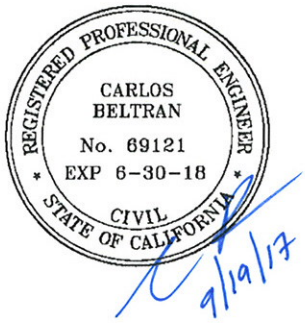
WINTERHAVEN PUBLIC SAFETY FACILITY PROJECT

Funded by:

California Department of Housing and Community Development (HCD) through its Community Development Block Grant (CDBG) Program and the County of Imperial.



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PROJECT MANUAL
SEPTEMBER 19, 2017

VOLUME 3 OF 4
SITE CIVIL TECHNICAL SPECIFICATIONS

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SITE CIVIL TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 – PROJECT DESCRIPTION

The project site is located in the unincorporated community of Winterhaven in the Imperial County. The community of Winterhaven is situated 57 miles east of the City of El Centro California, 1 mile north of the City of Yuma Arizona, and approximately 20 miles north of the United States/Mexico border. Winterhaven is primarily accessed from Interstate 8 to Winterhaven Drive.

The project site consists of off-site improvements, on-site improvements and a new ±9,700 square foot building at 518 Railroad Ave. in Winterhaven, California (APN No. 056–285–001). The project site is bounded by a private multi-family apartment building to south, a single family residence to the north and multi-family apartment buildings to the east.

The proposed ±9,700 square foot Public Safety Facility Building will be a shared facility for the County of Imperial Sheriff Department and the County of Imperial Fire Department. The proposed project includes construction of the new building facility, earthwork for the building pad preparation, grading, construction of retention basins, concrete site work including sidewalks, driveways, accessible ramps, concrete curbs, and P.C.C. ribbon gutters. The project also includes the installation asphalt concrete pavement, parking lot striping, installation of concrete wheel stops, installation of a new perimeter CMU wall, installation of new trash enclosure and the extension of existing water and sewer lines. The proposed project also includes installation class II base for parking area behind the proposed facility.

Off-site improvements are also part of this project. Off-site improvements include the installation asphalt concrete pavement for the widening of Railroad Avenue. Off-site improvements also include the installation of new P.C.C. sidewalks, commercial driveways and installation of curb and gutter.

The project also consists of the demolition of an existing concrete slab and an existing fence fronting the project.

The County of Imperial Fire Department currently occupies a temporary modular unit located at the project site. The County Fire Department will remain in operation and occupy the existing modular building during construction of the new facility. The existing modular building and existing parking area are located within the proposed site improvements including the new parking lot, concrete work, trash enclosure and the south retention basin. The contractor shall coordinate construction activities with the County Fire Department as construction of this project shall be required to be completed in two phases. Phasing may include separate design schedules, as well as separate construction schedules, in order to maintain the ongoing operations of the Fire Department. Phasing will be at the discretion of the Department. The total Base construction will not be altered by phasing. The total construction award, including all phases, may not exceed the Base Construction.

The contractor shall coordinate and provide the County the required space for the Fire Department to continue operations. Once a temporary certificate of occupancy has been obtained for the new facility, and the Fire Department has relocated to the new facility, the contractor shall continue with the construction of improvements located within the temporary modular building and existing parking area. The contractor will be allowed additional working days for the days the County Fire Department requires for the relocation from the temporary modular building to the new facility. (The relocation of the Fire Department shall not exceed five (5) working days). The contractor shall coordinate the removal of the temporary modular building and temporary fence and gate with the Fire Department personnel and the existing vendors.

The contractor will not be allowed a change order for required work stoppage during relocation of the County Sheriff and County Fire Department from the temporary modular building to the new facility. The contractor will be allowed additional working days for the days the County requires for the relocation. The contractor will not be allowed a change order for construction of the site improvements located within the existing modular building and existing parking lot due to the relocation of County departments and the work being completed in multiple phases. Phasing may include separate design schedules, as well as

separate construction schedules, in order to maintain the ongoing operations of the Fire Department. Phasing will be at the discretion of the Department. The total Base construction will not be altered by phasing. The total construction award, including all phases, may not exceed the Base Construction.

The Contractor shall coordinate the removal of the temporary modular unit with the modular manufacturer and the County Departments. Contractor shall schedule accordingly the removal of the modular building prior to the temporary certificate of occupancy being issued to avoid construction downtime.

It will also be necessary to relocate and adjust existing utilities and install/extend new utilities to provide services to the new Winterhaven Public Safety Facility. A listing of the relocated, adjusted, and new utilities are as follows:

1. Contractor shall coordinate with Imperial Irrigation District power connection to the new facility.

2. The contractor shall install a 2-inch backflow preventer and extend the two-inch water service to the new facility and remove the existing two-inch service to the existing temporary modular building. The contractor shall inform and coordinate the installation/extension of the water service to the new facility with Winterhaven County Water District (Rick Miller, Phone No. 928-920-9056).

3. The contractor shall extend the six-inch fire service water line to the new facility. Contractor shall install a 6 inch water meter and backflow preventer.

4. The contractor shall extend and complete the installation of the 1-inch irrigation service line. Contractor shall install a 1-inch water meter and backflow preventer.

5. Contractor shall adjust to designed finish grade an existing sanitary sewer manhole located on Railroad Avenue.

END OF SECTION 01010

SECTION 01070 - ABBREVIATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Wherever in these Contract Documents the following abbreviations or acronyms are used, they shall have the meanings indicated as follows:

1.02 ABBREVIATIONS AND ACRONYMS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of the State Highway and Transportation Officials
A2LA	American Association of Laboratory Accreditation
A.C.	Asphalt Concrete
ACI	American Concrete Institute
ADWR	California Division of Water Resources
AGC	Associated General Contractors
AGMA	American Gear Manufacturer's Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
AOS	Apparent Opening Size
APA	American Plywood Association
API	American Petroleum Institute
APN	Assessor's Parcel Number
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Society for Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturer's Association
CBC	California Building Code
CBR	California Bearing Ratio
CDX	Apa Rated Plywood Sheathing Exposure
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
ETL	Electrical Test Laboratories
ETL	Extract, Transform Load
EPDM	Ethylene Propylene Diene M-Class

FHWA	Federal Highway Administration
GAI	Geosynthetic Accreditation Institute
GCP	Construction General Permit
GPM	Gallons per Minute
GRI	Geosynthetic Research Institute
HDPE	High Density Polyethylene
HPC	Heterotrophic Plate Count
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IID	Imperial Irrigation District
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
ISA	Instrument Society of America
LAP	Laboratory Accreditation Program
LLDPE	Linear Low Density Polyethylene
MARV	Minimum Average Roll Value
MD	Machine Direction
MGD	Million Gallons per Day
MPA	Mega Pascal
MBMA	Metal Building Manufacturer's Association
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NGLI	National Lubricating Grease Institute
No.	Number
NOI	Notice of Intent
NOT	Notice of Termination
NSF	National Sanitation Foundation
NTPEP	National Transportation Product Evaluation Program
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OIT	Oxidative Induction Time
OS&Y	Outside Stem and York
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCC	Portland Concrete Cement
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
SBR	Styrene Butadiene Rubber
SCH	Schedule
SDR	Standard Dimension Ratio
SMA	Screen Manufacturer's Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPDT	Single Pole-Double Throw
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
SWPPP	Storm Water Pollution Prevention Plan
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USEPA	United States Environmental Protection Agency
UV	Ultra-Violet Disinfection

WCRSI	Western Concrete Reinforcing Steel Institute
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association
XMD	Cross Machine Direction

1.03 PLAN SHEET ABBREVIATIONS

%	Percent
AASHTO	American Association of State Highway and Transportation Officials
A.C.	Asphalt Concrete
A.C.P.	Asbestos Cement Pipe
AC-FT	Acer Feet
Agg.	Aggregate
AOS	Apparent Opening Size
APP	Approximate
ASTM	American Society for Testing and Materials
AVE	Average
AWWA	American Water Works Association
BC	Beginning of Curve
BLDG.	Building
BTM	Bottom
B.V.	Butterfly Valve
C2B	Class 2 Base
CC	Cubic Centimeter
C.I.	Cast Iron
CIRC	Circumferential
CL	Centerline
CLR	Clear
C.M.C.	Cement Mortar Coated
C.M.L.	Cement Mortar Lined
CPVC	Chlorinated Polyvinyl Chloride
D.I.	Ductile Iron
DIA	Diameter
DWG	Drawing
D/W	Driveway
Δ	Delta
EC	End of Curve
EF	Each Face
EL.	Elevation
E.P.	Edge of Pavement
EPDM	Ethylene Propylene Diene M-Class
EW	Each Way
FF	Finish Floor Elevation
FG	Finished Grade
F_L	Flowline
FL.	Flanged
F.M.	Flow Meter
FM	Force Main
FS	Finish Surface
GALV	Galvanized
GPH	Gallons per Hour
GPM	Gallons per Minute
GW	Ground Water
H.B.	Hose Bib
HDPE	High Density Polyethylene
HP	Horsepower

HPUD	Heber Public Utility District
HW	High Water
I.D.	Inside Diameter
INV. EL.	Invert Elevation
INV.	Invert
IPS	Iron Pipe Size
L.	Length
LBS	Pounds
MAX.	Maximum
MG	Million Gallon
MGD	Million Gallons per Day
M.H.	Manhole
MIN.	Minimum
MISC.	Miscellaneous
M.J.	Mechanical Joint
MPH	Miles per Hour
N. RIM	North Rim
N.S.	Native Surface
N.T.S.	Not To Scale
O.C.	On Center
O.D.	Outside Diameter
OHC	Overhead Cable
OHE	Overhead Electric Line
OHT	Overhead Telephone Line
OS&Y	Outside Stem & York
P.C.C.	Portland Concrete Cement
P.E.	Plain End
PL	Property Line
P.P.	Power Pole
PP#	Power Pole Number
PPM	Parts per Million
PSI	Pounds per Square Inch
PT	Pressure Transmitter
PVC	Polyvinyl Chloride
P/S	Prestressing
R.C.	Reinforced Concrete
ROW	Right-of-Way
S.	Slope
SCH	Schedule
SCHED	Schedule
SD	Storm Drain
SDFM	Storm Drain Force Main
SDR	Standard Dimension Ratio
SM	Static Mixer
SQ	Square
SS	Sanitary Sewer
SST	Stainless Steel
STA	Station
S/W	Sidewalk
SWPPP	Storm Water Pollution Prevention Plan
TBD	To Be Determined
TBM	Temporary Benchmark
T.C.	Top of Curb or Top of Concrete
TDH	Total Dynamic Head
TF	Top of Footing
TMH	Top of Manhole

TOE	Top of Slope
TOF	Top of Floor
TOW	Top of Wall
T.P.	Top of Pavement
TV	Television
TYP.	Typical
UE	Underground Electricity
UNO	Unless Noted Otherwise
UT	Underground Telephone
VERT	Vertical

END OF SECTION 01070

SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Whenever in these Specifications references are made to published specifications, codes, standards or other requirements, it shall be understood that when no date is specified, only the latest published specifications, standards or requirements of the respective issuing agencies, as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.

1.02 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

A. All work specified herein shall conform to or exceed the requirements of the referenced specifications, codes and standards to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications.

B. References herein to "Building Code" or UBC shall mean the Uniform Building Code of the International Conference of Building Officials (ICBO). The latest edition of the code, as of the date of award, as approved and adopted by the agency having jurisdiction, including all addenda, modifications, amendments or other lawful changes thereto, shall apply to the Work.

C. References herein to American Water Works Association or AWWA shall comply with the latest edition of the code, as of the date of award.

D. In case of conflict between codes, reference standards, drawings and other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The contractor shall bid the most stringent requirements.

E. Applicable Standard Specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards and specifications listed herein; except, that wherever references to "Standard Specifications" are made, the provisions therein for measurement and payment shall not apply.

F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

H. All materials and equipment appurtenances that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

I. References in the Contract Documents to "Standard Specifications" shall mean the Greenbook, formally known as the "Standard Specifications for Public Works

Construction" as published by the American Public Works Association, including all current supplements, addenda and revisions thereof, latest edition.

END OF SECTION 01090

SECTION 01300 - CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All submittals by the Contractor shall be submitted to the Construction Manager at the Site. The Construction Manager may submit the submittals to the Design Engineer if required as authorized by the Owner. The Construction Manager will forward the approved submittals to the Owner.

B. Within ten (10) days after the date of Notice to Proceed, the Contractor shall submit the following items to the Construction Manager:

1. A Construction Schedule providing the starting and completion dates of the various stages of the Work. The Contractor shall be prepared to discuss its construction schedule at the pre-construction conference.

2. Schedule of Values or lump sum price breakdown for progress payment purposes.

1.02 SUBMITTAL REQUIREMENTS AND PROCESS

A. The Contractor shall prepare a detailed list of required submittals required for the Winterhaven Public Safety Facility Project within five (5) days of receiving the Notice to Proceed. The Construction Manager will review and forward comments regarding the submittal list to the contractor within three (3) days after receiving the list. The Project Owner and County of Imperial staff shall also review and offer comments regarding the submittal list. The Construction Manager shall insure the submittal list for the Winterhaven Public Safety Facility Project is approved within 10 days after the issuance of the Notice to Proceed. The submittal list for the on-site and off-site civil improvements is included in the Material and Equipment Submittal List, Section 1.09.

B. Wherever called for in the Contract Documents or when requested by the Construction Manager, the Contractor shall furnish to the Resident Project Representative for review, six (6) copies of each submittal.

C. All submittals shall be accompanied by a submittal transmittal form. This form may be obtained from the Construction Manager. A separate transmittal form shall be used for each specific item for which a submittal is required. Each submittal should be referenced to the specification section requiring the submittal. All Contractor submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the Construction Manager. Each submittal shall be dated, signed and certified by the Contractor as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed and certified. No consideration for review by the Construction Manager of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer and any delays caused thereby shall be the sole responsibility of the Contractor.

D. Multiple-page submittals shall be collated into sets with each set stapled or bound.

E. The Construction Manager will return copies of each submittal to the Contractor with review comments within fifteen (15) calendar days following their receipt by the Resident Project Representative. There will be three (3) copies of a submittal returned to

the Contractor when marked either "NO EXCEPTIONS TAKEN" or "APPROVED AS NOTED", and no formal revision and re-submission of said submittal will be required. However, if one or more copies of the submittal are returned to the Contractor marked 'REVISE AND RESUBMIT" or 'REJECTED", the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Construction Manager.

F. Fabrication of an item shall commence only after the Engineer has reviewed the submittal and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "APPROVED AS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.

G. The Engineer's review of Contractor's submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in the Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.03 CONTRACTOR'S SCHEDULE SUBMITTAL

A. The Contractor shall submit to the Resident Project Representative a construction schedule for the Work showing a general plan for orderly progression of the Work including mobilization of plant and equipment and timing of procurement of major materials and equipment.

B. The Construction Manager may request that the Contractor provide a revised or updated Construction Schedule if, at any time, the Construction Manager considers the completion date to be in jeopardy because of any portion of the Work falling behind schedule or the sequence of operations becomes different from the previous schedule.

1.04 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEM SUBMITTAL

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance and quality required. Other items of material or equipment, or material or equipment of other Suppliers may be submitted to the Engineer for review under the circumstances described below subject to the *Instruction to Bidders* (Section 2, Article 11), *Standard General Conditions* (Article 6.05), and the following requirements:

1. The Contractor shall be responsible for resultant changes and all additional costs or credit to the Owner which the accepted substitution requires in the Contractor's work, the work of its subcontractors and of other contractors and shall effect such changes without cost to the Owner.

B. The procedure for review by the Engineer will include the following:

1. If proposed substitute material or equipment has been judged to be unacceptable by the Engineer, the Contractor shall provide the material or equipment named in the Contract Documents.

1.05 SAMPLES SUBMITTAL

A. The Contractor shall submit not less than two (2) samples, unless noted otherwise in a material or equipment specification, to the Engineer for acceptance at no additional cost to the Owner. Samples shall be submitted for acceptance a minimum of ten (10) days prior to ordering such material for delivery to the job site. If accepted by the Engineer, one (1) set of samples will be returned to the Contractor and one (1) set of samples shall remain at the job site until completion of the Work.

1.06 OPERATION, MAINTENANCE AND TECHNICAL MANUAL SUBMITTAL

A. The Contractor shall furnish operation, maintenance and technical manuals in accordance with Section 01730 – Operation and Maintenance Manuals.

B. All technical manuals shall be submitted to the Engineer not later than the seventy-five percent (75%) of construction completion date or fourteen (14) days prior to start-up of equipment if started before seventy-five percent (75%) completion of project. All discrepancies found in the technical manuals shall be corrected by the Contractor within thirty (30) days from the date of written notification by the Engineer.

1.07 AS-BUILT SUBMITTAL

A. The Contractor shall maintain, during the progress of the Work, one (1) set of As-Built Drawings and shall neatly mark on them all project changes from the details shown on the original Contract Drawings. Special attention shall be given to recording on the drawings the horizontal and vertical location of all buried utilities that differ from the locations indicated or which were revealed during the construction.

B. As-Built drawings shall be accessible to the Construction Manager at all times during the construction period and shall be delivered to the Construction Manager and the Design Engineer upon completion of the Work.

C. Upon substantial completion of the Work and prior to final acceptance the Contractor shall deliver a complete set of As-Built drawings to the Engineer.

1.08 SUPERINTENDENT SUBMITTAL

A. A letter designating the Project Superintendent shall be forwarded to the Construction Manager for his review. The letter shall also include emergency contact information for the Project Superintendent and other Contractor Representative.

1.09 MATERIAL AND EQUIPMENT SUBMITTAL LIST

1. General Requirements

1.1 Construction Schedule

1.2 Schedule of Values

1.3 Letter Designation Project Superintendent

1.4 Emergency Contact Number

1.5 Operation and Maintenance Manuals

1.6 Signs, traffic control devices, cones, barricades and all other items required per the Traffic Control Plan

1.7 Project Identity and Construction Signs

1.8 Contractor to forward a complete submittal list for the Winterhaven Public Safety Facility Project to the Construction Manager, Owner and County of Imperial Staff within 5 days of receiving the Notice to Proceed. See Section 01300, 1.0.2A.

2. Sitework

2.1 A.C. mix design. The percent bitumen, sieve analysis, durability, resistance (R-values), aggregate gradation, air voids and all other standard parameters.

2.2 Class 2 Base Gradation, Maximum Density and Sand Equivalent

2.3 3/4" Crushed Rock Gradation

2.4 Granular Sand Gradation, Maximum Density and Sand Equivalent

2.5 SS1h for tack coat

2.6 Pipe

A. PVC Pipe
B. Sanitary Sewer Cleanout Fittings

2.7 Copper Pipe

2.8 Pipe Fittings

A. Copper
B. Bronze
C. SDR 35 PVC
D. SCH 80 PVC
E. HDPE

2.9 Magnetic Detector Tape

2.10 Fence Materials

A. Wrought Iron Fence
B. 30 Ft Automated Gate
C. Pedestrian Gate
D. Masonry Wall Fence

2.14 Traffic Paint and Striping

2.15 Dry (Injection) Well

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- 7.3 Motors
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- 7.5 Water Meter Service Assembly and Ancillary Items
- 7.6 Backflow Preventer Assembly and Ancillary Items
- 7.7 Fire Hydrant Assembly and Ancillary Items
- 7.8 Ductile Iron Frame, Cover and Grate

7. Sidewalk Drain

8. Truncated Domes

9. Traffic Paint for Parking Lot

10. Handicap Sign

11. Parking Bumper Stops

12. Polyurethane Joint Sealant

END OF SECTION 01300

SECTION 01312 - PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Required to enable orderly review during pre-installation conference and progress of the Work, and to provide for systematic discussion of installation problems and other construction problems arisen, the Construction Manager will conduct project meetings throughout the construction period.

1.02 RELATED WORK SPECIFIED ELSEWHERE

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Division 1 - General Requirements.

2. The Contractor's relations with his Subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility and normally are not part of project meetings content.

1.03 SUBMITTALS

A. Conform to provisions of Section 01300 – Contractor Submittals of the Technical Specifications.

B. Agenda Items:

1. To the maximum extent practicable, advise the Construction Manager at least twenty-four (24) hours in advance of project meetings regarding items to be added to the agenda or requesting the cancellation of any Meeting.

C. Minutes:

1. The Construction Manager will compile minutes of each project meeting and will furnish one copy to the Contractor, Resident Project Representative, and all other involved parties.

2. Recipients of copies may make and distribute such other copies as they wish.

1.04 QUALITY ASSURANCE

A. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority to commit the Contractor to solutions agreed upon in the project meetings.

PART TWO - PRODUCTS (NOT APPLICABLE)

PART THREE - EXECUTION

3.01 MEETING SCHEDULE

A. Except as noted below for Preconstruction Meeting, project meetings will be held bi-weekly or as otherwise directed by the Construction Manager.

B. Coordinate as necessary to establish mutually acceptable schedule for additional meetings.

3.02 MEETING LOCATION

A. Project meetings will be held at the project site unless another location has been agreed upon prior to the biweekly meeting.

3.03 PRECONSTRUCTION MEETING

A. A Preconstruction Meeting will be scheduled after the Notice to Proceed has been issued.

1. Provide attendance by authorized representatives of the Contractor and major Subcontractors.

2. The Construction Manager will advise other interested parties.

B. Minimum Agenda: Data will be distributed and discussed on at least the following items.

1. Organizational arrangement of Contractor's forces and personnel, and those of the subcontractors, and materials suppliers.

2. Organizational arrangement of the Owner's forces and personnel and other authorized representatives.

3. Channels and procedures for communication.

4. Construction Schedule, including sequence of events and critical work.

5. Contract Documents, including distribution of required copies of original Documents and revisions.

6. Processing of Shop Drawings and other data submitted to the Construction Manager for review.

7. Processing of bulletin, addenda, field decisions, Requests for Information and Change Orders.

8. Rules and regulations governing performance of the Work.

9. Procedures for site security, project quality control, housekeeping, and related matters.

10. It is the responsibility of the Contractor for Site Safety & First Aid; however, it shall be on the agenda.

11. Procedures for contractor's request.

12. Emergency Information: The name, addresses, telephone and fax numbers of the Contractor, and Subcontractors, or their representatives, shall be filed with the Construction Manager prior to start of the Work.

3.04 PROJECT MEETINGS

A. Attendance:

1. To the maximum extent practicable, the Project Superintendent and other representatives who have full knowledge of the project and full authority to act for the Contractor shall represent the Contractor at Project Meetings throughout the progress of the Work.

2. Subcontractors, materials suppliers, and others may be invited to attend these Project Meetings in which their aspect of the Work is involved.

3. The Contractor may not cancel or be absent from any meeting without advanced approval from the Construction Manager. The Contractor must submit a written request with reason to the Construction Manager twenty-four (24) hours before the scheduled meeting. If approved, the Contractor shall notify all parties of the cancellation.

B. Minimum Agenda:

1. Review progress of the Work since last meeting. Review actual starts and finish dates of activities.

2. Review status (total complete and outstanding) of submittal for approval, Request for Information and Change Orders.

3. Identify old and new problems, which impede planned progress**,** identify responsible party for the follow-up actions. Mutually agree to a common solution and date of correction.

4. Develop corrective measures and procedures to regain lost time on the planned schedule.

5. Review Weekly Progress Reports including the forecasts.

6. Status of As-Builts.

7. Project site Walk-Through. Record all discussion and follow-up actions.

8. Any project site health and/or accident or safety issues.

3.05 SPECIFIC SITE MEETINGS

A. Required when necessary to enable orderly review and discussion of site conditions and problems requiring solution during the progress of the contracted work. Notify the Construction Manager of the need for additional site meetings as early as possible to resolve the problem without any impact to the Project Schedule.

B. Provide necessary labor, tools, and equipment such as shoring, scaffolding, ladder, etc. to gain access to the specific sites.

C. The Contractor or The Contractor’s authorized representative shall be present at all times.

All discussion and follow-up actions shall be recorded by the Construction Manager, and the minutes shall be distributed at the next meeting or at earliest time

END OF SECTION 01312

SECTION 01505 - MOBILIZATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Mobilization shall include obtaining all permits; moving plant equipment on-site; furnishing and erecting plants, temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:

1. Moving on to the site, Contractor's equipment and materials required for operations.
2. Installing temporary construction power, wiring and lighting facilities.
3. Establishing fire protection equipment and instructing designated personnel in the operation of such apparatus.
4. Providing all on-site Contractor communication facilities.
5. Providing on-site Contractor's sanitary facilities.
6. Arranging and setting up the Contractor's work and storage yard.
7. Obtaining all required permits.
8. Posting all OSHA required notices and establishment of safety programs.
9. Have Contractor's superintendent at the Site full time.
10. Submittal of Construction Schedule.
11. Submittal of Schedule of Values
12. Install Project Sign, by the Standard General Conditions, Article 19.
13. Costs of Insurance, Payment Bond, Performance Bond, Taxes, Permits, Freight and similar expenses.

1.02 PAYMENT FOR MOBILIZATION

A. Payment for Mobilization, as noted in the Proposal Forms and approved Schedule of Values, shall not be released to the Contractor unless all items in Paragraph "A" above have been satisfied.

END OF SECTION 01505

SECTION 01520 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

The Owner shall bear no costs of temporary facilities, unless noted otherwise.

It shall be the Contractor's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work and shall be subject to inspection and approval by the Owner's representative at any time within the duration of the Contract. All work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

1.02 POWER AND LIGHTING

The Contractor shall provide temporary electric power as necessary for the execution of the Work, including that required by all Subcontractors. Contractor shall make the necessary arrangements with utility purveyor to include all permits, applications and fees, and shall bear all costs for these temporary services and shall furnish and install all necessary transformers, metering facilities and distribution centers from branch circuits as may be required.

The Contractor shall provide lighting and outlets in temporary structures throughout the Project as may be required for safety, proper performance and inspection of the Work. If operations are performed during hours of darkness, or if natural lighting is deemed insufficient by Engineer, the Contractor shall provide adequate floodlights, clusters and spot illumination. The use of permanently installed lighting fixtures, lamps and tubes for work shall not be permitted except by special permission of Engineer. The Contractor shall make arrangements with Subcontractors for electrical services and lighting as may be necessary in the performance of their work.

1.03 WATER SUPPLY

A. General: The Contractor shall provide an adequate supply of water of a quality suitable for all domestic and construction purposes. Potable water shall be furnished by the Owner without charge.

B. Drinking Water: All drinking water on the site during construction shall be furnished by the Contractor and shall be bottled water or water furnished in approved dispensers. Notices shall be posted conspicuously throughout the site warning the Contractor's personnel that piped water for construction purposes may be contaminated and is not for human consumption.

C. Water Connections: The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission, in writing, of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the water system. For each such connection made the Contractor shall first attach to the fire hydrant or pipeline a valve, backflow preventer and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.

D. Removal of Water Connections: Before final acceptance of the Work all temporary water connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Engineer and to the agency owning the affected utility.

E. Fire Protection: The Contractor shall provide fire extinguishers and other fire protection equipment to adequately protect new and existing facilities and temporary facilities against damage by fire. Hose connections and hose, water casks, chemical equipment or other sufficient means shall be provided for fighting fires in the new, existing and temporary structures and other portions of the Work and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The Contractor's fire protection program shall conform to the requirements of the OSHA Standards for Construction. The Contractor shall employ every reasonable means to prevent the hazard of fire.

1.04 CONSTRUCTION OFFICE TRAILER

Not Applicable

1.05 SANITATION

A. Toilet Facilities: Portable chemical toilet facilities shall be provided wherever needed for the use of employees. Toilets at Site(s) shall conform to the requirements of Subpart "D", Section 1926.51 of the OSHA Standards for Construction. The Owner's toilet facilities shall not be used by the Contractor. Two (2) toilet facilities shall be positioned at the project site. One (1) toilet facility shall be for men. The other toilet facility shall be for women. Toilet facilities shall be relocated as required and be maintained close to daily work activities. The toilet facilities shall be cleaned and serviced on a weekly basis.

B. Sanitary and Other Organic Wastes: The Contractor shall establish adequate and regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto. Contractor may install temporary piping for toilet facilities to discharge into the incoming sewer.

1.06 COMMUNICATIONS

A. Telephone Services: The Contractor shall provide and maintain a phone line.

1.07 FENCE AND BARRICADES

The Contractor shall provide such protective fences and barricades as deemed necessary for public safety and to protect storage areas and the Work in place. The location and appearance of all fences shall be subject to the approval of the Engineer.

1.08 CONTRACTOR PARKING

The Contractor shall not park his equipment, nor allow his personnel to park, in any area except those specifically designated by the Engineer and Owner.

1.09 TEMPORARY LIVING QUARTERS

Temporary living quarters shall not be allowed on the Site or on publicly owned properties. In addition, all local zoning codes for the area in question shall be strictly adhered to.

1.10 REMOVAL OF TEMPORARY CONSTRUCTION FACILITIES

The Contractor shall remove temporary toilets, storage sheds and other temporary construction facilities from the site as soon as, in Engineer's opinion, the progress of Work permits. Contractor shall recondition and restore those portions of the site occupied by the same to a condition equal to or better than it was prior to construction.

END OF SECTION 01520

SECTION 01530 - PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall protect all existing utilities, piping and improvements not designated for removal and shall restore damaged or temporarily relocated utilities, piping and improvements to a condition equal to or better than they were prior to such damage or temporary relocation.

B. The Contractor shall verify the exact locations and depths of all underground piping and utilities shown and not shown and shall make exploratory excavations of all piping and utilities that may interfere with the Work. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities, piping and other improvements that will be encountered during construction operations and verify that such utilities or other improvements are adequately protected from damage due to such operations.

C. Maintaining in Service: All pipelines, electrical, power, telephone communication cables, gas and water mains shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the Owner. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement the Contractor, after necessary scheduling and approval, shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the Owner of the facility. In all cases of such temporary removal or relocation, the Work shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement to a new condition meeting the specification requirements.

D. All repairs to a damaged utility or improvement are subject to inspection and approval by a Resident Project Representative before being concealed by backfill or other work.

1.02 RIGHTS-OF-WAY

A. The Contractor shall refrain from commencing work or entering upon the rights-of-way of any oil, gas, sewer or water pipeline; any telephone or electric transmission line; any fence; or any other structure, until notified by the Engineer that the Owner has secured authority to do so. After authority has been obtained, the Contractor shall give the governing utility proper advanced notice of its intention to begin work.

1.03 RESTORATION OF PAVEMENT AND SIDEWALKS

A. All paved areas and sidewalks not designated for replacement, cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas unless otherwise noted. All sidewalks, curbs and gutters and pavements which are subject to partial removal shall be neatly saw-cut in straight lines. The sidewalk, curb and gutter and pavement shall be constructed in accordance with the Standard Details and Plans of the governing agency.

1.04 UNDERGROUND UTILITIES NOT SHOWN OR INDICATED

A. If the Contractor damages existing utilities, piping or improvements that are not illustrated or the location of which was not made known to the Contractor prior to excavation and the damage was not due to failure of the Contractor to exercise reasonable care the Contractor shall immediately notify the Engineer. If directed by the Engineer

repairs shall be made by the Contractor under the provisions for changes and extra work contained in Articles 10, 11 and 13 of the Standard General Conditions.

1.05 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications or telecommunication cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective utility purveyors or agencies or owners responsible for such facilities not less than three (3) working days prior to excavation so that a representative is afforded the opportunity to be present during the excavation work.

END OF SECTION 01530

SECTION 01550 - SITE ACCESS AND STORAGE

PART 1 - GENERAL

1.01 HIGHWAY AND STREET LIMITATIONS

A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress to the Site. It shall be the Contractor's responsibility to construct and maintain any haul roads required for its construction operations or define any alternate routes to the Site due to roadway or bridge restrictions.

B. Nothing herein shall be construed to entitle the Contractor to the exclusive use of any public street, utility right-of-way or the Site during the performance of the Work hereunder. The Contractor shall conduct its operations so as not to interfere unnecessarily with the authorized work of utility companies, other agencies, or the Owner's plant personnel. No street or access shall be closed without first obtaining permission of the Engineer or proper governmental authority. Where excavation is being performed in primary streets or highways one (1) lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown by the Contract Documents. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the Contractor to assure the use of sidewalks, access routes and the proper functioning of all gutters, sewer inlets and other drainage facilities.

C. Traffic Control: For the protection of traffic in public streets and construction workers at the Site, the Contractor shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other approved safety devices. All barricades, traffic cones, warning signs, lights and other approved safety devices shall be placed according to the agency requirements maintaining jurisdiction, as applicable. The Contractor shall take all necessary precautions for the protection of the Work and the safety of the Owner's personnel and the public. All barricades and obstructions shall be illuminated at night.

1.02 CONTRACTOR'S WORK AND STAGING AREA

A. The Owner will designate and arrange, for the Contractor's use, a portion(s) of the property on or adjacent to the Site for its exclusive use during the term of the Contract. The area is designated for an office, storage and shop area for construction operations relative to this Contract. Contractor shall be solely responsible for the security of its tools, supplies and equipment at the site. The staging area(s) for this project are illustrated on the new site plan of the Plans.

END OF SECTION 01550

SECTION 01560 - PROJECT ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.01 EXPLOSIVES AND BLASTING

A. The use or storage of explosives on the Work or site will not be permitted.

B. Controls outlined in the Environmental Report developed for this project shall be implemented throughout the course of construction. A copy of the Environmental Report is included in the Special Conditions.

1.02 DUST ABATEMENT AND RUBBISH CONTROL

A. The Contractor shall provide under the Contract all necessary measures to prevent its operation from producing dust in amounts damaging to property or causing a nuisance to Owner's plant personnel and operations or to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for damage resulting from any dust originating from its operations. The dust abatement measures shall be continued throughout the length of the Contract.

B. During the progress of the Work the Contractor shall keep the Site and other areas used by it in a neat and clean condition and free from any accumulation of rubbish and waste materials. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Site, and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with all applicable Safety Laws and Health Standards for Construction. The Owner's dumpster shall not be used by the Contractor.

C. Contractor shall implement regulations set by CAL EPA and the Imperial County Air Pollution Control District for all work activities related to this Project.

1.03 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval for use by either the U.S. Environmental Protection Agency, the U.S. Department of Agriculture or the local jurisdictional agency. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.04 CULTURAL RESOURCES

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical, architectural, archeological or cultural resources (hereinafter called "cultural resources). If potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Contractor shall immediately notify the Engineer.

2. The Engineer will issue a Field Order directing the Contractor to cease all construction operations at the location of such potential cultural resources find.

3. Such Field Order shall be effective until such time as a qualified archeologist can be called to assess the value of these potential cultural resources and make recommendations to the California State Historical Society Archeologist.

B. If the archeologist determines that the potential find is a bona fide cultural resource, at the direction of the California State Historical Society Archeologist, the Contractor shall suspend work at the location of the find under the provisions for changes contained in Articles 4, 8 and 18 of the Standard General Conditions and Supplementary Conditions 4.02, 4.06 and 4.06D.

1.05 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The entire project will disturb over an 1 acre and will require a Storm Water Pollution Prevention Plan (SWPPP). The Contractor shall prepare and implement a Storm Water Pollution Prevention Plan (SWPPP).

END OF SECTION 01560

SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. To the greatest extent possible for each unit of work, the Contractor shall provide products, materials or equipment from a single source.

B. Where more than one choice is available as options for Contractor's selection of a product, material or equipment, the Contractor shall select an option which is compatible with other products, materials or equipment already selected.

1.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall transport, deliver, handle and store products in accordance with supplier's written recommendations and by methods and means which will prevent damage, deterioration and loss including theft. Delivery schedules shall be coordinated to minimize long-term storage of products at the Site and overcrowding of construction spaces. The Contractor shall provide installation coordination to ensure minimum storage times for products recognized to be flammable, hazardous or easily damaged.

B. Products shall be delivered in a dry, undamaged condition in the supplier's unopened packaging. The Engineer and Owner reserve the right to reject all damaged products, materials and equipment. Rejected products shall be immediately removed from the Site.

C. Products, materials and equipment shall be stored in accordance with the manufacturer's written instructions, with seals and labels intact and legible. Motors, electrical gear, mechanical equipment with open bearings or moving parts or any product sensitive to the environment shall be stored in weather-tight enclosures with necessary temperature and humidity ranges maintained within the manufacturer's instructions.

D. Fabricated structural components shall be stored on supports above ground and in a manner to prevent accumulation of water and warping. Products subject to deterioration from atmospheric conditions shall be covered in a manner that will provide adequate ventilation to avoid condensation.

E. Products, materials and equipment not stored in a manner that will insure the maintaining of a new condition will be rejected by the Engineer. Such rejected products, materials and equipment shall be immediately removed from the Site.

END OF SECTION 01600

SECTION 01700 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 FINAL CLEANUP

A. The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily complied with the requirements for final cleanup of the site.

1.02 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment shall obtain and submit the following items to the Engineer for transmittal to the Owner:

1. Written guarantees, where required.

2. Operating manuals, technical manuals and instructions. The Contractor's attention is directed to the condition that one percent (1%) of the contract price will be deducted from any monies due the Contractor as progress payments if at the seventy-five percent (75%) construction completion point the approved technical manuals have not been submitted in accordance with Section 01300 - Contractor Submittals. The aforementioned amount will be retained by the Owner as the agreed estimated value of the approved technical manuals. Any such retention of money for failure to submit the approved technical manuals on or before the seventy-five percent (75%) construction completion point shall be in addition to the retention of any payments due to the Contractor as specified in Article 14 of the Standard General Conditions and the Agreement.

3. Manufacturers representatives installation, testing and startup report.

4. Keying.

5. Maintenance stock items, spare parts and special tools.

6. Completed As-Builts.

7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property or improvement pursuant to the provisions of law.

9. Extension of Performance Bond in accordance with Article 5.01A of the Standard General Conditions, if applicable.

1.05 MAINTENANCE AND GUARANTEE

A. The Contractor shall provide a bond to comply with the guarantee requirements contained in Article 5.01A of the Standard General Conditions.

B. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly the Owner reserves the right to do the Work and the Contractor and his surety

shall be liable to the Owner for the cost thereof. Replacement of native material or aggregate fill, backfill or resurfacing where it has settled below the required finish elevations shall be considered as part of such required repair work.

END OF SECTION 01700

SECTION 01722 - SURVEYING

PART 1 - GENERAL

The Contractor is responsible to employ a California-licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying to oversee the land survey work for this project.

1.01 DESCRIPTION

A. Permanent Survey Marker:

1. The Contractor shall be responsible for the preservation of survey monuments and benchmarks except as noted herein. At least two (2) working days before the start of construction, the Contractor shall submit acceptable preconstruction survey tie notes to the Engineer's office. These tie notes shall be prepared by a California-licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying. These survey tie notes will be for all survey markers or benchmarks that may be lost or disturbed due to construction. Lost or disturbed monuments shall be replaced at the Contractor's expense by a California Licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying. Post-construction survey monument ties acceptable to the Engineer shall be submitted to the Engineer's office before the completion of the Work (see "Monuments", Section 8771, Land Surveyors Act, Division 3, Chapter 15 of the Business and Professions Code). The California Licensed Land Surveyor will re-establish the monuments and bench marks where survey services are provided by the California Licensed Land Surveyor, providing the Contractor protects the preconstruction reference points. In this case, where the monuments are to be removed or damaged by the Contractor, the Contractor shall notify the Engineer in writing seven (7) calendar days before starting the Work.

B. Lot Stakes:

1. The Contractor shall preserve property line and corner survey markers, except where their destruction is unavoidable. The lot stakes shall be replaced per Item A.1 above. Markers that otherwise are lost or disturbed by its operations shall be replaced at the Contractor's expense by the Land Surveyor/Engineer contracted by the Contractor.

