

**Concrete for Structures  
Section 900**

**910 Portland Cement Concrete**

**911 Description**

911.01 General: This Item shall govern for Portland cement concrete to be used in concrete pavement, concrete structures and other concrete construction.

**912 Materials**

912.01 General: The concrete shall be composed of Normal Portland Cement or High Early Strength Portland Cement, fine aggregate, coarse aggregate and water, proportioned and mixed as hereinafter provided in these Specifications.

912.02 Cement and Admixtures: Only one brand of cement shall be used in any one structure, except by written permission of the Engineer.

Portland Cement shall meet the requirements prescribed in the Standard Specifications for Portland Cement, A.S.T.M. C-150.

All cement shall be properly protected against dampness, and no cement will be accepted which has become caked.

An air-entraining agent shall be used in the concrete. The air-entraining agent used shall be one of those permitted under Specifications for Air-Entraining Admixtures for Concrete, A.S.T.M. C-260. The concrete shall be designed to entrain five (5) percent air when Grade 1 or 2 coarse aggregate is used, six (6) percent when Grade 3 or 4 coarse aggregate is used, and seven (7) percent for Grades 5, 6, or 7.

Material removed by decantation, A.S.T.M. C-117	1.0%
Shale, slate or other similar materials	1.0%
Clay Lumps	0.25%
Soft Fragments	3.0%
Other deleterious substances including friable, thin, elongated or laminated pieces	3.0%

The sum of all deleterious ingredients, exclusive of material removed by decantation, shall not exceed 5% by weight.

912.03 Coarse Aggregates: The aggregate shall be free from an excess of salt, alkali, vegetable matter, or other objectionable materials, either free or as adherent coatings.

- A. Gravel shall consist of durable particles of gravel, crushed or uncrushed.
- B. Crushed stone shall consist of durable particles of rock of reasonable uniform quality throughout.

C. When tested by approved methods, the coarse aggregate shall conform to the gradation requirement shown below:

Agg. Grade No.	Nominal Size (in.)	Percent Retained on Each Sieve								
		2-1/2	2	1-1/2	1	3/4	1/2	3/8	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	
4	1			0	0-5		40-75		90-100	95-100
5	3/4				0	0-10		45-80	90-100	95-100
6	1/2					0	0-10	30-60	85-100	95-100
7	3/8						0	5-30	75-100	
8*	3/8						0	0-5	35-80	90-100

\*Grade 8 aggregate for use in extruded curbs

912.04 Fine Aggregate: Fine aggregate shall consist of sand or a combination of sand and not more than fifty (50) percent of stone screenings.

Sand shall be composed of clean, hard, durable uncoated fragments resulting from the crushed stone.

The maximum amount of deleterious substances shall not exceed the following percentages by weight:

Material removed by decantation A.S.T.M. C-117	3.0%
Clay lumps	0.5%
Other deleterious substances such as coal, shale, coated grains and soft flaky particles	2.0%

At the time of its use, the aggregate shall be free from frozen material and all foreign material such as wood, hay, burlap, paper, or dirt which may become mixed with the aggregate in stockpiles. The sand equivalent shall not be less than 80 and the fineness modulus shall be between 2.30 and 3.10. When tested by approved methods, the fine aggregate shall conform to the following grading requirements:

Aggregate Grade No.	Percent Retained on Each Sieve							
	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
1	0	0-5	0-20	15-50	35-75	65-90	90-100	97-100

912.05 Storage of Aggregate: The handling and storage of concrete aggregate shall be such as to prevent the admixture of foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be grubbed, cleared of all weeds and grass, and leveled off. The bottom layer of aggregate shall not be disturbed or used without recleaning. When the Contract requires the use of two (2) or more sizes of aggregates, the different sizes shall be stored in such a manner as to prevent intermixing.

Materials in all stockpiles shall be handled and placed in such a manner that segregation of materials within the pile will be avoided.

