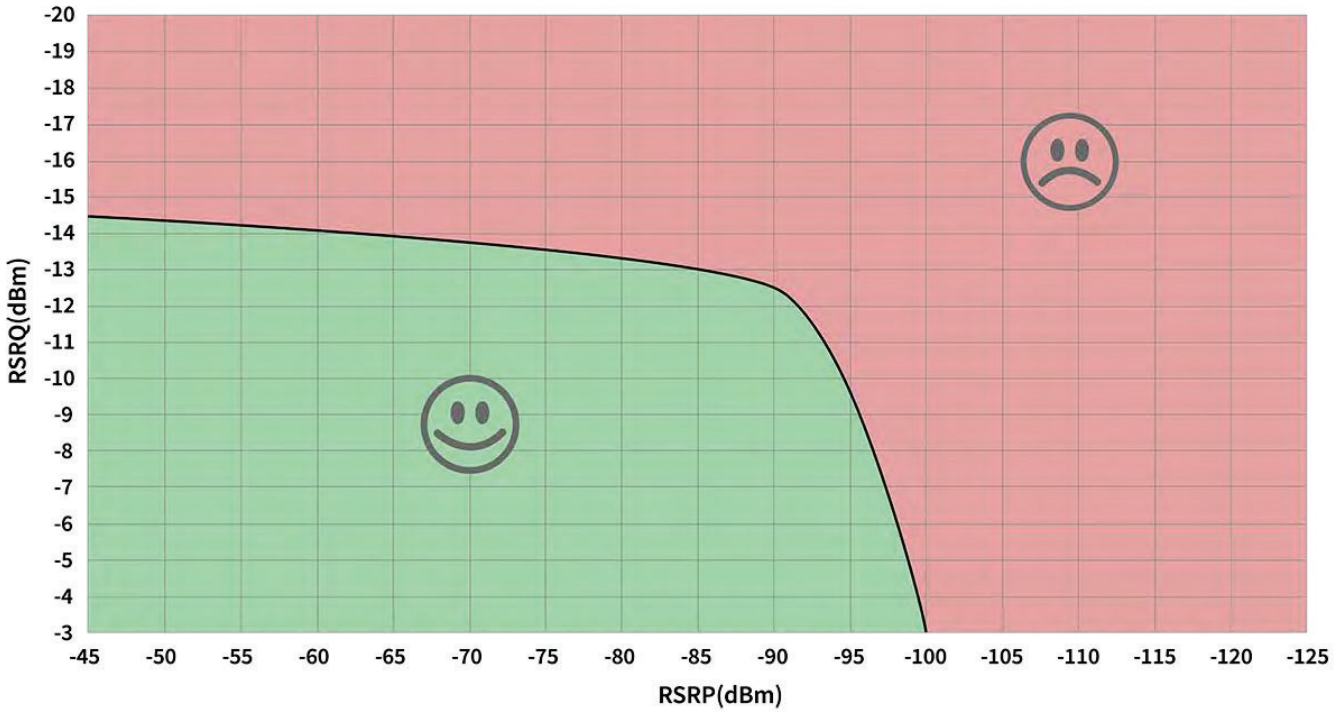
You must use a cellular signal detection device (such as a Siretta Snyper LTE or equivalent) to take signal strength readings at the exact proposed mounting location of the charging station. If the charging station does not have its own cellular connection, take the signal strength reading at the proposed mounting location of the gateway station.

In North America, ChargePoint products all support LTE bands 2, 4, and 5. The most commonly supported carriers to check during site evaluation are:

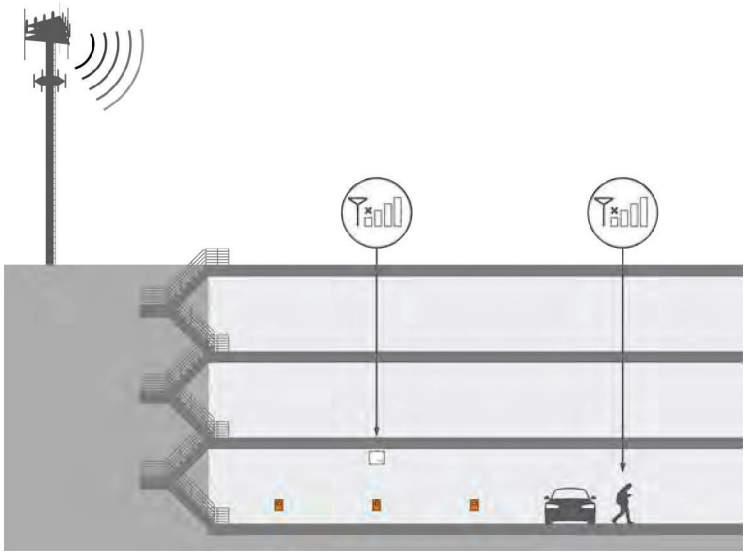
- US: AT&T, T-Mobile, and Verizon
- Canada: Rogers, Telus, and Bell

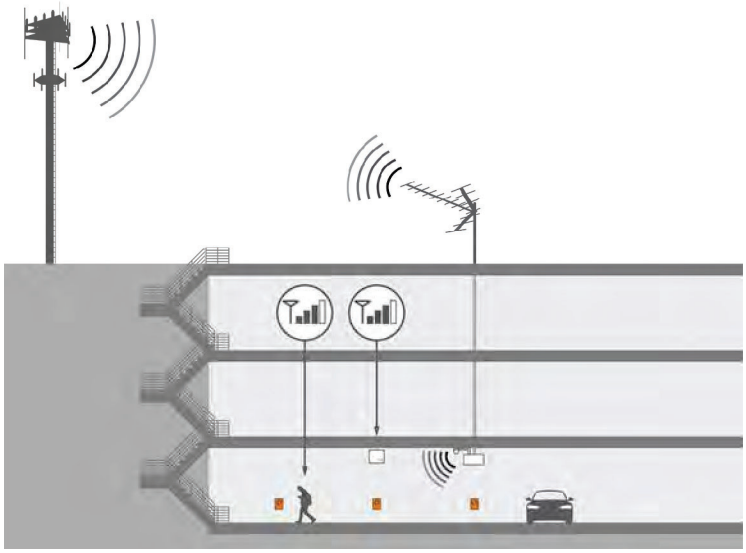
You must test the LTE signal strength at the proposed mounting location of every gateway station and ensure the location meets the minimum RSRQ at -12.5 dB or better, for RSRP measured at -90 dBm or better. Refer to the graph for acceptable combinations.

Note: These numbers are all negative, so -70 dBm is stronger than -85 dBm, and -90 dBm is weaker.



If the signal strength is weaker than this, take cellular readings at the location where any cellular signal booster antennas will be installed. Ensure enough signal exists for that repeater model. Install repeaters to boost the strength of the cellular signals. Repeaters are often required when installing charging stations in an underground garage or enclosed parking structure.