C. Survey Services:

1. The California Licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying contracted by the Contractor will perform and be responsible for the survey work at the Site unless otherwise noted on the Plans or Specifications. The Contractor shall preserve construction survey stakes and marks for the duration of their usefulness. If any construction survey stakes are lost or disturbed and need to be replaced, such replacement shall be accomplished by the Engineer at the expense of the Contractor.

2. The California Licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying contracted by the Contractor shall establish horizontal and vertical control points for construction. The Contractor shall notify the Engineer in writing at least five (5) full working days before survey services are required in connection with the laying out of any portion of the work. The Contractor shall dig all holes necessary for line and grade stakes when requested by the Engineer.

3. The Contractor shall be responsible for their own layout based on the Land Surveyor/Engineer's survey stakes and cut sheets. The Contractor shall allow sufficient time for checking and issuance of cut sheets by the Engineer.

4. Unless otherwise specified, stakes will be set and stationed by the Land Surveyor/Engineer for curbs, ribbon gutters, headers, sewer pipelines, water pipelines, storm drains, structures, and rough grade. A corresponding cut or fill to finished grade (or flowline) will be indicated on the cut sheet.

D. Line and Grade:

1. The California Licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying contracted by the Contractor shall set alignment and grade stakes only for all on-site pipelines that are six-inches (6") in diameter or larger. The Contractor shall furnish all other lines and grades required for proper execution of the work.

2. After exterior walls have been located for the building, the Contractor shall be responsible for the location of all interior construction including interior piping within the building.

3. All work shall conform to the lines, elevations, and grades illustrated on the Plans.

4. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer in writing. In the absence of such written notification, the Contractor shall be responsible for any error in the grade of the finished work.

5. Grades for underground pipelines will be established by the offset hubs at the surface of the ground. The Contractor shall be responsible for transferring the grades to the bottom of the trench and pipeline.

E. Benchmarks:

1. The Contractor shall use the benchmarks illustrated on the Plans to conduct grading work at the project site. The Contractor shall be allowed to establish temporary benchmarks; however, the Contractor shall establish the temporary benchmarks from the benchmarks illustrated on the Plans. The Contractor shall provide the Engineer with fully prepared Level Notes substantiating the correct elevation of the temporary benchmark.

F. The Contractor shall provide grade checkers to verify subbase, subgrade and final grade elevations prior to those grades being checked, verified and approved by the Engineer. The Contractor shall provide grade checkers to place bluetop staking in parking lots, basins, roadways or other specified locations as required by Improvement Plans. Bluetop stakes are stakes set to grade. The Engineer will verify the grading work after the bluetop stakes have been placed by the grade checkers. The Contractor shall review Section 02200 - Earthwork; Section 02221 - Trenching, Backfilling and Compacting and Section 02510 - Asphalt Concrete and Paving, required for any required bluetop staking for this project.

G. The California Licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying contracted by the Contractor shall provide three (3) sets of cut sheets to the Contractor within 24 hours after completing a staking activity.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 – Earthwork

B. Section 02221 – Trenching, Backfilling and Compacting

C. Section 02510 – Asphalt Concrete and Paving

PART 2 - EXECUTION

2.01 SURVEY REQUIREMENTS

2.01.1. Lath and hubs shall be placed along the limits of construction on 50 foot on center and at corners at the commencement of construction.

2.01.2. Establish demolition lines with a painted line along the existing sidewalk and A.C. pavement areas.

2.01.3. Establish P.C.C. barrier curb, curb and gutter and ribbon gutter staking with 3 foot offset hubs placed 25 foot on center, beginning points, end points, B.C.'s, E.C.'s, radius points, ¼ delta and ½ delta locations. Cut and Fill vertical distances to top of curb or flowline shall be provided.

2.01.4. Place 20 foot x 20 foot grid staking across A.C. pavement, landscaping areas and the storage area. Cut and Fill vertical distances referenced from the top of hub to the subbase design grade shall be provided.

2.01.5. Place 20 foot x 20 foot bluetop grid staking across pavement, landscaping areas and the storage area. The bluetop hubs shall be placed to the design subgrade (top of Class 2 Base) elevation.

2.01.6. Retention Basin. Establish hubs at a 3 foot offset from top of slope 15 foot on center along the upper perimeter of the Retention Basin. Cut and Fill vertical distances to the top of slope finish grade and slope staking information to the toe of slope shall be provided.

2.01.7. Provide Fence and Masonry Wall staking. Establish 3 foot offset hubs at 20 foot on center along the length of the Masonry Walls. Install hubs at the beginning and end of the walls and at all angle points. Install hubs at the beginning and end of all gate openings. Cut and Fill vertical distances referenced from the hubs to the top of the wall footings shall be provided.

2.01.8. Install offset hubs at an offset distance determined by the contractor for the site piping. The offset stakes shall be placed 15 foot on center and at all beginning points, end points, catch basins and stormwater manholes and sanitary sewer manholes. Cut and Fill vertical distances referenced from the top of hub to the pipeline flowline shall be provided.

END OF SECTION 01722

SECTION 01730 - OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish to the Engineer six (6) identical sets of operation, maintenance and technical manuals. The Contractor shall include in the manuals for each item of mechanical, electrical and instrumentation equipment the following:

1. Complete operating instructions, including recommended troubleshooting and start-up procedures; tabulation of proper settings for all pressure relief valves, pressure switches and other related equipment protection devices; detailed test procedures to determine performance efficiency of equipment; list of all electrical relay settings including alarm and contact settings.

2. Preventive maintenance procedures and schedules, including required lubricants, filters, adjustments and special tools.

3. Parts lists, by generic title and identification number, complete with exploded views of each assembly. Spare parts information shall be included for each mechanical, electrical and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address and telephone number of its nearest outlet for spare parts to facilitate the Owner in ordering.

4. Disassembly and reassembly instructions, including required special tools.

5. Record drawings including diagrams and schematics as required under the electrical and instrumentation portions of these specifications.

1.02 OPERATIONS AND MAINTENANCE MANUALS

A. General:

1. The “Operating and Maintenance Manual” is a bound compilation of drawings and data required for each project. These manuals, complete with drawings and data, shall be furnished to the Owner.

2. The Contractor has overall responsibility to obtain the necessary data from and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the Contractor for installation.

3. The number of binders (or “volumes”) required for each individual project will depend on the amount of information to be catalogued.

4. All information included shall be legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.

B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important mechanical, electrical and instrumental equipment components installed at the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

C. Quantity and Preparation (Submit through Engineer):

1. Operation and Maintenance Manuals shall be prepared for the project.

A. Three (3) sets to the Engineer.

B. Three (3) sets to Owner.

2. The quantities of drawings, manufacturer's literature, or other data required for these manuals are in addition to those otherwise required for normal distribution for approval during the construction period.

PART 2 - MATERIALS AND METHODS

2.01 PAGE SIZE

A. All pages shall be standard 8-½ x 11 inches size or approximate multiples (preferably 11 x 17 inches) folded to 8-½ x 11-inch manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.02 DRAWINGS

A. All drawings larger than 8-½ x 11" shall be folded and inserted in individual 8-½" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.03 BINDERS

A. Binders shall be Buckram binders with block lettering for sheet size 8-½ x 11 inches with 2" to 3-½" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".

B. The following information shall appear on the front cover and backbone:

1. "Operation and Maintenance Manual"

2. Project Name (Imperial County Winterhaven Public Safety Facility Project) and volume number if more than one volume

3. Owner's name

4. Engineer's name

5. General Contractor's name

Item 5 need not be printed on the backbone.

2.04 CONTENTS AND INDEXING

A. Manuals shall contain descriptions of the plant systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.

B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.

C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).

2. Outline drawings, special construction details, "as built" electrical wiring and control diagrams for all major and supplementary systems.

3. Manufacturer's test or calculated performance data and certified test curves.

4. Installation, operating and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer's brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.

6. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

7. Written warranties.

8. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I Treatment Plant and System Descriptions

Part II Purchased Equipment Data

Part III Test Reports and Valve Charts

Part IV Start-Up and Operation

Part V Preventative Maintenance Recommendations

9. A copy of the approved submittals for each piece of equipment.

10. A copy of all testing, adjusting and balancing reports.

11. Wiring diagrams marked with model and size and plan symbol.

12. Operating and Maintenance Manuals data for Part I shall be obtained directly from the mechanical and electrical consultants. (All consultant preparation cost.)

13. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

2.05 EQUIPMENT SUMMARY DATA FORMS INFORMATION SHEET

Equipment Summary Data Forms are intended to provide the Maintenance Department with sufficient information to catalogue newly purchased equipment items installed at the project site. This information is used for inventory purposes as well as for equipment performance tracking purposes. Each item of equipment installed at the facility must be documented on Equipment Summary Data Form. Examples of the form is attached. Additional requirements regarding submittal format, quantities, etc, are found elsewhere in this Specification.

1. Equipment item (included industry-accepted nomenclature).
2. Manufacturer address, phone/fax numbers
3. Supplier address (if different than above), phone/fax numbers
4. Equipment serial and model numbers
5. Size
6. Capacity
7. Rated output
8. Drive motor data (as appropriate).

In addition, information specific to the item described shall be provided as indicated on the following form.

EQUIPMENT SUMMARY
DATA FORM

EQUIPMENT ITEM: _____

EQUIPMENT COST: _____

EQUIPMENT SUPPLIER: _____

COMPONENT INFORMATION: **NAMEPLATE DATE:** **MANUFACTURER:**	
EQUIPMENT MODEL NO.:	**EQUIPMENT SERIAL NO.:**
EQUIPMENT MODEL DESIGNAITON:	**TYPE:**
SIZE:	**RATED OUTPUT:**
CAPACITY:	**SERVICE:**
COMPONENT INFORMATION: DRIVE MOTOR DATA **MANUFACTURER:**	
SERIAL NO.:	**HORSEPOWER:**
MODEL:	**FRAME:**
TYPE:	**VOLTAGE:**
ENCLOSURE:	**AMPERAGE:**
PHASE: **HERTZ:**	**SERVICE FACTOR:**
LUBRICATION REQUIREMENTS: MOTOR	
COMMENTS:	

2.06 INFORMATION SHEET FOR EQUIPMENT MAINTENANCE SUMMARY FORMS

Equipment Maintenance Summary forms are intended to provide the Maintenance Division with information sufficient to properly diagnose (troubleshoot, repair, check-out, and return an item of equipment to service. Standard information contained in each Form shall be as follows:

In addition, Maintenance information required to troubleshoot, repair, and return electrical/electronic equipment to service (including set point, derivatives, etc.) shall be included as required. The Maintenance Summary Form attached in intended to serve as a (minimum) guide to the information required per item of equipment. Additional requirements regarding submittal format, quantities, etc. are found elsewhere in this Specification.

1. Equipment item (include industry-accepted nomenclature)

2. Manufacturer address, phone/fax numbers

3. Equipment serial number(s)

4. Weight of individual components (over 100 pounds)

5. Nameplate date (including voltage, horsepower, lubrication requirements, speed, etc.)

6. Manufacturer's local representative address, phone/fax numbers

7. Maintenance operation(s) required. Listing shall include (1) Maintenance Operation to be performed. (2) frequency of said Maintenance Operation based on actual service conditions of installed equipment (i.e., type of duty, environmental factors). Reference shall be made to the appropriate section of the manufacturer's technical literature.

8. Lubricant list. List shall include a primary and two secondary manufacturer-approved lubricants.

9. Spare parts required for a minimum of one (1) year of equipment operation based on anticipated actual service conditions. Also the name, address, and phone number of the recommended source of spare parts shall be included if different than manufacturer's representative.

TYPICAL MAINTENANCE SUMMARY FORM

NOTE: SUPPLEMENTARY INFORMATION SHALL BE INCLUDED AS APPROPIATE

1. EQUIPMENT ITEM: _____

2. MANUFACTURER: _____
   ADDRESS: _____
   TELEPHONE NO.: _____ FAX NO.: _____

3. EQUIPMENT SERIAL/IDENTIFICATION NUMBERS: _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS): _____

5. NAMEPLATE DATA: _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE: _____
   ADDRESS: _____
   TELEPHONE NO.: _____
   FAX NO.: _____

7. MAINTENANCE OPERATION(S) REQUIRED: (attach separate sheet if required).

OPERATION	FREQUENCY	COMMENTS

8. LUBRICANT LIST. Provide Reference symbol used in items recommended.

SHELL	STANDARD OIL	GULF	ARCO	EQUAL

9. RECOMMENDED SPARE PARTS LISTS FOR MINIMUM OF ONE (1) YEAR UNINTERRUPTED SERVICE. (Attach separate sheet if required).

ITEM	PART NO.	QUANTITY REQUIRED (per unit)	UNIT COST	COMMENTS

END OF SECTION 01730

SECTION 01781 - SPARE PARTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. The Spare Parts supplier must be the manufacturer or a factory authorized representative of the manufacturer. The manufacturer will be responsible for any default of the representative that is not corrected by the representative in a timely and efficient manner. This responsibility includes replacing incorrect or defective parts, troubleshooting, and correcting problems that are traceable to the manufacturer's parts. The supplier shall provide, along with the Spare Parts List, a formal letter of certification from the manufacturer that the supplier is an authorized representative of the manufacturer.

2. The supplier shall be a stocking facility of the manufacturer of the proposed parts, or the manufacturer must maintain a stocking facility of these parts on the West Coast, or the supplier can guarantee delivery of spare parts within seventy-two (72) hours.

3. Spare Parts should be supplied in the manufacturer's original packaging and shall be new and unused. A statement shall be included to clearly indicate that the Spare Parts are new and unused.

4. The Spare Parts list shall be in addition to any other lists required under any other sections of these Specifications. This list shall include but is not limited to the following:

a) Current prices including delivery to the Site.

b) Original Equipment Manufacturer (OEM) part numbers, which identify interchangeability.

c) Make and type of equipment as well as model number.

d) Size.

e) Supplier's contact information.

f) Letter of certification from the manufacturer.

g) Materials.

h) Special tools.

i) Estimated delivery lead times.

j) Warranty: State terms of warranty of spare parts offered.

k) Cross-sectional, exploded view or assembly-type drawing with part numbers.

l) Manufacturer’s price list catalog.

m) Applicable trade discount (for budget purposes).

5. Delivery of all required Spare Parts shall be a condition precedent to receipt of Partial Completion or a Statement of Completion.

6. The Contractor shall be responsible for proper storage and protection of the Spare Parts until delivered to the Owner.

7. To ensure proper tracking of the Spare Parts the Contractor shall fill out and submit a Spare Parts List to the Engineer with the delivery of Spare Parts. The Contractor's cost of preparing and submitting the Spare Parts List(s), procuring, and inspection of the Spare Parts shall be included in the Contractor's lump sum bid, and therefore, no overhead or profit shall be added to the cost of the Spare Parts.

B. Required Spare Parts:

1. The Required Spare Parts Lists shall be included with the equipment submittal to the Engineer.

2. The Contractor shall include in the Bid the cost of providing the Required Spare Parts described under individual equipment Specifications.

C. Recommended Spare Parts:

1. The Contractor shall submit with each equipment submittal a list from the manufacturer of the Recommended Spare Parts adequate to ensure two (2) continuous years of normal operation after expiration of the equipment warranty. The cost of preparing and submitting the Recommended Spare Parts List(s) shall be included in the Contractor's lump sum bid.

2. The Recommended Spare Parts List(s) shall include items requiring replacement under the following conditions:

   a) Wear, corrosion, or erosion during normal operation.

   b) Failure which causes a shutdown of equipment or systems.

   c) Damage or breakage during routine maintenance or inspections of equipment.

   d) Custom or specially fabricated parts, and

   e) Long lead items.

3. The Contractor shall supply the Owner with all Spare Parts indicated on the Specifications.

END OF SECTION 01781

SECTION 01783 – AS-BUILT DRAWINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. As-Builts are full size drawings (Plans) and Record Project Manual which are marked up during construction to delineate the actual in-place constructed conditions. As-Builts shall be provided by the Contractor for this Project. Requirements for As-Builts, as specified elsewhere, shall supplement the requirements specified herein.

B. As-Builts shall include all changes in the Plans including those issued as Change Orders, Plan Clarifications, Addenda, Notice to Bidders, responses to Request for Information, Project Site Memos, and any additional details needed for the construction of the Project but not shown on the Plans. Any substructures encountered while excavating that are left in place shall be located by survey, to the satisfaction of the Engineer, shown, and identified on the As-Builts. All substructures including, but not limited to, concrete structures, electrical conduit and duct banks, drains and sanitary sewer pipelines, process piping, water lines, etc, whose installed location differs from that shown on the original Plans shall be precisely located by survey to the satisfaction of the Engineer and recorded on the As-Builts before backfilling.

C. As-Builts shall be marked with red ink or chemical fluid on one (1) set of full size prints to produce a record of the complete installation. Any additional drawings that may be required to indicate record conditions shall be prepared on 24" x 36" paper. All additions to the plans shall employ and use drafting standards which are consistent with the drafting standards used in the Contract.

D. The As-Builts, including those of all Subcontractors, shall be kept by the Contractor in the Contractor's Project Site Office, shall be updated during construction, and shall be available for the Engineer's inspection and copying at all times. The Engineer will review the As-Builts prior to submittal of all Monthly Payment Requests. If, in the opinion of the Engineer, the As-Builts are not current, approval of the Monthly Payment may be withheld until the drawings are made current.

E. Where the Plans are diagrammatic or lacking precise details, the Contractor shall produce dimensioned full size sheets as the As-Builts. For installations outside of the structures, the locations shall be given by coordinates and elevations. Where substructures are encased in concrete, the outside dimensions of the encasement shall also be given.

F. In the case of those Drawings which depict the detail requirements for equipment to be assembled and wired in the factory, the As-Builts shall be updated by indicating those portions which are superseded by final Shop Drawings and by including appropriate reference information describing the Shop Drawings by manufacturer, drawing and revision numbers.

G. At the Completion of the Work and after Final Inspection, the Contractor shall copy As-Built data, using red ink, onto a new set of Plans provided by the Owner. The Contractor shall certify to the completeness and accuracy of the "as installed" information indicated on the new set of Plans with its signature. The Contractor shall then deliver as a submittal to the Engineer, for review and approval, both the field developed As-Built Plans and the final signed As-Built Plans as a condition precedent to the Owner's release of any retained funds.

END OF SECTION 01783

SITE CIVIL TECHNICAL SPECIFICATIONS

DIVISION 2 - SITEWORK

SECTION 02050 - DEMOLITION AND SALVAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide demolition and removal of existing structural materials, vegetation, exterior fencing, utility facilities, miscellaneous equipment, facilities and structures within the property boundary of Winterhaven Public Safety Facility Project in accordance with the requirements of the Contract Documents and as illustrated on the Demolition Plan, Sheet 2 of Improvement Plans.

B. The Contractor shall repair or replace, without cost to the Owner and to the satisfaction of the Engineer, existing facilities disturbed or damaged during demolition and removal operations.

C. Immediately upon removal of demolition items, the Contractor shall legally dispose of demolished items not to be salvaged. Demolished items not to be salvaged shall be removed from the Site within two (2) calendar days of the commencement of demolition activities. ***Unless noted in the Plans, the Owner reserves the right to salvage any of the existing material or equipment. The Contractor, upon being notified by the Engineer, shall salvage and relocate to an Owner-designated, on-site storage area any materials or equipment the Owner desires to keep. The cost of the removal and relocation of the items shall be included in the contract price.*** No demolished items shall be sold while on the Owner's property.

END OF SECTION 02050

SECTION 02150 - SHEETING, SHORING AND BRACING

PART 1 - GENERAL

1.01 DESCRIPTION

This section provides requirements for sheeting, shoring, bracing, wales, posts, piling, anchorages and fastenings or other excavation supports, both temporary or permanent, for accomplishment and protection of Work.

1.02 QUALITY ASSURANCE

A. Design Requirements:

In accordance with Section 6500 of the Labor Code, the Contractor is required to obtain a permit, for the excavation of trench which is five feet (5') or more in depth and into which a person is required to descend, from the Division of Industrial Safety.

The Contractor shall furnish all labor, equipment and materials required to design, construct and remove all sheeting, shoring and bracing or other equivalent method of support for the walls of open excavations required for the construction of this project.

Excavation of any trench, pad area, foundation area, or structure five feet (5') or more in depth shall not commence until the Contractor has received approval from the Engineer of the Contractor's detailed plan for worker protection from the hazards of trench or soil wall collapse/failure.

Such plan shall be submitted at leave five (5) days before the Contractor intends to begin excavation and shall show the details of the design of shoring, bracing, sloping or other provisions to be made for worker protection during such excavation. No such plan shall allow the use of shoring, sloping or a protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety. The plan shall be prepared and signed by an engineer who is registered as a Civil or Structural Engineer in the State of California.

Prior to the beginning of excavations requiring shoring, the Contractor shall designate in writing to the Engineer, the person responsible to supervise the project safety measures and the person responsible to supervise the installation and removal of sheeting, shoring and bracing.

In addition to shoring the excavations in accordance with minimum requirements of the Industrial Safety Orders, it shall be the Contractor's responsibility to provide any and all additional shoring required to support the sides of the excavation against the effects of loads which may exceed those derived by using the criteria set forth in the Industrial Safety Orders. The Contractor shall be solely responsible for any damages which may result from his failure to provide adequate shoring to support the excavation under any or all of the conditions of grading which may exist, or which may arise during the construction of the project.

B. Material Standards:

Furnish lumber for shores, wales, and sheeting of grading required by the American Lumber Standards for the particular application.

1.03 SUBMITTALS

Contractor shall submit complete calculations of the sheeting system including sizing of sheeting wales, rakers, anchor system, struts, earth anchors, anchor piles, tie rods or any other components pertinent to the design prior to the start of any Work involving sheeting and bracing. All designs submitted shall be stamped and signed by an Engineer with a Civil or Structural designation with an active registration in the State of California.

1.04 JOB CONDITIONS

Buried debris may be found at some locations. Federal and local agency requirements for safety of job personnel and public will apply to work under the Section.

1.05 ALTERNATIVES

The use of application of alternative methods and materials, and the employment of proprietary systems under lease or franchise in lieu of that specified herein, may be allowed. Demonstration of suitability and compliance with these Specifications will be required. The application of alternative methods will be approved by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lumber:

1. Temporary Shores, Wales and Sheeting: Furnish structural grade planks, beams and posts as defined and specified for stress-grade lumber in the American Lumber Standards. Lumber may be rough, untreated, in random lengths, and shall be of standard dimensions.

2. Permanent Sheeting: When permanent sheeting is called for on the Drawings, provide and install planks, beams, posts and timers of unseasoned, rough, new southern yellow pine or Douglas Fir meeting the requirements of ASTM Standard D25, Class "C". In lieu of the above, lumber dressed to standard dimensions, dried and treated in accordance with Standard T-3 of the American Wood Preservers' Association may be utilized.

B. Fastenings:

Provide fastenings for permanent sheeting as recommended in the National Design Specification for stress-grade lumber and its fastening.

PART 3 - EXECUTION

3.01 INSTALLATION

Install sheeting and bracing for trench and structure excavation progressively as the removal of excavated material requires. Butt planks to exclude groundwater and fines, preventing the erosion of voids outside sheeting. In soft, wet ground drive sheeting to a lower level as excavation progresses to that sheeting is embedded in undisturbed earth. Bracing of sheet piling may be permitted to penetrate the structural concrete only as directed by the Owner. Refer to Section 03300 – Cast-in-Place Concrete. Install wales and struts at close intervals so as to prevent displacement of the surrounding earth and to maintain safe conditions in the Work area. Any damage proven to result from improper installations shall be the responsibility of the Contractor. Temporary sheeting for trench and structure excavation may be removed and reused. Withdraw

individual planks alternately as the backfill is raised, maintaining sufficient sheeting and bracing to protect the Work and workmen. Remove bracing completely. Where unstable conditions occur in the underlying strata from any cause, and withdrawal of sheeting will endanger the Work, a portion of the sheeting, including bracing, may be left in place with the approval of the Owner. Remove all wood within a zone extending four feet (4') below finished grade. Leaving such material in place shall not be cause for an increase in the contract price. The use of horizontal strutting below the barrel of a pipe or the use of a pipe as support will not be permitted. Sheet piling and timers in trench excavations shall be withdrawn in a manner so as to prevent subsequent settlement of the pipe or additional backfill loadings which might overload the pipe. Trench sheeting below the top of the pipe shall be left in place.

END OF SECTION 02150

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work of this Section includes all earthwork required for construction of the Work. Earthwork shall include, but not be limited to the loosening, removing, loading, transporting, depositing and compacting in its final location of all materials wet and dry, as required for the purposes of completing the work specified in the Contract Documents which shall include, but not be limited to: the sawcutting and removal of A.C. pavement, P.C.C. concrete and underlying material to a subbase design grade indicated on the Plans, the installation of subbase material to a subbase grade beneath A.C. pavement and concrete infrastructure, the excavation of pipeline trenches, the installation of backfill material within pipeline trenches, excavations for above-grade and below-grade structures, backfill requirements for material to be placed beneath above-grade and below-grade structures, backfill requirements for the areas surrounding above-grade and below-grade structures, building pad preparation, backfilling of manholes and catch basins, construction of earth embankments, backfilling of depressed areas, depressed areas resultant from demolition, the disposal of excess excavated materials, barrow of materials to make up deficiencies for fills; and all other incidental earthwork, all in accordance with the requirements of the Contract Documents.

Principal work items included in this Section are:

1. Site preparation, clearing and grubbing.

2. Preparation of fill areas.

3. Excavation and controlled fill construction.

4. Structural excavation and backfills.

5. Disposal of surplus and/or unsuitable materials.

6. Dust control and drainage control.

7. Grading

8. Clean-up.

1.02 REFERENCE STANDARDS

ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 75	Practice for Sampling Aggregates
ASTM D 422	Method for Particle-Size Analysis of Soils
ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop
ASTM D 1556	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Method for Moisture-Density Relations of Soils Using Remmer and Drop
ASTM D 1682	Test method for Breaking Load and Elongation of Textile Fabrics
ASTM D 2419	Test method for Sand Equivalent Values of Soil and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2922	Test Method for Density of Soil in Places by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test method for Water Content of Soil and Rock in Place by Nuclear Methods
ASTM D 3776	Test Method for Mass Per Unit Area (Weight) of Woven Fabric
ASTM D 4253	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Plate
ASTM D 4254	Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4751	Test Method for Determining the Apparent Opening Size of a Geotextile
CAL-OSHA	Title 8 General Industry Safety Orders

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02150 - Sheeting, Shoring and Bracing

B. Section 02221 - Trenching, Backfilling and Compacting

C. Section 02640 - PVC Pipe

D. Section 02726 - Manhole and Precast Vault Construction

1.04 DEFINITIONS

A. Site: The property owned by the County of Imperial. The site includes the Winterhaven Public Safety Facility Project.

B. Controlled Fill: Compacted suitable fill material in all areas of the site requiring filling to grade as shown on the Plans.

C. Structural Fill: Compacted suitable fill material which will support a structure or some part of a structure. This includes support material for P.C.C. structures and pads

D. Structural Backfill: Compacted suitable material placed between the wall of a structure and construction excavation slope up to finished grade.

E. Suitable Material: As specified herein shall be any material imported or excavated from the cut areas that is, in the opinion of the Engineer, suitable for use in constructing fills.

F. Waste Excavation: Also Surplus Material. Material from project excavations which is not suitable for use in backfill or compacted fills or is in excess of that required to be used for backfill or to construct fills.

G. Pipe Zone Backfill: Material suitable for placement below or surrounding the pipe to a given vertical distance above the pipe as required by the pipe section.

H. Pipe Trench Backfill: Material suitable for placement from the pipe zone to finish grade or to pavement subbase material.

1.05 SITE INVESTIGATION

A. Soil Investigation Report: A Geotechnical Report has been prepared for this project and is included in the Special Conditions Section of the Specifications.

B. Contractor's Responsibility: The Contractor shall carefully examine the site and make all inspections necessary in order to determine the full extent of the work required to make the completed Work conform to the Plans and Specifications. The Contractor shall satisfy himself/herself as to the nature and location of the Work, conditions, the conditions of the existing ground surface, and the character of equipment and facilities needed prior to and during prosecution of the Work. The Contractor shall satisfy himself/herself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered. The Contractor shall review water table conditions. Any inaccuracies or discrepancies between the actual field conditions and the Plans, or between the Plans and Specifications must be brought to the Engineer's attention in order to clarify the exact nature of the Work to be performed.

C. Existing Elevations: All existing elevations illustrated on the Plans are approximate. The Contractor shall recognize and acknowledge the condition that the bid lump sum price shall include all earthwork activities irrespective of the possible localized difference in contour elevations and actual ground; and that there will be no additional compensation from the Owner for earthwork changes, engineering, or field staking in this regard.

1.06 SAFETY

The Contractor shall familiarize himself/herself with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards", and "OSHA Safety and Health Regulations for Construction Safety Orders" and "Trench Construction Safety Orders" of the State of California, Department of Industrial Relations, Division of Occupational Health and Safety. A copy of these documents shall be kept on the job site.

1.07 ENVIRONMENTAL SAFEGUARDS AND REGULATIONS

The Contractor shall comply with regulations in force at all times to prevent pollution of air and water.

1.08 GEOTECHNICAL TESTING

The Contractor is responsible to employ a qualified Geotechnical Engineer to perform the required earthwork geotechnical testing specified within the contents of the Plans and Specifications. The cost for the Geotechnical Testing shall be borne by the Contractor. A copy of all tests shall be forwarded to the Engineer within four (4) days after the testing is complete. Geotechnical Earthwork Testing shall include in-situ native soil compaction testing, moisture-density soils testing, compaction testing, gradation testing, sand equivalent testing and similar testing. The Contractor shall bear the cost of retest and re-inspection of re-worked material due to faulty work.

1.09 STANDARDS FOR SOIL CLASSIFICATION, PROPERTIES AND TESTS

A. Earthwork and Embankment:

1. Classification - ASTM D 2487.

2. Physical Properties - ASTM D 854, D 2216.

3. Compaction - Modified Proctor ASTM D 1557-91.

B. Backfill for Trench:

1. Classification - ASTM D 2487.

2. Compaction - Modified Proctor ASTM D 1557-91.

3. Field Density Test - ASTM 1556-82; D 2937-83, D 2922-81 (as approved by Engineer).

C. Structural Fill and Backfill:

1. Classification - ASTM D 2487.

2. Attenberg Limits - PlastiOwner Index and Liquid Limit ASTM D 4318.

3. Compaction - Modified Proctor ASTM D 1557-91.

4. Physical Properties - ASTM D 854, D 2216.

5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Engineer).

D. Controlled Fills:

1. Classification - ASTM D 2487.

2. Physical Properties - ASTM D 854, D 2216.

3. Compaction - Modified Proctor ASTM D 1557-91.

4. CBR - ASTM D 1883 (R-Value - ASTM 2844).

5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Engineer).

E. Earth Embankments and Berms:

1. Classification - ASTM D 2487.

2. Physical Properties - ASTM D 854, D 2216.

3. Compaction - Modified Proctor ASTM D 1557-91

4. CBR - ASTM D 1883.

5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Engineer).

F. Borrow:

1. Classification - ASTM D 2487.

2. Other properties - as determined by requirements at point of use.

G. Pipe Trenches:

1. Classification - ASTM D 2487.

2. Physical Properties - ASTM D 854, D 2216.

3. Compaction - Modified Proctor ASTM D 1557-91.

4. CBR - ASTM D 1883.

5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Engineer).

1.10 COMPACTION

The maximum dry density, optimum moisture content and field density of each soil type used in the controlled compacted fill shall be determined as stated in Section 1.09 above.

1.11 INSPECTION

Observation and compaction tests shall be obtained by the Geotechnical Engineer employed by the Contractor during the filling and compacting operations.

1.12 GUARANTEE

Work required by this Section shall be subject to the guarantee requirements stated in the Conditions of the Contract and included in the Performance/Maintenance Bond.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Controlled Fill Material: Materials for controlled fill shall consist of any material imported or excavated from the *cut areas* that, in the opinion of the Engineer, is appropriate for use in constructing fills. The material shall contain no rocks or hard lumps greater than 12 inches in size and shall contain at least 40 percent of material smaller than ¾-inch in size. Materials greater than 6 inches in size shall be placed by the Contractor in windrows on a clean, overexcavated or unyielding compacted fill or firm natural ground surface. Select native or imported granular soil (sand equivalent greater than 30) shall be placed and thoroughly flooded over and around all windrowed rock, such that voids are filled. Windrows of oversize material should be staggered so that successive strata of oversized material are not in the same vertical plane. No nesting or rocks shall be permitted. No material of a perishable, spongy, or otherwise of an improper nature shall be used in filling.

Material placed within 24 inches of rough grade shall be select material that contains no rocks or hard lumps greater than 6 inches in size and that swells less than 3 percent when compacted as hereinafter specified for compacted fill and when subjected to an axial pressure of 160 PSF, if not specified in the Geotechnical report.

Representative samples of material to be used for fill shall be tested in the laboratory by the Geotechnical Engineer in order to determine the maximum density, optimum moisture content, sand equivalent and classification of the soil. In addition, the Geotechnical Engineer shall determine the approximate bearing value of a recompacted saturated sample by direct shear tests or other tests applicable to the particular soil.

During grading operations, soil types other than those analyzed in the report of the soil investigation may be encountered by the Contractor. The Geotechnical Engineer shall be consulted to determine the suitability of these soils. The Contractor shall bear the expenses of the Geotechnical investigation.

B. Structural Fill Material: Materials shall consist of crushed rocks, Class 2 Base, granular sand, decomposed granite (crusher fines) or fine gravel either imported or manufactured from excavated onsite rocky material.

The crushed aggregate, granular sand, decomposed granite (crusher fines) or fine gravel shall be uniformly graded. The following gradations shall apply:

1. Granular Sand:

Clean granular sand free of clay, shale and deleterious material. Sand shall be compacted to 95 percent of maximum density at optimum water content per ASTM D 1557 unless otherwise noted on the Plans. The material shall conform

to a sand equivalent of 30 or greater. The maximum amount of material passing the Number 200 sieve shall be 5 percent. The sand shall conform to the following gradation percentages:

SIEVE SIZE	GRANULAR SAND % PASSING
3/8”	100
No. 4	98-90
No. 8	90-75
No. 10	75-60
No. 16	60-50
No. 30	50-38
No. 40	38-29
No. 50	29-19
No. 100	19-7
No. 200	5-0

The Contractor shall supply a 5-gallon sample of sand material to the material testing laboratory within five (5) days after the Notice to Proceed is issued. The gradation, sand equivalent and maximum density of the sand material shall be determined. The test results shall be forwarded to the Engineer. The cost of testing shall be incurred by the Contractor. The gradation of the granular sand shall be determined and the test results forwarded to the Engineer prior to the delivery of the granular sand material to the Site. Prior to the placement of sand the native subbase grade shall be checked and approved by the Engineer.

Crusher fines shall be allowed to be utilized in lieu of sand if approved by the Engineer.

2. Crusher Fines:

Crusher fines shall consist of decomposed granite indigenous to the Imperial Valley. Crusher fines utilized for this project shall conform to the following gradation requirements:

SIEVE SIZE	PERCENT PASSING
5/8”	100
No. 4	80-100
No. 8	50-85
No. 30	30-50
No. 200	4-15

The sand equivalent shall be 20 or greater.

The Contractor shall supply a five-gallon sample of crusher fines material to the material testing laboratory within five (5) days after the Notice to Proceed is issued. The Gradation and Maximum Density of the crusher fines material shall be determined. The test results shall be forwarded to the Engineer for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

3. Fine Gravel:

Clean fine gravel free of clay, shale and deleterious material. Fine gravel shall be compacted with a plate compactor with one pass in maximum 1 foot lifts. Additional lifts shall not be added until previous lifts shall have been passed over by the plate compactor. The maximum amount of material passing the ¼" Sieve shall be 2 percent. The fine gravel shall conform to the following gradation percentages:

SIEVE SIZE	PERCENT PASSING
3/8"	100
1/4"	0-2

The Contractor shall supply a five-gallon sample of fine gravel material to the material testing laboratory within five (5) days after the Notice to Proceed is issued. The Gradation and Maximum Density of the fine gravel material shall be determined. The test results shall be forwarded to the Engineer for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

4. Class 2 Base:

The Class 2 Base material shall conform to Caltrans Section 26, Latest Edition, for 25mm maximum base material. The gradation requirements are as follows:

SIEVE SIZE	CLASS 2 BASE % PASSING
1"	100
¾"	87-100
No. 4	30-65
No. 30	5-35
No. 200	0-12

The sand equivalent shall be 25 or greater. An angular aggregate is to be used. Class 2 Base material shall be compacted to 95 percent of maximum density according to ASTM D 1557, unless otherwise noted on the Plans or Details. The tolerance for the Class 2 Base between design subgrade elevation and actual subgrade elevation as constructed in the field shall be plus or minus 0.02 feet as referenced from the design subgrade. Prior to the placement of Class 2 Base, the native subbase grade shall be checked and approved by the Engineer. The native subbase grade shall be within plus or minus 0.05 feet of native subbase design grade prior to the placement of Class 2 Base.

The Contractor shall supply a 5-gallon sample of the Class 2 Base to the material testing laboratory within four (4) days of the Notice to Proceed. The material shall be delivered to the testing laboratory to determine the maximum density, gradation, R-value, sand equivalent and durability index of the Class 2 Base. A copy of the test results shall be forwarded to the Engineer by the Geotechnical Consultant for review. The gradation of the Class 2 Base shall be determined and the test results forwarded to the Engineer for approval prior to the delivery of the Class 2 Base material to the Site. *Class 2 Base utilizing recycled materials shall not be allowed.*

C. Structural Backfill Material: Structural Backfill Material shall consist of the same material listed with the Structural Fill Material item above.

D. Special Crushed Rock Bedding and Structure Foundation: When groundwater is encountered in the excavation and/or where indicated on the Plans, the material in the bottom of the trench or excavation shall be removed to a depth directed by the Geotechnical Engineer and replaced with 3/4-inch maximum crushed rock bedding or 1" round rock bedding. The rock beddings shall be installed and compacted per these Specifications. The 3/4-inch maximum crushed rock and 1" round rock materials shall be approved by the Geotechnical Engineer before use.

The bottom and sidewalls of the trench shall be covered with a geotextile. The geotextile fabric shall extend to the top of the pipe zone material on both sides of the trench excavation, and cover the top of the crushed rock and or 1-inch round rock.

1. 3/4-Inch Maximum Crushed Rock

Crushed rock shall be the product of crushing rock or gravel. Fifty percent (50%) of the particles by weight retained on a 3/8-inch sieve shall have their entire surface area composed of faces resulting from fracture due to mechanical crushing. Not over 5% shall be particles that show no faces resulting from crushing. Less than 10% of the particles that pass the 3/8-inch sieve and are retained on the No. 4 sieve shall be waterworn particles. Gravel shall not be added to the crushed rock. Crushed rock (3/4") shall have the following gradation:

SIEVE SIZES	3/4-INCH MAX. CRUSHED ROCK % PASSING
1"	100
3/4"	90-100
1/2"	30-60
3/8"	0-20
No. 4	0-5
No. 8	-

The ¾-inch maximum crushed rock shall be compacted with a plate compactor in one pass in maximum 1 foot lifts. Additional lifts shall not be added until previous lifts shall have been passed over by the plate compactor.

The Contractor shall supply a five-gallon sample of the ¾-inch maximum crushed rock material to the material testing laboratory within four (4) days of the Notice to Proceed. The Gradation and Sand Equivalent of the crushed rock shall be determined. The tests results shall be forwarded to the Engineer for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

2. 1" Round Rock

The 1-inch round rock material shall conform to the following gradation requirements:

SIEVE SIZES	1-INCH ROUND ROCK % PASSING
1-1/2"	100
1"	96
3/4"	79
1/2"	25

3/8” 1

The 1-inch round rock shall be compacted with a plate compactor in one pass in maximum 1 foot lifts. Additional lifts shall not be added until previous lifts shall have been passed over by the plate compactor.

