

## SECTION 03360

### SHOTCRETE

#### 1.0 GENERAL

##### 1.1 Scope

This section consists of repair of concrete surfaces of the reinforced concrete canal lining as indicated on the Drawings. The work includes labor, equipment, and materials required to properly clean and prepare the existing concrete substrate and application of shotcrete repair.

The work covered by this section includes, but is not limited to, the following:

- a. Application of new shotcrete lining over entire section of canal including walls and slab where indicated on the Drawings.
- b. Repair of spalled/eroded concrete surfaces on the walls and slab of the canal.
- c. Applying shotcrete overlay to existing lining.

##### 1.2 General

###### 1.2.1 General Requirements

Shotcrete shall be applied by the wet-mix method. Shotcrete may be applied with an automated system acceptable to the Construction Administrator. All shotcrete shall be accurately formed, properly placed, and finished as specified herein.

The Contractor shall inform the District at least two working days prior to placement of shotcrete.

###### 1.2.2 Governing Standards

Shotcrete shall comply with the recommendations of ACI 506R-90, "Guide to Shotcrete", and the requirements of ACI 506.2-95, "Specification for Shotcrete", except as otherwise specified.

###### 1.2.3 Workers' Qualifications

Workers, including the foreman, nozzleman, and delivery equipment operator, shall be fully qualified to perform the work. The nozzleman shall have had a minimum of 2 years of recent experience on similar structural shotcrete work and shall demonstrate ability to satisfactorily place the material in accordance with the recommendations of ACI 506.3R, "Guide to Certification of Shotcrete Nozzlemen".

The shotcrete equipment system shall be of a design and size that has given satisfactory results on similar work in the last five years. At the time of the bid, the Contractor shall have a minimum of two operable shotcrete equipment systems available that have been used to achieve satisfactory results. The shotcrete equipment system used shall be capable of discharging mixed materials into the hose under close control and shall be able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from any slugs.

### 1.3 **Submittals**

All submittals of drawings; mix designs; manufacturers' certificates of compliance, recommendations, and test data; reports; catalog data sheets; and other data shall be submitted to the Construction Administrator in accordance with Section 01300, **SUBMITTALS**.

#### 1.3.1 **Proposed Mix Design**

Reports and certifications on proposed materials and mix proportions for each concrete mix design shall be submitted for review within 10 days after the preconstruction conference and prior to conducting the laboratory trial batches for the mix design. The report for each shotcrete mix submitted shall contain the following information:

Total gallons of water per cubic yard.  
Brand, size, and quantity of fibers.

Brand, type, composition, and quantity (volume and weight) of cement.

Source, class, composition, and quantity of fly ash, if used.

Specific gravity and gradation of each aggregate, as furnished, in accordance with ASTM C33. Reports for fine aggregate shall include source and type, gradation and fineness modulus, deleterious substances, water-soluble chloride ion, and sand equivalent. Reports for coarse aggregate shall include source and type, gradation and abrasion loss, deleterious substances, results of sodium or magnesium sulfate soundness test, and water-soluble chloride ion.

Absorption of shotcrete.

Volume and weight (saturated surface dry) of each aggregate per cubic yard.

Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture, if any.

Air content.

Water-soluble chloride ion for each aggregate and each mix design.

Compressive strength required and strength achieved at 7 and 28 days.

All tests and reports required for preliminary review shall be made by an independent testing laboratory at the expense of the Contractor.

#### 1.3.2 **Drawings and Data**

Data describing the equipment to be used for proportioning, mixing, and transporting concrete, including compressed air equipment and proposed arrangement and capacity, shall be submitted. In the case of ready-mixed concrete, certification that the ready-mix plant complies with the requirements of ASTM C94 will be acceptable.

Samples of concrete materials; product data; and manufacturer's installation instructions for joint materials, admixtures, repair materials, sealers, and hardeners shall be submitted.

Procedures for hot and cold weather shotcreting shall be submitted when such

conditions are anticipated.

Bar lists and drawings for the fabrication and placing of reinforcement shall be submitted for review and shall have sufficient plans, elevations, and sections to adequately detail and label all reinforcement. The bar lists and drawings shall also include a reference to the structure in which the reinforcement will be installed and to the project drawing showing the reinforcement.

### **1.3.3 Manufacturer's Certificate of Compliance**

A manufacturer's certificate of compliance, which includes the name of the project and, when requested, copies of independent test results confirming compliance with specified requirements, shall be submitted to the Construction Administrator for cement, steel reinforcement, admixtures, and fly ash.

### **1.4 Storage of Materials**

Cement and fly ash shall be stored in suitable moisture proof enclosures. Cement and fly ash which have become caked or lumpy shall not be used and shall be replaced at the expense of the Contractor.

Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches of aggregate piles in contact with the ground shall not be used.

### **1.5 Quality Assurance**

The shotcrete applicator shall submit through Contractor a satisfactory experience record including references from previous application of the specified materials to structures of similar design and complexity.

## **2.0 PRODUCTS**

### **2.1 Lining Requirements for Mix Design**

Concrete materials shall be selected and concrete shall be proportioned, placed, and cured in a manner that will minimize shrinkage and cracking as specified herein and in accordance with ACI 544.3R. Concrete temperatures shall be controlled both before and after placement to minimize cracking. Any rise in concrete temperature caused by environmental conditions that will be conducive to excessive shrinkage shall be controlled with blankets or other acceptable means of insulation.

#### **2.1.1 Cement Content**

Cement content for wet-mix shotcrete shall be at least 705 pounds per cubic yard (7.5 sacks).

#### **2.1.2 Fly Ash Content**

At the option of the Contractor, fly ash may be substituted for up to 15 percent of the portland cement on the basis of 1.5 pounds of fly ash added for each pound of cement reduction.

#### **2.1.3 Fine Aggregate**

Fine aggregate shall be well graded, with a fineness modulus of 2.30 to 3.00.

#### **2.1.4 Maximum Water-Cement Ratio**

The maximum water-cement ratio of wet-mix shotcrete shall be 0.40 on a weight (mass) basis, or, if fly ash is used, the combined mass of cement plus fly ash shall be used to determine the water-cementations materials ratio.

**2.1.5 Total Air Content**

The total volumetric air content of wet-mix shotcrete delivered shall be 6 percent plus or minus 1 percent.

**2.1.6 Compressive Strength**

Minimum compressive strength at 28 days, as determined by ASTM C42, shall be 4,000 psi. Minimum compressive strength at 7 days shall be 3,000 psi.

**2.1.7 Admixtures**

The admixture content, batching method, and time of introduction to the mix, when used, shall be in accordance with the manufacturer's recommendations for minimum shrinkage for compliance with these specifications.

No calcium chloride or admixture containing chloride from other than impurities from admixture ingredients will be acceptable.

**2.1.8 Fiber Concrete**

Polypropylene fibers shall be added to the concrete materials at the time the materials are batched for the concrete at the rate of 1.5 pounds per cubic yard. Fiber length shall be as recommended by the manufacturer. Batching and mixing procedures shall be in accordance with the manufacturer's recommendations. Fibers shall be randomly oriented and uniformly distributed throughout the concrete.

**2.1.9 Proportions**

Shotcrete proportions shall be one part cement to not more than four parts fine aggregate by weight.

**2.2 Materials**

All materials for shotcrete shall conform to the following requirements:

Portland Cement	ASTM C150, Type II only, low alkali.
Fly Ash	ASTM C618, Class F, except loss on ignition shall not exceed 4 percent. Class C fly ash will not be acceptable.
Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand may be acceptable subject to preliminary review.
Coarse Aggregate	ASTM C33 and combined aggregate gradation limits in ACI 506R-90, Table 2.1.
Water	Clean and free from deleterious substances meeting the requirements of ASTM C94.
Admixtures	ASTM C1141, Type II, wet-mix process

	only.
Retarder	ASTM C494, Type D; Grace "Daratard-17", Master Builders "Pozzolith 300R", General Resource Technology "Polychem-R", or approved equal.
Water-Reducer	ASTM C494, Type A; Grace "WRDA with Hycol", Master Builders "Pozzolith 300N", General Resource Technology "Polychem 400 NC", or approved equal.
Air-Entraining Agent	ASTM C260; Grace "Darex AEA", Master Builders "MB-AE-10", Sika Chemical "AER", or approved equal.
Fibers	Collated, fibrillated, polypropylene fibers; Fibermesh, Forta Fibre, Grace, or approved equal.
Polyethylene Film	Project Standard PS17, 6 mils or thicker.
Membrane Curing Compound	Fed Spec TT-C-800, Type 1, water based, VOC-compliant acrylic, maximum VOC 2.9 lb/gal, minimum 30 percent solids, non-yellowing, unit moisture loss 0.390 kg/m <sup>2</sup> maximum; Euclid "Super Aqua Cure VOX", L&M Chemical "Dress & Seal WB30", Symons "Cure & Seal 31%E", or approved equal.
Reinforcing Steel Bars	ASTM A615, Grade 60, deformed.
Welded Wire Fabric	ASTM A185 or A497.
Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected.

### **2.3 Reinforcement**

Reinforcement shall be accurately formed and shall be free from loose rust, scale, concrete splatter, and contaminants which reduce bond. Unless otherwise indicated on the drawings or specified herein, the details of fabrication shall conform to ACI 315 and ACI 318.

Welding or tack welding of reinforcement shall not be permitted.

### **2.4 Batching and Mixing**

Shotcrete shall be furnished by an acceptable supplier. Batching and mixing shall conform with ASTM C94 for wet-mix shotcrete. Wet-mix shotcrete material shall be shot within 90 minutes after batching.

#### **2.4.1 Consistency**

The consistency of shotcrete shall be suitable for the placement conditions.

#### **2.4.2 Delivery Tickets**

A delivery ticket shall be prepared for each load of ready-mixed (wet-mix) shotcrete. A copy of each ticket shall be handed to the Construction

Administrator by the truck operator at the time of delivery. Tickets shall show name and location of shotcrete supplier, the project name, the mix identification, the quantity of shotcrete delivered, the quantity of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

## **2.5 Preliminary Testing**

Contractor shall submit the following preliminary tests.

### **2.5.1 Cement**

The Contractor shall supply the Construction Administrator with certified copies of supplier's (source) test reports showing chemical composition and physical analysis for each shipment delivered to the concrete supplier, and certifying that the cement complies with ASTM C150 and these specifications. The certificate shall be signed by both the Contractor and the concrete supplier.

### **2.5.2 Water-Soluble Chloride**

One test, performed in accordance with ASTM C1218, shall be conducted on the shotcrete mix. Maximum water-soluble chloride ion concentrations in hardened shotcrete at an age of 28 days shall not exceed 0.10 percent by mass weight of cement. Test results shall be reported as the percent of chloride ions in the shotcrete and as a percent of chloride ion relative to the weight of cement in the shotcrete. Chloride testing of the shotcrete components, except aggregates, will be at the discretion of the Contractor. Copies of reports for such tests shall be furnished to the Construction Administrator.

### **2.5.3 Laboratory Shrinkage Limits**

Based on modified ASTM C157 test procedures, the shrinkage limits of concrete shall be the average drying shrinkage of each set of three test specimens cast in the laboratory from a trial batch as measured at the 21 days' drying age, and shall not exceed 0.036 percent.

### **2.5.4 Aggregates**

Aggregates shall be sampled and tested in accordance with ASTM D75 and C136. In addition, the bulk specific gravity of each aggregate shall be determined in accordance with ASTM C127 and ASTM C128. Absorption testing of shotcrete shall be in accordance with ASTM C642.

### **2.5.5 Compression Test**

Two compression test cylinders shall be made; one tested at 7 days and the other tested at 28 days. Wet-mix shotcrete test specimens shall be made, cured, and stored in conformity with ASTM C192 and tested in conformity with ASTM C39.

### **2.5.6 Fly Ash**

Fly ash shall be sampled and tested in accordance with ASTM C618 and C311. The Contractor shall supply the Construction Administrator with certified copies of supplier's (source) test reports showing chemical composition and physical analysis and certifying that the fly ash complies with the specifications. The certificate shall be signed by both the Contractor and the concrete supplier.

## **3.0 EXECUTION**

### **3.1 Storage and Handling**

Reinforcing steel shall be carefully handled and protected from the elements and exposure to corrosion. Reinforcing steel shall be stored on supports which prevent the steel from touching the ground.

### **3.2 Preparation of Surface**

The limits of each placement shall be predetermined by the Contractor and shall be acceptable to the Construction Administrator. All shotcrete within such limits shall be placed in one continuous operation. Preparation and placement shall be as specified in ACI 506.2, unless otherwise specified.

Before shotcrete is placed, reinforcement and embedments shall be rigidly secured in proper position. All dirt, mud, water, organic material, and debris shall be removed from the space to be occupied by shotcrete. All surfaces encrusted with dried shotcrete and concrete from previous placement operations shall be cleaned. The entire installation shall be acceptable to the Construction Administrator.

#### **3.2.1 Surface Preparation of Existing Concrete Surfaces**

Prior to surface preparation, canal shall be cleaned of debris in accordance with Section 02050, **SITE PREPARATION AND DEMOLITION**.

All loose and deteriorated existing concrete shall be removed down to sound materials. All concrete surfaces shall be checked for delamination to ensure all concrete surfaces are sound.

The Contractor shall remove--by sandblasting, grinding, wire brushing, or high pressure water jets--all deteriorated, loose, unsound material, oil, grease, mud, laitance, contaminants, or other foreign material that may inhibit bonding of shotcrete. Areas to be repaired shall be chipped out to remove offsets causing abrupt changes in thickness. All edges shall be square cut to avoid feathered edges. The surface shall be dampened.

#### **3.2.2 Reinforcing Steel Treatment and Repair**

Where corrosion or surface preparation activities have exposed reinforcing steel, the following procedure shall be used.

Exposed reinforcing must be mechanically cleaned to remove all contaminant. If half the diameter of the reinforcing steel, or more, is exposed, chip out concrete behind the reinforcing steel a minimum of 1/2 inch for placement of repair material. Substrate shall have fractured aggregate profile.

Determine section loss and splice where loss exceeds 15 percent to 25 percent of the steel area.

Abrasive blast all exposed steel surfaces to remove all contaminants and corrosion products.

### **3.3 Placement**

Shotcrete shall be placed in multiple layers, with each layer placed over the previous layer while the previous layer is still plastic. Wet-mix shotcrete shall be placed with a minimum air capacity at the nozzle of 400 cubic feet per minute. Shotcrete shall not sag or slough.

### **3.3.1 Reinforcement**

Reinforcement, including welded wire fabric, shall be accurately positioned on supports, spacers, hangers, or other reinforcement, and shall be secured in place with wire ties or suitable clips.

With the exception of contact splices, the clear distance between parallel bars shall not be less than 2-½ inches nor less than 3 bar diameters.

Before shotcrete is placed, reinforcement shall be rigidly secured in proper position. All surfaces encrusted with dried concrete from previous placements shall be cleaned and the entire installation shall be acceptable to the Construction Administrator. Remove all frost and ice before concrete is placed.

### **3.3.2 Shotcreting**

Particular care shall be taken during placement of shotcrete to maintain a uniform spray distance from the surface and to keep the nozzle as nearly perpendicular to the application surface as possible.

The shotcrete shall be applied to cleaned surfaces which have been prepared as specified, and shall be compact, with no sand pockets.

At the edge of any section where the operations are temporarily suspended, the shotcrete shall be brought to a tapered edge, with the taper extending back for not less than 12 inches.

Prior to placing the adjacent section, the surface of the tapered edge shall be cleaned by scraping and blowing away all rebound, and washing down with air and water blast. No square joints will be permitted.

As the operation progresses, all rebound shall be kept out of the work. If the rebound does not fall clear of the work, it shall be removed by proper methods. No shotcrete shall be placed over rebound and in case of such condition arising, the Contractor shall remove, at his own expense, any shotcrete so placed. All rebound removed shall be discarded and shall not be included in batches.