For other regions, or if the site does not have strong signal on these bands, contact your ChargePoint representative for additional solutions.

ChargePoint strongly recommends a consultation with a cellular connectivity specialist before all installations. A consultation can verify:

- Service with a supported carrier on a supported LTE band
- Available signal and local noise levels on applicable bands
- Site changes to correctly meet your needs, both for station bandwidth and other phone coverage for customer or tenant satisfaction

Repeaters

Some sites require repeaters to ensure strong signal to all stations. If a repeater is required, look for a model with these features:

- Specifically LTE compatible on the listed bands
- Multi-carrier
- Multi-band
- Not already dedicated to FirstNet or other first responder-specific networks
- Auto-gain recommended

Note: Do not rely on readings taken with a cell phone when conducting site surveys. Many signal boosters and network extenders may not be compatible with ChargePoint hardware, including certain types of Distributed Antenna Systems (DAS), micro/nano/pico/femto-cells, and carrier- or band-specific signal boosters.

Pedestal Mount Concrete Preparation 5

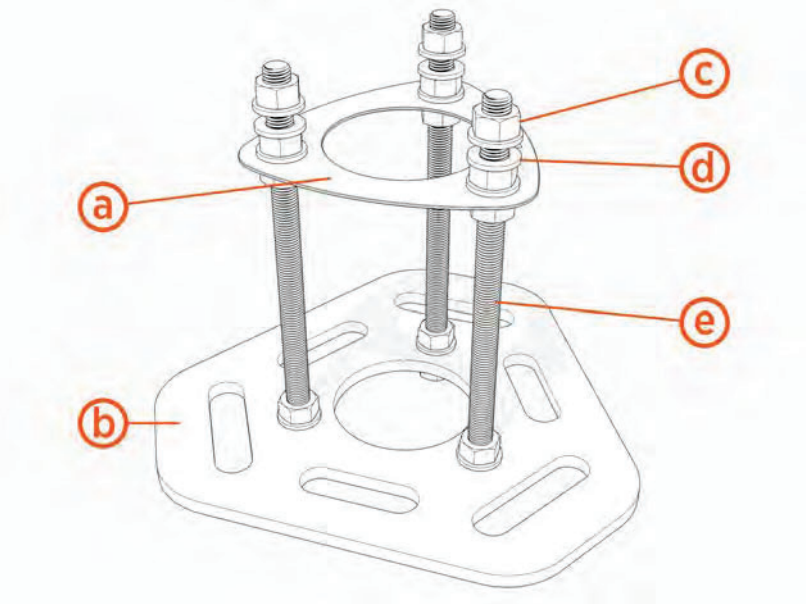
Concrete Mounting Template

You must use a ChargePoint Concrete Mounting Template (CMT) when installing a new pedestal mount charging station or replacing an existing non-ChargePoint pedestal mount station.

Use a CMT when installing charging stations on existing concrete (on an intermediate floor only).

You must order the CP6000 CMT separately, with sufficient lead time before site construction. This kit ships separately from the ChargePoint CP6000 charging station.

a. Upper template
b. Lower template
c. Nuts (x 15)
d. Washers (x 18)
e. Anchor bolts (x 3)



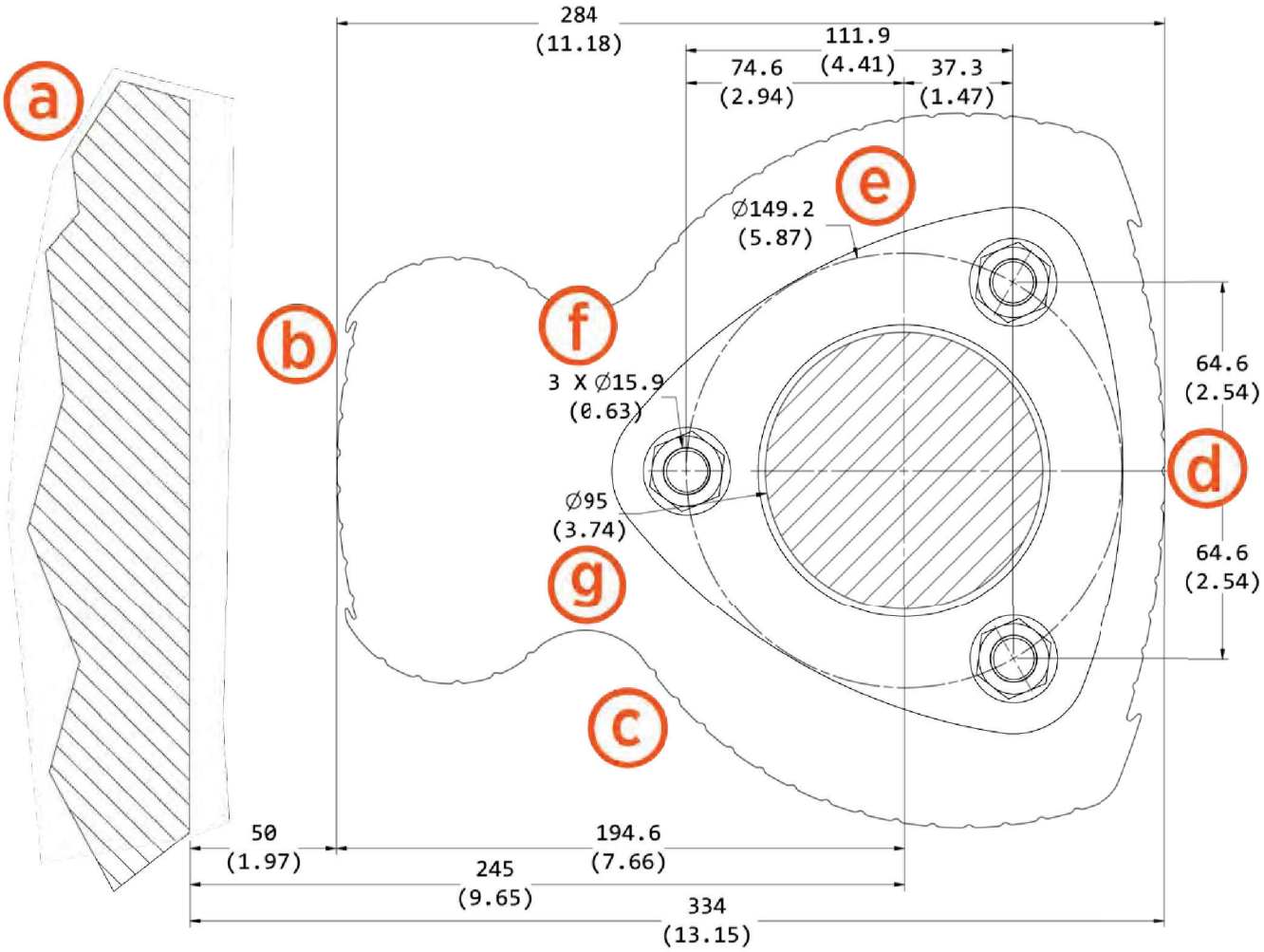
Note: You do not need a CMT if you are installing a wall mount charging station or replacing an existing ChargePoint station.