The Contractor shall supply a five-gallon sample of the 1- inch round rock material to the material testing laboratory within four (4) days of the Notice to Proceed. The Gradation of the round rock shall be determined. The tests results shall be forwarded to the Engineer for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

PART 3 - EXECUTION

3.01 GENERAL

The Work performed under this Specification shall be constructed to the lines, grades, elevations, slopes and cross-sections indicated on the Plans, specified herein, and/or directed by the Owner. Slopes, graded surfaces, and drainage features shall present a neat uniform appearance upon completion of the Work.

It shall be the Contractor’s responsibility (1) to maintain adequate safety measures and working conditions; and (2) to take all measures necessary during the performance of the Work to protect the entire project area and adjacent properties which would be affected by this Work from storm damage, flood hazard, caving of trenches and embankments, and sloughing of material, until final acceptance by the Owner. It shall be the Contractor’s responsibility to maintain completed areas until the entire project area is in satisfactory compliance with the job specification.

Utility lines and structures indicated on the Plans which are to remain in service shall be protected by the Contractor from any damage as a result of his/her operation. Where utility lines or structures not shown on the Plans are encountered, the Contractor shall report them to the Owner before proceeding with the Work. The Contractor shall bear the cost of repair or replacement of any utility lines or structures which are broken or damaged by his/her operations.

3.02 REMOVALS, CLEARING AND GRUBBING

A. Clearing: Clearing consists of the complete removal of objectionable materials and obstructions above and below the ground surface including tree stumps, brush, grass, vegetative matter and other objectionable materials within the project limits. All brush and organic material shall be removed before placing any earth fills. It shall be the Contractor’s responsibility to save and protect all trees that lie outside the construction area.

B. Grubbing: Grubbing consists of the complete removal of stumps, including tap roots or lateral roots 1-1/2 inches or more in diameter, and the removal of brush, grass or weeds to depths below the natural ground as specified herein. Stumps shall be grubbed to a depth of 3 feet and grass or weeds shall be grubbed to a depth of 6 inches below the natural ground surface, or to the depths as determined in the field by the Engineer at the time of construction.

C. Protection: Existing items not designated to be demolished or removed shall be protected from damage. Any such item damaged by the Contractor shall be restored or replaced immediately at the Contractor’s expense.

D. Debris and Waste Material: All debris and waste material resulting from demolition, clearing and grubbing shall be removed from the site and disposed of by the Contractor.

3.03 DUST CONTROL

The Contractor shall take all steps possible to prevent and reduce dust arising from the construction activity. Section 01560 Project Environmental Controls elaborates on dust control requirements.

3.04 CARE OF DRAINAGE WATER

Contractor shall take care of drainage water from the construction operations, and of stormwater and/or wastewater reaching the construction area from any source, so that damage is not incurred to the excavation, pipe or structures. The Contractor shall be responsible for any damages to persons or property on or off the Site due to such drainage water or to the interruption or diversion of such stormwater or wastewater on account of his/her operation.

Such grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any water accumulating therein shall be removed by pumping or by other reviewed methods.

Protection of the site during construction shall be the responsibility of the Contractor. Completion of a portion of the project shall not preclude that portion or adjacent areas from the requirements for site protection until such time as the entire project is complete.

3.05 EXCAVATION

A. General: The Contractor shall perform all excavation necessary or required as illustrated on the Plans. The excavation shall include the removal and disposal of all earth materials of whatever nature encountered, which shall include both rock excavation and common excavation when both are present, and shall include the furnishing, placing and maintaining of shoring and bracing necessary to safely support the sides of the excavations. See Technical Specifications Section 02150 Sheeting, Shoring and Bracing.

B. Excavation for Structures: Structure excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of such materials shall conform to the lines and grades shown on the Plans and/or herein specified. Temporary structure excavations shall at all times conform to the Requirements of the State of California, Division of Occupational Health and Safety, and pertinent requirements contained in referenced Geotechnical Investigation Report and Specification Section 02150 - Sheeting, Shoring and Bracing.

Continuous wall and isolated footings shall be underlain by a minimum compacted controlled fill thickness to a minimum 1.5 times the footing width or greater if indicated in the referenced Geotechnical Investigation Report or as required by the Plans. This zone of over-excavation, scarification and recompaction shall extend a minimum of five feet (5') beyond the footing lines unless otherwise illustrated on the Plans. Exposed native surface shall be scarified, and brought to optimum moisture content and compacted to a minimum of 95 percent relative compaction if required by the Geotechnical Investigation Report or the Plans.

All surfaces to receive concrete slabs-on-grade shall be underlain by a minimum compacted controlled fill thickness of 18 inches or greater if indicated in the referenced Geotechnical Investigation Report or as required by the Plans. This shall be accomplished by combination of over-excavation and recompaction to 95% of relative compaction or as required by the Geotechnical Investigation Report or as required by the Plans.

Contingent upon locations, all surfaces to receive compacted fill shall be scarified, brought to near optimum moisture content and compacted to required percentage of relative compaction as specified herein unless otherwise indicated on the Plans.

Rough grade excavations for structures and footings will be inspected by the Geotechnical Engineer to verify that the excavations extend into satisfactory soils and are free of loose and disturbed materials.

Foundation for tanks, pump vaults or subsurface chambers shall have structural fill material extending 12 inches, minimum, below the structural base slab to native material, which has been scarified and compacted to 95% relative compaction unless otherwise indicated on the Plans.

3.06 CONTROLLED FILL

A. General: Controlled fill shall consist of native material, granular sand, Class 2 Base, crusher fines or other material as indicated on the Plans. The subbase grade shall be excavated to within plus or minus 0.05 feet of design grade prior to the placement of controlled fill. The design subbase grade shall be field verified and approved by the Engineer prior to the placement of the controlled fill material. The Engineer shall determine the number and location of points to check for the subbase grade elevation compliance. Prior to the Engineer's inspection of the subbase grade, the Contractor shall establish bluetop stakes on a 20-foot by 20-foot grid across the area controlled fill is to be placed.

If the controlled fill consists of native material it shall be placed in maximum 1-foot lifts and compacted to 90 percent of maximum density at optimum water content per ASTM D 1557. Additional native soil lifts shall not be placed until previous lifts have attained the specified compaction requirement and are approved by both the on-site geotechnical representative and the Engineer.

Granular sand, Class 2 Base and crusher fine controlled fill material shall be placed in maximum 8-inch lifts and compacted to 95 percent of maximum density at optimum water content per ASTM D 1557. Additional granular sand, Class 2 Base or crusher fine lifts shall not be placed until previous lifts have attained the specified compaction requirement and are approved by both the on-site geotechnical representative and the Engineer.

B. Preparing Areas To Be Filled: All vegetation and objectionable material shall be removed by the Contractor from the surface upon which the fill is to be placed and any loose and porous soils shall be removed or compacted to a depth specified by the Geotechnical Engineer. The surface shall then be plowed or scarified to a minimum depth of 6 inches until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal:vertical), horizontal keys and vertical benches shall be excavated into the adjacent slope area. Keying and benching shall be sufficient to provide at least 6-foot wide benches and a minimum of 4 feet vertical bench height within the firm natural

ground, firm bedrock or engineered compacted fill. No compacted fill shall be placed in an area subsequent to keying and benching until the area has been reviewed by the Geotechnical Engineer. Material generated by the benching operation shall be moved sufficiently away from the bench area to allow for the review of the horizontal bench prior to placement of fill.

After the foundation for the fill has been cleared, plowed or scarified, it shall be disced or bladed by the Contractor until it is uniform and free from large clods, brought to the proper moisture content and compacted as specified.

C. Placing, Spreading and Compacting Fill Material: The fill material shall be placed by the Contractor in thin layers that when compacted shall not exceed 8 inches for granular sand, Class 2 Base and crusher fines and 12 inches deep for native material. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to obtain uniformity of material in each layer.

When the moisture content of the fill material is below that required by the Geotechnical Engineer, water shall be added by the Contractor until the moisture content is as required for the specified compaction.

When the moisture content of the fill material is above that required by the Geotechnical Engineer, the fill material shall be aerated by the Contractor by blading, mixing, or other satisfactory methods until the moisture content is as required for the specified compaction.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers or other types of acceptable compacting equipment. Equipment shall be of such design that it shall be able to compact the fill to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient passes over the material to ensure that the desired density has been obtained.

Compacted fill slopes shall be overbuilt and cut back to grade, exposing the firm, compacted inner core. The slopes shall be overbuilt a minimum of five feet (5'). If the desired compaction is not achieved, the existing slope shall be overexcavated and reconstructed. The amount of overbuilding shall be increased until the desired compaction is achieved on the slope. The Contractor shall provide thorough mechanical compaction to the outer edge of the overbuilt slope surface. There shall be no excessive loose soil on the slopes.

The Contractor shall provide and maintain adequate erosion control facilities during the construction of the fill areas. The erosion control facilities shall be maintained in optimum condition until the permanent drainage system and vegetation is complete. The facilities shall be inspected following significant rainfall, repairs made and excess sediment removed. It shall be the Contractor's responsibility to prevent the discharge of sediment off-site or to adjacent watercourses.

3.07. STRUCTURE FILL AND STRUCTURE BACKFILL MATERIAL

A. Placement of Structure Backfill: Before beginning backfilling, all foreign material, including water, shall be removed from the space to be backfilled and the area to be backfilled shall be inspected and approved by the Geotechnical Engineer. Sloping sides of the excavated space shall be stepped to prevent wedging action of the backfill against the structure. No backfill shall be placed around or upon any structure until it is proven

that the concrete has attained satisfactory strength in accordance with the Division 3 of Technical Specifications and that the structure as a whole is adequate to receive backfill. The compressive strength shall be determined by tests on representative cylinders cured under conditions similar to those prevailing at the site.

B. General: Structure fill and structure backfill shall consist of granular sand, Class 2 Base, crusher fines or other material as indicated on the Plans. The subbase grade shall be excavated to within plus or minus 0.05 feet of design grade prior to the placement of structure fill and structure backfill. The design subbase grade shall be field verified and approved by the Engineer prior to the placement of the structure fill or structure backfill material. The Engineer shall determine the number and location of points to check for the subbase grade elevation compliance. Prior to the Engineer's inspection of the subbase grade the Contractor shall establish bluetop stakes on a 20-foot by 20-foot grid across the area which structure backfill is to be placed.

Granular sand, Class 2 Base and crusher fine structure fill and structure backfill material shall be placed in maximum 8-inch lifts and compacted to 95 percent of maximum density at optimum water content per ASTM D 1557. Additional granular sand, Class 2 Base or crusher fine lifts shall not be placed until previous lifts have attained the specified compaction requirement and are approved by both the on-site geotechnical representative and the Engineer.

C. Placing, Spreading and Compacting Fill Material: The structural fill and structural backfill material shall be placed by the Contractor in thin layers that when compacted shall not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to obtain uniformity of material in each layer.

When the moisture content of the fill material is below that required by the Geotechnical Engineer, water shall be added by the Contractor until the moisture content is as required for the specified compaction.

When the moisture content of the fill material is above that required by the Geotechnical Engineer, the fill material shall be aerated by the Contractor by blading, mixing, or other satisfactory methods until the moisture content is as required for the specified compaction.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers or other types of acceptable compacting equipment. Equipment shall be of such design that it shall be able to compact the fill to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient passes over the material to ensure that the desired density has been obtained.

Compacted fill slopes shall be overbuilt and cut back to grade, exposing the firm, compacted inner core. The slopes shall be overbuilt a minimum of five feet (5'). If the desired compaction is not achieved, the existing slope shall be overexcavated and reconstructed. The amount of overbuilding shall be increased until the desired compaction is achieved on the slope. The Contractor shall provide thorough mechanical compaction to the outer edge of the overbuilt slope surface. There shall be no excessive loose soil on the slopes.

The Contractor shall provide and maintain adequate erosion control facilities during the construction of the fill areas. The erosion control facilities shall be maintained in optimum condition until the permanent drainage system and vegetation is complete. The facilities shall be inspected following significant rainfall, repairs made and excess

sediment removed. It shall be the Contractor's responsibility to prevent the discharge of sediment off-site or to adjacent watercourses.

3.08 SUITABLE MATERIAL AND WASTE EXCAVATION

A. General: Suitable material or waste excavation consists of native material. The subbase grade shall be excavated to within plus or minus 0.05 feet of design grade prior to the placement of suitable material or waste excavation material. The design subbase grade shall be field verified and approved by the Engineer prior to the placement of the suitable material or waste excavation material. The Engineer shall determine the number and location of points to check for the subbase grade elevation compliance. Prior to the Engineer's inspection of the subbase grade the Contractor shall establish bluetop stakes on a 20-foot by 20-foot grid across the area suitable material or waste excavation material is to be placed.

The suitable material or waste excavation material shall be placed in maximum 1-foot lifts and compacted to 90 percent of maximum density at optimum water content per ASTM D 1557. Additional suitable material or waste excavation material lifts shall not be placed until previous lifts have attained the specified compaction requirement and are approved by both the on-site geotechnical representative and the Engineer.

B. Placing, Spreading and Compacting Suitable Material and Waste Excavation Material: The suitable material and waste excavation material shall be placed by the Contractor in 1-foot lifts. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to obtain uniformity of material in each layer.

When the moisture content of the fill material is below that required by the Geotechnical Engineer, water shall be added by the Contractor until the moisture content is as required for the specified compaction.

When the moisture content of the fill material is above that required by the Geotechnical Engineer, the fill material shall be aerated by the Contractor by blading, mixing, or other satisfactory methods until the moisture content is as required for the specified compaction.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers or other types of acceptable compacting equipment. Equipment shall be of such design that it shall be able to compact the fill to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient passes over the material to ensure that the desired density has been obtained.

Compacted fill slopes shall be overbuilt and cut back to grade, exposing the firm, compacted inner core. The slopes shall be overbuilt a minimum of five feet (5'). If the desired compaction is not achieved, the existing slope shall be overexcavated and reconstructed. The amount of overbuilding shall be increased until the desired compaction is achieved on the slope. The Contractor shall provide thorough mechanical compaction to the outer edge of the overbuilt slope surface. There shall be no excessive loose soil on the slopes.

The Contractor shall provide and maintain adequate erosion control facilities during the construction of the fill areas. The erosion control facilities shall be maintained in optimum condition until the permanent drainage system and vegetation is complete. The facilities shall be inspected following significant rainfall, repairs made and excess

sediment removed. It shall be the Contractor's responsibility to prevent the discharge of sediment off-site or to adjacent watercourses.

3.09 ESTABLISHMENT OF SUBBASE GRADE, SUBGRADE OR FINISH GRADE

Finish Grade is defined as the finish surface grade. For instance, the top of an A.C. or P.C.C. paved surface is referred to as finish grade.

Subgrade is defined as the grade of the material beneath the finish surface. For instance, the top of Class 2 Base grade beneath an A.C. or P.C.C. paved surface is referred to as subgrade.

Subbase is defined as the grade of the material beneath the base material. For instance, the top of native material beneath the Class 2 Base subgrade material of an A.C. or P.C.C. paved roadway is the subbase grade.

Finish grade surfaces are to be graded to within plus or minus 0.02 feet from design grade as illustrated on the Grading Plans. The Contractor shall place bluetop stakes on a 20-foot x 20-foot grid across the top of the finish grade surface during final grading. A bluetop stake is defined as a stake placed at the finish grade elevation within the tolerance of plus or minus 0.02 feet of finish grade. The Engineer shall obtain elevations across finish grade surfaces at locations determined by the Engineer prior to accepting and approving the finish grade surfaces. The Contractor shall rework areas not conforming to the finish surface grade tolerance as required. Work items to occur after the establishment of finish grade shall not occur until the Engineer has approved the finish grade.

Subgrade surfaces are to be graded to within plus or minus 0.02 feet from design grade as illustrated on the Grading Plans. Bluetop stakes shall be placed on a 20-foot x 20-foot grid pattern across rectangular or square facilities such as parking lots and access roads. The Engineer shall obtain elevations across the subgrade surfaces at locations determined by the Engineer prior to accepting and approving the subgrade surfaces. The Contractor shall rework areas not conforming to the subgrade tolerance as required. Work items to occur after the establishment of subgrade shall not occur until the Engineer has approved the finish grade.

Subbase surfaces are to be graded to within plus or minus 0.05 feet of subbase design grade as illustrated on the Grading Plans. Bluetop stakes shall be placed on a 20-foot x 20-foot grid pattern across rectangular or square facilities such as parking lots, access roads, sludge beds, etc. The Engineer shall obtain elevations across the subbase surfaces at locations determined by the Engineer prior to accepting and approving the subbase surfaces. The Contractor shall rework areas not conforming to the subbase design grade tolerance as required. Work items to occur after the establishment of subbase grade shall not occur until the Engineer has approved the subbase grade.

3.10 COMPACTION TEST SCHEDULE

The following **compaction test(s)** shall apply to this project:

NO.	ITEM	FREQUENCY
1	A compaction test for granular sand or Class 2 Base under sidewalk/curb and gutter sections along Railroad Avenue	3 tests

2	A compaction test for the P.C.C. driveway entrances Class 2 Base along Railroad Avenue.	2 tests/Driveway
3	A compaction test for the Class 2 Base beneath the P.C.C. concrete section in front of the Trash Enclosure.	2 test
4	Compaction tests for trash enclosure Class 2 Base beneath masonry wall P.C.C. footing.	2 tests
5	Compaction tests for native material beneath the P.C.C. concrete section in front of the Trash Enclosure	2 tests
6	Compaction test for Class 2 Base beneath P.C.C. ribbon gutter.	2 tests
7	Compaction test for native material beneath P.C.C. ribbon gutter.	2 tests
8	Compaction test of native material (subbase) beneath A.C. parking lot.	4 tests
9	Compaction test for Class 2 Base beneath A.C. parking lot.	6 tests
10	Compaction test of native material (subbase) beneath A.C. paving on Railroad.	3 tests
11	Compaction test for Class 2 Base beneath A.C. paving on Railroad.	4 tests
12	Compaction tests for the native material beneath the on-site sidewalks	4 tests
13	Compaction tests for the granular fill beneath the on-site sidewalks	6 tests

14	Compaction tests for the native material beneath the masonry perimeter CMU walls.	9 tests
15	Compaction tests for the Class 2 Base beneath the masonry perimeter CMU walls.	9 tests
16	Building Pad compaction tests. Granular soil to be placed beneath the building slab in 8-inch lifts according to the Geotechnical Report. Obtain compaction tests for each 8-inch lift.	16 tests

3.11. CLEAN-UP

Upon completion of Work in this Section, all rubbish and debris shall be removed from the site. All construction equipment and implements of service shall be removed and the entire area involved shall be left in a clean, neat and acceptable condition.

END OF SECTION 02200

SECTION 02221 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in the Technical and Special Conditions form a part of this Section. The Work of this Section includes all labor, machinery, construction equipment and appliances to perform in a professional manner all trench excavation and backfill work illustrated on the Plans and herein specified.

A. Principal items included:

1. Trench excavation, backfill and compaction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 – Earthwork

B. Section 02150 – Sheeting, Shoring and Bracing

C. Piping & Conduit Work specified in other Sections

1.03 SAFETY

The Contractor shall be familiarized with, and shall at all times conform to all applicable regulations of "Excavations, Trenching, and Shoring" of OSHA Safety and Health Regulations for Construction, "General Construction Safety Orders" and "Trench Construction Safety Orders" of the State of California, Department of Industrial Relations, Division of Occupational Health and Safety.

1.04 INSPECTION AND CONTROL

The Contractor shall provide inspection and testing by a Geotechnical Engineer approved by the Engineer engaged and paid for by the Contractor. In this regard, a Geotechnical Engineer may be engaged by the Owner, who shall act as the direct representative of the Owner in geotechnical work, to perform inspection of the removal and replacement of unsuitable materials, all excavations, and the placement and compaction of all fills and backfills within the limits of earthwork on this Project. Costs for all such inspections and tests will be paid by the Contractor, and Contractor shall bear the cost of retest and re-inspection of reworked fills and backfills due to compaction test failure.

1.05 REQUIREMENTS

A. General:

1. The Work performed under this Specification shall be constructed to the lines, grades, elevations, slopes and cross-sections indicated on the Plans, specified herein, and/or directed by the Engineer in writing. Slopes, graded surfaces, and drainage features shall present a neat, uniform appearance upon completion of the Work.

2. It shall be the Contractor's responsibility (1) to maintain adequate safety measures and working conditions; and (2) to take all measures necessary during the performance of the Work to protect the entire project area and adjacent

properties which would be affected by this Work from storm damage, flood hazard, caving of trenches, cavings of excavations, and embankments, and sloughing of material, until final acceptance by the Owner. It shall be the Contractor's responsibility to maintain completed areas in good condition until the entire project area is in satisfactory compliance with the Project Specifications.

3. Contractor shall be responsible for the excavation and disposition of unsuitable or surplus material by approved means of conveyance away from the working area.

B. Protection of Existing Utilities:

1. Utilities: Unless otherwise illustrated on the Plans or stated in the Specifications, all utilities, both underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements, agreements and approvals with the utility purveyor, Owner and Engineer and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall be reconstructed in its original or new location as soon as possible and to a condition at least as good as its previous condition. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by the Engineer, Owner and the utility purveyor.

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are illustrated on the Plans. This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not illustrated on the Plans is discovered, it shall be brought to the immediate attention of the Engineer for a determination regarding alternatives to the conflict.

2. Building, Foundations and Structures: Where trenches are located adjacent to buildings, foundations and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction except where authorized in the Special Conditions or in writing by the Engineer. Water settling of backfill material in trenches adjacent to structures will not be permitted.

3. Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: These underground facilities shall be adequately supported by the Contractor. Support for plastic pipe shall be continuous along the bottom of the pipe. Support for metal pipe and electrical conduit may be continuous or nylon webbing may be used for suspension at no greater than ten foot (10') intervals. The Contractor shall avoid damaging the plastic pipe, pipe ways or conduits during trench backfilling and during foundation and bedding placement.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Granular Sand Material: Granular sand material shall consist of imported granular sand complying with Section 02200, of the specifications.

B. Crusher Fines: Crusher fines material shall consist of imported decomposed granite complying with Section 02200, of the specifications.

C. Class 2 Base Material: Class 2 Base material shall consist of imported virgin (not recycled) Class 2 Base complying with Section 02200, of the Specifications.

D. Crushed Rock Bedding: Crushed rock bedding shall consist of imported rock complying with Section 02200, of the Specifications.

E. 1-inch Round Rock: 1-inch Round Rock material shall consist of import rock material complying with Section 02200, of the Specifications.

F. Concrete: 5000 PSI compressive strength, minimum, as specified in Division 3, Concrete, of the Specifications.

G. Pipelines: Use materials shown on the Plans and as specified in other pertinent Sections of the Specifications.

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION

A. Excavation for Trenches: Shall include the removal of all material of any nature for the installation of the pipe or facility and shall include the construction of trench shoring and stabilization measures, timbering and all necessary installations for dewatering.

B. Minimum Width of Trench: The minimum width of pipe trenches, measured at the crown of the pipe, shall not be less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells and the minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections, and such minimum width shall be exclusive of all trench supports.

C. Maximum Width of Trench: The maximum allowable width of trench for all pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 16 inches, and such maximum shall be inclusive of all timbers. A trench wider than the outside diameter plus 16 inches may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry the additional trench load. Such modifications shall be submitted for the Engineer's review. Whenever such maximum allowable width of trench is exceeded for any reason, except as provided for on the Plans or in the Specifications, or by the written direction of the Engineer, the Engineer may, at its discretion, require that the Contractor, at his own expense for all labor and materials, cradle the pipe in 5,000 PSI compressive strength concrete, or other approved pipe bedding.

D. Maximum Length of Open Trench: Except by special permission by the Engineer only that amount of open trench shall be permitted, which shall allow for that amount of pipeline construction, including excavation, construction of pipeline, and backfill in any one location, which can be completed in one day; however, maximum length of open trench shall never exceed 600 feet. This length includes open excavation, pipe laying and appurtenant construction and backfill which has not been temporarily resurfaced.

E. Trench Side Slopes:

1. Temporary trench excavations shall at all times conform to the safety requirements hereinbefore specified in Section entitled “Safety”.

2. Loose cobbles or boulders shall be removed from the sides of the trenches before allowing workmen into the excavation, or the trench slopes must be protected with screening or other methods. Trench side slopes shall be kept moist during construction to prevent local sloughing and raveling. Surcharge loads due to construction equipment shall not be permitted within 10 feet of the top of any excavated slope.

3. If the Contractor elects to shore or otherwise stabilize the trench sides, he shall file with the Engineer copies of drawings for same prepared, signed and stamped by a Civil Engineer duly registered in the State of California before commencing excavation.

F. Excess Trench Excavation: If any trench, through the neglect of the Contractor, is excavated below the bottom grade required, it shall be refilled to the bottom grade, at the Contractor’s expense for all labor and material, with granular sand material compacted to a firm stable foundation.

3.02 BRACING TRENCHES

The sides of the trenches shall be supported with plank sheeting and bracing in such a manner as to prevent caving of the sides of the trench. Space left by withdrawal of sheeting or shoring shall be filled completely with dry granular material blown or rammed in place. Trench shoring shall be completed per the recommendations of the Geotechnical Report and OSHA Standards.

3.03 PIPING BEDDING

The Contractor shall excavate to four inches (4”) below the bells or couplings for the full width of the trench and shall place four inches (4”) of granular material upon which the pipe is to be laid, unless indicated otherwise on the Plans. Construct pipe bedding as indicated on the Plans.

At pipe subgrade, if foundation soil in trench is soft, wet, spongy, unstable or does not afford solid foundation for pipe, the Contractor shall excavate as directed by the Engineer and provide stable base by excavating any unsuitable material 18” minimum below the subgrade base or as the Engineer determines is necessary for placement of pipe bedding. A filter fabric shall be placed in the trench bottom and along the trench sidewalls in the pipe zone to the top of the pipe zone material. A crushed rock material shall be placed at the bottom of the trench and sidewalls of the pipe to a point 1 foot above the pipe. The crushed rock material shall be hand tamped in 16-inch lifts along the sidewalls. The crushed rock shall be compacted with a plate compactor in minimum 6 inch lifts beneath the pipe and over the top of the pipe.

Where rock is encountered in the trench, the Contractor shall excavate to a minimum 18 inch depth below subgrade or as the Engineer determines is necessary, and shall construct a base by placing crushed rock bedding upon which a subgrade can be prepared.

Before any pipe is lowered in place, the trench bottom shall be prepared so that each pipe shall be supported for the full length of the barrel with full bearing on the bottom segment of the pipe equal to a minimum of one-half (1/2) of the pipe OD, and a width equal to the trench width. All adjustments in line and grade shall be made by scraping away or filling and tamping in under the barrel of the pipe. Wedging or blocking is not permitted.

The pipe bedding shall be compacted to a minimum of 90 or 95 percent relative compaction as hereinafter specified or as required by the Plans.

3.04 BACKFILLING PIPE TRENCHES

A. Backfilling Pipe Zone: Backfill material for the pipe zone shall consist of imported granular material or two sack cement/sand slurry as required by the Plans. Place material in the trench simultaneously on each side of the pipe for the full width of the trench and the depth of the pipe zone in layers 6 inches in depth. Each layer shall be thoroughly compacted by tamping. In all cases, backfilling of the pipe zone must be accomplished by hand. Particular attention shall be given to underside of the pipe and fittings to provide a firm support along the full length of the pipe. The pipe zone shall be considered to extend 12 inches above the top of the pipe unless otherwise illustrated on the Plans, and shall be compacted in the trench to a relative compaction of not less than 90 or 95 percent of maximum density per ASTM D 1557 as illustrated on the Plans. Care shall be taken not to damage pipe and fittings or special coatings on the pipe and fittings.

1. Use of material other than those specified shall be reviewed by the Engineer prior to use. The Contractor shall bear all cost of removal of rejected material, its hauling to an authorized disposal site, and cost of providing required material to complete the bedding and backfilling.

B. Backfilling Pipe Trench: After the pipe has been laid in the trench and has been inspected and approved, and backfilling in the pipe zone is complete and compacted, the remainder of the trench may be backfilled. The backfill material shall be granular sand or Class 2 Base as specified in Paragraph 2.01 and illustrated on the Plans. Care shall be taken to ensure that no voids remain under, around or near the pipe.

1. The Contractor shall incur the expense to remove and dispose of the excess trench excavation material displaced by the trench import material and include the costs in the bid.

C. Compaction: The maximum dry density and optimum moisture content of each soil type used in the controlled compacted fill shall be determined by ASTM D 1557-91. Field density tests shall be determined in accordance with ASTM D 1556-82, ASTM D 2937-83 and ASTM D 2922-81.

D. Placement and Compaction of Trench Backfill: The placement and compaction of all trench backfill shall be as follows:

1. Mechanically Compacted Backfill: With approval of the Engineer, backfill shall be mechanically compacted by means of tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers to 90 or 95 percent relative compaction as illustrated by the Plans. Impact-type pavement breakers (stompers or hydro-hammers) shall not be permitted over any pipe. Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements or improvements installed under the Contract. The Contractor shall make his own determination in this regard. Backfill shall be placed in horizontal layers not exceeding eight inches (8”). Each layer shall be evenly spread, the moisture content brought to near optimum condition and then tamped or rolled until the specific relative compaction has been attained. Additional backfill lifts shall not be placed until previous lifts have been satisfactorily compacted and tested and approved by the Engineer.

3.05 CENTRAL PIPELINE INSTALLATION REQUIREMENTS

A. Depth of Pipe: Unless otherwise illustrated on the Plans, all pipelines shall have coverage of at least 36 inches between the top of the pipe and the finished surface. All gravity line invert elevations and locations illustrated on the Plans are intended to be exact and any change in alignment and grade shall be reviewed in accordance with the Contract Documents to the satisfaction of the geotechnical testing representative and Engineer. All force and gravity mains shall have 1 foot vertical clearance between themselves and all other utilities. At all water main, sewer and stormwater crossings, both gravity and force mains shall have 20 linear feet of concrete encasement centered at the crossing as required by the State of California Department of Health.

B. Changes in Line and Grade: In the event obstructions not shown on the Plans, are encountered during the progress of the Work, which will require alterations to the Plans, the Engineer shall issue the necessary revisions to the Plans and order the necessary deviation from the line or grade. The Contractor shall not make any deviation from the specified line and grade without prior review and approval by the Engineer. Should any deviations in line and grade be permitted by the Engineer in order to reduce the amount of rock excavation or for other similar convenience to the Contractor, any additional costs for thrust blocks, valves, air and vacuum valve assemblies, blow-off assemblies, extra pipe footage, concrete, sewer structures, or other additional costs shall be borne by the Contractor.

1. Contractor shall include in his Bid provisions to cover any deviation from the invert grade shown on the Plans to facilitate the extra depth required to avoid possible conflicts between existing gravity pipelines and other utilities with new water, stormwater or sewer forcemains.

C. Pipe Installation:

All pipe and fittings, and accessories furnished by the Contractor shall be new material free from rust or corrosion. All piping and fittings shall be cleaned on the inside when installed and the Contractor shall take all necessary precautions to insure that the lines are kept free of any foreign matter and dirt until the work is completed. All pipes shall be carefully placed and supported at the proper lines and grades as shown on the Plans. Piping runs shown on the Plans shall be followed as closely as possible, except for minor adjustments as approved by the Engineer to avoid other piping or structural features. Bedding material shall first be placed so that the pipe is supported for the full length of the barrel with full bearing on the bottom segment of the pipe. Hunching of the pipe shall not be allowed. Pipe will be carefully inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection by the Engineer. Any corrective work shall be approved by the Engineer. Pipe shall be laid true to line and grade with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the bell or collar which shall not bear upon the subgrade or bedding. Any pipe which is not in true alignment or shows any undue settlement after laying shall be taken up and relaid at the Contractor's expense. Pipe shall be laid upgrade with the socket ends of the pipe upgrade unless otherwise authorized by the Engineer. Pipe sections shall be laid and joined in such a manner that the offset of the inside of the pipe at any joint will be held to a minimum at the invert. The maximum horizontal offset at the invert of the pipe shall be 1% of the inside diameter of the pipe or 0.02 feet, whichever is smaller. The vertical grade shall be ± 0.02 feet of the design invert. In joining socket pipe, the spigot of each pipe shall be so seated in the socket of the adjacent pipe as to give a uniform annular space all around the pipe in the socket.

The following pipe installation items shall be required:

1. No pipe shall be laid which is damaged, cracked, checked or spalled or has any other defect deemed by the Engineer to make it unacceptable, and all such sections shall be permanently removed from the Work.

2. At all times when the Work of installing pipe is not in progress, all openings into the ends of the pipelines shall be kept tightly closed with suitable plywood or sheet metal bulkheads to prevent the entrance of animals and foreign materials and to prevent water from entering the pipe.

3. Keep the pipe trench free from water at all times and take all necessary precautions to prevent the pipe from floating due to water entering the trench from any sources. Any damage is the Contractor's full responsibility. Restore and replace the pipe to its specified conditions and grade if it is displaced due to floating.

4. All pipelines adjoining concrete structures (including manholes) shall have a flexible joint, such as sleeve transition couplings, within 36 inches from the face of such concrete structures. Flexible joints shall be installed on all pipe 4" and larger whether or not a flexible joint is illustrated on the Plans. Where the flexible joint is illustrated on the Plans, install the joint at the location indicated.

3.06 COMPACTION OF PIPE BEDDING AND BACKFILL

Unless specified in the Plans or Earthwork Specification (Section 02200), the following compaction test for piping shall be required.

A. One (1) compaction test for the granular sand fill pipe bedding along each 100 lineal foot of water, sewer or stormwater pipe placed for each 1 foot lift of material installed.

B. One (1) compaction test shall be obtained for each 1 foot lift of Class 2 Base material along each 100 foot section of water, sewer or stormwater pipeline installed.

C. One (1) compaction test shall be required for each 1 foot of vertical sand fill material placed along each 100 feet of water, sewer or stormwater pipeline installed.

D. One (1) compaction test shall be obtained for each 1 foot lift of native material along each 100 foot section of water, sewer or stormwater pipeline installed.

E. One (1) compaction test shall be obtained for each 1 vertical foot of native material placed around stormwater or sanitary sewer manholes. A geotechnical testing representative shall be present at the time the sanitary sewer or stormwater pipeline and sanitary sewer or stormwater manholes are backfilled to monitor the placement of backfill material and complete compaction testing. Additional lifts shall not be installed until previous lifts have attained the specified compaction and is approved by the on-site geotechnical representative and Engineer.

3.07 CLEAN-UP

Immediately upon completion of Work for this Section, all rubbish and debris shall be removed from the Site. All pipe trench areas shall be finish graded with a "blade" or "motor patrol". All construction equipment and implements of service shall be removed and the entire area involved shall be left in a neat, clean and acceptable condition.

END OF SECTION 02221

SECTION 02510 - ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in the Technical Specifications form a part of this Section. Provide labor, equipment, tools and materials to accomplish asphalt concrete paving as indicated on the Plans and/or on the Proposal forms.

A. Related work not included in this Section:

1. Section 02200 - Earthwork

2. Section 02221 – Trenching, Backfilling and Compacting

1.02 REFERENCE SPECIFICATION

Asphalt concrete paving work shall be in accordance with the latest edition of State of California, Department of Transportation Standard Specifications (Caltrans Std. Specs.).

1.03 PAVEMENT REMOVAL AND REPLACEMENT

A. General: Pavement removal and replacement for all public roads, including aggregate base and temporary paving where required, shall comply with the Plans and requirements of the agency issuing the Encroachment Permit. In roads established under formation of a special road district, the specifications of the Encroachment Permit shall apply. Any private roads and streets, including driveways in which the surface is removed or damaged, shall be restored to the original grade and crown by the Contractor in accordance with the paving requirements described herein. Removed or damaged sections shall be restored with the type of improvements (or better) conforming to that which existed at the time the Contractor entered upon the work.

It shall be the responsibility of the bidder to observe and familiarize himself/herself as to the existing pavement sections prior to submitting a Bid.

B. Pavement Cutting: Pavement shall be cut to a straight edge parallel to the pipe alignment, curb and gutter, barrier curb, pavement edge, etc., prior to excavation. Method of pavement cutting shall be sawcutting for the full depth of the pavement. Under no circumstances shall excavation be started prior to sawcutting of the pavement. If the adjacent pavement is disturbed during the Contractor's operation, the pavement shall be recut on straight lines to remove the damaged pavement before resurfacing. Portland cement concrete pavement and sidewalk shall also be sawcut as required.

C. Asphalt Concrete Pipe Trench Pavement: Where required by the agency issuing the Encroachment Permit or other agency having jurisdiction, and where specified in the Contract Documents, an asphalt concrete cap shall be placed in the area of the pipe trench or pipe excavation area. The installation of the asphalt concrete pavement shall be in accordance with the specifications and policies of the agency having jurisdiction. In the event the agency requirements conflict with the Plan requirements, the most stringent will apply.

1.04 TEMPORARY PAVEMENT

Install temporary pavement in accordance with the requirements of the agency issuing the Encroachment Permit and Engineer. Steel plates may be allowed to cover excavation areas within road right of ways as approved by the governing agency and Engineer.

1.05 PAYMENT

Payment for asphalt paving (new or replacement) shall be per unit price (ton) as indicated on the Proposal forms. The contractor shall include in the schedule of values the Unit Price per ton of AC pavement. Certified quantity tickets (tons) shall be provided to the Construction Manager on the job site as the material is delivered and signed so as to certify delivery and acceptance. Any material for which asphalt concrete quantity tickets are not submitted as the material is delivered will not be accepted. Payment for asphalt concrete designated to be on a Lump Sum as shown on the bid schedule basis will require tickets to be submitted and accepted by the Construction Manager.

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE PAVING

A. MIX: Hot Mix Asphalt, Type A per Caltrans Standard Specifications Section 39.

B. THICKNESS: As specified on the Plans.

C. AGGREGATE SIZE: ½-inch maximum, medium per Caltrans Standard Specifications Section 39.

D. ASPHALT BINDER: PG 70-10.

E. PRIME COAT: Per Caltrans Standard Specifications Section 39, if required per the Plans.

2.02 SLURRY SEAL

A. MIX: Type I Slurry Seal per Section 203.5 of Standard Specifications for Public Works Construction, "Greenbook," 2012 Edition.

2.03 FOG SEAL

A. SPECIFICATION: Caltrans Std. Specs. Section 37.

B. MATERIAL: Slow setting, mixing type asphaltic emulsion per Caltrans Std. Specs. Section 94.

2.04 PRIME COAT AND TACK COAT

A. SPECIFICATION: Caltrans Standard Specifications Section 39.

B. MATERIAL: SS-1h emulsified asphalt

PART 3 - EXECUTION

3.01 ASPHALT CONCRETE PAVING

Asphalt Concrete shall be applied with a vibratory machine. The hot mix asphalt type shall be HMA , Type A, ½-inch, with PG 70-10 per the latest edition of Caltrans Standard Specifications and as approved by the Engineer. The minimum bitumen shall be in accordance with the approved mix design. The Asphalt Concrete shall be compacted to 95 percent of maximum density per ASTM D-1559. The temperature of the asphalt when delivered to the application site shall range between 285° *F* and 359° *F*. The finished surface shall be within ± 0.02 feet of finish design grade with maximum high and low variance occurring in a maximum of 10 horizontal feet.

Rollers of the vibratory, steel wheel or pneumatic-tired type may be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment which causes excessive crushing of the aggregate will not be permitted.

After spreading, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor.

The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller or from any other cause shall be corrected at once.

Rolling shall continue until the roller marks are eliminated, the surface is of uniform texture and true to grade and cross-section and the required field density is obtained.

To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers.

Any mixtures that become loose and broken, mixed with dirt, or in any way defective, shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor’s expense.