**913 Classifications and Proportions**

913.01 Design: Concrete shall be proportioned as determined by the Consulting Engineer, by absolute volumes and in accordance with the requirements hereinafter set forth. For placement of concrete involving twenty-five (25) cubic yards or less in one continuous placement, the requirements for absolute volume batch design may be waived by the City Engineer, and a mix proportion may be determined by trial mixes; however, the requirements for weighing and measuring materials shall not be waived. The concrete shall be uniform and workable. The minimum cement content, maximum allowable water content, and the maximum slump for the various classes of mixes shall conform to the following:

Class	Min. Cement Sacks per C. Y.	Min. 28-Day Compressive Strength (psi)	Min 7-Day Flexural Strength (psi)	Max. Water/Cement Ratio Gals/sk	Slump (Inches)
A	5.00	3,000	425	6.50	2-1/2 to 4-1/2
B	4.00	2,000	280	8.00	2-1/2 to 4-1/2
C	6.00	3,600	510	6.00	2-1/2 to 4-1/2
P	5.00	N.A.	555	6.25	1-1/2 to 3

Strength tests shall be tested according to TEX-418-A and TEX-420-A. The maximum amount of coarse aggregate (dry, loose volume) per cubic foot of finished concrete shall not exceed 0.50 cubic feet.

The net amount of water will be the amount added at the mixer, plus the free water in the aggregates. No water allowance will be made for evaporation after batching.

The concrete mix will be designated with the intention of producing concrete which will have compressive strength, when tested on test specimens cured under field laboratory conditions, equal to or greater than the values in the table above.

Fly ash may be substituted for cement up to a maximum of 10% of the cement weight.

913.02 Consistency: The quantity of water to be used will be determined by the Engineer and shall be such as to give a mixture containing the minimum amount of water consistent with the required workability. The quantity of water shall be varied only by the Engineer. In general, the consistency of concrete mixtures shall be such that:

- A. The mortar will cling to the coarse aggregate
- B. The concrete is not sufficiently fluid to aggregate when transported to the place of deposit.
- C. The concrete, when dropped directly from the discharge chute of the mixer, will flatten out at the center of the pile, but the edges of the pile will stand up and not flow.
- D. The mortar will show no free water when removed from the mixer.
- E. The concrete will settle into place when deposited in forms and, when transported in metal chutes at an angle of thirty (30) degrees with the horizontal, it will slide and not flow into place.

F. The surface of the finished concrete will be free from a surface film of free water.

Any concrete mix failing to meet the above outlined consistency requirements, although meeting the slump requirements, will be considered unsatisfactory; and the mix shall be changed to correct such unsatisfactory conditions. In cases where the characteristics of the aggregates furnished are such that, with the maximum allowable amount of water the specified slump and consistency requirements are not met, the Contractor may provide aggregates of an improved grading, or the Engineer will modify the mix design to meet the slump and consistency requirements by adding cement as may be necessary.

Consistency and quality of concrete should allow efficient placement and completion of finishing operations before initial set. Retempering shall not be allowed. When field conditions are such that additional moisture is needed for final concrete surface finishing operation, required water shall be applied to surface by fog spray only and shall be held to a minimum. Concrete shall be workable, cohesive, possess satisfactory finishing qualities and of stiffest consistency that can be placed and vibrated into a homogeneous mass within slump requirements specified in Table 3. Excessive bleeding shall be avoided and in no case will it be permissible to expedite finishing and drying by sprinkling the surface with cement powder. No concrete will be permitted with a slump in excess of the maximums shown unless water reducing admixtures have been previously approved. Slump values shall conform to TXDOT Test Method TEX-415-A.