The Concrete Mounting Template kit components you need to use, the tools required, and the installation steps vary depending on the type of installation: new concrete or existing concrete.

WARNING: Do not use expanding anchor bolts. Do not install the CP6000 on an asphalt surface.

CMT - Pedestal Mount With CMK

Note: Images are not to scale. Measurements appear in metric units (mm), followed by imperial equivalents (inches).



a. Wall
b. CMK footprint
c. Pedestal footprint
d. Front
e. Bolt circle
f. Bolt or anchor
g. Conduit stub-up within this area (new concrete only)

Tools and Materials

In addition to the CP6000 Concrete Mounting Template kit, the site construction team needs:

- Digging tools (shovel, spade, etc.)
- Materials to prepare the form for pouring concrete
- Concrete as specified by site drawings
- Rebar as specified by site drawings
- 24 mm (1 in) wrench
- Level
- Cut-resistant gloves
- Drill or hydraulic hole punch (if using armored cable)
- Conduit, ducting, or armored cable in the amounts and types specified by site drawings, that complies with local code (see the rest of this document for conduit sizes and routing)

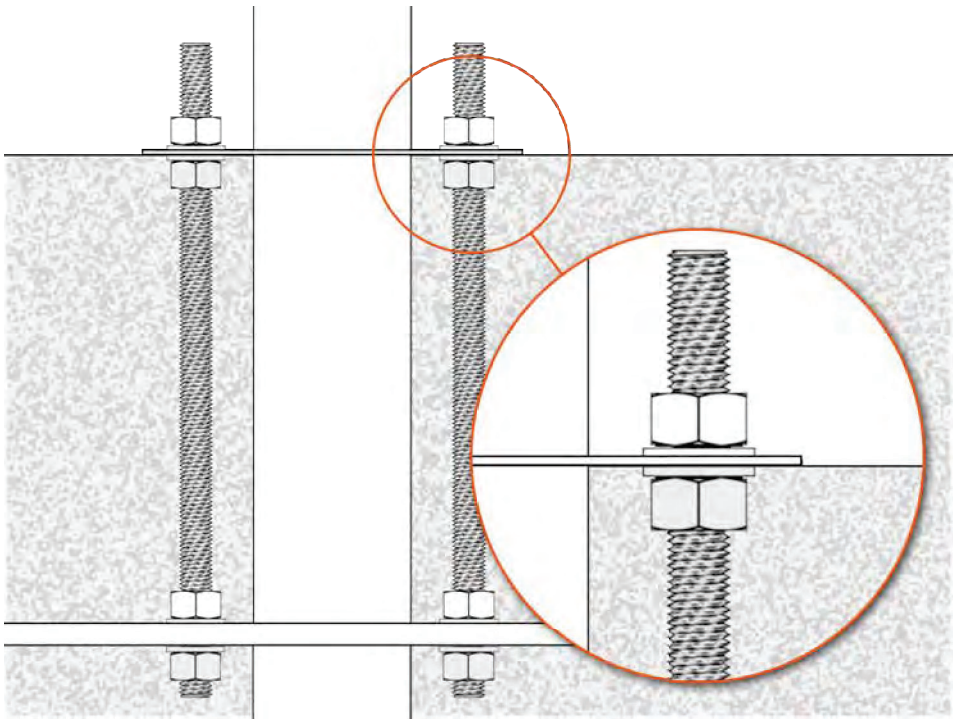
Installation into New Concrete

WARNING: Failure to install the ChargePoint CP6000 in accordance with these instructions and all local building practices, climate conditions, safety standards, and all applicable codes and ordinances may lead to risk of death, injury, or property damage, and will void the Limited One-Year Parts Exchange Warranty.

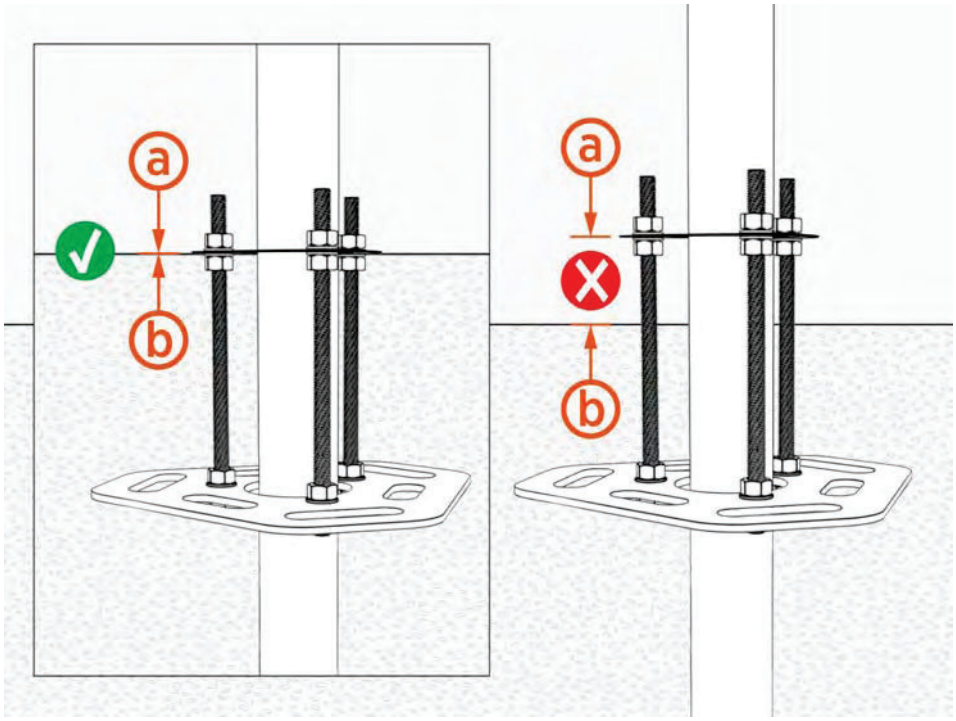
1. Trench and excavate an opening to accommodate the wiring conduit and the concrete mounting pad that meets local codes and requirements, per site drawings.
2. Run conduit to each station as needed. If the station needs wired Ethernet access, run Ethernet conduit.
3. Build the form and lay rebar for the foundation.
    - The concrete block must measure at least 600 mm (24 in) on all sides.
    - The conduit stub-up needs to measure between 152 mm (6 in) and 590 mm (23.2 in) above the concrete surface

    IMPORTANT: It is critical that the conduits are positioned properly and plumb. The tolerance where the conduits enter the station is 2 mm (1/16 in).
4. Align the CP6000 CMT over the conduit stub-ups with the two bolts facing forward and the third bolt to the rear.

5. Slide the CP6000 CMT over the conduit stub-ups until the top surface of the template is level with the top surface of the concrete when poured.

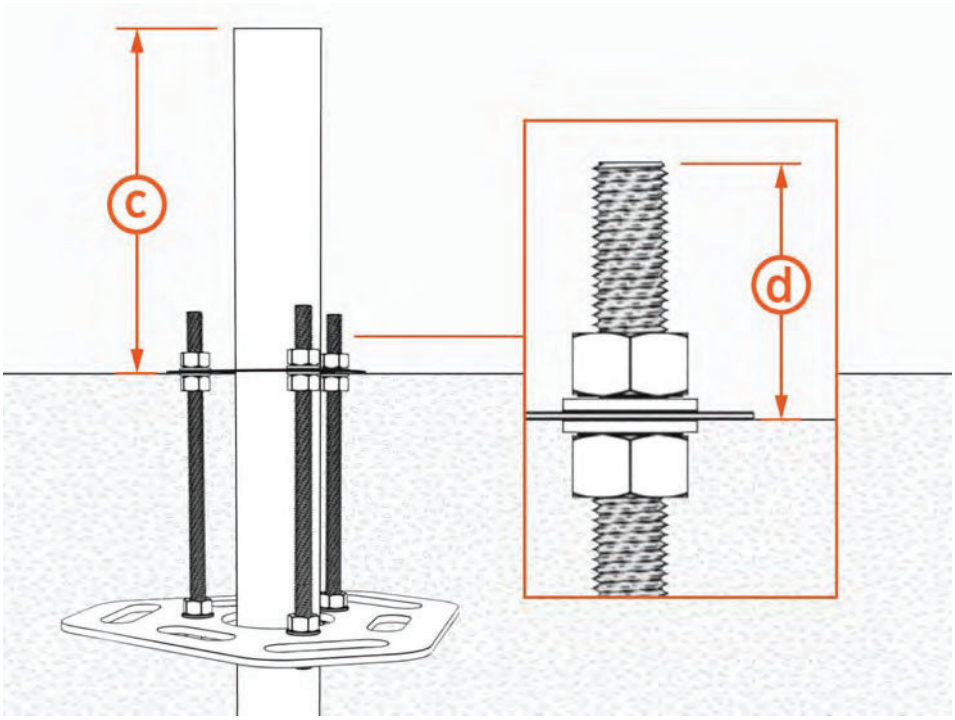


The bottom of the upper template **(a)** must align with the surface of the concrete **(b)**.

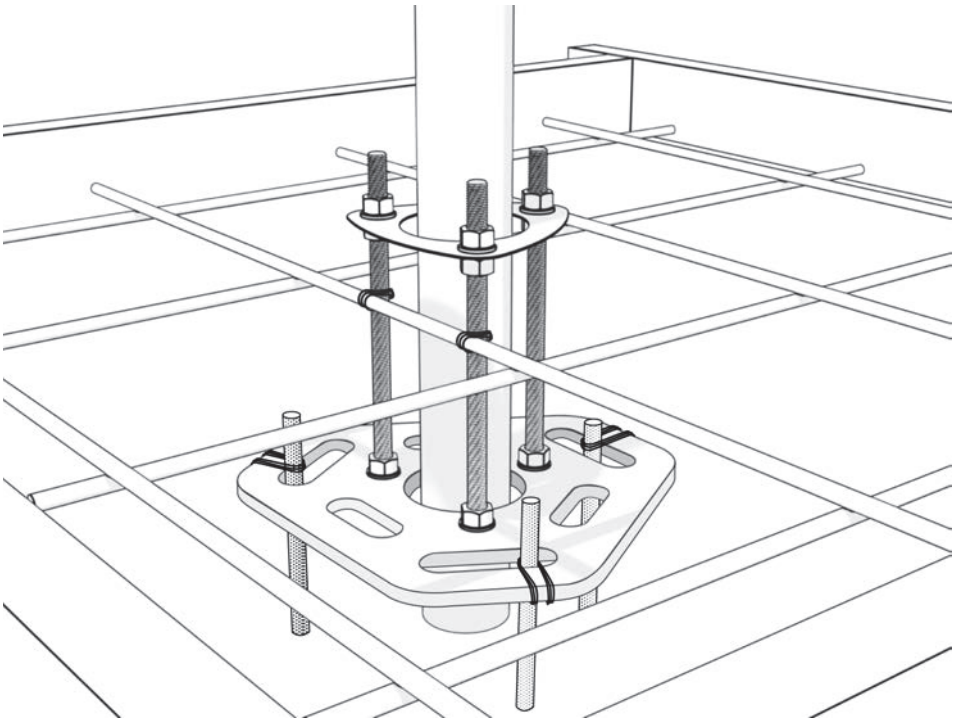


6. Ensure the conduits are plumb.

7. Use a level to check that the CP6000 CMT is level from front to back and from side to side.
8. Conduit height **(c)** must be between 152 mm (6 in) and 590 (23-1/4 in). Each bolt **(d)** must extend between 60 mm (2-1/2 in) and 100 mm (4 in) above the concrete surface.



9. Before pouring concrete, tie the CP6000 CMT to rebar to help hold it in place.



IMPORTANT: The CP6000 CMT and the conduit must be secured in place to prevent them from moving out of position while the concrete is poured and curing.

10. Pour the concrete.

    Note: Make sure the concrete surface between the conduits is completely level and free of any irregularities.

11. Refer to the measurements in this guide and ensure the anchor rod locations are correct before the concrete is dry.
12. Use a level to ensure the bolts are plumb.

You are now ready to install the CP6000 pedestal mount charging station.

Install on Existing Concrete

IMPORTANT: Always check local codes to ensure compliance. You may need to adjust these instructions to comply with codes that apply at your installation location.

Review the CP6000 Site Design Guide and ensure that the dimensions of the existing concrete slab meet the requirements.

If you are installing a Cable Management Kit (CMK), make sure there is adequate clearance behind the power stub-up for the CMK.

To safely mount a CP6000 charging station, the concrete must be at least 150 mm (6 in) thick. At this thickness, all of the CP6000 mounting bolts must be positioned as follows:

- At least 380 mm (15 in) from the front edge
- At least 300 mm (12 in) from the side edges
- At least 150 mm (6 in) from the rear edge of the concrete slab

IMPORTANT: If the existing pad does not meet the specifications above, a structural engineer must inspect and approve the pad for CP6000 charging station dimensions and weight.