The Contractor shall pay for all costs associated with the preparation of the Mix Design. The Contractor shall bear the cost for compaction test and extraction/gradation tests required for this project. A total of four (4) compaction tests shall be required for this project. A total of one (1) extraction gradation test shall be required for this project.

A sample of the bituminous mix will be obtained each morning pavement operations are occurring, or as approved by the Engineer and Geotechnical Consultant. The sample shall be obtained by the geotechnical testing consultant. The maximum density of the sample shall be determined. The results of the test will be used to base the field density tests against. An extraction from the sample shall be taken to determine the percentage of bitumen in the mix. The gradation of the sample shall also be obtained. Density tests will be taken during the rolling operation. The pavement shall continue to be rolled until the desired density is obtained. The costs associated with the testing shall be borne by the Engineer.

A. Application: Mixing, transporting and placing of asphalt concrete shall be in accordance with all applicable provisions of Caltrans Std. Specs. Section 39. Asphalt concrete shall not be placed when the atmospheric temperature is below 60°*F*, or during unsuitable weather.

B. Pressure Treated Headers: Provide 2"x4" pressure treated headers for all pavement edges, if required per the Plans.

C. Repairs: Deficient paving and/or low areas with inadequate drainage and damaged paving due to subgrade failure, inadequate trench compaction, etc., shall be repaired by the Contractor at no additional cost to the Owner.

3.02 ASSOCIATED PAVING RELATED WORK

A. Manhole Covers: Adjust sewer and storm drain manhole covers 3 inches below the finish design pavement surface prior to the installation of A.C. pavement. Raise the manhole covers to finish pavement grade after paving operations are completed. Place a 1-foot wide, 1-foot deep 5000 PSI concrete ring concentric around the manhole level with the finish pavement surface.

B. Valve Covers: Adjust water valve risers and covers 3 inches below the finish design pavement surface prior to the installation of A.C. pavement. Raise the valve risers and covers to finish pavement grade after paving operations are completed. Place an 8-inch wide, 8-inch deep 5,000 PSI concrete ring concentric around the water valve riser and cover level with the finish pavement surface.

C. Striping: Replace the traffic striping and pavement markers over the areas receiving the overlay. Paint new onsite striping as illustrated on the Plans.

D. Traffic Signs: Replace traffic signs temporarily removed during the construction work.

3.03 FOG SEAL

A. Application: Apply fog seal at a rate of 0.06 to 0.10 gallons per square yard of surface area.

B. Fog Seal Schedule: Apply fog seal not less than fourteen (14) days following placement of asphalt concrete surfacing.

3.04 PRIME COAT AND TACK COAT

A. Prime coat and Tack coat shall be applied in accordance with Caltrans Standard Specifications Section 39, unless otherwise approved to not coat by County of Imperial and the Engineer, in writing.

B. Prime coat shall be applied at the approximate total rate of 0.25-gallon per square yard of surface covered, if required per the Plans.

C. Prime coat shall be applied at a temperature conforming to the range of temperatures provided in Caltrans Specification Section 93-1.03, "Mixing and Applying," for distributor application of the grade of liquid asphalt being used.

D. Tack coat of asphaltic emulsion shall be furnished and applied in conformance with the provisions in Caltrans Standard Specifications Section 94, "Asphaltic

Emulsions," and shall be applied to all vertical surfaces of existing pavement, curbs, gutters and construction joints in the surfacing against which additional material is to be placed, to a pavement to be surfaced and to other surfaces designated in the special provisions.

E. Tack coat shall be applied in one application at a rate of from 0.02-gallon to 0.10-gallon per square yard of surface covered.

F. Before placing a layer of Open Graded asphalt concrete on any other type of asphalt concrete or on an existing bituminous pavement, tack coat shall be applied in on application at a rate of from 0.05-gallon to 0.10-gallon per square yard of surface covered.

G. Prime coat or tack coat shall be applied only so far in any one day than is planned to be covered by asphalt concrete during the same day, unless otherwise authorized by the Engineer. When asphaltic emulsion is used as a tack coat, asphalt concrete shall not be placed until the asphaltic emulsion has cured.

H. Immediately in advance of placing asphalt concrete or asphalt concrete base, additional prime coat or tack coat shall be applied as directed by the Engineer to areas where the prime coat or tack coat has been damaged, and loose or extraneous material shall be removed, and no additional compensation will be allowed therefore.

I. A similar tack coat shall be applied to the surface of any course, if the surface is such that a satisfactory bond cannot be obtained between it and a succeeding course.

J. The contact surfaces of all cold pavement joints, curbs, gutters, manholes, and the like shall be painted with Grade SS-1h emulsified asphalt immediately before the adjoining asphalt concrete is placed.

3.05 PAVING SCHEDULE

Unless otherwise approved by the Engineer, all permanent paving shall commence only after construction of all other contract work is completed.

The asphalt paved surface may be damaged during the construction activities of the Winterhaven Public Safety Facility Project. The Contractor shall repair any damaged asphalt paved surface. The Contractor shall apply Type I Slurry Seal Coat on the asphalt paved surface after the construction of the building is completed.

END OF SECTION 02510

SECTION 02600 – PAVEMENT MARKINGS AND PAINTED TRAFFIC STRIPES

PART 1 - GENERAL

1.01 DESCRIPTION

This item shall consist of the painting of markings and stripes on the surface of the A.C. pavement in accordance with the locations and requirements illustrated on the Plans. All painting of markings and stripes shall conform to Caltrans Standard Plans and Specifications, latest edition, unless noted otherwise.

PART 2 - PRODUCTS

2.01 PAINT

Paint shall meet the requirements of the Standard Specifications for Public Works Construction, "Greenbook", 2012 edition, Section 214-4.2 and the Table 214-4.1(a).

2.02 RAPID DRY PAINT

The paint shall conform to the rapid dry paint specified in the Standard Specifications for Public Works Construction, "Greenbook", 2012 edition, Section 214.

2.03 REFLECTIVE MEDIA

A glass sphere reflective media shall be required per Section 214-3 of the Standard Specifications for Public Works Construction, "Greenbook", 2012 edition.

PART 3 - EXECUTION

3.01 WEATHER LIMITATIONS

The painting shall be performed only when the surface is dry, when the atmospheric temperature is above 60 degrees F., and when the weather is not foggy or windy.

3.02 EQUIPMENT

All equipment for the work shall be approved by the Engineer and shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job. The mechanical marker shall be an atomizing spray-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall be designated so as to apply markings of uniform cross sections and clear-cut edges without running or spattering.

3.03 PREPARATION OF SURFACE

Immediately before application of the paint, the pavement surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material which would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials.

3.04 LAYOUT OF MARKINGS

The proposed markings shall be laid out in advance of the paint application according to the dimensions required by the Plans and Specifications or by Caltrans Standards.

3.05 APPLICATION

Markings shall be applied at the locations and to the dimensions and spacing shown on the Plans. Paint shall not be applied until the layout and condition of the surface have been approved by the Engineer.

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at a rate specified in the Standard Specifications for Public Works Construction, "Greenbook", 2012 edition, Section 214.

The addition of thinner will not be permitted. The edges of the markings shall not vary from a straight line more than ¼ inch in 50 feet, and the dimensions shall be within a tolerance of plus or minus 2 percent.

The Contractor shall furnish certified test reports for the materials shipped to the project. The reports shall not be interpreted as a basis for final acceptance. The Contractor shall notify the Engineer upon arrival of shipment of the paint to the job site. All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the project site or destroyed until authorized by the Engineer.

A minimum of two (2) coating applications shall be applied. Two (2) coating applications shall be completed at least fifteen (15) days after the slurry seal coat application has been completed on the asphalt pavement surface.

3.06 PROTECTION

After application of the paint, all markings shall be protected from damage until the paint is dry. All surfaces shall be protected from disfiguration by spatter, splashes, spillage or drippings of paint.

END OF SECTION 02600

SECTION 02640 - PVC PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish and install all Polyvinyl Chloride (PVC) plastic pipe, fittings, transitions, connections and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

B. Section 02221 - Trenching, Backfilling and Compacting

C. Section 02666 – Pressure Pipeline Water Testing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

ASTM D 1784 and ASTM D 1785	Specifications for Polyvinyl Chloride (PVC) Plastic Pressure Pipe
ASTM D 3034	Specifications for Polyvinyl Chloride (PVC) Plastic Gravity Sewer Pipe
AWWA C 900 and AWWA C 905	Specifications for Polyvinyl Chloride (PVC) Plastic Water Pressure Pipe
ASTM D 2321	Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
NSF / ASNI 61	Drinking Water System Components – Health Effects

1.04 CONTRACTOR SUBMITTALS

A. Contractor shall submit copies of the manufacturer's product specifications according to the requirements of Section 01300 - Contractor Submittals.

PART 2 - PRODUCTS

2.01 PVC (POLYVINYL CHLORIDE) PRESSURE PIPE, 4 INCHES AND SMALLER SOLVENT-WELDED

A. All PVC pressure pipe 4 inches and smaller shall be made from all new rigid unplasticized polyvinyl chloride and shall be Normal Impact Class 12454-B, Schedule 80, to conform to ASTM D 1785, unless otherwise shown. Elbows and tees shall be of the same material and schedule as the pipe. Unless otherwise shown, joint design shall be for solvent-welded construction.

2.02 AWWA C 900 AND AWWA C 905 WATER PIPELINE WITH BELL AND SPIGOT JOINTS

This Specification designates general requirements for unplasticized polyvinyl chloride (PVC) plastic class water pipe with integral bell and spigot joints for the conveyance of water. Pipe shall meet the requirements of AWWA C 900 or AWWA C 905 "Polyvinyl Chloride (PVC) Water Distribution".

All pipe shall be suitable for use as pressure conduit, provisions must be made for expansion and contraction at each joint with an elastomeric ring. The bell shall consist of an integral wall section with a factory installed, solid cross-section elastomeric ring which meets the requirements of ASTM F 477. The bell section shall be designed to be at least as hydrostatically strong as the pipe wall and meet the requirements of AWWA C 900. Sizes and dimensions shall be as shown in this Specification. Joint design shall meet qualification requirements of ASTM F 3139. Each pipe shall be tested to four times the pressure class of the pipe for a maximum of 5 seconds. The integral bell shall be tested with the pipe. Standard laying lengths shall be 20 feet (±1") for all sizes.

The pipe stiffness using F/ΔY for PVC class water pipe is contained in the table below:

CLASS	DR	FΔy (PSI)
100	25	129
150	18	364
200	14	815

Pipe shall withstand, without failure at 73°F, an impact of a falling missile, TUP C, at the following levels (per ASTM D 2444):

Pipe Size (IN.)	Impact (FT./LBS.)
4	100
6	100
8	100
10	120
12	120

There shall be no visible evidence of shattering or splitting when the energy is imposed.

Randomly selected samples tested in accordance with ASTM D 1599 shall withstand, without failure, pressures listed below when applied in 60-70 seconds.

Class	Minimum Burst Pressure At 73°F (PSI)
100	535
150	755
200	985

Pipe for this Project shall conform with the specifications for AWWA C 900, DR 18 PVC pipe material for diameter sizes 4-inches through 12 inches and AWWA C 905, DR 25 PVC pipe material for diameter sizes 14 inches through 36-inches unless otherwise indicated on the Plans.

2.03 PVC (POLYVINYL CHLORIDE) GRAVITY PIPE

A. Pipe shall conform to the requirements of ASTM D 3034 for SDR 35 gravity pipe, unless otherwise indicated on the Plans.

B. All pipe joints shall be of the bell and spigot type with electrometric seals and conform to the requirements of ASTM D 3212. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. Gasket material shall conform to the requirements of ASTM F 477.

C. All fittings shall be fabricated from pipe meeting the requirements of these standards. Fabricated miter joints shall be reinforced by fusion heat welding. All fittings shall be approved for use by the pipe manufacturer and shall be capable of accepting bell and spigot connections.

1. There shall be no sign of flaking or disintegration when immersed in anhydrous acetone for 20 minutes as described in ASTM D 2152.

D. All pipe shall be from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 as defined in ASTM 1784.

E. Minimum pipe stiffness at 5 percent deflection shall be 46 PSI for all sizes when tested in accordance with ASTM D 2412, External Loading Properties of Plastic Pipe by Parallel-Plate Loading".

F. Each pipe shall be identified with the name of manufacturer, nominal size, cell classification, ASTM designation F 1803, the pipe stiffness designation "PS-46" and manufacturer's date code.

2.04 NSF / ANSI STANDARD 61

Piping, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61 as being suitable for contact with potable water.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE

A. All pipe, fittings, etc., shall be carefully handling and protected against damage, impact shocks and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground, but shall be supported in a manner which will protect the pipe against injury whenever stored at the Site. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

B. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. Damaged pipe shall be replaced with new undamaged sections of pipe.

C. Before placement of the pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work. As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, rocks and any other debris following completion of pipe laying prior to testing, disinfecting and placing the completed pipeline in service.

D. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted and the bedding shall be such that it forms a continuous, solid bearing for the

full length of the pipe. Bell holes shall be formed at the ends of the pipe to prevent joint loading at the bells or couplings.

E. Where necessary to raise or lower the pipe grade due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer.

F. No pipe shall be installed upon a foundation into which frost has penetrated or any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

G. Immediately before jointing bell and spigot pipe, both the bell and spigot end of the pipe shall be thoroughly cleaned and lubricated with an approved vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper alignment. Tilting of the pipe to insert the spigot into the bell will not be permitted.

H. Solvent-welded and heat-fused joints shall be carefully and thoroughly cleaned immediately before jointing the pipe. Particular care shall be taken in making solvent-welded joints to ensure a uniform, homogeneous and complete bond.

I. Pipe installation shall conform with Technical Specification Section 02221 - Trenching, Backfilling and Compacting. If this installation of pipe section and Section 02221 conflict, the most stringent specification shall apply.

END OF SECTION 02640

SECTION 02680 - TESTING OF HYDRAULIC STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

Test all concrete pump station, manholes, basins and other structures designed to contain water, after concrete has reached the design strength, prior to back-filling and application of any coating system. Test by filling structure with water. The Contactor shall perform all cleaning, flushing, testing and appurtenant work, including conveyance of test water from Owner-designated source to point of use, and including all disposal thereof, complete and acceptable, for hydraulic structures and appurtenant piping all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-In-Place Concrete

B. Section 02666 - Pressure Pipeline Water Testing

PART 2 - PRODUCTS

2.01 MATERIALS REQUIREMENTS

A. Temporary hoses to convey water to the structures, temporary bulkheads, water plugs, electrical circuitry, pumps, fuel, suction hoses, discharge hoses and any other ancillary materials.

PART 3 - EXECUTION

3.01 GENERAL

A. Prior to testing, all hydraulic structures shall be thoroughly cleaned and all surfaces hosed down with a high-pressure hose and nozzle. All water, dirt and foreign material accumulated in this cleaning operation shall be removed from the structure and disposed of by the Contractor.

B. All hydraulic structures and appurtenant piping shall be tested for leaks. All testing operations shall be conducted in the presence of the Engineer.

C. The Contractor shall notify the Engineer at least four (4) days in advance of any planned testing and shall review the testing procedures with the Engineer. The source of water, conveyance of water and disposal of water shall be reviewed.

D. Water for testing will be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use. The Contractor shall be responsible for removing the water from the structure at the conclusion of the testing and locating an acceptable point of discharge approved by the Engineer.

E. If industrial paint finishes or other protective coatings are to be applied to the interior surfaces of the hydraulic structure, such coatings shall be applied after all testing operations have been completed.

F. All evaporation and level measuring devices required shall be provided by the Contractor.

G. All pumps, power, piping, fuel and any other equipment, fittings and accessories required to make all connections necessary to fill the structure with water prior to testing and emptying the structure of water after testing.

H. Contractor shall fill the structure with water to the extreme high operating water surface level or to overflow weir level. The fill level shall be determined by the Engineer.

I. Maintain full for 48 hours before beginning the test period to permit concrete absorption and adjustment of valves, slidegates or temporary bulkheads.

J. At completion of tests remove all temporary piping and connections. Dispose of testing water to a location acceptable to the Engineer.

3.02 TESTING PERIOD AND PROCEDURE

A. Test Period: Five (5) consecutive 24 hour periods totaling 5 days. Contractor shall obtain daily measurements of air and water temperature, rainfall and water level.

B. Test Procedure:

1, After test period, Contractor shall measure water level at each side of the tank to determine leakage and loss from evaporation. Engineer shall observe and verify measurements and evaporation loss.

2. Contractor shall determine evaporation loss, using a standard 48 inch evaporation pan and level measuring device located adjacent to the tank. Engineer shall observe the evaporation loss procedure.

3. Contractor shall mark all running or dripping leaks on exposed surfaces that have not healed autogenously during the test. Contractor shall repair all identified areas to the satisfaction of the Engineer.

4. If leakage from the structure exceeds 0.25% of the storage capacity of the concrete structure, then Contractor shall identify the location of the leaks and repair the leaks. Obtain measurements on a daily basis. If the water loss exceeds the 5 day allowable leakage after a daily reading, then leakage repair shall immediately commence.

5. Complete repair work in accordance with Division 3 - Concrete Specifications. Repairs by painting or surface treatment will not be acceptable.

6. Continue the test and repair leaks iteratively until the structure satisfies both the leakage calculation requirement and the visible leakage requirement.

3.03 CLEAN UP AND POST-TESTING ITEMS

A. Upon completion of all work performed under this Section, remove from the site all excess materials, storage facilities and temporary facilities. Smooth and remove off debris from areas which were used or occupied during concrete construction and leakage testing.

B. Remove all testing water from the concrete structures. After clean-up items are satisfactorily accomplished, backfilling of the concrete structures and coating operations shall be allowed to proceed.

END OF SECTION 02680

SECTION 02726 - MANHOLE AND PRECAST VAULT CONSTRUCTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated on the Plans and specified herein.

B. This section covers the work necessary for the construction of manholes and precast vaults and catch basins. Manholes and vault details are as illustrated on the Plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02730 - Sanitary Sewer and Stormwater Gravity Pipeline System Testing

B. Section 03300 - Cast-in-Place Concrete

C. Section 02200 - Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with the applicable reference specifications as specified in the General Requirements.

B. Comply with the current provisions of the following Codes and Standards.

1. Commercial Standards:

ASTM A 48	Specification for Gray Iron Castings
ASTM C 150	Specification for Portland Cement

2. Standard Specifications:

SSPWC Section 206-3	Gray Iron Casting

1.04 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with the General Requirements.

B. Shop Drawings: The Contractor shall furnish complete shop drawings for all precast manhole sections, vaults, catch basins, cast iron frames and covers, and appurtenances for review by the Engineer in accordance with Submittals of the General Requirements.

1.05 QUALITY ASSURANCE

A. Inspection: After installation, the CONTRACTOR shall demonstrate that all manholes, vaults, and catch basins have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.01 GRANULAR BASE

A. Granular base shall conform to Sections 02200 - Earthwork; and 02221 - Trenching, Backfilling and Compacting.

2.02 CONCRETE

A. Ready-mixed, conforming to ASTM C 94, Alternate B. The concrete class for manhole bases and vault shall be 560-C-3250. The concrete class for manhole and precast vault walls and top shall be 560-C-3250. Maximum size of aggregate shall be 1.5 inches. Slump shall be between 2 and 5 inches. The concrete shall attain 5,000 PSI compressive strength after 28 days.

2.03 FORMS

A. Exterior exposed surfaces shall be plywood. Others shall be matched boards, plywood, or other approved material. Provide forms on all vertical surfaces. Formwork shall comply with Section 03100 - Concrete Formwork. Trench walls, large rock, or native material will not be approved as form material.

2.04 REINFORCING STEEL

A. Conform to ASTM A 615, Grade 40, deformed bars.

2.05 POURED-IN-PLACE MANHOLES

A. Poured-in-place type manholes may be used provided all details of construction are accepted by the Engineer.

2.06 PRECAST MANHOLE SECTIONS

A. Precast manhole sections shall be a minimum of 48 inches in diameter, conforming to any details illustrated on the Plans and to ASTM C 478. Minimum wall thickness shall be 5 inches for reinforced sections and 5 1/2 inches for unreinforced sections. Provide eccentric cones for all manholes. Cones shall have same wall thickness and reinforcement as manhole section. Top and bottom of all sections shall be parallel. Manholes shall be provided without steps. Joints shall be tongue-and-groove with rubber gaskets conforming to ASTM C 443. The Contractor's attention is directed to specification for mortar hereinafter.

B. Prior to the delivery of precast manhole and vault sections to the Site, yard tests shall be conducted at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material which is to be supplied for the job. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 14.

2.07 PRECAST BASE SECTIONS AND BASES

A. At the option of the Contractor, precast base sections or manhole and vault bases may be used provided all details of construction are approved by the Engineer. Base sections shall have the base slab integral with sidewalls. Base slab shall be constructed in accordance with the details illustrated on the Plans or Standard Details of the governing agency. Tie reinforcing steel to wall steel.

2.08 MANHOLE AND VAULT EXTENSIONS

A. Concrete grade rings for extensions shall be a maximum of 11 inches high and shall be approved by the Engineer before installation.

B. In general, manhole and vault extensions will be used on all manholes in roads or streets or in other locations where a subsequent change in existing grade may be likely. Extensions will be limited to a maximum height of 11 inches unless otherwise approved by the Engineer. Finish grade for manhole covers shall conform to finished ground or street surface level, unless otherwise directed by the Engineer. Manhole covers and frames shall be placed 3 inches below the finished pavement surface prior to the installation of A.C. pavement. After A.C. pavement installation is successfully completed the manhole covers and frames shall be placed to the level of the finished pavement surface. A 1-foot wide, 1 foot deep P.C.C. collar shall be placed around the manhole frame and cover 3/8 inches below the level of the finished pavement surface.

2.09 MORTAR

A. Standard premixed mortar conforming to ASTM C 387 or proportion 1 part Portland cement to 2 parts clean, well-graded sand which will pass a 1/8 inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the pipe when using the standard tongue-and-groove type joint. If the Keylock type joint is used, the consistency shall be such that excess mortar shall be forced out of the groove and support is not provided for the next precast manhole section to be placed. Mortar mixed for longer than 30 minutes shall not be used.

2.10 PREFORMED PLASTIC GASKETS

A. Preformed plastic gaskets may be used in lieu of mortar type joints and shall be Kent-Seal No. 2 manufactured by Hamilton Kent Manufacturing Company, Kent, OH; Ram-Nek, manufactured by K.T. Snyder Company, Inc., Houston, TX; or approved equal, meeting all requirements of Federal Specification SS-S-00210.

2.11 PIPE STUBOUTS FOR FUTURE SEWER OR STORMWATER CONNECTIONS

A. Pipe stubouts shall be the same type as approved for use in lateral, main, or trunk pipeline construction. Strength classifications shall be the same class as in adjacent trenches. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Rubber gasketed watertight plugs shall be furnished with each stubout adequately braced against all hydrostatic or air test pressures.

2.12 PRECAST CONCRETE VAULT AND CATCH BASINS

A. The precast concrete vault shall be precast with a 28 day, 5000 psi minimum compressive strength concrete and designed for AASHTO H-20 loading. Minimum dimensions shall be as illustrated on the Plans. Provide openings for pipes and grating as illustrated on the Plans.

2.13 STORMWATER VAULT STEPS

A. Stormwater vault steps shall be made of minimum 3/4-inch galvanized steel bar conforming to ASTM A 36. Steps shall be 12 inch wide minimum, center-to-center of legs, and shall be drop pattern with a 2 inch drop. Bends shall be made around a 1 inch radius minimum, 2 inch radius maximum mandrel. There shall be 3 inch minimum embedment in precast concrete stormwater vault sections and 4-1/2 inch minimum projection from the face of concrete at point of embedment to the center of the step. There shall be a 2 inch hook on the embedment end. Galvanizing shall conform to ASTM A 123 and shall be accomplished after bending.

B. The installed steps shall be located so as to provide a continuous ladder with steps equally spaced vertically in the assembled stormwater vault at 12 inches ± ¾ inch. The steps shall be capable of withstanding a force of 350 pounds, applied at any place on the step and in any direction which projects from the point of application through a diameter of the step cross-section at that point, with no permanent deformation resulting. Steps shall be cast in stormwater vault sections by the manufacturer.

2.14 MANHOLE FRAMES AND COVERS

A. Cast iron or ductile iron of size and shape illustrated on the Plans. Covers shall have the word “SEWER” or “STORMWATER”, as appropriate in 2 inch raised letters. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and all defects, and shall conform to ASTM A 48, Class 30B. Plane or grind bearing surfaces to ensure flat, true surfaces. Covers shall be true and seat within ring at all points. Frames shall have a minimum opening of 24 inches for a 4 foot diameter manhole and 30 inches for 5 foot diameter manholes.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILL

A. Conform to applicable portions of Section 02200 - Earthwork, and Section 02221 - Trenching, Backfilling and Compacting. Backfill around manholes and vaults.

3.02 GRANULAR BASE

A. Remove water from the excavation. Unless specified in the Plans, place a minimum of 18 inches of Class 2 Base or 1 inch rock and thoroughly compact with a mechanical or power vibrating tamper.

3.03 CONCRETE BASE

A. Construct concrete base in conformance with the details illustrated on the Plans. Vibrate to densify the concrete and screed so that the first precast manhole section to be placed has a level, uniform bearing for the full circumference.

B. Deposit sufficient mortar on base to assure watertight seal between base and manhole wall or place the first precast section of manhole in concrete base before concrete has set (preferred). First section shall be properly located and plumbed at 90-degree angles.

C. If material in bottom of trench is unsuitable for the manhole, excavate below the flow line as directed by Engineer, and backfill to required grade with 1 inch rock. Place a filter fabric material in the excavation above the level of the concrete base prior to installing the 1 inch rock.

3.04 PLACING PRECAST MANHOLE SECTIONS

A. Clean ends of sections of foreign materials. Thoroughly wet joint with water prior to placing mortar. Place mortar on groove of lower section. Set next section in place. Fill joint completely with mortar of the proper consistency. Trowel interior and exterior surfaces smooth on standard tongue-and-groove joints. Wipe or otherwise clean the excess mortar from the inside of the Keylock joint.

B. When a Keylock joint is used, it is the intent that the void between the tongue-and-groove be completely filled with mortar, and that the interior and exterior end faces of the section to be placed seat fully on the previously placed section.

C. Prevent mortar from drying out and cure by applying an approved curing compound or comparable approved method. Chip out and replace all cracked or defective mortar. Completed manholes shall be rigid and watertight.

3.05 PREFORMED PLASTIC GASKETS

A. Carefully inspect precast manhole sections to be joined. Sections with chips or cracks in the tongue shall not be used. Preformed plastic gaskets shall be installed in strict conformance with the manufacturer's recommendations. Only pipe primer furnished by the gasket manufacturer will be approved.

3.06 MANHOLE INVERT

A. Construct manhole inverts in conformance with details illustrated on the Plans, and with smooth transitions to ensure an unobstructed flow through the manhole. Remove all sharp edges or rough sections which tend to obstruct flow. Where a full section of pipe is laid through a manhole, break out the top section as indicated and cover exposed edge of pipe completely with mortar. Trowel all mortar surfaces smooth.

3.07 FLEXIBLE JOINTS

A. Provide joints in all pipe not more than 1.5 feet from manhole walls. Lay pipes entering manholes on firmly compacted granular sand backfill or rock to undisturbed native earth. Granular sand backfill or rock shall be as specified hereinbefore.

B. Where the last joint of the installed pipeline up to the manhole is more than 1.5 feet from the manhole base, a 6 inch concrete encasement shall be constructed around the entire pipe from the manhole base to within 1.5 feet of the pipe joint. The pipe encasement shall be constructed monolithically with the manhole base. Pipes installed out of the manhole shall be shortened to ensure the first joint is no more than 1.5 feet from the manhole base.

3.08 PIPE STUBOUTS FOR FUTURE SEWER AND STORMWATER CONNECTIONS

A. Install stubouts in manholes for future sewer and stormwater connections as illustrated on the Plans or as required by the Engineer. Maximum length shall be 1.5 feet outside the manhole wall. Grout pipes in precast walls or manhole base to provide watertight seal around pipes. Construct invert channels in accordance with details shown on the Plans. Provide compacted granular sand or 1 inch rock as specified hereinbefore to undisturbed earth under all stubouts.

B. Install semi-permanent plugs at the end of stubouts with gasket joints similar to sewer and stormwater pipe being used. Plugs shall be capable of withstanding all internal or external pressures without leakage. All plugs to be braced to prevent blowoffs.

3.09 PERMANENT PLUGS

A. Clean interior contact surfaces of all pipes to be cut off or abandoned as illustrated on the Plans. Construct concrete plugs at the end of all pipes 18 inches or less in diameter. Minimum length of concrete plugs shall be 8 inches. For pipe 21 inches and larger, the plugs may be constructed of common brick or concrete block. Plaster the exposed face of block or brick plugs with mortar. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage.

3.10 MANHOLE EXTENSIONS

A. Install extensions in conformance with the details illustrated on the Plans, and to a maximum height of 12 inches unless a larger height is approved by the Engineer. Lay grade rings in mortar with sides plumb and tops level. Seal joints with mortar as specified for manhole sections. Extensions shall be watertight.

3.11 MANHOLE FRAMES AND COVERS

A. Install frames and covers on top of manholes to positively prevent all infiltration of surface or groundwater into manholes. Frames shall be set in a bed of mortar with the mortar carried over the flange of the ring as shown in the Manhole Details on the Plans. Set frames so that tops of covers are flush with surface of adjoining pavement or ground surface, unless otherwise illustrated or directed by the Engineer except within A.C. pavement surfaces. A 1 foot wide, 1 foot deep P.C.C. collar shall be placed around all manhole rings and covers. The concrete ring and manhole frames and covers in A.C. pavement areas shall be placed 3/8 inch lower than the finished A.C. pavement surface. The manhole frame and cover shall be lowered 3 inches below the finished A.C. pavement surface prior to the installation of the A.C. pavement.

3.12 MANHOLES OVER EXISTING SEWERS AND STORMWATER

A. Construct manholes over existing operating sewer and stormwwater lines at locations illustrated on the Plans. Perform necessary excavation work as required to break into the existing sewer and stormwater pipeline and construct the manhole. Comply with previously-noted specifications.

B. Maintain flow through existing sewer and stormwater pipelines at all times, and protect new concrete and mortar work for a period of 7 days after concrete has been placed. Advise Engineer of plans for diverting wastewater flow and obtain Engineer's approval before starting. Engineer's approval will not relieve Contractor of responsibility for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.

C. Construct the new base under the existing sewer and stormwater and the precast sections as specified herein.

D. Break out the existing pipe within the new manhole, cover the edges with mortar, and trowel smooth.

3.13 SPECIAL MANHOLES

A. Construct special manholes in conformance with applicable parts of these Specifications and as illustrated on the Plans.

3.14 PRECAST CONCRETE VAULT

A. Install precast concrete vaults at the locations illustrated on the Plans. Provide necessary excavation and backfill as specified herein and as specified by Section 02200 - Earthwork and Section 02221 - Trenching, Backfilling and Compacting.

3.15 HYDROSTATIC TESTING

A. Hydrostatic testing of manholes and vaults shall be completed in conformance with Section 02730 - Sanitary Sewer and Stormwater Gravity Pipeline System Testing.

3.16 MANHOLES - INTERIOR COATING SYSTEM

The interior of all manholes, including the manhole base surfaces and grade rings shall be coated according to the provisions of this specification:

A. Install a low temperature 100 percent solids acrylated epoxy primer system designed to provide positive cure down to 20°*F* and extremely rapid room temperature cure. The solids acrylated epoxy is to be applied as a primer material to the interior of the manhole surfaces. Apply the polyurethane system over the primer system within the surface interior of the P.C.C. manhole per the manufacturer's recommendations. The interior surface of the P.C.C. manhole shall be primed with a 1- to 3 mil thickness of 100 percent solids acrylated epoxy primer system to the abrasive grit blasted ring and to all concrete surfaces, including into the invert down to the low flow water line. Allow the primer to tack up (sticky to the touch). A 125 mil thickness polyurethane coating system shall be applied to the primer and all interior surfaces of the P.C.C. manhole after the primer has attained the required consistency.

Prior to the application of the 100 percent solids acrylated epoxy primer and polyurethane protective lining, the manhole shall be thoroughly cleaned by high water pressure blast at pressures of 34.5 MPA (5,000 PSI), minimum to 68.9 MPA (10,000 PSI) maximum. Debris from cleaning shall not be allowed to enter the pipeline system. The Contractor shall provide the necessary debris containment devices while maintaining pipeline flow. The Contractor shall remove and dispose of all debris collected from the cleaning operation per 500 1.4 of the *Greenbook* specifications.

The cured polyurethane lining shall be spark tested for pinholes with a spark tester set at 15,000 volts minimum. All pinholes shall be repaired as specified in the *Greenbook* Specification 500 2.4.9.

All pinholes in the protective lining shall be marked off on surface areas containing pinholes to a point 6 inches beyond all pinholes, primed with epoxy, and re-coated with polyurethane to a minimum additional thickness of 30 mils. Blisters, uncured lining and surface imperfections shall be completely removed and the areas re-coated with epoxy primer and polyurethane lining to a point 6 inches beyond the repair areas at a minimum thickness of 100 mils.

The epoxy primer and polyurethane lining shall meet or exceed the requirements specified in *Greenbook* Specification 303-2 and *Greenbook* Table 500 2.4.10(A) as follows:

TABLE 500-2.4.10(A)

	POLYURETHANE	**EPOXY**
Tensile Strength ASTM D 638, Type IV, MPA (PSI)	13.8 (2,000)	41.4 (6,000)
Elongation at Break, % ASTM D 638, Type IV	50	5
Wear Resistance, MG. Wt. Loss Taber Abrasion, S-17	60	100
Hardness, Shore D, Durometer ASTM D 2240	55	75
Tear Resistance, KG/MM (PPI) ASTM D 903	2.7 (150)	N/A
Peel Strength, Concrete, G/MM (PLI) ASTM D 903	125 (7) 1	125 (7) 1
Adhesive Strength, KPA (PSI) ASTM C 190 (Modified Briquet)	2760 (400) 1	2760 (400) 1

Test results shall be verified on a per-job basis or as required by the Engineer.

The coating system shall be a Zebron Number 386 or an approved equal. The coating system shall be applied per the manufacturer's recommendations.

END OF SECTION 02726

SECTION 02730 - SANITARY SEWER AND STORMWATER GRAVITY PIPELINE SYSTEM TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated on the Plans and specified herein.

B. This Section covers the performance of all pipeline flushing and testing, complete, for stormwater and sanitary sewer system piping as specified herein and in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02726 - Manhole and Precast Vault Construction.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with the applicable reference specifications as specified in the General Requirements.

1.04 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with the General Requirements.

B. The Contractor shall submit in writing all proposed plans for testing, and for water conveyance, control and disposal. The Contractor shall also submit written notice four (4) days in advance of the proposed testing schedule for review and concurrence of the Engineer.

1.05 QUALITY ASSURANCE (NOT USED)

PART 2 - PRODUCTS

2.01 GENERAL

A. Temporary valves, plugs, bulkheads, and other air pressure testing and water control equipment and materials shall be provided by the Contractor subject to the Engineer's review. No materials shall be used which will be injurious to pipeline structure and future function. Air test gauges shall be laboratory-calibrated annually test gauges and shall be recalibrated by a certified laboratory at the Contractor's expense prior to the leakage test, only if required by the Engineer.

PART 3 - EXECUTION

3.01 GENERAL

A. Unless otherwise specified, water for testing will be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use. The Contractor shall provide all double backflow reduced pressure principal check valves approved by the State of California

Health Department, hand-operated valves, water meters and all related piping and fittings to be attached to the water source (in most cases a fire hydrant) as required by the Owner.

B. Release of water from pipelines, after testing has been completed, shall be performed as reviewed by the Engineer. The Contractor shall be responsible for the removal and deposition of the water. The Contractor shall be responsible for identifying the point of deposition of the water. The Contractor shall bear all expenses relative to the removal of the water.

C. All testing operations shall be performed in the presence of the Engineer.

3.02 TESTING OF PIPELINE

A. General: All gravity sewer pipes and service laterals and stormwater pipes shall be tested for exfiltration and/or infiltration and deflection, as specified. All manholes shall be tested for leakage, as specified. Manholes shall be tested prior to backfill placement, whereas all pipe shall be backfilled prior to testing. All leakage tests of sanitary sewer and stormwater systems shall be in conformance with SSPWC Section 306-1.4.1. For pressure sewers (force main tests), the force mains shall be tested in accordance with the hydrostatic testing requirements of a potable water pipeline per Section 02666 of this document.

B. Water Exfiltration Test shall be in conformance with SSPWC Section 306-1.4.2.

C. Water Infiltration Test shall be in conformance with SSPWC Section 306-1.4.3. Unless otherwise specified, infiltration will be measured by the Contractor using measuring devices approved by the Engineer.

D. Air Pressure Test shall be accomplished by means of "Low Pressure Air Testing". Tests may be conducted by the Contractor or an independent testing firm. However, acceptance tests shall be made only in the presence of the Engineer.

Test Procedure:

1. Before testing, the pipe shall be thoroughly cleaned.

2. The Contractor shall seal off the section of pipe to be tested at each manhole connection. Test plugs must be securely braced within the manholes.

3. A minimum of two (2) connection hoses to link the air inlet test plug with an above ground test monitoring panel must be provided.

   a) One hose is to induce air through the test plug and into the test chamber.

   b) The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.

4. Under no circumstances are workers to be allowed in the connecting manholes while a pressure test is being conducted.

5. Add air slowly into the test section. After an internal pressure of 4.0 PSI is obtained, allow internal air temperature to stabilize.

6. After stabilization period, adjust the internal air pressure to 3.5 PSI, disconnect the air supply and begin timing the test.

7. Refer to “Air Test Table”, below, to determine the length of time (minutes) the pipeline section being tested must sustain air pressure while no losing in excess of 1 PSI as monitored by the test gauge. If the section of pipeline to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.

8. Sections so determined to have lost 1 PSI or less during the test period will have passed the leakage test. Those sections losing in excess of 1 PSI during the test period will have failed the leakage test.

9. Appropriate repairs must then be completed and the line re-tested for acceptance.

AIR TEST TABLE			
Minimum Test Time for Various Pipe Sizes*			
Nominal Pipe Size, In.	T (Time), Min/100 Ft.	Nominal Pipe Size, In.	T (Time), Min/100 Ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

*The time has been established using the formulas contained in ASTM C 828, Appendix

E. At the Contractor's option, joints may be air tested individually, joint by joint, with the use of specialized equipment. The Contractor shall submit its joint testing procedure for the Engineer's review and approval prior to testing. Prior to each test, the pipe at the joint shall be wetted with water. The maximum test pressure shall be 3.0 PSI. The minimum allowable pressure drop shall be 1.0 PSI over a 30 second test period.

F. Water Pressure Test shall be in conformance with SSPWC Section 306-1.4.5.

G. Deflection Test: All flexible and semi-rigid main line pipe shall be tested in accordance with SSPWC Sections 306-1.2.12 and 306-1.2.13 for deflection, joint displacement, or any other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing. The mandrel shall be a full circle, solid cylinder, or a rigid, non-adjustable, odd-numbered leg (9 leg minimum) steel cylinder, accepted by the Engineer as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside diameter of the pipe and the minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. Obstructions encountered by the mandrel shall be corrected by the Contractor.

3.03 TESTING OF MANHOLES

A. All sewer and stormwater manholes shall be hydrostatically tested for leakage after installation, but prior to being backfilled. Prior to hydrostatic testing, all manholes shall be visually inspected for leaks. All leaks or cracks shall be repaired by the Contractor,

prior to hydrostatic testing, to the satisfaction of the Engineer. All pipes entering the manhole shall be sealed at a point outside the manhole walls so as to include testing of the pipe/manhole joints. The manhole shall be filled with water to a level 2 inches below the top of the frame. Safety lines shall be secured to all plugs utilized. After a period of at least one (1) hour to allow the water level to stabilize and soak into the concrete interior surfaces, the manhole shall be refilled and the water level shall be checked and documented. The water level shall be checked after a period of 4 hours. Leakage in each manhole shall not exceed 0.05 gallon per hour per foot of head above the invert. The Contractor shall be required to make all necessary repairs and retest the manhole in the event the water test fails. The exterior of the manhole shall be inspected during this period for visible evidence of leakage. Visible moisture, sweating, or beads of water on the exterior of the manhole shall not be considered leakage, but any water running across the surface will be considered leakage and shall be repaired to the satisfaction of the Engineer regardless of the volume of water lost.