Shotcreting shall be ceased immediately if excessive aggregate rebound and cement loss occur. Shotcrete shall not be placed during adverse weather conditions which may result in excessive moisture loss.

In cases where concrete is repaired in the vicinity of a contraction joint, the repairs shall be made to preserve the isolation between components on either side of the joint.

Chipping may be required where existing concrete bonds with new concrete.



### **3.3.3 Cold Weather Shotcreting**

Shotcrete shall not be placed in cold weather when the ambient temperature is below 40°F and falling, and when the shotcrete is likely to be subjected to freezing temperatures before gaining sufficient strength to avoid damage. Materials may be heated in order that the temperature of the shotcrete, when deposited, shall be not less than 50°F or more than 80°F. The temperature of the shotcrete shall be maintained in accordance with ACI 301 and the recommendations of ACI 306R. Shotcrete shall be protected in accordance with the recommendations of ACI 306R.

### **3.3.4 Hot Weather Shotcreting**

Shotcrete shall not be placed in hot weather when the ambient temperature is above 90°F and rising. Hot weather shotcreting shall be in accordance with the requirements of ACI 301 and the recommendations of ACI 305R. During periods of extremely hot weather, the placement schedule shall be arranged in a manner acceptable to the Construction Administrator and shall provide time for the temperature of the previously placed coat to begin decreasing. The aggregate and mixing water shall be cooled to below 80°F.

### **3.3.5 Low Humidity Shotcreting**

Surfaces exposed to drying wind shall be water cured continuously from the time the shotcrete has taken initial set. Placement of shotcrete during periods of low humidity shall be in accordance with the requirements of ACI 301 and the recommendations of ACI 305R.

### **3.3.6 Thickness Control**

Shotcrete thickness shall be controlled by the use of vertical and horizontal shooting wires. Shooting wires shall be installed under tension and spaced no more than 3 feet apart to establish uniform and correct shotcrete thicknesses. Wires of 18 to 20-gage diameter high tensile strength steel shall be used. Shooting wires shall be removed after shotcrete placement and shall not be embedded in the shotcrete surface. Shooting wires shall scribe the contour of the wall from top to bottom.

Prior to placement of shotcrete, the Contractor shall submit details of thickness control procedures and aids to the Construction Administrator for review. During application of shotcrete coats, the Contractor shall demonstrate the effectiveness of his control procedures.

## **3.4 Finishing**

Freshly placed shotcrete shall receive a natural gun finish and trowel finish. Once the shotcrete has reached initial set, the surfaces shall receive a broom finish.

## **3.5 Repairing Defective Shotcrete**

Construction Administrator will continuously inspect the shotcrete coating during and after application. Porous shotcrete, sand pockets, drummy sounding shotcrete, and other defects shall be removed and replaced by the Contractor. Defects in shotcrete surfaces shall be repaired to the satisfaction of the Construction Administrator at the expense of the Contractor. Shotcrete repair work shall conform with ACI 506.2.

Core holes shall be repaired in accordance with Article 5.3.7 of ACI 301. Core holes shall not be filled with shotcrete.

If newly placed shotcrete is subjected to rain that washes out cement or is damaged by ground water or storm runoff or otherwise makes the shotcrete unacceptable to the Construction Administrator, the shotcrete layer in question shall be removed and replaced at the Contractor's expense.

### **3.6 Curing**

Shotcrete shall be protected from loss of moisture for at least 7 days after placement. Curing of shotcrete shall be done by methods which will keep the concrete surfaces adequately wet for the specified curing period.

#### **3.6.1 Water Curing**

Water saturation of shotcrete surfaces shall begin as soon as possible after initial set. The rate of water application shall be regulated to provide complete surface coverage with a minimum of runoff. Acceptable methods of water curing are described in ACI 308.

#### **3.6.2 Membrane Curing**

Unless otherwise specified, membrane curing compound may be used instead of water curing on shotcrete.

Membrane curing compound shall be sprayed at a coverage rate of not more than 300 square feet per gallon. The spray equipment shall have sufficient capacity to continuously spray curing compound at approximately 40 psi with a suitable nozzle as recommended by the manufacturer. Surfaces shall be covered with curing compound within 30 minutes after final finishing.

When VOC-compliant curing compounds are used, surfaces shall be covered with white polyethylene sheeting immediately after the curing compound has become dry to the touch. Polyethylene sheeting shall completely cover the surfaces and shall overlap the edges for proper sealing and anchorage. Joints between sheets shall be sealed. All tears, holes, and other damage shall be promptly repaired. Covering shall be anchored continuously at edges, and shall be anchored as necessary to prevent billowing on the surface.

Curing compound shall be suitably protected against abrasion during the curing period.

### **3.7 Protection**

Shotcrete shall be protected from erosion due to rain by means of a sheet cover acceptable to the Construction Administrator for a minimum of 7 days.

### **3.8 Removal and Disposal of Excess Material**

Contractor shall promptly, safely, and legally dispose of all excess material off the Project site.

### **3.9 Field Quality Control Testing**

At the discretion of the Construction Administrator, field control tests required during the progress of the work may be made at the expense of the District.

The frequency specified for each field control test is approximate. If additional field control tests are necessary, in the opinion of the Construction Administrator, all such tests shall be made.

A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements, after they are covered, will be an indication of insufficient cover or poor application and probable voids. In this case, the application of shotcrete shall be immediately suspended and the work carefully inspected by the Construction Administrator. Corrective measures, if any, shall be implemented and completed prior to resuming the shotcreting operations.

The shotcreting procedure may be corrected by adjusting the nozzle distance and orientation perpendicular to the surface or water content of the shotcrete mix. All overspray shall be removed from the surface. The shotcreted surface shall be broomed and roughened if needed to ensure proper bond.

### **3.9.1 Compression Tests**

One set of four compression test cylinders shall be made each day shotcrete is placed. Two cylinders shall be tested at an age of 7 days and the remaining cylinders shall be tested at an age of 28 days. Test cylinders shall be at least 6 inches in diameter and have an L/D ratio of at least 2.

Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the shotcrete represented by the cylinders was placed, the number of the delivery truck or batch, the air content, the slump, the unit weight, and the concrete temperature.

Compression tests will be evaluated in accordance with ACI 318.

Test reports shall be prepared in four copies and shall be distributed by the testing laboratory directly to the Construction Administrator and the Contractor.

### **3.9.2 Air Content**

Air content shall be determined from each batch of concrete from which concrete compression test cylinders are made, in accordance with ASTM C231 and verified in accordance with ASTM C138.

### **3.9.3 Shrinkage Tests**

Shrinkage tests shall be performed once for each 50 cubic yards of shotcrete. Shrinkage testing shall be conducted as specified for the preliminary trial mixes.

The average drying shrinkage of each set of test specimens measured at the 21 days drying age shall not exceed 0.048 percent.

**\*\*\*END OF SECTION\*\*\***

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### 1.0 GENERAL

##### 1.1 Section Includes

- A. Formwork.
- B. Reinforcement.
- C. Mix Design.
- D. Placement Procedures.
- E. Finishes.

##### 1.2 References

- A. AASHTO M182 – “Burlap Cloth Made from Jute or Kenaf.”
- B. ACI 117R – "Commentary on Standard Specifications for Tolerances for Concrete Construction and Materials."
- C. ACI 222R - "Corrosion of Metals in Concrete."
- D. ACI 228.1R - "In-Place Methods to Estimate Concrete Strength."
- E. ACI 301 – “Standard Specification for Structural Concrete.”
- F. ACI 302.1R – “Guide for Concrete Floor and Slab Construction.”
- G. ACI 304 – “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.”
- H. ACI 305R – “Hot Weather Concreting.”
- I. ACI 306.1 – "Standard Specification for Cold Weather Concreting."
- J. ACI 308 - "Standard Practice for Curing Concrete."
- K. ACI 309 – “Guide for Consolidation of Concrete”
- L. ACI 311.1R - "ACI Manual of Concrete Inspection (SP-2)."
- M. ACI 311.4R - "Guide for Concrete Inspection."
- N. ACI 311.5R - "Guide for Specifying Batch Plant Inspection and Field Testing of Ready-Mixed Concrete."
- O. ACI 318R – “Commentary to Building Code Requirements for Structural Concrete.”
- P. ACI 347R – “Guide to Formwork for Concrete.”

- Q. ACI SP-15 – “Field Reference Manual.”
- R. ACI SP-66 – “Detailing Manual.”
- S. ASTM A82 – “Standard Specification for Steel Wire, Plain, for Concrete Reinforcement”
- T. ASTM A185 – “Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.”
- U. ASTM A496 – “Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.”
- V. ASTM A497 – “Standard Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.”
- W. ASTM A615 – “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.”
- X. ASTM A706 – “Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.”
- Y. ASTM C31 - "Standard Practice for Making and Curing Concrete Test Specimens in the Field."
- Z. ASTM C33 – “Concrete Aggregates.”
- AA. ASTM C39 – “Standard Test Method for Compressive Strength of Concrete.”
- BB. ASTM C42 – “Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.”
- CC. ASTM C94 – “Standard Specification for Ready-Mixed Concrete.”
- DD. ASTM C143 – “Standard Test Method for Slump of Portland Cement Concrete.”
- EE. ASTM C150 – “Standard Specification for Portland Cement.”
- FF. ASTM C171 – “Standard Specification for Sheet Materials for Curing Concrete.”
- GG. ASTM C172 – “Standard Practice for Sampling Freshly Mixed Concrete.”
- HH. ASTM C231 – “Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.”
- II. ASTM C260 – “Standard Specification for Air-Entraining Admixtures for Concrete.”
- JJ. ASTM C330 – “Standard Specification for Lightweight Aggregates for Structural Concrete.”
- KK. ASTM C441 - "Test Method for Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction."

- LL. ASTM C618 – “Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Concrete.”
- MM. ASTM D698 - "Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).]"
- NN. ASTM D1557 - "Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [56,000 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).]"
- OO. ASTM D1752 – “Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.”
- PP. CRSI MSP-1 – “Manual of Standard Practice.”
- QQ. Portland Cement Association (PCA) - "PCA Design and Control of Concrete Mixtures, 13th edition."
- RR. Wire Reinforcement Institute (WRI) - "WRI Manual of Standard Practice."

### 1.3

#### **Submittals**

- A. Submit the following information to the Construction Administrator for review and approval:
  1. Concrete Mix Proportions: Submit sources, proportions and testing data for all constituent materials, water-cement (w/c) ratio, and mixture characteristics for all designs of Portland Cement Concrete. The design mix shall be stamped and signed by a California Registered Civil Engineer. Submittal shall include copies of all trial mix reports, and the proportions of all materials used shall conform to the approved mix design.
  2. Concrete Admixtures: Submit specification sheets and a statement of suitability provided by manufacturer for all admixtures used in the concrete mix design.
  3. Portland Cement Concrete Test Reports: Submit copies of laboratory trial batch test reports or field-test data.
  4. Bond Breakers and Form Release Agents: Submit certificate of compliance with NSF 61 for all bond breakers and form release agents to be used on concrete surfaces exposed to drinking water.
  5. Shop Drawings for Reinforcement: Submit shop drawings, designed and stamped by a California Registered Civil Engineer, for fabrication, bending, and placement of concrete reinforcement. Comply with the most recent edition of ACI SP-66, “ACI Detailing Manual”, showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Include mill tags identifying mill and the melt or heat number for the reinforcing steel.
  6. Concrete Formwork: Submit formwork design stamped and signed by a California Registered Civil Engineer.

7. Related Materials: Submit specification sheets for all related materials used for concrete work including, but not limited to, evaporation reducer, fibrous reinforcement, joint filler, bonding agents, structural repair and patching mortar, and curing compounds.
  8. Samples of Materials: As requested by the Construction Administrator, submit samples of materials listed above, including names, sources, and descriptions.
  9. Favorable Weather Conditions: Prior to placement of concrete, the Contractor shall submit to the Construction Administrator a favorable local weather report which depicts no imminent rain or showers during the pour and initial setting, unless the Contractor can provide adequate protection against rain water to the satisfaction and approval of the Construction Administrator.
- B. A pre-placement conference shall be held a minimum of seven (7) days prior to first concrete placement. Attendees shall include representatives of the Construction Administrator, Contractor, Place and Finish Subcontractors, and any other necessary persons dealing with the concrete portion of the project, as determined by the Construction Administrator. Agenda shall include, but not be limited to the following topics: concrete placement, consolidation, finishing, testing, and curing procedures.

#### 1.4

##### **Quality Assurance**

- A. Perform Work in accordance with all referenced codes, specifications, and standards, except as modified herein.
- B. Contractor shall have available in the field office and be familiar with a copy of the ACI Field Reference Manual SP-15. This field reference manual is a compilation of selected ACI and ASTM references listed in ACI 301. A foreman experienced in work being done shall be on the job at all times.
- C. All laboratory trial batch test reports and/or field-test data for the concrete materials and development of the concrete mixtures shall be the responsibility of the Contractor, and shall be subject to the review and approval by the Construction Administrator.
- D. The design of concrete mixtures, and the shop drawings for concrete formwork reinforcement shall be the responsibility of the Contractor, and shall be subject to review and approval by the Construction Administrator.
- E. All testing and inspection services required for the placement of concrete will be provided by the District. Cost of such work, except as specifically stated otherwise, will be paid for by the District. Methods of tests will comply in detail with the latest applicable ASTM Test Methods.

#### 1.5

##### **Delivery and Storage**

- A. Store and protect all materials on the jobsite in accordance with the manufacturer's recommendations.
- B. Reinforcing steel shall be stored in such a manner as to prevent the accumulation of rust, scale, or other deleterious substances on the surface. Reinforcing steel

shall be transported, unloaded, and stored in such a manner as to prevent yielding of the steel due to bending or kinking.

## 2.0 **PRODUCTS**

### 2.1 **Form Materials**

- A. **Forms for Exposed Finish Concrete:** Plywood (Class I, B-B EXT – APA, or equal), metal, plastic, tempered concrete form-grade hardboard, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints and to conform to joint system shown on Drawings.
- B. **Forms for Unexposed Finish Concrete:** Plywood (Class I, B-B EXT – APA, or equal), lumber, metal, or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.
- C. **Form Coatings:** Provide commercial formulation form-coating compounds with a maximum Volatile Organic Compounds (VOC) of 250 mg/L that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. **Form Accessories:** Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Wire ties shall not be permitted. Provide units that will leave no metal closer than 1-1/2 inches (38 mm.) to exposed surface. Provide ties that will leave holes no larger than 1 inch (25 mm.) diameter in concrete surface, with regular shape. Form ties, or any part thereof, for concrete in contact with drinking water shall be non-organic and leave no residue on the concrete surface.

### 2.2 **Reinforcing Materials**

- A. **Reinforcing Bars:** Shall be deformed, except spirals may be plain. Reinforcement shall be grades as shown on the Drawing and conform to one of the following: a) ASTM A615, Grade 60, deformed; b) ASTM A706. Reinforcing steel shall be new material, free from rust or scale, or any defects affecting its usefulness.
- B. **Steel Wire:** Plain wire shall conform to ASTM A82, plain, cold-drawn steel. Deformed wire shall conform to ASTM A496.
- C. **Supports for Reinforcement:** Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Use wire-bar-type supports complying with CRSI MSP-1.
  - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
- D. **Welded Wire Fabric Reinforcement:** Plain welded wire fabric shall conform to ASTM A185. Deformed welded wire fabric shall conform to ASTM A497. Fabric may be used in place of reinforcing bars only for curbs and slabs on grade, not part of the structural foundation system, if approved by the Construction



Administrator, provided the fabric has a cross-sectional area per linear foot not less than that of the reinforcing bars. Fabric shall be provided in flat sheet form.

- E. Tie Wire: Wire shall be 16 gauge or heavier, black annealed.