Replace an Existing Charging Station

If you are replacing a CPF50 charging station, contact ChargePoint to order a CPF50 Adapter Kit.

If an existing charging station (from a manufacturer other than ChargePoint) is already in place at the installation site, complete these tasks:

- Turn off all power to the station and disassemble according to the original manufacturer's instructions.
- Cut away any existing bolts or non-power conduit stub-up to ground level.
- You may need to plug cut-away conduits at the slab end and disconnect wiring at the other end.

IMPORTANT: If existing conduit stub-up diameter is greater than 32 mm (1-1/4 in), you must remove the concrete and replace it.

Tools Required

Electric hammer drill with 12 mm (1/2 in) or larger chuck.

Consumables Required

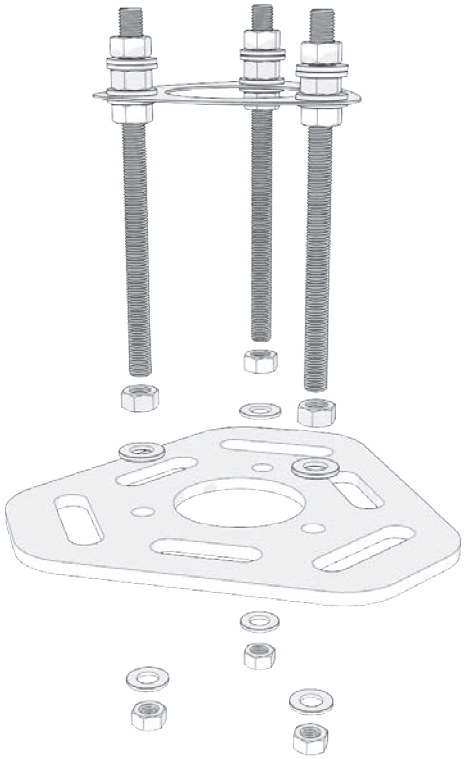
The following table lists and describes consumable items that you will need. The quantity listed in the table is based on installation of one charging station.

Note: The consumption rate of these products varies depending on conditions at the installation site.

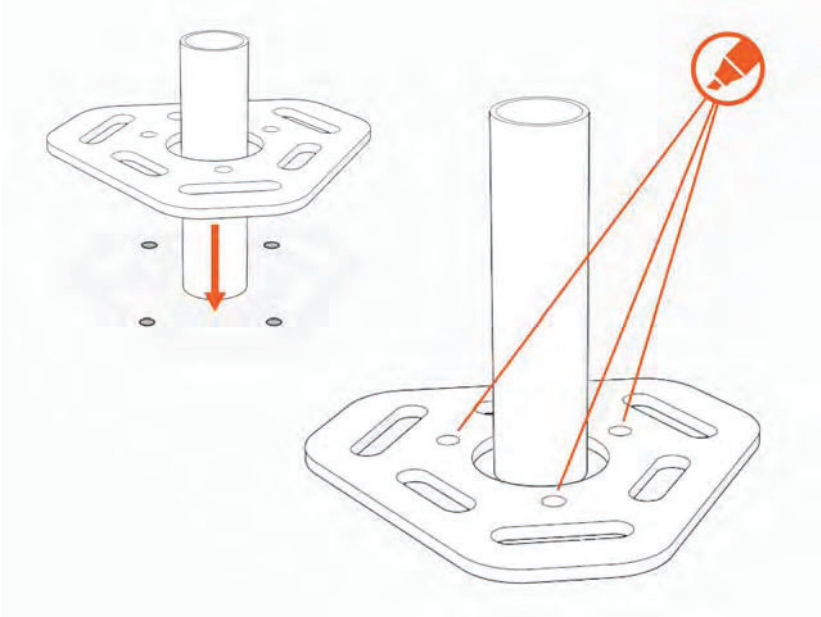
Quantity	Description	Purpose
1	Epoxy adhesive for concrete such as Hilti RE-500	Fill drilled holes.
1	Electrical cleaning and maintenance aerosol, any angle spray duster, 235 ml (8 oz)	Clean drilled holes. Note: Compressed air will work.
1	Slow spiral round-shank masonry drill bit • 19 mm (3/4 in) diameter • 12.5 mm (1/2 in) shank • 254 mm (10 in) drill depth • 305 mm (12 in) length overall	Drill 19 mm (3/4 in) holes in concrete. Note: The holes must be at least 150 mm (6 in) deep.
1	Drill bit for concrete embedded rebar, round • 19 mm (3/4 in) bit size • 12.5 mm (1/2 in) shank diameter • 305 mm (12 in) length overall	Drill 19 mm (3/4 in) hole through rebar.
1	Nylon loop handle brush • 19 mm (3/4 in) brush diameter • 75 mm (3 in) length brush • 216 mm (8 1/2 in) length overall	Clean drilled holes.
1	Push-on round cap, fits 16 mm (5/8 in) - 17.5 mm (11/16 in) OD, 12.7 mm (1/2 in) inside height, pack of 100	Keeps the epoxy inside the drilled holes in situations where the slab is only 150 mm (6 in) deep.

Installation Instructions

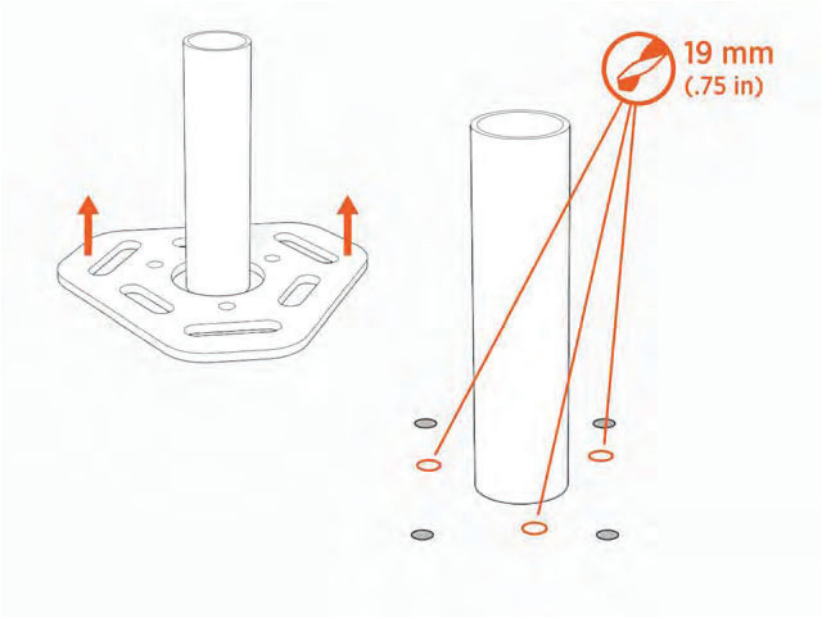
1. Remove the lower template and all nuts and washers from below the upper template.



2. Place the lower template on the concrete and mark the hole locations.
    - When placing the template, consider the charging station's total footprint.
    - If installing over an existing conduit stub-up or armored cable, position the center of the template around that stub-up / cable.



3. Remove the template and drill three 19 mm (0.75 in) diameter holes 250 mm (9.85 in) deep into the concrete.
    - You may need two drill bits: one for the concrete (with the pilot) and another for the rebar (without the pilot). Always start the hole using the standard drill bit, and then switch to the rebar drill bit only if drilling through rebar.



4. Remove all dust from inside the drilled holes using compressed air, a vacuum, or a brush.
5. Remove the bolts from the upper template.
6. Fill each hole with epoxy to about 65 to 75 mm (2.5 to 3 in) below the top of the hole. Continue immediately to the next step because the epoxy sets quickly.

   Note: Inserting the threaded bolts displaces the epoxy, causing it to fill the holes to the grade level. If the epoxy is below grade level after the next step, add more epoxy.

7. Place the upper template over the holes.
8. Insert the bolts through the upper template into the holes.

   IMPORTANT: Rotate the bolts as you insert them. This allows the epoxy to fully coat the threads of the bolts, reducing the amount of trapped air.

   Note: Leave the upper template in place.
9. Use a bubble level to ensure the bolts are plumb.
10. Allow the epoxy to cure (depending on cure times recommended by the epoxy manufacturer).

You are now ready to install the CP6000 pedestal mount charging station.

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75-001535-01 r2

APPENDIX F – CHARGERPOINT CONSTRUCTION SIGN OFF FORM

CP6000 Construction Signoff Form

Submit this form and required photos to installdispatch@chargepoint.com. Review datasheets, site design, and installation guides defining ChargePoint specifications at: chargepoint.com/guides.

IMPORTANT: All installations must comply with local and regional code. ChargePoint provides concrete pad guidance in the CP6000 Site Design Guide that is applicable for most sites; however, pad sizes may vary. Ensure site drawings have been completed and approved by a structural engineer for this site.

Customer Information	
Customer name	
Customer contact name	
Customer contact phone	
Customer contact email	

Site Information	
Street and number	
City	
State	
Country	
Zip code	
Number of chargers to be installed	
Expected start of construction works	
Expected installation and commissioning date	

Site Contractor Information		
Contractor type	ChargePoint designated	[ ]
	Customer designated	[ ]
Contractor company name		
Contractor site lead name		
Contractor site lead phone		
Contractor site lead email		

Installer Information		
Installer type	ChargePoint recommended	[ ]
	Customer recommended	[ ]
Installation company name		
Installer contact name		
Installer contact phone		
Installer contact email		

Note: If the station installer arrives to install the charging station and finds these items incomplete, you will incur a separate re-dispatch fee.

Take the following photos for each location throughout the site construction process.

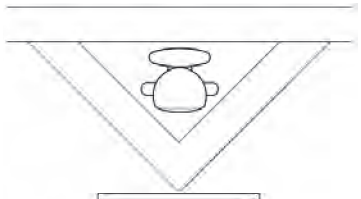
Required Pictures	
1. All trenching completed and conduit/ducting is in place.	
2. Concrete pad completed, showing anchor bolts and duct or conduit stub-ups in place. -or - Wall station location with flex conduit and wire for each station.	
3. Overall space around each mounting location, showing all service clearances are available.	
4. The electrical panel's specification label, to show total panel configuration and capacity.	
5. Open electrical panel with the dead front panel removed, showing terminations.	
6. The open electrical panel with the dead front panel on, showing breaker amperage ratings and labels for CP6000 connections.	
7. CP6000 charging station sites are oriented correctly. The front of the station must face the path of travel, for example.	
8. Circuit capacity.	

Civil Work, Pedestal Mount

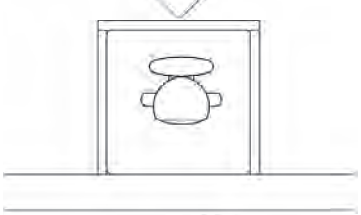
ChargePoint recommends:

1. The concrete pad was designed and approved by a structural engineer for this specific site, or supports these specifications:
   - Concrete 2,500 PSI minimum - Follow concrete manufacturer mix recommendations
   - At least 600 mm (24 in) on each side, including depth
   - Follows one of the three recommended pedestal patterns in the Site Design Guide:

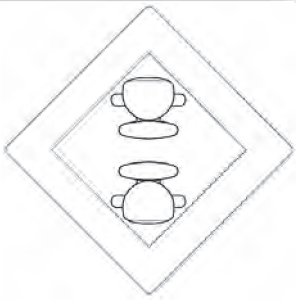
     In front of a curb 900 mm (3 ft) x 2
     Area: 0.42 m^2 (4.5 ft^2)
     Volume: 0.26 m^3 (9 ft^3)



     Behind a curb in a planter or berm 600 mm (2 ft) on each side
     Area: 0.37 m^2 (4 ft^2)
     Volume: 0.23 m^3 (8 ft^3)



     Two stations back to back, centered between four spaces 900 mm (3 ft) on each side
     Area: 0.84 m^2 (9 ft^2)
     Volume: 0.51 m^3 (18 ft^3)
     -or-