END OF SECTION 02730

SITE CIVIL TECHNICAL SPECIFICATIONS

DIVISION 3 - CONCRETE

SECTION 03100 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide concrete formwork, bracing, shoring, supports, and false work, in accordance with the Contract Documents.

B. Work included in this Section: Principal items are:

1. Furnishing, erection, and removal of forms.

2. Shoring and bracing of formwork.

3. Setting of embedded items and pipe sleeves for mechanical and electrical work under direction of respective trade.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 03200 - Reinforcement Steel

2. Section 03290 - Joints in Concrete Structures

3. Section 03300 - Cast-in-Place Concrete

4. Section 03315 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1.	PS 1	U.S. Product Standard for Concrete Forms, Class 1
2.	PS 20	American Softwood Lumber Standard
3.	ACI 117	Standard Tolerances for Concrete Construction and Materials
4.	ACI 347	Recommended Practice for Concrete Formwork

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall, in accordance with the requirements in the Specification Section 01300 – Contractor Submittals, submit detailed drawings of the false work proposed to be used. Such drawings shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the false work, means of protecting existing construction which supports false work, and typical soil conditions.

B. The Contractor shall, in accordance with the requirements in the Specification Section 01300 – Contractor Submittals, submit the following:

1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.

2. Form gaskets.

C. The Contractor shall provide concrete construction joints and expansion joints of the types and locations indicated on the Plans. The Contractor shall submit shop drawings showing the proposed location and type of required construction for any joints not shown on the Plans, and the sequence of forming and concrete placing operations.

D. Forms and false work to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 PSF (minimum). The minimum design load for combined dead and live loads shall be 100 PSF.

E. The Contractor shall design formwork prior to fabrication, placing the order, or use on the jobs.

F. The Contractor shall design joints in forms to remain mortar-tight and withstand placing pressures without bulging outward or creating surface patterns.

G. Calculations shall be signed and sealed by a Professional Civil or Structural Engineer registered in the State of California for both the forming system and the stresses induced on the form system.

H. Suitable and effective means shall be provided for holding adjacent edges and end panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets or similar surface defects in the finished concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete.

1.05 QUALITY ASSURANCE

A. The Contractor shall comply with the requirements of California Division of Occupational Health and Safety Construction Safety Orders Section 1717 and OSHA Part 1926, Section 1926.701 that apply to the Work of this Section. The Contractor shall prepare and maintain at least one copy of the required Plans at the site. Design of the structures shown on the Plans does not include any allowance or consideration for imposed construction loads. The Contractor shall provide forms, shoring and false work adequate for imposed live and dead loads, including equipment, height of concrete drop, concrete and foundation pressures, stresses, lateral stability, and other safety factors during construction.

B. Tolerances: The Contractor shall employ formwork complying with ACI 347 Guide to Formwork for Concrete, except as exceeded by the requirements of regulatory agencies, or as otherwise indicated or specified. The Contractor shall design and construct formwork to produce finished concrete conforming to tolerances given in ACI 117.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise expressly accepted by the Engineer, all lumber brought on the Site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

Walls:	Steel or plywood panel
Columns:	Steel, plywood or fiberglass
Roof and Floor:	Plywood
All Other Work:	Steel panels, plywood or tongue and groove lumber

B. Form materials which may remain or leave residues on or in the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.02 FORM AND FALSE WORK MATERIALS

A. Materials for concrete forms, formwork, and false work shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.03 FORM TIES

A. Form ties with integral waterstops shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be Burke Penta-Tie System by The Burke Company; Richmond Snap-Tys by the Richmond Screw Anchor Company; or equal.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when approved by the Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. Use Burke Taper-Tie System by The Burke Company; Taper-Ty by the Richmond Screw Anchor Company; or equal.

2.04 FORM COATING

A. Non-grainrising and nonstaining resin or polymer type that will not leave residual matter on surface of concrete or adversely effect bonding to concrete of paint, plaster, mortar, protective coatings, waterproofing or other applied materials. Coatings containing mineral oils, paraffins, waxes or other nondrying ingredients, are not permitted. For concrete surfaces contacting potable stored water, use only coatings and form-release agents that are completely nontoxic.

2.05 FORM JOINT SEALERS

A. For joints between form panels, use resilient foam rubber strips, non-hardening plastic-type caulking compound free of oil, or waterproof pressure-sensitive plastic tape of minimum 8 mil thickness and 2 inches width. For form tie holes, use rubber plugs, plastic caulking compound, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at no increased cost to the Owner. The Contractor shall provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, false work, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

C. Unless otherwise indicated, exterior corners in concrete members shall be provided with ¾ inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

D. The Contractor shall notify the Engineer at least 48 hours prior to concrete placement so the completed formwork can be inspected.

E. Final inspection will be made only after all formwork, embeds, blowouts, screeds, ties, final adjustments, and related work have been completed by the Contractor.

F. The Contractor shall correct defective work identified by the Engineer, prior to delivery of the concrete.

G. Neither the review of the Contractor's drawings nor inspection of forms by the Engineer shall relieve the Contractor of responsibility for the adequacy of the forms nor from the necessity for remedying all defects which may develop or become apparent with use. The Engineer may at any time condemn any section or sections of the forms found

deficient. The Contractor shall promptly remove the condemned forms from the Work and replace them.

3.02 FORM DESIGN

A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8 inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the Engineer. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the Engineer.

B. Wall Forms:

1. All walls shall be formed by methods acceptable to the Engineer and to the correct elevations and location illustrated on the Plans.

2. Pouring Openings:

a) The minimum pouring opening size shall be 18” x 18”.

b) The bottom of the lower openings shall be no more than 48 inches from the top of the wall-footing.

c) The horizontal centerline distance between such openings shall not exceed 96 inches nor shall the distance between the nearest opening and the bulkhead for the vertical joint exceed 36 inches.

d) The vertical centerline distance between horizontal rows of openings shall not exceed 96 inches.

e) Under no circumstances shall forming be such that the drop of concrete in the forms will exceed 4 feet in any one place.

3.03 CONSTRUCTION

A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties:

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with non-shrink grout as specified for "Finish of Concrete Surfaces" in Section 03315 - Grout. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.

2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

D. Embedded Items:

1. Before the placement of concrete within the forms, each trade having embedded items, including waterstops within the forms and affected by the pour, shall certify that all items are properly located and braced. This certification shall be provided by the Contractor to the Engineer at least 48 hours in advance of placement.

3.04 EMBEDDED PIPING AND ROUGH HARDWARE

A. The Contractor shall consult with all trades which require openings for the passage of pipes, conduits and other inserts, and properly and accurately install the necessary pipe sleeves, anchors, or other required inserts, and properly size the equipment pads. The Contractor shall reinforce openings as indicated and required. The Contractor shall locate conduits or pipes so as not to reduce the strength of the construction, and in no case, place pipes, other than conduits in a slab 4-1/2 inches or less in thickness. The Contractor shall not embed conduit having an outside diameter greater than 1/3 of the thickness of the slab in a concrete slab, nor place conduit below bottom reinforcing steel or over top reinforcing steel. Conduits may be embedded in walls, provided they are not larger in outside diameter than 1/3 the thickness of the wall, are not spaced closer than three diameters on center, and do not impair the strength of the structure. The Contractor shall support embedded pipes and conduits independently from reinforcing steel in a manner to prevent metallic contact, and thereby, prevent electrolytic deterioration. The Contractor shall place embedded pipes and conduits as nearly as possible to the centerline of the concrete section. The Contractor shall submit all conduit, piping and other wall penetrations, reinforcements and anchor bolt sizing and locations for review and approval.

3.05 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be accomplished with care so as to avoid injury to the concrete. No heavy loading on green, insufficiently cured concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms for supported slab, but not shoring, shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28 day strength specified in Section 03300 - Cast-in-Place Concrete; provided, that no forms shall be disturbed or removed under an individual panel or until before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28 day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the Engineer from several test cylinders obtained by the Contractor for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7 day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the Engineer.

B. The Contractor shall not backfill against walls until the top slab is in place and all concrete has obtained compressive strength equal to the specified 28 day compressive strength.

C. Immediately upon removal of the forms, the concrete surfaces shall be thoroughly wetted and shall be kept wet until the curing compound is applied or other curing procedure made effective, in accordance with the specification requirements.

D. The Contractor shall assume the responsibility for damage resulting from improper and premature removal of forms.

3.06 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be filled with non-shrink grout.

3.07 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the Contractor shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.08 FALSE WORK

A. The Contractor shall be responsible for the design, engineering, construction, maintenance, and safety of all false work, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the

provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the California Division of Industrial Safety.

3.09 REMOVAL OF SHORING AND FALSE WORK

A. The Contractor shall not remove shoring and false work until 21 days after concrete placement, or concrete has attained at least 90 percent of the 28 day design compressive strength as demonstrated by control test cylinders, but not sooner than 14 days. If testing is competed to review the 90 percent compressive strength, the Contractor shall incur the cost.

3.10 LOAD RESTRICTION

A. The Contractor shall not impose construction, equipment or permanent loads on columns, supported slabs, or supported beams until concrete has attained the 28 day design compressive strength.

END OF SECTION 03100

SECTION 03200 - REINFORCEMENT STEEL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide concrete reinforcement steel, welded wire fabric, couplers, concrete inserts, wires, clips, supports, chairs, spacers, and other accessories, complete, all in accordance with the Contract Documents.

B. Work Included in this Section: Principal items are:

1. Furnishing and placing bar and mesh reinforcing for cast-in-place concrete.

2. Furnishing reinforcing steel bars for masonry, including delivery to the site.

3. Submittals.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 03100 - Concrete Formwork

2. Section 03300 - Cast-in-Place Concrete

3. Section 03315 - Grout

4. Section 03400 – Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

C. Commercial Standards (Current Edition):

1.	ACI 315	Details and Detailing of Concrete Reinforcement
2.	ACI 318	Building Code Requirements for Structural Concrete
3.	CRSI MSP	Concrete Reinforcing Steel Institute Manual of Standard Practice
4.	CRSI PRB	Concrete Reinforcing Steel Institute Placing Reinforcing Bars
5.	WRI	Manual of Standard Practice for Welded Wire Fabric

6.	AWS D 1.4	Structural Welding Code - Reinforcing Steel
7.	ACI 117	Standard Tolerance for Concrete Construction Materials

D. ASTM Standards in Building Codes (Current Edition):

1. ASTM A 82: Specification for Steel Wire, Plain, for Concrete Reinforcement

2. ASTM A 185: Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement

3. ASTM A 615: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

4. ASTM A 706: Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement

5. ASTM A 775: Specification for Epoxy-Coated Reinforcing Steel Bars

E. National Sanitation Foundation

1. NSF / ANSI 61: Drinking Water System Components – Health Effects

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel before fabrication in accordance with the requirements of the Specification Section 01300 – Contractor Submittals.

B. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross-section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the Contractor shall submit manufacturer's literature including instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

D. If reinforcement steel is spliced by welding at any location, the Contractor shall submit mill test reports which shall include the information necessary for the determination of the carbon equivalent as specified in AWS D 1.4. The Contractor shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; a mere statement that AWS procedures will be followed will not be acceptable.

1.05 QUALITY ASSURANCE

A. If requested by the Engineer, the Contractor shall furnish samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests will

be paid by the Contractor. Costs of additional tests due to material failing initial tests shall also be paid by the Contractor.

B. If reinforcement steel is spliced by welding at any location, the Contractor shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the Work. Such qualifications shall be as specified in AWS D 1.4.

C. If requested by the Engineer, the Contractor shall furnish samples of each type of welded splice used in the Work in a quantity and of dimensions adequate for testing. At the discretion of the Engineer, radiographic testing of direct butt welded splices will be performed. The Contractor shall provide assistance necessary to facilitate testing. The Contractor shall repair any weld which fails to meet the requirements of AWS D 1.4. The costs of testing will be paid by the Contractor. The costs of all tests which fail to meet specified requirements shall also be paid by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIAL REQUIREMENTS

A. Materials which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.02 REINFORCEMENT STEEL

A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement or as otherwise indicated.

2. All welded reinforcement, specifically detailed or otherwise indicated, shall be low-alloy Grade 60 deformed bars conforming to the requirements of ASTM A 706.

3. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either provided in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be provided in flat sheets only.

4. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

5. Tie wire shall be Annealed Steel, 14 gauge minimum.

B. Accessories:

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice, Chapter 3, including special requirements for supporting epoxy-coated reinforcing bars. Wire bar supports shall be CRSI

Class 1 for maximum protection with a 1/8 inch minimum thickness of plastic coating which extends at least ½ inch from the concrete surface. Plastic shall be gray in color.

2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where indicated and where approved by the Engineer. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.

C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross-section of the bar.

2.04 WELDED SPLICES

A. Welded splices shall be provided where indicated and where approved by the Engineer. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.

B. Provided materials shall be capable of conforming to the Weld Splice requirements of AWS D 1.4.

2.05 EPOXY GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall be in conformance with Section 03315 - Grout.

2.06 MANUFACTURERS

A. Couplers/welded splices shall be manufactured by one of the following or equal:

1. Lenton Form Saver by Erico Products

2. Dowel Bar Splicer System by Richmond Screw Anchor Company

2.07 NSF / ANSI STANDARD 61

A. All cementitious material, admixtures, curing compounds, and other industrial produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

PART 3 - EXECUTION

3.01 GENERAL

A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Uniform Building Code and the supplementary requirements indicated herein.

3.02 FABRICATION AND DELIVERY

A. The Contractor shall conform to CRSI MSP, Chapters 6 and 7, except as otherwise indicated or specified. The Contractor shall bundle reinforcement and tag with suitable identification to facilitate sorting and placing, and transport and storage at the site so as not to damage material. The Contractor shall keep a sufficient supply of tested, approved, and proper reinforcement at the site to avoid delays.

B. Bending and Forming: The Contractor shall bend bars of indicated size and accurately form in accordance with the requirements of ACI 315 and ACI 318 to shapes and lengths indicated on the Plans and required by methods not injurious to materials. The Contractor shall not heat reinforcement for bending. Bars with kinks or bends not conforming with approved shop drawings will be rejected.

C. Fabricating Tolerance: All fabrication of reinforcing bars shall meet the requirements of ACI 117.

D. Reinforcing Bars for Masonry: The Contractor shall detail and fabricate bars at the shop, ready for installation by masons.

3.03 PLACING

A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangars which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. Limitations on the use of bar support materials shall be as follows:

1. Concrete Dobies: Permitted at all locations except where architectural finish is required.

2. Wire Bar Supports: Permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.

3. Plastic Bar Supports: Permitted at all locations except on grade.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.

E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the UBC.

F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the approval of the Engineer.

G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on center, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.

H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on center in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be allowed.

I. Epoxy-coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.

J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.04 SPLICES

A. Splicing shall be in accordance with ACI 318, unless otherwise noted on the Plans.

B. Vertical Bars: Except as specifically detailed or otherwise indicated, splicing of vertical bars in concrete is not permitted, except at the indicated or approved horizontal construction joints or as otherwise specifically detailed.

C. Horizontal Bars: Except as specifically detailed or otherwise indicated, splicing of horizontal bars in concrete is not permitted.

D. Mechanical Couplers: Unless otherwise indicated or approved by the Engineer, use of mechanical couplers is not permitted.

E. Welding: Except as specifically detailed or otherwise indicated, welding of reinforcing bars is not permitted.

3.05 ADDITIONAL REINFORCING

A. The Contractor shall provide additional reinforcing bars at sleeves and openings as indicated on the Plans.

3.06 WELDED WIRE MESH

A. The Contractor shall install necessary supports and chairs to hold the wire mesh in place during concrete pours. The Contractor shall straighten mesh to lay in a flat plane and bend mesh as shown or required to fit work. The Contractor shall provide laps of no less than one complete mesh, unless otherwise detailed, and shall tie every other wire at laps. Roll mesh is not acceptable.

3.07 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation:

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.

2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.

3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.

4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.

5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.

6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material will be expelled from the hole during dowel placement.

7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

3.08 CLEANING AND PROTECTION

A. Reinforcing steel delivered to the jobsite shall be suitably stored off the ground and protected from oils, mud, concrete splatter and all conditions conducive to corrosion until embedded in concrete.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, recleaned.

END OF SECTION 03200

SECTION 03320 - UNDERSLAB VAPOR BARRIER

PART 1 -- GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing moisture barrier and sand under concrete slabs-on-grade.

B. Related Sections:

1. Prepare subgrade according to Section 02200 and/or the Soils Report.
2. Concrete is specified in Section 03300.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300 – Contractor Submittals of the Specifications.

B. Product Data: Include independent laboratory test results showing compliance with ASTM and ACI Standards. Include manufacturer's installation instructions for placement, seaming, and pipe boot installation.

1.03 SUBSTITUTIONS

Substitutions will not be allowed unless otherwise specified on the plans or approved during the submittal phase by the Construction Manager.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

Protect products against damage during field handling and installation.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. Stego Wrap Vapor Retarder by Stego Industries

B. Vapor-Block by Raven Industries

C. Architect approved equal

2.02 MATERIALS

A. Vapor Retarder must have the following qualities:

1. 10 mil thickness minimum.
2. Permeance of 0.01 UP perms as tested by ASTM E154.
3. Puncture resistance of 2,600 grams per ASTM D1709, Method B.
4. ASTM E 1745 Class A (Plastics) after conditioning testing.

B. Vapor Retarder Tape:

1. Water Vapor Transmission Rate :ASTM E 96, 0.3 perms or lower
2. Minimum 8-mils thick
3. Minimum 4 inches wide
4. Manufactured from High Density Polyethylene
5. Pressure Sensitive Adhesive

C. Pipe Boots: Construct from vapor barrier sheeting material and pressure sensitive tape in accordance with manufacturer's instructions.

D. Sand: Clean yard sand, free from excessive dirt, debris, organic matter, and fines smaller than No. 200 sieve size.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Below grade and grading work and items penetrating moisture barrier shall be completed prior to start of installation.

B. Examine the areas and conditions under which work of this Section will be performed.

C. Correct conditions detrimental to timely and proper completion of the Work.

D. Do not proceed until unsatisfactory conditions are corrected.

E. Beginning of installation means acceptance of conditions.

3.02 INSTALLATION REQUIREMENTS

A. Vapor Barrier Sheeting:

1. Install in accordance with manufacturer's instructions and ASTM E1643.
2. Unroll with the longest dimension parallel with the direction of the pour.
3. Lap vapor barrier over footings and seal to foundation walls.
4. Overlap joints 6-inches and seal with pressure sensitive tape.
5. Seal penetrations, including pipes, with pipe boot.
6. Penetrations through vapor barrier sheeting except for reinforcing steel and permanent utilities are not permitted.
7. Repair damaged areas by cutting patches of vapor barrier sheeting, overlapping damaged area 6-inches and taping all four sides with pressure sensitive tape.

B. Sand Cushion:

1. Provide 2-inch layer over moisture barrier, unless otherwise indicated.
2. Spread over surfaces required and work to fill voids; leave in stable condition with finished surfaces reasonably uniform at established grade.

*****END OF SECTION*****

SECTION 03290 - JOINTS IN CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide joints in concrete at the locations indicated, complete, in accordance with the Contract Documents.

B. Waterstops shall be provided in all construction and expansion joints of hydraulic or below grade structures unless specifically noted otherwise in the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.

1. Section 03100 - Concrete Formwork

2. Section 03200 - Reinforcement Steel

3. Section 03300 - Cast-in-Place Concrete

4. Section 07900 – Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

C. National Sanitation Foundation

1. NSF / ANSI 61: Drinking Water System Components – Health Effects

D. Federal Specifications (Current Edition):

1. TT-S-0227E(3): Sealing Compound, Elastomeric Type, Multi-Component for Caulking, Sealing, and Glazing Buildings and Other Structures.

2. SS-S-210A: Sealing Compound for Expansion Joints.

E. U.S. Army Corps of Engineers Specifications:

1. CRD-C572: PVC Waterstop.

F. ASTM Standards in Building Codes (Current Edition):

1. ASTM A 775: Specification for Epoxy-Coated Reinforcing Steel Bars

2. ASTM C 920: Specification for Elastomeric Joint Sealants

3. ASTM D 412: Test Methods for Rubber Properties in Tension

4. ASTM D 624: Test Method for Rubber Property - Tear Resistance

5. ASTM D 638: Test Method for Tensile Properties of Plastics

6. ASTM D 746: Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

7. ASTM D 747: Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

8. ASTM A 775: Specification for Epoxy-Coated Reinforcing Steel Bar

9. ASTM D 1056: Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

10. ASTM D 1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

11. ASTM D 2000: Standard Classification System for Rubber Product in Automotive Applications

12. ASTM D 2240: Test Method for Rubber Property - Durometer Hardness

13. ASTM D 2241: Specification for Poly Vinyl Chloride (PVC) Pressure-Related Pipe (SDR-series)

1.04 TYPES OF JOINTS

A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.

B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided unless otherwise indicated on the Plans.

C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours; the joint shall be formed as indicated. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise indicated, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop.

D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will likely occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is filled afterward with a joint sealant material as specified.

1.05 CONTRACTOR SUBMITTALS

A. The Contractor shall submit the following in compliance with Section 01300 – Contractor Submittals:

1. Waterstops: Before production of the required materials, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be provided under this Contract. The balance of the material to be used under this Contract shall not be produced until after the Engineer has reviewed the qualification samples.

2. Joint Sealant: Before ordering the sealant material, the Contractor shall submit sufficient data to show general compliance with the requirements of the Contract Documents.

3. Before the sealant is used on the job, the Contractor shall submit certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements.

4. Shipping Certification: The Contractor shall furnish written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meet or exceed the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

5. Joint Location: The Contractor shall submit placement shop drawings illustrating the location and type of all joints for each structure.

1.06 QUALITY ASSURANCE

A. Waterstop Inspection: All waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without the Contractor having made prior arrangements with the Engineer to provide for the required inspections. Not less than 48 hours' notice shall be given to the Engineer for scheduling such inspections.

B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joins shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the Contractor at no increase in cost to the Owner.

C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

1. Offsets at joints greater than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

3. Any combination of offset or exterior crack which will result in a net reduction in the cross-section of the waterstop in excess of 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

4. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2-inch in 10 feet.

5. Porosity in the welded joint as evidenced by visual inspection.

6. Bubbles or inadequate bonding which can be detected with a penknife test. If, while prodding the entire joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.

D. Waterstop Samples: Before use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the Engineer for review. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be provided under this Contract. Field samples of fabricated fittings will be selected at random by the Engineer for testing by a laboratory at the Contractor's expense. When tested, PVC waterstops shall have a tensile strength across the joints equal to at least 600 PSI.

E. Construction Joint Sealant: The Contractor shall prepare adhesion and cohesion test specimens as indicated, at intervals of 5 working days while sealants are being installed.

F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Sealant specimens shall be prepared between two concrete blocks (1 inch to 2 inches by 3 inches). Spacing between the blocks shall be 1 inch. Coated spacers (2 inches by 1 ½ inch by ½ inch) shall be used to ensure sealant cross-sections of ½ inch by 2 inches with a width of 1 inch.

2. Sealant shall be cast and cured according to manufacturer's recommendations except that the curing period shall be not less than 24 hours.

3. Following curing period, the gap between blocks shall be widened to 1-1/2 inch. Spacers shall be used to maintain this gap for 24 hours before inspection for failure.

1.07 WARRANTY

A. The Contractor shall furnish a 5 year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, along with a statement that it agrees to repair or replace, to the satisfaction of the Owner and at no additional cost to the Owner, any defects that appear during the warranty period.

PART 2 - PRODUCTS

2.01 GENERAL

A. All joint materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use.

2.02 PVC WATERSTOPS

A. General: Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The Contractor shall obtain from the waterstop manufacturer and submit to the Engineer current test reports and a written certification that the material to be shipped meets the

physical requirements outlined in the U.S. Army Corps of Engineers Specification CRD-C572 and those listed herein.

B. Flatstrip and Center-Bulb Waterstops: At no place shall the thickness of flatstrip waterstops, including the center-bulb type, be less than 3/8 inch. Flatstrip and center-bulb waterstops shall be manufactured by Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal.

C. Multi-Rib Waterstops: Multi-rib waterstops, where required, shall be manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.

D. Other Types of Waterstops: When other types of waterstops not listed above are required and indicated, they shall be subjected to the same requirements as those listed herein.

E. Waterstop Testing Requirements: When tested in accordance with the standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Std.
Tensile Strength-min (PSI)	1,750	D 638, Type IV
Ultimate Elongation-min (%)	350	D 638, Type IV
Low Temp Brittleness-max (degrees *F*)	-35	D 746
Stiffness in Flexure-min (PSI)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (PSI)	1,500	D 638, Type IV
Ultimate Elongation-min (%)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (%)	+0.25/-0.10	-----
Change in Durometer, Shore A	+5	D 2240
Finish Waterstop		
Tensile Strength-min (PSI)	1,400	D 638, Type IV
Ultimate Elongation-min (%)	280	D 638, Type IV

2.03 JOINT SEALANT

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73°*F* and 50% relative humidity):

Work Life	45 - 180 minutes

Time to Reach 20 Shore "A" Hardness (at 77°*F*, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	200 PSI, minimum
Ultimate Elongation (ASTM D 412)	400%, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray

C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be two-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for two-part material, as applicable.

2. For vertical joints and overhead horizontal joints, only "nonsag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.

3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing nontracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.

4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.

D. All sealants, wherever shown, or required hereunder shall be PSI-270 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation, or equal.

E. Sealants for nonwaterstop joints in concrete shall conform to the requirements of Section 07900 – Sealants and Caulking.

2.04 JOINTS MATERIALS

A. Bearing Pad: Bearing pad to be neoprene conforming to ASTM D 2000 BC 420, 40 durometer hardness unless otherwise indicated.

B. Neoprene Sponge: Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D 1056, Type 2C3-E1.

C. Joint Filler:

1. Joint filler for expansion joints in water holding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.

2. Joint filler material in other locations shall be of the preformed nonextruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.

2.05 BACKING ROD

A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant used and shall have a tensile strength of not less than 40 PSI and a compression deflection of approximately 25% at 8 PSI. The rod shall be 1/8 inch larger in diameter than the joint width except that a 1 inch diameter rod shall be used for a ¾ inch wide joint.

2.06 BOND BREAKER

A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Select Cure CRB as manufactured by Select Products Co., Upland, California, or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.07 SLIP DOWELS

A. Slip dowels in joints shall be A 36 smooth epoxy-coated bars, as indicated on the Plans, and conforming to ASTM A 775.

2.08 PVC TUBING

A. PVC tubing in joints shall be Schedule SDR 13.5, conforming to ASTM D 2241.

2.09 NSF / ANSI STANDARD 61

A. All cementitious material, admixtures, curing compounds, and other industrial produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

PART 3 - EXECUTION

3.01 GENERAL

A. Waterstops of the type indicated shall be embedded in the concrete across joints as indicated. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.

B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct

rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 SPLICES IN WATERSTOPS

A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:

1. The material not be damaged by heat sealing.

2. The splices have a tensile strength of not less than 60% of the unspliced material's tensile strength.

3. The continuity of the waterstop ribs and of its tubular center axis be maintained.

B. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.

C. All joints with waterstops involving more than two ends to be joined together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated before placement in the forms, allowing not less than 24 inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24 inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

D. Where a centerbulb waterstop intersects and is joined with a noncenterbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.03 JOINT CONSTRUCTION

A. Setting Waterstops: To eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions shall be made to support and anchor the waterstops during the progress of the Work and to ensure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working it in the vicinity of all joints.

B. In placing flat-strip waterstops in the forms, a means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise indicated, all waterstops shall be held in place with light wire ties on 12 inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

E. Joint Location: Construction joints, and other types of joints, shall be provided where indicated. When not indicated, construction joints shall be provided at 25 foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints, of any type, shall be submitted for acceptance by the Engineer.

F. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.

G. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.

H. The space so formed shall be filled with a joint sealant material as specified. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel, unless otherwise indicated on Plans.

I. Construction Joint Sealant: Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with grooves, which shall be filled with a construction joint sealant. The material used for forming the grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sandblasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant filler shall be thoroughly cleaned, as outlined for the grooves, before application of the sealant.

J. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant before application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.

K. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before Work is commenced, the crew performing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.

L. Thorough, uniform mixing of two-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, arrange to have the crew performing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.

M. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured

or partially cured sealant and primer, and shall be resealed with the indicated joint sealant. All costs of such removal, joint treatment, resealing and appurtenant work shall be at no additional cost to the Owner.

END OF SECTION 03290

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide finished structural concrete, complete, in accordance with the Contract Documents.

B. The following types of concrete are covered in this Section:

1. STRUCTURAL CONCRETE: Normal weight (145 PCF) concrete to be used in all cases except where noted otherwise in the Contract Documents.

2. LEAN CONCRETE: Concrete to be used for thrust blocks, anchor blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the Plans as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.

C. The term "hydraulic structure" used in these Specifications refers to environmental engineering concrete structures for the containment, treatment, or transmission of water, or other fluids.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 03100 - Concrete Formwork

2. Section 03200 - Reinforcement Steel

3. Section 03290 - Joints in Concrete Structures

4. Section 03315 – Grout

5. Section 07110 – Membrane Waterproofing

6. Section 09800 – Protective Coatings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Buildings Officials (ICBO).

C. National Sanitation Foundation

1. NSF / ANSI 61: Drinking Water System Components – Health Effects

D. Federal Specifications:

1. UU-B-790A(1)(2): Building Paper, Vegetable Fiber (Kraft, Water-Proofed, Water Repellant and Fire Resistant)

E. Commercial Standards:

1. ACI 117: Standard Tolerances for Concrete Construction and Materials

2. ACI 214: Recommended Practice for Evaluation of Strength Test Results of Concrete

3. ACI 301: Specifications for Structural Concrete for Buildings

4. ACI 309: Consolidation of Concrete

5. ACI 315: Details and Detailing of Concrete Reinforcement

6. ACI 318: Building Codes Requirements for Reinforced Concrete

7. ACI 350R: Environmental Engineering Concrete Structures

F. ASTM Standards in Building Codes:

1. ASTM C 31: Practice for Making and Curing Concrete Test Specimens in the Field

2. ASTM C 33: Specification for Concrete Aggregates

3. ASTM C 39: Test Method for Compressive Strength of Cylindrical Concrete Specimens

4. ASTM C 40: Test Method for Organic Impurities in Fine Aggregates for Concrete

5. ASTM C 42: Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

6. ASTM C 88: Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

7. ASTM C 94: Specification for Ready-Mixed Concrete

8. ASTM C 136: Test Method for Sieve Analysis of Fine and Coarse Aggregates

9. ASTM C 138: Test Method for Unit Weight, Yield, and Air Content of Concrete

10. ASTM C 143: Test Method for Slump of Hydraulic Cement Concrete

11. ASTM C 150: Specification for Portland Cement

12. ASTM C 156: Test Method for Water Retention by Concrete Curing Materials

13. ASTM C 157: Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete

14. ASTM C 192: Practice for Making and Curing Concrete Test Specimens in the Laboratory

15. ASTM C 231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

16. ASTM C 260: Specification for Air-Entraining Admixtures for Concrete

17. ASTM C 289: Test Method for Potential Reactivity of Aggregates (Chemical Method)

18 ASTM C 309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete

19. ASTM C 494: Specification for Chemical Admixtures for Concrete

20. ASTM C 107: Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

21. ASTM D 1751: Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)

22. ASTM D 2419: Test Method for Sand Equivalent Value of Soils and Fine Aggregate

23. ASTM E 119: Method for Fire Tests of Building Construction and Materials

1.04 CONTRACTOR SUBMITTALS

A. Mix Designs: Before starting the Work and within 14 days of the Notice to Proceed, the Contractor shall submit to the Engineer, for review, preliminary concrete mix designs which shall illustrate the proportions and gradations of all materials proposed for each class and type of concrete specified herein in accordance with Specification Section 01300 – Contractor Submittals. The mix designs shall be checked and certified to conform to these Specifications by an independent testing laboratory acceptable to the Engineer to be in conformance with these Specifications. All costs related to such checking and testing shall be borne by the Contractor at no cost to the Owner.

B. Delivery Tickets: Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount of water allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.

C. The Contractor shall provide the following submittals in accordance with ACI 301:

1. Mill tests for cement.

2. Admixture certification. Chloride ion content must be included.

3. Aggregate gradation and certification.

4. Materials and methods for curing.

D. The Contractor shall provide catalog cuts and other manufacturer's technical data demonstrating compliance with the requirements indicated and specified herein for all admixtures used in the concrete mix design.

1.05 QUALITY ASSURANCE

A. GENERAL

1. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.

2. The cost of all laboratory tests requested by the Engineer for cement, aggregates, and concrete, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C 1077.

3. Concrete for testing shall be supplied by the Contractor at no cost to the Owner and the Contractor shall provide assistance to the independent testing laboratory acceptable to the Engineer in obtaining samples, and disposal and clean up of excess material.

4. A minimum of one (1) set of concrete cylinders and a slump test shall be obtained for every major concrete placement. A minimum of one (1) set of concrete cylinders shall be obtained for all concrete structures, foundations and slabs. One (1) set of cylinders shall be obtained for every forty (40) yards of concrete placed for a particular pour. For instance, if the walls of a structure require eighty (80) yards of concrete; then two (2) sets of concrete cylinders shall be required. If concrete cylinders for compression testing and a slump test are not required, then the delivery tickets accompanying the concrete vendor's truck shall be forwarded to the Construction Manager. A specific listing of concrete tests required for this project follows:

ITEM NO.	ITEM	TESTING REQUIRED
1.	Sidewalk sections along Railroad Avenue, including P.C.C. curb and gutter.	One (1) set of concrete cylinders and slump test.
2.	Driveway Entrances along Railroad Avenue and Concrete Area in front of Trash Enclosure	One (1) set of concrete cylinders and slump test.
3.	Parking Lot P.C.C. ribbon gutter and on-site Sidewalks	One (1) set* of concrete cylinders and slump test.
4.	On Site P.C.C. Curb and Gutter and Free Standing Curb	One (1) set*of concrete cylinders and slump test.

5.	P.C.C. masonry wall footings.	Two (2) sets of concrete cylinders and slump test.
6.	New Building Slab, footings and bond beam.	A minimum of one (1) set of concrete cylinders and slump test required for each day concrete is installed. In addition, one (1) set of cylinders and one (1) slump test shall be obtained for each 50 yards of concrete placed for an individual concrete pour.

B. Field Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. Each set of test specimens will consist of four (4) cylinders.

2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31. Specimens shall be 6-inch diameter by 12-inch high cylinders.

3. Compression tests shall be performed in accordance with ASTM C 39. One (1) test cylinder will be tested at 7 days and two (2) at 28 days. The remaining cylinder will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5, “Concrete Quality”, and as specified herein.

2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 PSI, when ordered at equivalent water content as estimated by slump.

3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.

4. When the standard deviation of the test results exceeds 640 PSI, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 PSI below or the average of any three (3) consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard deviation.

5. All concrete which fails to meet the ACI requirements and these Specifications is subject to removal and replacement at no cost to the Owner.

D. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise illustrated:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: ¼ inch In 20 feet or more: ½ inch
Variation from the level or from the grades shown.	In 10 feet: ¼ inch In 20 feet or more: ½ inch
Variation from the plumb.	In 10 feet: ¼ inch In 20 feet or more: ½ inch
Variation in the thickness of slabs and walls.	Minus ¼ inch; Plus ½ inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus ¼ inch

E. Floor Slab Surface Hardener:

1. Job Mockup: In a location designated by the Engineer, place a minimum 100 square feet floor mockup using materials and procedures proposed for use in the Project. Revise materials and procedures as necessary to obtain acceptable finish surface. Maintain the same controls and procedures used in the acceptable mockup throughout the Project.

2. Field Service: During job mockup and initial period of installation, the manufacturer of the surface hardener shall furnish the service of a trained, full-time representative to advise on proper use of the product. Notify surface hardener manufacturer at least three (3) days before initial use of the product.

3. Installer Qualifications: Installer shall have a minimum of three (3) years experience and shall be specialized in the application of dry shake surface hardeners.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. General:

1. All materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use within 30 days of application.

2. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one (1) brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.

B. All materials furnished for the Work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.

C. Storage of materials shall conform to the requirements of Section 2.5 of ACI 301 or the SSPWC.

D. Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand Portland Cement conforming to ASTM C 150 for Type V. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the Work, and before its use, the brand shall be acceptable to the Engineer. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these Specifications.

2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section, only if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids concentration (over 1,000 mg/l) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the Engineer, shall be nonreactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified herein. Lightweight sand for fine aggregate will not be permitted.

a) Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than ¾ inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the Paragraph in Part 2 entitled “Trial Batch and Laboratory Tests” for the use of the size groups.

b) Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D 2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.

c) Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.

d) When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

e) When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

f) When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.

g) When tested in accordance with ASTM C 33, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.

4. Ready-mix concrete shall conform to the requirements of ASTM C 94.

5. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be nontoxic after 30 days.

a) Set controlling and water reducing admixtures: Admixtures may be added at the Contractor's option to control the set, affect water reduction, and increase workability. The addition of an admixture shall be at no increase in cost to the Owner. The use of an admixture shall be subject to acceptance by the Engineer. Concrete containing an admixture shall be first placed at a location determined by the Engineer. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

1) Concrete shall not contain more than one water-reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the Engineer.

2) Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80°*F*, a set retarding admixture such as Plastocrete by Sika Corporation; Pozzolith 300R by Master Builders; Daratard by W. R. Grace; or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40°*F*, a noncorrosive set accelerating admixture such as Plastocrete 161FL by Sika Corporation; Pozzutec 20 by Master Builders; Daraset by W. R. Grace; or equal shall be used.

3) Normal range water reducer shall conform to ASTM C 494, Type A, WRDA 79 by W. R. Grace; Pozzolith 322-N by Master Builders; Plastocrete 161 by Sika Corporation; or equal. The quality of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.

4) High range water reducer shall conform to ASTM C 494, Type F or G. Daracem 100 or WDRA 19 by W. R. Grace; Sikament FF or Sikament 86 by Sika Corporation; Rheobuild 1000 or Rheobuild 716 by Master Builders; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.

5) If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches + ½ inch before adding the high range water reducing admixture at the job site. The high range water-reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested before each day's operation of the job site system.

6) Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

7) Flyash: Flyash shall not be used.

2.02 CURING MATERIALS

A. Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C 309:

1. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Spartan Cote Cure-Seal Hardener by the Burke Company; Super Rez Seal by Euclid Chemical Company; MB-429 as manufactured by Master Builders; or equal. Water-based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent-based compound. Water-based curing compounds shall be Aqua Resincure by the Burke Company; Aqua-Cure by Euclid Chemical Company; Masterkure-W by Master Builders; or equal.

2. Polyethylene sheet for use as a concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.

3. Polyethylene-coated water proof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently

bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A(1)(2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.

4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.

5. Curing mats for use in Curing Method 6 as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

6. Evaporation retardant shall be a material such as Confilm as manufactured by Master Builders; Eucobar as manufactured by Euclid Chemical Company; or equal.

2.03 NONWATERSTOP JOINT MATERIALS

A. Materials for nonwaterstop joints in concrete shall conform to the following requirements:

1. Preformed joint filler shall be a nonextruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.

2. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the Engineer.

