

- k. Prestressing - End plates shall be placed perpendicular to the slope of the prestressing bar at the anchorage.

All prestressing steel shall be stressed by means of the hydraulic jacks conforming to the requirements set forth herein.

All jacks shall be equipped with accurate reading, calibrated, hydraulic-pressure gages to permit the stress in the prestressing steel to be computed at any time. A certified calibration curve shall accompany each jack. The prestress shall also be checked by elongation of the prestressing steel. Care shall be taken to insure that the modulus of elasticity used to compute the prestress is the modulus reported for the mill heat of the steel being stressed.

Tensioning of the prestressing steel shall not commence until tests on concrete cylinders, manufactured and cured under the same conditions as the members to be prestressed, indicate the concrete of the members has attained a compressive strength of at least 4000 pounds per square inch.

For multiple span bridges, the first span to be tensioned shall be stressed from both ends. The second span shall be tensioned from only one end. Before proceeding with the next tensioning operation, the Engineer shall review the data and revise, where necessary, the prestressing force.

- l. Placing - Any deviation from normal placing operations will be noted in the special specifications.
- m. Grouting of Prestressing Units

All prestressing units shall be bonded. The prestressing units shall be detailed to provide grout and vent connections. The vendors of most tendons supply the grout and vent details.

The grout mixture shall consist of Portland Cement and water mixed to the consistency of a heavy paint. One pound of "Plastiment", as manufactured by the Sika Chemical Corporation, or approved equal, per sack of cement, shall be added to the grout. Other grout mixtures may be used with the approval of the Engineer.

Before grouting, the space around the prestressing steel shall be cleared of all debris and obstructions. This can be done by pumping water through the grout tubes following which the ducts shall be blown out with compressed air to remove all water, dirt, or other foreign substances. Grout shall then be injected under a moderate pressure until the sheath is filled with grout as evidenced by a steady stream of grout coming out of the vent tubes. The grout shall completely fill the enclosures. The grouting equipment shall be capable of grouting to a pressure of at least 100 pounds per square inch.

After the girders have been pressure grouted as specified herein, no superimposed load shall be applied to the bridge span until three (3) days have elapsed.

SC-24 - Pressure Grouting

- a. General - The work consists of the internal consolidation of existing masonry structures and native rock by means of Portland cement grout introduced under pressure.
- b. Grout Holes and Check Holes shall be drilled into the masonry or rock to the diameters and depths shown on the plans. Cores shall be recovered for all check holes.

The pattern of the holes may be varied at the direction of the Engineer to meet the requirements of obtaining complete consolidation.

Check holes may be drilled in any direction and at any length to determine the degree of consolidation. Cores removed from the check holes shall be marked by the Contractor and carefully preserved in wooden core boxes which shall be marked to show the locations of the holes. The boxes shall have division strips and marking blocks to indicate core recovery at not more than 5 feet intervals. Boxes shall be delivered to the designated storage place.

Holes shall have a minimum diameter of  $1\frac{1}{2}$  inches. They shall be drilled to such a depth and in such a manner as necessary to intercept joints and internal voids. No horizontal holes which have been drilled completely through masonry shall be used for pressure grouting. Instead, such holes shall be completely plugged with Portland cement mortar.

- c. Grouting - When both the masonry structure and the foundation bed are to be grouted, the bed material shall be completely grouted and tested by check cores before starting work on the structure.

Operations must be conducted as to meet conditions encountered during the course of the work. Continuous shifts may be required, or the work may be intermittent.

Only an experienced supervisor shall be in charge of grouting operations; one who is familiar with the equipment, the materials and the grouting process.

For river work, the Contractor shall employ a licensed diver with suitable equipment for inspection and repair of the underwater portions of the work.

All defective materials shall be removed from the surfaces of the masonry to be grouted. Inspection shall be made for points of leakage and indications of voids. Large openings shall be sealed with mortar. Small openings shall be left open to provide vents for air and water. As grouting progresses, the small openings shall be left open or sealed as required. The bases of structures shall be kept clear so that joints and voids may be flushed, and that excess leakage of grout may be observed and corrected.

Generally, the grout mixture shall consist of Portland cement, finely divided mineral filler, and intrusion agent, sand when required and water, all thoroughly mixed and brought to the proper consistency.

The amount of sand to be used shall be determined by starting the grouting operation with neat cement-plus-filler grout, and adding sand in gradually increasing proportions until the optimum ratio of sand to cement-plus-filler has been reached which will give a free flowing and satisfactory grout. If it is found that the addition of sand retards the free flow of the grouting materials, the sand shall be omitted or reduced as directed.

1. Portland Cement shall conform to ASTM Designation C-150, Type 1. One bag of cement will be equivalent to 94 pounds of bulk cement, and one cubic foot in volume.
2. Mineral filler shall be a finely powdered material having a specific surface of not less than 3000 square centimeters per gram, composed essentially of compounds of amorphous silica, alumina, and iron which possesses the property of combining with lime that is liberated during the process of the hydration of Portland cement. One bag of mineral filler will be considered equivalent to 75 pounds of bulk filler and one cubic foot in volume.
3. Intrusion agent shall be a compound possessing such characteristics that it will inhibit early stiffening of the grout, tend to hold the solid constituents of the grout in colloidal suspension and expand slightly before the time of initial set of the grout so as to have a neutralizing effect on the setting shrinkage of the grout.
4. Sand shall consist of hard, tough, durable, uncoated particles. The shape of the particles shall be generally rounded or cubical and reasonably free from flat or elongated pieces. Sand shall be well graded from fine to coarse and the gradation shall conform to the following requirements as delivered to the mixer:

<u>Sieve Designation</u>	<u>Cumulative Percentage by Weight</u>	
<u>U.S. Std. Square Mesh</u>	<u>Passing</u>	<u>Retained</u>
16	95-100	0-5
30	60-85	15-40
50	20-50	50-80
100	10-30	70-90
200	0-5	95-100

5. Water used in grouting shall be fresh, clean and free from injurious amounts of sewage, oil, acid, alkali, salts or organic matter.
6. Mixing and Pumping - Grout inserts shall be set in the drilled holes and the interior voids washed clean with water under pressure, prior to the application of the grout. For inclined holes, grout shall be introduced through a pipe smaller than the drilled holes having a short section of flexible hose ("packer") near the end. The pipe and packer shall be inserted nearly to the bottom of the hole and progressively pulled up as grouting is completed at various levels. The grout pressure shall cause the packer to swell and confine the grout to the lower layers.

Grouting shall be started at the lowest row of holes and at the hole nearest the center line of the structure.

Grouting must continue at any one hole until it is completed. If grout appears in adjacent holes or joints at the same elevation, such holes shall be temporarily plugged and grouting continued in the original hole until grout appears at the next adjacent hole at the same elevation or at the next line of holes above the one being grouted. When this condition occurs, grouting of the original hole shall be discontinued and the grout line moved to the last hole at the lowest elevation at which grout appeared, and the same procedure followed until all the holes in the lowest line have been grouted, at which time grouting shall proceed in a like manner along the next line of holes above etc., until the entire structure has been completely filled.

Excessive pressure should be avoided to prevent damage and waste of grout. When breakouts occur in the surrounding ground, they shall be plugged, or the grout line shall be moved to another location. If the grout line is removed, grouting may be resumed in the original locations after the elapse of 24 hours. If the breakout cannot be plugged, all grouting work shall be suspended until the next day. New holes shall be drilled and the same procedure followed until grout is brought up into the masonry.

- d. Equipment - The minimum equipment to be furnished shall include the following:
1. Two specially equipped, air-driven, duplex, double acting slush pumps, capable of operating at a maximum discharge pressure of 100 p.s.i. The pumps shall be arranged so that in emergencies the second pump can be put into operation without delay.
  2. A mechanical grout mixer.
  3. A mechanically agitated sump.
  4. A suitable water meter, graduated in cubic feet and tenths.
  5. A tank for auxiliary water supply to be used in flushing and pressure washing operations.

SC-25 - Waterproofing - Hot Application

The two-coat painted waterproofing shall consist of a primer and two coats of hot bituminous material.

Waterproofing asphalt shall conform to the specification for Asphalt for Damp-proofing and Waterproofing (ASTM D 449 Type A).

Primer for use with asphalt in waterproofing shall conform to the Specification for Primer for use with Asphalt in Damp-proofing and Waterproofing (ASTM D 41).

Waterproofing shall not be applied in wet weather or when the temperature is below 50°F., without approval by the Engineer.

Surfaces to be waterproofed shall be dry and clean. Concrete shall be cured before primers or waterproofing are applied. Asphalt primers shall be applied cold. Painted or mop coats shall be applied hot.

The primer shall be well worked in to give a uniform coating and shall dry at least 24 hours before the first paint or mop coat is applied.

The amount of bitumen for each paint coat or mop coat shall be not less than  $\frac{1}{2}$  gallons for each 100 square ft. of surface. The bitumen shall be stirred frequently while being heated. Kettles shall be equipped with armored thermometers.

Surfaces of concrete or steel which may come in contact with waterproofing shall be given one coat of asphaltic primer before the first mopping of asphalt.

Waterproofing (Hot Application) shall be used for all waterproofing work unless otherwise shown in the plans or noted in the specifications.

#### SC-26 - Waterproofing - Cold Application

Waterproofing of walls below grade shall be done at locations, and to the extent as shown on the drawings.

The materials shall have an asphalt base and shall be suitable for cold application by brush, trowel or spray.

The work shall be done with one prime coat and one top coat, and in accordance with the manufacturer's directions. These directions of the manufacturer shall be followed by the application of additional coats in cases where the product requires such coatings for satisfactory results.

The primer shall conform to the current ASTM Designation D-41.

The top coating shall be a manufactured product, ready for application directly from the containers without heating or other processing.

Materials shall be tested and approved by the City for use on the contract.

Surfaces to receive waterproofing shall be clean and dry. Burrs shall be removed. Holes, joints, and cracks shall be pointed flush with mortar. High spots shall be cut off or ground smooth. Dust and foreign matter shall be removed.

Primer shall be applied in quantity sufficient for full coverage of the surfaces. Under-primed and skimmed surfaces shall receive additional priming. The prime coat and top coatings shall be thoroughly dry before application of succeeding coats.

Backfilling materials shall not be placed against the finished waterproofing in any case until the elapse of 24 hours. The manufacturer's directions shall be followed for certain products where more than 24 hours is required before backfilling.

No waterproofing shall be applied when the air temperature is below 50 degrees F. Higher temperatures may be required for the particular product submitted for use.

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