### 2.3 Concrete Accessories

- A. Waterstops: Waterstops shall be manufactured from virgin polyvinyl chloride plastic compound that does not contain any scrap or reclaimed material. The waterstop shall have a minimum tensile strength of 2000 psi (13.8 MPa), and shall conform to CRD-C-572.
1. Construction and Shrinkage Control Joints: Waterstop shall be 6 inch (150 mm.) by 3/8 inch (9.4 mm.) ribbed type. Waterstop shall be Style 679 by Greenstreak Inc., St. Louis, MO; Style R 6-38 by Vinylex Corp., Knoxville, TN; or equal.
  2. Expansion Joints: Waterstop shall be 9 inch (225 mm.) by 3/8 inch (9.4 mm.) ribbed type with 1 inch (25 mm.) outside diameter center bulb. Waterstop shall be Style 735 by Greenstreak Inc., St. Louis, MO; Style RB 9-38H by Vinylex Corp., Knoxville, TN; or equal.
  3. Waterstop Material Between New and Existing Canal Liner at MP 8.65: Waterstop shall be a hydrophilic rubber joint sealant De Neet Swellseal 2010; Adeka Ultraseal MC-2010; Sikawell S; or equal.
- B. Sealant: Refer to Section 07900, Sealant and Caulking, of the specifications.

### 2.4 Concrete Materials

- A. Portland Cement: Shall conform to ASTM C150, Type II, unless otherwise specified in Paragraph 2.5. Use same type, brand and source throughout the project.
- B. Normal Weight Aggregates: Shall conform to ASTM C33 except as modified herein. Provide aggregates from a single source throughout project.
1. Local aggregates not complying with ASTM C33 but that special tests or actual service have shown to produce concrete of adequate strength and durability may be used when acceptable to the Construction Administrator.
  2. The maximum size coarse aggregate shall not exceed: a) 2 inches (50 mm.) for plain concrete; b) 1 inch (25 mm.) for a reinforced section 10 inches (250 mm.) or greater in thickness with a clear distance between reinforcement at least 2-1/4 inches (56 mm.); c) 3/4 inch (19 mm.) for reinforced sections less than 10 inches (250 mm.) in thickness.
  3. Fine aggregates shall have a pH value between 5.5 and 8.5.
- C. Water: Clean and free from injurious amounts of oils, acid, alkali, organic matter, or other deleterious substances.

- D. Admixtures: When specified in the concrete mix design, admixtures shall be used in accordance with the manufacturer's specifications. All admixtures shall be added at the batch plant, unless otherwise specified by the Construction Administrator.
- E. Fibermesh: 100% virgin polypropylene fibrillated fibers manufactured for concrete reinforcing to provide greater control of cracking.

## 2.5

### **Concrete Mix Design**

- A. Class A Concrete: Class A concrete shall be used for fence posts and concrete paving. Class A concrete shall meet the following requirements, unless otherwise specified on the Project Drawings or approved by the Construction Administrator:
  - 1. Coarse Aggregate: Shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33, Class 57 (Nominal size: 1 inch [25 mm.] to No. 4 sieve) or Class 467 (Nominal size: 1-1/2 inch [37.5 mm.] to No. 4 sieve). Refer to Paragraph 2.4.B.2 for additional coarse aggregate size restrictions.
  - 2. Slump: Concrete slump at the point of delivery shall not be greater than 4 inches +/- 1 inch (100 mm. +/- 25 mm.). If a field applied admixture is to be used that will increase the slump of concrete, the slump must be measured first and shall comply with the abovementioned requirements prior to the addition of the admixture to the concrete, (refer to Paragraph 2.4.E regarding restrictions to use of admixtures). Concrete shall be of such consistency that it can be readily worked into the corners and angles of the forms, and around the reinforcement, inserts, and castings without permitting materials to segregate or free water to collect on the surface, with consideration given to the methods of placing and compacting.
  - 3. Compressive Strength: The minimum 28-day compressive strength of the concrete shall be 2,500 psi (17.2 MPa). Testing of concrete shall be in accordance with ASTM C39.
  - 4. Water Cement (W/C) ratio shall be 0.45 maximum on a weight basis. The water-cement ration of the approved mix design shall be rigorously maintained.
- B. Class B Concrete: Class B concrete shall be used for the Markley Canyon apron, minor concrete at MP26.3 and canal lining at MP 8.65, if used in place of shotcrete. Class B concrete shall meet the following requirements, unless otherwise specified on the Project Drawings or approved by the Construction Administrator:
  - 1. Coarse Aggregate: Shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33, Class 67 (Nominal size: 3/4 inch [19 mm.] to No. 4 sieve). Refer to Paragraph 2.4.B.2 for additional coarse aggregate size restrictions.
  - 2. Slump: Concrete slump at the point of delivery shall not be greater than 3 inches +/- 1 inch (75 mm. +/- 25 mm.). If a field applied admixture is to be used that will increase the slump of concrete, the slump must be measured first and shall comply with the abovementioned requirements prior to the addition of the admixture to the concrete, (refer to Paragraph

2.4.E regarding restrictions to use of admixtures). Concrete shall be of such consistency that it can be readily worked into the corners and angles of the forms, and around the reinforcement, inserts, and castings without permitting materials to segregate or free water to collect on the surface, with consideration given to the methods of placing and compacting.

3. Air-Entraining Admixture: Shall conform to ASTM C260 and shall be MICRO AIR by Master Builders, Inc., or equal. The maximum amount of entrained air measured at discharge from the truck shall be: 1) 3.0 percent (3.0%) maximum for finished slabs; b) 3.5 to 5.0 percent (3.5% to 5.0%) for all other uses. Air content shall be measured in accordance with ASTM C231.
4. Pozzolans: At the Contractor's option, pozzolans may be used in the concrete mix design to replace cement. Pozzolan for cement replacement shall conform to ASTM C618 Class N or Class F (fly ash).
5. Compressive Strength (Concrete at MP 26.9 and Concrete Canal Lining): The minimum 28-day compressive strength of the concrete shall be 3,000 psi (20.7 MPa), as determined by testing of samples taken from the transportation unit at point of discharge. Testing of concrete shall be in accordance with ASTM C39.
6. Compressive Strength (Apron, Grade Beam and Drilled Piers at Markley Canyon): The minimum 28-day compressive strength of the concrete shall be 4,500 psi (31.0 MPa), as determined by testing of samples taken from the transportation unit at point of discharge. Testing of concrete shall be in accordance with ASTM C39.
7. Cement Content: The minimum cement content shall be 500 pounds per cubic yard (lb./yd.<sup>3</sup>) of concrete. (450 pounds per cubic yard [lb./yd.<sup>3</sup>] minimum with the additional of pozzolans.)
8. Water Content: The water-cement (w/c) ratio of the approved mix design shall be rigorously maintained.
9. Fibermesh: Provide minimum 1.5 pounds of fibermesh per cubic yard.

## 2.6

### Related Materials

- A. Evaporation Reducer: Shall be CONFILM by Master Builders, Inc., ProFilm 19 by Pro Mix Technologies, or equal; a spray applied product that reduces the rate of surface moisture evaporation under hot, dry and/or windy conditions. Product shall be used to minimize plastic shrinkage cracking and shall not affect the cement hydration process.
- B. Epoxy Bonding Agent: Shall be 100 percent (100%) solids, two component epoxy bonding compound for bonding new concrete to existing concrete. The color of the components shall be of contrasting color so when mixed according to manufacturer recommendations shall produce a third color. The epoxy bonding agent shall be CONCRETSIVE Liquid LPL by Master Builders, Inc., A-H Poly-Epoxy Bonding #100 by Anti Hydro International, Inc., or equal.

- C. Structural Repair Mortar: Shall be a shrinkage compensated, rheoplastic, one-component, cementitious based, hand or low velocity spray applied material suited for repairing distressed horizontal, vertical or overhead concrete. Material shall be EMACO S Series by Master Builders, Inc., CR-60 Super Bond Repair Cember by Lone Star Epoxies, Inc., or equal.
- D. Patching Mortar: Shall be a single-component, polymer modified cementitious based mortar suited for patching and/or resurfacing of distressed horizontal, vertical or overhead concrete. Material shall be EMACO R Series by Master Builders, Inc., Sika MonoTop 611 by Sika Corporation, or equal.
- E. Absorptive Cover: Shall be burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yd (oz./yd.<sup>2</sup>), complying with AASHTO M182, Class 2. When used, absorptive cover shall be covered with specified Moisture-Retaining Cover.
- F. Moisture-Retaining Cover: Shall be one of the following, complying with ASTM C171.
  - 1. Waterproof paper.
  - 2. Polyethylene film.
  - 3. Polyethylene-coated burlap.
- G. Water Content: The water-cement (w/c) ratio of the approved mix design shall be rigorously maintained.

## 2.7 **Production of Concrete**

- A. Ready Mixed Concrete: Shall comply with requirements of ASTM C94, except as modified herein.
  - 1. Plant equipment and facilities shall conform to the "Checklist for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.
  - 2. Add ingredients at the batch plant during the mixing time with the weights recorded on the delivery ticket. This includes all cementitious materials, aggregates, water, admixtures, and fibers.

## 3.0 **EXECUTION**

### 3.1 **General**

- A. Mix, place, consolidate, finish and cure concrete in accordance with the requirements of ACI 301.

### 3.2 **Forms**

- A. General: Design, erect, support, brace, and maintain formwork to safely and adequately support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Design of formwork shall meet the requirements of all applicable building codes, and shall be prepared and stamped by a California Registered Civil Engineer. Formwork shall be designed to support pressure resulting from placement and consolidation of concrete.

Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Design of all formwork shall be the responsibility of the Contractor.

- B. Design: Formwork shall be designed in accordance with ACI 347. Special consideration shall be taken to allow for conveying of concrete in the forms.
- C. Tolerances: Formwork construction tolerances shall comply with ACI 117.
- D. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blockings, screeds, bulkheads, anchorages and inserts, and other features as required in work or on Project Drawings. Use selected materials to obtain required finishes. Formwork shall be tight with backup provided at joints to prevent loss of mortar. Formwork for architectural concrete shall be watertight.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Place form ties so ends can be removed with a minimum of spalling. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
- F. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exposed corners and edges as shown on Project Drawings, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints. Provide 3/4 inch (19 mm.) chamfer strips in the corners of formwork for permanently exposed surfaces.
- H. Provisions for Other Trades: Coordinate with other trades to provide openings in concrete formwork as required. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment. Surfaces of the formwork and embedded materials shall be clean before concrete is placed. Formwork shall be clear of standing water before concrete is placed.
- J. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure forms to support screed strips that accommodate strike-off templates or compacting-type screeds. Camber formwork as shown on Project Drawings or as required to compensate for anticipated deflections in formwork due to loading of plastic concrete. Screeds shall be set to like camber.

### 3.3

#### **Placing Reinforcement**

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice and other materials that may reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by the Construction Administrator. Provide the minimum cover as indicated on the drawings and in conformance with ACI 318.
- D. Place, support and fasten reinforcement as shown on the Project Drawings. Do not exceed the placing tolerances specified in ACI 117 before the placement of concrete. Placing tolerances shall not reduce the cover requirements except as specified in ACI 117. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. All reinforcement shall be bent cold. No preheating is allowed. Field bending or straightening of reinforcing steel is not permitted.
- F. Splicing: Splices of tensile reinforcement at points of maximum stress is not allowed. Unless otherwise shown on drawings, all splices shall be a minimum of Class B splices per ACI 318. Only lap splices shall be allowed, and stagger all splices between adjacent bars unless otherwise shown on the drawings.

### 3.4

#### **Joints**

- A. Construction Joints: Locate and install construction joints as shown on the Contract Drawings, or at 15'-0" on center spacing.
  - 1. Provide keyways as indicated on Project Drawings. Unless otherwise shown, longitudinal keyways shall be at least 1-1/2 inches (37.5 mm) deep in construction joints in walls, and between walls and footings. The set surface shall have an average roughened surface of full amplitude of approximately 1/4 inch (6 mm.), clean and free of laitance.
  - 2. If load transfer between existing concrete surface and new concrete placement will not be accomplished by keyway, load transfer dowels or other approved mechanical load transfer device, use bonding agent as specified in Paragraph 2.6.C on existing concrete surfaces that will be joined with fresh concrete. Follow manufacturer's directions on mixing and timing of placement.
- B. Isolation Joints in Slabs on Grade: Construct isolation joints in slabs on grade at points of contact between slabs on grade and vertical surfaces, such as column pedestals, foundation walls, shear walls, grade beams and elsewhere as shown on the Project Drawings.
- C. Control Joints in Slabs on Grade: Construct control joints in slabs on grade in accordance with ACI 302.1 and Project Drawings.
  - 1. Sawed control joints shall be made as soon as the concrete has hardened sufficiently to prevent dislodgment of aggregates. Saw a continuous slot to a depth of one-fourth the thickness of the slab, but not

less than 1 inch (25 mm.). Complete sawing within twelve (12) hours of placement. Control joints shall be filled with epoxy joint filler as specified in Paragraph 2.6.B, in accordance with manufacturer's recommendations.

2. If joint pattern is not shown on Project Drawings, distance between control joints shall not exceed thirty-six (36) times the slab thickness for slabs less than or equal to 5 inches (125 mm.) thick; thirty (30) times the slab thickness for slabs greater than 5 inches (125 mm.) thick but less than or equal to 8 inches (200 mm.); and twenty-four (24) times the slab thickness for slabs greater than eight 8 inches (200 mm.) thick. Joints shall be located to conform to bay spacing wherever possible (at column centerlines, half bays, and third bays). The ratio of the length to width of any panel shall not exceed 1.5 to 1.0. Length to width ratio shall not apply to sidewalks and curbs.

D. Expansion and Contraction Joints: Expansion and contraction joints shall be filled with preformed sponge rubber expansion joint filler as specified in Paragraph 2.3.B. Joint filler shall be firmly bonded to the previously poured joint face with a suitable adhesive, and the new concrete shall be poured directly against the joint filler.

E. Waterstops: Provide waterstops as specified in Paragraph 2.3.A in construction, contraction, and/or expansion joints as shown on the Project Drawings. Install waterstops to form continuous diaphragm in each joint. The lengths of pre-molded waterstop shall be selected to minimize the number of joints. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions.

### 3.5 Installation of Embedded Items

A. General: Set and build into Work anchorage devices and other embedded items required for other work as shown on Project Drawings.

B. Equipment Anchor Bolts: Set anchor bolts for machines and equipment to templates at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

### 3.6 Preparation of Formed Surfaces

A. General: Coat contact surfaces of forms with a nonresidual, low-VOC, form release agent as specified in Paragraph 2.1.F before reinforcement is placed.

B. Do not allow excess form release agent to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

C. Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is not acceptable.

### 3.7 Concrete Placement

A. Inspection: Complete formwork installation, reinforcing steel placement, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Prior to placement of concrete, the Construction Administrator shall inspect the work, and no

placement shall occur unless approval is received from the Construction Administrator.