2.04 MISCELLANEOUS MATERIALS

A. Damp-proofing agent shall be an asphalt emulsion, such as Hydrocide 600 by Sonneborn; Damp-proofing Asphalt Coating by Euclid Chemical Company; Sealmastic by W. R. Meadows Inc., or equal.

B. Bonding agents shall be epoxy adhesives conforming to the following products for the applications specified:

1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concresive Liquid (LPL), as manufactured by Master Builders; BurkEpoxy MV as manufactured by The Burke Company; or equal.

2. For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel as manufactured by Sika Corporation; BurkEpoxy NS as manufactured by The Burke Company; Concresive Paste (LPL) as manufactured by Master Builders; or equal

2.05 CONCRETE DESIGN REQUIREMENTS

A. Mix Design:

1. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. In mix designs, the percentage of sand of the total weight of fine and coarse aggregate shall not exceed 41 for hydraulic structures or 50 for all other structures, unless noted otherwise. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be subject to review by the Engineer.

2. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following table:

Type of Work	Min. 28-Day Compressive Strength (PSI)	Max Size Aggregate (in)	Minimum Cement Per CU YD (lb)	Max W/C Ratio (by weight)
Structural Concrete:				
Normal weight reinforced concrete (145 pcf)	5,000	3/4	658	0.45
Lean Concrete	4,500	3/4	611	0.45

NOTE: The Contractor is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water-reducing agent may be required to achieve workability demanded by the Contractor's construction methods and aggregates. The Contractor is responsible for any costs associated with furnishing concrete with the required workability.

3. Adjustments to Mix Design: The mixes used shall be changed whenever such chance is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

B. Consistency:

1. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary,

with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (in)
All concrete, unless noted otherwise	4 inches + 1/2-inch
With high range water reducer added	5 inches + 1/2-inch

C. Trial Batch and Laboratory Tests:

1. Before placing any concrete, a testing laboratory approved by the Engineer will prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the Contractor. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch will be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and six compression test specimens from each batch. The cost of not more than three laboratory trial batch tests for each specified concrete strength will be borne by the Contractor. The Contractor shall furnish and deliver the materials in steel drums to the approved testing laboratory. Any additional trial batch testing required shall be performed by the testing laboratory at no additional cost to the Owner.

2. The determination of compressive strength will be made by testing 6-inch diameter by 12 inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.

3. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.

4. In lieu of trial batch and laboratory tests specified in this Section, the Contractor may submit previously-designed, tested, and successfully-used concrete mixes, using materials similar to those intended for this project, together with a minimum of three certified test reports of the 28 day strength of the proposed concrete mix.

D. Shrinkage Limitation:

1. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21 day drying age or at 28 day drying age shall be 0.036 percent or 0.042 percent, respectively. Use a mix design for construction

that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.

2. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Owner for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints, modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

E. Measurement of Cement and Aggregate:

1. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment acceptable to the Engineer.

2. Weighing Tolerances:

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

F. Measurement of Water:

1. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the Engineer and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

2.06 READY-MIXED CONCRETE

A. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.

B. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within one and one-half hour (90 minutes) after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.

C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the

equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the one-quarter (1/4) and three-quarter (3/4) points of the load during discharge give slumps differing by more than one inch (1") when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the Work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the Engineer in accordance with Subsection 03300-1.04B.

G. The use of nonagitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

2.07 FLOOR HARDENER (SURFACE APPLIED)

A. Surface hardener shall be a light reflective nonoxidizing metallic aggregate dry shake surface hardener.

1. Surface hardener shall be premeasured, premixed and packaged at the factory.

2. Apply surface hardener at the rate of 1.8 to 2.5 lb per square foot.

3. Surface hardener shall be Alumiplate@, by Master Builders, Inc., or equal.

B. Curing Compound shall meet the moisture retention requirements of ASTM C 309 and surface hardener manufacturer's recommendations.

C. Monomolecular Film: Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by surface hardener manufacturer.

2.08 NSF / ANSI STANDARD 61

A. All cementitious material, admixtures, curing compounds, and other industrial produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

PART 3 - EXECUTION

3.01 PROPORTIONING AND MIXING

A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3, "Proportioning" of ACI 301.

B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.

C. Slump: Maximum slumps shall be as specified herein.

D. Retempering: Retempering of concrete or mortar which has partially hardened shall not be permitted.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. General: Earth surfaces shall be thoroughly wetted by sprinkling, before the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the Engineer, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. The joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum of ¼ inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints, and the joint surface shall be coated with an epoxy-bonding agent, unless indicated otherwise, before the new concrete is placed.

C. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent Work; provided that construction joints shall be made only where acceptable to the Engineer.

D. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

E. All inserts or other embedded items shall conform to the requirements herein.

F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where illustrated on the Plans or by approved shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.

G. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the Engineer.

H. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Engineer.

I. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported before placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

J. Openings for pipes, inserts for pipe hangars and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.

K. Anchor bolts shall be accurately set, and shall be maintained in position by templates while embedded in concrete.

L. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.03 HANDLING, TRANSPORTING AND PLACING

A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.

B. Nonconforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no additional expense to the Owner.

C. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the Engineer. The Contractor shall notify the Engineer in writing at least 48 hours in advance of placement of any concrete.

D. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

E. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.

F. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slap to the top, for the full width of the placement. As the Work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

G. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90°*F* nor less than 55°*F* for sections less than 12 inches thick nor less than 50°*F* for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When the temperature of the concrete is 85°*F* or above, the time between the introduction of the cement to the aggregates and discharge at the Siteshall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90°*F*, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90°*F*. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

H. Cold Weather Placement:

1. Placement of concrete shall conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.

2. Remove all snow, ice and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above 32°*F* before concrete placement.

3. Maintain the concrete temperature above 50°*F* for at least 3 days after placement.

I. Hot Weather Placement:

1. Placement of concrete shall conform to ACI 305R - Hot Weather Concreting, and the following.

2. Only set retarding admixture shall be used in concrete when air temperature is expected to be consistently over 80°*F*.

3. The maximum temperature of concrete shall not exceed 90°*F* immediately before placement.

4. From the initial placement to the curing state, concrete shall be protected from the adverse effect of high temperature, low humidity, and wind.

3.04 PUMPING OF CONCRETE

A. General: If the pumped concrete does not produce satisfactory end results, discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment: The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall maintain a standby pump on the site during pumping.

C. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.

D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.

E. Aluminum conduits for conveying the concrete shall not be permitted.

F. Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.05 ORDER OF PLACING CONCRETE

A. The order of placing concrete in all parts of the Work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints. The placing of units shall be accomplished by placing alternate units in a manner such that each unit placed shall have cured at least 7 days for hydraulic structures and 3 days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two (2) adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for all other structures.

B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least ¾ inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about ½ inch above the underside of the strip. About one (1) hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.06 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309) high speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the Engineer.

B. Care shall be exercised in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional

vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.

C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 FINISHING CONCRETE SURFACES

A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Part 1, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Formed Surfaces: No treatment is required after form removal except for curing, repair or defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as specified or as shown.

1. Surface holes larger than ½ inch in diameter or deeper than ¼ inch are defined as surface defects in basins and exposed walls.

C. Unformed Surfaces: After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:

1. FINISH U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

2. FINISH U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Engineer.

3. FINISH U3 - After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.

4. FINISH U4 - Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.

D. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs which are water bearing with slopes 10 percent and less	U4
Sloping slabs which are water bearing with slopes greater than 10 percent	U4
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Top surface of walls	U4

E. Floor Hardener (Surface Applied) - Required

1. Provide concrete with the following additional requirements:

   a) Maximum slump of 4 inches when peak ambient temperatures are expected to be more than 65°*F*, and no more than 3 inches when ambient temperatures are below 65°*F*.

   b) Maximum air content of 3 percent.

   c) Do not use calcium chloride or set-accelerating admixtures containing calcium chloride.

   d) Do not use admixtures that increase bleeding.

   e) Do not use fly ash.

2. After the concrete has been leveled and as soon as the concrete will support an operator and machine without disturbing the level or working up excessive fines, float the surface of the slab with a mechanical float fitted with float shoes. Following floating, apply 1/2 to 2/3 of the total amount of dry shake surface hardener so that a uniform distribution of surface hardener is obtained. The use of a mechanical spreader is recommended. Once the shake has absorbed sufficient moisture (indicated by the darkening of the shake), float the surface. Immediately apply the remaining 1/3 to 1/2 of the shake and allow to absorb

moisture. Do not place dry shake on concrete surface when bleed water is present.

3. Use finishing machines with detachable float shoes. Compact surface by a third mechanical floating if time and setting characteristics of the concrete will allow. Do not add water to the surface.

4. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel with blades set relatively flat. Remove all marks and pinholes in the final raised trowel operation.

5. Follow all application instructions of the floor surface hardener manufacturer.

6. Cure finished floors using fill-forming curing compound recommended by surface hardener manufacturer. Uniformly apply curing compound over the entire surface at a coverage that will provide moisture retention in excess of the requirements of ASTM C 309. Maintain ambient temperature of 50°*F* or above during the curing period.

7. Keep floors covered and free of traffic and loads for a minimum of 14 days after completion.

3.08 ARCHITECTURAL FINISH

A. General: Architectural finishes shall be required only where specifically called out on the Plans. In all other cases, the paragraph above, entitled "Finishing Concrete Surfaces", shall apply.

1. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and all form-tie holes filled as indicated herein.

2. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.

3. All architecturally treated concrete surfaces shall conform to the accepted sample required herein in texture, color, and quality. It shall be the Contractor's responsibility to maintain and protect the concrete finish.

B. Smooth Concrete Finish:

1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be prepared by mixing one (1) part Portland Cement and one (1) part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 1/2 gray and 1/2 white Portland Cement, as determined by the Engineer. White Portland Cement shall be Atlas White or equal. Calcium chloride in the amount of 5 percent by volume of the cement shall be used in the brush coat. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all surface grout had been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.

2. Cleaning operations for any given day shall be terminated at panel joints. It is essential that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a point or grout film.

3. In the event that improper manipulation results in an inferior finish, rub such inferior areas with carborundum bricks.

4. Before beginning any of the final treatment on exposed surfaces, treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the Engineer and preserve said trial area undisturbed until the completion of the job.

C. Sandblasted Concrete Finish:

1. Sandblasting shall be done in a safe manner acceptable to local authorities and per OSHA requirements. The sandblasting shall be a light sandblast to remove laitance and to produce a uniform fine aggregate surface texture with approximately 1/32 to 1/16 inch of surface sandblasted off. Corners, patches, form panel joints, and soft spots shall be sandblasted with care.

2. A 3 square foot sample panel of the sandblasted finish shall be provided by the Contractor for acceptance by the Engineer before staring the sandblasting Work. The sample panel shall include a corner, plugs, and joints and shall be marked after approval. All other sandblasting shall be equal in finish to the sample panel.

3. Protection against sandblasting shall be provided on all surfaces and materials not requiring sandblasting but within or adjacent to areas being sandblasted. After sandblasting, the concrete surfaces shall be washed with clean water and excess sand removed.

3.09 CURING AND DAMP-PROOFING

A. General: All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the Work, and described in detail in the following paragraphs:

Surface To Be Cured or Damp-proofed	Method
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	6
Floor slabs on grade	6
Slabs not on grade	6

B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 6, herein.

C. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.

E. Method 4: The surface shall be sprayed with a liquid curing compound.

1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.

2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the new application of additional curing compound over the damaged portion.

3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just before the placing of new concrete.

4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2 hour period; provided, however, that any such repairs which cannot be made within the said 2 hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

5. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the previously coated panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.

6. Before final acceptance of the Work, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage surface finish.

F. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of

curing compound in accordance with Method 4, herein. Not less than 1 hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2 inch wide strips of sealing tape or with edges lapped not less than 3 inches and fastened together with a waterproof cement to form a continuous watertight joint.

2. The curing blankets shall be left in place during the 14 day curing period and shall not be removed until after concrete for adjacent Work has been placed. Should the curing blankets become torn or otherwise ineffective, replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8 inch minimum thickness, laid over the curing blanket. Add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6: This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days, beginning immediately after the concrete has reached final set or forms have been removed or until the concrete surface is covered with the curing medium. The entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.

2. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes and to be substantially in contact with the concrete surface. All edges shall be continuously held in place.

3. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours. The concrete shall be maintained in a cool condition from the heat of hydration and the solar heat of the sun.

4. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4, herein.

5. Dispose of excess water from the curing operation to avoid damage to the Work.

H. Damp-proofing: The exterior surface of all buried roof slabs shall be damp-proofed as follows:

1. Immediately after completion of curing the surface shall be sprayed with a damp-proofing agent consisting of an asphalt emulsion. Application shall be in two (2) coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an

application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Damp-proofing material shall be as specified herein.

2. As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, apply additional whitewash.

3.10 PROTECTION

A. Protect all concrete against injury until final acceptance by the Owner.

B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.11 CURING IN COLD WEATHER

A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40°*F*; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.

B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50°*F* for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50°*F*. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50°*F*.

C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40°*F* in 24 hours. In the spring, when the mean daily temperature rises above 40°*F* for more than 3 successive days, the specified 72 hour protection at a temperature not lower than 50°*F* may be discontinued for as long as the mean daily temperature remains above 40°*F;* provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects

shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.

B. Defective surfaces to be repaired shall be cut back from trueline in a minimum depth of ½ inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of 1 sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas White Portland Cement as is required to make the color of the patch match the color of the surrounding concrete.

C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

E. Before filling any structure with water, all cracks that may have developed shall be "vee'd" and filled with construction joint sealant for water-bearing structures conforming to the materials and methods specified in Section 03290 - Joints in Concrete Structures. This repair method shall be accomplished on the water bearing face of members. Before backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.

2. Small holes in members which are water-bearing or in contact with soil or other fill materials, shall be filled with nonshrink grout. Where a face of the member is exposed to view, the nonshrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the paragraph in Part 3 entitled - Treatment of Surface Defects.

3. Small holes through all other concrete members shall be filled with nonshrink grout, with exposed faces treated as above.

B. Patching Large Holes:

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified.

2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless required otherwise by the Improvement Plans or approved shop drawings.

3. Large holes in members which are water bearing or in contact with soil or other fill, shall have a bentonite type waterstop material placed around the perimeter of the hole as specified in the Section 03290 - Joints in Concrete Structures, unless there is an existing waterstop in place.

3.14 CARE AND REPAIR OF CONCRETE

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time before the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

END OF SECTION 03300

SECTION 03315 - GROUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide grout in accordance with the Contract Documents.

B. The following types of grout shall be covered in this Section:

1. Cement Grout

2. Packaged Grout

A. Nonshrink Grout: This type of grout is to be used wherever grout is illustrated in the Contract Documents unless another type is specifically referenced.

B. Epoxy Grout

C. Pump and Motor Grout

3. Topping Grout and Concrete Fill

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

1. CRD-C 621 Corps of Engineers Specification for Non-Shrink Grout

B. National Sanitation Foundation

1. NSF / ANSI 61: Drinking Water System Components – Health Effects

C. ASTM Standard in Building Codes:

1. ASTM C 109: Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)

2. ASTM C 531: Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings

3. ASTM C 579: Test Methods for Compressive Strength of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings

4. ASTM C 827: Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixture

5. ASTM C 881: Specification for Epoxy-Resin-Base Bonding System for Concrete

6. ASTM C 882: Standard Test for Bond Strength of Epoxy-Resin Systems Used with Concrete

7. ASTM C 884: Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay

8. ASTM D 638: Standard Test Methods for Tensile Properties of Plastics

9. ASTM D 696: Test Method for Coefficient of Linear Thermal Expansion of Plastics

10. ASTM D 2471: Standard Test Methods for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements indicated herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of nonshrink and epoxy grout used in the Work in accordance with the requirements of the Specification Section 01300 – Contractor Submittals.

1.05 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be prepared by a Geotechnical Consultant/Laboratory to be compensated by the Contractor. The Engineer shall approve the Geotechnical Consultant/Laboratory firm.

2. Compression tests and fabrication of specimens for cement grout and nonshrink grout shall be performed as specified in ASTM C 109 at intervals during construction as determined by the Engineer. A set of three (3) specimens will be prepared for testing at 7 days, 28 days, and each additional time period as appropriate. The Contractor shall bear the expenses related to this item.

3. Compression tests and fabrication of specimens for epoxy grout shall be performed as specified in ASTM C 579, Method B, at intervals during construction as determined by the Engineer. A set of three (3) specimens will be prepared for testing at 7 days, and each earlier time period as appropriate. The Contractor shall bear the expenses relative to this item.

4. Placed grout, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

5. The cost of all laboratory tests on grout will be borne by the Contractor. The Contractor shall assist the approved Geotechnical Consultant/Laboratory Firm in obtaining specimens for testing. The Contractor shall also be responsible,

without additional cost to the Owner, for additional tests and investigation on work performed which is non-compliant with the Specifications. The Geotechnical Consultant/Laboratory Firm shall supply all materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 - Cast-in-Place Concrete, except as modified herein or elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 CEMENT GROUT

A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland Cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 5,000 PSI.

B. Cement grout materials shall be as specified in Section 03300 - Cast-in-Place Concrete.

2.02 PREPACKAGED GROUTS

A. Nonshrink Grout:

1. Nonshrink grout shall be a prepackaged, inorganic, nongas-liberating, nonmetallic, cement-based grout requiring only the addition of water. The manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout indicated herein shall be that recommended by the manufacturer for the particular application.

2. Class A nonshrink grouts shall have a minimum 28 day compressive strength of 6,000 PSI; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD-C 621.

3. Class B nonshrink grouts shall have a minimum 28-day compressive strength of 5,000 PSI and shall meet the requirements of CRD-C 621.

4. Application:

a) Class A nonshrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is indicated; except, for the applications of Class B nonshrink grout and epoxy grout indicated herein. Class A nonshrink grout may be used in place of Class B nonshrink grout for all applications.

b) Class B nonshrink grout shall be used for the repair of all holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, nonshrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any nonreactive diluents. Resins containing butyl glycidyl either (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be BurkEpoxy Anchoring Grout by The Burke Company, Sika or an approved equal.

2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.

3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75°*F*.

4. The epoxy grout shall develop a compressive strength of 5,000 PSI in 24 hours and 10,000 PSI in 7 days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.

5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2 inch diameter by 4 inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the void area in the plate measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.

6. The peak exotherm of a 2-inch diameter by 4 inch high cylinder shall not exceed 95°*F* when tested with 75°*F* material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree *F* when tested according to ASTM C 531 or ASTM D 696.

7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications in the Contract Documents where grout type is not specifically indicated.

8. For crack repair, the Contractor shall use pressure injection epoxy grout as recommended by the manufacturer and approved by the Engineer.

C. Grout for Pumps and Motors

1. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:

   a) Creep shall be less than 0.005 in/in when tested by ASTM C 881 method. The test shall be at 70°*F* and 140°*F* with a load of 400 PSI.

   b) Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17×10^{-6} in/in/degree *F* when tested by ASTM C 531.

   c) The compressive strength shall be a minimum of 12,000 PSI in 7 days when tested by ASTM C 579 Method 8, modified.

d) Bond strength of grout to Portland Cement concrete shall be greater than 2,000 PSI when using ASTM C 882 test method.

e) Grout shall pass the thermal compatibility test when overlayed on Portland Cement concrete using test method ASTM C 884.

f) Tensile strength and modulus of elasticity shall be determined by ASTM D 638. The tensile strength shall not be less than 1,700 PSI and the modulus of elasticity shall not be less than 1.8×10^6 PSI.

g) Gel time and peak exothermic temperature shall be determined by ASTM D 2471. Peak exothermic temperature shall not exceed 110° *F* when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.

h) The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150°*F*, with a load of 2,000 PSI.

2. Primer, if required, shall conform to the written recommendations of the grout manufacturer.

3. Surface preparations shall conform to the written recommendations of the grout manufacturer.

4. Placement and Curing:

a) Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.

b) A grouting performance demonstration/training session shall be conduced by the grout manufacturer's representative prior to foundation and base plate preparation and the first grouting on site. This training session shall demonstrate proper preparation and installation methods and that the grouting material meets the strength requirements.

5. Grout shall be Escoweld, Chockfast Red Epoxy Grout as manufactured by Philadelphia Resin Corp.; Five Star DP Epoxy Grout as manufactured by Five Star Products, Inc.; or equal.

2.03 TOPPING GROUT AND CONCRETE FILL

A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 03300 - Cast-in-Place Concrete, shall apply except as noted otherwise herein.

B. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, sitework concrete, as specified in Section 03300 - Cast-in-Place Concrete, may be used when accepted by the Engineer.

C. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent by Weight Passing
1/2”	100
3/8”	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 30	0

D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.

E. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 4,000 PSI.

2.04 CURING MATERIALS

A. Curing materials shall be as specified in Section 03300 - Cast-in-Place Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.05 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

2.06 NSF / ANSI STANDARD 61

A. All cementitious material, admixtures, curing compounds, and other industrial produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

PART 3 - EXECUTION

3.01 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as indicated in Section 03300 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of Class A nonshrink grout and epoxy grout shall provide on-site technical assistance to Contractor upon request.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the Engineer.

D. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

E. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

3.02 GROUTING PROCEDURES

A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be accomplished according to the instructions and recommendations of the manufacturer.

B. Base Plate Grouting:

1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum 1 inch thickness of grout or a thickness as indicated on the Plans.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted for acceptance by the Engineer.

C. Topping Grout and Concrete Fill:

1. All mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping and concrete fill shall be one inch (1") unless otherwise specified by the Plans. Where the finished surface of concrete fill is to form an intersecting angle of less than 45° with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

3. The base slab shall be thoroughly cleaned and wetted prior to placing topping or concrete fill. No topping or concrete fill shall be placed until the slab is free from standing pools, ponds of water. A thin coat of neat Type II cement grout shall be broomed onto the surface of the slab just before topping or concrete fill placement. The topping or concrete fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted concrete fill for tank and basin bottoms where scraping mechanism are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or concrete fill have hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used to assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.03 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION 03315

SECTION 03320 - CONCRETE SEALERS

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Work included: Seal, harden or color concrete surfaces where indicated on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Concrete floor sealer/hardener/densifier shall react with concrete surfaces to produce a dense, hydrophobic, insoluble, moisture barrier to seal out contaminants, while hardening and densifying concrete surface.

C. Related work:

1. Documents affecting work of this Section included, but are not necessarily limited to, Special Conditions, and Sections in Division 1 of these Specifications.

2. Section 03300: Cast-In-Place Concrete

3. Section 03345: Concrete Finishing

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Use an applicator currently approved in writing by the manufacturer of the specified product.

1.03 SUBSTITUTIONS

Substitutions will not be allowed unless otherwise specified on the plans or approved during the submittal phase by the Construction Manager.

1.04 SUBMITTALS

A. Submit in accordance with Section 01300 – Contractor Submittals of the Specifications.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Sufficient technical data to prove compliance with the specified requirements.

2. Evidence satisfactory to the Architect that the proposed applicator is currently approved by the manufacturer of the specified product.

1.05 JOB CONDITIONS

A. Ensure concrete has been cured a minimum of 3-days, is free of curing compounds and other sealers, and is free of laitance, grease, oil, and contaminants.

B. Protect adjacent surfaces/areas from damage due to over-spray

1.06 EXTENDED WARRANTY

Warranty sealed concrete floors to be free of dusting from abrasion for a period of 10-years from date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 -- PRODUCTS

2.01 SEALER

A. Wherever the Drawing indicates concrete with sealer, the surface shall be treated with ready-to-apply clear sealing compound. Where a sealer is used in conjunction with a hardener with color, use only a product recommended by the manufacturer of the hardener as accepted by the Architect.

B. Comply with ASTM C 309, Type I, Class B.

C. Acceptable products:

1. Curcrete Chemical Company Inc. (Springville, Utah) “Ashford Formula”.

2. "Industrial Concrete Sealer" by Burke Company, San Mateo, California, (213) 724-6690.

3. "Sealtight Intex" by W.R. Meadows, Inc., Benica, California, (714) 759-5006.

4. "Lithothane Concrete Sealer" by L.M. Scofield Company, Los Angeles, California, (213) 723-5285.

2.02 HARDENER

A. Wherever the Drawings indicate concrete with hardener, the surface shall be treated with a non-metallic dust-on floor hardener.

B. Acceptable products:

1. "Non-metallic Floor Hardener" by Burke Company.

2. "Mastercron" by Master Builders, Inc., Anaheim, California, (714) 978-6961.

3. "Lithocrome" by L.M. Scofield.

2.03 HARDENER WITH COLORS

A. Wherever the Drawings indicate colored concrete floor hardener, the surface shall be treated with a non-metallic dust-on hardener in colors selected by the Architect.

B. Acceptable products:

1. "Lithocrome Color Hardener" by L.M. Scofield Company.

2. "Colorcron" by Master Builders, Inc.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which the work of this Section will be performed.

B. Correct conditions detrimental to timely and proper completion of the Work.

C. Do not proceed until unsatisfactory conditions are corrected.

D. Beginning of installation means acceptance of conditions.

3.02 APPLICATION OF SEALER

A. Preparation:

1. On freshly finished concrete surfaces, no additional surface preparation is required.

2. On areas where forms are recently removed, remove all form oil and breaking compound residue to assure penetration of the product in to the pores of the material to be treated.

3. On existing concrete, vertical surfaces, and masonry surfaces:

a. Sweep all areas to be treated, using a fine bristle broom, or hose off with water and let dry to remove all surface dust and dirt.

b. Free the surface from all contaminants which would inhibit penetration of the product into the pores of the material to be treated.

c. Remove all curing, sealing, and coating agents by use of chemical or mechanical means as necessary.

d. If acid is used to remove surface coatings, flush the surface with water sufficiently to remove all acid and acid residue.

4. When applying near windows, mask the glass.

5. Avoid contact with plant life, glass, aluminum, and other finished surfaces. Where contact occurs, immediately wipe a damp cloth or flush with water.

6. Avoid contact with asphaltic concrete.

B. Application:

1. On freshly finished surfaces, spray the product with a low pressure sprayer immediately following the finishing operation.

a. To assure proper curing, apply the product to the entire surface as soon as the surface is firm enough to walk on, and before checking and temperature cracking begins.

b. Keep the entire surface wet for 30 minutes by brooming excess product on to the dry spots, or by re-spraying the dry spots immediately.

c. As the product begins to dry into the surface and becomes slippery underfoot, lightly sprinkle the surface with water to aid penetration and to bring alkali to the surface.

d. As the product again begins to dry into the surface and become slippery underfoot, flush the surface with water and squeegee the surface totally dry, removing all excess product and alkali or other impurities brought to the surface.

2. On broom-finished surfaces, no flushing is required, but squeegee or broom the excess product form surface after 30 to 40 minutes.

3. On cured concrete surfaces, saturate the surface with the specified product.

a. If dry spots appear, broom excess material onto the dry spots or re-spray them immediately.

b. Keep the entire surface wet with the product for 30 minutes.

c. If, after 30 to 40 minutes, the majority of the product has not been absorbed into the surface, broom or squeegee the excess product from low spots and puddles so it will be absorbed into the surface, or remove such excess product from the surface.

d. If, after 30 to 40 minutes, the majority of the product is still on the surface, wait until the surface becomes slippery underfoot and then flush the entire surface with clear water and squeegee completely dry. If no water is available, squeegee the excess product from the surface after 30 minutes so that the surface is completely dry.

3.03 APPLICATION OF HARDENER

Apply the hardener after the surface of the concrete has reached the stage where no excess moisture shows, but while still plastic.

1. Hardener shall be applied at the rate of 40 pounds per 100 square feet of surface for the initial application.

2. Hardener shall be evenly distributed and thoroughly floated into the surface mortar with a wood float. 20 pounds of additional hardener shall be applied over each uniform color and texture.

3. All hardener and/or colored concrete floors shall be cured and protected with concrete curing paper or plastic until just prior to final cleaning.

4. Before applying curing paper or plastic, interior floors treated with colored hardener shall be given a heavy protective coat of colored wax left unpolished, and then immediately covered with the paper. If wax is not applied within two (2) hours after final troweling, the concrete shall be sprayed with a fine water mist and kept continuously moist until wax is applied, unless spraying is not recommended by the manufacturer of the hardener.

5. Cleaning and finishing: After all other work including plastering and painting has been completed, the curing paper shall be removed and waxed floors cleaned of protective wax coating. Clean all floors to remove dirt, stains or blemishes, and repair and restore damaged floors to their original condition. The hardener manufacturer's recommendations, directions, and recommended materials and methods shall be used for the protective wax coating, cleaning and finishing work.

*****END OF SECTION*****

SECTION 03345 - CONCRETE FINISHING

PART 1 -- GENERAL

1.01 DESCRIPTION

Work included: Provide finishes on cast-in-place concrete as called for on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Except as may be modified herein or otherwise directed by the Architect, comply with ACI 301, "Specifications for Structural Concrete for Buildings".

1.03 SUBSTITUTIONS

Substitutions will not be allowed unless otherwise specified on the plans or approved during the submittal phase by the Construction Manager.

1.04 SUBMITTALS

A. Submit in accordance with Section 01300 – Contractor Submittals of the Specifications.

B. Product data, submit:

1. Materials list of items proposed to be provided under this Section;

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

3. Manufacturer's recommended installation procedures which, when accepted by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.05 PRODUCT HANDLING

Comply with pertinent provisions of Division 1.

1.06 CLOSE-OUT: also comply with the requirements of Section 01700 – Project Closeout.

A. Reports:

None required.

B. As-Builts:

Not required

C. Operation and Maintenance Data:

None required.

D. Extra Materials:

None required.

E. Extended Warranty:

Comply with the requirements of General Condition Article 6 and Section 01700.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. General:

1. Carefully study the Drawings and these Specifications, and determine the location, extent, and type of required concrete finishes.

2. As required for the Work, provide the following materials, or equals accepted in advance by the Architect.

B. Liquid bonding agent: "Weld-Crete," manufactured by the Larsen Products Corporation.

C. Curing and protection paper:

1. Comply with ASTM C171, Type 1, regular.

2. Accepted products:

a) "Sisalkraft, Seekure 896";

b) Equal non-staining products faced with polyethylene film.

D. Slip-resistant abrasive aggregate:

1. Provide aluminum oxide grains, uniformly graded, screen size 12-13, 14-36 or 16-30.

2. Acceptable product:

a) Emerchrome Floor Hardener by L.M. Scofield Company.

b) Frictex H by Sonneborn.

c) or approved equal.

2.02 OTHER MATERIALS

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the acceptance of the Architect.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed.

B. Correct conditions detrimental to timely and proper completion of the Work.

C. Do not proceed until unsatisfactory conditions are corrected.

D. Beginning of installation means acceptance of conditions.

3.02 FINISHING OF FORMED SURFACES

A. General:

1. After removal of forms, give exposed concrete surfaces the finish specified below.

2. Revise the finish as needed to secure the acceptance of the Architect.

B. Rubbed finish:

1. Do not start cleaning operations until all contiguous surfaces to be cleaned are completed and accessible.

2. Do not permit cleaning as the work progresses.

3. Mix one part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having the consistency of thick paint.

4. Substitute white portland cement for part of the gray portland cement as required to produce a color matching the color of surrounding concrete, as determined by a trial patch.

5. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout, and apply the grout uniformly with brushes or spray gun.

6. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes.

7. While the grout is still plastic, remove all excess grout by working the surfaces with a rubber float, sack, or other means.

8. After the surface whites from drying (above 30 minutes at normal temperatures), rub vigorously with clean burlap.

9. Keep the surface damp for at least 36 hours after final rubbing.

3.03 FINISHING SLABS

A. Definition of finishing tolerances:

1. "Class A": True plane within 1/8" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.

2. "Class B": True plane within 1/4" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.

B. Scratched finish: For surfaces scheduled to receive bond-applied cementitious applications.

1. After the concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen the surface with stiff brushes or rakes before the final set.

C. Floated finish: For surfaces intended to receive roofing.

1. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further until ready for floating.

2. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.

3. During or after the first floating, check the planeness of the surface with a ten foot straightedge applied at not less than two different angles.

4. Cut down high spots and fill low spots, and produce a surface with a Class B tolerance throughout.

5. Refloat the slab immediately to a uniform sandy texture.

D. Troweled finish:

1 Provide a floated finish as described above, followed by a power troweling and then a hand troweling which is relatively free from defects, but which still may show some trowel marks.

a. Monolithic Trowel Finish: For all floor surfaces not otherwise specified. Steel trowel and retrowel to smooth surface. After concrete has set enough to ring true, retrowel to a burnished impervious finish, free of trowel marks or other blemishes.

b. Steel Float Finish: for all slabs to receive resilient tile, waterproof membrane, or carpeting. Same as monolithic finish except omit burnish retroweling.

c. Fine Swirl Finish (when shown on the Drawings): Prepare same as steel float finish. When ready, perform such finishing operations as necessary to produce Architect-selected fine textured, non-slip finish. Construct sample panel for Architect's acceptance prior to placement. Sample panel shall consist of tooled edges and have a tooled joint within field of panel.

2 Provide a finished surface essentially free from trowel marks, uniform in texture and appearance, and in a plane of Class A tolerance.

E. Broom finish: For slabs to receive thin set tiles, apply steel float finish followed by very fine broom finish. For surfaces to receive mortar setting beds and for exterior concrete driveway ramps, curbs and gutters, spandrels, etc.

1. Provide a finished surface uniform in texture and appearance, and in a plane of Class A tolerance. Roughen surface with coarse broom.

F. Rock Salt finish: Exterior walkways and pavings except where non-slip finish is specified.

1. Provide a floated finish as described above.

2. While the surface is still plastic, broadcast rock salt into the surface and embed uniformly into the surface by light tamping.

3. Float the surface until it has been brought to a true plane with Class B tolerance.

4. After the concrete has completely set, flood the surface with water to dissolve the rock salt, using a fine bristle brush as necessary to remove the salt.

5. Provide a sample panel at the site of the proposed finish and receive the acceptance of the Architect of that finish prior to placing of the paving.

G. Non-slip finish: For exterior platforms, steps, and landings; and Interior and exterior pedestrian ramps.

1. Provide a floated finish as described above.

2. While the surface is still plastic, broadcast abrasive aggregate as specified in Paragraph 2.01.F above and work into the surface according to the manufacturer's recommendations.

3. Complete finishing surface as described above for a troweled finish, and as recommended by the aggregate manufacturer.

3.04 CURING AND PROTECTION

A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures, and mechanical injury.

B. Preservation of moisture:

1. Unless otherwise directed by the Architect, apply one of the following procedures to concrete not in contact with forms, immediately after completion of placement and finishing.

a. Ponding or continuous sprinkling;

b. Application of absorptive mats or fabric kept continuously wet;

c. Application of sand kept continuously wet;

d. Continuous application of team (not exceeding 150° F) or mist spray;

e. Application of waterproof sheet materials specified in Part 2 of this Section;

f. Application of other moisture-retaining covering as accepted by the Architect.

g. Where forms are exposed to the sun, minimize moisture loss by keeping the forms wet until they can be removed safely.

2. Cure concrete by preserving moisture as specified above for at least ten days.

C. Temperature, wind, and humidity:

1. Cold weather:

a) When the mean daily temperature outdoors is less than 40° F, maintain the temperature of the concrete between 50° F and 70° F for the required curing period.

b) When necessary, provide proper and adequate heating system capable of maintaining the required heat without injury due to concentration of heat.

c) Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

2. Hot weather: When necessary, provide wind breaks, fog spraying, shading, sprinkling, ponding, or wet covering with a light colored material, applying as quickly as concrete hardening and finishing operations will allow.

3. Rate of temperature change: Keep the temperature of the air immediately adjacent to the concrete during and immediately following the curing period as uniform as possible and not exceeding a change of 5° F in any one hour period, or 50° F in any 24 hour period.

D. Protection from mechanical injury:

During the curing period, protect the concrete from damaging mechanical disturbances such as heavy shock, load stresses, and excessive vibration.

1. Protect finished concrete surfaces from damage from construction equipment, materials, and methods, by application of curing procedures, and by rain and running water.

2. Do not load self-supporting structures in such a way as to over stress the concrete.

*****END OF SECTION*****

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SECTION 03400 - PRECAST CONCRETE

PART 1 -- GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the precast concrete work in accordance with the Contract Documents.

B. This Section covers the design, fabrication, delivery and installation of all plant precast concrete units, including connections, complete, in place, as shown and specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03315 - Grout

B. Section 07900 – Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with reference standards of the General Requirements.

B. NSF / ANSI 61: Drinking Water System Components – Health Effects

C. Comply with the current provisions of the following Codes and Standards, as applicable:

1. Commercial Standards:

ACI 301	Specifications for Structural Concrete
ACI 304	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 311	Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347	Guide to Formwork for Concrete
AWS A5.4	Welding Rods and Electrodes
AWS D1.1	Welding and Cutting
AWS D1.4	Structural Welding Code – Reinforcing Steel
ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement

ASTM A 193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 351	Specification for Steel Castings, Austenitic, for High-Temperature Service
ASTM A 497	Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 580	Specification for Stainless and Heat-Resisting Steel Wire
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 666	Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
ASTM A 775	Specifications for Epoxy-Coated Reinforcing Steel Bars
ASTM C 33	Specification for Concrete Aggregates
ASTM C 67	Method for Sampling and Testing Brick and Structural Clay Tile
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 150	Specification for Portland Cement
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 204	Test Method for Fineness of Portland Cement by Air Permeability Apparatus
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 311	Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 494	Test Method for Shear Fatigue of Sandwich Core Materials

ASTM D 2240	Test Method for Rubber Property -- Durometer Hardness
AWS B2.1	Specification for Welding Procedure and Performance Qualification
PCI MNL-116	Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
PCI MNL-117	Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
PCI MNL-121	Manual for Structural Design of Architectural Precast Concrete

2. Government Standards:

CSS	Caltrans Standard Specifications.

1.04 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with the General Requirements.

B. Shop Drawings:

1. Shop drawings shall provide details in accordance with ACI 315 and ACI 318 including installation details.

2. Shop drawings, including design computations, shall be stamped and signed by a Civil or Structural Engineer registered in the State of California and shall be approved by the Engineer.

3. Shop drawings shall indicate precast unit identification marks, location of units in the Work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop drawings shall include erection drawings. Shop drawings shall also include design computations for above-mentioned drawings.

4. Shop drawings shall be divided into complete separate submittals for each structure. Each complete submittal shall consist of a panel schedule and shop drawings.

a. Panel Schedule: Showing all exterior elevations of the structure, including all precast concrete enclosure faces exposed to view, in its associated shop drawing submittal. Elevations at a minimum scale of 1/8" = 1'-0" shall be drawn, identifying the type and location of each panel by a number which corresponds to the panel number appearing on an associated shop drawing; this same number shall be permanently marked on the back of each panel as they are fabricated.

b. Shop Drawings: Showing all elevations, dimensions, horizontal and vertical sections, openings, inserts, reinforcing, anchorage devices, pick-up points, details, design computations, and other requirements for each different type of panel to be incorporated into the portion of the project

covered by the submittal. Drawings shall be 24 inches x 36 inches maximum.

c. For bridge structures, shop drawings for precast concrete piles shall conform to Section 49-3 of the CSS.

C. Small Samples:

1. Unless otherwise specified on the contract documents, two 72 inch by 72 inch samples of precast concrete unit finish shall be submitted, as required for the project. Each sample shall show matrix color, surface color, surface texture, and panel back finish.

2. When so requested by the Engineer, submit samples of cast-in gaskets, anchorages and other attachments and accessories.

3. The face of each sample shall contain at least two areas of approved size and shape which have been chipped out and then patched and repaired and one form joint; the color, texture and appearance of patched areas and form joint shall match that of adjacent surface.

4. Samples will be inspected for color and texture match to the samples selected by the Engineer, uniformity of color and texture throughout the panel and acceptability of patching and joint treatment. Exposed face of samples shall be tested for efflorescence in accordance with ASTM C 67; rating shall not be more than "slightly effloresced."