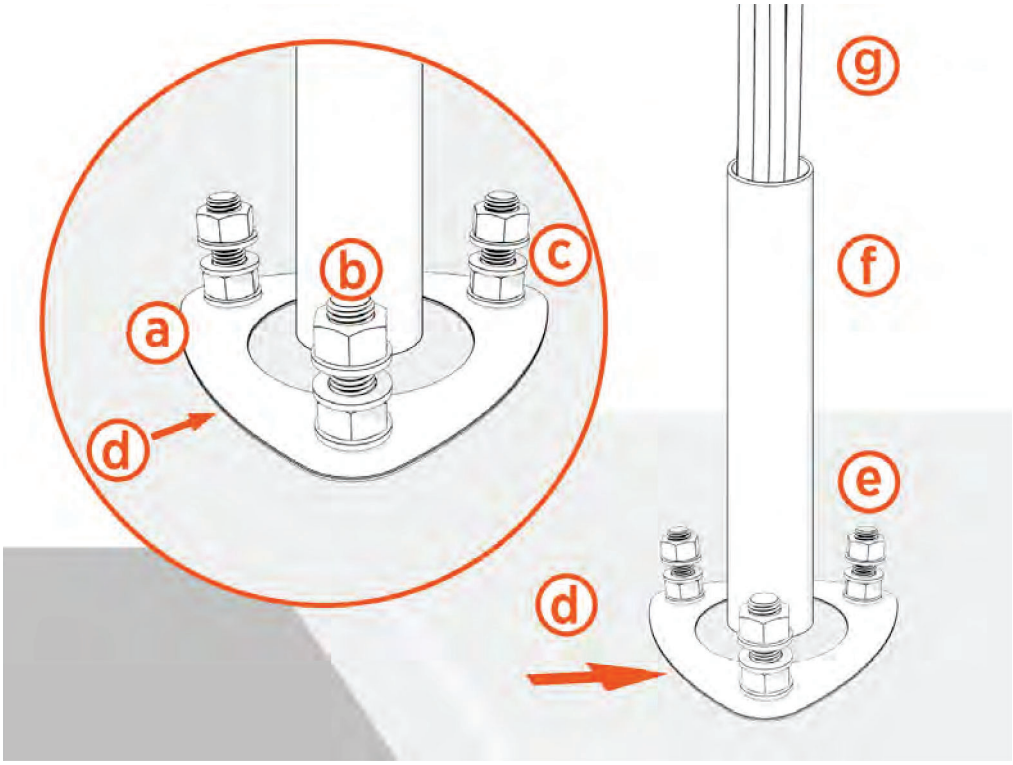


     Existing concrete with:
     - A minimum concrete volume of 0.23 m^3 (8 ft^3)
     - A minimum concrete depth of least 150 mm (6 in) thick
   - Mounting bolts or chemical anchors (not expanding bolts) positioned at least 153 mm (6 in) from the edges of the pad when measured from the center of any bolt
2. Three anchor bolts must extend 60 mm (2 1/3 in) but not more than 100 mm (4 in) above the concrete, with two bolts in the front and one bolt behind the duct or conduit stub-up. Bolts are plumb and secure in concrete or epoxy.
3. The center of the duct or conduit stub-up for a pedestal mount station with a CMK is at least 245 mm (9.65 in) from obstructions to the rear.
4. Ducts or conduit stub-ups measure between 152 mm (6 in) and 590 mm (2 ft) above grade.
5. Ensure any site slopes, walls, or fencing do not trap water around the charging station installation site. The system is only built to withstand water to the height of the duct or conduit stub-up.

IMPORTANT: You must use a ChargePoint CP6000 Concrete Mounting Template (CMT) for pedestal mount station installations. Refer to the CP6000 Site Design Guide on chargepoint.com/guides for more information.

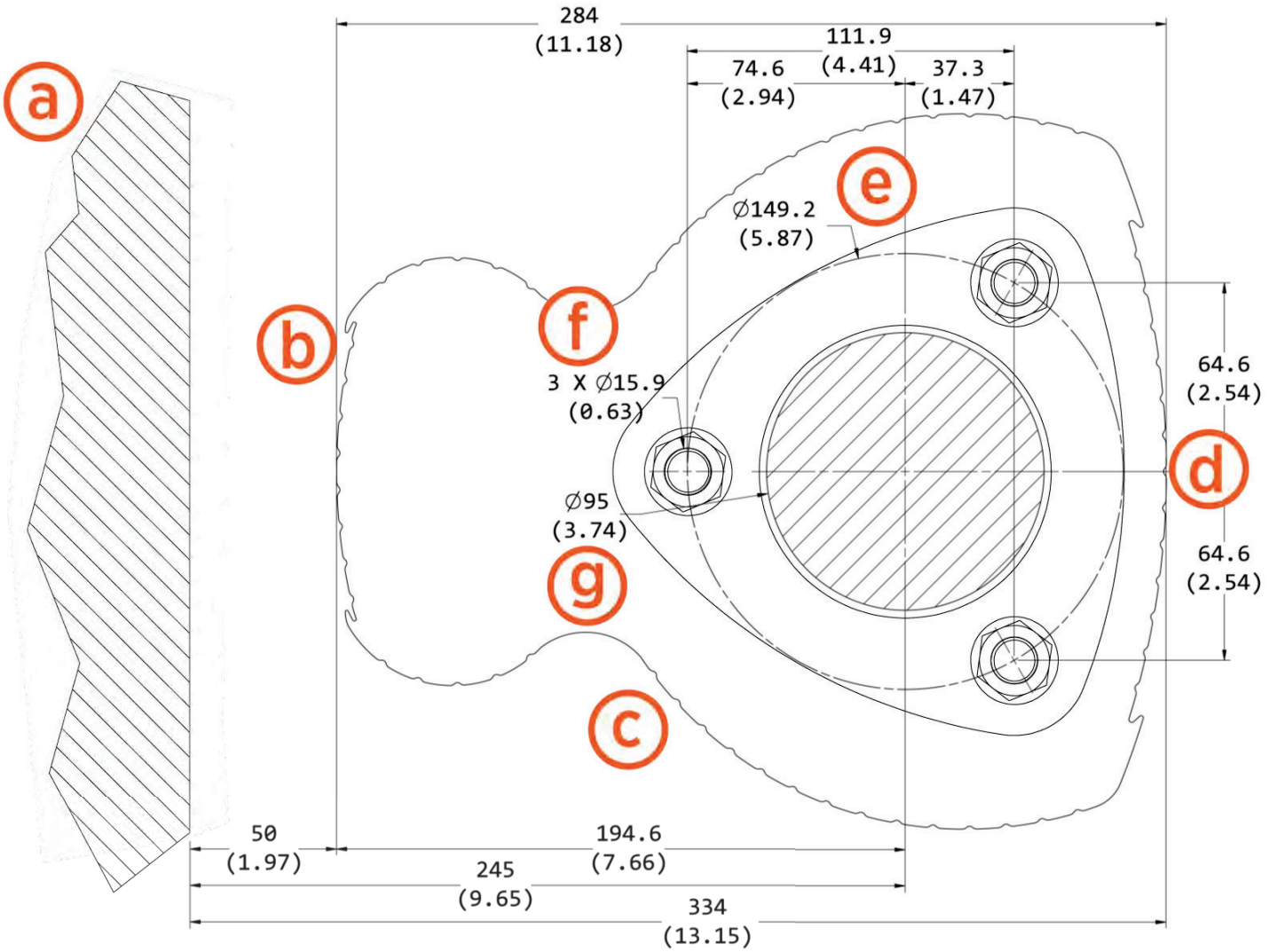
You should see the following:

a. Concrete mounting template
b. Three bolts set into concrete
c. Two nuts and three washers on each bolt
d. Template front
e. Bolts extending 60 mm (2 1/3 in) to 100 mm (4 in)
f. Conduit stub-up measuring 152 mm (6 in) to 590 mm (2 ft)
g. Approximately 1.5 m (5 ft) of service wiring
h. CPF50 adapter cover (only if replacing CPF50)

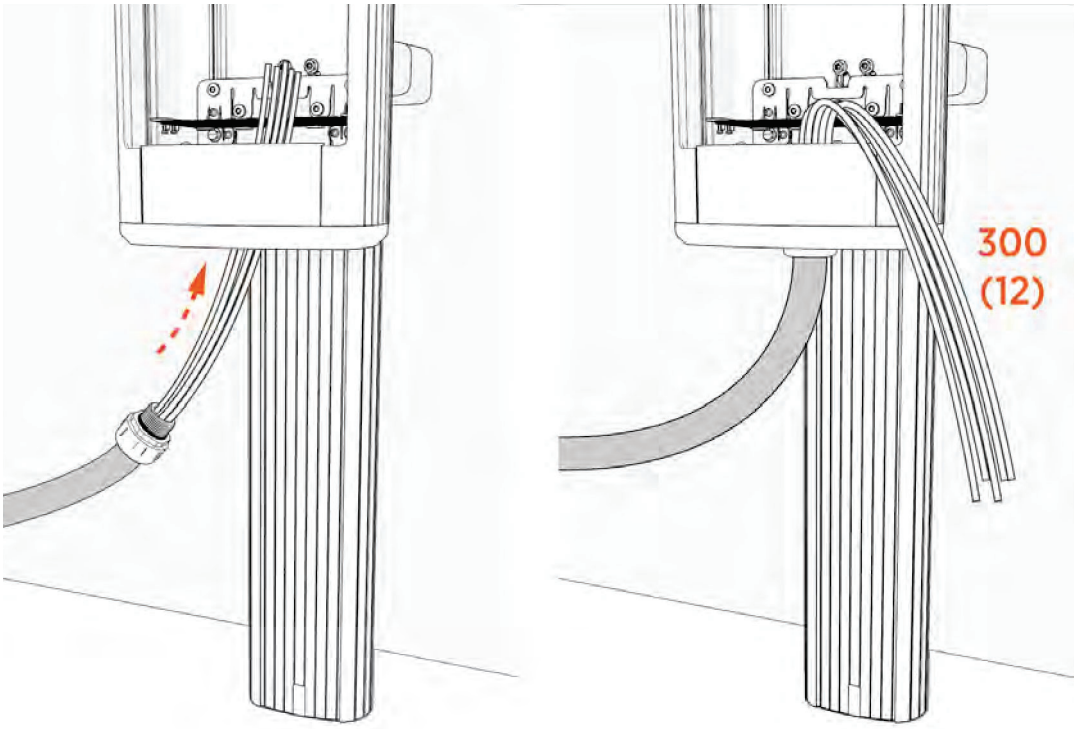


Pedestal Mount With CMK

Note: Images are not to scale. Measurements appear in metric units (mm), followed by imperial equivalents (inches).



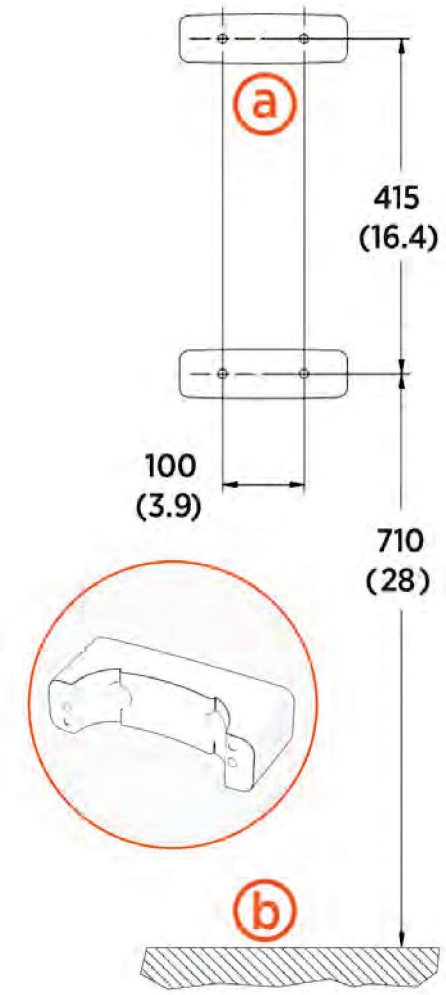
a. Wall
b. CMK footprint
c. Pedestal footprint
d. Front
e. Bolt circle
f. Bolt or anchor
g. Conduit stub-up within this area (new concrete only)

Civil Work, Wall Mount	
	1. Conduit brings wire to the station. Conduit diameter must be at least 19 mm (3/4 in) and cannot exceed 38 mm (1 1/2 in). If larger capacity is required, create two entry points, one on either side of the station, for parallel conductors.
	2. The length of wire available from the end of the conduit or the wall mount base needs to be at least 300 mm (12 in). **Note:** Measurements appear in metric units (mm), followed by imperial equivalents (inches). 

Wall Mount Bracket Hole Locations

Note: Images are not to scale. Measurements appear in metric units (mm), followed by imperial equivalents (inches).

a. Wall mount brackets
b. Ground level



Electrical Work	Select/Value
Electrical infrastructure has been completed in accordance with all applicable codes and ChargePoint specifications.	
Each of these types of non-GFCI circuit breakers feeds each port. Select the applicable configuration.	
Breaker type feeding each port	
Two pole non-RCD overcurrent protection	
One pole non-RCD overcurrent protection (circuit sharing)	
Circuit breaker rating:	20 A 30 A 40 A 50 A 60 A 70 A 80 A 100 A
Each circuit breaker is new or in good working order.	
Check each connection and ensure each one is clean and torqued to specifications.	
Breakers in the panel are labeled correctly.	
System neutral is bonded.	
The transformer nameplate shows that wiring is Wye(Y) connected, 3-phase or single phase with bonded neutral plus Ground. **Note:** Delta (floating or grounded) configuration is not supported.	
Specifications for wire used: Type AWG/mm^2 Insulation type Voltage rating Temperature rating	

Network Connectivity			
Validate Mobile Network and Carrier availability. 2G is only applicable for early version stations. If applicable, 4G Signal RSSP should be better than -90dB. A minimum of -85dB is recommended for good connectivity and smooth operation.			
Carrier name	**4G (dBi)**	**3G (dBi)**	**2G (dBi)**
1.			
2.			
3.			
Note: For 3G and 2G, is a signal repeater necessary? Are the readings in the table outside an acceptable range? The installation of signal repeaters is recommended for areas with poor cellular connectivity.			

Accessibility

Comply with regional accessibility laws, regulations, and ordinances. The charging station must not block ramps or pathways and the height of the interactive display cannot exceed the maximum height as dictated by local laws.

Signage

Refer to local and regional code to design the following elements for the site:

- Any required re-striping of parking spaces
- EV or Accessible EV signs
- EV or Accessible EV paint markings on and around the parking spaces

Site Comments

I, _____ hereby certify that the scope of work in this form has been correctly completed.

Signature	Date

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75-001507-01 r1