- B. General: Comply with ACI 304 and ASTM C94 except as modified herein. Concrete in each integral part shall be placed continuously. Contractor shall not commence with Work of any part unless the facilities and forces on hand are sufficient to complete the placing and finishing of work.
- C. When a truck or mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one and one-half (1<sup>1/2</sup>) hours, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening for the concrete, or when the temperature of the concrete is 85° F., or above, a time less than one and one-half (1<sup>1/2</sup>) hours may be required.
- D. When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one (1) hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening for the concrete, or when the temperature of the concrete is 85° F. or above, the time between the introduction of cement to the aggregates and discharge shall not exceed forty-five (45) minutes.
- E. Each load of ready-mixed concrete delivered at the jobsite shall be accompanied by a ticket showing volume of concrete, the concrete mix identification number, and the total amount of water added to the load. The ticket shall also show the time of day at which the materials were batched and for transit-mixed concrete, the reading of the revolution counter at the time the truck mixer is charged. The Contractor shall be responsible for collecting and delivering all concrete tickets to the Construction Administrator the day of the pour.
- F. No additional water shall be incorporated into the concrete during the hauling or after arrival to the delivery point, unless requested by the Contractor and authorized by the Construction Administrator. If the Construction Administrator authorizes additional water to be incorporated into the concrete, the Contractor has the sole responsibility to verify that the specified maximum water-cement (w/c) ratio or slump will not be exceeded.
- G. The slump of the concrete shall be measured prior to placement of the concrete in the forms and prior to addition of any field applied admixtures. Refer to Paragraph 2.5 for the maximum allowable slump. Also refer to Paragraph 2.4.E for restrictions to using of admixtures.
- H. Placing Concrete in Forms: Deposit concrete continuously or in layers so that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or other planes of weakness. The maximum free fall of concrete shall be 3 feet (900 mm.) and the maximum lift thickness shall be 18 inches (450 mm.). If a section cannot be placed continuously, provide construction joints as herein specified or as shown on the Project Drawings. Deposit concrete to avoid segregation at its final location. Place concrete with square ends and level tops.
- I. Consolidate Concrete with Vibrators: All concrete shall be thoroughly consolidated by means of mechanical vibrators. Vibration shall be in accordance with ACI 309, minimum frequency of 8,000 vibrations per minute. Do not use vibrators to transport the concrete in the forms. Contractor shall provide adequate number of vibrators to consolidate concrete work within five (5) minutes after it is deposited.



- J. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of joints, until the placing of a panel or section is completed.
1. Consolidate slab concrete during placing operations using a vibrator screed for slabs less than 6 inches (150 mm) thick. For 6 inches (150 mm) and greater thickness, use internal vibration. Keep the vibrator perpendicular to the surface of the concrete at all times.
  2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Use of a "jitterbug" is not allowed. Do not disturb slab surfaces prior to beginning finishing operations.
  3. The evaporation rate of water from exposed surfaces of plastic concrete shall not exceed 0.20 lb./ft<sup>2</sup>/hr. Windbreaks, foggers, and/or the application of the surface applied evaporation reducer as specified in Paragraph 2.6.A shall be used to limit the evaporation rates as specified. The rate of evaporation chart in ACI 305R shall be used to determine the evaporation rate of water.
- K. Cold Weather: When cold weather conditions exist, place concrete in compliance with ACI 306.
- L. Hot Weather: When hot weather conditions exist, place concrete in compliance with ACI 305.
- M. Wet Weather: Do not begin to place concrete in the rain or under the threat of rain during the pour and initial set unless concrete is protected, per the approval of the Construction Administrator, against addition of extra water. Refer to Paragraph 1.3.A.9 for submittal of favorable local weather report prior to placement of concrete.

### 3.8 Finish of Formed Surfaces

- A. Rough Form Finish: Shall be used for formed concrete surfaces not exposed to view in the finished structure or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm.) high rubbed down or chipped off.
- B. Smooth Form Finish: Shall be used for formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, corrosion control coating, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas as described in Paragraph 3.14.A.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise shown on Project Drawings.

### 3.9

#### **Unformed Finishes**

- A. **General**: Use the following finishes as specified or as shown on Project Drawings.
- B. **Float Finish**: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or portland cement terrazzo; and as otherwise indicated. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Slab shall meet the conventional straightedge flatness tolerance requirements of ACI 117. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. Do not overfinish concrete.
- C. **Trowel Finish**: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other final finish. Unless otherwise specified, slab shall meet the conventional straightedge flatness tolerance requirements of ACI 117. Grind smooth surface defects that would telegraph through applied floor covering system.
- D. **Trowel and Fine Broom Finish**: Apply trowel and fine broom finish to monolithic slab surfaces to be covered by thinset terrazzo, or ceramic or quarry tile, that is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- E. **Nonslip Broom Finish**: Apply nonslip broom finish to exterior concrete subjected to foot or wheel traffic, steps, and ramps, and elsewhere as shown on Project Drawings. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Construction Administrator before application.

### 3.10

#### **Concrete Curing and Protection**

- A. **General**: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect freshly placed concrete from rainfall or rainfall runoff. Protect concrete from rapid moisture loss before and during finishing operations with evaporation reducer specified in Paragraph 2.6.A or fog spray. Apply evaporation reducer in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling. Curing shall begin as soon as the finishing operation has been completed and the surface will not be damaged by the curing method. Curing shall be maintained for not less than seven (7) days unless otherwise specified by the Construction Administrator. Water used for curing shall be potable.
- B. **Cure Time for Canal Lining Repair at MP 8.65**: Curing shall proceed for a minimum of three days after concrete placement. The minimum three day compressive strength of the concrete shall be at least 50 percent of the 28-day compressive strength indicated in Part 2.5B, as measured by ASTM C39.

- C. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, or combinations thereof, as herein specified.
1. Provide moisture curing by one of the following methods.
    - a. Keep concrete surface continuously wet by covering with water.
    - b. Use continuous water-fog spray.
    - c. Cover concrete surface with absorptive cover specified in Paragraph 2.6.F, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inches (100 mm.) lap over adjacent absorptive covers. Moisture retaining cover specified in Paragraph 2.6.G shall be placed over absorptive cover to prevent drying out.
  2. Provide moisture retaining cover curing as follows:
    - a. Cover concrete surfaces with moisture retaining cover specified in Paragraph 2.6.G placed in widest practical width with sides and ends lapped at least 3 inches (75 mm.) and sealed by waterproof tape or adhesive.
    - b. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- D. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces for seven (7) days by moist curing with forms in place. If forms are removed prior to completion of specified seven (7) day period, continue curing by methods specified in Paragraph 3.10.B.
- E. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of specified curing methods in Paragraph 3.10.B.
- F. Shrinkage Control Joints: Allow a minimum 48-hour cure time for shrinkage control joints and seals.

### 3.11

#### Removal of Forms

- A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees Fahrenheit (50°F [10°C]) for twenty-four (24) hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations as specified in Paragraph 3.10 are executed.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, and other structural elements, shall not be removed prior to fourteen (14) days or until in-place concrete has attained at least 75 percent (75%) of design minimum 28-day compressive strength (f'c).
- C. Formwork supporting retaining walls shall not be removed nor earth retaining walls backfilled prior to fourteen (14) days or until in-place concrete has attained at least 75 percent (75%) of design minimum 28-day compressive strength (f'c).

- D. Form-facing material may be removed four (4) days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.12

3.12

### **Reuse of Forms**

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to the Construction Administrator.

3.13

### **Miscellaneous Concrete Items**

- A. Filling In: Fill in holes and openings left in concrete structures for passage of Work by other trades, unless otherwise shown or directed, after Work of other trades is in place. Mix, place, and cure concrete fill as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still fresh and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on Project Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.14

### **Concrete Surface Repairs**

- A. Repair of Surface Defects: After removal of forms, repair and patch defective areas with patching mortar specified in Paragraph 2.6.E.
- B. Structural Repair of Honeycomb and Rock Pocket Areas: In honeycomb and rock pocket areas, saw cut area and remove material down to solid concrete. Saw cut edges shall be perpendicular to the concrete surface. Place structural repair mortar as specified in Paragraph 2.6.D in accordance with the manufacturer's recommendations. Protect and cure repair mortar as specified in Paragraph 3.10.

3.15

### **Quality Control Testing During Construction**

- A. General: The District shall employ a testing laboratory to perform tests and to submit test reports. Testing laboratory shall furnish all equipment for taking samples and testing. Sampling and testing of concrete shall be performed by ACI certified Concrete Field Technicians Grade 1.
- B. Sampling Fresh Concrete: Shall conform to ASTM C172 and ASTM C94 except as modified herein. Sampling and testing for quality control during placement of concrete shall include the following, or as directed by the Construction Administrator.

1. Slump: ASTM C143; one test at point of discharge for each day's placement of each type/class of concrete. Additional tests shall be taken when concrete consistency seems to have changed and when compression test specimens are taken.
  2. Air Content: ASTM C231 pressure method for normal weight concrete; one (1) for each day's placement of each type/ class of concrete. Additional tests shall be taken when compressive test specimens are taken.
  3. Concrete and Ambient Temperature: Test hourly when air temperature is 40 degrees Fahrenheit (40°F [4°C]) and below, when 80 degrees Fahrenheit (80°F [27°C]) and above, and each time a set of compression test specimen are made.
  4. Compression Test Specimen: ASTM C31; one (1) set of ten (10) standard cylinders for compressive strength testing, unless otherwise directed by the Construction Administrator. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.
  5. Compressive Strength Tests: ASTM C39; one set as specified in Paragraph 3.15.B.4 for each day's pour exceeding 5 cubic yards (4 m<sup>3</sup>) plus additional sets for each 50 cubic yards (40 m<sup>3</sup>) more than the first 25 cubic yards (20 m<sup>3</sup>) of each concrete type/class placed in any one (1) day; three (3) specimen shall be tested at three (3) days, three (3) specimen shall be tested at seven (7) days, three (3) specimen shall be tested at twenty-eight (28) days, and one (1) specimen retained in reserve for later testing if required. When frequency of testing will provide fewer than five (5) strength tests for a given class of concrete, conduct testing from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
  6. Test results will be reported in writing to Construction Administrator, Ready Mix Producer and Contractor within twenty-four (24) hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at twenty-eight (28) days, concrete mix proportions and materials, compressive strength, and type of break for three (3) day, seven (7) day and twenty-eight (28) day tests.
  7. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Construction Administrator. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed by the Construction Administrator. Contractor shall pay for such tests if unacceptable concrete is verified.
- C. Should the strengths shown by the test specimens made and tested in accordance with the above provisions fall below the values specified in Paragraph 2.5, the Construction Administrator shall have the right to require changes in proportions to apply on the remainder of the Work. Furthermore, the Construction Administrator shall have the right to require additional curing on those portions of the structure represented by the test specimens that failed. The cost of such additional curing is to be at the Contractor's expense. In the event

that such additional curing does not give the required strength, as evidenced by core and/or load tests, the Construction Administrator shall have the right to require strengthening or replacement, at Contractor's cost, portions of the structure which fail to develop the required strength.

- D. Should the strength of test cylinders, at the seven (7) day break, fall below 60 percent (60%) of the required 28-day compressive strength, the concrete shall be rejected and shall be removed and replaced.

**\*\*\* END OF SECTION\*\*\***

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## SECTION 02205

### SOIL AND AGGREGATE MATERIALS

#### 1.0 GENERAL

#### 1.1 Section Includes

- A. Type I Backfill.
- B. Type II Backfill.
- C. Type IV Backfill
- D. Type I Drain Rock.
- E. Stockpiling.

#### 1.2 Related Sections

- A. Section 02220, EXCAVATING, BACKFILLING, AND COMPACTING
- B. Section 03300, CAST-IN-PLACE CONCRETE

#### 1.3 References

- A. ASTM C136 – “Test Method for Sieve Analysis of Fine and Coarse Aggregate.”
- B. ASTM D422 – “Test Method for Particle-Size Analysis of Soils.”
- C. ASTM D2419 – “Test Method for Sand Equivalent Value of Soils and Fine Aggregate.”
- D. ASTM D2844 – “Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils.”
- E. ASTM D4318- “Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.”
- F. ASTM G51 – “Test Method for Measuring pH of Soil for Use in Corrosion Testing.”
- G. ASTM G57 – “Test Method for Field Measurement of Soil Resistivity using the Wenner Four-Electrode Method.”
- H. STANDARD SPECIFICATIONS and STANDARD PLANS – California Department of Transportation (Caltrans), July 1999 or latest edition.

#### 1.4 Submittals

- A. Submit the following to the Construction Administrator for review:
  - 1. Material Source: Submit the name of source for all imported materials.
  - 2. Grading and Quality Requirements: Submit compliance with backfill grading and quality requirements. Submit testing results for all materials, prior to placement.



2.0

## **PRODUCTS**

2.1

### **Fill and Backfill Materials**

- A. General: No material shall be used for backfill which, because of excessive moisture or any other reason, cannot be compacted to the degree specified. Any such material shall be considered unsuitable, and if it is deposited in the trench, it shall be removed and replaced with suitable material.
- B. Granular Fill
  - 1. Material shall be crushed rock material that meets the gradation and quality requirements of the STANDARD SPECIFICATIONS, Sections 68-1.025 for Class I, Type B Permeable Material, 2 -inch maximum size.
  - 2. Material shall be clean and durable crushed stone.
  - 3. Material shall not slake or decompose with alternate wetting and drying.
- C. Type I Backfill: Type I Backfill shall meet the following requirements:
  - 1. Material shall meet the gradation and quality requirements of the STANDARD SPECIFICATIONS, Sections 26-1.02A for Class II Aggregate Base, ¾ -inch maximum size.
  - 2. Resistivity: Material shall have a minimum resistivity of 3000 ohm-cm, as determined by G-57.
  - 3. pH: Material shall have a pH between 5.5 and 8.5, as determined by ASTM G51.
- D. Type II Backfill: Type II Backfill shall meet the following requirements:
  - 1. Material may be excavated and re-used from the site, or may be imported from off site borrow areas.
  - 2. Material shall be free from organic matter, debris, asphaltic material, or other unsuitable materials, or lumps or rocks larger than three (3) inches.
  - 3. Material shall have a plasticity index (PI) of 20 or less as determined by ASTM D4318.
  - 4. pH: Material shall have a pH between 5.5 and 8.5, as determined by ASTM G51.
- E. Type III Backfill: Type III Backfill shall meet the following requirements:
  - 1. Material shall be clean, sound, and durable natural sand.
  - 2. Material shall meet the following grading requirements, as determined by ASTM C136:

PERCENTAGE PASSING	
SIEVE SIZE	OPERATING RANGE
3/4 inch	100
No. 4	90-100
No. 20	0-60
No. 200	0-15

3. Sand Equivalent: Material shall have a minimum sand equivalent value of thirty (30), as determined by ASTM D2419.
4. Resistivity: Material shall have a minimum resistivity of 2000 ohm-cm, as determined by ASTM G57.
5. pH: Material shall have a pH between 6.5 and 8.5, as determined by ASTM G51.

F. Type IV Backfill: Type IV backfill shall meet the following requirements:

1. Material shall be imported, washed and graded sand, graded creek or bank gravel, river run rock, or combinations thereof. The reuse of native material is not permitted.
2. The material shall form a dense, well-compacted embedment and shall not contain any crushed particles.
3. Material shall conform to the following grading requirements:

PERCENTAGE PASSING	
SIEVE SIZE	OPERATING RANGE
3/4 inch	90-100
3/8 inch	65-90
No. 4	50-75
No. 40	15-30
No. 200	0-5

4. Sand Equivalent: Material shall have a minimum sand equivalent value of 75, as determined by ASTM D2419.
5. Resistivity: Material shall have a minimum resistivity of 3000 ohm-cm, as determined by ASTM G57.
6. pH: Material shall have a pH between 5.5 and 8.5, as determined by ASTM G51.

- G. Type I Drain Rock: Type I Drain Rock shall meet the following requirements:
  - 1. Material shall meet the requirements of the STANDARD SPECIFICATIONS Section 68-1.025, for Class II Permeable Material.
  - 2. Material shall be clean and durable natural gravel or crushed stone.
  - 3. Material shall not slake or decompose with alternate wetting and drying.

3.0 **EXECUTION**

3.1 **Stockpiling**

- A. Stockpile materials at locations designated by the Construction Administrator.
- B. Separate differing materials with dividers, or stockpile apart to prevent mixing.
- C. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- D. Stockpiled area must not direct runoff onto private property, roads, or storm drain systems.

**\*\*\*END OF SECTION\*\*\***

## SECTION 02220

### EXCAVATING, BACKFILLING, AND COMPACTING

#### 1.0 GENERAL

#### 1.1 Section Includes

- A. General Excavation.
- B. Trench Excavation.
- C. General Backfill and Compaction.
- D. Trench Backfill and Compaction.

#### 1.2 Related Sections

- A. Section 02205, SOIL AND AGGREGATE MATERIALS
- B. Section 03300, CAST-IN-PLACE CONCRETE

#### 1.3 References

- A. Standard Details:
  - 1. Contra Costa County – August 1966, or latest edition.
  - 2. Contact individual agencies for additional information.
- B. ASTM D1556 – “Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.”
- C. ASTM D1557 – “Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.”
- D. ASTM D2922 – “Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.”
- E. STANDARD SPECIFICATIONS and STANDARD PLANS – California Department of Transportation (Caltrans), July 1999.
- F. Construction Safety Orders, California Code of Regulations, Title 8, Chapter 4 – State of California Occupational Safety and Health Standards Board (CAL/OSHA), 1999.

#### 1.4 Submittals

- A. Submit the following to the Construction Administrator for review:
  - 1. Excavation Permit: The Contractor shall submit a CAL/OSHA excavation permit prior to commencing with work.
  - 2. Groundwater and Surface Water Handling Plan: The Contractor shall submit a groundwater and surface water-handling plan; detailing the methods of keeping the excavation free of water.

1.5 **Quality Assurance**

- A. Perform work in accordance with all referenced codes, specifications, and standards, except as modified herein.
- B. Verify that survey, benchmark, control point, and intended elevations for the work are as shown on the Drawings.

1.6 **Dewatering**

- A. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- B. The Contractor shall furnish all materials and equipment and perform all work required to install and maintain the drainage systems it proposes for handling groundwater and surface water encountered during construction of structures and pipelines.

2.0 **PRODUCTS**

2.1 **Backfill Materials**

- A. General: No material shall be used for backfill which, because of excessive moisture or any other reason, cannot be compacted to the degree specified. Any such material shall be considered unsuitable, and if it is placed, it shall be removed and replaced with suitable material.
- B. Type I Backfill: Type I Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- C. Type II Backfill: Type II Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- D. Type III Backfill: Type III Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- E. Type IV Backfill: Type IV Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- F. Controlled Low Strength Material (CLSM): Shall be specified in Section 02312, **CONTROLLED LOW STRENGTH MATERIAL**.

3.0 **EXECUTION**

3.1 **Preparation**

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns, and other features remaining as a portion of the final landscaping.
- C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic. Any modification or relocation of

such items shall be made at the Contractor's expense.

- D. Prior to excavation, the Contractor shall notify the appropriate regional center of all excavations, as required under Government Code Section(s) 4216-4216.9. The Contractor shall contact Underground Service Alert at 1-800-227-2600 for the location of subsurface installations. It shall be the responsibility of the Contractor to determine the exact location and depth of all utilities, including service connections, which have been marked by the respective owners, and which the Construction Administrator believes may affect or be affected by the Contractor's operations.
- E. Locations of known underground utilities and structures are shown on the drawings as they are supposed to exist. Appurtenances and service laterals are not usually shown. Locations shown may be based on information furnished by the utility owners at the time of design, derived from visible surface facilities, or based on subsurface exploration.
- F. The Contractor shall notify the District, County, City, and other agencies having jurisdiction, and any other parties directly or indirectly affected by the project, forty-eight (48) hours in advance of the intention to commence excavation.
- G. The Contractor shall identify a suitable location to store excavated materials that will minimize the obstruction of traffic.

### 3.2

#### General Excavation

- A. General:
  - 1. All lines and grades shall be established by the Contractor, in accordance with the Project Drawings and Specifications. The Contractor shall submit verification record of all such survey work to the Construction Administrator, as may be required. The Contractor shall carefully preserve all survey stakes and reference points. Should any stakes or points be removed or destroyed during the installation, they shall be reset by the Contractor at the Contractor's expense.
  - 2. Remove all materials encountered that may interfere with the completion of the work.
  - 3. Blasting will not be permitted.
  - 4. Excavation shall be kept dry throughout construction operations.
  - 5. Excavated surfaces shall be properly graded to provide good drainage.
  - 6. **Classification of Excavated Materials.** No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Work, regardless of the type, character, composition, or condition thereof.
  - 7. **Preservation of Trees.** No trees shall be removed outside excavated or filled areas, unless their removal is authorized by the District. Trees left standing shall be adequately protected from permanent damage by construction operations.

B. Stripping:

1. Topsoil and other materials unsuitable for use in the work shall be removed from excavation and fill areas, as required to expose satisfactory material or foundation.
2. Topsoil and other unsuitable materials shall be offhauled and disposed of legally off the project site.

C. Excavation:

1. Excavate to the required lines and grades, as shown on the Drawings.
2. Material below the foundation grade shall not be disturbed, except where so indicated on the Drawings or by the Construction Administrator. The foundation grade for concrete placement shall not be more than ½-inch above the specified grade at any point, and the average elevation over any selected area, ten (10) square feet in dimension, shall be at or below the established grade.
3. Where the material at the bottom of the excavation is of soft or unstable material, has been saturated and degraded, or is otherwise considered unsuitable for the support of structures, the Contractor shall overexcavate to an additional depth, as required by the Construction Administrator, backfill with Type I Backfill Material, and compact in accordance with the requirements of these specifications.
4. Excavation shall include the removal of all soil, rock, pavement, tree stumps and other vegetation or vegetable matter, waste or debris, abandoned pipelines and other structures shown on the Drawings, ground water and materials of any nature which interfere with the construction work.
5. Excavations shall provide adequate working space and clearances for the Work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.
6. Except where exterior surfaces are specified to be damp proofed, monolithic concrete manholes and other concrete structures or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.
7. **Stabilization.** Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.
8. Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized subgrades shall

not be above subgrade elevations indicated on the Drawings.

D. Dewatering

1. Contractor shall design, install, operate, maintain, and remove all necessary dewatering systems. Contractor shall have sole responsibility for all aspects of furnishing, operating, maintaining, and removing the dewatering systems. Methods for care of surface water and for controlling the surface and groundwater levels shall be subject to approval of the Construction Administrator
2. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the Work. Each excavation shall be kept free of standing water during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
3. Maintain all excavations to be backfilled free of water at all times during the work. Take care during excavation to prevent disturbing foundations. If groundwater is encountered during excavation, commence dewatering and provide dewatering in advance of and concurrently with further excavation. Dewatering shall be accomplished in a manner that will prevent loss of fine material from foundation or excavated surfaces, will maintain stability and prevent heaving of excavated slopes and bottoms of excavations, and will result in construction operations being performed in conditions free of standing water and excess moisture that prevents foundation preparation and fill placement as specified. Foundations shall be free of water at the time backfill, bedding, or concrete is placed. Water control shall continue as necessary to prevent damage to operations and finished work.
4. If suitable foundation material has been disturbed by the Contractor's operations, has been damaged by water, or has been removed for the Contractor's convenience in dewatering the foundation, the foundation shall be restored by the Contractor, at the Contractor's expense, to a condition at least equal to the undisturbed foundation as determined by the Construction Administrator.
5. All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth as required, beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.
6. Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.
7. Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.
8. Contractor shall obtain from the appropriate agencies and authorities, the dewatering and storm water discharge permits required to remove and



dispose of groundwater, surface water, and any other water used in Contractor's operations. The permits shall be obtained prior to start of construction.

E. Bracing Excavations:

1. Excavations shall be braced and supported such that ground adjacent to the excavation will not settle or slide, and so that all surfaces or subsurface improvements, both public and private, will be fully protected from damage.
2. If any damage does result to such improvements, the Contractor shall perform the necessary repairs or reconstruction at their own expense, and to the satisfaction of the owner of the damaged improvement as directed by the Construction Administrator.

F. Sheeting and Shoring

1. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported with steel sheet piling and shoring as necessary to prevent caving or sliding.
2. Sheet piling or other excavation support systems shall be installed as necessary to limit the extent of excavations for deeper structures and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and shall install adequate protection systems for prevention of damage to existing facilities.
3. Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state of California and retained by Contractor.
4. Trench sheeting may be removed if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, it shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Trench sheeting shall be removed unless otherwise permitted by Construction Administrator. Trench sheeting will not be removed, if in the opinion of Construction Administrator, removal of the sheeting will cause damage to the facility it is protecting. If left in place, the sheeting shall cut off twelve (12) inches below finished grade. The design of the support system shall be such as to permit complete removal while maintaining safety and stability at all times.

G. Safety: The Contractor shall make sufficient excavation to construct all the work contained in the contract documents and shall abide by the requirements of the State of California Occupational Safety and Health Standards Board (CAL/OSHA) "Construction Safety Orders" and "General Industrial Safety Orders."

H. Disposal of Unsuitable Material:

1. All excavated material not utilized in the construction shall become the property of the Contractor and be removed and disposed of legally off the

project site.

2. No excavated materials shall be removed from the site of the work or disposed of by the Contractor, except as approved by the Construction Administrator. Materials shall be neatly piled until used or otherwise disposed of as directed. Material shall be stored in an area of sufficient distance from excavations so as not to create a surcharged soil loading adjacent to the excavation.

### 3.3 **Trench Excavation**

#### A. General

1. All trench excavation shall be open cut from the surface.
2. Contractor shall excavate all tie-in points to verify conditions prior to manufacturing the pipes.
3. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment.
4. Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits.

#### B. Mechanical Excavation.

1. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
2. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, and that trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.

#### C. Cutting Concrete Surface Construction.

1. In paved area, pavement shall be cut and removed on neat lines to minimum trench width specified. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1½-inches deep along each side of the trench and along the perimeter of cuts for structures.
2. Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than six (6) inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. The trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to

the center line of the trench.

3. Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.
4. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

D. Excavation Below Pipe Subgrade.

1. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, to provide for the installation of granular embedment or CLSM.
2. Bell holes shall provide adequate clearance for tools and methods used for installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

E. Artificial Foundations in Trenches.

1. Whenever unsuitable or unstable soil conditions are encountered, trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable material. In such cases, adjustments will be made in the Contract Price in accordance with the provisions of the General Conditions.

3.4 **General Backfill and Compaction**

A. General:

1. Remove all loose material, wood, and debris from the trench prior to backfilling.
2. Backfill to level of original ground surface, to underside of pavement base course, or as shown on the Drawings. Backfill for concrete structures shall not be placed until the concrete has attained at least ninety percent (90%) of design strength.
3. Remove sheeting, shoring, and bracing using methods that minimize caving. Metal sheeting, shoring, and bracing may be left in place on approval by the Construction Administrator.

B. Structural Backfill :

1. When material beneath the foundation grade for structures is required to be excavated, the excavation shall be backfilled with material shown on the drawings, or as directed by the Construction Administrator. Material shall be placed and spread in successive, approximately horizontal lifts not exceeding eight (8) inches in loose thickness.
2. The sides of structures shall be backfilled as shown on the Drawings. Material shall be placed and spread in successive, approximately

horizontal lifts not exceeding eight (8) inches in loose thickness.

C. Fill:

1. Fills shall be constructed from Type I or II Backfill Material as shown on the Drawings or directed by the Construction Administrator. In areas where over-excavation is required fills shall be constructed with Type III backfill.
2. All topsoil shall be stripped, and the foundation prepared for constructing the fill.
3. Exposed surfaces shall be scarified to a depth of at least six (6) inches (unless the surface is rock), and compacted at a moisture content that will permit proper compaction as outlined in these specifications.
4. Prior to placing fill material, obtain the Construction Administrator's approval of the site preparation in the area to be filled.
5. Place and spread the material in successive, approximately horizontal layers, not exceeding eight (8) inches in loose thickness.
6. Earth slopes shall be keyed into as the work is brought up.
7. Portions of the fill surface shall be moistened, scarified, or plowed, as directed by the Construction Administrator, to a depth of at least six (6) inches, and recompact when necessary to produce a uniform, stable fill.

D. Compaction:

1. Structure Fill or Backfill:
  - a. Sides of Structures: Compact each lift to not less than ninety percent (90%) relative compaction, in accordance with ASTM D1557.
  - b. Structure Foundation: Compact each lift to not less than ninety-five percent (95%) relative compaction, in accordance with ASTM D1557.
2. Fill: Compact each lift to not less than ninety percent (90%) relative compaction, in accordance with ASTM D1557. Where Type I backfill is used, compact to at least 95 percent (95%) relative compaction in accordance with ASTM D 1557. Compact upper six (6) inches of road subgrade or ditch to not less than ninety-five percent (95%) relative compaction, in accordance with ASTM D1557.
3. At the time of compaction, the moisture content of the fill and backfill material shall be such that the required relative compaction will be obtained. Condition material which contains insufficient moisture or excess moisture until the moisture content is such that the relative compaction will be obtained.
4. Compaction Equipment shall be standard type capable of producing the specified relative compaction with the specified fill and backfill materials.

5. Hand-operated tampers shall be used only in areas which are inaccessible to self-propelled or towed mechanical compacting equipment, or where damage to existing facilities by the use of self-propelled or towed compacting equipment is probable.
6. If the compacted fill material fails to pass the compaction test requirements of these specifications, no additional material shall be placed until the unsatisfactory fill has been reworked or replaced and satisfactory compaction test results are obtained.
7. Tolerances: The elevation of the top layer of any one compacted fill material shall not vary more than ½-inch from the elevation indicated on the Drawings.
8. Controlled Low Strength Material (CLSM) does not require compaction.

### 3.5 **Pipe Bedding, Embedment and Backfill**

#### A. Pipe Bedding

1. Pipe bedding will consist of either Controlled Low Strength Material as per Section 02312 or Type IV Backfill as per Section 02205.

#### B. Pipe Embedment

1. For permanently installed pipes pipe embedment will consist of either CLSM as per Section 02312 or Type IV Backfill as per Section 02205.
2. For the temporary bypass system, pipe embedment shall consist of either Type II Backfill per Section 02205 or CLSM per Section 02312 at the direction of the Construction Administrator, If Type II Backfill is used for installation of the temporary bypass diversion, the plasticity index requirement in Section 02205 can be waived at the discretion of the Construction Administrator.

#### C. Trench Backfill

1. Material used for permanent pipe installations will consist of Type II Backfill as per specification Section 02205.
2. Material used during installation of the temporary bypass system will consist of Type II Backfill as per Section 02205, except that the plasticity index requirement in Section 02205 Part C. can be waived at the discretion of the Construction Administrator. Native soils are acceptable provided they are free of organics, debris and particles greater than 3 inches in diameter.
3. Material used for backfilling the trench of the temporary bypass diversion after removal of the pipe shall consist of Type II Backfill as per Section 02205, except that the plasticity index requirement in Section 02205 Part C can be waived at the discretion of the Construction Administrator. Native soils are acceptable provided they are free of organics, debris and particles greater than 3 inches in diameter.

D. Placement and Compaction of Granular Embedment Material

1. Granular bedding and embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.
2. After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof by shovel slicing or other suitable methods to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.
3. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
4. Embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified and also around the restrained pipe sections.
5. Each lift of granular embedment material shall be vibrated with a mechanical probe type vibrator or shovel sliced during placement to ensure that all spaces beneath the pipe are filled. Granular embedment shall be placed in maximum lift thickness of six (6) inches and compacted. Each lift of embedment material shall be compacted with three (3) passes (round trip) of a platform type vibrating compactor.
6. Where indicated on the Drawings, migration of soil into the embedment material shall be prevented with filter fabric Type A or by use of inundated sand embedment. Filter fabric shall be placed on the trench surfaces so that it completely surrounds the embedment material. Joints shall be lapped twelve (12) inches.

E. Placement of CLSM Bedding and Embedment- Shall be as specified in Section 02312- Controlled Low Strength Material

F. Placement and Compaction of Trench Backfill

1. Place and spread the material in successive, approximately horizontal layers, not exceeding eight (8) inches in loose thickness.
2. Compact each lift to not less than ninety percent (90%) relative compaction, in accordance with ASTM D1557. Compact upper six (6) inches of road subgrade to not less than ninety-five percent (95%) relative compaction, in accordance with ASTM D1557.
3. At the time of compaction, the moisture content of the trench backfill material shall be such that the required relative compaction will be obtained. Condition material which contains insufficient moisture or excess moisture until the moisture content is such that the relative compaction will be obtained.
4. Compaction Equipment shall be standard type capable of producing the specified relative compaction with the specified trench backfill materials.

5. If the compacted fill material fails to pass the compaction test requirements of these specifications, no additional material shall be placed until the unsatisfactory fill has been reworked or replaced and satisfactory compaction test results are obtained.
6. The compaction requirements for temporary backfills used for the MP 8.65 canal bypass diversion can be waived upon approval by the Construction Administrator.

3.6 **Testing**

- A. General: As part of the inspection program, the Construction Administrator or designee will take samples and perform moisture content, gradation, Atterberg limits, compaction, and density tests during placement of backfill materials to check compliance with these Specifications. The Contractor shall remove surface material at locations designated by the Construction Administrator and provide such assistance as necessary for sampling and testing by the Construction Administrator.
- B. Standards: Unless otherwise specified, the most recent standard of the following test methods shall be used:

TEST DESCRIPTION	ASTM TEST METHOD NUMBER
Maximum Density and Optimum Moisture Content	D-1557
Relative Compaction	D-1556 or D-2922

3.7 **Unusual Conditions**

- A. In the event that any unusual conditions not covered by the special provisions are encountered during grading operations, the Construction Administrator shall be immediately notified in accordance with the General Requirements.

**\*\*\* END OF SECTION \*\*\***

## SECTION 02830

### CHAIN LINK FENCES AND GATES (GALVANIZED)

#### 1.0 GENERAL

#### 1.1 Section Includes

- A. Fence framework, fabric, gates, and accessories.
- B. Excavation for post bases; concrete footing for posts.
- C. Removal of existing fencing.

#### 1.2 Related Sections

- A. Section 02060, SITE PREPARATION AND SELECTIVE DEMOLITION
- B. Section 03300, CAST IN PLACE CONCRETE

#### 1.3 References

(All ASTM Specifications as referenced shall be of the latest edition.)

- A. ASTM A153 "Zinc Coating (Hot-Dip) on Iron and Steel Hardware."
- B. ASTM A392-96 "Zinc-Coated Steel Chain-Link Fence Fabric."
- C. ASTM F626-96a "Fence Fittings."
- D. ASTM A780 "Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings."
- E. ASTM F552 "Terminology Related to Chain Link Fencing."
- F. ASTM F900-94 (2000) "Industrial and Commercial Swing Gates."
- G. ASTM F1043-00 "Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework."
- H. ASTM F1083-97 "Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structure."
- I. ASTM F567-00 "Practice for Installation of Chain Link Fence."
- J. PRODUCT MANUAL – Chain Link Fence Manufacturers Institute (CLFMI).

#### 1.4 Definitions

- A. Definitions shall be in accordance with ASTM F552.
- B. NPS – Nominal pipe size designator in accordance with ASTM F1083.
- C. CLFMI – Chain-Link Fence Manufactures Institute.



1.5

**System Description**

- A. Fence Height as indicated on the Drawings or match existing fence height, in case of replacement.
- B. Line Post Spacing Intervals not exceeding 8 feet (2.4 m).
- C. Fence Post and Brace Strength – In accordance with ASTM F1043 quality.
- D. Setback Inside From Property Line – 6 inch (150 mm) nominal, unless noted differently on Drawings.
- E. Canal Property Line Fence Height – 6 feet nominal.
- F. Canal Lining Fence at Structures Height – 5 feet nominal. 7 feet height at Milepost 8.65 work site.
- G. Walk Gate Width – 4 feet nominal unless otherwise shown on the Drawings.

1.6

**Submittals**

- A. Submittals shall be in accordance with Section 01300. Submit a certification to indicate that the material was produced in accordance with these specifications.
- B. Product Data – Provide data on fabric, posts, accessories, fittings, and hardware. Include galvanizing/coating certification and manufacturer's technical literature.
- C. Shop Drawings – Indicate plan layout, spacing of components, post footing dimensions, hardware anchorage, and schedule of components.

1.7

**Quality Assurance**

- A. Perform work in accordance with ASTM F567 and PRODUCT MANUAL of CLFMI.
- B. All materials shall be new. Old, improperly galvanized, or coated or damaged materials are not permitted.
- C. Fence, gate, and accessories shall be the product of a single manufacturer, and the manufacturer's warranty shall be for the entire fencing system.

1.8

**Qualifications**

Manufacturer shall be company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

2.0

**PRODUCTS**

2.1

**Manufacturers**

- A. Master-Halco – (Local rep. Thompson & Fence Co. 925-932-1029)
- B. American Fence Products – (918) 835-0898
- C. Southwestern Wire, Inc. – (405) 447-6900
- D. Or others as approved equal.

2.2

**Materials**

- A. Materials and Components – Conform to CLFMI Product Manual.
- B. Fabric Size – CLFMI Standard Industrial Service; with a 2-inch mesh, 9 gage, galvanized steel wire with a nominal diameter of 0.15 inches, and a minimum breaking strength of 1,290 pounds. With the following diamond count per height of fabric:

Height of Fabric	36"	42"	48"	60"	72"	84"	96"	120"	144"
Diamond Count	10.5	12.5	13.5	17.5	20.5	24.5	27.5	34.5	41.5

- C. Fence Frame & Fittings - ASTM F1083 Schedule 40 hot-dip galvanized, Type I steel pipe, welded construction, with yield strength of 40 ksi minimum. Fittings shall meet the requirements of ASTM F626.
- D. Gates – Shall be as shown on the drawings with required hinges, fittings and all accessories. Swing gates shall meet the requirements of ASTM F900.
- E. Portland Cement Concrete – Produced from commercial quality aggregates and cement; containing not less than 470 pounds of cement per cubic yard. Water cement ratio not to exceed 0.5. Compressive Strength at 28 days shall not be less than 2,000 psi.

2.3

**Components**

- A. Line (Intermediate) Post – shall be Type I, galvanized steel schedule 40 pipe with a minimum nominal outside diameter of 1.90 inches, nominal weight of 2.72 lb/ft for fences up to six feet in height; and a minimum nominal outside diameter of 2.375 inches, nominal weight of 3.65 lb/ft for fences over six feet in height. A 10% average tolerance in nominal weight is allowed.
- B. Terminal Post, which includes Corner, End, and Pull Posts, shall be same type of steel as the Line Post with a minimum outside diameter of 2.875 inches and a minimum weight of 5.8 pounds per foot.
- C. Brace, Corner, End, Walk Gate and Latch Posts – Type I, round steel schedule 40.
- D. Brace – 1.25 inches nominal pipe size, steel schedule 40; plain end, sleeve coupled.
- E. Fabric – 2-inch diamond mesh interwoven wire, 9-gage thick; top and bottom selvage knuckle end closed. For Property Line Fence the top selvage shall be twisted (barbs ups) and the bottom selvage knuckle end closed.
- F. Tension Wire – 7 gage thick steel, single strand.
- G. Tension Band (Truss Rods) – 3/8-inch diameter steel.
- H. Tie Wires and Hog Rings – 9 gage thick steel, single strand.
- I. Post Clips – 6 gauge thick steel.

- J. Truss Rods and Tighteners – 3/8-inch diameter steel for truss rods. Tighteners shall be steel, malleable iron, or wrought iron, ¼-inch thick nominal.
- K. Turnbuckles – Commercial quality steel, malleable iron, or wrought iron, required on all Truss rods.
- L. Stretcher Bar (Tension Bar) shall be 0.25 inch by 0.75 inch.
- M. Stretcher Bar Bands shall be placed on 12-inch centers.
- N. Gates
  - 1. Gates shall be of the dimensions as shown on the Drawings.
  - 2. Gates posts shall be fabricated from steel and shall have a minimum moment resistance of 1,400 foot-pounds in any direction.
  - 3. Gates greater than 8 feet in length shall have interior vertical members installed so that no panel exceeds eight feet in length. Interior vertical members shall be constructed of not less than 1.66 inches outside diameter.
  - 4. Gate frames shall be trussed with 3/8-inch adjustable truss rods. The corners of the gate frames shall be fastened together and reinforced with a malleable iron fitting designed for the purpose, or by welding. Welding quality shall meet the requirements of Part C - Acceptance Criteria of Section 6 Inspection of the Structural Welding Code - Steel, ANSI/AWS D1.1-2000 and shall develop the full strength of the connecting members. All welds shall be ground smooth and coated as similar new fence members.
  - 5. Chain link fence fabric specified for the fence shall be attached to the gate frame by the use of stretcher bars and tie wire as specified for fence construction, and suitable tension connectors shall be spaced approximately 12 inches on centers.
  - 6. The gate shall be hung by at least two steel or malleable iron hinges not less than three inches in width, so designed as to securely clamp to the gate post and permit the gate to be swung back against the fence.
  - 7. Keepers shall be provided for each gate leaf over five feet wide. Gate keepers shall consist of a mechanical device for securing the free end of the gate in full open position.
- O. Gate Posts and Latch Posts – For gate opening of less than 12 feet, shall be round steel members with a minimum outside diameter of 2.875 inches and a minimum weight per foot of 5.8 pounds. For gate opening of greater than 12 feet, shall have a minimum diameter of 4 inches and a minimum weight per foot of 9.1 pounds.

#### 2.4 **Accessories**

- A. Caps – Cast steel, galvanized; sized to post diameter, set screw retainer, as specified in ASTM F626.
- B. Fittings – Sleeves, bands, clips, brace ends, tension bars, fasteners, and fittings; all steel as specified in ASTM F626.

2.5

**Finishes**

- A. Fabric – Galvanized to ASTM A392 Class 2; nominal 2 oz/ft<sup>2</sup> coating. Fabric coating shall be either “Galvanized after Weaving (GAW)” or “Galvanized before Weaving (GBW)”, both types are acceptable. Wire shall be zinc-coated by either the hot-dip or electrolytic process.
- B. Frame and Fittings – Hot-Dip galvanized to ASTM F1083, nominal 2 oz/ft<sup>2</sup> coating. Framework material design shall meet the requirements of Group IA of Table 2 of ASTM F1043.
- C. Hardware – Galvanized to ASTM A153; nominal 2 oz/ft<sup>2</sup> coating.
- D. Accessories – Same finish as hardware.
- E. Galvinal, Bezinal, or Galfan coatings, which combine zinc and aluminum, shall not be used.
- F. Finishes for the gates shall be same as those specified for the fences.

3.0

**EXECUTION**

3.1

**Preparation**

- A. Clear 2-feet each side of fence line before excavating post holes. Care should be taken to avoid damaging landscape within this four-foot fencing strip.
- B. Protect existing trees, shrubs, and other features identified by Construction Administrator.

3.2

**Installation**

- A. Post Footings
  - 1. Excavate post holes to dimensions indicated on the plans.
  - 2. Verify items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.
  - 3. Verify post footings are free from debris prior to concrete placement.
  - 4. Ensure cast parts are not disturbed during concrete placement.
  - 5. Locate and set in place items which will be cast directly into concrete.
  - 6. Provide 2-inch clearance between bottom of post footing excavation and bottom of metal post.
- B. Set all posts plumb, in concrete footings with top of footing flush with finish grade. Slope top of concrete for water runoff. End latch, gates, and corner posts shall have a minimum resisting moment, in any direction, of 1,400 foot-pounds. All other posts (e.g., line posts) shall have a minimum resisting moment of 800 foot-pounds perpendicular to fence line and 400 foot-pounds parallel to fence line.
- C. Install framework, fabric, and accessories, and gates in accordance with ASTM F567 and manufacturer’s instructions. Install fence and gates as indicated on the plans, per manufacturer’s instructions, and the CLFMI Product Manual.

- D. Place fabric on side of posts, braces, and gates facing away from interior of District Property or away from canal.
- E. The fabric shall be fastened to line posts with tie wires or post clips and to tension wires with tie wires or hog rings. These fasteners shall be spaced approximately 12 inches on center on line posts and at 12 inches on center on tension wires.
- F. Approval of the Construction Administrator shall be obtained prior to any field welding or cutting. Field welds and cuts shall be coated as specified by the fence coating manufacturer to preserve the integrity of the coating.
- G. Line Post Footing Depth Below Finish Grade – 3-feet or the dimensions shown on the plans, whichever is deeper.
- H. Corner, End, Latch, and Pull Post Footing Depth Below Finish Grade – 3-feet or the dimensions shown on the plans, whichever is deeper.
- I. Walk Gate Post Footing Depth Below Finish Grade – 3-feet or the dimensions shown on the plans, whichever is deeper.
- J. Brace each corner, end, gate, and latch post to adjacent line post with horizontal top brace and diagonal truss rods. Install brace one bay from each corner, end, gate, and latch post.
- K. Install top brace and truss rods on gate leaves.
- L. Do not stretch fabric until concrete footings have cured for at least seven (7) days.
- M. Do not fasten gate leaves to gate posts until concrete footings have cured seven (7) days.
- N. Stretch fabric between pull posts or at intervals of 100 feet maximum, whichever is less.
- O. Position bottom of fabric 2 inches above finish grade.
- P. Fasten fabric to top brace, line posts, braces, and bottom tension wire with tie wire at maximum 15-inch on center. Attach fabric to end, corner, pull, gate, and latch posts with tension bars and tension bar clips.
- Q. Install bottom tension wire stretched taut between terminal posts.
- R. Install gate with fabric to match fence. Gates to open freely and without obstruction. Install two hinges per leaf, latch, and catches.
- S. Connect new fence to existing fence(s) as indicated on the plans or as directed by Construction Administrator. At a minimum, provide corner posts with braces for every direction of strain at junction with existing fences. Fasten tension wire in new and existing fences to posts. New fences shall not be connected to structures unless specifically shown on plans or directed by Construction Administrator. Normally, an end post is installed adjacent to structures and the fence is connected only to the end post.

- T. Spread excavated material along right-of-way, locations indicated by Construction Administrator. Spread material is not to impede existing drainage patterns.
- U. Remove excess and waste concrete from site.
- V. Attach gate operator to swing gate in accordance with manufacturer's instructions. All gate hardware shall be thoroughly secured, properly adjusted, and left in perfect working order. Hinges shall be adjusted so that the gate will hang level.

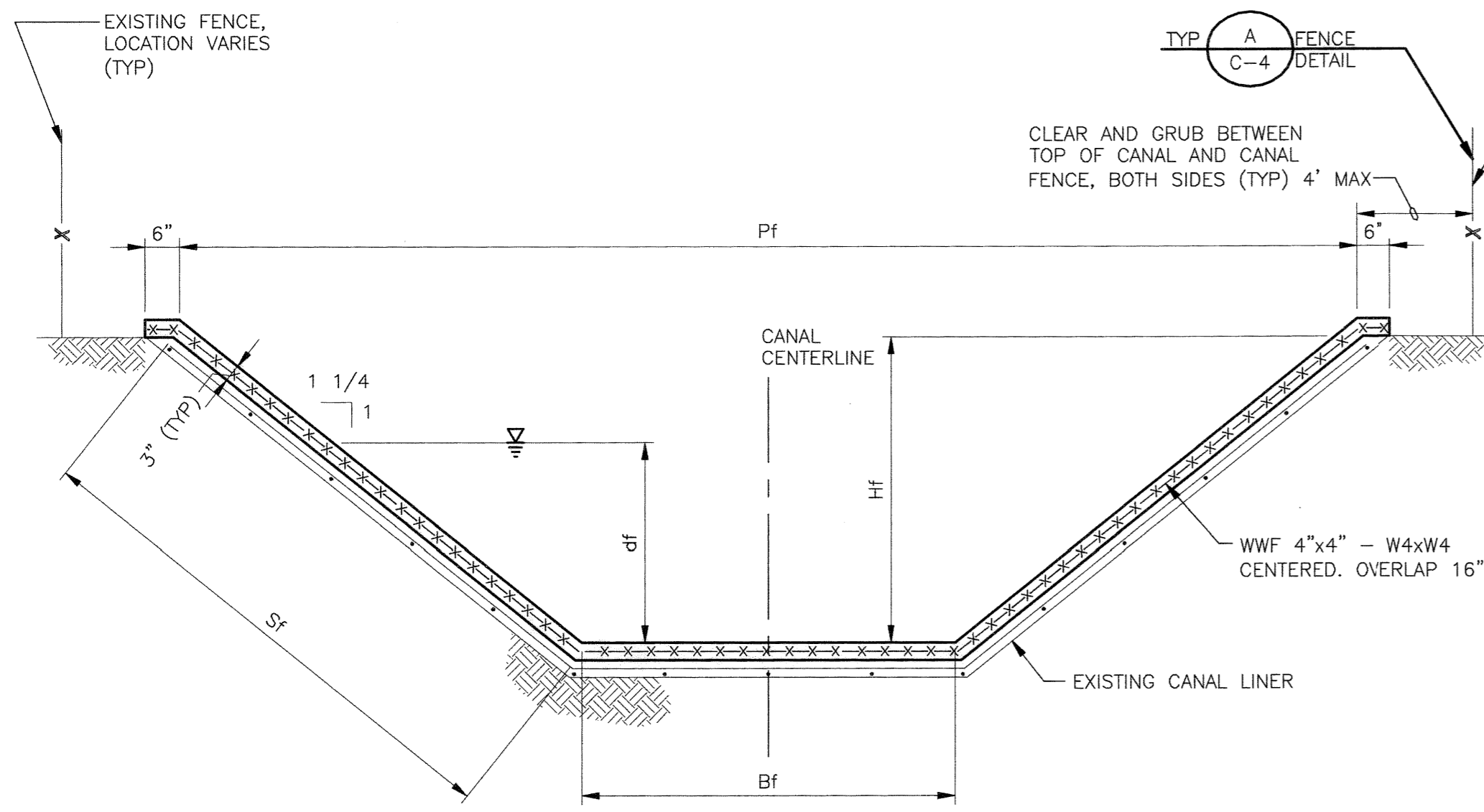
3.3

**Erection Tolerances**

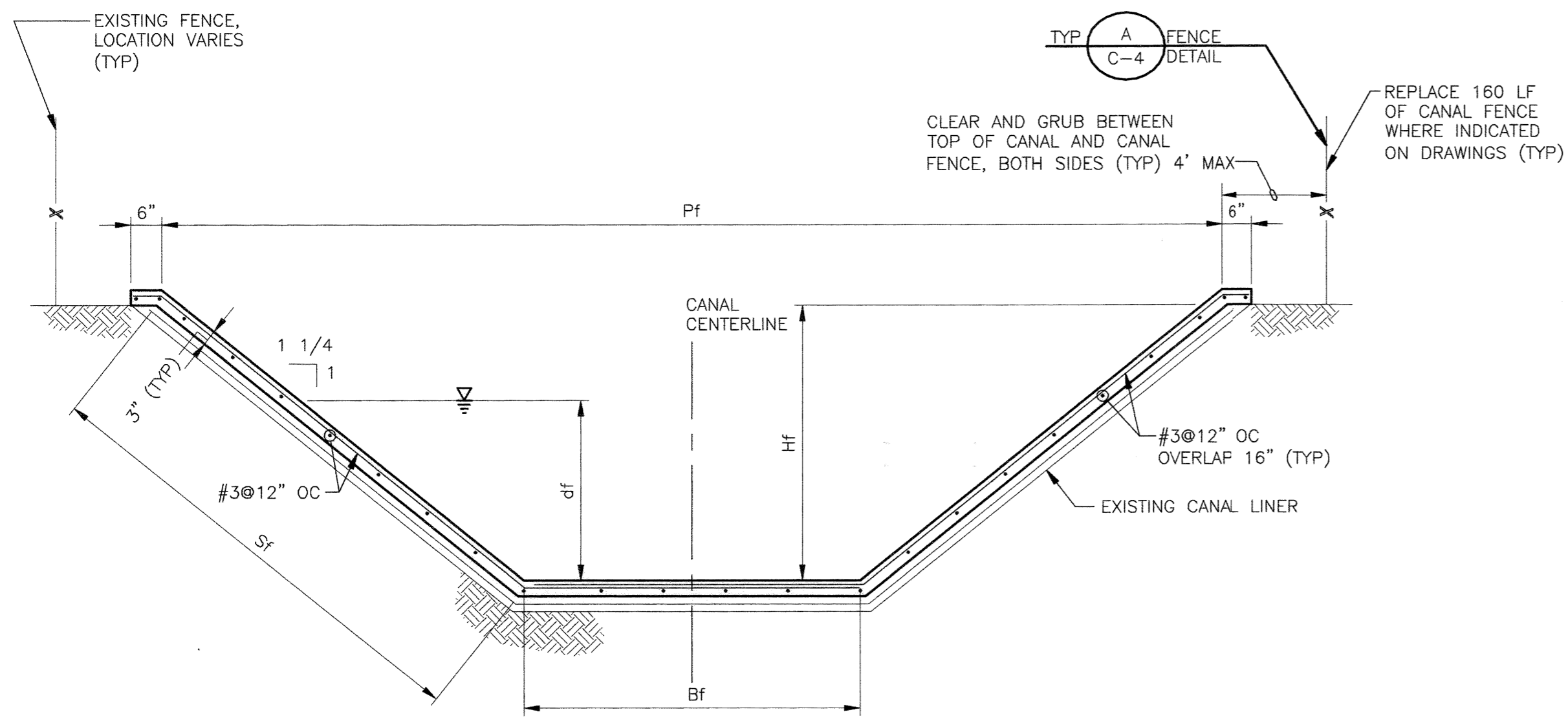
- A. Maximum Variation From Plumb—1/4"(6 mm).
- B. Maximum Offset From True Position—1" (25 mm).

**\*\*\*END OF SECTION\*\*\***

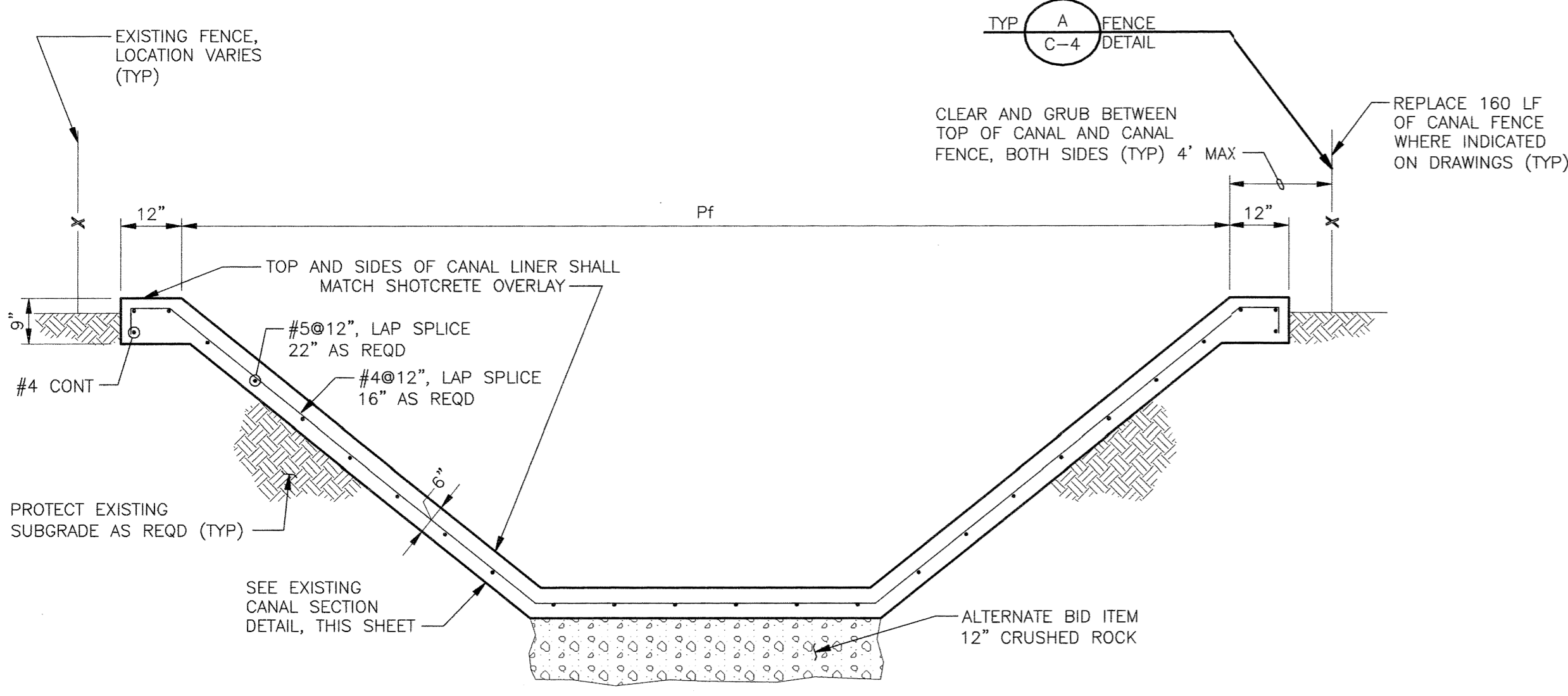
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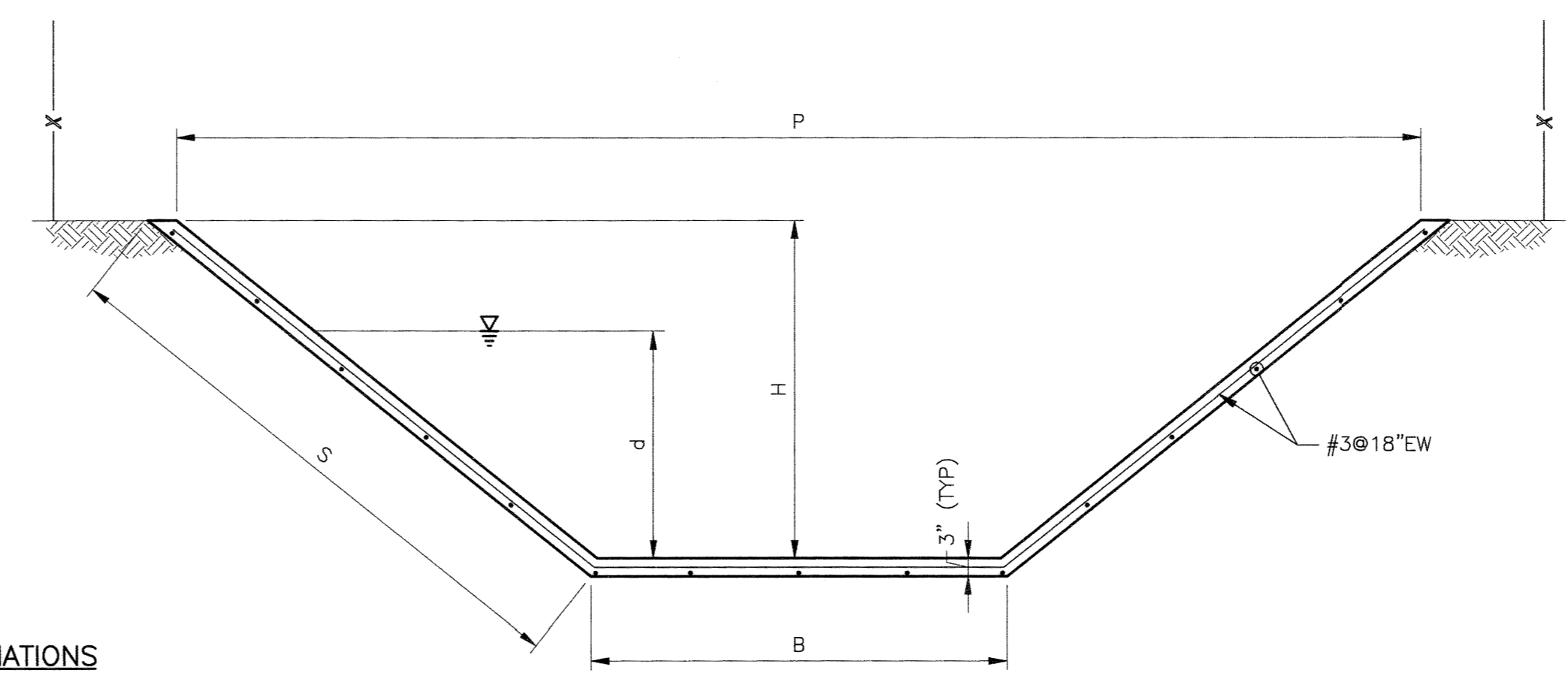
**CANAL SECTION - REPAIR TYPE A**  
**(SHOTCRETE OVERLAY WITH WELDED WIRE FABRIC)**  
 NO SCALE



**CANAL SECTION - REPAIR TYPE B**  
**(SHOTCRETE OVERLAY WITH REINFORCEMENT BARS)**  
 NO SCALE



**NEW CANAL SECTION - REPAIR TYPE C**  
 NO SCALE



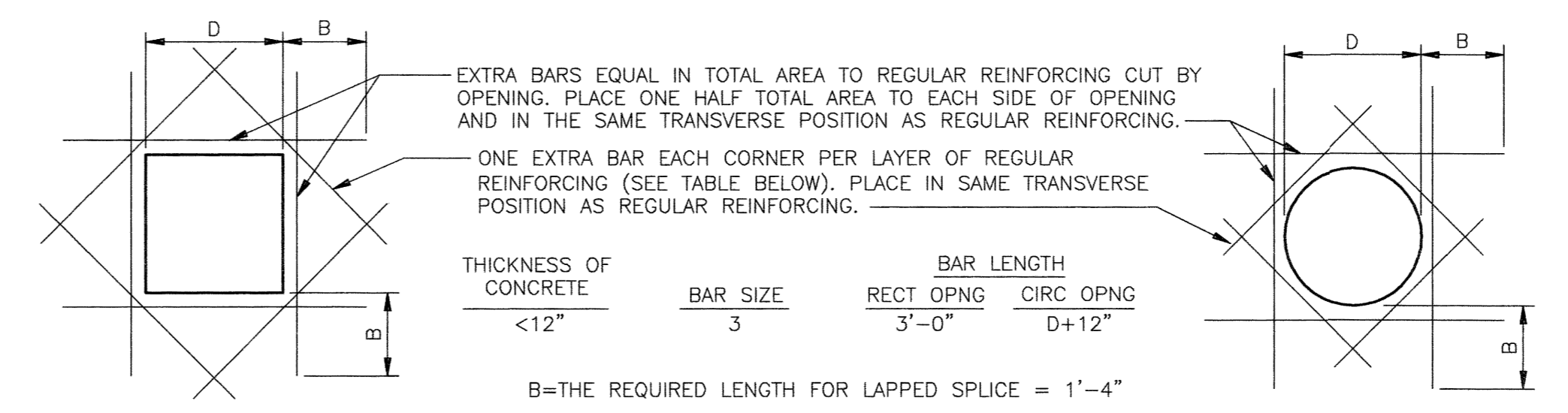
**EXISTING CANAL SECTION**  
 NO SCALE

**ABBREVIATIONS**

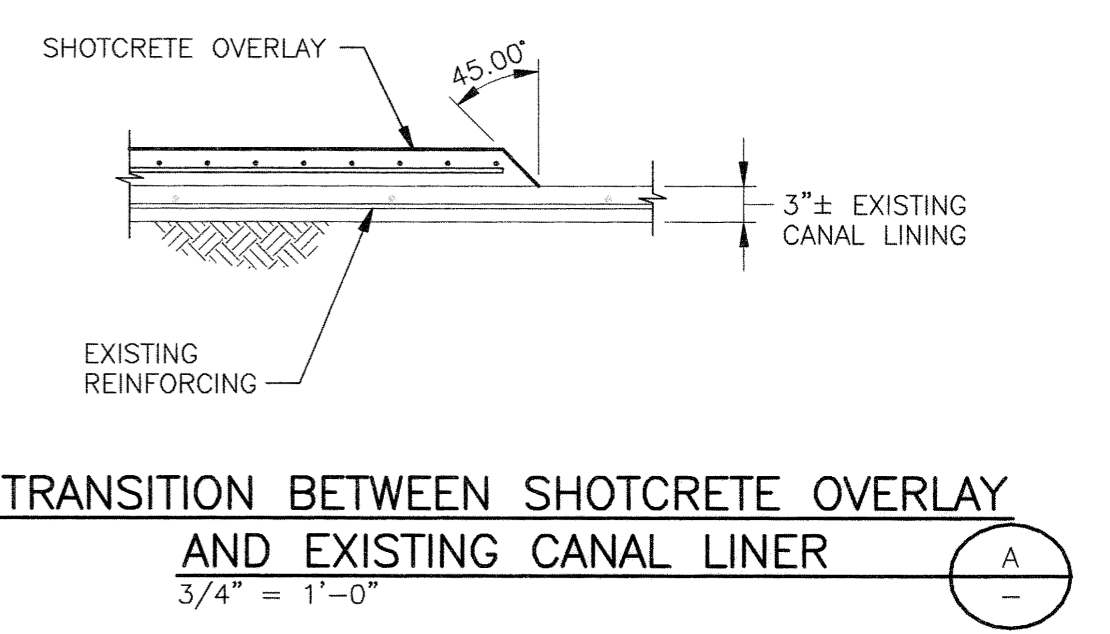
- B = CANAL BOTTOM WIDTH
- d = FLOW DEPTH
- f = FINAL
- H = CANAL DEPTH
- MP = MILE POST
- P = CANAL TOP WIDTH
- S = LENGTH OF SIDEWALL
- SEC = CONTRA COSTA CANAL SECTION
- Q = DESIGN FLOW

EXISTING CONTRA COSTA CANAL DIMENSIONS										FINAL CONTRA COSTA CANAL DIMENSIONS WITH 3-INCH SHOTCRETE OVERLAY						
SEC	MP	to	MP	d (ft)	H (ft)	B (ft)	P (ft)	S (ft)	Q (cfs)	SEC	df (ft)	Hf (ft)	Bf (ft)	Pf (ft)	Sf (ft)	Q (cfs)
17	41.57	43.37	43.58	3.58	4.08	5.0	15.2	6.53	92	17	3.33	3.83	4.8	14.3	6.1	72
18*	43.37	44.08	44.08	3.46	3.96	5.0	14.9	6.34	86	18	3.21	3.71	4.8	14.0	5.9	67

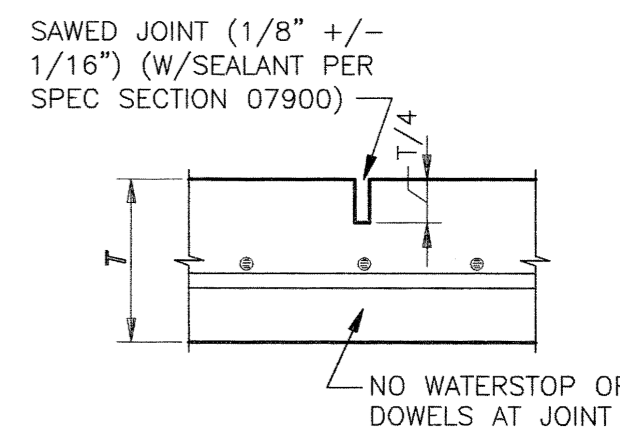
\* NOT IN SCOPE



**TYPICAL EXTRA REINFORCING AT OPENINGS 12" TO <= 54"**  
 (EXTRA REINFORCING NOT REQUIRED ON OPENINGS < 12")

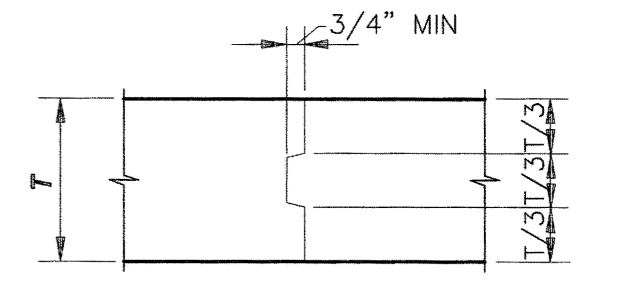


**TRANSITION BETWEEN SHOTCRETE OVERLAY AND EXISTING CANAL LINER**  
 3/4" = 1'-0"



**TYPICAL CONTROL JOINT**

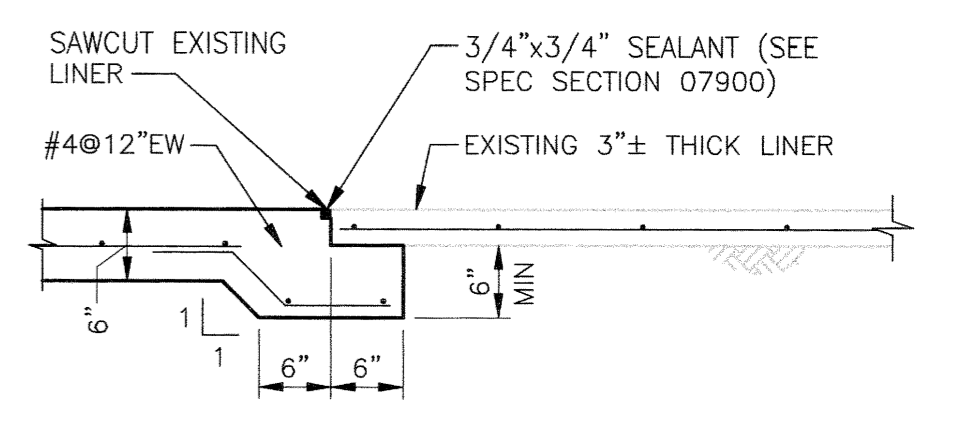
- NOTES:
- JOINT FORMED WITH TOOL OR INSERT STRIP MAY BE SUBSTITUTED FOR SAWED TYPE.
  - SPACING OF CONTROL JOINTS SHALL BE 8' MIN AND 10' MAX WITH A TOLERANCE OF ±10 PERCENT.



**SLABS**

**TYPICAL CONSTRUCTION JOINT**

- NOTE:
- REINFORCING STEEL IS CONTINUOUS THROUGH ALL CONSTRUCTION JOINTS.
  - CONSTRUCTION JOINTS SHALL BE MADE AT END OF DAY'S PLACEMENT

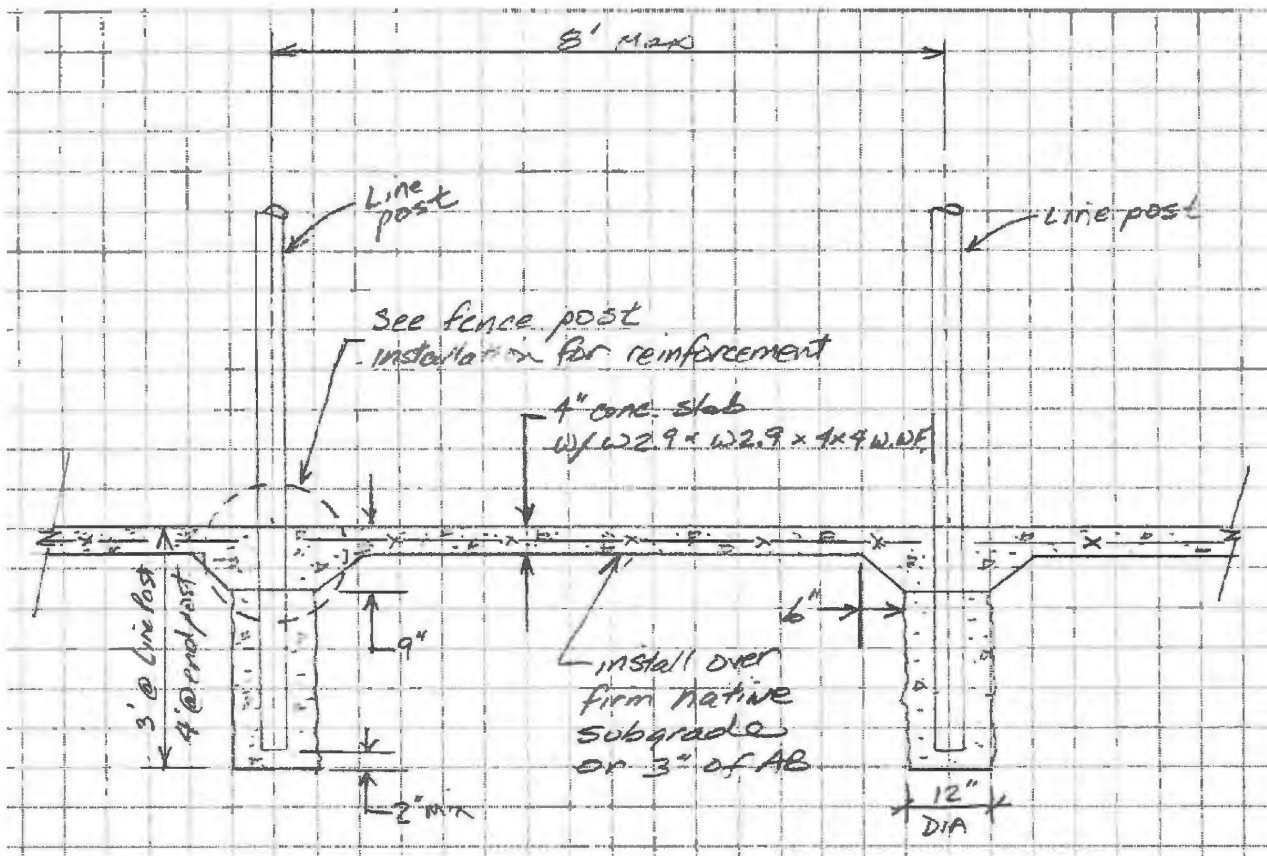


**TYPICAL JOINT BETWEEN NEW & EXISTING CANAL LINER**

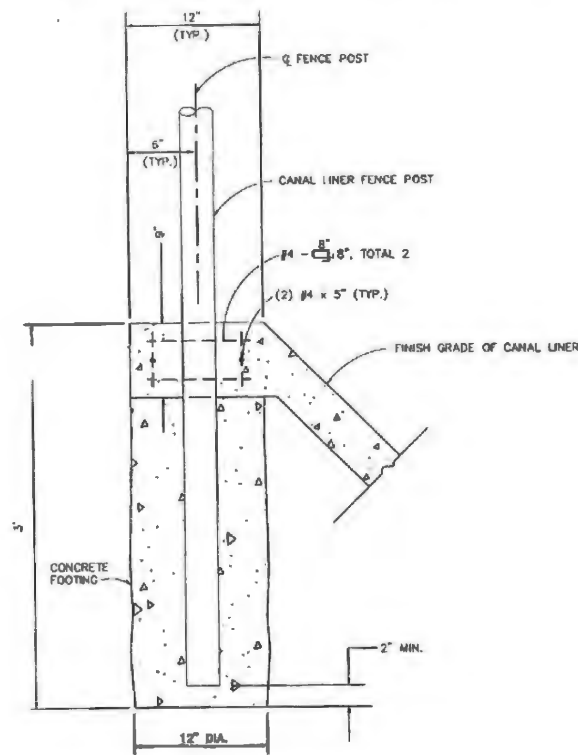
SUPERCEDED BY  
 REV. 1 8/18/04  
 DATE

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						DRAWN BY: GT	
						CHECKED BY: DSW	
						PROJECT NO.: 103068	SCALE: AS SHOWN
						CAL GRID: N/A	ASSESSOR'S BOOK: N/A
						CAD FILE: D6965.dwg	PLOT DATE: 10/10/03
DATE: 0	ISSUED FOR BID				10/10/03		TITLE: <b>LOOP CANAL SHOTCRETE OVERLAY</b> SECTIONS AND DETAILS
							SHEETS 5 OF 6 DRAWING NO. D-6965 CONSULTANT C-3 REV. 0





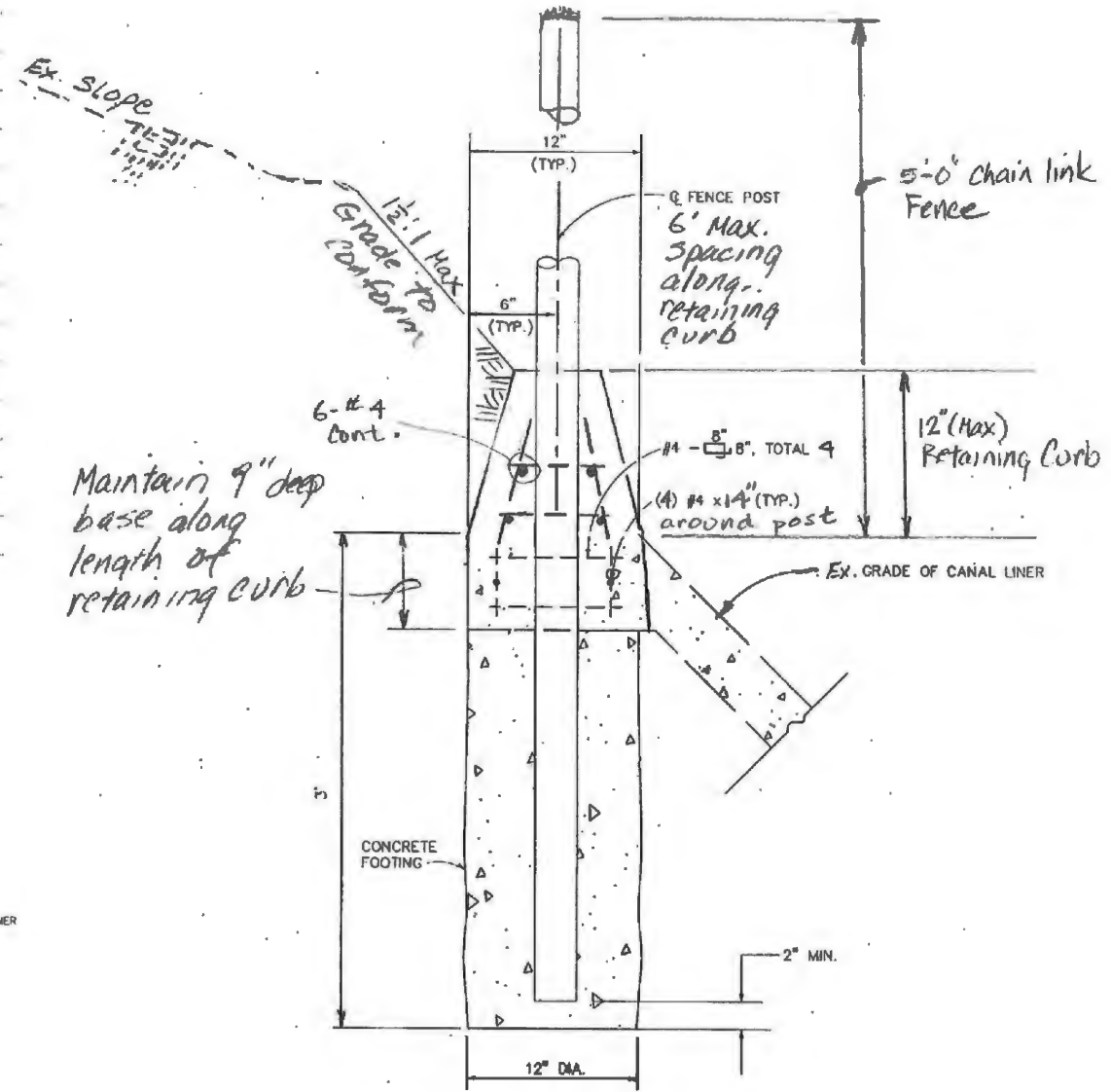
Detail 2-A



FENCE POST INSTALLATION DETAIL

NO SCALE

Detail 2-B



Retaining Curb  
Detail 2-C