5. If the Engineer rules a sample, or samples, to be unacceptable, the Contractor shall fabricate and resubmit additional samples at no additional cost to the Owner.

6. When approved, one sample will be kept at the Engineer's office and the other shall be picked up by the Contractor and returned to the manufacturing plant. These sample panels will be used as a comparison to judge acceptability of the full-size panel samples and, where necessary, the production precast units.

D. Full-Size Panel Samples at Manufacturing Plant:

1. After the small samples and shop drawings have been approved, and prior to fabricating panels for the project, a full-size panel of specified color and each finish shall be produced and erected at the manufacturing plant for inspection and approval by the Engineer.

2. The full-size panels shall be fabricated utilizing tools, forms, materials and techniques proposed and the dimensions, profile cross section, color and texture required for the project. Panels will be inspected for color and texture to match approved samples, uniformity of color and texture throughout the panel, accuracy and sharpness of shape, acceptability of patched and repaired areas, and form joint treatment.

3. If the Engineer rules a sample to be unacceptable, the Contractor shall fabricate additional revised panel(s) at no additional cost to the Owner. When approved, panels shall be preserved, remain at the plant, and become the job standard against which all panels will be compared as they come off the production line.

E. Full-Size Panel Samples at Project Site: From the first loads of acceptable panels for the Project, the Engineer will select one panel of each texture which is scheduled to be erected

in a prominent location. If the Engineer chooses, panels may be selected from a later load. The selected panel(s) together with the Small Sample from Section 1.4.C kept at the Engineer's office, will become the Site standard against which all panels will be compared.

F. Mix Proportions: Prior to commencing operations, including fabrications of the precast concrete for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, with certification stamp and signature by a Civil or Structural Engineer registered in the State of California. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.

G. Test Reports: Tests for compressive strength of concrete shall be performed by an approved independent commercial testing laboratory at no cost to the Owner. Copies of test reports including all test data and all test results shall be submitted for review and approval of the Engineer.

H. Certificates of Compliance: Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.

I. Manufacturer's Qualifications: Prior to commencing operations, a statement shall be submitted giving the qualifications of the precast concrete Manufacturer, and evidence that the Manufacturer and plant are PCI certified.

1.05 QUALITY ASSURANCE

A. General Requirements: Design precast members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete units, registered in the State of California and conforming to requirements of PCI MNL-121 and to ACI 318.

1. Precast Manufacturer and erectors shall be qualified in accordance with PCI MNL-117 and MNL-116.

2. Welding shall be in accordance with AWS D 1.1, AWS D 12.1, AWS B 2.1, and AWS A 5.4.

3. Manufacture, Transportation and Installation: The Manufacturer shall specialize in providing precast products and services normally associated with precast concrete construction with high quality architectural finishes similar to that indicated on the Plans, using procedures complying with PCI MNL-116 and MNL-117, and PCI plant certified for at least 5 years.

4. Use adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the Work of this Section.

B. Sample:

1. Prebid samples representing the color, surface, texture and panel back finish specified and required for this project can be viewed at the Engineer's office, by bidders and precast concrete Manufacturers prior to submitting bids.

2. It shall be the Contractor’s responsibility to assure that all precast architectural concrete conforms to specified requirements for quality and appearance. The only appearance criterion is that all precast architectural finishes provided for this project conform in appearance, when viewed from a distance of 20 feet, to the design, color, and texture as represented by the prebid sample except that closeup inspection shall not exhibit any evidence of "bugholes" on exposed surfaces exceeding 1/8 inch and in quantity not more than 2 average per square foot.

C. Sample Construction (Building structures only):

1. A typical precast concrete combination sectioned wall and related perimeter window assembly shall be constructed and provided by the Contractor. This sample construction, after approval, shall serve for comparison as a sample of construction requirements for the rest of the building.

2. The precast concrete units shall structurally support the window assemblies and include anchorage inserts for windows as indicated. Use of drilled-in anchorage inserts for window supports and anchorage of other items is prohibited. Sample construction shall be sealed and finished as required for completed wall.

3. The sample construction shall demonstrate precast concrete units and window framing, sealants, anchorage, and other elements of construction. The sample construction will be inspected and judged for compliance with requirements and visual appearance including, but not limited to, uniformity of color and texture, acceptability of patching and repair, and conformance to required tolerances. If the sample does not provide an acceptable window assembly or meet visual appearance or tolerance requirements as determined by the Engineer, the Contractor shall modify, repair, or reconstruct the sample at no additional cost.

4. At the Engineer's request, the Contractor shall dispose of the sample at no cost to the Owner.

1.06 DESIGN REQUIREMENTS

A. General: The precast concrete panel and connection designs shown hereon represent minimum precast construction requirements. The Manufacturer shall verify the panel and connection designs for all handling, erection, and service conditions, and shall provide any additional materials necessary to meet the design conditions.

B. Standards and Loads (Building Structures only): The precast panel and connection design and construction shall conform to all applicable codes and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. The precast or prefabricated, nonbearing, nonshear wall panels and connections which are attached to or enclose the exterior, shall resist, in addition to initial handling and erection loads and dead loads, the following forces:

1. Wind pressure and load combinations relative to panel design in accordance with the latest edition of the California Building Code.

2. Seismic loads relative to panel design in accordance with the latest edition of the California Building Code.

3. The design shall be based on a differential temperature of 50°*F* between interior and exterior faces of the units and 80°*F* (40 degrees from erected temperature) average panel temperature differential.

4. Stresses due to restrained volume changes caused by shrinkage and temperature differentials shall be accounted for.

C. Connections (Building Structures only): Prior to submitting shop drawings, the Contractor shall verify the precast connection designs shown against the aforementioned and following design criteria and provide any additional materials necessary to meet the design conditions.

1. The panel joints shall be designed to accommodate an in-plane movement between stories of 0.005 times the story height in inches but not less than ¾ inch.

2. Panel connections shall accommodate building movement and permit panels to move freely so as not to resist in plane deformation of the main frame structural system. Adjustment shall be provided to accommodate misalignment of structure without permanent distortion, damage to components, racking of joint connection, breakage of seals, or moisture penetration.

D. Concrete Mix: The concrete mix shall be designed by the Manufacturer, with certification stamp and signature by a Civil or Structural Engineer registered in the State of California, and approved by the Engineer, using the materials and quantities specified to meet all of the requirements of this specification.

1. Proportioning of Concrete Mixes: Mixes shall be proportioned by weight except water and admixtures may be batched by volume if desired. Trial mixes and testing to meet requirements of the strengths of concrete specified is the Contractor's responsibility. Design mix shall contain similar materials as those proposed for use in the Work.

2. Admixtures: Concrete shall contain an air entraining admixture in proportion so as to provide 4 percent plus or minus 1 percent total air in the concrete as determined by ASTM C 173 or C 231. Set retarding admixtures may be used provided cement content is not reduced. Water reducing admixtures may be used provided they are used in the mix design studies. High-range water reducers (superplasticizers) shall be used only where specifically called for in this Section, otherwise superplasticizers shall not be used without written approval from the Engineer. No admixture may contain chlorides, bromides, or fluorides.

3. Water: Clean, potable water. The Contractor shall provide tests to assure that no more than 200 parts per million total aggregated content of chlorides, bromides, and fluorides are present.

4. If a variance from the Local Authority is required for the precast concrete mix design, the Contractor shall be responsible for submitting and obtaining the 5,000 PSI precast concrete mix variance. The admixtures used in the mix design shall be used in approved combinations and proportions in accordance with the local requirements.

E. Formwork: Formwork shall be designed to withstand high-frequency vibration and to ensure finished units.

F. Pickup Points and Boxouts: Pickup points, boxouts, and inserts on panel faces and surfaces to be exposed are prohibited except as approved by the Engineer.

1.07 DELIVERY, STORAGE AND HANDLING

A. General: Deliver precast concrete units to the job-site in such quantities and at such times as to assure the continuity of construction. Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design incorporated support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.

B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.

C. Units shall be marked with date of production and final position in structure in location not visible after erection.

D. Precast units shall be stored off the ground in a manner to keep markings visible, and to prevent cracking, distortion, warping, staining or other physical damage, and they shall be protected from weather, marring, and overload.

E. Stainless Steel Hardware: Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 – PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type V, "low alkali," white color. "Low alkali" requirement may be waived if not reactive as defined in Appendix to ASTM C 33. Submit laboratory test reports.

B. Aggregate: ASTM C 33, ½ inch maximum coarse aggregate size fine aggregate ratio to total aggregate volume = 0.35 min, 0.55 max.

1. Water Absorption, Coarse Aggregate: ASTM C 127.

2. Water Absorption, Fine Aggregate: ASTM C 128.

C. Reinforcing Steel: ASTM A 615, Grade 60, deformed epoxy coated in accordance with ASTM A 775.

D. Welded Wire Fabric:

1. Plain: ASTM A 185, epoxy coated.

2. Deformed Steel: ASTM A 497, epoxy coated.

3. Fabricated Steel Bar or Rod Mats: ASTM A 184, epoxy coated.

E. Tie Wire: ASTM A 580, Type 316L, cold finished annealed, Huntington Alloy Co. "Monel", "Inconel", or an approved equal.

F. Air Entrainment Admixture: ASTM C 260.

G. Water Reducing or Retarding Admixtures: ASTM C 494, Type C, D, or F/G, with no chloride, bromide, and fluoride ingredients. Use Pozzolith 300-R manufactured by Master Builders, Plastiment manufactured by Sika Chemical Corp., or an approved equal.

H. Silica Fume Slurry Admixture: 45 to 50 percent silica fume, water, and superplasticizer as dispersant. Silica Fume: 85 percent amorphous silicon dioxide in accordance with ASTM C 311; loss on ignition shall not exceed 6 percent and moisture shall not exceed 3 percent in accordance with ASTM C 311. Surface area not less than 10,000 square meters per kilogram at bed porosity of 0.50 in accordance with ASTM C 204.

Reduce water in mix by 5.6 to 9.5 lbs. for each gallon of slurry added to mix, as recommended by slurry Manufacturer used.

Add Owner-approved slurry to concrete mix to achieve 7.5 percent dry silica fume by weight of cement. Mixing procedures as recommended by silica fume slurry manufacturer. Sika "Sikacrete 950"; W.R. Grace "Force 10,000" or approved equal. Submit applicable Owner-approved Research Report with shop drawing submittal.

I. Pigment: Pure mineral type, color-resistant to alkalis, nonfading. Color as required to produce finished concrete matching color and appearance of prebid sample and the 72 inch by 72 inch sample at the Engineer's office.

2.02 SUPPORT DEVICES

Unless otherwise specified on the Plans, the following requirements shall apply:

A. Connecting and Support Devices: ASTM A 666, Type 316L stainless steel.

B. Bolts: ASTM A 193, Grade B8M (Type 316).

C. Nuts and Washers: ASTM A 194, Grade 8M (Type 316).

D. Weld Filler Metal for Stainless Steel: Stainless steel to stainless steel; AWS A5.4, Grade 316L filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32 inch diameter.

E. Primer: Zinc-dust, zinc oxide primer in a phenolic resin spare varnish vehicle, TT-P-641 Type III (for galvanized surfaces).

2.03 ACCESSORIES

Unless otherwise specified on the Plans, the following requirements shall apply:

A. Plates, Angles, Anchors, and Studs: ASTM A 666, Type 316L stainless steel. Austenitic Steel Castings for Embedments and Anchorage Assemblies: ASTM A 351, Type CF3M, with Type 316 stainless steel bolts, nuts, and washers.

B. Reglets: Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion.

C. Bearing Pads: Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D 2240.

D. Sealant: Specified in Section 07900 – Sealants and Caulking.

E. Gaskets: ASTM C 509, preformed, firm, cellular, neoprene, sized to be under constant compression at the joints, and manufactured in lengths to minimize field splices.

F. For bridge structures, expansion and fixed joints and bearings shall conform with CSS Section 51-1.12.

2.04 FORMS AND MOLDS

A. Forms: Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections. Comply with PCI MNL 117, Division V, Section 2, Article 5.2.1.

B. Form Release Agent: Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer.

C. Surface Sealer: Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by Manufacturer and proved compatible with surface sealer.

D. Molds: Fabricate using steel, concrete, fiberglass, reinforced plastic or wood.

a. Selection of materials for molds shall be at manufacturer's option, except that wood shall not be used without specific prior approval of the Engineer.

b. Cast elements in molds of rigid construction, accurate in detail with precise corners and arises, and designed to provide close control of dimensions, radii, and details as indicated on the Plans.

c. Prior to casting of precast elements, molds shall have surface joints, radii, and corners filled, ground, filed, straightened, or otherwise removed to provide finished concrete surface that is smooth and dense, free of honeycombing, air pockets, offsets, sinkages, or other irregularities.

d. Mold Release Agents: Synthetic resin or organic compound containing no wax, oil, silicates, or varnish, and compatible with specified coatings, sealants, fresh concrete, curing process, and adhesives.

e. Cast molds with release agents to facilitate removal of elements from molds.

2.05 MIX

Silica Fume Concrete: Minimum 5,000 PSI (unless noted otherwise on the project plans), 28 day compressive strength; aggregate 3/8 inch max; water - 305 lbs per cu yd; cement - 750 lbs per cu yd; w/c ratio 0.40 max; slump range 3 inches to 5 inches with silica fume slurry; air entrainment 4 percent plus or minus 1 percent; 7.5 percent dry silica fume by weight of cement, provided through specified silica fume slurry; add superplasticizer to achieve desired working slump for precast concrete as may be required by silica fume slurry Manufacturer. Add colorant as required to achieve match with Engineer's sample. Moist cure by spray mist.

2.06 FABRICATION

A. General: Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116 (structural features), PCI MNL-117 (nonstructural features, surface treatments, patching, and tolerances). Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the Engineer upon request.

Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.

Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. The maximum amount of damage shall not exceed 2 percent of the surface area of each bar.

Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as indicated on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement permitted. Welding when allowed shall conform to AWS D 1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.

Adequate reinforcing steel shall be provided to control cracking. Maximum permissible crack width:

Surfaces exposed to weather: 0.005 inch.

Surfaces exposed to view but not weather: 0.01 inch

Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment.

Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during panel construction. Do not use powder actuated fasteners for surface attachment of accessory items except as specifically approved by the Engineer and specifically accepted by the precast unit manufacturer. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.

Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.

Precast units shall be removed from formwork using procedures conforming to PCI MNL-117. Minor patching in plant acceptable, providing structural adequacy and appearance of units are not impaired. Each precast unit shall be identified with corresponding code on erection drawings, in location not visible to finished work.

Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.

B. Fabrication and Tooling of Stainless Steel Connections and Embedments: All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.

Welding of stainless steel shall conform to AWS A 5.4, AWS B 2.1 and AWS D1.1, using tungsten inert gas procedures and 316L filler metal for stainless steel to stainless steel and 309 filler metal for stainless steel to carbon steel. Surfaces shall be sanded smooth (do not grind), and oxidized discoloration removed (blue heat tint). Threaded parts of stainless steel bolts shall be lubricated with graphite suspended in alcohol (Neo-Lube) every time that nut is run on or off the threads. No other lubricant is acceptable.

Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.07 FINISH OF PRECAST UNITS

A. Backs and Sides (Unexposed Edges): Smooth, dense, uniform surface free from blemishes. Defects in backs and sides (unexposed edges) shall be repaired as approved.

B. Faces: Appearance, color, and texture finish of all panels shall match appearance, color and texture of the approved sample panels constructed by the Contractor. Panels that do not match shall be rejected. Repairs will be acceptable only if structural adequacy and appearance of product are not impaired and the repair and surrounding area match the approved sample panels at the Engineer's office.

Mechanical finishing of panels at precast plant shall be at essentially the same age (or strength) of concrete to assure finished appearance is uniform from panel to panel.

To reduce possibility of stains occurring during transportation and erection, sealer shall be applied at the plant as recommended by Manufacturer and the precaster and shall be guaranteed in writing that sealer will not alter or yellow the original precast concrete color in any way and that it is compatible with the joint sealants to be used on the project. Seal finish surfaces of precast units to be exposed in completed Work as follows: apply a uniform coat of surface sealer in accordance with Manufacturer's written instructions. Apply sealer by method and in quantity required to provide coverage specified by sealer Manufacturer. Forty-eight (48) hours after application of sealer, apply water to face of each panel in sufficient quantity to determine if full sealer coverage was achieved. Panels not fully sealed shall be resealed and retested. A second coat shall be applied at the Site after erection and cleanup in accordance with the Manufacturer's instructions.

2.08. PRECAST PRESTRESSED CONCRETE SLAB BRIDGES

Precast prestressed concrete slab bridges shall conform to the provisions in Section 51, “Concrete Structures," of the CSS and these specifications.

Forms for providing the circular voids in the slabs shall be watertight and shall be constructed of an approved material that will resist breakage or deformation during the placement of the concrete and will not materially increase the dead load of the span. The forms shall be properly supported and tied and shall remain in correct position at all times during the placement of the concrete.

Except where otherwise shown on the Plans, the top surface of the slab shall be given a coarse texture by brooming with a stiff bristled broom or by other suitable devices which will result in uniform transverse scoring, in advance of curing operations. The requirements of the seventh paragraph of Section 51-1.17, "Finishing Bridge Decks," of the CSS shall not apply.

When slab spans with concrete deck are shown on the Plans, the top surfaces shall be cleaned as specified for construction joints in Section 51-1.13, "Bonding," of the CSS. 5. When slab spans

with an asphalt concrete overlay are shown on the Plans, the removal of laitance and curing compound from the top surfaces will not be required.

After the concrete slabs are in final position, the anchor dowel holes shall be filled with mortar.

2.09 PRECAST PRESTRESSED CONCRETE BRIDGE MEMBERS

Precast reinforced concrete girders shall conform to the provisions in Section 51, “Concrete Structures," of the CSS.

The top surface of the member shall be given a coarse texture by brooming with a stiff bristled broom or by other suitable devices that will result in uniform transverse scoring, in advance of curing operations. That portion of the top surface of box girders that is to be covered by expanded polystyrene shall be given a wood float finish. Remaining portions of the surface of the girders shall be given the coarse textured finish. The requirements of the seventh paragraph of Section 51-1.17, "Finishing Bridge Decks," of the CSS shall not apply.

When box girders with a concrete deck are shown on the plans, surfaces noted to be given a coarse broom finish shall be cleaned of surface laitance and curing compound before placing deck concrete. Exposure of clean aggregate will not be required.

When Double T girders with concrete deck are shown on the Plans, surfaces noted to be given a coarse broom finish shall be cleaned of surface laitance and curing compound before placing deck concrete. Exposure of clean aggregate will not be required.

2.10 NSF / ANSI STANDARD 61

A. All cementitious material, admixtures, curing compounds, and other industrial produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Examination: The Contractor shall verify that the structure, anchors, devices, and openings are ready to receive Work of this Section. Beginning of installation means acceptance of existing condition.

B. Preparation: The Contractor shall provide for erection procedures and induced loads, during erection, maintain temporary bracing in place until final support is provided, provide necessary hoisting equipment and safety and protective devices.

C. Erection: The units shall be erected in accordance with approved shop/erection drawings without damage to shape or finish or adjacent work. Damaged panels shall be replaced or repaired. Unless otherwise shown, members shall be erected level and plumb within allowable tolerances.

The Contractor shall align and maintain uniform horizontal and vertical joints as erection progresses, provide approved shims and wedges as required, and when members required adjustment beyond design or tolerance criteria, discontinue affected work. Units shall be secured in place and field welds, scratches and otherwise damaged steel surfaces shall be touched up.

Field fabrication and erection of stainless steel shall conform to the procedures outlined in the paragraph entitled "Fabrication and Tooling of Stainless Steel Connectors and Embedments."

The vertical units shall be set dry, without grout, attaining joint dimension with lead or plastic shims and spacers.

Pickup points, boxouts, inserts, bearing surfaces, and open spaces at connections and joints shown shall be grouted with non-shrink grout system(s) recommended by the manufacturer of the precast units, in accordance with Section 03315 - Grout. The color and texture of concrete surfaces of adjacent areas shall be finished to match in the same plane. Provide forms or other acceptable method to retain the grout in place until it is sufficiently hard to support itself. Pack spaces with stiff grout material, tamping voids completely full. Place the grout in a manner to finish smooth, plumb, and level with adjacent concrete surfaces. Keep grouted surfaces damp for not less than 24 hours after grout has taken its initial set. Promptly remove grout material from exposed surfaces before its hardens.

D. Tolerances: In accordance with requirements of PCI MNL-117 unless otherwise indicated.

1. Variation from Plane of Location: ¼ inch in 10 feet and 3/8 inch in 100 feet maximum, compensating not cumulative.

2. Offset from True Alignment between Two Connecting Members: ¼ inch maximum.

3. Out of Square: 1/8 inch in 10 feet maximum, noncumulative.

4. Variation in Dimensions Indicated in Shop Drawings: Plus or minus 1/8 inch.

5. Misalignment of Anchors, Inserts, Openings: 1/8 inch, maximum.

6. Bowing or Warpage of Units: 1/700 of panel dimension.

7. Exposed Joint Dimension: ¾ inch plus or minus 1/8 inch.

8. Location of Reglets: ¼ inch from true position.

E. Joint Sealing: Specified in Section 07900 – Sealants and Caulking.

3.02 CLEANING

A. No sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast units shall be cleaned using a cleaning detergent recommended by the sealer manufacturer and water applied with a soft bristle brush, and thoroughly rinsed using clean water or other approved procedures.

B. Units shall be cleaned when temperature and humidity conditions are such that surfaces dry rapidly (e.g., 70°*F* and rising, 50 percent Relative Humidity or less).

C. Discolorations which cannot be removed by these procedures shall be considered defective work, and repaired or replaced as directed by the Engineer.

D. Just before final acceptance by the Engineer, clean precast units to remove dirt and stains.

3.03 PROTECTION

Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

3.04 PRECAST PRESTRESSED CONCRETE SLAB BRIDGES

Transverse connections for precast deck units shall conform to the following requirements:

A. After the deck units are in final position, the anchor bars shall be mortared in and the mortar between the ends and in the keyways between the members shall be placed.

B. No equipment or other loads shall be allowed on spans that have mortar between the deck units or in the anchor bar holes that has been in place less than 72 hours.

C. Deck shear connector rods, shown as tie rods on the Plans, shall conform to the following:

1. Bolts, rods, nuts, and plate or beveled washers shall be structural steel; lock washers shall be ANSI heavy duty spring washers; and all metal shall be hot-dip galvanized after fabrication in conformance with the provisions in Section 75-1.05, "Galvanizing," of the CSS.

2. Openings for transverse connections shall be accurately placed and shall conform to the details shown on the Plans.

3. Nuts shall be tightened to a snug fit after the deck units are positioned and prior to placing mortar in the keyways.

4. Nuts shall be tightened after the mortar in the keyways between the units has been in place at least 24 hours. Threads at the ends of bolts or rods shall be burred to prevent loosening of the nut.

5. Where the ends of transverse rods will be exposed, the nuts and ends of rods shall be recessed so that all metal will be at least 1” inside the surface of the member. After the nuts have been tightened, the recess shall be filled with mortar.

3.05 PRECAST PRESTRESSED CONCRETE BRIDGE MEMBERS

Temporary lateral bracing shall be provided for precast girders. The bracing shall be installed at each end of each girder, except notched ends, prior to the release of the erection equipment from the girder and shall remain in place until 2 days after the concrete diaphragms have been placed. The bracing shall be adequate to prevent overturning of the girders prior to completion of the Work and as a minimum shall be capable of resisting a lateral force of 15 PSF of girder side area applied laterally in either direction to the top of the girder. Girder erection shall not be started until the temporary lateral bracing proposed for use by the Contractor has been approved by the Engineer.

Keyways shall be filled with Class 1 concrete, conforming with CSS Section 90-1, produced from aggregate with a 1 inch, maximum grading. The penetration of the concrete shall be near the lower limit of the specified nominal penetration. Keyways shall be mortar-tight before placing concrete. The concrete shall be thoroughly consolidated.

No equipment or other loads will be allowed on spans until at least 72 hours after the last mortar has been placed in the anchor dowel holes or the last concrete has been placed in the keyways.

Deck shear connector rods, shown as tie rods on the Plans, shall conform to the following:

A. Bolts, rods, nuts and plate or beveled washers shall be structural steel; lock washers shall be ANSI heavy duty spring washers; and all metal shall be hot-dip galvanized after fabrication in conformance with the provisions in Section 75-1.05, "Galvanizing," of the CSS.

B. Openings for transverse connections shall be accurately placed and shall conform to the details shown on the Plans.

C. Nuts shall be tightened to a snug fit after the deck units are positioned and prior to placing mortar in keyways.

D. Nuts shall be tightened after the mortar in the keyways between the units has been in place at least 24 hours. Threads at the ends of bolts or rods shall be burred to prevent loosening of the nut.

E. Where the ends of transverse rods will be exposed, the nuts and ends of rods shall be recessed so that all metal will be at least 1” inside the surface of the member. After the nuts have been tightened, the recess shall be filled with mortar.

The anticipated deflection and method to accommodate deflection of precast prestressed concrete girders, prior to the time the deck concrete is placed, shall be shown on the Plans in conformance with the provisions in General Requirements. The deflection shall include the following:

i. Anticipated upward deflection caused by the prestressing forces.

ii. Downward deflection caused by the dead load of the girder.

iii. Deflection caused by the creep and shrinkage of the concrete for the time interval between the stressing of the girders and the planned placement of the deck.

Such deflection shall be substantiated by calculations that consider the ages of the girder concrete at the time of stressing and the Contractor's planned placement of the deck. All deflection calculations shall be based on the concrete producer's estimate of the modulus of elasticity at the applicable concrete age.

Adjustments to accommodate girder deflections, which occur prior to the time the deck concrete is placed, may include revisions in bearing seat elevations, but any such adjustments shall be limited by the following conditions:

A. The minimum permanent vertical clearance under the structure as shown on the Plans shall not be reduced.

B. The profile grade and cross slope of the deck shall not be changed.

C. A minimum of 1 inch of deck slab concrete between the top of the precast girders and the deck slab reinforcement shall be maintained.

D. A minimum of 1 inch of deck slab concrete between the top of the expanded polystyrene in the area between the girder webs and the deck slab reinforcement shall be maintained.

Girders with unanticipated girder deflection and which cannot comply with conditions A, B, and C will be rejected in conformance with the provisions in General Requirements.

Adjustments to accommodate girder deflections will not be considered a change in dimensions. Full compensation for increases in the cost of construction, including increases in the quantity of deck or bearing seat concrete, resulting from adjustments to accommodate girder deflections shall be considered as included in the Contract price paid for the various items of work involved and no additional compensation will be allowed therefore.

END OF SECTION 03400

SITE CIVILTECHNICAL SPECIFICATIONS

DIVISION 4 - MASONRY

04100	REINFORCED MASONRY
04200	MORTAR AND GROUT FOR MASONRY WORK

SECTION 04100- REINFORCED MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description: The work under this section includes furnishing all labor, materials and equipment, and performing all operations in connection with all masonry work and concrete block indicated on the Drawings, specified herein, or reasonably required to complete all masonry work. Coordinate with other trades and install all embeds and inserts required.

B. Related Work: The following related work is described under other sections of these Specifications:

1. Section 03200 - Reinforcement Steel

2. Section 04200 - Mortar and Grout for Masonry Work

1.02 SUBMITTALS

A. Submit shop drawings indicating bar sizes, spaces, locations, quantities of reinforcement, bending and cutting schedules and spacing devices.

B. Submit product data on masonry units.

1.03 QUALITY CONTROL

A. Company specializing in performance of work of this Section for a minimum of 5 years. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Masonry work shall be inspected under the direction of a Registered Civil Engineer experienced in design of this work and licensed in the State of California.

1.04 DELIVERY AND STORAGE

A. All materials shall be delivered, stored and handled so as to prevent the inclusion of foreign materials and/or damage. Packaged materials shall be delivered and stored in original packages until ready for use. Packages or materials showing evidence of damage shall be rejected.

PART 2 - PRODUCTS

2.01 MASONRY UNITS

A. Concrete block shall be hollow concrete masonry units conforming to the requirements for Grade N units, Type I under ASTM Specification C 90.

B. Masonry units shall be 6”x8”x16” nominal as manufactured by Orco Block Co. or approved equal (909) 849-789).

1. Block types, sizes, and patterns as indicated on the Drawings.

2.02 MORTAR AND GROUT

A. Mortar shall be as specified in Section 04200 and shall develop a compressive strength of not less than 750 lbs. per square inch at seven (7) days or less than 1800 pounds per square inch at twenty-eight (28) days or as specified on the Plans. The total clay content, including that in the sand, shall not exceed 2 percent of the sand content or 6 percent of the cement content.

B. Grout fill for cells shall consist coarse grade. Minimum grout strength to be 2000 pounds per square inch (PSI) unless otherwise specified on the Plans.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Verify items provided by other Sections of work are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

D. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors per the Plans.

B. Provide temporary bracing during installation of masonry work as required. Maintain in place until building structure provides permanent bracing.

C. Preparation: Concrete surface to receive masonry shall be free from all dirt, oil, curling compound, or other deleterious substance. All such surfaces shall be thoroughly washed with water before laying block and shall be in a condition to provide maximum suction at the time the mortar bed is placed.

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. Lay concrete masonry units in running bond. One Course is one unit and one mortar joint and is equal to 8 inches. Form flush mortar joints. Do not use chipped or broken units.

3.04 ENVIRONMENTAL CONDITIONS

A. Do not place masonry units when air temperature is below 40°*F*.

B. Protect masonry from direct exposure to wind and sun when erected in ambient air temperature of 99°*F* or greater in the shade, with relative humidity less than 50%.

3.05 PLACING AND BONDING - CMU

A. General:

1. Do not commence installation of the work of this Section until horizontal and vertical alignment of foundation is within ½ inch of plumb and the lines shown on the Plans.

2. Use masonry saws to cut and fit masonry units.

3. Set units plumb, true to line, and with level courses accurately spaced.

4. Clean the top surface of foundation free from dirt, debris, and laitance, and expose the aggregate prior to start of installing first course of sandblasting or water blasting.

5. Accurately fit the units to plumbing, ducts, openings, and other interfaces, neatly patching all holes.

6. Keep the walls continuously clean, preventing grout and mortar stains. If grout does run over, clean immediately.

7. All bolts embedded in masonry shall be grouted in place with not less than 1 inch of grout between the bolt and a masonry unit and shall be accurately set with templates.

B. Do not use chipped or broken units. If such units are discovered in the finished wall, the Engineer shall require the immediate removal and replacement of the damaged units with new units at no additional cost to the Owner.

C. Laying Up: Pattern shall be running bond.

1. Place units in mortar with full shoved bed and head joints.

2. Align vertical cells of hollow units to maintain a clear and unobstructed system of flues.

3. Hold racking to an absolute minimum.

4. Provide running bond with vertical joints located at center of masonry units in the alternate course below.

5. Lay solid masonry units in full bed or mortar, with full head joints, uniformly jointed with other work.

6. Interlock intersections and external corners.

D. Buttering corners of joints or excessive furrowing of mortar joints shall not be permitted.

E. Remove excess mortar as Work progresses.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Cut mortar joints flush where resilient base is scheduled. Joints shall be 3/8 inch thick. Split block joints shall be raked.

I. Isolate masonry partitions from vertical structural framing members with a control joint.

J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 REINFORCEMENT AND ANCHORAGES - CONCRETE UNIT MASONRY

A. Install horizontal joint reinforcement 16 inches unless Plans note otherwise.

B. Place joint reinforcement continuous in first joint below top of walls or as illustrated on the Plans.

C. Lap joint reinforcement ends minimum 40 bar diameters. Install reinforcement in first horizontal course above openings. Extend minimum 24 inches each side of openings.

D. Support and secure reinforcing bars from displacement. Maintain position with ½ inch of dimensioned position. Provide metal accessories to ensure adequate alignment of steel during grout filling operations.

E. Embed anchors attached to structural steel members. Embed anchorages in every second block joint.

F. Reinforce joint corners and intersections with strap anchors 16 inches OC or as illustrated on the Plans.

3.07 GROUTED COMPONENTS

A. Support and secure reinforcing bars from displacement. Maintain position within ½ inch of dimensioned position.

B. Place and consolidate grout fill without displacing reinforcing. Solidly fill all cells and courses unless otherwise indicated on the Drawings. Maximum grout lift shall be 24 inches.

C. Consolidate grout at time of pour by puddling with mechanical vibrator to completely fit all voids and interstices in the masonry work.

3.08 ENGINEERED MASONRY

A. Lay masonry units with core cells vertically aligned clear of mortar and unobstructed.

B. Place mortar in masonry unit bed joints back ¼ inch from edge of unit grout spaces, bevel back and upward. Permit mortar to cure seven (7) days before placing grout.

C. Reinforce masonry unit cores with reinforcement bars and grout as indicated.

D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters or as illustrated on the Plans. See the Plans for indication of locations where splicing is unacceptable.

E. Wet masonry unit surfaces in contact with grout just prior to grout placement.

F. Grout spaces less than 2 inches in width with fine grout using low lift grouting techniques. Grout spaces equal to or greater than 2 inches in width with course grout using high or low lift grouting techniques.

G. When grouting is stopped for more than one (1) hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.

H. Low Lift Grouting: Place first lift of grout to a height of 16 inches and rod for grout consolidation. Place subsequent lifts in 8 inch increments and rod for grout consolidation.

3.09 CONTROL AND EXPANSION JOINTS

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

B. Install performed control joint devices in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions. Control joints shall be 12'-0" O.C. maximum.

3.10 BUILT-IN WORK

A. As work progresses, build in metal door frames, anchor bolts, plates, and other items furnished by other Sections.

B. Build in items plumb and level.

C. Bed anchors of metal doorframes in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build in organic materials subject to deterioration.

3.11 DEFECTIVE MASONRY OR MATERIALS

A. Any masonry materials delivered to the job site that do not conform to the requirements of these Specifications, shall be immediately removed from the Work. Completed masonry that does not conform to the requirements of the Plans and these Specifications shall be deemed defective materials and/or workmanship, and the Contractor shall remove it from the site, at no extra cost to the Owner.

3.12 CURING

A. All masonry work shall be kept continuously moist until and for not less than three (3) days after grouting. Curing water shall not be permitted to pond around buildings or structures.

3.13 TOLERANCES

A. Maximum Variation from Alignment of Columns: ¼ inch.

B. Maximum Variation from Unit to Adjacent Units: 1/32 inch.

C. Maximum Variation from Plane of Wall: ¼ inch in 10 feet and ½ inch in 20 feet or more.

D. Maximum Variation from Plumb: ¼ inch per story non-cumulative.

E. Maximum Variation from Level Coursing: 1/8 inch to 3 feet and ¼ inch in 10 feet; ½ inch in 30 feet.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.

3.14 CUTTING AND FITTING

A. Cut and fit for pipes, conduits, sleeves, and grounds. Coordinate with other Sections of work to provide correct size, shape, and location.

B. Obtain Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 CLEANING

A. Clean surfaces of masonry as required for proper application of the specified finishes.

B. Concrete Unit Masonry:

1, Use all means necessary to prevent staining of the exposed face by mortar, grout, and other material.

2. Remove mortar and grout stains as the work progresses.

3. Upon completion of the work of this Section, clean all exposed veneer surfaces with a 10% solution of muriatic acid in clear water, using fiber bristle brooms or brushes, followed by thorough rinsing with clear water.

4. In the event ordinary cleaning is not adequate, use a light sandblasting or other means as directed by the Engineer, and at no additional cost to the Owner.

5. Replace defective mortar. Match adjacent work.

3.16 CONTINUOUS INSPECTION

A. Masonry work shall be inspected during laying of masonry units, placing of reinforcing bars and grouting by the Engineer. The Engineer shall coordinate the obtaining of test samples with the approved Geotechnical Testing Consultant Firm employed by the Contractor. The Engineer shall check the materials, details of construction and construction procedures.

3.17 TEST

A. Test masonry prisms as per quantity and method in U.B.C. 7105.3.2.

B. Mortar shall be tested as per U.B.C. Standards.

C. Grout shall be tested as per U.B.C. Standards.

3.18 PROTECTION OF FINISHED WORK

A. Protect finished installation.

B. Without damaging completed work, provide protective boards at exposed external corners, which may be damaged by construction activities.

END OF SECTION 04100

SECTION 04200 - MORTAR AND GROUT FOR MASONRY WORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description:

1. Mortar and grout for masonry construction.

B. Related Work:

1. Section 04100 - Reinforced Masonry

1.02 SUBMITTALS

A. Submit product data and samples.

1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site. Protection of products delivered to the site.

B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperatures to minimum 40°*F* prior to, during, and 48 hours after completion of masonry work.

B. Protect construction from direct exposure to wind and sun when erected in ambient air temperature of 99°*F* or greater in the shade, with relative humidity less than 50%.

1.05 MIX TESTS

A. Testing of Mortar Mix: In accordance with ASTM C 780. Test mortar mix for compressive strength. Minimum compressive strength shall be 1,800 pounds per square inch.

B. Testing of Grout Mix: In accordance with ASTM C 1019. Test grout mix for compressive strength. Minimum compressive strength shall be 2,000 pounds per square inch. For this project, the contractor shall be required to compensate a Geotechnical Consultant for all costs to perform a minimum of four (4) separate compressive strength tests.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C 150, Type V.

B. Mortar Aggregate: ASTM C 144, standard masonry type.

1. Provide clean, sharp, well-graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter complying with UBC Standards.

2. Not less than 3% shall pass the No. 100 sieve.

C. Hydrated Lime: ASTM C207, Type S.

D. Grout "Coarse": 1 part Portland Cement to 2-1/4 parts minimum to 3 parts maximum of damp loose sand to 1/10 part lime putty and 2 parts coarse of maximum 3/8 inch aggregate with sufficient water to achieve fluid consistency per ASTM C476. Not less than 5% of the sand shall pass No. 100 sieve. Use in grout spaces 2 inches wide or more and in all filled cell construction.

E. Grout "Fine": 2-1/4 to 3 parts maximum damp, loose sand to 1/2 to 1/4 part lime putty with 1 part Portland Cement and sufficient water to achieve fluid consistent per ASTM C 476. Not less than 5% of the sand shall pass No. 100 sieve. To be used where shown on Plans and where grout space is less than 2 inches in the least dimension.

F. Water: Clean, potable and free from deleterious amounts of acids, alkalis and organic materials.

G. Lime Putty: Shall be made from pulverized (processed) quick lime or from hydrated lime.

2.02 COLOR

A. Mortar and Grout Color: Provide pre-ground mineral oxides, non-fading and alkali proof as manufactured by L.M. Scoffield or approved equal. **Color shall be selected by the County of Imperial. Contractor to submit color samples to the County for approval.**

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C 270 - Type S.

B. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

C. Do not use anti-freeze compounds to lower the freezing point of mortar. Do not use any admixtures unless specifically accepted in advance by the Engineer through the submittal process.

D. Use mortar within 2 hours after mixing at temperatures of 80°*F*, or 2-1/2 hours at temperatures under 50°*F*.

E. Mechanically mix in a batch mixer for not less than 3 minutes, using only sufficient water to produce a mortar which is spreadable and of a workable consistency.

F. Re-temper mortar with water as required to maintain high plasticity. Do not re-temper mortar after 1-1/2 hours following initial mixing.

2.04 GROUT MIXING

A. Mix concrete in accordance with ASTM C 94.

B. Add admixtures in accordance with manufacturer's instructions when previously approved. Provide uniformity of mix.

1. Waterproofing admixture shall be A.C. Horn's "Hydratite" or approved equal.

2. To reduce early water loss and produce expansive action admixture shall be Sika Grout Aid.

C. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Request inspection of spaces to be grouted. Do not proceed until all sub-surfaces and spaces are acceptable.

3.02 INSTALLATION

A. Install mortar and grout to requirements of the specific masonry Sections.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not displace reinforcement while placing grout.