<b>Type of Construction</b>	<b>Slump, inches</b>	
	<b>Maximum</b>	<b>Minimum</b>
Cased Drilled Shafts	4	3
Reinforced Foundation Caissons and Footings	3	1
Reinforced Footings and Substructure Walls	3	1
Uncased Drilled Shafts	6	5
Thin-walled Sections (9 inches or less)	5	4
Prestressed Concrete Members	5	4
Precast Drainage Structures	6	4
Wall Sections over 9 inches	4	3
Reinforced Building Slabs, Beams, Columns and Walls	4	1
Bridge Decks	4	2
Pavements, Fixed-form	3	1
Pavements, Slip-form	1-1/2	1/2
Sidewalks, Driveways and Slabs on Ground	4	2
Curb & Gutter, Hand-vibrated	3	1
Curb & Gutter, Hand-tamped or spaded	4	2
Curb & Gutter, Slip-form/extrusion machine	2	1/2
Heavy Mass Construction	2	1
High Strength Concrete	4	3
Riprap and Other Miscellaneous Concrete	6	1
Under Water or Seal Concrete	6	5

## 914 Quality of Concrete

914.01 Testing Requirements: Concrete made of acceptable materials, of the proportions specified by the Engineer, and in complete accordance with the requirements of the construction methods and details specified for the class of work involved, will be considered as of satisfactory quality.

During the progress of the work, the Contractor shall provide an independent laboratory to test cylinders and/or beams, perform slump and entrained air tests and make temperature checks, as required, to insure compliance with the specifications.

The cost of all testing shall be included in the unit price bid for concrete of the various classes, and shall be paid by the contractor.

914.02 Ready-Mix Concrete: Ready mix concrete meeting all parts of this Specification may be used by the Contractor subject to the following requirements:

- A. A written mix design shall be furnished to the City Engineer by the Contractor prior to the use of a ready mix concrete.
- B. Supplier of the ready mix concrete must be capable of transporting and pouring concrete within 60 minutes of loading concrete into a mixer truck. When requested by the City Engineer, loading tickets stamped with the correct time and date of loading will be required. Failure to pour concrete within 60 minutes of loading will be grounds for rejection of the concrete. Failure of the ready mix supplier to continuously supply concrete such that placement of concrete proceeds essentially uninterrupted will be grounds for rejection of the ready mix supplier by the City Engineer.
- C. A strength test is defined as the average of the breaking strength of two (2) cylinders or two (2) beams as the case may be. Each specimen will be tested in accordance with Test Methods Tex-418-A or Tex-448-A. A minimum of one strength test will be required for every twenty-five (25) cubic yards. Pours under 25 cubic yards will be tested as directed by the City Inspector. Tests for slump and entrained air content shall be required for every set of beams or cylinders made.
- D. When the quantity of entrained air is found to be more than three (3) percentage points over or two (2) percentage points under those values given herein, the concrete will be rejected. Repeated rejections of individual loads of ready mix concrete by the City Inspector will be grounds to reject the supplier of the ready mix concrete for the remainder of a project.

## 920 Concrete Construction

920.01 General: The Contractor shall give the City Engineer sufficient advance notice before starting to place concrete in any unit of the structure to permit the inspection of forms, the reinforcing steel placement, and preparations for casting. Unless authorized by the City Engineer, no concrete shall be placed in any unit prior to the completion of the form work and the placement of the reinforcement.

Concrete placing shall be so regulated as to permit finishing operations to be completed in the daylight hours.

920.02 Weather Conditions: The City Engineer reserves the right to order postponement of the placing operations when, in his opinion, impending weather conditions may result in rainfall or

low temperatures which will impair the quality of the finished work. In case rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work. In case of drop in temperature, the provisions set forth in subsection Placing Concrete in Cold Weather, of this item, shall be applied.

920.03 Sequence: The sequence of placing concrete shall be as directed by the Engineer. The operation of depositing and compacting the concrete shall be conducted so as to form a compact, dense, impervious mass of uniform texture which shall show smooth faces on all surfaces. The placing shall be so regulated that the pressures caused by the plastic concrete shall not exceed the loads used in the design of forms.

920.04 Methods: The method and manner of placing shall be such as to avoid the possibility of segregation or separation of the aggregate or the displacement of the reinforcement. Concrete shall not have a free fall of more than five (5) feet. The spattering of forms or reinforcement bars shall be prevented. Any hardened concrete splatter ahead of the plastic concrete shall be removed.

920.05 Cold Joints: Cold joints in a monolithic placement shall be avoided. Not more than one (1) hour shall elapse between adjacent or successive placements of concrete. The time requirement may be extended by 1/2 hour when the concrete contains a normal dosage of retarding admixture. An approved retarding agent shall be used to control stress cracks and/or cold joints in placements where differential settlement and/or setting time may induce stress cracking.

920.06 Chutes, Troughs, or Pipes: Chutes, troughs, or pipes used as aids in placing concrete shall be arranged and used so that the ingredients of the concrete will not be separated. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in the forms; or the ends of such chutes shall terminate in vertical downspouts. All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by a thorough flushing with water before and after each placement. Water used for flushing shall be discharged clear of the concrete in place and in a location acceptable to the Engineer. The use of chutes in excess of thirty-five (35) feet total length for conveying concrete will not be permitted except by specific authorization from the City Engineer.

920.07 Consolidation: All concrete shall be well compacted and the mortar flushed to the surface of the forms by continuous working with concrete spading implements or mechanical vibrators of an approved type. The vibrators shall be applied to the concrete immediately after deposit and shall be moved throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms until it has been reduced to a plastic mass. The mechanical vibrator shall not be operated so that it will penetrate or disturb layers placed previously which have become partially set or hardened. The vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures but shall not be done to an extent that will cause segregation. Vibration shall be supplemented by hand spading if necessary to insure the flushing of mortar to the surface of all forms.

920.08 Forms: Forms shall be practically mortar-tight, rigidly braced and strong enough to prevent bulging between supports. Forms may be constructed of plywood not less than 1/2" in thickness. The grain of the face plies on plywood forms shall be placed parallel to the span between the supporting studs or joists.

All metal appliances used inside of forms for alignment purposes shall be removed to depth of at least 1/2" from the concrete surface. Any tire wires used shall be cut back at least 1/2 inch from the face of the concrete. Metal and wooded spreaders which are separate from the forms shall be removed entirely as the concrete is being placed.

The facing of all forms shall be treated with bond breaking coating of such composition that will not discolor the concrete surface. Care shall be exercised to prevent coating the reinforcing steel.

Forms shall be filleted at all sharp corners and edges with triangular chamfer strips measuring 3/4" on the sides.

Each part of the forms shall be filled by depositing concrete directly as near its final position as possible. The coarse aggregate shall be worked back from the face of the forms and concrete shall be forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point in the forms and running or working it along the forms will not be allowed. After the concrete has taken initial set, the forms shall not be jarred or any strain placed on projecting reinforcement.

Forms for vertical surfaces may be removed when the concrete has aged not less than 12 hours. Inside forms (walls and top slabs) for box culverts and sewers may be removed after concrete has aged not less than 24 hours.

## 921 Curing

921.01 General: The Contractor shall inform the Engineer of the methods proposed for curing; shall provide the proper equipment and material in adequate amounts; and shall have the proposed methods, equipment and material approved prior to placing concrete. The choice of curing methods shall be at the option of the Contractor.

All concrete shall be cured for a period of four (4) curing days. Top slabs of direct traffic culverts shall be cured for ten (10) days. A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50 F for at least 19 hours, or on colder days if satisfactory provisions are made to maintain the temperature of all surface of the concrete above 40 F for the entire 24 hours. The required curing period shall begin when all concrete therein has attained its initial set.

### 921.02 Types:

- A. Form Curing: When forms are left in contact with the concrete, other curing methods will not be required except for exposed surfaces and for cold protection.
- B. Water Curing: All exposed surfaces of the concrete shall be kept wet continuously for the required curing time.
- C. Wet Mat Curing: This curing method shall consist of keeping the concrete continuously wet by maintaining wet cotton mats in direct contact with the concrete for the required curing time.
- D. Water Spray: This curing method shall consist of overlapping sprays or sprinklers that keep all unformed surfaces continuously wet.
- E. Membrane Curing: Unless otherwise provided herein or shown on the plans, either Type 1-D or Type 2 membrane curing compound may be used. Membrane curing shall not be applied to dry surfaces, but shall be applied just after free moisture has disappeared. When membrane curing is used for complete curing, the film shall remain unbroken for the minimum curing period specified.

**922 Dowels and Anchor Bolts**

922.01 Placement: Dowels and anchor bolts may be cast-in-place or installed by grouting with grout, epoxy or epoxy mortar. Holes for grouting may be formed or drilled. Holes shall be thoroughly cleaned of all loose material, oil, grease, or other bond breaking substance and blown clean with filtered compressed air. The void between the hole and dowel or bolt shall be completely filled with grouting material.

Holes for dowels shall be a minimum of 12 inches deep. When grout or epoxy mortar is used, the diameter of the hole shall not be less than twice the dowel or bolt diameter nor more than the diameter plus 1-1/2 inches. When using epoxy, the hole shall be 1/16 inch to 1/4 inch greater than the dowel or bolt diameter.

**923 Placing Concrete in Adverse Weather**

923.01 Cold Weather: No concrete shall be placed when the atmospheric temperature is at or below 40°F. (taken in the shade away from artificial heat) unless permission to do so is given in writing by the City Engineer. When such permission is given, or in cases where the temperature drops below 40F. after the concreting operations have been started, the Contractor shall furnish sufficient canvas and framework or other type of housing to enclose and protect the structure in such a way that the air around the forms and fresh concrete can be kept at a temperature not less than 50°F. for a period of five days after the concrete is placed. Sufficient heating apparatus such as stoves or steam equipment and fuel to furnish all required heat shall be supplied.

It is understood that the Contractor is responsible for the protection of concrete placed under any and all weather conditions. Permission given by the City Engineer to place concrete during freezing weather will in no way relieve the Contractor of the responsibility for satisfactory results. Should concrete placed under such conditions prove unsatisfactory, it shall be removed and replaced at the expense of the Contractor.

923.02 Hot Weather: Adequate measures shall be taken by the Contractor to insure concrete placed during hot and/or particularly dry weather does not "flash set." No concrete will be placed which has a temperature of 95°F. or higher when taken at the job site immediately before placement.

Acceptable preventive measures include the addition of chopped or cubed ice to the concrete mixture. Each 100 lbs. of ice added will be considered equal to the addition of 12 gallons of water. In no case will the addition of more than 700 lbs. of ice be permitted per 8 cubic yard load of concrete.

Temperature control of coarse aggregate stockpiled outdoors is acceptable providing the aggregate does not attain a coating which inhibits proper binding of the cement.

**940 Concrete Structures**

**941 Curb & Gutter**

See Section 280, Concrete Curb & Gutter

**942 Sidewalks**

942.01 Description: This item shall consist of concrete sidewalks composed of Portland Cement concrete, constructed as herein specified on an approved subgrade, in conformity to the lines, grades and details established by the Engineer.



**942.02 Construction Methods:** The subgrade shall be excavated and shaped to the lines, grades and cross section as indicated or as directed by the Engineer and shall be thoroughly compacted. A cushion 2" minimum thickness of crushed screenings, gravel and sand, crushed rock, or coarse sand shall be spread, wetted thoroughly, tamped and leveled. The sand cushion shall be moist at the time the concrete is placed.

If the subgrade is undercut by more than 4 inches or the natural ground is below top of subgrade by more than 4 inches then necessary backfill shall be made with an approved material and compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade is rock or gravel, 70 percent of which is rock, the 2 inch cushion need not be used. The City Engineer will determine if the subgrade meets the above requirements.

Forms shall meet the requirements as specified under Section 920.08.

Expansion joint material 3/4 inch thick, shall be provided where the new construction abuts an existing structure, sidewalk or driveway. Similar expansion material shall be placed around all obstructions protruding through the sidewalk. The expansion joint material shall be placed vertically and shall extend the full depth of the concrete. Maximum spacing of expansion joints shall be 40 feet. Weakened plane joints shall be spaced at 5 feet on center. Normal dimensions of the weakened plane joints shall be 1/4 inch deep. All joints shall be 90 degrees to centerline of walk and shall match any previously placed concrete joints.

Reinforcement for sidewalks shall be grade 60 steel conforming to ASTM A-615 and consisting of 1 layer of 6X6 - W2.9 X W2.9 wire fabric or #3 bars, placed not more than 18 inches on center both directions. All reinforcement shall be placed equidistant from the top and bottom of the concrete. Care shall be exercised to keep steel in its proper position during the depositing of the concrete. Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches will be permitted. Splices in the #3 bars shall have a minimum lap or 12 inches.

Where driveways cross sidewalks, additional reinforcing shall be placed in the sidewalk so as indicated.

The concrete, its materials and placement, shall meet the requirements specified under Section 910 "Portland Cement Concrete".

The Contractor shall provide for independent lab testing for compliance to the specifications. Required tests and frequency shall be as shown in Section 914 "Quality of Concrete".

**942.03 Measurement:** Accepted work performed as prescribed in this section will be measured by the square yard of surface area of Concrete Sidewalk.

**942.04 Payment:** The work performed as prescribed by this item will be paid for at the unit price bid per square yard for Concrete Sidewalk. This price shall be full compensation for preparing the subgrade, for furnishing and placing all materials (including cushion material), all reinforcing steel, joints, expansion joint materials, and for all other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

### **943 Concrete Box Culverts**

**943.01 Description:** This item shall govern the materials used and the constructing, furnishing, and placing of concrete box culverts and wing walls on a prepared grade at the location shown in accordance with the construction plans details.

943.02 **Types:** Unless otherwise indicated, the Contractor shall have the option of furnishing cast-in-place, precast (formed), or precast (machine made) box culverts.

- B. When precast box culverts are used under traffic, the design loads shall consist of the impact load, the dead load, and the live load meeting the requirements of ASTM C-789 or ASTM C-850. Each box section shall bear the name or trademark of producer, date of manufacture, and the box size.
- C. Cast-in-place concrete boxes shall conform to the details shown on the plans and to the requirements of Section 910 "Portland Cement Concrete".

943.03 **Construction Methods:** Excavation, bedding, and backfill shall be in accordance with the requirements of Section 600 "Pipe and Appurtenances". When two pre-cast sections are fitted together on a flat surface, in the proper position, the joint opening shall not exceed one (1) inch.

943.04 **Testing:** The Contractor shall provide independent laboratory testing of cast-in-place box culverts. Test specimens shall be in accordance with Section 914 "Quality of Concrete".

**944 Reinforcing Steel**

944.01 **Description:** This Item shall govern for the furnishing and placing of deformed and smooth reinforcing steel, of the size and details shown on the plans and in accordance with this Item.

944.02 **Materials:** Unless otherwise shown on the plans or specified herein, the reinforcing steel shall be Grade 60. Smooth round bars shall be designated by size number through No. 4. Smooth bars above No. 4 shall be designated by diameter in inches. The nominal size, area and weight of reinforcing steel bars covered by this specification are as follows:

Bar Size Number	Nominal Diameter (Inches)	Nominal Area (Sq. Inches)	Weight per Lineal Foot
2	0.250	0.05	0.167
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.650
18	2.257	4.00	13.60

Wire for fabric reinforcement shall conform to ASTM A82 or A496. Wire fabric shall conform to ASTM A185 or A497. Where deformed wire is required, the size number shall be preceded by "D" and for smooth wire the prefix shall be "W". Welded wire fabric will be designated as shown in the following example:

6 x12 – W16 x W8; indicating six (6) inch longitudinal wire spacing and twelve (12) inch transverse wire spacing with smooth number 16 wire longitudinally and smooth number 8 wire transversely.

944.03 Splicing: Splicing of bars, lap spliced or welded, shall be as shown on plans or specified herein. Splices not provided for on the plans will be permitted in slabs 15 inches or less in thickness, columns, walls and parapets. Splices will not be permitted in bars 30 feet or less in plan length. For bars exceeding 30 feet in plan length, the distance center to center of splices shall not be less than 30 feet minus one splice length, with no more than one individual bar length less than 10 feet.

**MINIMUM LAP REQUIREMENTS**

SIZE	UNCOATED	COATED
No. 3	1'-0"	1'-6"
No. 4	1'-6"	2'-3"
No. 5	1'-10"	2'-9"
No. 6	2'-3"	3'-4"
No. 7	3'-0"	4'-6"
No. 8	3'-9"	5'-7"
No. 9	4'-8"	7'-0"
No. 10	5'-7"	8'-4"
No. 11	6'-7"	9'-10"

Welded wire fabric shall be spliced using a lap length that will include the overlap of a minimum of two (2) cross wires plus two (2) inches on each sheet or roll.

For box culvert extensions with less than one (1) foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in above table. For extensions with more than one (1) foot of fill, a minimum of six (6) inch lap will be required.

944.04 Placing: Unless otherwise shown on the plans, dimensions shown for reinforcement are to the centers of the bars. Reinforcement shall be placed as near as possible in the position shown on the plans. In the plane of steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch. Cover of concrete to the nearest surface of steel shall meet the above requirements but shall never be less than one (1) inch.

The reinforcement shall be accurately located in the forms, and firmly held in place, before and during concrete placement, by means of bar supports, adequate in strength and number in order to prevent displacement and to keep the steel at the proper distance from the forms. Bars shall be supported by standard bar supports with plastic tips, plastic bar supports, or precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms.

Mortar or concrete blocks shall be anchored to the steel with a suitable tie wire. Bar supports shall be placed in rows at four (4) feet maximum spacing in each direction. Before concrete placement, all mortar, mud, dirt, etc., shall be cleaned from the reinforcement. If the reinforcement is not adequately supported or tied to resist settlement, floating upward, overturning of truss bars, or movement in any direction during concrete placement, concrete placement will be halted until corrective measures are taken.

944.05 Storing: Steel reinforcement shall be stored above the ground upon platforms, skids, or other supports and shall be protected from damage and deterioration. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil, or other foreign materials.

944.06 Payment: The work performed, materials furnished, and all labor, tools, equipment and incidentals necessary to complete the work under this Item will not be measured or paid for directly, but will be considered subsidiary to the various bid items of the contract.

945 Concrete Admixtures

945.01 Description: This item shall govern material requirements of admixtures for Portland cement concrete.

945.02 Materials: All admixture submittals must be approved by the Engineer. No admixture shall be chloride-based or have chloride(s) added in the manufacturing process. Admixtures must be pretested by the Texas Department of Transportation (TXDOT) Materials and Tests Engineer and be included in the State's current approved admixture list. All admixtures must retain an approved status through the duration of a mix design's one-year approval period.

945.03 Air-Entraining Admixture: An "Air Entraining Admixture" is defined as a material which, when added to a concrete mixture in the proper quantity, will entrain uniformly dispersed microscopic air bubbles in the concrete mix. The admixture shall meet the requirements of ASTM Designation: C 260 modified as follows:

- (a) The cement used in any series of test shall be either the cement proposed for the specific work or a "reference" Type I cement from one mill.
- (b) The air entraining admixture used in the reference concrete shall be Neutralized Vinsol Resin.

945.04 Water-Reducing Admixture: A "Water-reducing Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and required strength. This admixture shall conform to ASTM C 494, Type A.

945.05 Accelerating Admixture: An "Accelerating Admixture" is defined as an admixture that accelerates the setting time and the early strength development of concrete. This admixture shall conform to ASTM C 494, Type C. The accelerating admixture will contain no chlorides.

945.06 Water-reducing, Retarding Admixture: A "Water-reducing, Retarding Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and retard the initial set of the concrete. This admixture shall conform to ASTM C 494, Type D.

945.07 High-range Water Reducing Admixtures: A "High-range Water Reducing Admixture", referred to as a superplasticizer, is defined as a synthetic polymer material which, when added to a low slump concrete mixture increases the slump without adversely affecting segregation, impermeability or durability of the mix. This admixture shall conform to ASTM C 494, Type F or G.

945.08 Fly Ash: Fly ash used in Portland cement concrete as a substitute for Portland cement or as a mineral filler shall comply with TXDOT Materials Specification D-9-8900 and be listed on TXDOT's current list of approved fly ash sources. Fly ash obtained from a source using a process fueled by hazardous waste (30 Texas Administrative Code, Section 335.1) shall be prohibited. This applies to any other specification concerning the use of fly ash. Contractor shall maintain a record of source for each batch. Supplier shall certify that no hazardous waste is used in the fuel mix or raw materials.

945.09 Certification and Product Information: The Contractor shall submit the name of the admixture proposed and manufacturer's certification that the selected admixtures meet the requirements of this item and of ASTM C 260 and C 494 as applicable. Admixtures for a mix design shall be of the same brand. If more than one admixture is proposed in the concrete mix, a

statement of compatibility of components shall accompany certification. Manufacturer's product literature shall specify when in the batching/mixing operation the admixture must be added.

The Engineer may request additional information such as infrared spectrophotometry scan, solids content, pH value, etc., for further consideration. Any unreported changes in formulation discovered by any of the tests prescribed herein may be cause to permanently bar the manufacturer from furnishing admixtures for Owner's work.

**945.10 Construction Use of Admixtures:** All admixtures used shall be liquid except high-range water reducers which may be a powder. Liquid admixtures shall be agitated as needed to prevent separation or sedimentation of solids; however, air agitation of Neutralized Vinsol Resin will not be allowed.

No admixture shall be dispensed on dry aggregates. Admixtures shall be dispensed at the batching site separately, but at the same time as the mixing water. Only high range water reducers may be introduced into the mix at the job site.

When other admixtures are used with fly ash, the amount of the other admixture to be used shall be based on the amount of Portland cement only and not the amount of Portland cement and fly ash.

When high-range water reducers are to be added at the job site, transit mixers shall be used. Admixture manufacturer literature shall indicate recommended mixing methods and time for the specific equipment and mix design used. The transit mix equipment shall not be loaded in excess of 63 percent of its rated capacity to ensure proper mixing of the admixture at the site. If during discharging of concrete a change in slump in excess of 30% is noted, the remaining concrete shall be rejected unless prior approval was given by the Engineer to retemper a load with a second charge of admixture. Retempering with water shall not be allowed.

Accelerating admixtures will not be permitted in combination with Type II cement.

All mixes with air entrainment shall have a minimum relative durability factor of 80 in accordance with ASTM C 260. Dosage of air entrainment admixtures may be adjusted by the Contractor to stay within the specified tolerances for air entrainment of Section 914.02(D).

#### **946 Fibrous Concrete**

**946.01 Description:** This item shall govern for the furnishing and placing of concrete reinforced with fibrous mesh in accordance with these specifications and with details as shown on the plans.

##### **946.02 Materials:**

- A. Concrete: All concrete shall conform to the requirements of Section 910, "Portland Cement Concrete".

Unless otherwise shown on the plans or in the bid item, the concrete shall be Class A concrete.

- B. Reinforcement: Reinforcement shall be 100% virgin polypropylene fibrillated fibers specially manufactured for use as concrete reinforcement and meeting the requirements of ASTM C-1116. The fibrous material shall not contain reprocessed olefin. Each container of fibrous material shall bear the manufacturer's name and/or trademark and the net weight of fibrous material in the package.

The specific gravity of the fibrous material shall be 0.91 plus or minus .05. The tensile strength shall be 80 to 110 psi. The lengths of the fibrous material shall be 1/2, 3/4, 1 1/2 and 2 inches in length.

Unless otherwise shown on the plans, each cubic yard of concrete shall contain no less than 1 1/2 pounds of fibrous material. The fibrous material shall be added to the concrete mix at the time the mix is batched.