D. Remove grout spaces of excess mortar.

END OF SECTION 04200

SITE CIVIL TECHNICAL SPECIFICATIONS

DIVISION 5 – METALS

05120	STRUCTURAL STEEL
05220	CONCRETE BOLTS
05500	MISCELLANEOUS METALS

SECTION 05120- STRUCTURAL STEEL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide structural steel beams, columns, bracings, galvanizing, and appurtenances, complete, in accordance with the Contract Documents.

1.02 RELATED SECTIONS

A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.

B. Related Work Specified in Other Sections:

1. Section 03200 - Reinforcement Steel.

2. Steel supports, hangars, brackets and other miscellaneous items accessory to the mechanical and electrical installations.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

B. Commercial Standards (Current Edition):

1.	AISC M 011	Manual of Steel Construction for Shop and Field Welding.
2.	AISC S 326	Design, Fabrication and Erection of Structural Steel for Buildings.
3.	AWS B 3.0	Welding Procedures and Performance Qualifications.
4.	AWS D 1.1	Structural Welding Code - Steel.
5.	AWS W 1	Welding Metallurgy

C. ASTM Standards in Building Code (Current Edition):

1.	ASTM A 6	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
2.	ASTM A 36	Structural Steel (Except “W” rolled shapes)
3.	ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
4.	ASTM A 325	High Strength Bolts for Structural Steel Joints
5.	ASTM A 490	Heat-Treated Structural Steel Bolts
6.	ASTM A 992	High Strength Structural Steel (“W” rolled shapes)

7. ASTM A 500 — Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall furnish submittals to the Engineer for review in accordance with the Specification Section 01300 – Contractor Submittals.

B. Shop Drawings and Erection Drawings: The shop drawings shall provide a materials and specification list, construction and fabrication details, layout and erect diagrams, and the method of anchorage to adjacent construction. The shop drawings shall give the location, type, size and extent of welding and bolted connections, and clearly distinguish between shop and field connections. Before submittal of the shop drawings, the Contractor shall coordinate the shop drawings and related trades to ensure proper mating of assemblies. All work shall conform to the approved shop drawings.

C. Test Reports: The Contractor shall furnish certified physical and chemical mill test reports for material used for structural members. All tests shall be performed in accordance with applicable ASTM Standards.

1.05 DELIVERY

A. The Fabricator shall deliver the fabricated material to the job site in the sequence as approved by the Engineer.

B. All shipped material to be piece-marked for erection with metal tags or other appropriate method approved by the Engineer.

C. All material shipments shall include sufficient bolts for erection, plus at least the following extra bolts:

1. Add a minimum of 5% for unfinished bolts.

D. The Engineer reserves the right to inspect fabricated material at Fabricator's shop. The Engineer's expenses for shop inspections shall be borne by the Contractor. In the event the Engineer identifies faulty materials or workmanship in fabricated material at the Fabricator's shop, the materials shall be re-fabricated at no cost to the Owner. The Engineer shall be notified at least 7 days before the shipment of material. Shipments of material shall not be delayed if the Engineer does not require inspection.

E. Material damaged in shipment shall be replaced or repaired at the Contractor's expense at no additional cost to the Owner.

1.06 QUALITY ASSURANCE

A. The Contractor shall fabricate and erect structural steel work in accordance with the latest edition of AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except whenever there is a discrepancy between the Plans and this Section, the Plans will govern.

B. Continuous Inspections:

1. The Contractor shall perform all welding and high strength bolting of structural steel assemblies under continuous inspection of the Engineer. Should such fabrication be performed in the shop of a licensed Fabricator approved by the Engineer, only the field welding and high strength bolting of structural steel assemblies will be required to be performed under continuous inspection of the Engineer.

2. The Contractor shall notify the Engineer at least 48 hours in advance of the needed inspection.

3. The Contractor shall provide copies of inspection reports to the Engineer and Building Department, if applicable.

1.07 WARRANTY

A. The Fabricator shall furnish a warranty to the Owner to replace or repair all defective material and workmanship within 18 months of shipment, or 12 months of plant startup, whichever occurs first, excluding defects due to normal usage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: All materials shall be new, sound and conform to the requirements herein. Unless otherwise indicated, structural steel shall be coated per Technical Specification - Division 9 requirements.

B. Structural Steel: Rolled shapes, plates and bars shall conform to the latest edition of the AISC "Manual of Steel Construction", and shall also conform to current ASTM Designation A 36. All "W" rolled shapes shall conform to A 992.

C. Pipe: Pipe shall conform to ASTM A 53, Grade B seamless galvanized as required, Schedule 40, except as otherwise shown on the Plans.

D. Tubes: Tubes shall conform to ASTM A 500 Grade B.

E. Welding Electrodes: The Contractor shall use steel electrodes conforming with AWS D 1.1, except that E7024 rods or electrodes shall not be used.

2.02 FABRICATION

A. Fabrication shall be in accordance with AISC S 326 and indicated requirements. All structural steel welding in off-site fabrication shops shall be continuously inspected by the Engineer with the inspection cost of the Engineer to be borne by the Contractor. The continuous inspection will be waived if the work is done in a shop certified by the Council of American Building Officials (CABO), or listed by the International Conference of Building Officials (ICBO) Evaluation Services, Inc.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Structural assemblies and shop and field welding shall meet the requirements of AISC M 011 and AISC S 326.

2. Measurements and dimensions shall be verified by the Contractor at the site.

3. Bolt holes shall be 1/16 inch larger than the nominal size of bolts. Where thick metals are indicated, holes shall be sub-punched and drilled, or reamed.

4. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.

5. Bolts shall not be permitted to drift, and holes shall not be enlarged to correct misalignment. In the event of mismatching of holes, new materials shall be provided.

6. Structural steel completely encased in concrete shall not be galvanized or painted, and shall have a clean surface for bonding to concrete.

7. Damaged structural steel shall be replaced. Use of salvaged, reprocessed, or scrap materials shall not be permitted.

B. Welding: Welding shall be performed by operators who have been qualified by tests as prescribed by AWS-W1 Section 7, to perform the type of welding indicated. Welding shall comply with AWS Code for Arc Welding in Building Construction, Section 4, Workmanship. Electrodes shall be matching per AWS.

C. Coating: The Contractor shall coat structural steel in accordance with Technical Specification - Division 9 requirements.

3.02 INSPECTION

A. The Engineer reserves the right to inspect all materials and workmanship covered in this Specification. However, such inspection shall not relieve the Contractor of his responsibility to furnish materials and workmanship in accordance with the Contract requirements. If inspection indicates a weld or part of the material is defective, the Contractor shall remove and replace it at the Contractor's expense.

B. Shop inspection may include, but not be limited to, the following:

1. Verification of conformance of materials with this Specification and the Plans. The limits of acceptability and repair of surface imperfections for structural steel shall be in accordance with ASTM A 6.

2. Visual and dimensional inspection of shop-fabricated structural steel members and assemblies shall be in conformance with this Specification and the Plans.

3. Verification of welding procedures, welding operations and welder and tacker certificates of qualification shall be in accordance with this Specification and AWS D 1.1.

END OF SECTION 05120

SECTION 05220 - CONCRETE BOLTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide concrete anchor bolts, inserts, complete, in accordance with the Contract Documents. Principal items are anchor bolts placed in concrete, adhesive anchors, expansion bolts, and drilled anchors.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

C. Federal Specifications:

1.	MIL-A-907E	Antiseize Thread Compound, High Temperature

D. Commercial Standards (Current Edition):

1.	American Welding Society AWS A 5 Series.	
2.	ANSI/AWS B 3.0	Welding Procedure and Performance Qualifications
3.	ANSI/AWS D 1.1	Specification for Welding Code - Steel
4.	ANSI/AWS D 1.3	Specification for Welding Sheet Steel in Structure
5.	AISC	American Institute of Steel Construction - Manual of Steel Construction

E. ASTM Standards in Building Codes (Current Edition):

1.	ASTM A 36	Specification for Structural Steel
2.	ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3.	ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A 193	Specifications for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
5.	ASTM A 194	Specifications for Carbon and Alloy Steel Nuts for Bolts and High Pressure and High Temperature Service
6.	ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile

7.	ASTM A 320	Specification for Alloy Steel Bolting Materials for Low-Temperature Service
8.	ASTM A 563	Specification for Carbon and Alloy Steel Nuts

1.04 CONTRACTOR SUBMITTALS

A. Shop Drawings: Shop drawings of all concrete bolts shall be submitted to the Engineer for review in accordance with the Specification Section 01300 – Contractor Submittals.

B. An International Conference of Building Officials (ICBO) report listing the ultimate load capacity in tension and shear for each size and type of adhesive and expansion concrete anchor used shall be submitted for review. The Contractor shall submit manufacturer's recommended installation instructions and procedures for all adhesive and expansion anchors for review and approval. The Contractor shall follow approved procedures during installation of concrete anchors.

C. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICBO report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75°*F*.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Anchor Bolts: Anchor bolts shall be fabricated of materials complying with SSPWC Subsections 206-1.4.1 and 209-2.2, and as follows:

1. Steel bolts: ASTM A 307 Grade A.

2. Fabricated steel bolts: ASTM A 36.

3. Stainless steel bolts, nuts, washers: ASTM A 320, Type 316.

B. Standard Service Bolts (not Buried or Submerged): Except where otherwise indicated, all bolts, anchor bolts, and nuts shall be steel, galvanized after fabrication as indicated herein unless the bolts are for pipe fittings, transition couplings, mechanical restrained joint fittings, flanged coupling adapters or other piping or piping fittings. The bolts and hardware for these items are specified in Section 02650. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 307, Grade A or B, or threaded parts of ASTM A 36.

C. Buried or Submerged Bolts: Unless other corrosion-resistant bolts are indicated, all bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be Type 316 stainless steel conforming to ASTM A 193 for bolts, and to ASTM A 194 for nuts, unless the bolts are for pipe fittings, transition couplings, mechanical restrained joint fittings, flanged coupling adapters or other piping or piping fittings. The bolts and hardware for these items are specified in Section 02650. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E.

1, Antiseize lubricant shall be classified as acceptable for potable water use.

2. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131; AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or equal.

D. Bolt Requirements:

1, The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads, and nuts shall be Heavy Hexagon Series.

3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case, more than ½ inch beyond the nut.

E. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1, Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Epoxy anchor grout shall comply with Section 03315 - Grout. Threaded rod shall be stainless steel Type 316.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not indicated above, and shall be Hilti HVA, or equal. Threaded rod shall be galvanized steel.

F. Expanding-Type Anchors: Expanding-type anchors, if indicated or permitted, shall be steel expansion-type ITW Ramset/Redhead "Trubolt" anchors; McCullock Industries "Kwick-Bolt"; or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Expansion-type anchors, which are to be embedded in grout, may be steel. Nonembedded buried, or submerged anchors shall be stainless steel.

G. Powder-Driven Pins: Powder-driven pins for installation in concrete shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded-heads capable of transmitting the loads the shanks are required to support.

H. Impact Anchor: Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force. It shall have a zinc sleeve with a mushroom-style head and stainless steel nail pin. Anchors shall be Metal Hit Anchors, manufactured by Hilti, Inc.; Rawl Zamac Nailin, manufactured by the Rawlplug Company, or equal.

2.02 GALVANIZING

A. Iron and Steel: ASTM A 123, with average weight per square foot of 2.0 ounces, and not less than 1.8 ounces per square foot.

B. Ferrous Metal Hardware Items: ASTM A 153 with average coating weight of 1.3 ounces per square foot.

C. Touch-Up Material For Galvanized Coatings: Repair galvanized coatings marred or damaged during erection or fabrication by use of DRYGALV, as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or equal, applied in accordance with the manufacturer's instructions.

2.03 WELDING ELECTRODES

A. Steel Electrodes: Use welding electrodes conforming with AWS D 1.1, except E7024 rods or electrodes shall not be used.

B. Aluminum Electrodes: Contingent upon alloys being welded, use only inert gas-shielded arc or resistant-welding process with filler alloys conforming to UBC Standard No. 28, Table 28-1-C. Use no process requiring a welding flux.

C. Stainless Steel Electrodes: Perform welding of stainless steel with electrodes and techniques as contained in pertinent AWS A5 series specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Installation: Except as otherwise indicated, the fabrication and installation of anchor bolts shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".

B. Install adhesive expansion and drilled anchor bolts in accordance with method specified in ICBO for manufacturer product.

C. Powder-Driven Pins: Powder-driven pins shall be installed by a craftsman who is certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = Pin's shank diameter:

Material Penetrated by Pin	Material's Minimum Thickness	Pin's Shank Penetration in Supporting Material	Minimum Space From Pin's CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D minimum	14D	20D

3.02 WELDING

A. Perform all welding in accordance with the "Structural Welding Code-Steel", AWS D 1.1, and current revisions. Use only welders qualified by tests in accordance with AWS B 3.0.

3.03 GALVANIZING

A. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using “Galvinox”, “Galvo-Weld”, or equal.

3.04 INSPECTION

A. The Engineer reserves the right to inspect all materials and workmanship covered in this Section. Such inspections will not relieve the Contractor’s responsibility to furnish materials and workmanship in accordance with the Specifications. If inspections indicate that materials or workmanship are defective, the Contractor shall remove and replace the defective work at no additional cost to the Owner.

END OF SECTION 05220

SECTION 05500 - MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide miscellaneous metals and appurtenances, complete, in accordance with the Contract Documents.

B. Work Included in This Section: Principal items are:

1. Shop/erect drawings and samples.

2. Metal grating with incidental supports and attachments.

3. Steel channels and/or angle frames and thresholds with anchors.

4. Welding electrodes.

5. Pipe supports with saddles, hangers, bracing and attachments as detailed and required, except as provided by other trades.

6. Miscellaneous iron and steel items indicated, specified, or required for completion of the Contract, unless included under other Sections.

7. Coating, including field touch-up.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of the following Sections apply to the Work of this Section. Other, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 03200 - Reinforcement Steel

2. Section 03300 - Cast-in-Place Concrete

3. Section 03315 - Grout

4. Section 05120 - Structural Steel

5. Section 05220 - Concrete Bolts

6. Steel supports, hangers, brackets and other miscellaneous items accessory to mechanical and electrical installations indicated on the Plans, or covered in Divisions 15 and 16.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

C. Except as otherwise indicated, the current editions of the following Federal Specifications apply to the Work of this Section:

1.	QQ-F-461	Floor Plate, Steel, Rolled.
2.	MIL-G-18015 A	(Ships) Aluminum Planks, (6063-T6).
3.	MIL-A-907E	Antiseize Thread Compound, High Temperature.

D. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

1. Commercial Standards:

AA-M32C22A41	Aluminum Association
AASHTO	HS-20 Truck Loading
AISC	Specification for Design, Fabrication and Erection of Structural Steel for Buildings with Commentary and Code of Standard Practice for Steel Buildings and Bridges.
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ANSI/AWS D 1.1	Structural Welding Code - Steel
ANSI/AWS D 1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Specification for Qualification and Certification of Welding Inspectors
NFPA 101	Life Safety Code
NAOMM	Metal Stairs Manual
AWS-AS	Welding of Stainless Steel with Electrodes and Techniques

2. ASTM Standards in Building Codes:

ASTM A 36	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
ASTM A 193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
ASTM A 276	Specification for Stainless Steel Bars and Shapes
ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile
ASTM A 320	Specification for Alloy-Steel Bolting Material for Low-Temperature Service
ASTM A 424	Specification for Steel, Sheet, for Procelain Enameling
ASTM A 500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 536	Specification for Ductile Iron Casting
ASTM A 563	Specification for Carbon and Alloy Steel Nuts
ASTM A 569	Specification for Steel, Carbon (0.15 Maximum Percent), Hot Rolled Sheet and Strip Commercial Quality
ASTM A 575	Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 786	Specification for Rolled Steel Floor Plates
ASTM B 98	Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B 210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B 221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 438	Specification for Sintered Bronze Bearings (Oil-Impregnated)

3. Trade Standards:

Welded Austenitic Chromium-Nickel Stainless Steel Technique and Properties, as published by the International Nickel Company, Inc., New York, New York.

Procelain Enamel Institute, Inc.

1.04 CONTRACTOR SUBMITTALS

A. Shop Drawings: Shop drawings shall be submitted in accordance with Section 01300 – Contractor Submittals.

B. Layout Drawings: Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.

1.05 QUALITY ASSURANCE

A. Miscellaneous metals shall be fabricated and erected in accordance with the latest edition of the AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except whenever there is a discrepancy between the Plans and this Specification, the Plans shall govern.

B. Aluminum work shall be fabricated and erected in conformance with applicable requirements of the UBC and referenced standards of the Aluminum Association.

C. Continuous Inspections: All welding and high strength bolting of structural steel assemblies shall be conducted under the continuous inspection of an International Conference of Building Officials (ICBO) certified "Special Inspector" selected by the Owner with costs borne by the Contractor. Should such fabrication be performed in the shop of a licensed fabricator approved by the governing building official and certified by the ICBO Evaluation Services, Inc., only the field welding and high strength bolting of structural steel assemblies will be required to be performed under continuous inspection of the ICBO-certified "Special Inspector". The Engineer shall be notified at least 48 hours in advance of inspections. Copies of inspection reports shall be provided to the Owner, Contractor and Engineer and governing building official.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel: Structural steel shall be coated per Technical Specification - Division 9 and conform to the following requirements:

1.	Shapes, Plates, Bars	ASTM A 36
2.	Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B Schedule 40, unless noted otherwise.
3.	Tubes	ASTM A 500, Grade B

B. Aluminum: Aluminum structural shapes shall be new and conform to applicable Federal Specification for 6061-T6 alloy, unless otherwise noted. Aluminum Pipe shall conform to Schedule 40, or greater, unless otherwise noted.

C. Stainless Steel: Unless otherwise designated or approved, stainless steel alloy types shall conform to ASTM A 167 and ASTM A 276 as follows:

1. Stainless steel plates, pipe and structural shapes: Type 316L.

2. Stainless steel bolts, nuts and washers: Type 316L where connecting or bearing on aluminum.

D. Cast Iron: Cast iron shall conform to ASTM A 48, except as otherwise noted.

E. Ductile Iron: Ductile iron shall conform to ASTM A 536, using Grade 60-40-18 or better, except as otherwise noted.

2.02 METAL GRATING

A. General: Metal grating shall be of the design sizes, and types indicated. All grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners. Grating shall conform to the following requirements:

1. All pieces of grating shall be fastened in two locations to each support.

2. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 1/4 inch or the span divided by 180, whichever is less. The loading to be used for determining stresses and deflections shall be the uniform live load 125 PSF, or a concentrated load of 1,000 pounds.

B. Grating Materials: Grating materials shall conform to the following requirements:

1. Grating material shall be of welded steel, coated after fabrication or aluminum as indicated in the Plans. Cross bars shall be welded in position.

a) Steel grating shall be coated per Technical Specification - Division 9.

2. No single piece of grating shall weigh more than 50 pounds, unless indicated otherwise. Grating shall be serrated bar grating.

3. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.

C. Grating Fastening Devices: For metal gratings, either welded or mechanical attachments shall be used.

2.03 WELDING ELECTRODES

A. Steel Electrodes: Welding electrodes shall conform with AWS D 1.1, except E7024 rods or electrodes shall not be used.

B. Aluminum Electrodes: Contingent upon alloys being welded, only inert gas-shielded arc or resistant-welding process with filler alloys conforming to UBC Standard No. 28, Table 28-1-C shall be used. No process requiring a welding flux shall be used.

C. Stainless Steel Electrodes: Welding of stainless steel with electrodes and techniques shall conform to the pertinent AWS A 5 series specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

2.05 BOLTS

A. Bolt Requirements: Bolts shall comply with the following:

1. Nuts shall be capable of developing the full strength of bolts. Threads shall be Coarse Thread Series conforming to the requirements of the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than ½ inch beyond the nut.

B. Standard Service Bolts: Except where otherwise indicated, bolts and nuts shall be stainless steel.

2.06 MANUFACTURERS

A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

1. Grating:

a) McNichols.

b) Owner approved equal.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".

1. The Work of this Section shall be coordinated with related trades. Particular attention is required for items to be embedded in concrete work. All punchings and drillings, indicated or required, shall be provided for attachment of other work to that of this Section.

2. Compliance with Safety Requirements. Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangars and etc., which are not shown on the Plans, shall conform to the Division of Occupational Health and Safety, General Industrial Safety Orders, State of California.

B. Protection: The Contractor shall provide and be responsible for protection and repair of adjacent surfaces and areas which may become damaged as a result of work in this Section. Work performed hereunder shall be protected until completion and final acceptance of project by the Engineer. The Contractor shall repair or replace all damaged or defective work to original specified condition at no additional cost to the Owner.

1. Finished floor surfaces and adjacent work shall be protected from damage. Concrete floors shall not be overloaded. Mobile equipment used in placing steel shall have pneumatic tires. Steel members shall not be placed directly on floors; pads of timber or other material shall be used for cushioning.

2. Where welding is completed in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

C. Pipe and Conduit Supports and Bracing: Supports and bracing for pipe and conduit shall be fabricated and installed as detailed on the Drawings and in a fully coordinated manner with the Work of other trades. Where shown or indicated, hot-dip galvanized shall be provided after fabrication, with touch-up of abraded or burned galvanizing using materials specified in this Section.

D. Embedded Steel Channel and Angle Frames: Embedded steel channel and angle frames shall have continuously welded joints. Exposed welds shall be ground flush.

3.02 WELDING

A. Welding Steel: Welding shall be performed in accordance with the "Structural Welding Code - Steel", AWS D 1.1, and current revisions, except where the Gas Metal Arc Welding (GMAW) process is used, the short-circuited mode shall only be used for light gauge material (12 gauge and lighter). Welders shall be qualified by tests in accordance with AWS B3.0.

3.03 COATING

A. All structural steel plates, shapes, bars and fabricated assemblies shall be coated per Technical Specification - Division 9.

END OF SECTION 05500

SITE CIVIL TECHNICAL SPECIFICATIONS

DIVISION 6 - FENCING

SECTION 06100
FENCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ornamental Fencing.

1.2 RELATED SECTIONS

A. Section 02200 - Earth Moving.

B. Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

A. ASTM A 653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM A 787 - Standard Specification for Electric-Resistance-Welded Metallic- Coated Carbon Steel Mechanical Tubing.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300 – Contractor Submittals.

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 plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic and maintenance of all operating components.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with a minimum of 5 years documented experience with ornamental fencing of the type and scale specified.

B. Installer Qualifications: Installer with a minimum of 5 years documented experience with ornamental fencing of the type and scale specified.

C. Mock-Up: Provide a mock-up for evaluation and application workmanship.

1. Do not proceed with remaining work until workmanship and color are approved by County.
2. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

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

B. Identify each package with manufacturer's name.

C. Store fence material and accessories in secure and dry place.

1.7 WARRANTY

A. Provide manufacturers 10 Year Limited Warranty for Ornamental Fencing.

B. Provide manufacturers 10 Year Limited Warranty for Ornamental Gates.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Iron World Manufacturing, LLC, which is located at: 9390 Davis Ave.; Laurel, MD 20723; Toll Free Tel: 866-310-2747; Tel: 301-776-7448; Fax: 301-776-7449;; Web:www.ironworldfencing.com

B. Substitutions: Permitted, submit for review by Project Engineer/Project Architect or County as applicable.

C. Requests for substitutions will be considered in accordance with provisions of project specifications manual.

2.2 ORNAMENTAL FENCING

A. Commercial: Maverick-C (Commercial) with a 15 gauge channel. Each pickets is fastened to rails with 1/4 inch industrial aircraft drive rivets that provide the strength of a welded product without rusting. Maverick-C sections can rack up to 24 inches on a standard punch channel.
1. Style:
   a. Aberdeen with smooth top rail.
2. Height: 6 feet.
3. Width, Nominal Center to Center of Posts: 8 feet.
4. Color:
   a. Custom color as selected by the County.
5. Rails
   a. Two rail.
6. Pickets: Spaced at 3-15/16 inch face to face.
   a. Size:
      1) 1 inch square.
   b. Thickness:
      1) 16 gauge.
7. Posts:
   a. Size/Thickness:
      1) 3 inch square, 12 gauge.
8. Horizontal rail Trim:
   a. 4 inch rings.
   b. 9 inch rings.
   c. 4 inch diamonds.
   d. 9 inch diamonds.

9. Finials
    a. Spear
    b. Ball
    c. Fleur
10. Brackets
    a. Swivel
    b. Straight

2.3 SLIDE GATES

A. Ornamental Slide Gates:
    1. Style:
        a. Aberdeen:
            1) Single Sliding.
    2. Height: 6 feet.
    3. Width, Nominal Center to Center of Posts: 5 feet.
    4. Color:
        a. Custom color as selected by the County.
    5. Gate Frame: Fabricated of aluminum alloy 6063-T6. All square members are 2 inches square weighing 0.94 lb/ft and conforms to ASTM B 221. Frame is welded to top one piece track and top frame member. Provide with 2 swivel type 8 bearing truck assembles for each leaf. Overhang is a minimum of 40 percent of opening size.
    6. Interior horizontal rails and pickets.
        a. Fabricate of aluminum "U" channels 1-3/8 inches wide by 1-1/2 inches high and 11 gauge metal thickness. Rails are punched to receive pickets and rivets and welded inside vertical external uprights. Pickets are riveted to "U" channel using 1/4 inch industrial drive rivets. Pickets are welded to horizontal members.
            1) Bracing: Provide diagonal adjustable length truss cable to prevent sagging. Provide one cable in each direction per 8 feet maximum of gate length.
            2) Track: Provide an enclosed combination Easy Glider track and top rail aluminum extrusion weighing 3.72 lb/ft that will withstand a 2,500 lb reaction load.
        b. Pickets: Pickets are galvanized steel spaced at 3-15/16 inches face to face.
            1) Size:
                a) 1 inch square.
            2) Thickness:
                a) 18 gauge.
    7. Truck Assembly: Swivel type with a galvanized steel base unit and 8 lubricated and sealed ball bearing rollers. Each roller is 2 inches in diameter and 9/16 inch in width. Truck shall have 2 galvanized steel side rollers to assure alignment in track. Truck assemblies are held to post brackets using a 1/2 inch galvanized bolt and will withstand a 2,500 lb. reaction load. Brackets are galvanized steel and will withstand a 5000 lb. reaction load.
    8. Hardware: Provide with galvanized steel gate latch and keepers.
    9. Posts: Gate posts are 4 inches square and weight 5.77 lb/ft.
        a. Single gates with single tracks require 3 gate posts (1 latch post and 2 support posts).
        b. Single gates with dual tracks require 5 gate posts (1 latch post and 2 dual support posts).
        c. Double gates with single tracks require 4 gate posts (4 support posts).
        d. Double gates with dual tracks require 8 gate posts (4 dual support posts).

2.4 MATERIALS

A. Fence Posts: Galvanized square steel tubular members in conformance with ASTM A 787 with a G90 zinc coating of 0.90 oz/sf and steel with a 45,000 psi (310 MPa) yield strength.

B. Gate Posts: Galvanized square steel tubular members in conformance with ASTM A 653 with a G90 zinc coating of 0.90 oz/sf and steel with a 45,000 psi (310 MPa) yield strength.

C. Gates and Gate Frames: As specified.

D. Finish:
1. All steel parts to be galvanized to prevent corrosion.
2. Pre-treat and clean surfaces to accept finish coat.
3. Coat with TGIC polyester resin powder applied by the electrostatic spray process to 3.0 mil thickness.
4. Finish is baked for 15 to 20 minutes at a temperature of 400 degrees F.

2.5 CONCRETE FOOTINGS

A. General: Comply with ACI 301 for cast-in-place concrete; materials consisting of Portland cement complying with ASTM C150, aggregates complying with ASTM C33, and potable water.

B. Concrete Mixes: Normal-weight concrete air entrained with not less than 3000-psi (20.7-MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.

C. Footings: Footings shall be minimum 3,000 psi after twenty-eight days concrete. Footing sizes shall be determined by Engineer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until boundaries and grading has been properly prepared.

B. Verify that property lines and legal boundaries of work are clearly established.

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

3.2 PREPARATION

A. Clean and or prepare surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set post uniformly as indicated on the Drawings.

C. Set posts plumb in concrete having a diameter 4 times the diameter of the post, and 6 inches deeper than the bottom of the post. Forms are not necessary or recommended.

D. Check each post for vertical and top alignment.

E. Attach panels to brackets using one way security bolts.

F. Install and secure specified post tops

G. Install gate posts a minimum of 36 inches into firm soil. Diameter of the footing shall be a minimum of 4 times the diameter of the post. Footing shall be 6 inches deeper than the bottom of the posts, or a minimum of 42 inches. Finish concrete with a slope for all water to drain away from post.

H. Attach all hardware to gate in such a way that it cannot be removed by unauthorized persons.

I. Adjust gate as required. Make sure that gate rolls smoothly free of binding.

J. Attach latch and make sure that gate is received by latch in a secure manner.

K. Install privacy panels in accordance with the manufacturer's instructions.

3.4 ERECTION 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.

3.5 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION

SECTION 06200
ELECTRIC GATE OPERATOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric Gate Operators:
   1. Heavy-duty, industrial, gear-driven slide gate operators (LiftMaster Model SL595).

1.2 RELATED SECTIONS

A. Section 06100 - Fencing.

B. Section 03300 - Cast-in-Place Concrete: Concrete mounting pads.

C. Division 26 - Electrical.

1.3 REFERENCES

A. National Electrical Manufacturers Association (NEMA): NEMA ICS 6 - Industrial Control and Systems: Enclosures.

B. Underwriters Laboratories (UL): UL 325 - Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

C. Underwriters Laboratories (UL): UL 991 - Standard for Tests for Safety-Related Controls Employing Solid-State Devices.

D. International Organization for Standardization: ISO 9001 - Quality Management Systems.

1.4 SUBMITTALS

A. Product Data: Equipment list, system description, electrical wiring diagrams for installation, and 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.

B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge conditions, and accessories.
   1. Operation, installation, and maintenance manuals including wiring diagrams.
   2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials and products in strict compliance with manufacturer's instructions and industry standards.

B. Store products indoors in manufacturer's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 Certified Manufacturer.

B. Installer Qualifications: Installation performed by factory authorized contractor specifically trained in gate operation systems of the type found within this section.
   1. Provide documentation of maintenance and repair service availability for emergency conditions.
   2. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.7 WARRANTY

A. Manufacturer's Standard Limited Warranty:
   1. Warranty Period: 2 years.
   2. Warranty Period: 2 years for operator, 10 years for operator frame.
   3. Warranty Period: 3 years for residential applications.
   4. Warranty Period: 5 years.
   5. Warranty Period: 5 years for commercial applications, 7 years for residential applications.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: LiftMaster, which is located at: 300 Windsor Dr.; Oak Brook, IL 60523; Toll Free Tel: 800-282-6225; Fax: 630-516-8412; Email:request info (specs@liftmaster.com); Web:LiftMaster.com

B. Substitutions: County approval required.

2.2 GATE OPERATORS

A. Gate Operators: LiftMaster SL595 Industrial Gear-Driven Slide Gate Operator.
   1. Compliance: UL Listed. Compliant to the UL 325, UL 991 and CSA C22.2 No. 247 standards.
      a. This model is intended for use in Class I, II, III and IV vehicular slide gate applications.
      b. To be UL 325 compliant, two independent safety entrapment protection devices must be installed at each entrapment zone (the inherent reversing system in this gate operator counts as one device). Devices such as monitored photo eyes or edge sensors are required to be installed with this operator.
      c. Only LiftMaster monitored photo eyes or edge sensors may be used with this operator to meet the UL 325 Standard.
   2. Monitored Safety Inputs: 3 inputs per board (main board and expansion board) totaling 6 inputs with any combination of up to:
      a. Main Board:
         1) 1 Monitored Close Photo Eye input
         2) 1 Monitored Open Photo Eye input
         3) 1 Monitored Open Safety Edge or Open Photo Eye input
      b. Expansion Board
         1) 2 Monitored Safety Edge or Photo Eye inputs (selectable for Open or Close).
         2) 1 Monitored Photo Eye input (selectable for Open or Close).
      c. 8 Monitored edges available when Transceiver is added.
   3. Warranty: 2 years.
   4. Operator Speed: 12 inches (305 mm) per second.
   5. Electrical Power Requirements:
      a. 115/208/230V AC, single phase, 60 Hz.
      b. 208/230/460/575V AC, 3-phase, 60 Hz.
   6. Accessory Electrical Power Requirements: 24V AC.

a. Main Board: 12V AC, maximum 500mA.
b. Terminal Strip:
    1) 2.2A maximum for 115/208-230V AC, single phase.
    2) 2.2A maximum for 208/230-460 V AC, three phase
    3) 1.3A maximum for 575V AC, three phase

7. Gear Reduction: 20:1 wormgear reducer in synthetic oil bath.
8. Motor: Switchless 1 HP, continuous duty
    a. Capacity: Supports gate lengths up to 70 feet (21.5 m) and gate weights up to 1,700 pounds(71 kg).
    b. Recommended Cycles per Hour: 25.
9. Motor: Switchless 1 1/2HP, continuous duty (115/230V, single phase only).
    a. Capacity: Supports gate lengths up to 80 feet (24.4 m) and gate weights up to 2,100 pounds (953 kg).
    b. Recommended Cycles per Hour: 25.
10. Motor: Switchless 2 HP, continuous duty (208/230/460/575V, 3- phase only).
    a. Capacity: Supports gate lengths up to 80 feet (27.4 m) and gate weights up to 2,500 pounds (1134 kg).
    b. Recommended Cycles per Hour: 25.
11. Metal Frame: 7 gauge pre-galvanized steel.
12. Chassis: Powder-coated galvanized steel.
13. Enclosure: NEMA 3R enclosure; oil-tight, weatherproof NEMA 3R cabinet, lockable.
14. Chain: #50 nickel-plated, 25 feet (7620 mm) supplied with each unit.
15. Gearbox: All-weather.
16. Internet Connectivity: MyQ Technology.
    a. 902 to 928 MHz
    b. 50-channel FHSS (Frequency Hopping Spread Spectrum).
    c. LiftMaster 828LM Internet Gateway enables monitoring and control of gate operators via internet-enabled smartphone, tablet or computer
    d. Provides two-way communication between gate operator and MyQ accessories to enable remote open, close and monitoring of gate.
17. Receiver:
    a. Security+ 2.0 3-channel on-board radio receiver, holds up to 50 remote controls (unlimited with use of 811LM/813LM), HomeLink compatible
    b. Transmits 310 MHz, 315MHz, 390 MHz
18. Inherent Reversing Sensor: Utilizes Current Sense and RPM Sensor to detect obstructions or increased loads. Reverses gate when closing or stops/reverses the gate when opening.
19. Lockout/Tagout: Prevents power from being switched on when servicing operator. Safeguards workers from high voltage power.
20. Wireless Dual-Gate Operation:
    a. Built-in wireless communication will operate primary and secondary operator without having to run a communication wire.
    b. Support for through-beam photo eye in the wireless dual-gate setup. Can attach emitter and receiver to each operator, eliminating the communication wire between them.
21. LED Diagnostic Display: Simplifies installation and troubleshooting.
22. Colored Terminal Blocks: Provides easy identification of safety and fire department inputs.
23. Programmable Auxiliary Relays: 2 programmable relays with 6 settings each.
    a. Pre-warning or gate-in motion sounder
    b. Switch on/off devices at open or Close Limits or while gate is in motion.
    c. Tamper detection if gate is pushed off Close Limit
    d. Cycle quantity feedback.
    e. Red/Green Light to control gate traffic.
24. Quick Close, Anti-Tailgate: Quickly secures property, preventing unauthorized access.
25. Sequenced Access Management: Capable of sequentially controlling the operator in

tandem with a barrier gate.

26. Surge/Lightning Protection: Industrial Surge Protection on high and low voltage inputs. Protects against lightning strikes at a 50-foot (15.2m) radius.
27. Plug-in Loop Detector Inputs: Programmed inputs for shadow, interrupt and exit.
28. External Alarm Reset Button: Allows for quick reset of the gate operator when the alarm has been activated.
29. Warning Device: UL 325 compliant entrapment warning alarm has ability to be set for pre-operation warning; provides a 3-second warning prior to and during gate movement.
30. Maximum Run Timer: Protects against damage to the gate and operator by limiting the unit's runt time to 120 seconds.
31. Lockable External Manual Disconnect: Allows gate to be opened in the event of a power loss without removing the operator cover.
32. Mechanical Braking: the mechanical braking system adds substantial gate position control at all points in travel. The solenoid-actuated b rake system also prevents the gate from being back-driven
33. Friction Clutch: Adjustable friction clutch helps protect gate and operator from damage should the gate meet an obstruction.
34. Limit Settings: Driven limit nut switches are fully adjustable to provide precision, accuracy and reliability.
35. Operating Temperature Range:
    a. Without heater: -4 degrees F (-20 degrees C) to 140 degrees F (60 degrees C).
    b. With optional heater: -40 degrees F (-40 degrees C) to 140 degrees F (60 degrees C).
36. MyQ Enabled Accessories:
    a. LiftMaster 828LM Internet Gateway: Allows remote monitoring from internet-enabled computer, tablet or smartphone.
    b. LiftMaster 829LM Garage and Gate Monitor: Allows remote monitoring and operation.
    c. LiftMaster 823LM Remote Light Switch: Controls light remotely
    d. LiftMaster 825LM Remote Light Control: Allows remote monitoring and operation.
37. Accessories: Safety Monitoring Devices:
    a. Monitored Photo Eyes and Wireless Edge Kits.
        1) LiftMaster LMRRU Reflective Photo Eyes.
        2) LiftMaster LMTBU Thru-Beam Photo Eyes.
        3) LiftMaster LMWEKITU Wireless Edge Kith with Transmitter and Receiver.
        4) LiftMaster LMWETXU Wireless Edge Transceiver
    b. Wired Monitored Edges (all require use of LMWEKITU)
        1) LiftMaster S50 Small Profile Monitored Edge
        2) LiftMaster L50 Large Profile Monitored Edge
        3) LiftMaster WS4 Wrap-Around 4 foot (1219 mm) square monitored edge
        4) LiftMaster WS5 Wrap-Around 5 foot (1524 mm) square monitored edge
        5) LiftMaster WS6 Wrap-Around 6 foot (1829 mm) square monitored edge
        6) LiftMaster WR4 Wrap-Around 4 foot (1219 mm) square monitored edge
        7) LiftMaster WR5 Wrap-Around 5 foot (1524 mm) square monitored edge
        8) LiftMaster WR6 Wrap-Around 6 foot (1829 mm) square monitored edge
38. Accessories: Provide the optional accessories listed below.
    a. LiftMaster LOOPDETLM Plug-in Loop Detector
    b. LiftMaster KPW250 - Wireless Commercial Keypad
    c. LiftMaster 892LT 2-Button Security+ 2.0 Learning Remote Control
    d. LiftMaster 894LT 4-Button Security+ 2.0 Learning Remote Control
    e. LiftMaster 811LM 1-Button Encrypted DIP Remote Control
    f. LiftMaster 813LM 3-Button Encrypted DIP Remote Control
    g. LiftMaster IPAC - Internet Protocol Access Control Entry System

h. LiftMaster EL2000SS Stainless Steel Commercial and Gated Community Telephone Entry System.
i. LiftMaster Star1000 Commercial Access Control Receiver
j. LiftMaster PPWR Passport Receiver with Security+ 2.0 Technology
k. LiftMaster PPV1 Passport 1-Button Remote
l. LiftMaster PPK1 Passport 1-Button Mini Remote
m. LiftMaster KPR2000 Single Access Remote Control Keypad and Proximity Reader
n. LiftMaster HTRNB Heater Kit
o. LiftMaster Power Wheels, 4 inch (101 mm) or 6 inch (152 mm) heat-treated wheels

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Inspect and prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions.

B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions. Test for proper operation and adjust until satisfactory results are obtained.

3.3 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION