

Standard Specifications Manual

SERIES 400 - CONCRETE STRUCTURES AND MISCELLANEOUS CONCRETE

Item No.

- 401 Structural Excavation Backfill
- 402 Controlled Low Strength Material
- 403 Concrete for Structures
- 404 Pneumatically Placed Concrete
- 405 Concrete Admixtures
- 406 Reinforcing Steel
- 407 Fibrous Concrete
- 408 Concrete Joint Materials
- 409 Membrane Curing
- 410 Concrete Structures
- 411 Surface Finishes for Concrete
- 413 Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)
- 414 Concrete Retaining Walls
- 416 Waterstops
- 420 Drilled Shaft Foundations
- 424 Prestressed Concrete Planks
- 425 Prestressed Concrete Structures
- 430 P.C. Concrete Curb and Gutter
- 431 Machine Laid PCC Curb and Gutter
- 432 P.C. Concrete Sidewalks
- 433 P.C. Concrete Driveways
- 434 P.C. Concrete Medians and Islands
- 435 P.C. Concrete Steps
- 436 P.C. Concrete Valley Gutters
- 438 Elastomeric Materials
- 439 Parking Lot Bumper Curbs
- 461 Trash and Litter Coffins
- 470 Curb Cuts for Sidewalk Ramps and Driveways
- 480 Concrete Paving Units
- 485 Concrete Paving Units for Sidewalk Ramps

ITEM NO. 401 STRUCTURAL EXCAVATION AND BACKFILL

401.1 Description

This item shall consist of the excavation for the placing of structures, except pipe sewers, for the disposal of such excavated material and for the backfilling around completed structures to the level of the original ground or grade indicated. The work shall include all necessary pumping or bailing, sheathing, drainage, and the construction and removal of any required cofferdams. Unless otherwise indicated, the work included hereunder shall provide for the removal of old structures or portions thereof (abutments, buildings, foundations, wingwalls, piers, etc.), trees and all other obstructions necessary to the proposed construction.

Where excavation is not classified, it will be grouped under "Unclassified Structural Excavation", which shall include the removal of all materials encountered regardless of their nature or the manner in which they are removed.

Where excavation is classified, it shall be classed as "Common Structural Excavation" or "Rock Structural Excavation" in accordance with the following criteria:

"Common Structural Excavation" shall include the removal of all materials other than rock.

"Rock Structural Excavation" shall include the removal of firm and compact materials that cannot be excavated with power equipment, without first being loosened or broken by blasting, slogging or drilling.

401.2 Materials

(1) Sand

- (a) Fine aggregate sand shall be Grade 1 conforming to [Item No. 302](#), "Aggregates for Surface Treatments".
- (b) Native Sand shall be local material obtained from approved sources and subject to the approval of the Engineer.

(2) Flexible Base

Flexible base shall conform to [Item No. 210](#), "Flexible Base".

(3) Lime Stabilized Base

Lime stabilized base shall conform to [Item No. 202](#), "Hydrated Lime and Lime Slurry" and Item No. 203, "Lime Treatment for Materials in Place".

(4) Concrete Base

Concrete base shall conform to Class J Concrete [Item No. 403](#), "Concrete for Structures".

(5) Granular Material

- (a) Coarse aggregate shall conform to [Item No. 403](#) "Concrete for Structures".
- (b) Foundation Rock

Foundation rock shall be well graded, hard, durable coarse aggregate ranging in size from 2 to 6 inches.

(c) Pea Gravel

Pea gravel shall consist of hard, durable, opaque gravel, free of clay, loam, sand or other foreign substances, ranging in size from ¼ inch to 3/8inch conforming to ASTM C 33.

(6) **Cement Stabilized Backfill**

Cement Stabilized backfill shall conform to Class J Concrete, [Item No. 403](#), "Concrete for Structures", or as approved by the Engineer.

401.3 Construction Methods

- (1) Excavation shall be done in accordance with the lines and depths indicated or as established by the Engineer. Unless otherwise indicated or permitted by the Engineer no excavation shall be made outside a vertical plane 3 feet from the footing lines and parallel thereto.
- (2) Excavation shall conform to elevations indicated or raised or lowered by written order of the Engineer, when such alterations are judged proper. When deemed necessary to increase or decrease the plan depth of footings, the alterations in the details of the structure shall be as directed by the Engineer. The Engineer shall have the right to substitute revised details resulting from consideration of changes in the design conditions.
- (3) When a structure is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final excavation to grade shall not be performed until just before the footing is placed. Equipment selected and used by the Contractor for excavation which disturbs what was otherwise stable subgrade material, as shown by laboratory tests, will not be used as a justification for payment for excavating to extra depth or for payment for stabilizing materials which may be ordered by the Engineer.
- (4) Excavated material required to be used for backfill may be deposited by the Contractor in storage piles as indicated or at points convenient for its rehandling during the backfilling operations, subject to the approval of the Engineer, who may require that the survey center line of the structure and the transverse or hub line of any unit of the structure be kept free of any obstruction. The Contractor shall adjust any stockpiles, to facilitate surveying and the work of other Contractors working in the immediate proximity, as directed by the Engineer.
- (5) Excess excavated material or excavated material not satisfactory for use as backfill shall be disposed of in a manner satisfactory to the Engineer or designated representative.
- (6) For all single and multiple box culverts, pipe culverts, pipe arch culverts and box sewers of all types, where the soil encountered at established footing grade is a quicksand, muck or similar unstable material, the following procedure shall be used unless other methods are indicated:

The depth to which unstable material is removed will be determined by the Engineer. It will not exceed 2 feet below the footing of culverts that are 2 feet or more in height and will not exceed the height of culverts for those less than 2 feet high. Excavation shall be carried at least 1 foot horizontally beyond the limits of the structure on all sides. All unstable soil removed shall be replaced with suitable stable material, in uniform layers of suitable depth for compaction as directed by the Engineer. Each layer shall be wetted, if necessary and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil which has sufficient stability to properly sustain the adjacent sections of the roadway embankment will be considered a suitable foundation material.

When, in the opinion of the Engineer, it is not feasible to construct a stable footing as outlined above, the Contractor shall construct it by the use of special materials, such as flexible base, cement stabilized base, cement stabilized backfill or other material, as directed by the Engineer. This work will be paid for as provided below.

Special materials used or additional excavation made for the Contractor's convenience to expedite the work will not be paid for directly, but shall be subsidiary to the various classes of structural excavation. In addition, if the Contractor's construction methods and equipment creates conditions necessitating usage of special materials or additional excavation, the work and materials will not be paid for directly, but shall be subsidiary to the various classes of structural excavation.

- (7) When the material encountered at footing grade of a culvert is found to be partially rock or incompressible material and partially a compressible soil which is satisfactory for the foundation, the incompressible material shall be re-moved for a depth of 6 inches below the footing grade and backfilled with a compressible material similar to that used for the rest of the structure.
- (8) When the material encountered at footing grade of a bridge bent or pier is found to be partially of rock or in-compressible material, and partially of a compressible material, the foundation shall not be placed until the Engineer has inspected the footing and authorized such changes found necessary to provide an adequate foundation.

401.4 Cofferdams

The term cofferdams, whenever used in this specification, designates any temporary or removable structure constructed to hold the surrounding earth, water or both, out of the excavation, whether the structure is formed of earth, timber, steel, concrete or a combination of these. It includes earthen dikes, timber cribs, any type of sheet piling, removable steel shells and the like and all necessary bracing and it shall be understood also to include the use of pumping wells or well points for the same purpose. The cost of cofferdams, when required, shall be included as a part of the bid price for excavation.

It is the intent of this specification to require that a suitable cofferdam which will provide a safe work area be provided for all excavation when necessary in order to control water

so that the foundation may be placed in a dry condition, as to preclude sliding and caving of the walls of the excavation. Where no ground or surface water is encountered, the cofferdam need be sufficient only to protect the workmen and to avoid cave-ins or slides beyond the excavation limits.

The type, strength and clearance of cofferdams, insofar as such details affect the character of the finished work and the safety of laborers and inspectors working therein, will be subject to review by the Engineer, but the Engineer's review shall in no way relieve the Contractor of responsibility for the adequacy and safety of the cofferdam design. Other details or design will be left to the choice of the Contractor, who will be responsible for the successful completion of the work. Approval of the drawings by the Engineer will not relieve the Contractor of responsibility in any manner. The interior dimensions of cofferdams shall provide sufficient clearance for the construction and removal of any required forms and the inspection of their exteriors and to permit pumping outside of the forms.

Unless otherwise indicated, cofferdams shall be removed by the Contractor after the completion of the substructure without disturbing or marring the structure.

401.5 Pumping or Bailing

The manner of pumping or bailing from the interior of any foundation enclosure shall preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of concrete or for a period of at least 24 hours thereafter, unless from a suitable sump separated from the concrete work by a water-tight wall.

401.6 Backfilling

(1) General

As soon as practicable, all portions of excavation not occupied by the permanent structure shall be backfilled. Backfill material shall be free from large or frozen lumps, wood or other extraneous material.

That portion of backfill which will not support any portion of completed roadbed or embankment shall be placed in layers not more than 10 inches in depth (loose measurement) and shall be compacted to a minimum of 95 percent of maximum density as determined by SDHPT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions.

If the excavation has been made through a hard material resistant to erosion, the backfill around piers and in front of abutments and wings may be ordered by the Engineer to be of stone or lean concrete. Unless otherwise indicated, such backfill shall be paid for as extra work.

That portion of the backfill which will support any portion of the roadbed or embankment shall be placed in uniform layers not more than 10 inches in depth (loose measurement) wetted uniformly to the moisture content required and shall be compacted to a minimum of 95 percent of maximum density, as determined by SDHPT Test Method Tex-114-E by means of mechanical tampers or rammers, except that the use of rolling equipment of the type generally used in

compaction embankments will be permitted on portions which are accessible to such equipment. All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in the same manner as specified above for backfill material. These provisions require the mechanical compaction by means of either rolling equipment or mechanical tampers or rammers, of all backfill and embankment adjoining the barrels and wingwalls of culverts and adjoining all sides of bridge abutments and retaining walls, regardless of whether or not such embankment or backfill is above or below the original surface of the ground and regardless of whether the excavation at the structure site was performed conforming to [Item No. 111](#), "Excavation", this item, "Structural Excavation", [Item No. 110](#), "Street Excavation" or [Item No. 120](#), "Channel Excavation". Unless otherwise indicated, hand tamping will not be accepted as an alternate for mechanical compaction. As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth, free of any appreciable amount of gravel or stone particles larger than 4 inches in greatest dimension and of a gradation that permits thorough compaction. When, in the opinion of the Engineer, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, provided that no particles larger than 12 inches or smaller than 6 inches may be used. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density. When required by the plans or by written order of the Engineer, cement stabilized material shall be used for backfilling.

All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications therefore.

Where no embankment is involved on the project and no specifications therefore are included in the contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.

No backfill shall be placed against any abutment or retaining wall until such structure has been in place at least 7 days. No backfill shall be placed adjacent to or over structures until the top slab has attained 500 psi flexural strength. Backfill placed around abutments and piers shall be deposited on both sides to approximately the same elevation at the same time.

Care shall be taken to prevent any wedging action of backfill against the structure and the slopes bounding the excavation shall be stepped or serrated to prevent such action.

(2) **Pipe Culverts**

The following requirements shall apply to the backfilling of pipe culverts in addition to the pertinent portions of the general requirements given in the preceding section.

Selected bedding material other approved material shall be wetted, if required, and placed along both sides of the pipe equally, in uniform layers not exceeding 6 inches in depth (loose measurement) and thoroughly compacted so that there shall be a berm of thoroughly compacted material on each side of the pipe. The method and degree of compaction shall be the same as specified above for portions of backfill within the limits of embankment or roadbed.

Filling and/or backfilling shall be continued in this manner to the elevation of the top of the pipe. Special care shall be taken to secure thorough compaction of the material placed under the haunches of the pipe. All fill or backfill below the top of pipe shall be compacted mechanically in the manner and to the density prescribed above, regardless of whether or not such material is placed within the limits of the embankment or roadbed. In the case of pipe placed in trenches, that portion of the backfill above the top of the pipe which supports embankment or the roadbed shall receive mechanical compaction as specified above and the portion which will not support any portion of embankment or roadbed shall be placed in layers not more than 10 inches in depth (loose measurement) and shall be compacted by whatever means the Contractor chooses, to a density comparable with the adjacent, undisturbed material. Embankments above the top of pipe shall be placed conforming to [Item No. 132](#), "Embankments". During construction adequate cover must be provided to protect the structure from damage.

Whenever excavation is made for installing pipe culverts or box sewers across private property or beyond the limits of the embankment, the top soil removed in excavating the trench shall be kept separate and replaced as nearly as feasible in its original position and the entire area involved in the construction operations shall be restored to a presentable condition.

(3) Cement Stabilized Backfill

When indicated, trenches shall be backfilled with Cement Stabilized Backfill.

Cement Stabilized Backfill above the pipe may be dry enough to be transported without special mixing equipment.

On structures other than pipe culverts, special mixing equipment will not be required to transport the cement stabilized backfill unless otherwise indicated.

Hand-operated mechanical tampers may be used with approval of the Engineer for compacting this backfill.

401.7 Measurement

Unless otherwise indicated, structural excavation for pipe headwalls, inlets, manholes, culvert widening (extensions), bridge abutments and side road and private entrance pipe culverts will not be measured but shall be considered subsidiary to the various bid items. Determination of quantities for structural excavation shall be made by the method of average end-areas using the following limits to establish templates for measurement.

- (1) For all structures requiring measurement, except the barrels of pipe culverts, no material outside of vertical planes 1 foot beyond the edges of the footings and parallel thereto will be included.
- (2) For the barrels of pipe culverts of 42 inches or less nominal or equivalent diameter, no material outside of vertical planes 1 foot beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. For the barrels of pipe culverts more than 42 inches in nominal or equivalent diameter, no material outside of vertical planes located 2 feet beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included.
- (3) If a cofferdam, as herein defined, is used, the limitations indicated above shall apply just as if no cofferdams were used.
- (4) Where excavation in addition to that allowed for the footings is required for other portions of the structure, such as for the cap, cross strut or tie beam of a pier or bent or for the superstructure, measurements for such additional excavation will be limited laterally by vertical planes 1 foot beyond the face of the member and parallel thereto and vertically to a depth of 1 foot below the bottom of such member.
- (5) Except as allowed by the above conditions, no account will be taken of any excavation necessary for placing forms or false work.
- (6) Except at side road culverts, all street excavation called for on the contract plans at all structure sites shall be assumed to be completed before starting the structural excavation and the measurement of structural excavation will include only material below or outside the limits of the completed street excavation. Excavation for side road and private entrance pipe culverts will not be measured for payment but shall be subsidiary to the Item.
- (7) On all structures of bridge classification where the contract plans call for channel excavation at the structure site, it shall be assumed to have been completed before starting the structural excavation and the measurement of structural excavation will include only material below or outside the limits of the completed channel section. The method of measurement for payment will be in accordance with this procedure regardless of the actual construction methods followed.
- (8) Where excavation diagrams are indicated, they shall take precedence over these provisions.
- (9) Measurement will not include materials removed below footing grades to compensate for anticipated swellage due to pile driving and it will not include material required to be removed due to swellage beyond the specified limits during pile driving operations.
- (10) Measurement will not include additional yardage caused by slips, slides, cave-ins, siltings or fillings due to the action of the elements or the carelessness of the Contractor. Water will not be classed as excavated material.

- (11) Where rock, other incompressible or unstable material is undercut to provide suitable foundation for pipe or box culverts, such material below grade, ordered by the Engineer to be removed, will be measured for payment.
- (12) Except for any required undercut, quantities for "Structural Excavation", as indicated, shall be considered as final quantities and no further measurement will be required, unless the alignment, grades or structure locations are revised by the Engineer during construction. Final determination of quantities for individual structures will be made, if in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities indicated and actual quantities due to changes in cross sections or apparent errors. Excavation quantities for foundations indicated where cofferdams are required shall be considered as final quantities and no further measurement will be made.
- (13) For any footing, foundation or other structure unit within the scope of this specification, additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation or structure unit, when such grade change is authorized by the Engineer. Measurement will be made by the addition to or the deduction from, the original quantities for the volume of excavation involved in the authorized grade change.
- (14) Cement stabilized backfill shall be measured by the backfill diagram as indicated. The quantity of "Cement Stabilized Backfill" as indicated shall be considered as final quantities and no further measurement will be required, unless alignment or grade elevations as indicated are revised by the Engineer. If such revisions result in an increase or decrease in this quantity, the final quantity will be revised by the amount represented by the changes in alignment or grade elevations.

401.8 Payment

Payment for all work prescribed under this item and measured as provided above will be made at the unit price bid per cubic yard for the particular class of excavation specified on the plans in the amount shown on the plans and in the proposal. Payment for revised quantities will be made as specified above and for the removal of unstable and incompressible material as noted below.

Payment for removal and replacement of unstable or incompressible material below the footing grades of culverts and box sewers as indicated above will be made as follows:

When indicated or the Engineer directs the use of special materials such as flexible base, cement stabilized base, cement stabilized backfill or other special material, payment for excavation below the footing grades shall be made at the unit price bid for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation", as the case may be. Payment for furnishing, hauling, placing and compacting the flexible base, cement stabilized base, cement stabilized backfill or other special material will be made at the unit price bid for these items in the bid or in accordance with pertinent provisions for extra work.

Where special materials are not required or specified, the removal and replacement of the unstable material will be performed as described above. Payment therefore will be made at a price equal to 200 percent of the unit price bid per cubic yard for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation", as the case may be, which price shall be full compensation for removing the unstable or incompressible material, furnishing, hauling, placing and compacting suitable material required to replace it and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment for "Concrete Base" and "Cement Stabilized Backfill" measured as prescribed above shall be made at the unit price bid per cubic yard of "Cement Stabilized Backfill". Such payment shall be full compensation for furnishing all materials, tools, labor, equipment, sheathing and incidentals required to perform the applicable work prescribed herein.

Should the Engineer judge it necessary to lower the structure footings to an elevation below the grade indicated, payment for the "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation" as the case may be, required below plan grade down to and including an elevation 5 feet below plan grade for any individual footing will be made at a unit price equal to 115 percent of the contract unit bid price. Payment for the excavation from an elevation over 5 feet below plan grade down to and including an elevation 10 feet below plan grade will be made at a unit price equal to 125 percent of the contract unit bid price for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation" as the case may be. No increase in unit price will be allowed for other bid items of the contract and no additional compensation will be allowed for any required cofferdam adjustments made necessary by such lowering of footings. These provisions shall not apply to the lowering of culverts, except when the flow line grade is lowered 1 foot or more below plan grade.

In cases where the extra depths required for any footing or footings exceeds 10 feet, a supplemental agreement shall be made covering the quantities removed from depths in excess of 10 feet below plan grade.

No direct payment will be made for filling or backfilling around structures. Payment for the backfilling and compacting of areas which were removed as structural excavation shall be included in the unit prices bid for the various classes of structural excavation.

At the end of each estimate period, the Engineer shall determine the completed portion of the total work under [Item No. 401](#) "Structural Excavation and Backfill" and payment shall be made accordingly.

Filling or backfilling of areas above the natural ground level or above the limits of street excavation or channel excavation sections shall be considered as [Item No. 132](#), "Embankment" and payment therefore shall be included in the unit prices bid for the various classes of [Item No. 110](#), "Street Excavation", [Item No. 120](#), "Channel Excavation" or [Item No. 130](#), "Borrow".

Where no channel excavation is provided for at culvert sites and where it is necessary to excavate beyond the limits of structural excavation, as herein described in order that the culvert may function properly, such excavation shall be included with structural excavation or shall be subsidiary to structural excavation and backfill as may be indicated.

Payment for all work prescribed under this item shall be full compensation for all excavation and backfill including compaction, all soundings, constructing all cofferdams, all dewatering and for furnishing all materials, labor, equipment, tools, sheathing, bracing, cofferdams, pumps, drills, explosives and incidentals necessary to complete the work, except for specific allowances stated above.

Payment will be made under one of the following:

- Unclassified Structural Excavation - Per Cubic Yard-Plan Quantity.
- Common Structural Excavation – Per Cubic Yard.
- Rock Structural Excavation - Per Cubic Yard.
- Concrete Base - Per Cubic Yard.
- Cement Stabilized Backfill - Per Cubic Yard.

End

Ref: [110](#), [111](#), [120](#), [130](#), [132](#), [202](#), [203](#), [210](#), [302](#), [403](#)

ITEM NO. 402

CONTROLLED LOW STRENGTH MATERIAL

402.1 Description

This item governs Controlled Low Strength Material (CLSM) used for trench backfill and for filling abandoned culverts, pipes, other enclosures, and for other uses as indicated on the drawings, or as approved by the Engineer or designated representative. CLSM is a low strength, self-compacting, flowable, cementitious material used in lieu of soil backfill. It is intentionally prepared at low strength to allow for future removal using conventional excavation equipment.

The CLSM shall be composed of Portland cement or fly ash, or both, filler aggregate and water. The CLSM, specified for use in filling abandoned culverts, pipes, or other enclosures, shall contain a settlement compensator, in addition to the other ingredients, to minimize settlement of the CLSM within the enclosure.

Normal Set CLSM shall be provided whenever the material will remain uncovered or will not be subjected to traffic or other loads within 24 hours after placement. Fast Set CLSM shall be provided whenever the material will be covered, subjected to traffic or other loads within 24 hours, or needed to expedite construction.

CLSM can be used for permanent subgrade repairs below the base layer, but shall not be used for permanent pavement repairs. For temporary traffic applications, a minimum 2 inch (50 mm) cap composed of Hot Mix-Cold Laid Asphaltic Concrete (TxDoT Standard Specification Item 334) shall be placed on the CLSM.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

402.2 Submittals

The submittal requirements of this specification item include:

- A. A mix design submittal including the results of unconfined compressive strength tests, air entrainment (if applicable), flow consistency, hardened unit weight, and timed Ball Drop and corresponding Penetrometer tests.
- B. Certifications and test results for the cement fly ash, and admixtures.
- C. Particle-size gradation and specific gravity tests on the filler aggregate.

402.3 Materials

- A. Cement.

Portland cement shall conform to ASTM C 150, Type I (General Purpose).

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

B. Fly Ash

Fly ash shall conform to the requirements of Standard Specification [Item No. 405](#), "Concrete Admixtures" and TxDOT Specification [Item 437](#).

C. Filler Aggregate.

Filler aggregate shall consist of sand, stone screenings, pavement milling cuttings or other granular material that is compatible with the other mixture components. The filler aggregate shall be fine enough to stay in suspension to the extent required for proper flow without segregation, and, in the case of filling of enclosures, for minimal settlement. Filler aggregate shall have a Plasticity Index (TxDOT Test Method Tex-106-E) less than 15 and shall conform to the following gradation:

Sieve Designation US (SI)	Percent Passing
No. 200 (75mm)	0 - 10

D. Mixing Water.

Mixing water shall conform to the requirements of Standard Specification [Item No. 403](#), "Concrete for Structures".

E. Settlement Compensator

An air entraining admixture with a higher than usual dosage, which meets the requirements of Standard Specification [Item No. 405](#), "Concrete Admixtures", shall be used as a settlement compensator. The settlement compensator may be introduced to the CLSM at the job site by placement of prepackaged admixture in capsules or bags in the mixing drum in accordance with the admixture manufacturer's recommendations.

402.4 Mix Design

The proportioning of CLSM shall be the responsibility of the Contractor. The Contractor shall furnish a mix design conforming to the requirements herein, for review and approval by the Engineer or designated representative. The mix design shall be prepared by a qualified commercial laboratory and then reviewed and signed by a registered Professional Engineer licensed in the State of Texas.

The Mix Design submittal must include:

- A. Test results for unconfined compressive strength, air entrainment (if applicable), flow consistency, hardened unit weight, and timed Ball Drop (ASTM C-360) and corresponding Penetrometer tests (with a concrete pocket penetrometer),
- B. Certifications and test results for the cement, fly ash, and admixtures, and
- C. Results of particle-size gradation and specific gravity tests on the filler aggregate. The submittal shall include Penetrometer tests performed every thirty

minutes until the Ball Drop test shows a 2-inch (50 mm) indentation, as well as the predicted Penetrometer reading that corresponds to a 3-inch (75 mm) Ball Drop indentation. Particle-size gradation shall be determined using a series of sieves that gives no fewer than five uniformly spaced points for graphing the entire range of particle sizes larger than a No. 200 sieve (75- μ m).

The Contractor shall perform the work required to substantiate the design at no cost to the Owner/Developer, including all testing. Approved mix designs shall be valid for one year, provided there are no changes in the type, source, or characteristics of the materials during that year.

At the end of one year, the mix design may be submitted for renewal, provided that:

- A. field tests of the CLSM during the year have been satisfactory,
- B. there have been no changes in type or source of the materials of the mix, and
- C. the characteristics of the materials have not changed significantly since the original submittal.

The Contractor shall also submit certifications and test results for the cement, fly ash and admixtures, and particle-size gradation and specific gravity test results for the filler aggregate. The Contractor shall compare results of tests made on the filler aggregate at the end of the year to the results of tests reported in the original submittal. Gradation changes less than ten percent in percent passing any sieve and specific gravity changes less than five percent shall not be considered significant.

402.5 Strength

The CLSM mix designs shall meet the unconfined compressive strength requirements outlined in the table below. The compression tests shall be conducted in accordance with TxDOT Method Tex-418-A, using approved unbonded caps on specimens with four-inch (100 mm) diameter and eight-inch (200 mm) height [or three-inch (75 mm) diameter by six-inch (150 mm) high specimens if a smaller capacity loading device gives more accurate results].

Unconfined Compressive Strength, psi (mPa)		
Age	Normal Set CLSM	Fast Set CLSM
3 hours	—	35 (240) minimum
24 hours	35 (240) minimum	—
28 days	300 (2.0) maximum	300 (2.0) maximum

402.6 Flow Consistency

Flow consistency shall be established in tests involving the use of a six-inch (150 mm) length by three-inch (75 mm) diameter open-ended straight tubing made of steel, plastic or other non-absorbent material that is non-reactive with cement or fly ash. The tube shall be placed with one end on a horizontal flat surface and held in a vertical position. The tube shall then be filled to the top with CLSM. The top surface shall be struck off with a suitable straight edge and any spillage shall be removed from the base of the tube. Within five seconds thereafter the tube shall be raised carefully, using a steady upward lift with no lateral or torsional motion. The entire test, from the start of filling until removal of the tube, shall be completed within 1½ minutes without interruption.

After removal of the tube, the spread of the CLSM shall be measured immediately along two diameters that are perpendicular to one another. The average of those two measurements is defined as the flow consistency of the mix. The flow consistency of the CLSM shall be considered satisfactory if a circular-type spread of the mix occurs without segregation and a flow consistency (average diameter of spread) of 8 inches (200 mm) or more is achieved.

402.7 Air Entrainment

Air entraining admixture shall be added as a settlement compensator, whenever the CLSM will be used to fill an enclosure (Section 402-1). The dosage shall be sufficient to result in an air content of 15 to 25 percent (as determined by TxDOT Method Tex-416-A) at the time of placement of the CLSM.

402.8 Field Strength Tests

Ball Drop or Penetrometer tests shall be used to determine when the CLSM has developed sufficient strength to be covered or subjected to traffic or other loads as approved by the Engineer or designated representative.

The Ball Drop test shall be performed according to the latest version of ASTM C-360. An indentation diameter of three inches (75 mm) or less, and the absence of a sheen or any visible surface water in the indentation area shall indicate that the CLSM has achieved the desired strength. Because trench width and depth may affect the test results, the Contractor may perform this test on a control sample of CLSM in a two-foot (600 mm) square by six-inch (150 mm) deep container.

Penetrometer tests using a hand-held, spring reaction-type device commonly called a concrete pocket penetrometer, shall be performed on the surface of the CLSM. A Penetrometer reading equal to or greater than the value established in the mix design (Section 402.4) for a Ball Drop test indentation of 3-inches (75 mm), shall indicate that the CLSM has achieved the desired strength.

402.9 Construction Methods

A. General

The height of free fall placement of the CLSM shall not exceed four feet (1.2 meters). Since CLSM is considered to be self-compacting, a vibrator shall not be allowed. The CLSM shall not be covered with any overlying materials or

subjected to traffic or other loads until the Ball Drop test or the Penetrometer test shows acceptable results (Section 402.8) or until the CLSM has been in place a minimum of 24 hours for Normal Set CLSM and a minimum of 3 hours for Fast Set CLSM. Curing of the CLSM will not be required.

B. Utility Line Backfill

After the utility pipe has been placed and the proper bedding material placed in accordance with the details on the drawings, the trench may be immediately backfilled with the CLSM to the subgrade level shown on the drawings, or as directed by the Engineer or designated representative.

C. Culvert Backfill

Care shall be taken to prevent movement of the structure. If the pipe or structure moves either horizontally or vertically, the CLSM and the structure shall be immediately removed and the pipe or structure re-laid to proper line and grade.

D. Other Backfill

CLSM may be used for backfill material in lieu of soil as shown on the drawings, or as approved by the Engineer or designated representative.

E. Filling Abandoned Culverts, Pipe, or other Enclosures

The CLSM shall be placed in a manner that allows all air or water, or both, to be displaced readily as the CLSM fills the enclosure.

402.10 Acceptance Testing During Construction

The Engineer or designated representative may perform flow consistency, air entrainment, and unconfined compressive strength tests to determine if the CLSM meets the specification requirements. The number and frequency of acceptance tests will be determined by the Engineer or designated representative.

402.11 Measurement and Payment

Work performed and materials furnished as prescribed by this item will not be measured nor paid for directly but shall be considered subsidiary to the various bid items in the contract.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS
--

Standard Specification Item 402, "CONTROLLED LOW STRENGTH MATERIAL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No 403	Concrete for Structures
Item No 405	Concrete Admixtures

SPECIFIC CROSS REFERENCE MATERIALS - continued

Standard Specification Item 402, "CONTROLLED LOW STRENGTH MATERIAL"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 420	Concrete Structures
Item No. 421	Portland Cement Concrete
Item No. 437	Concrete Admixtures

RELATED CROSS REFERENCE MATERIALS

Standard Specification Item 402, "CONTROLLED LOW STRENGTH MATERIAL"

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-106-E	Method Of Calculating the Plasticity Index of Soils
Tex-416-A	Air Content of Freshly Mixed Concrete By The Pressure Method
Tex-418-A	Compressive Strength of Cylindrical Concrete

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
ASTM C 150	Portland Cement
ASTM C 360	Ball Penetration in Fresh Portland Cement Concrete
ASTM C 403	Time of Setting of Concrete Mixtures by Penetration Resistance

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 504	Adjusting Structures
Item No. 506	Manholes
Item No. 508	Miscellaneous Structures and Appurtenances
Item No. 510	Pipe

ITEM NO. 403
CONCRETE FOR STRUCTURES

403.1 Description

This item shall govern quality, storage, handling, proportioning and mixing of materials for Portland cement concrete construction of buildings, bridges, culverts, slabs, prestressed concrete and incidental appurtenances.

403.2 Materials

Concrete shall be composed of Portland cement or Portland cement and fly ash, water, aggregates (fine and coarse), and admixtures proportioned and mixed as hereinafter provided to achieve specified results.

(1) Cementitious Materials

Portland cement shall conform to ASTM C 150, Type I (General Purpose), Type II (General Purpose with Moderate Sulfate Resistance) and Type III (High Early Strength). Type I shall be used when none is specified. Type I and Type III shall not be used when Type II is specified. Type III may be used in lieu of Type I when the anticipated air temperature for the succeeding 12 hours will not exceed 60°F. All cement shall be of the same type and from the same source for a monolithic placement.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

Fly ash (denoted by TxDOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's Portland cement content by absolute volume. Fly ash shall not be used in mix designs with less than five (5) sacks of Portland cement per cubic yard unless specifically permitted by the contract Drawings or project manual. Fly Ash may be used in all other classes of concrete, except that Type B fly ash shall not be used with Type II cement. Fly ash shall conform to the requirements of Item 405, "Concrete Admixtures."

(2) Mixing Water

Water for use in concrete and for curing shall be potable water free of oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl or sulfates as SO₄.

Contractor may request approval of water from other sources. Contractor shall arrange for samples to be taken from the source and tested at his expense. Water quality tests shall conform to AASHTO Method T 26 except where such methods are in conflict with provisions of this specification.

(3) Coarse Aggregate

Coarse aggregate shall consist of durable particles of crushed or uncrushed gravel, crushed blast furnace slag, crushed stone or combinations thereof; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material either free or as an adherent coating. It shall not contain more than 0.25 percent by weight of clay lumps, nor more than 1.0 percent by weight of shale nor more than 5 percent by weight of laminated and/or friable particles when tested in accordance with TXDOT Test Method TEX-413-A. It shall have a wear of not more than 40 percent when tested in accordance with TXDOT Test Method TEX-410-A.

Unless otherwise indicated, coarse aggregate shall be subjected to 5 cycles of the soundness test conforming to TXDOT Test Method TEX-411-A. The loss shall not be greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

Coarse aggregate shall be washed. The Loss by Decantation (TXDOT Test Method TEX-406-A), plus allowable weight of clay lumps, shall not exceed 1 percent or value indicated on the plans or in the project manual, whichever is less. If material finer than the # 200 sieve is definitely established to be dust of fracture of aggregates made primarily from crushing of stone, essentially free from clay or shale as established by TXDOT Test Method TEX-406-A, the percent may be increased to 1.5.

The coarse aggregate factor may not be more than 0.82; however, when voids in the coarse aggregate exceed 48 percent of the total rodded volume, the coarse aggregate factor shall not exceed 0.85. The coarse aggregate factor may not be less than 0.68 except for a Class I machine extruded mix that shall not have a coarse aggregate factor not lower than 0.61.

When exposed aggregate surfaces are required, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable for exposed aggregate pedestrian surfaces (i.e. sidewalks, driveways, medians, islands, etc.). Grade 5 aggregates shall be used for exposed aggregate finishes.

When tested by approved methods, the coarse aggregate including combinations of aggregates when used, shall conform to the grading requirements shown in Table 1.

Grade	Nom. Size	2-1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8
1	2 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"		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

(4) Fine Aggregate

Fine aggregate shall consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps. When subjected to color test for organic impurities per TXDOT Test Method TEX-408-A, it shall not show a color darker than standard.

Acid insoluble residue of fine aggregate used in slab concrete subject to direct traffic shall not be less than 28 percent by weight when tested conforming to TXDOT Test Method TEX-612-J.

When tested by approved methods, the fine aggregate, including combinations of aggregates, when used, shall conform to the grading requirements shown in Table 2

3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
0	0-5	0-20	15-50	35-75	65-90	90-100	97-100

Where sand equivalence is greater than 85, retainage on No. 50 sieve may be 65 to 94 percent. Where manufactured sand is used in lieu of natural sand, the percent retained on No. 200 sieve shall be 94 to 100. Sand equivalent per TXDOT Test Method TEX-203-F shall not be less than 80 nor less than otherwise indicated, whichever is greater. The fineness modulus will be determined by adding the percentages by weight retained on sieve Nos. 4, 8, 16, 30, 50 and 100 and dividing the sum of the six sieves by 100. For Class A and C concrete, the fineness modulus shall be between 2.30 and 3.10. For Class H concrete, the fineness modulus shall be between 2.40 and 2.90.

(5) Mineral Filler

Mineral filler shall consist of stone dust, clean crushed sand, approved fly ash or other approved inert material.

(6) Mortar (Grout)

Mortar for repair of concrete shall consist of 1 part cement, 2 parts finely graded sand and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce color required. When required by the Engineer, an approved latex adhesive shall be added to the mortar.

(7) Admixtures

All admixtures shall comply with the requirements of ITEM 405 CONCRETE ADMIXTURES. Calcium chloride-based admixtures shall not be approved.

403.3 Storage of Cement and Fly Ash

Cement and fly ash shall be stored in separate and well ventilated, weatherproof buildings or approved bins which will protect the material from dampness or absorption of moisture. Storage facilities shall be easily accessible and each shipment of packaged cement shall be kept separated to provide for identification and inspection. Engineer may permit small quantities of sacked cement to be stored in the open for a maximum of 48 hours on a raised platform and under waterproof covering.

403.4 Storage of Aggregates

Aggregates shall be stockpiled in sizes to facilitate blending. If the aggregate is not stockpiled on a hard, non-contaminant base, the bottom 6-inch layer of the stockpile shall not be used without recleaning the aggregate. Where space is limited, stockpiles shall be separated by walls or other appropriate barriers. Aggregate shall be stockpiled and protected from the weather a minimum of 24 hours prior to use to minimize free moisture content. When stockpiles are too large to protect from the weather, accurate and continuous means acceptable to the Engineer shall be provided to monitor aggregate temperature and moisture. Aggregates shall be stockpiled and handled such that segregation and contamination are minimized.

403.5 Measurement of Materials

Water shall be accurately metered. Fine and coarse aggregates, mineral filler, bulk cement and fly ash shall be weighed separately. Allowances shall be made in the water volume and aggregate weights during batching for moisture content of aggregates and admixtures. Volumetric and weight measuring devices shall be acceptable to Engineer.

Batch weighing of sacked cement is not required; however, bags, individually and entire shipments, may not vary by more than 3 percent from the specified weight of 94 pounds per bag. The average bag weight of a shipment shall be determined by weighing 50 bags taken at random.

403.6 Mix Design

Contractor shall furnish a mix design acceptable to the Engineer for class of concrete specified. The mix shall be designed by a qualified commercial laboratory and signed/sealed by a Texas-registered Professional Engineer to conform with requirements contained herein, to ACI 211.1 or TXDOT Bulletin C-11 (and supplements thereto). Contractor shall perform, at his own expense, the work required to substantiate the design, including testing of strength specimens. Complete concrete design data shall be submitted to the Engineer for approval. The mix design will be valid for a period of one (1) year provided that there are no changes to the component materials.

At the end of one (1) year, a previously approved mix may be resubmitted for approval if it can be shown that no substantial change in the component materials has occurred. The resubmittal analysis must be reviewed, signed and sealed by a Texas-registered Professional Engineer. This resubmittal will include a reanalysis of specific gravity, absorption, fineness modulus, sand equivalent, soundness, wear and unit weights of the aggregates. Provided that the fineness modulus did not deviate by more than 0.20 or that the reportioned total mixing water, aggregate and cement (or cement plus fly ash) are within 1, 2, and 3 percent, respectively, of pre-approved quantities, a one-year extension on the approval of the mix may be granted by the Engineer. Updated cement, fly ash, and admixture certifications shall accompany the resubmittal.

Approved admixtures conforming to Item 405, "Concrete Admixtures" may be used with all classes of concrete at the option of the Contractor provided that specific requirements of the governing concrete structure specification are met. Water reducing and retarding agents shall be required for hot weather, large mass, and continuous slab placements. Air entraining agents may be used in all mixes but must be used in the classes indicated on Table 4. Unless approved by the Engineer, mix designs shall not exceed air contents for extreme exposure conditions as recommended by ACI 211.1 for the various aggregate grades.

403.7 Consistency and Quality of Concrete

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.

Table 3: Slump Requirements		
Type of Construction	Slump, inches	
	Maximum	Minimum
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

During progress of the work, Owner's/Developer's testing laboratory shall cast test cylinders and/or beams as a check on compressive and/or flexural strength of concrete actually placed. Owner's/Developer's testing laboratory may also perform slump tests, entrained air tests and temperature checks to ensure compliance with specifications.

Proportioning of all material components shall be checked prior to discharging. Excluding mortar material for pre-coating of the mixer drum [403.8(2)] and adjustment for moisture content of admixtures and aggregates, material components shall fall within the range of $\pm 1\%$ for water, $\pm 2\%$ for aggregates, $\pm 3\%$ for cement, -2% for fly ash and within manufacturer recommended dosage rates for admixtures except that air entrainment shall be $\pm 1-1/2$ points of the mix design requirements.

Unless otherwise specified, concrete mix temperature shall not exceed 90° F except in mixes with high range water reducers where a maximum mix temperature of 100° F will be allowed. Cooling an otherwise acceptable mix by addition of water or ice will not be allowed.

Test beams or cylinders will be required for small placements such as manholes, inlets, culverts, wing walls, etc. Engineer may vary the number of tests to a minimum of 1 for each 25 cubic yards placed over a several day period.

Test beams or cylinders shall be required for each monolithic placement of bridge decks or superstructures, top slabs of direct traffic culverts, cased drilled shafts, structural beams and as otherwise directed by Engineer for design strength or early form removal. Test beams or cylinders made for early form removal or use of structure will be at Contractor's expense, except when required by Engineer.

A strength test shall be defined as the average of breaking strength of 2 cylinders or 2 beams as applicable. Specimens will be tested conforming to TXDOT Test Method TEX-418-A or TEX-420-A. If required strength or consistency of class of concrete being produced cannot be secured with minimum cementitious material specified or without exceeding maximum water/cementitious material ratio, Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase cementitious material content in order to provide concrete meeting these specifications. Test specimens shall be cured using the same methods and under the same conditions as the concrete represented. Design strength beams and cylinders shall be cured conforming to TXDOT Bulletin C-11 (and supplements thereto).

When control of concrete quality is by 28-day compressive tests, job control will be by 7-day flexural tests. If the required 7-day strength is not secured with the quantity of cement specified in Table 4, changes in the mix design shall be made and resubmitted for approval.

Table 4: Classes of Concrete						
Class	Sk Cement Per CY	Minimum 28 Day psi	Minimum Beam 7 Day psi	*Maximum W/C Ratio	Coarse Agg. Number	**Air Ent.
A	5.0	3000	500	6.5	1,2,3,4,5	Yes
B	4.0	2000	300	8.0	2,3,4,5	No
C	6.0	3600	600	6.0	1,2,3,4,5	Yes
D	4.5	2500	425	7.5	2,3,4	No
H	6.0	As indicated	As Indicated	5.5	3,4	Yes
I	5.5	3500	575	6.2	2,3,4,5	Yes
J	2.0	800	N/A	N/A	2,3,4,5	No
S	6.0	3600	600	5.0	2,3,4,5	Yes

Notes:

1. Grade 1 coarse aggregate may be used in massive foundations only (except case drilled shafts) with 4 inch minimum clear spacing between reinforcing steel.
2. When Type II cement is used in Class C or S concrete, the 7-day beam break requirement will be 550 psi; with Class A, 460 psi., minimum.
3. *The design water-cement ratio shall be appropriately adjusted for mixes with fly ash per ACI 211.1 or TXDOT C-11 (and supplements thereto), as applicable.
4. **Maximum air design contents for the five grades of coarse aggregate, unless otherwise approved by Engineer, are: 4.5% for Grade 1, 5.5% for Grade 2, and 6.0% for Grades 3, 4, and 5.

403.8 Mixing and Mixing Equipment

All equipment, tools and machinery used for hauling materials and performing any part of the work shall be maintained in such condition to insure completion of the work without excessive delays. Mixing shall be done in a mixer of approved type and size that will produce uniform distribution of material throughout the mass and shall be capable of producing concrete meeting requirements of ASTM C 94, Ready-mixed Concrete and these specifications. Mixing equipment shall be capable of producing sufficient concrete to provide required quantities. Entire contents of the drum shall be discharged before any materials are placed therein for a succeeding batch. Improperly mixed concrete shall not be placed in a structure. The mixer may be batched by either volumetric or weight sensing equipment and shall be equipped with a suitable timing device that will lock the discharging mechanism and signal when specified time of mixing has elapsed.

(1) Proportioning and Mixing Equipment

For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer or a volumetric or weight batch mixer of the rotating paddle type may be used.

When approved by Engineer in writing or when specified for use, these mixers may be used for other types of concrete construction, including structural concrete, if the number of mixers furnished will supply the amount of concrete required for the particular operation in question.

These mixers shall be designed to receive all the concrete ingredients, including admixtures, required by the mix design in a continuous uniform rate and mix them to the required consistency before discharging. Mixers shall have adequate water supply and metering devices.

For continuous volumetric mixers, the materials delivered during a revolution of the driving mechanism or in a selected interval, will be considered a batch and the proportion of each ingredient will be calculated in the same manner as for a batch type plant.

Mixing time shall conform to recommendations of manufacturer of mixer unless otherwise directed by Engineer.

(2) Ready-mixed Concrete

Use of ready-mixed concrete will be permitted provided the batching plant and mixer trucks meet quality requirements specified herein. When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the mixer drum. Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

- (a) A ticket system will be used that includes a copy for the Inspector. Ticket will have machine stamped time/date of concrete batch, weight of cement, fly ash, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on ticket may be cause for rejection of concrete.
- (b) Sufficient trucks will be available to support continuous placements. Contractor will satisfy Engineer that adequate standby trucks are available to support monolithic placement requirements.
- (c) A portion of mixing water required by the mix design to produce the specified slump may be withheld and added at the job site, but only with permission of Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken. Additional cement shall not be added at the job site to otherwise unacceptable mixes.
- (d) A metal plate(s) shall be attached in a prominent place on each truck mixer plainly showing the various uses for which it was designed. The data shall include the drum's speed of rotation for mixing and for agitating and the capacity for complete mixing and/or agitating only. A copy of the manufacturer's design, showing dimensions of blades, shall be available for inspection at the plant at all times. Accumulations of hardened concrete shall be removed to the satisfaction of the Engineer or designated representative.
- (e) The loading of the transit mixers shall not exceed capacity as shown on the manufacturer's plate attached to the mixer or 63 percent of the drum volume, whichever is the lesser volume. The loading of transit mixers to the extent of causing spill-out enroute to delivery will not be acceptable. Consistent spillage will be cause for disqualification of a supplier.
- (f) Excess concrete remaining in the drum after delivery and wash water after delivery shall not be dumped on the project site unless approval of the dump location is first secured from the Engineer or designated representative.

(3) Hand-mixed Concrete

Hand mixing of concrete may be permitted for small placements or in case of an emergency and then only on authorization of the Engineer. Hand-mixed batches shall not exceed a 4 cubic foot batch in volume. Material volume ratios shall not be leaner than 1 part cement, 2 parts large aggregate, 1 part fine aggregate and enough water to produce a consistent mix with a slump not to exceed 4 inches. Admixtures shall not be used unless specifically approved by the Engineer.

403.9 Excavation, Placing of Concrete, Finishing, Curing and Backfill

Excavation, placing of concrete, finishing, curing and backfill shall conform to Item 401, "Structural Excavation and Backfill", and Item 410, "Concrete Structures".

403.10 Measurement

Where measurement of concrete for a structure is not provided by another governing pay item in the Project Manual, measurement shall be made under this specification in accordance with the following.

The quantities of concrete of the various classifications which constitute the completed and accepted structure or structures in place will be measured by the cubic yard, each, square foot, square yard or linear foot as indicated in the Project Manual. Measurement will be as follows:

(1) General

- (a) Measurement based on dimensions shall be for the completed structure as measured in place. However, field-measured dimensions shall not exceed those indicated on the plans or as may have been directed by the Engineer in writing.
- (b) No deductions shall be made for chamfers less than 2 inches in depth, embedded portions of structural steel, reinforcing steel, nuts, bolts, conduits less than 5 inches in diameter, pre/post tensioning tendons, keys, water stops, weep holes and expansion joints 2 inches or less in width.
- (c) No measurement shall be made for concrete keys between adjoining beams or prestressed concrete planks.
- (d) No measurement shall be made for fill concrete between the ends or adjoining prestressed concrete planks/box beams at bent caps or between the ends of prestressed concrete planks/box beams and abutment end walls.
- (e) No measurement shall be made for inlet and junction box invert concrete.
- (f) No measurement shall be made for any additional concrete required above the normal slab thickness for camber or crown.

(2) Plan Quantity. For those items measured for plan quantity payment, adequate calculations have been made. If no adjustment is required by Article 403.11, additional measurements or calculations will not be required or made.

- (3) Measured in Place. For those items not measured for Plan Quantity payment, measurement will be made in place, subject to the requirements of Article 403.10(1)(a) above.

403.11 Payment

The work performed and materials furnished as prescribed by this item and measured in accordance with the applicable provisions of "Measurement" above will be paid for as follows.

The quantity to be paid for will be that quantity shown on the contract plans and/or in the Project Manual, regardless of errors in calculations, except as may be modified by the following.

Plan Quantities will be adjusted:

- (1) When a complete structure element has been erroneously included or omitted from the plans, the quantity shown on the plans for that element will be added to or deducted from the plan quantity and included for payment. A complete structure element will be the smallest portion of a total structure for which a quantity is included on the plans. Quantities revised in this manner will not be subject to the provisions contained elsewhere in the contract.
- (2) When the plan quantity for a complete structure element is in error by 5 percent or more, a recalculation will be made and the corrected quantity included for payment. Quantities revised in this manner will not be subject to the provisions contained elsewhere in the contract.
- (3) When quantities are revised by a change in design, the "plan quantity" will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions contained elsewhere in the contract.

The party to the contract requesting the adjustment shall present to the other, a copy of the description and location, together with calculations of the quantity for the structure element involved. When this quantity is certified correct by the Engineer, it will become the revised plan quantity.

Payment for increased or decreased costs due to a change in design on those items measured as "Cubic Yard", "Each", "Square Foot", "Square Yard" or "Linear Foot" will be determined by Change Order. Quantities revised in this manner will be subject to the provisions contained elsewhere in the contract.

The unit prices bid for the various classes of concrete shown shall be full compensation for furnishing, hauling, and mixing all concrete material; placing, finishing and curing all concrete; all grouting and pointing; furnishing and placing drains; furnishing and placing metal flashing strips; furnishing and placing expansion joint material required by this item; and for all forms and false work, labor, tools, equipment and incidentals necessary to complete the work.

(Structure or Structural Component) - Per (Unit Measure).

End

ITEM NO. 404 PNEUMATICALLY PLACED CONCRETE

404.1 Description

This item shall consist of furnishing and placing of "Pneumatically Placed Concrete" for riprap, concrete channel, canal lining, tunnel lining, encasement of designated structural steel members, the covering of designated portions of concrete structures, the repair of deteriorated or damaged concrete and for other miscellaneous construction as indicated.

404.2 Materials

Cement, water and sand shall conform to the requirements of [Item No. 403](#), "Concrete for Structures".

Fine aggregate shall conform to the requirements of [Table 2](#), Grade 1 and coarse aggregate shall conform to the requirements of [Table 1](#), Grade 7, as described in TxDot Standard Specifications Item No. 421 "Portland Cement Concrete", unless otherwise indicated. Air entraining admixtures, retarders and water reducing admixtures, if used, shall comply with [Item No. 405](#), "Concrete Admixtures".

Bar reinforcement and wire fabric reinforcement shall conform to [Item No. 406](#), "Reinforcing Steel".

Expansion joint material shall conform to the requirements of [Item No. 410](#), "Concrete Structures".

Steel drive pins or studs used for the attachment of reinforcing when covering designated portions of concrete structures with pneumatically placed concrete shall be capable of being driven to the specified depth without deforming or otherwise becoming unsuitable for the purpose intended. The pins shall have a minimum diameter of 1/8 inch and a minimum length of 2 inches. Size and location of drive pins or studs and method of attachment of reinforcing shall be as indicated.

The equipment used for driving the pins or studs shall be of the type which uses an explosive for the driving force and shall be capable of inserting the stud or pin to the required depth without damage to the surrounding concrete. The Engineer may require that a test be made of the equipment prior to approving it for use.

Expansion hook bolts, 1/4 inch diameter, shall be placed in a drilled hole of the size and depth recommended by the manufacturer. The Engineer may require that a test be made of the driving equipment for steel drive pins and check the pull out quality of the expansion bolts, prior to approving their use.

404.3 Proportioning and Mixing

The Contractor shall submit a mix design for approval of the Engineer. The basic mix design shall conform to the following:

TABLE 1

Type	*Minimum of 1 Part Cement to	28 Day Compressive Strength Cores
I	4 Parts Aggregate	3600 psi Minimum
II	5 Parts Aggregate	3000 psi Minimum
III	7 Parts Aggregate	2000 psi Minimum

* The Contractor may use a design containing more cement than required by this specification, when approved by the Engineer.

At the time of mixing, the sand shall contain from 3 to 6 percent moisture. When visual inspection indicates that lumps or oversize particles are going into the machine, all materials shall be thoroughly mixed and passed through a ¼ inch sieve before being placed in the machine. The minimum mixing time for each batch shall be not less than 1½ minutes after the sand and cement are in the drum when the drum rotates at a peripheral speed of about 200 feet per minute. Each batch shall be entirely discharged before recharging begins.

The cement and aggregates shall be measured by volume with enough water added to bring the materials to the desired consistency. Test panels will be required prior to approval of the mix design. The concrete will be applied to a plywood panel and shall be a minimum size of 18 inches x 18 inches x 3 inches in depth. The panel will be shot with the same air pressure and nozzle tip to be used for the production work. The panel will be cured in the same manner required for the particular usage required by the contract.

Three 2 inch diameter cores will be taken from each panel and tested in compression at 7 days. The average strength of the cores shall be a minimum of 70 percent of the strengths required in [Table I](#). Testing of cores shall conform to SDHPT Test Method Tex-424-A.

The Engineer may require additional test panels during the progress of the work if there is any change in materials, equipment or nozzle operator.

If, in the opinion of the Engineer, the cylinder strengths are indicating undesirable variation in the concrete, the Contractor may be required to change the mix design and/or method of placing so as to correct this condition.

Mixing and application may be done by either the dry mix or wet mix process. The materials shall be thoroughly and uniformly mixed using a mixer designed for pneumatic concrete application. It may be either a paddle type or drum type mixer. Transit mix concrete may be used for the wet process. No water shall be added to the mix after mixing and before application. Mixed material that has not been used within 45 minutes shall be rejected and no remixing or tempering will be permitted.

All mixing and placing equipment shall be cleaned at regular intervals and be kept in acceptable working condition. The nozzle liner, water and air injection system should be inspected daily and replaced when the parts are worn.

404.4 Construction Methods

(1) Reinforcement

All reinforcement to be embedded in pneumatically placed concrete shall be clean and free from loose mill scale, rust, oil or other coatings which might prevent adequate bond.

Reinforcement shall be secured rigidly in the position indicated. The clear distance between reinforcing bars shall be at least 2½ inches.

Minimum clear distance between forms and reinforcement and for cover shall be as indicated. Space shall be provided for splicing bars in the approved manner.

For the covering of designated portions of concrete structures, welded wire fabric shall be held securely about ¾ inch out from the surface to be covered. Adjacent sheets shall lap at least 6 inches and sheets shall be fastened together securely by tying at intervals not to exceed 18 inches. In placing the wire fabric, steel drive pins spaced at 2 feet on centers each way shall be driven to a penetration of not less than 1 inch or ¼ inch hook bolts installed conforming to manufacturer's recommendation into the face of the designated portion to be covered. The wire fabric shall be fastened securely to each pin or bolt. Any pin that does not reach the desired depth or hook bolt that does not anchor properly in its hole may remain in place but must be supplemented by an additional pin meeting specification requirements. The welded wire fabric shall have a minimum of 1 inch cover to the finished concrete surface.

For the encasement of designated portions of steel structures, the welded wire fabric shall be bent to a template to conform as nearly as possible to the outlines of the steel members to be encased. Holes not less than ½ inch nor more than 1 inch in diameter shall be provided in the webs of the members as near as practicable to the flanges for the purpose of attaching the reinforcing fabric. These holes shall be spaced approximately 3 feet on center. The welded wire fabric shall be held securely about ¾ inch out from the surfaces of the members to be encased. Adjacent sheets shall lap at least 6 inches and sheets shall be fastened together securely by tying at intervals not to exceed 18 inches. In placing the wire fabric, 3/8 inch round rods shall be fastened to the structural steel through the holes provided in the webs of the members to be encased and the fabric shall be tied securely outside to rods. Ties shall be spaced approximately 12 inches on centers. The formed fabric shall conform, insofar as possible, to the shape of the structural member with a space of ¾ inch between the fabric and the faces of the members to be encased.

(2) Existing Structural Steel and Concrete Surfaces

Pneumatically placed concrete for encasing structural steel shall be Type II unless otherwise indicated. All steel and concrete surfaces shall be cleaned thoroughly of all paint, rust, loose mill, scales, grease and such other foreign materials which are likely to prevent adequate bond between the surface to be encased or covered and the pneumatically placed concrete. Structural steel to be encased with pneumatically placed concrete shall not be painted. Concrete

surfaces to be covered with pneumatically placed concrete shall be kept damp a day in advance of application and shall be thoroughly cleaned and washed with water and compressed air just prior to the application.

The encasement concrete shall be given a wood float finish and water cured for 4 days.

(3) Repair of Existing Concrete

A Type I mixture shall be used for structure repair. Deteriorated or loose concrete shall be removed from the areas designated to be repaired or restored within the limits indicated or as designated by the Engineer. Concrete adjacent to a crack shall be removed in such a manner as to leave the existing reinforcing steel throughout the repair area as intact as possible. Concrete and reinforcing steel surfaces which will be in contact with pneumatically placed concrete shall be sandblasted clean, then the surface cleaned of loose material with filtered compressed air.

Exposed areas are to be sprayed with water, followed with another spraying after 10 minutes, then not later than 10 minutes after the second water spray, the repair area or the cavity will be filled with pneumatically placed concrete, tying in the wire mesh as required. A steel edged screed shall be used to cut surface to original lines. A steel trowel shall be used for final finish.

For curing, the repair area shall have a piece of wet cotton mat taped into place cover the repaired area followed with a covering of 4 mil minimum sheet plastic also taped into place. The sheet plastic shall be larger than the mat and shall be continuously taped at the edges with 3 inch minimum width tape (air duct tape or better) to completely enclose the mat and hold in the moisture. After 4 days or longer the mat and cover may be removed.

After the curing period the patches will be tested by striking with a hammer to check for soundness and bond to existing concrete.

(4) Riprap and Ditch Lining

Pneumatically placed concrete for riprap and for channel or canal linings shall be the type indicated. The concrete shall be placed to the limits indicated or as designated by the Engineer. The surface shall be given a wood float finish or a gun finish as directed by the Engineer. Curing of riprap and/or ditch lining shall be by either Type I or II membrane conforming to [Item No. 409](#), "Membrane Curing".

(5) Operating Requirements

The compressor or blower used to supply air shall be capable of delivering a sufficient volume of oil free air at a pressure range of 30 to 85 psi as required by the size of the nozzle employed. Required capacity of compressor and operating pressures are shown in [Table 2](#) for the various nozzle sizes. Steady pressure must be maintained through-out the placing process. The water pump shall be of sufficient size and capacity to deliver the water to the nozzle at a pressure of not less than 15 psi in excess of the required air pressure.

Table 2
COMPRESSOR CAPACITIES

Compressor Capacity Cubic Feet per Minute	Hose Diameter Inches	Maximum Size of Nozzle Tip, Inches	Operating Air Pressure Available, psi
250	1	$\frac{3}{4}$	40
315	1 $\frac{1}{4}$	1	55
365	1 $\frac{1}{2}$	1 $\frac{1}{4}$	55
500	1 $\frac{5}{8}$	1 $\frac{1}{2}$	65
600	1 $\frac{3}{4}$	1 $\frac{5}{8}$	75
750	2	1 $\frac{3}{4}$	85

The values shown in [Table 2](#) are based on a hose length of 150 feet with the nozzle not more than 25 feet above the delivery equipment. Operating pressures shall be increased approximately 5 psi for each additional 50 feet of hose and approximately 5 psi for each 25 feet the nozzle is raised.

(6) Operating Requirements for the Wet Mix Process

The pump shall operate so that the line pressure is between 100 psi and 300 psi for delivery hoses with 1 $\frac{1}{2}$ inch to 3 inch diameters. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain continuous placement. When transit mix concrete is used, this equipment shall conform to [Item No. 403](#), "Concrete for Structures".

(7) Rebound

Rebound material shall not be used.

(8) Construction Joints

Particular care shall be given to the formation of construction joints. Unless otherwise indicated, all joints subject to compressive stress or over existing construction joints shall be square butt joints. Tapered joints will be permitted at other locations except the outside 1 inch shall be perpendicular to the surface.

(9) Placing of Pneumatically Placed Concrete

Proper consistency shall be controlled at the nozzle valve by the operator for the dry mix process and a low water-cement ratio must be maintained. The consistency of the mix and the water shall be controlled by the mixer pump or by the transit mix truck when used for the wet mix process. The mix shall be sufficiently wet to adhere properly and sufficiently dry so that it will not sag or fall from vertical or inclined surfaces or separate in horizontal work.

When encasing structural steel members or covering portions of structures the concrete may be applied in 1 coat; however, if the concrete, after being placed, shows any tendency to sag, it shall be applied in 2 or more coats. Pneumatically placed concrete for overhead work shall be placed in 2 or more coats as may be necessary to insure proper bond and to eliminate sag. In covering vertical surfaces, placing of the concrete shall begin at the bottom and be completed at the top.

The nozzle shall be held at such distance (2 to 4 feet) and position that the stream of flowing concrete shall impinge as nearly as possible at right angles to the surface being covered. Any deposit of loose sand shall be removed prior to placing any original or succeeding layers of pneumatically placed concrete. Should any deposit of loose sand be covered with pneumatically placed concrete, the concrete shall be removed and replaced with a new coat of pneumatically placed concrete after the receiving surface has been properly cleaned.

Before channel or canal lining or riprap is placed, the earth canal or channel slopes shall have been compacted uniformly and thoroughly and brought to a uniform moist condition. The subgrade for lining shall be excavated and fine graded to the required section. The use of forms for lining will not be required. The surfaces of pneumatically placed concrete for both channel lining and riprap shall be finished accurately by hand floating methods before the concrete has attained its initial set.

The original surface and each surface which is permitted to harden before applying succeeding layers, shall be washed with water and air blast or a stiff hose stream and loosened material removed. Sand which rebounds and does not fall clear of the work or which collects on horizontal surfaces shall be blown off from time to time to avoid leaving sand pockets. Concrete shall not be applied to a surface containing frost or ice. Where standing or running water is encountered, it shall be removed before applying the concrete. No work shall be done without the permission of the Engineer when the temperature is lower than 35 F. After placing, the concrete shall be protected from freezing or quick drying.

(10) **Curing**

Pneumatically placed concrete shall be cured conforming to [Item No. 410](#), "Concrete Structures".

(11) **Workmen**

Only experienced foremen, gunmen, nozzle men and rodmen shall be employed and satisfactory written evidence of such experience shall be furnished the Engineer or his representative upon demand.

404.5 Measurement

Measurement of pneumatically placed concrete for encasement of structural steel members, repair and restoration of concrete structures, tunnel linings and miscellaneous structures will be by the square foot, in place, or by the cubic yard of the actual contact area.

Measurement of pneumatically placed concrete for riprap and ditch lining, shall conform to [Item No. 591](#), "Riprap for Slope Protection".

404.6 Payment

Pneumatically placed concrete, measured as provided above, will be paid for at the unit price bid per square foot or cubic yard for "Pneumatically Placed Concrete" of the type specified.

The unit price bid per square foot shall be full compensation for all cement, aggregate, water, reinforcement, furnishing and driving all steel drive pins, for mixing, placing and curing pneumatically placed concrete and for all labor, tools, equipment and incidentals necessary to complete the work. Excavation for channel and canal lining will be paid for conforming to [Item No. 120](#), "Channel Excavation". Shaping and fine grading of channel or canal slopes and floors and excavation required for shaping slopes for headerbanks will not be paid for directly but shall be included in the unit price bid for "Pneumatically Placed Concrete". When headerbanks upon which "Pneumatically Placed Concrete" is to be placed have been built by prior contract, excavation for shaping or slopes will be paid for conforming to [Item No. 401](#), "Structural Excavation and Backfill".

Payment will be made under:

_____Inch Pneumatically Placed Concrete -	Per Square Foot.
Pneumatically Placed concrete	Per Cubic Yard.

End

Ref.: [120](#), [401](#), [403](#), [405](#), [406](#), [409](#), [410](#), [591](#)

ITEM NO. 405 CONCRETE ADMIXTURES

405.1 Description

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

405.2 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.

- (1) **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.
- (2) **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.
- (3) **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.
- (4) **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.
- (5) **High-range Water Reducing Admixtures:** A "High-range Water Reducing Admixture", referred to as a super plasticizer, 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.

- (6) **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.

405.3 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/Developer's work.

405.4 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 [ITEM 403](#) CONCRETE FOR STRUCTURES.

405.5 Measurement and Payment

The requirements of this specifications shall not be measured and paid for directly, but shall be subsidiary to the various bid items in the project manual.

End

Ref.: [403](#)

**ITEM NO. 406
REINFORCING STEEL**

406.1 Description

This item shall consist of the furnishing and placing of reinforcing steel, deformed and smooth, of the size and quantity indicated and in accordance with these specifications.

406.2 Materials

(1) Bars

Bar reinforcement shall be deformed and shall conform to ASTM A 615, A 616, Grades 40, 60 or 75 and shall be open-hearth, basic oxygen or electric furnace new billet steel, unless otherwise indicated. Large diameter new billet steel (Nos. 14 and 18), Grade 75, will be permitted for straight bars only.

Where bending of bar sizes No. 14 or No. 18 of Grades 40 or 60 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM specification. The required bend shall be 90 degrees at a minimum temperature of 60 F around a pin having a diameter of 10 times the nominal diameter of the bar and shall be free of cracking.

Spiral reinforcement shall be either smooth or deformed bars or wire of the minimum diameter indicated. Bars for spiral reinforcement shall comply with ASTM A 675, A 615 or A 617. Wire shall comply with ASTM A 82. The minimum yield strength for spiral reinforcement shall be 40,000 psi.

In cases where the provisions of this item are in conflict with the provisions of the ASTM Designation to which reference is made, the provisions of this item shall govern.

Report of chemical analysis showing the percentages of carbon, manganese, phosphorus and sulphur will be required for all reinforcing steel when it is to be welded, except for drill shafts. No tack welding will be allowed. All welding shall conform to the requirements of AWS D-1-72.

The nominal size and area and the theoretical weight (lbs.) of reinforcing steel bars covered by these specifications are as follows:

Bar Size Number	Nominal Diameter Inches	Nominal Area Square Inches	Weight per Linear 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

continued			
Bar Size Number	Nominal Diameter Inches	Nominal Area Square Inches	Weight per Linear Foot
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	7.65
18	2.257	4.00	13.60

Smooth bars, larger than No. 4, may be steel conforming to the above or may be furnished in any steel that meets the physical requirements of ASTM A 36.

Smooth, round bars shall be designated by size number through No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

(2) **Welded Wire Fabric**

Wire for fabric reinforcement shall be cold-drawn from rods hot-rolled from open-hearth, basic oxygen or electric furnace billet. Wire shall conform to the requirements of the Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A 82 or A 496. Wire fabric, when used as reinforcement, shall conform to ASTM A 185 or A 497.

When wire is ordered by size numbers, the following relation between size number, diameter in inches and area shall apply unless otherwise indicated:

Size W Number	Nominal Diameter (inch)	Nominal Area square inches
31	0.628	0.310
30	0.618	0.300
28	0.597	0.280
26	0.575	0.260
24	0.553	0.240
22	0.529	0.220
20	0.505	0.200
18	0.479	0.180
16	0.451	0.160

continued			
Size W	Number	Nominal Diameter (inch)	Nominal Area square inches
	14	0.422	0.140
	12	0.391	0.120
	10	0.357	0.100
	8	0.319	0.080
	7	0.299	0.070
	6	0.276	0.060
	5.5	0.265	0.055
	5	0.252	0.050
	4.5	0.239	0.045
	4	0.226	0.040
	3.5	0.211	0.035
	3	0.195	0.030
	2.5	0.178	0.025
	2	0.160	0.020
	1.5	0.138	0.015
	1.2	0.124	0.012
	1	0.113	0.010
	0.5	0.080	0.005

Where deformed wire is required, the size number shall be preceded by D and for smooth wire the prefix W shall be shown.

(3) **Chairs and Supports**

Chairs and Supports shall be steel, precast mortar or concrete blocks cast in molds meeting the approval of the Engineer/Architect of sufficient strength to position the reinforcement as indicated when supporting the dead load of the reinforcement, the weight of the workers placing concrete and the weight of the concrete bearing on the steel. Chairs shall be plastic coated when indicated.

Chair Types and Applicable Uses	
Structural or Architectural Elements (columns, beams, walls, slabs) exposed to weather, not subjected to sand blasting, water blasting or grinding.	Galvanized steel or steel chairs with plastic coated feet.
Structural or Architectural Elements exposed to weather and subject to sand blasting, water blasting or grinding.	Stainless steel chairs.
Structural or Architectural Elements not exposed to weather or corrosive conditions.	Uncoated steel chairs
Slabs and grade beams cast on grade.	Steel chairs with a base with 9 inch ² minimum area or sufficient area to prevent the chair from sinking into fill or subgrade. Precast mortar or concrete blocks meeting the requirements of this item may be used.

406.3 Bending

The reinforcement shall be bent cold, true to the shapes indicated. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection.

Unless otherwise indicated, the inside diameter of bar bends, in terms of the nominal bar diameter (d), shall be as follows:

Bends of 90 degrees and greater in stirrups, ties and other secondary bars that enclose another bar in the bend shall be:

Bar Number	Grade 40	Grade 60
3, 4, 5	3d	4d
6, 7, 8	4d	5d

All bends in main bars and in secondary bars not covered above shall be:

Bar Number	Grade 40	Grade 60	Grade 75
3 thru 8	6d	6d	—
9, 10	8d	8d	—
11	8d	8d	8d
14, 18	10d	10d	—

406.4 Tolerances

Fabricating tolerances for bars, from plan dimensions shall not be greater than shown in Figure 1 under 440.4 "Tolerances" contained in TxDot Standard Specification, Item No. 440, "Reinforcing Steel".

406.5 Storing

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel indicated.

406.6 Splices

No splicing of bars, except when indicated or specified herein, will be permitted without written approval of the Engineer. No substitution of bars will be allowed without the approval of the Engineer. Any splicing of substituted bars shall conform to [Table 1](#).

Splices not indicated will be permitted in slabs not more than 15 inches in thickness, columns, walls and parapets, but not included for measurement, subject to the following:

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 1 splice length, with no more than 1 individual bar length less than 10 feet. Splices not indicated, but permitted hereby, shall conform to [Table 1](#). The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.

Table 1
Minimum Lap Requirements

Bar Number	Grade 40	Grade 60
3	1 foot 0 inches	1 foot 0 inches
4	1 foot 2 inches	1 foot 9 inches
5	1 foot 5 inches	2 feet 2 inches
6	1 foot 9 inches	2 feet 7 inches
7	2 feet 4 inches	3 feet 5 inches
No. 8	3 feet 0 inches	4 feet 6 inches
No. 9	3 feet 10 inches	5 feet 8 inches
No. 10	4 feet 10 inches	7 feet 3 inches
No. 11	5 feet 11 inches	8 feet 11 inches

Spiral steel shall be lapped a minimum of 1 turn. Bar No. 14 and No. 18 may not be lapped.

Welding of reinforcing bars may be used only where indicated or as permitted herein. All welding operations, processes, equipment, materials, workmanship and inspection shall conform to the requirements indicated. All splices shall be of such dimension and character as to develop the full strength of the bar being spliced.

End preparation for butt welding reinforcing bars shall be done in the field, except Bar No. 6 and larger shall be done in the shop. Delivered bars shall be of sufficient length to permit this practice.

For box culvert extensions with less than 1 foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in [Table 1](#). For box culvert extensions with more than 1 foot of fill, a minimum lap of 6 inches will be required.

Unless otherwise indicated, dowel bars transferring tensile stresses shall have a minimum embedment equal to the minimum lap requirements shown in [Table 1](#). Shear transfer dowels shall have a minimum embedment of 12 inches.

406.7 Placing

Reinforcement shall be placed as near as possible in the position indicated. Unless otherwise indicated, dimensions shown for reinforcement are to the centers of the bars. In the plane of the 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 ¼ inch. Cover of concrete to the nearest surface of steel shall be as follows:

	Minimum Cover, Inches
(a) Concrete cast against and permanently exposed to earth	3
(b) Concrete exposed to earth or weather:	
Bar No. 6 through 18 bars	2
Bar No. 5, W31 or D31 wire and smaller	1½
(c) Concrete not exposed to weather or in contact with ground:	
Slabs, walls, joists:	
Bar No. 14 and 18	1½
Bar No. 11 and smaller	1
Beams, columns:	
Primary reinforcement, ties, stirrups, spirals	1½
Shells, folded plate members:	
Bar No. 6 and larger	1
Bar No. 5, W31 or D31 wire, and smaller	1

Vertical stirrups shall always pass around the main tension members and be attached securely thereto. The reinforcing steel shall be spaced its required distance from the form surface by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers or approved precast mortar or concrete blocks. For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.

All reinforcing steel shall be tied at all intersections, except that where spacing is less than 1 foot in each direction, alternate intersections only need be tied. For reinforcing steel cages for other structural members, the steel shall be tied at enough intersections to provide a rigid cage of steel. Mats of wire fabric shall overlap each other 1 full space as a minimum to maintain a uniform strength and shall be tied at the ends and edges.

Where prefabricated deformed wire mats are specified or if the Contractor requests, welded wire fabric may be substituted for a comparable area of steel reinforcing bar plan, subject to the approval of the Engineer.

A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases and when specifically authorized by the Engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2½ inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required and the surface to be placed adjacent to the forms shall be a true plane, free of surface imperfections.

Reinforcement shall be supported and tied in such a manner that a sufficiently rigid cage of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the above.

No concrete shall be deposited until the Engineer has reviewed the placement of the reinforcing steel and all mortar, mud, dirt, etc, shall be cleaned from the reinforcement, forms, workers' boots and tools.

406.8 Measurement

The measurement of quantities of reinforcement furnished and placed will be based on the calculated weight of the steel actually placed as indicated, with no allowance made for added bar lengths for splices requested by the Contractor nor for extra steel used when bars larger than those indicated or with a higher grade of steel are substituted with the permission of the Engineer. Tie wires and supporting devices will not be included in the calculated weights. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in this item.

Measurement required by a change in design will be computed as described above for the actual steel required to complete the work.

406.9 Payment

This item shall be paid for at the unit price bid per pound of "Reinforcing Steel", which price shall be full compensation for furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

Reinforcement in items specifically including the reinforcement shall not be paid for directly, but shall be included in the unit price bid for the items of construction in which the reinforcing steel is used.

Payment, when included as a contract pay item, will be made under:

Reinforcing Steel - Per Pound.

End

ITEM NO. 407 FIBROUS CONCRETE

407.1 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.

407.2 Materials

(1) Concrete

All concrete shall conform to the requirements of [Item 403](#), "Concrete for Structures".

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

(2) 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 ksi. The lengths of the fibrous material shall be ½, ¾, 1½ and 2 inches in length.

Unless otherwise shown on the plans, each cubic yard of concrete shall contain no less than 1½ pounds of fibrous material. The fibrous material shall be added to the concrete mix at the time the mix is batched.

407.3 Excavation, Placing of Concrete, Finishing, Curing and Backfill

All excavation, placing of concrete, finishing, curing and backfilling shall be in accordance with the [Item 401](#), "Structural Excavation and Backfill", and [Item 410](#), "Concrete Structures".

407.4 Measurement

The quantities of concrete of the various classes which constitute the completed and accepted work in place will be measured by the cubic yard, each, square foot or linear foot as indicated in the Project Manual. Measurement will be as follows:

- (1) Plan Quantity.** For those items measured for plan quantity payment, adequate calculations have been made. No additional measurements or calculations will be made.
- (2) Measured in Place.** For those items not measured for Plan Quantity payment, measurement will be made in place. However, field measured dimensions shall not exceed those indicated on the plans or as may have been directed by the Engineer in writing.

407.5 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid for Fibrous Concrete of the class specified, which price shall be full compensation furnishing, hauling and mixing all materials; placing, finishing and curing all concrete; and for all forms, labor, tools, equipment and incidentals necessary to complete the work.

Fibrous Concrete, (Class specified) - Per (Unit Measure).

END

Applicable References:

Standard Specifications: Item Nos. [401](#), [403](#), [410](#)

**ITEM NO. 408
CONCRETE JOINT MATERIALS**

408.1 Description

This item shall govern for the furnishing and placing of all longitudinal, contraction and expansion joint material in concrete work as herein specified in the various items of these specifications as indicated or as directed by the Engineer.

408.2 Materials

(1) Preformed Asphalt Board

Preformed asphalt board formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and meeting the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751.

(2) Preformed Nonbituminous Fiber Material

Preformed nonbituminous fiber material shall meet the requirements of the Standard Specifications for the Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(3) Boards

Boards obtained from Redwood timber, of sound heartwood, free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler.

(4) Joint Sealer (Concrete Pavement)

This material shall be a one part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air and shall have the following properties:

As Supplied	
Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 maximum
Working Time, minutes	10
Tack-Free Time at 77 F± 2F Min. MIL-2-8802D Sec. 4.8.7	60
Cure time, at 77F (25C), days	7-14
Full Adhesion, days	14-21

As Supplied - continued	
As Cured---after 7 days at 77 F (25C) and 40% RH	
Elongation, percent minimum	1200
Durometer Hardness, Shore A, points ASTM 2240	15
Joint Movement Capability, percent	+100/-50
Tensile Strength, maximum elongation, psi	100
Peel Strength, psi	25

The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperature.

(5) **Backer Rod**

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement and shall be used with joint sealer.

(6) **Joint Sealing Material**

Joint Sealing Material for other than pavement use may be a two-component, synthetic polymer or cold-pourable, self leveling type meeting the following requirements:

The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. It shall cure sufficiently at an average temperature of 77±3F so as not to pick up under wheels of traffic in a maximum of 3 hours.

Performance Requirements:

When tested in accordance with Test Method Tex-525-C, the joint sealing material shall meet the above curing times and the requirements as follows:

It shall be of such consistency that it can be mixed and poured or mixed and extruded into joints at temperatures above 60 F.

Penetration 77F.150 gm. Cone, 5 sec., max.-cm	0.90
Bond and Extension 75%, 0F, 5 cycles: Dry Concrete Blocks	Pass
Wet Concrete Blocks	Pass
Steel Blocks (Primed if specified by manufacturer)	Pass
Flow at 200 F	None
Water content % by weight, max.	5.0
Resilience:	
Original sample min. % (cured)	50
Oven-aged at 158 F. min. %	50
For Class 1-a material only	
Cold Flow (10 min.)	None

408.3 Construction Methods

The Contractor shall install "Concrete Joint Materials" which will function as a compatible system. Joint sealer shall not be placed where a bond braker is present.

Asphalt, Redwood board or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of ½ inch thick or as indicated. Wood materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer's recommendations.

The material used for side walk expansion joints shall conform to 408.2 (3) above, unless otherwise indicated.

The material used for curb and gutter expansion joints filler shall conform to any in 408.2 above, except when placed adjacent to concrete pavement, the joint material shall match the pavement joint material.

408.4 Measurement and Payment

No additional compensation will be made for materials, equipment or labor required by this item, but shall be considered subsidiary to the various items included in the contract.

End

ITEM NO. 409 MEMBRANE CURING

409.1 Description

This item shall consist of curing concrete pavement, concrete base, pavement, curbs, gutters, retards, sidewalks, driveways, medians, islands, concrete riprap, cement stabilized riprap, concrete structures and other concrete as indicated by applying an impervious liquid membrane forming material.

409.2 Material

The liquid forming membrane curing compound shall comply with the "Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete", ASTM C 309, Type 1-D clear or translucent, with fugitive dye or Type 2 white pigmented. The material shall have a minimum flash point of 80 F when tested by the "Pensky-Martin Closed Tester", ASTM D 93.

It shall be of such consistency that it can be satisfactorily applied as a fine mist through an atomizing nozzle by means of approved pressure spraying equipment at atmospheric temperatures above 40 F.

It shall be of such nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete or its components. Type 1 compound shall contain a fugitive dye that will be distinctly visible not less than 4 hours nor more than 7 days after application.

Type 2 compound shall not settle out excessively or cake in the container and shall be capable of being mixed to a uniform consistency by moderate stirring and shall exhibit a daylight reflectance of not less than 60 percent of that of magnesium oxide when tested as indicated.

The compound shall produce a firm, continuous, uniform moisture impermeable film, free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. When applied to the damp concrete surface at the rate of coverage indicated, the compound shall dry to the touch in not more than 4 hours and shall not be tacky or track off concrete after 12 hours.

It shall adhere to horizontal and vertical surfaces in a tenacious film and shall not run off or show an appreciable sag, disintegrate, check, peel or crack during the required curing period.

Under traffic, the compound shall not pick up or peel and shall gradually disintegrate from the surface.

The compound shall be delivered to the job only in the manufacturer's original containers, which shall be clearly labeled with the manufacturer's name, the trade name of the material and a batch number or symbol with which test samples may be correlated.

The water retention test shall be in accordance with the following:

Percentage loss shall be defined as the water lost after the application of the curing material was applied. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the following:

24 hours after application	2 percent
72 hours after application	4 percent

409.3 Construction Methods

The membrane curing compound shall be applied after the surface finishing has been completed and immediately after the free surface moisture has disappeared. The surface shall be sealed with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the manufacturer and directed by the Engineer, but not less than 1 gallon per 180 square feet of area. The Contractor shall provide satisfactory means and facilities to properly control and check the rate of application of the compound.

The compounds shall not be applied to a dry surface, but shall be applied just after free moisture has disappeared.

The compound shall be thoroughly agitated during its use and shall be applied by means of approved mechanical power pressure sprayers for street and bridge applications. The sprayers used to apply the membrane to concrete exposed surfaces shall travel at a uniform speed along the forms and be mechanically driven. The equipment shall be of such design that it will insure uniform and even application of the membrane material. The sprayers shall be equipped with satisfactory atomizing nozzles. On small miscellaneous items, the Contractor be permitted to use hand-powered spray equipment. For all spraying equipment, the Contractor shall provide facilities to prevent the loss of the compound between the nozzle and the concrete surface during the spraying operations.

At locations where the coating shows discontinuities, pinholes or other defects or if rain falls on the newly coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately at the same rate of coverage specified herein.

To insure proper coverage, the Engineer shall inspect all treated areas after application of the compound for the period of time designated in the specification for curing, either for membrane curing or for other methods. Dry areas are identifiable because of the lighter color of dry concrete as compared to damp concrete. All suspected areas shall be tested by placing a few drops of water on the suspected areas. If the water stands in rounded beads or small pools which can be blown along the surface of the concrete without wetting the surface, the water impervious film is present. If the water wets the surface of the concrete as determined by obvious darkening of the surface or by visible soaking into the surface, no water-impervious film is present. Should the foregoing test indicate that any area during the curing period is not protected by the required water-

impervious film an additional coat or coats of the compound shall be applied immediately and the rate of application of the membrane compound shall be increased until all areas are uniformly covered by the required water-impervious film.

The compounds shall not be applied to a dry surface and if the surface of the concrete has become dry, it shall be thoroughly moistened prior to the application of the membrane by fogging or mist application. Sprinkling or coarse spraying will not be allowed.

When temperatures are such as to warrant protection against freezing, curing by this method shall be supplemented with an approved insulating material capable of protecting the concrete for the specified curing period.

If at any time there is reason to believe that this method of curing is unsatisfactory or is detrimental to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one of the other methods specified under the specifications.

Curing compounds shall be compatible with the adhesion of toppings or overlays where curing has been applied to the concrete base surface in order to assure adequate bond.

When forms are stripped before the 4 minimum curing days have passed, curing shall continue by an approved method.

409.4 Measurement and Payment

Membrane curing will not be measured for payment. The work and materials prescribed herein will not be paid for directly, but shall be included in the unit price bid for the item of construction in which these materials are used.

End

ITEM NO. 410 CONCRETE STRUCTURES

410.1 Description

This item shall consist of the construction of all types of structures involving the use of structural concrete, except where the requirements are waived or revised by other governing specifications.

All concrete structures shall be constructed in accordance with the design requirements and details indicated, in conformity with the pertinent provisions of the items contracted for, the incidental items referred to and in conformity with the requirements herein.

410.2 Materials

(1) Concrete

Concrete shall conform to [Item No. 403](#), "Concrete for Structures".

The class of concrete for each type of structure or unit shall be as indicated or by pertinent governing specifications.

(2) Expansion Joint Material

(a) Preformed Fiber Material

Fiber material shall conform to [Item No. 408](#), "Concrete Joint Materials".

(b) Joint Sealing Material

Sealants shall conform to [Item No. 408](#), "Concrete Joint Materials".

(c) Asphalt Board

Asphalt Board shall conform to [Item No. 408](#), "Concrete Joint Materials".

(d) Rebonded Neoprene Filler

Rebonded neoprene filler shall consist of ground closed cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions indicated.

Filler material shall have the following physical properties and shall meet the requirements of ASTM D 1752, Type where applicable:

Property	Method	Requirements
Color		Black
Density	ASTM D 1752 Type 1	40 PCG Minimum
Recovery	ASTM D 1752 Type 1	90% Minimum
Compression	ASTM D 1752 Type 1	50 to 500 psi
Extrusion	ASTM D 1752 Type 1	0.25 In. Maximum
Tensile strength	ASTM D 1752 Type 1	20 psi Minimum
Elongation		75% Minimum

The manufacturer shall furnish the Engineer with certified test results as to the compliance with the above requirements and a 12 inch x 12 inch x 1 inch sample from the shipment for approval.

(3) Waterstop

Unless otherwise indicated, copper waterstop shall be 16-ounce material conforming to [Item No. 720](#), "Metal for Structures". Rubber waterstops or Polyvinyl Chloride (PVC) waterstops shall conform to [Item No. 438](#), "Elastomeric Materials".

(4) Curing Materials

Curing materials shall conform to [Item No. 409](#), "Membrane Curing", except curing of bridge decks and the top of direct traffic culverts shall be cured with Type I (Resin Base) curing compound only.

(5) Admixtures

Retarding, water reducing and air entraining agents shall comply with [Item No. 405](#), "Concrete Admixtures".

410.3 General Requirements

Before starting work, the Contractor shall inform the Engineer fully of the construction methods he proposes to use, the adequacy of which shall be subject to the review by the Engineer. Plans for forms and falsework for piers and superstructure spans over 20 feet long and for all widening details shall be submitted to the Engineer for review, if requested. Similar plans shall be submitted for other units of the structure, if requested by the Engineer. The plans shall be prepared on standard 24 inch by 36-inch sheets and shall show all essential details of the proposed forms, falsework and bracing to permit a structural analysis. Four sets of such plans will be required.

Concurrence on the part of the Engineer in any proposed construction methods, approval of equipment or of form and falsework plans does not relieve the Contractor of the responsibility for the safety or correctness of his methods and adequacy of his equipment or from carrying out the work in full accordance with the contract.

Unless otherwise indicated, the requirements in the succeeding paragraphs shall govern the time sequence in which construction operations may be carried on and for the opening of completed structures to traffic:

Superstructure members, forms, falsework or erection equipment shall not be placed on the substructure before the concrete therein has attained a 500 psi flexural strength.

Storage of materials on completed portions of a structure will not be permitted until all curing requirements for those particular portions have been met.

No forms shall be erected on concrete footings supported by piling or drilled shafts until the concrete therein has attained a minimum flexural strength of 400 psi. Such work may begin on spread footings after the therein has aged at least 2 curing days. Concrete may be placed as soon as the forms and reinforcing steel are approved.

The support of tie beam and/or forms by falsework placed on previously placed tie beams is permissible provided such beams have attained 500 psi flexural strength, curing requirements are completed and the beams are properly supported to eliminate stresses not provided for in the design.

Bridges and direct traffic culverts shall not be opened to construction traffic or to the traveling public until authorized by the Engineer in accordance with the following:

Authorization may be given after the last slab concrete has been in place at least 14 days for light construction traffic not to exceed a 3/4-ton vehicle.

Authorization to place embankments to allow normal construction traffic and when necessary to the traveling public, may be given after the last slab concrete has been in place 30 days or when the minimum compressive strength (f_c') has reached the 28 day strength conforming to [Item No. 403](#), "Concrete for Structures" or as indicated.

410.4 Drains

Weep holes and roadway drains shall be installed and constructed as indicated.

410.5 Expansion Joints

Joints and devices to provide for expansion and contraction shall be constructed where and as indicated.

The bearing area under the expansion ends of concrete slabs and slab and girder spans shall be given a steel trowel finish and finished to the exact grades required. The material used to separate expansion surfaces shall be as indicated and placed so that concrete or mortar cannot be subsequently worked around or under it.

Concrete adjacent to armor joints and finger joints shall be placed carefully to avoid defective anchorage and porous or honeycombed concrete in such areas.

All open joints and joints to be filled with expansion joint material shall be constructed using forms adaptable to loosening or early removal. To avoid expansion or contraction damage to the adjacent concrete, these forms shall be loosened as soon as possible after final concrete set to permit free movement of the span without requiring full form removal.

Preformed fiber joint material or other material indicated shall be used in the vertical joints of the roadway slab, curb, median or sidewalk. The top 1-inch thereof shall be filled with joint sealing material, as specified herein. When different material is indicated it shall be used.

Prior to placing the sealing material, the vertical faces of the joint shall be cleaned of all laitance by sandblasting or by mechanical routing. Cracked or spalled edges shall be repaired. The joint shall be blown clean of all foreign material and sealed.

Where preformed fiber joint material is used, it shall be anchored to the concrete on one side of the joint by light wire or nails to prevent the material from falling out.

Finished joints shall conform to the plan details with the concrete sections completely separated by the specified opening or joint material.

Soon after form removal and again where necessary after surface finishing, all projecting concrete shall be removed along exposed edges to secure full effectiveness of the expansion joints.

410.6 Construction Joints

The joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. The term monolithic placement shall be interpreted to mean that the manner and sequence of concrete placing shall not create construction joints.

Construction joints shall be of the type and at the locations indicated. Additional joints will not be permitted without written authorization from the Engineer and when authorized, shall have details equivalent to those indicated for joints in similar locations.

Unless otherwise provided, construction joints shall be square and normal to the forms. Bulkheads shall be provided in the forms for all joints, except when horizontal. All vertical construction joints shall be chamfered. All horizontal construction joints shall be routed or grooved.

Construction joints requiring the use of joint sealing material shall be as indicated or as directed by the Engineer. The material will be indicated on the plans without reference to joint type.

A concrete placement terminating at a horizontal construction joint shall have the top surface roughened thoroughly as soon as practicable after initial set is attained. The surfaces at bulkheads shall be roughened as soon as the forms are removed.

The hardened concrete surface shall be thoroughly cleaned of all loose material, laitance, dirt or foreign matter and saturated with water so it is moist when placing fresh concrete against it. Forms shall be drawn tight against the existing concrete and the joint surface flushed with grout just prior to placing the fresh concrete.

410.7 Foundation

Excavation for foundations shall conform to [Item No. 401](#), "Structural Excavation and Backfill".

Concrete for foundation seals, unless otherwise indicated on the Drawings, shall be Class C Concrete with a coarse aggregate grade of 2, 3, 4 or 5 and placed in accordance with the requirements herein. The top of the completed seal shall not vary from plan grade or the grade established by the Engineer or designated representative.

Where a concrete seal is indicated on the Drawings, the design will be based on the normal water elevation as indicated on the Drawings. If the foundation concrete can be placed in a dry excavation at the time of construction, the seal will not be required. If additional seal is necessary for the conditions existing during the time of construction, its thickness shall be increased as deemed necessary by the Contractor and at his expense. If the conditions existing at the time of construction require a seal for placing the foundation concrete in a dry excavation and none is indicated, the Contractor shall place an adequate seal at his expense.

The seal shall be allowed to set for at least 36 hours before the caisson or cofferdam is dewatered, after which the top of the seal shall be cleaned of all laitance or other soft material and all high spots exceeding the above limitation shall be cut off and removed.

410.8 Falsework

The Contractor is totally responsible for all falsework. He shall design and construct to safely carry the maximum anticipated loads and to provide the necessary rigidity. Details of falsework construction shall be subject to review by the Engineer, but Engineer's review shall in no way relieve the Contractor of responsibility of the adequacy and safety of the falsework design.

All timber used in falsework shall be sound, in good condition and free from defects which will impair its strength. When wedges are used to adjust falsework to desired elevations, they shall be used in pairs to insure even bearing.

Sills or grillages shall be large enough to support the superimposed load without settlement and unless founded on solid rock, shale or other hard materials, precautions shall be taken to prevent yielding of the supporting material.

Falsework, which cannot be founded on a satisfactory spread footing, shall be placed on piling driven to a bearing capacity sufficient to support the superimposed load without settlement. The safe bearing capacity of piling shall be determined by test loads or by such other methods that may be required or acceptable to the Engineer.

In general, each falsework bent shall be capped transversely by a member of proper size. A short cap section forming a T-head may be substituted to permit the removal of portions of the forms without disturbing the falsework. Caps shall be securely fastened to each pile or column in the bent and set at the proper elevation to produce, in conjunction with the use of approved wedges or jacks, permanent camber indicated, plus a construction camber covering allowance for deformation of the forms and falsework. The use of wedges to compensate for incorrectly cut bearing surfaces will not be permitted. Each falsework bent shall be securely braced to provide the stiffness required with the bracing securely fastened to each pile or column it crosses.

In setting falsework for arches, allowances shall be made for settlement of falsework, deflection of the arch and permanent camber. Provision shall be made by suitable

wedges, sand jacks or other acceptable devices for the controlled lowering of falsework when the arch is swung. Falsework may be required to be placed on jacks to provide for settlement correction during concrete placement.

When the falsework is no longer required, it shall be removed. Falsework piling shall be pulled or cut off not less than 6 inches below finished ground level. Falsework and piling in a stream, lake or bay shall be completely removed to a point specified by the Engineer to prevent any obstruction to the waterway.

410.9 Forms

Forms for precast prestressed concrete members and for prestressed piling shall be constructed conforming to [Item No. 425](#), "Prestressed Concrete Structures".

(1) General

Except where otherwise indicated, forms may be of either timber or metal.

Forms for round columns exposed to view shall be of steel, except that other materials will be allowed with written permission of the Engineer.

Forming plans shall be submitted for approval. Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. For job-fabricated forms an additional live load of 50 pounds per square foot shall be allowed on horizontal surfaces. The maximum unit stresses shall not exceed 125 percent of the allowable stresses used by the Owner for the design of structures.

Commercially produced structural units used in formwork shall not exceed the manufacturer's maximum allowable working load for moment, shear or end reaction. The maximum working load shall include a live load of 35 pounds per square foot of horizontal form surface and sufficient details and data shall be submitted for use in checking formwork details for approval.

Forms shall be practically mortar-tight, rigidly braced and strong enough to prevent bulging between supports and maintained to the proper line and grade during concrete placement. Forms shall be maintained in a manner that will prevent warping and shrinkage.

Deflections due to cast-in-place slab concrete and railing shown in the dead load deflection diagram shall be taken into account in the setting of slab forms.

All forms and footing areas shall be cleaned of any extraneous matter before placing concrete.

Permission to place concrete will not be given until all of such work is complete to the satisfaction of the Engineer.

If, at any stage of the work, the forms show signs of bulging or sagging, the portion of the concrete causing such condition shall be removed immediately, if necessary and the forms shall be reset and securely braced against further movement.

(2) Timber Forms

Lumber for forms shall be properly seasoned, of good quality and free from imperfections, which would affect its strength or impair the finished surface of the concrete. The lumber used for facing or sheathing shall be finished on at least 1 side and 2 edges and shall be sized to uniform thickness.

Form lining will be required for all formed surfaces, except for the inside of culvert barrels, inlets, manholes and box girders, the bottom of bridge decks between beams or girders, surfaces that are subsequently covered by backfill material or are completely enclosed and any surface formed by a single finished board. Lining will not be required when plywood forms are used.

Form lining shall be of an approved type such as masonite or plywood. Thin membrane sheeting such as polyethylene sheets shall not be used for form lining.

Forms may be constructed of plywood not less than 1/2 inch in thickness, with no form lining required. The grain of the face plies on plywood forms shall be placed parallel to the span between the supporting studs or joists.

Plywood used for forming surfaces, which remain exposed, shall be equal to that specified as B-B Plyform Class I or Class II Exterior of the U.S. Department of Commerce, National Bureau of Standards, U.S. Product Standard, latest edition.

Forms or form lumber to be reused shall be maintained clean and in good condition. Any lumber which is split, warped, bulged, marred or has defects that will produce inferior work shall not be used and if condemned, shall be promptly removed from the work.

Studs and joists shall be spaced so that the facing form material remains in true alignment under the imposed loads.

Wales shall be spaced close enough to hold forms securely to the designated lines and scabbed at least 4 feet on each side of joints to provide continuity. A row of wales shall be placed near the bottom of each placement.

Facing material shall be placed with parallel and square joints and securely fastened to supporting studs.

Forms for surfaces receiving only an ordinary finish and exposed to view shall be placed with the form panels symmetrical, i.e., long dimensions set in the same direction. Horizontal joints shall be continuous.

Molding specified for chamfer strips or other uses shall be made of materials of a grade that will not split when nailed and which can be maintained to a true line without warping. Wood molding shall be mill cut and dressed on all faces. Unless otherwise indicated, forms shall be filleted at all sharp corners and edges with triangular chamfer strips measuring 3/4 inch on the sides.

Forms for railings and ornamental work shall be constructed to standards equivalent to first class millwork. All moldings, panel work and bevel strips shall be straight and true with neatly mitered joints designed so the finish work is true,

sharp and clean cut. All forms shall be constructed to permit their removal without marring or damaging the concrete. The forms may be given a slight draft to permit ease of removal.

Metal form ties of an approved type or a satisfactory substitute shall be used to hold forms in place and shall be of a type that permits ease of removal of the metal as hereinafter specified.

All metal appliances used inside of forms for alignment purposes shall be removed to a depth of at least 1/2 inch from the concrete surface. They shall be made so the metal may be removed without undue chipping or spalling and when removed, shall leave a smooth opening in the concrete surface. Burning off of rods, bolts or ties will not be permitted.

Any wire ties used shall be cut back at least 1/2 inch from the face of the concrete and properly patched.

Devices holding metal ties in place shall be capable of developing the strength of the tie and adjustable to allow for proper alignment.

Metal and wooden spreaders, which are separate from the forms, shall be removed entirely as the concrete is being placed.

Adequate clean-out openings shall be provided for narrow walls and other locations where access to the bottom of the forms is not readily attainable.

Prior to placing concrete, the facing of all forms shall be treated with oil or other bond breaking coating of such composition that it will not discolor or otherwise injuriously affect the concrete surface. Care shall be exercised to prevent coating of the reinforcing steel.

(3) Metal Forms

The foregoing requirements for timber forms as regards design, mortar-tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse and wetting shall also apply to metal forms, except that these will not require lining, unless specifically indicated.

The thickness of form metal shall be as required to maintain the true shape without warping or bulging. All bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms, which do not present a smooth surface or line up properly, shall not be used. Metal shall be kept free from rust, grease or other foreign materials.

(4) Form Supports for Overhang Slabs

Form supports which transmit a horizontal force to a steel girder or beam or to a prestressed concrete beam will be permitted, but shall not be used unless a structural analysis has been made of the affect on the girder or beam and approval is granted by the Engineer.

When overhang brackets are used on prestressed concrete beams, the following shall apply:

- (a) In normal spans or in spans skewed not more than 15 degrees, overhang brackets may be used to support standard slab overhangs of widths not exceeding 3 feet, 1 1/2 inches without additional support or bracing, when Type A, B, C and Type IV beams are used. When the 15-degree skew angle is exceeded, additional support shall be provided by welding No. 5 reinforcing bars to the stirrups of the exterior beam and adjacent interior beam. Such bars shall be approximately 1 1/2 inches above the bottom of the slab and spaced not more than 5 feet, center to center.
- (b) In normal or skewed spans with standard overhangs not exceeding 3 feet, 1 1/2 inches, additional support shall be provided using No. 5 bars as specified above and in addition, braces or struts, equivalent in size to a 4 inch x 4 inch timber, shall be wedged between the bottom flanges of the exterior and adjacent interior beam and spaced not more than 15 feet between struts or struts and permanent diaphragms, when TxDoT Size 48 inch through 72 inch beams are used.
- (c) Spans in which the overhang width exceeds 3 feet, 1 1/2 inches will require additional support for the outside beams to resist torsion. Details of the Contractor's proposed method of providing additional support shall be included with the slab forming plans submitted to the Engineer for review and approval.
- (d) To counteract torsion effects, diaphragm concrete shall be placed and cured and the diaphragm bars tightened prior to slab placing.

Holes in steel members for support of overhang brackets may be punched or drilled full size or may be torch cut to 1/4 inch under size and reamed full size. In no case shall the holes be burned full size. The hole shall be left open unless indicated to be filled with a button head bolt. They shall never be filled by welding.

410.10 Placing Reinforcement

Reinforcement in concrete structures shall be placed carefully and accurately and rigidly supported as provided in [Item No. 406](#), "Reinforcing Steel". Reinforcing steel supports shall not be welded to I-beams or girders or stirrups of prestressed concrete beams.

410.11 Placing Concrete, General

The minimum temperature of all concrete at the time of placement shall not be less than 50 F. The maximum temperature of any concrete, unless otherwise indicated, shall not exceed 95 F when placed. The maximum temperature of cast-in-place concrete in bridge superstructures, diaphragms, parapets, concrete portions of railing, curbs and sidewalks and direct traffic box culverts shall not exceed 85 F when placed. Other portions of structures, when indicated, shall require the temperature control specified.

For continuous placement of the deck on continuous steel units, the initial set of the concrete shall be retarded sufficiently to insure that it remains plastic in not less than 3 spans immediately preceding the one being placed. For simple spans, retardation shall be required only if necessary to complete finishing operations.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finishing, the required water shall be applied to the surface by fog spray only and shall be held to a minimum amount. Fog spray for this purpose may be applied with hand operated fogging equipment.

The height of free fall of concrete shall be limited to 3 - 4 feet to prevent segregation.

The maximum time interval between the addition of cement to the batch and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature whichever is higher	Maximum Time
Non-agitated Concrete	
35°F to 79°F	30 minutes
Over 80°F	15 minutes
Agitated Concrete	
90°F or above	45 minutes
75°F to 89°F	60 minutes
35°F to 74°F	90 minutes

The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for bridge decks, top slabs of direct traffic culverts and cased drilled shafts and 1 hour for all other concrete except that the maximum time shall not exceed 30 minutes for non-agitated concrete.

From the time of initial strike off until final finish is completed and required interim curing is in place, the unformed surfaces of slab concrete in bridge decks and top slab of direct traffic culverts and concrete slabs, shall be kept damp, not wet, to offset the effects of rapid evaporation of mixing water from the concrete due to wind, temperature, low humidity or combinations thereof. Fogging equipment capable of applying water in the form of a fine fog mist, not a spray, will be required. Fogging will be applied at the times and in the manner directed by the Engineer.

Fogging equipment may be either water pumped under high pressure or a combination of air and water, either system in combination with a proper atomizing nozzle. The equipment shall be sufficiently portable for use in the direction of any prevailing winds. The equipment shall be adapted for intermittent use to prevent excessive wetting of the surfaces.

Upon completion of the final finish, interim curing will be required for slab concrete in bridge decks and top slabs of direct traffic culverts as follows:

- (1) Required water curing shall begin as soon as it can be done without damaging the concrete finish.
- (2) Unless otherwise indicated, Type 1 membrane curing compound (Resin Base Only) shall be applied to the slab surface.

The Contractor shall give the Engineer sufficient advance notice before placing concrete in any unit of the structure to permit the review of forms, reinforcing steel placement and other preparations. Concrete shall not be placed in any unit prior to the completion of formwork and placement of reinforcement therein.

Concrete mixing, placing and finishing shall be done in daylight hours, unless adequate provisions are made to light the entire placement site.

Concrete placement will not be permitted when impending weather conditions will impair the quality of the finished work. If rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work. If conditions of wind, humidity and temperature are such that concrete cannot be placed without cracking, concrete placement shall be done in the early morning or at night.

The sequence for placing concrete shall be as indicated or as required herein. The placing shall be regulated so the pressures caused by the plastic concrete shall not exceed the loads used in the form design.

The method of handling, placing and consolidation of concrete shall minimize segregation and displacement of the reinforcement and produce a uniformly dense and compact mass. Concrete shall not have a free fall of more than 4 feet, except in the case of thin wall sections. Any hardened concrete spatter ahead of the plastic concrete shall be removed.

The method and equipment used to transport concrete to the forms shall be capable of maintaining the rate of placement. Concrete may be transported by buckets, chutes, buggies, belt conveyers, pumps or other acceptable methods.

When belt conveyers or pumps are used, sampling for testing will be done at the discharge end. Concrete transported by conveyers shall be protected from sun and wind, if necessary, to prevent loss of slump and workability. Pipes through which concrete is pumped shall be shaded and/or wrapped with wet burlap, if necessary, to prevent loss of slump and workability. Concrete shall not be transported through aluminum pipes, tubes or other aluminum equipment. The coarse aggregate content of the concrete shall be within the limits specified in [Item No. 403](#), "Concrete for Structures".

Chutes, troughs, conveyers or pipes shall be arranged and used so that the concrete ingredients will not be separated. When steep slopes are necessary, the chutes shall be equipped with baffle boards or made in short lengths that reverse the direction of movement or the chute ends shall terminate in vertical downspouts. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in them. All transporting equipment shall be kept clean and free from hardened concrete coatings. Water used for cleaning shall be discharged clear of the concrete.

Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point and running or working it along the forms will not be allowed.

Concrete shall be deposited in the forms in layers of suitable depth but not more than 36 inches in thickness, unless otherwise directed by the Engineer.

The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete without a cold joint. Not more than 1 hour shall elapse between adjacent or successive placements of concrete. Unauthorized construction joints shall be avoided by placing all concrete between the authorized joints in one continuous operation.

An approved retarding agent shall be used to control stress cracks and/or authorized cold joints in mass placements where differential settlement and/or setting time may induce stress cracking, such as on false work, in deep girder stems, etc.

Openings in forms shall be provided, if needed, for the removal of laitance or foreign matter of any kind.

All forms shall be wetted thoroughly before the concrete is placed therein.

All concrete shall be well consolidated and the mortar flushed to the form surfaces by continuous working with immersion type vibrators. Vibrators which operate by attachment to forms or reinforcement will not be permitted, except on steel forms. At least 1 standby vibrator shall be provided for emergency use in addition to the ones required for placement. For lightweight concrete, vibrators of the high frequency type, which produce a minimum of 7000 impulses per minute, will be required.

The concrete shall be vibrated immediately after deposition. Prior to the beginning of work, a systematic spacing of the points of vibration shall be established to insure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms. Immersion type vibrators shall be inserted vertically, at points 18 to 30 inches apart and slowly withdrawn. The vibrator may be inserted in a sloping or horizontal position in shallow slabs. The entire depth of each lift shall be vibrated, allowing the vibrator to penetrate several inches into the preceding lift. Concrete along construction joints shall be thoroughly consolidated by operating the vibrator along and close to but not against the joint surface. The vibration shall continue until thorough consolidation and complete embedment of reinforcement and fixtures is produced, but not long enough to cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

Holes for anchor bolts in piers, abutments, bents or pedestals may be drilled or formed by the insertion of oiled wooden plugs or metal sleeves in the plastic concrete. Formed holes shall be large enough to permit horizontal adjustments of the bolts. The bolts shall be carefully set in mortar. In lieu of the above, anchor bolts may be set to exact locations when the concrete is placed.

Slab concrete shall be mixed in a plant located off the structure. Carting or wheeling concrete batches over completed slabs will not be permitted until they have aged at least 4 full curing days or timber planking, placed on top of the slab for the carts to traverse along. Carts shall be equipped with pneumatic tires. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

Exposed concrete surfaces, while still plastic, shall be stamped with an impression having the Contractor's name, the month and year. The stamp shall be of an approved design.

After concrete has taken its initial set, to prevent damage to the concrete at least 1 curing day shall elapse before placing strain on projecting reinforcement.

The storing of reinforcing or structural steel on completed roadway slabs generally shall be avoided and when permitted, shall be limited to quantities and distribution that will not induce excessive stresses.

410.12 Placing Concrete in Cold Weather

(1) General

The Contractor is responsible for the protection of concrete placed under any and all weather conditions and is responsible for producing concrete equal in quality to that placed under normal conditions. Should concrete placed under adverse weather conditions prove unsatisfactory, it shall be removed and replaced.

(2) Cast-in-Place Concrete

Concrete may be placed when the atmospheric temperature is not less than 35 F. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32 F.

Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum specified concrete temperature, the aggregate and/or the water shall be heated uniformly, in accordance with the following:

The water temperature shall not exceed 180 F and/or the aggregate temperature shall not exceed 150 F. The heating apparatus shall heat the mass of aggregate uniformly. The temperature of the mixture of aggregates and water shall be between 50 F and 85 F before introduction of the cement.

All concrete shall be effectively protected as follows:

- (a) The temperature of slab concrete of all unformed surfaces shall be maintained at 50 F or above for a period of 72 hours from time of placement and above 40 F for an additional 72 hours.
- (b) The temperature at the surface of all concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottom of slabs and other similar forms shall be maintained at 40 F or above for a period of 72 hours from time of placement.
- (c) The temperature of all concrete, including the bottom slabs of culverts placed on or in the ground, shall be maintained above 32 F for a period of 72 hours from time of placement.

Protection shall consist of providing additional covering, insulated forms or other means and if necessary, supplementing such covering with artificial heating. Curing shall be provided during this period until all requirements for curing have been satisfied.

When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before permission is granted to begin placement.

Sufficient extra test specimens will be made and cured with the placement to ascertain the condition of the concrete as placed prior to form removal and acceptance.

(3) Precast Concrete

A fabricating plant for precast products which has adequate protection from cold weather in the form of permanent or portable framework and covering, which protects the concrete when placed in the forms and is equipped with approved steam curing facilities may place concrete under any low temperature conditions provided:

- (a) The framework and covering are placed and heat is provided for the concrete and the forms within 1 hour after the concrete is placed. This shall not be construed to be 1 hour after the last concrete is placed, but that no concrete shall remain unprotected longer than 1 hour.
- (b) Steam heat shall keep the air surrounding the concrete between 50 F and 85 F for a minimum of 3 hours prior to beginning the temperature rise, which is required for steam curing.

410.13 Placing Concrete in Hot Weather

When the temperature of the air is above 85°F, an approved retarding agent will be required in all exposed concrete, concrete used in superstructures, top slabs of direct traffic culverts and all cased drilled shafts regardless of temperatures. Concrete mix temperatures shall not exceed 90°F except for mixes that include high range water reducers where a maximum mix temperature of 100°F will be allowed.

If the concrete mix temperature is expected to exceed 90°F (or 100°F in mixes with high range water reducers) ice may be utilized to lower the concrete mix temperature. Ice may be added to the concrete mix as a portion by weight of the mix water. However the addition of ice shall not exceed 50 percent of the total mix water weight.

When weather conditions are such that the addition of ice at 50 percent of the mix water is not sufficient to reduce the concrete mix temperature to an acceptable temperature, concrete work shall not be allowed.

When ice is to be used in hot weather concrete placement, the Contractor shall furnish a mix design (Section 4.4 of Standard Specification Item No. 360, "Concrete Pavement" and Section 6 of Standard Specification Item No. 403, "Concrete for Structures") acceptable to the Engineer for class of concrete specified.

410.14 Placing Concrete in Water

Concrete shall be deposited in water only when indicated or with written permission of the Engineer. The forms, cofferdams or caissons shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited.

Pumping will not be permitted during the concrete placing nor until it has set for at least 36 hours.

The concrete shall be placed with a tremie, closed bottom-dump bucket or other approved method and shall not be permitted to fall freely through the water nor shall it be disturbed after it has been placed. Its surface shall be kept approximately level during placement.

The tremie shall consist of a watertight tube 14 inches or less in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.

Bottom-dump buckets used for underwater placing shall have a capacity of not less than 1/2 cubic yard. It shall be lowered gradually and carefully until it rests upon the concrete already placed and raised very slowly during the upward travel; the intent being to maintain still water at the point of discharge and to avoid agitating the mixture.

The placing operations shall be continuous until the work is complete.

Unless otherwise indicated, all concrete placed under water shall be Class E.

410.15 Placing Concrete in Superstructure

Unless otherwise indicated, simple span roadway slabs shall be placed without transverse construction joints by using a longitudinal screed or a self-propelled transverse finishing machine. The screed shall be adequately supported on a header or rail system sufficiently stable to withstand the longitudinal or lateral thrust of the equipment. Unless otherwise indicated, temporary intermediate headers will be permitted for placements exceeding 50 feet in length for the longitudinal screed, provided the rate of placement is rapid enough to prevent a cold joint and these headers are designed for early removal to permit satisfactory consolidation and finish of the concrete at their locations.

Unless otherwise indicated, slabs on continuous units shall be placed in one continuous operation without transverse construction joints using a longitudinal screed or a self-propelled transverse finishing machine. Rails for transverse finishing machines supported from the beams or girders shall be installed so they may be removed without damage to the slab. Bond between removable supports and the concrete shall be prevented in a manner acceptable to the Engineer. Rail support parts, which remain embedded in the slab, shall not project above the upper mat of reinforcing steel. Rail or screed supports attached to I-beams or girders shall be subject to "General Requirements" stated above.

For continuous placement of slabs on steel or prestressed members, continuous slab and girder units or continuous slab spans, the Contractor shall submit his rate of placement schedule. For simple span units, a minimum rate of placement for a particular unit may be indicated. If not so indicated, the Contractor shall satisfy the Engineer that the equipment furnished is capable of placing, finishing and curing the slab at an acceptable rate to insure compliance with the specifications.

The profile gradeline may require adjustment, due to variation in beam camber and other factors, to obtain the required cover over the slab reinforcement. Beams shall be set in a sufficient number of spans so that when adjustment is necessary the profile gradeline can be adjusted over suitable increments so that the revised gradeline will produce a smooth riding surface.

One or more passes shall be made with the screed over the bridge deck segment prior to the placement of concrete thereon to insure proper operation and maintenance of grades and clearances.

Slab concrete shall be deposited between the exterior beam and the adjacent beam prior to placing concrete in the overhang portion of the slab.

For transverse slab finishing, concrete shall be placed in transverse strips, proceeding from the lowest end of the placement.

For longitudinal screeding, concrete shall be placed in longitudinal strips starting at a point in the center of the segment adjacent to one side, except as provided herein and the strip completed by placing uniformly in both directions toward the ends except that for spans on a grade of 1.5 percent or more, placing shall start at the lowest end. The width of strips shall be such that the concrete therein will remain plastic until the adjacent strip is placed. Where monolithic curb construction is specified, the concrete shall be placed therein in proper sequence to be monolithic with the adjacent longitudinal strips of the slabs.

Forms for the bottom surface of concrete slabs, girders and overhangs shall be maintained true to the required vertical alignment during concrete placing. An approved system of checking shall be used to detect any vertical movement of the forms or falsework. Unless otherwise indicated, girders, slab and curbs of deck girder spans shall be placed monolithically.

The girder stems shall be filled first and the slab concrete placed within the time limits specified in "Placing Concrete, General" above.

Construction joints when permitted for slab placements on steel and prestressed concrete beams shall be as indicated. Where plans permit segmental placing, without specifying a particular order of placement, any logical placing sequence, which will not result in the overstressing of any of the supporting members, will be permitted subject to the approval of the Engineer.

Any falsework under steel girder or truss spans shall be released and the spans swung free on their permanent supports before placing any slab concrete thereon.

When the curb forms are filled, the top of curb and sidewalk section shall be brought to the correct camber and alignment and finished as described in "Treatment and Finishing of Horizontal Surfaces Except Roadway Slabs" and "Ordinary Surface Finish", below.

The slab shall be finished as specified in "Finish of Roadway Slabs", below. When the slab is to receive an additional wearing surface or level up (widening), it shall be given a reasonable smooth float or screed finish.

410.16 Placing Concrete in Concrete Arches

Concrete shall be placed in arch rings so the loading is kept symmetrical on the falsework. The arch rings and ribs shall be placed in one continuous operation unless otherwise indicated or permitted by the Engineer. The spandrel walls or columns and the beams shall not be placed until the arch is swung. Floor slab, railing, parapet walls, etc., shall not be placed until all spandrels are complete. Slab placement shall be symmetrical about the transverse centerline so the loading of the arch is kept approximately symmetrical.

The placing sequence shall be as indicated.

410.17 Placing Concrete in Box Culverts

In general, construction joints will be permitted only where indicated.

Where the top slab and walls are placed monolithically in culverts more than 4 feet in clear height, an interval of not less than 1 nor more than 2 hours shall elapse before placing the top slab to allow for shrinkage in the concrete wall.

The base slab shall be trowel finished accurately at the proper time to provide a smooth uniform surface. Top slabs, which carry traffic, shall be finished as specified for roadway slabs in "Finish of Roadway Slabs", below. Top slabs of fill type culverts shall be given a reasonably smooth float finish.

410.18 Placing Concrete in Foundations and Substructure

Concrete shall not be placed in footings until the depth and character of the foundation has been inspected by the Engineer and permission has been given to proceed.

Placing of concrete footings upon seal courses will be permitted after the caissons or cofferdams are free from water and the seal course cleaned. Any necessary pumping or bailing during the concrete placement shall be done from a suitable sump located outside the forms.

All temporary wales or braces inside cofferdams or caissons shall be constructed or adjusted as the work proceeds to prevent unauthorized construction joints in footings or shafts.

When footings can be placed in a dry excavation without the use of cofferdams or caissons, forms may be omitted if desired by the Contractor and approved by the Engineer and the entire excavation filled with concrete to the elevation of the top of footing in which case measurement for payment will be based on the footing dimensions indicated.

Concrete in columns shall be placed monolithically unless otherwise indicated. Columns and caps and/or tie beams supported thereon may be placed in the same operation. To allow for shrinkage of the column concrete, it shall be placed to the lower level of the cap or tie beam and placement delayed for not less than 1 hour nor more than 2 before proceeding.

410.19 Treatment and Finishing of Horizontal Surfaces Except Roadway Slabs

All unformed upper surfaces shall be struck off to grade and finished. The use of mortar topping for surfaces under this classification will not be permitted.

After the concrete has been struck off, the surface shall be floated with a suitable float. Bridge sidewalks shall be given a wood float or broom finish or may be striped with a brush as specified by the Engineer.

The tops of caps and piers between bearing areas shall be sloped slightly from the center toward the edge and the tops of abutments and transition bents sloped from the back wall to the edge, as directed by the Engineer, so that water will drain from the surface and shall be given a smooth trowel finish. When indicated, the coating of caps and piers shall be done using Type X epoxy material. Unless otherwise indicated, the color shall be concrete gray. Bearing areas for steel units shall be constructed in such a manner to have a full and even bearing upon the concrete. When the concrete is placed below grade, bearing areas may be raised to grade on beds of Portland cement mortar consisting of 1 part cement, 2 parts sand and a minimum amount of water.

Bearing seat buildups or pedestals for concrete units may be cast integrally with the cap or with a construction joint as follows:

The construction joint area under the bearing shall have the surface roughened thoroughly as soon as practical after initial set is obtained. The bearing seat buildups shall be placed using a latex based grout or an epoxy grout, mixed in accordance with the manufacturer's recommendation. Pedestals shall be placed using Class C concrete, reinforced as indicated.

Bearing areas under elastomeric pads shall be given a slightly textured wood float finish.

410.20 Finish of Roadway Slabs

In all roadway slab-finishing operations, camber for specified vertical curvature and transverse slopes shall be provided.

For concrete slab or concrete girder spans cast in place on falsework, an additional amount of camber shall be provided to offset the initial and final deflections of the span. The additional amount of camber shall be determined from the dead load deflection diagram indicated. When dead load deflection is not indicated, the additional amount of camber shall be 1/8 inch per 10 foot of span length but not to exceed 1/2 inch. For pan girder spans the additional camber for initial and final deflections shall be approximately 1/2 inch for 30-foot spans and 3/4 inch for 40-foot spans.

Roadway slabs supported on prestressed concrete beams, steel beams or girders shall receive no additional camber, except that for slabs without vertical curvature, the longitudinal camber shall be approximately 1/4 inch.

Work bridges or other suitable facilities shall be provided from which to perform all finishing operations and check measurements for slab thickness and reinforcement cover.

As soon as the concrete has been placed and vibrated in a section of sufficient width to permit working, the surface shall be struck off, leveled and screeded, carrying a slight excess of concrete ahead of the screed to insure filling of all low spots. The screed shall be designed rigid enough to hold true to shape and shall have sufficient adjustments to provide for the required camber. A vibrating screed shall be used in all slabs more than 20 feet in width. When utilized, a vibrating screed shall be heavy enough to prevent undue distortion. The screeds shall be provided with a metal edge.

Longitudinal screeds shall be moved across the concrete with a saw like motion while their ends rest on headers or templates set true to the roadway grade or on the adjacent finished slab.

The surface of the concrete shall be screeded a sufficient number of times and at such intervals to produce a uniform surface, true to grade and free of voids. If necessary, the screed surface shall be worked to a smooth finish with a long handled wood or metal float of the proper size or hand floated from bridges over the slab.

The Contractor shall perform sufficient checks with a long handled 10-foot straightedge on the plastic concrete to insure that the final surface will be within the tolerances specified below. The check shall be made with the straightedge parallel to and perpendicular to the centerline. Each pass thereof shall lap half of the preceding pass. All high spots shall be removed and all depressions over 1/16 inch in depth shall be filled with fresh concrete and floated. The checking and floating shall be continued until the surface is true to grade and free of depressions, high spots, voids or rough spots.

Rail support holes shall be filled with concrete and finished to match the top of the slab.

A broom finish shall be applied with longitudinal screeding. A broom or burlap drag finish shall be applied with transverse screeding.

Unless otherwise indicated, the burlap drag shall consist of 4 or more layers of 10 ounce burlap fabric, free of seams, dirt or hardened concrete; it shall be kept wet when in use and it shall be drawn over the surface in as many passes as required to produce the desired texture depth. Broom finishes shall be applied with stiff bristled brooms. The Contractor shall have on hand at all times brooms for the purpose of providing the desired texture depth when surface conditions are such that the burlap drag will not provide it.

Upon completion of the floating and/or straight edging and before the disappearance of the moisture sheen, the surface shall be given a broom or burlap drag finish. The grooves of these finishes shall be parallel to the structure centerline. It is the intent that the average texture depth resulting from the number of tests directed by the Engineer be not less than 0.035 inch with a minimum texture depth of 0.030 inch for any one test when tested in accordance with SDHPT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

At the option of the Contractor or when indicated, the surface shall be given its final texture by saw grooving to meet the above requirements. Saw grooving may be done a minimum of 4 days after the slab concrete has been placed. If saw grooving is done prior to the completion of curing, the curing shall be continued after sawing to provide the minimum curing time required.

When the plans require that a concrete overlay be placed on the slab (new construction) or on prestressed concrete box beams, the slab or top surface of shear key and diaphragm concrete shall be given a metal tine finish of approximately 0.050 inch.

When the plans indicate an asphaltic tack coat and overlay be placed on the slab (new construction) or on prestressed concrete box beams, the slab or the top surface of shear key and diaphragm concrete shall be given a lightly textured broom finish, similar to a sidewalk finish having an average texture depth of approximately 0.025 inch.

After the concrete has attained its final set, the roadway surface shall be tested with a standard 10-foot straightedge. The straightedge shall be placed parallel to and perpendicular to the centerline of roadway to bridge any depressions and touch high spots. Ordinates of irregularities measured from the face of the straightedge to the surface of the slab shall not exceed 1/8 inch, making proper allowances for camber, vertical curvature and surface texture. Occasional variations, not exceeding 3/16 inch will be acceptable, if in the opinion of the Engineer it will not affect the riding qualities.

Irregularities exceeding the above requirements shall be corrected. Areas, which are corrected, to produce satisfactory riding qualities shall be provided with an acceptable surface texture in a manner approved by the Engineer.

410.21 Placing Survey Monuments

The Contractor shall obtain City Survey Monuments from the Engineering and Development Services Department Construction Inspection Division. Unless installed by other methods acceptable to the Engineer or designated representative, monuments shall be embedded in freshly poured concrete at locations indicated and accessible to survey equipment at the completion of the project. The monuments shall be installed flush with the adjacent concrete in a workmanlike manner.

410.22 Curing Concrete

The Contractor shall inform the Engineer fully of the methods and procedures proposed for curing, shall provide the proper equipment and material in adequate amounts and shall have the proposed method, equipment and material approved prior to placing concrete.

Inadequate curing and/or facilities therefore shall be cause for the Engineer to notify the Contractor, in writing, that the work is unsatisfactory and the concrete will have to be removed and replaced.

All concrete shall be cured for a period of 4 curing days except as noted herein.

Exceptions to 4 Day Curing

Description	Required Curing
Upper Surfaces of Bridge Slabs and Top Slabs of Direct Traffic Culverts	8 curing days (Type I or III cement). 10 curing days (Type II cement)
Concrete Piling (nonprestressed)	6 curing days

When the air temperature is expected to drop below 35 F, the water curing mats shall be covered with polyethylene sheeting, burlap-polyethylene blankets or other material to provide the protection required by "Placing Concrete in Cold Weather", below.

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 colder days if satisfactory provisions are made to maintain the temperature at all surfaces 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.

The following methods are permitted for curing concrete subject to the restrictions of Table 1 below and the following requirements for each method of curing.

(1) Form Curing

When forms are left in contact with the concrete, other curing methods will not be required except for cold weather protection.

When forms are stripped before the 4-day minimum curing time has elapsed, curing shall continue by an approved method.

(2) Water Curing

All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as indicated in [Item No. 403](#), "Concrete for Structures". Seawater will not be permitted. Water, which stains or leaves an unsightly residue, shall not be used.

(a) Wet Mat

Polyethylene sheeting or burlap-polyethylene blankets placed in direct contact with the slab will be required when the air temperature is expected to drop below 40 F during the first 72 hours of the curing period. Wet mats placed in direct contact with the slab will be required when the air temperature is expected to remain above 40 F for the first 72 hours of the curing period. Damp burlap blankets made from 9-ounce stock may be placed on the damp concrete surface for temporary protection prior to the application of the cotton mats, which may be placed dry and wetted down after placement.

The mats shall be weighted down adequately to provide continuous contact with all concrete surfaces where possible. The surfaces of

the concrete shall be kept wet for the required curing time. Surfaces, which cannot be cured by contact, shall be enclosed with mats, anchored positively to the forms or to the ground, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all surfaces of the concrete wet.

(b) Water Spray

This method shall consist of overlapping sprays or sprinklers that keep all unformed surfaces continuously wet.

(c) Ponding

This method requires the covering of the surfaces with a minimum of 2 inches of clean granular material, kept wet at all times or a minimum of 1 inch depth of water. Satisfactory provisions shall be made to provide a dam to retain the water or saturated sand.

(3) Membrane Curing

Unless otherwise indicated, either Type 1-D or Type 2 membrane curing compound may be used where permitted except that Type 1-D (Resin Base Only) will be permitted for slab concrete in bridge decks and top slabs of direct traffic culverts.

TABLE 1

STRUCTURE UNIT DESCRIPTION	REQUIRED		PERMITTED	
	Water for Complete Curing	Membrane for Interim Curing	Water for Complete Curing	Membrane for Complete Curing
Upper surfaces of Bridge Roadway, Median and Side walk Slabs, Top Slabs of Direct Traffic, and Culverts.	X	X (resin base)		
Top Surface of any Concrete Unit upon which Concrete is to be placed and bonded at a later interval (Stub Walls, Risers, etc.). Other Superstructure Concrete (curbs, wing- walls, Parapet IIs, etc.).	X		*X	*X
Top Surface of Precast and/or Pre-stressed Piling.	X	X		
All Substructure Concrete Culverts, Box Sewers, Inlets, Manholes, Retaining Walls, Riprap.			*X	*X

* Polyethylene Sheeting, Burlap-Polyethylene Mats or Laminated Mats in close intimate contact with the concrete surfaces, will be considered equivalent to water or membrane curing for items under 4.

For substructure concrete, only one Type of curing compound will be permitted on any one structure. Material requirements and construction methods shall conform to [Item No. 409](#), "Membrane Curing", except as changed herein. The membrane shall be applied in a single, uniform coating at the rate of coverage recommended by the manufacturer and as approved by the Engineer, but not less than 1 gallon per 180 square feet of area. Tests for acceptance shall be at this specified rate.

Membrane curing shall not be applied to dry surfaces, but shall be applied just after free moisture has disappeared. Formed surfaces and surfaces which have given a first rub shall be dampened and shall be moist at the time of application of the membrane.

When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane, which is damaged, shall be corrected immediately by reapplication of membrane. Unless otherwise indicated, the choice of membrane type shall be at the option of the Contractor, except that the Engineer may require the same curing method for like portions of a single structure.

410.23 Removal of Forms and Falsework

Except as herein provided, forms for vertical surfaces may be removed when the concrete has aged not less than 1 day when Type I or Type II cement is used and not less than 1/2 day when Type III cement is used, provided it can be done without damage to the concrete.

Forms for inside curb faces may be removed in approximately 3 hours provided it can be done without damage to the curb.

Weight supporting forms and falsework for structures, bridge components and culvert slabs shall remain in place a minimum of 4 curing days after which they may be removed if the concrete has attained a flexural strength of 500 psi as evidenced by strength tests using specimens made from the same concrete and cured under the same conditions as the portion of the structure involved. Forms for other structural components may be removed as specified by the Engineer.

Inside forms (walls and top slabs) for inlets, box culverts and sewers may be removed after the concrete has aged not less than 3 days and has acquired a flexural strength of not less than 300 psi, provided an overhead support system, approved by the Engineer, is used to transfer the weight of the top slab to the walls of the box culvert or sewer before the support provided by the forms is removed.

If all test beams made for the purpose of form removal have been broken without attaining the required strength, forms shall remain in place for a total of 14 curing days.

Formwork supporting weight of concrete, such as beam soffits, joints and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Compressive strength of in-place concrete shall be determined by testing field-cured specimens representative of the concrete within the members.

The above provisions relative to form removal shall apply only to forms or parts thereof which are constructed to permit removal without disturbing forms or falsework required to be left in place for a longer period on other portions of the structure.

Backfilling against walls of Type I or Type II cement shall not take place for a minimum of 7 days. Backfilling against walls of Type III cement shall not take place until the flexural beam strength has reached 500 psi or the wall has cured for 5 days.

410.24 Defective Work

Any defective work discovered after the forms have been removed shall be repaired as soon as possible in accordance with "Finishing Exposed Surfaces", below.

If the surface of the concrete is bulged, uneven or shows excess honeycombing or form marks, which in the opinion of the Engineer cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

410.25 Finishing Exposed Surfaces

(1) Ordinary Surface Finish

An Ordinary Surface Finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher grade or class of finish. Higher grades and classes of finish shall conform to [Item No. 411](#), "Surface Finishes for Concrete". Where neither a grade or class of finish is specified, an Ordinary Surface Finish only, will be required.

Ordinary Surface Finish shall be provided as follows:

After form removal, all porous or honeycombed areas and spalled areas shall be corrected by chipping away all loose or broken material to sound concrete.

Featheredges shall be eliminated by cutting a face perpendicular to the surface. Shallow cavities shall be repaired using adhesive grout or epoxy grout. If judged repairable by the Engineer, large defective areas shall be corrected using concrete or other material approved by the Engineer.

Holes and spalls caused by removal of metal ties, etc., as required by "Forms", above, shall be cleaned and filled with adhesive grout or epoxy grout. Exposed parts of metal chairs on surfaces to be finished by rubbing, shall be chipped out to a depth of 1/2 inch and the surface repaired.

All fins, runs, drips or mortar shall be removed from surfaces, which remain exposed. Form marks and chamfer edges shall be smoothed by grinding and/or dry rubbing.

Grease, oil, dirt, curing compound, etc., shall be removed from surfaces requiring a higher grade of finish. Discolorations resulting from spillage or splashing of asphalt, paint or other similar material shall be removed.

Repairs shall be dense, well bonded and properly cured and when made on surfaces, which remain exposed and do not require a higher finish, shall be finished to blend with the surrounding concrete.

Unless otherwise indicated Ordinary Surface Finish shall be the final finish for the following exposed surfaces: inlets, manholes, sewer appurtenances, inside of culvert barrels, bottom of bridge decks between beams or girders, vertical and bottom surfaces of interior concrete beams or girders.

(2) Rubbed Finish

In general, the following areas shall require a rubbed finish and shall receive a first and second rubbing:

- (a) The top, exterior and roadway faces of curbs and parapet walls.
- (b) All concrete surfaces of railing.
- (c) The exterior vertical faces of slab spans, rigid frames, arches and box girders.

- (d) The outside and bottom surfaces of fascia beams or girders (except precast concrete beams).
- (e) The underside of overhanging slabs to the point of juncture of the supporting beams.
- (f) All vertical surfaces of piers, columns, bent caps, abutments, wing walls and retaining walls which are exposed to view after all backfill and embankments is placed.
- (g) Exposed formed surfaces of inlet and outlet structures on culverts, transition structures, headwalls and inlets.
- (h) Such other surfaces specified elsewhere to receive a rubbed finish and such additional surfaces required by the Engineer to receive a rubbed finish.

After removal of forms and as soon as the mortar used in pointing has set sufficiently, surfaces to be rubbed shall be wet with a brush and given a first surface rubbing with a medium coarse carborundum stone. This rubbing shall be done before the concrete has cured more than 48 hours.

The second rubbing shall present a cleaned uniform appearance free from drip marks and discoloration. It shall be given with a No.30 carborundum stone or an abrasive of equal quality.

If the Contractor elects to use an epoxy paint in lieu of the second rubbings he may do so upon approval of the Engineer.

(3) Special Surface Finishes

Striated, exposed aggregate and other special surface finishes shall conform to [Item No. 411](#), "Surface Finishes for Concrete" and/or with the requirements indicated.

410.26 Measurement and Payment

No direct measurement or payment will be made for the work to be done or the equipment to be furnished under this item, but shall be considered subsidiary to the particular items required by the bid.

End

Ref: [401](#), [403](#), [405](#), [406](#), [408](#), [409](#), [411](#), [425](#), [438](#), [720](#)

ITEM NO. 411

SURFACE FINISHES FOR CONCRETE

411.1 Description

This item shall govern the furnishing of all materials and the application by the methods of construction indicated on the Drawings for the application of a surface finish to concrete.

411.2 Materials

- (1) Masonry Sand

Masonry sand shall conform to ASTM C 144.

- (2) White Cement

White cement shall conform to ASTM C 150.

- (3) Portland Cement

All cement unless otherwise indicated shall be Portland cement conforming to ASTM C 150.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

- (4) Membrane Curing

Membrane curing shall conform to Item No. 409, "Membrane Curing".

- (5) Adhesive Grout

This subsection sets forth the requirements for three epoxy adhesives with different viscosity's designed to bond fresh Portland Cement concrete to existing Portland Cement concrete, hardened concrete to hardened concrete and steel to fresh or hardened concrete. These adhesives are as follows:

Type V: Standard (medium viscosity) for applying to horizontal and vertical surfaces. This material is suitable for surface sealing of fine cracks in concrete.

Type VI: Low viscosity for application with spray equipment to horizontal surfaces.

Type VII: Paste consistency for overhead application and where a high buildup is required. This material is suitable for surface sealing of cracks in concrete, which are veed out prior to sealing, and for grouting of dowel bars where clearance is 1/16 inch or less.

- (a) **Mixing Ratio:** The ratio of resin and hardener components to be mixed together to form the finished adhesive shall be either 1 to 1 or 2 to 1 by volume.

Any specific coloring of resin and/or hardener components desired will be stated by the Engineer.

- (b) **Fillers, pigments and thixotropic agents:** All fillers, pigments and/or thixotropic agents in either the epoxy resin or hardener component must be of sufficiently fine particle size and dispersed so that no appreciable separation or settling will occur during storage.

Any fillers present in the low viscosity version must be of such a nature that they will not interfere with application by spray equipment or abrade or damage such equipment.

The concrete adhesive shall contain no volatile solvents.

- (c) **Consistency:** The adhesives shall comply with the following:

	Type V	Type VI	Type VII
Viscosity of mixed adhesive 77 ±1 F, Poises	400 Maximum	150 Maximum	must be sufficiently fluid to apply by trowel or spatula without difficulty
Pot Life at 77 F, minutes minimum - 30			
Set Time at 77 F (Time required to attain 180 psi), hours maximum - 12			

Thixotropy test shall be performed at both 77 and 120 F. Average thickness of cured adhesive remaining on test panel, mils minimum.

Type V	Type VII
30	45

Samples of the individual components in sealed containers shall be maintained at 115 + 3 F for 2 weeks. The mixed adhesive prepared from these samples must still comply with the minimum thixotropy requirements.

The viscosity of the Type V and Type VI versions must not show an increase of more than 20 percent compared with the viscosity prior to the stability test. The Type VII adhesive must still be sufficiently fluid to apply by trowel or spatula without difficulty.

- (d) **Physical Properties of the Cured Adhesive**

Property	Requirements
Adhesive Shear Strength, psi, minimum	2200
Water Gain, percent by weight, maximum	0.20
Ability to bond fresh Portland cement concrete to cured Portland cement concrete, psi, minimum (7 days cure time)	400

(6) Synthetic Resin Paint

Type X Epoxy: This is a high solids epoxy coating designed for application by brush or roller. The materials can also be applied by airless spray by addition of a maximum of 5 percent toluene solvent at the direction of the Engineer.

Raw Materials: The basic raw materials to be incorporated into this coating are listed below, along with the specific requirements for each material. The final decision as to the quality of materials shall be made by the Engineer. After the Engineer has approved the brand names of raw materials proposed by the Contractor, no substitution will be allowed during the manufacture without prior approval of the Engineer.

Epoxy Resin: The basic epoxy resin used in the formulation shall be an unmodified liquid resin conforming to the following chemical and physical requirements:

Viscosity at 25.0 + 0.1 C, cps	7,000 to 10,000
Weight per epoxy equivalent, gms per gm - mole	175 to 195
Color (Gardner Number), maximum	5
Hydrolyzable chlorine, maximum % by weight	0.2
Specific gravity, 25/25 degrees	1.14. to 1.18

Test methods to be used in determining these qualities are listed below:

- (a) Viscosity - Test for Kinematic Viscosity (ASTM Designation: D 445).
- (b) Weight per Epoxy Equivalent - Test for Epoxy Content of Epoxy Resins (ASTM Designation: D 1652).
- (c) Color - Test for Color of Transparent Liquids (Gardner Color Scale) (ASTM Designation: D 1544).
- (d) Hydrolyzable Chlorine - Test for Hydrolyzable Chlorine Content of Liquid Epoxy Resins (ASTM Designation D: 1726).
- (e) Specific Gravity - Method of Test for Density of Paint, Varnish, Lacquer and Related Products (ASTM Designation: D 1475).

Pigment

Titanium Dioxide: The titanium dioxide used in this formulation shall be equivalent to DuPont R-900. This shall be a pure, chalk-resistant, rutile titanium dioxide meeting the requirements of ASTM D 476, Type III.

Extender: The extender used in this formulation shall be Nyad 400, manufactured by Interpace Pigments. Specific requirements are as follows:

Particle size distribution	Minimum	Maximum
Minus 20 microns, percent by weight	95	
Minus 10 microns, percent by weight	70	80
Minus 5 microns, percent by weight	40	50
Minus 3 microns, percent by weight	30	40
Minus 1 micron, percent by weight	14	20
Oil Absorption (rub out, lbs/100 lbs)		25 maximum
Brightness (G.E.)	92.5 minimum	

411.3 Grade of Finish

(1) General

The grade and/or class of finish shall be as described herein and as indicated.

"Grade" of finish designates the areas to which a higher finish is to be applied beyond the requirements of an Ordinary Surface Finish. Four grades of finish are included herein.

"Class" of finish designates the materials or the process to be used in providing the grade of finish. Three classes of finish are included herein.

For structures and surfaces not described herein under grade of finish, a class of finish only may be indicated. Where neither a grade nor class is specified, an Ordinary Surface Finish only will be required as specified in Item No. 410, "Concrete Structures".

Where the plans specify a grade and class of finish, i.e., Grade II, Class C, only that type of finish shall be furnished.

Where the plans specify a grade of finish only, i.e., Grade I Finish, any of the classes of finish may be furnished. Only one class of finish shall be furnished on any individual structure, twin structures or on structures in close proximity to each other, except as specified for prestressed concrete members below.

(2) Grade I

The following areas shall receive a Class A, B or C (two rub) Finish, except that prestressed members shall receive either a Class A or B Finish only.

All concrete surfaces of railing, including the parapet types; exterior vertical faces of slabs, slab spans, arches and box girders; the outside and bottom surfaces of fascia beams or girders (including prestressed members); the underside of overhanging slabs to the point of juncture of the supporting beam; all exposed vertical surfaces of bents and piers and bottom surfaces of bent caps; all exposed surfaces of tie beams, abutments, bridge wingwalls, culvert headwalls and wingwalls and retaining walls exposed to view after all backfill and is placed.

Unless otherwise indicated, the underside of the slab of slab spans shall be finished its entire width.

Unless otherwise indicated, exposed surfaces of pump houses and other miscellaneous concrete surfaces shall receive a Class A, B or C (one rub) Finish.

(3) Grade II

All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs and slab spans shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive a Class A or B finish only. The underside of slab spans shall receive an Ordinary Surface Finish only.

(4) Grade III

All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive an Ordinary Surface Finish.

(5) Grade IV

The top and roadway faces only of all concrete railing, including the parapet types and bridge wingwalls shall receive a Class A, B or C (one rub) Finish. All other surfaces described under Grade I shall receive an Ordinary Surface Finish.

411.4 Class of Finish

The Class of Finish designates either an adhesive grout material, a paint-type material or a rubbing process applied to surfaces specified in "Grade of Finish", as required above and/or as indicated.

Unless otherwise indicated the color shall be concrete gray.

(1) Class A

This finish shall consist of an adhesive grout textured coating with a minimum 1/16 inch thickness, composed of 1 part white cement, 1 part natural (gray) cement, 2 parts masonry sand, 1 part (latex) emulsion and enough water to form a viscous slurry of a consistency that may be applied by spray gun, brush or roller without appreciable running or sagging. The proportions of white and gray cement may be varied slightly to obtain the desired color.

Gradation of the masonry sand shall be as required to produce a texture satisfactory to the Engineer.

Prepackaged materials meeting these requirements and acceptable to the Engineer as to color, texture and appearance will be permitted.

(2) Class B

The finish shall be a paint-type material, consisting of a synthetic resin, containing fibrous as well as texturing pigments, which when applied by a 1 coat spray application at the rate of 45 + 5 square feet per gallon will yield an acceptable textured coating. Certification by the manufacturer of the above materials will be required.

(3) Class C

This finish shall consist of a one rub or two rub system, as the case may be, meeting the requirements set forth below under "Construction Methods".

411.5 Approval of Surface Finishing Materials

The material to be furnished shall meet the requirements of TxDOT Specification D-9-8110, Structural Coatings, latest revision.

In addition to the above, the manufacturer shall furnish the following:

- (1) At the time of original request for approval of the surface finishing material, the manufacturer shall supply a 1-gallon sample of the material to the Engineer, if requested.
- (2) Each 6 months after approval of the material, the manufacturer shall furnish a notarized certification indicating that the material originally approved has not been changed or altered in any way. Any change in formulation of a surface finish shall require retesting prior to use.

The Engineer may request additional information to be submitted such as infrared spectrophotometry scan, solids content, etc., for further identification. A change in formula discovered by any of the tests prescribed herein or by other means and not reported and retested, may be cause to permanently bar the manufacturer from furnishing surface finish materials for Owner's/Developer's work.

The Owner/Developer reserves the right to perform any or all of the tests required by this specification as a check on the tests reported by the manufacturer. In case of any variance, the Owner/Developer tests will govern.

411.6 Construction Methods

Prior to application of any of the finishes required herein, concrete surfaces shall be given an Ordinary Surface Finish. For Class A and B materials, concrete surfaces shall be clean and free of dirt, grease, curing compound or any other bond breaking substance. Class A shall be applied on moistened surfaces but Class B requires a dry surface. The temperature of the atmosphere, concrete and compound shall be above 50 F for Classes A and B at the time of application. The finished surfaces shall be protected against rain or freezing for a period of 24 hours after application.

Class A materials shall be applied by spraying, by roller or by brush. Class B materials shall be applied by spraying only. All applications shall provide an acceptable texture of the proper coverage.

The Class A and B material shall be applied after all preparation work required by Ordinary Surface Finish has been completed.

The Class C Finish shall be performed with a carborundum stone as follows, after all preparatory work required by Ordinary Surface Finish has been completed:

For a two-rub system, the first rubbing shall bring the wetted concrete face to a paste and produce a smooth dense surface without pits, form marks or other irregularities. The use of cement or grout to form the paste will not be permitted. Striping with a brush and washing after the first rubbing will not be required. Chamfer lines shall be finished during the second rubbing.

The first rubbing shall be done soon after form removal. Membrane curing, if used, shall be applied after the first rub is complete. Prior to the second rubbing, any remaining curing membrane shall be removed from the surface by brushing, buffing or other satisfactory methods.

The second rubbing shall be performed when conditioning the structure for final acceptance. The specified surfaces shall be cleaned of drip marks and discolorations and given a final rubbing. The surface shall be striped neatly with a brush and the paste allowed to take a reset, after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

For a one rub system, the rubbing requirements shall be the same as for the first rub above, except chamfer lines shall be finished and the paste spread uniformly, striped with a brush and allowed to take a reset after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

411.7 Special Surfaces Finishes

(1) General

When special surface finishes are required for retaining walls, panels, copings or similar construction, the Contractor shall prepare sample panels for approval of the finish and the method of application. Unless otherwise indicated, panel or pattern arrangement and dimensions may be varied to achieve a more pleasing appearance or to utilize forming material more efficiently when approved by the Engineer/Architect. Aggregates, materials, variation of panel or pattern arrangement, dimensions and other features affecting the work shall be approved prior to start of the work.

(2) Striated Finish

The striated (grooved) pattern shall be as indicated or as approved by the Engineer.

The finish shall be made by lining the forms with striated sheets of plywood, plastic, fiberglass, metal or other material acceptable to the Engineer. The striations on the panels shall be of a smooth, wide pattern, not sharp or angular.

A chamfer groove shall be used along all edges of each panel. All ties, bolts or other forming accessories shall be located along the chamfer grooves or panel edges.

(3) Exposed Aggregate Finish

(a) Structural Concrete

Exposed aggregate panels may be either raised, recessed or as indicated with the sides of each panel chamfered as directed by the Engineer.

The aggregate used for this finish shall be approved by the Engineer. Unless otherwise indicated, aggregate shall conform to the grading requirements of Grade 2 aggregate except that a minimum of 50 percent shall be retained on the $\frac{3}{4}$ -inch sieve. Gravel of predominately rounded particles shall be used, except that when indicated or approved by the Engineer in writing, crushed stone may be used. The aggregate shall be large enough to remain firmly anchored in the face of the final product. The depth shall be 1/4-inch minimum to 1/2-inch maximum, unless otherwise indicated or directed by the Engineer.

A surface retarder that penetrates the concrete approximately 1/4 inch shall be applied to the forms or concrete surface as an aid in achieving the desired finish. Wood forms may require 2 or 3 coatings to compensate for absorption. Form joints shall be taped or caulked to prevent escape of the retarder during placing operations.

Treated form surfaces shall be protected from sun and rain while exposed to the atmosphere. In case of high humidity or if rain has dampened the forms prior to placing concrete, a reapplication of the surface retarder may be required to provide uniform coverage of the retarder on the forms.

Adjacent areas of fresh concrete not requiring exposed aggregate finish shall be protected when the retarder is applied.

The finish shall be obtained by sandblasting, bush hammering, water blasting or other methods, as approved by the Engineer. Horizontal surfaces may be finished by a combination of brushing and washing, but only after the concrete has set sufficiently to prevent loosening of the aggregate.

Unless otherwise directed by the Engineer, forms for surface requiring exposed aggregate finish shall be removed 12 to 15 hours after concrete placement. The exposed aggregate operation shall be accomplished immediately after form removal. Except for the time required for obtaining the exposed aggregate finish, curing of all surfaces shall be maintained for the minimum 4 day curing time. All surfaces shall be either water cured or may be cured with an approved clear membrane compound. If water curing is used, it shall be followed by a clear membrane curing compound conforming to Item No. 409, "Membrane Curing".

Care shall be taken to ensure proper vibration at all points of concrete placement to prevent honeycomb or segregation of the materials. Vibration shall be done in such a manner as to provide adequate penetration of previously placed concrete lifts. Care shall be taken to prevent contact of the vibrator with the face form.

(b) Sidewalks

When exposed aggregate surfaces are required for sidewalks, driveways and/or medians, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable. Grade 5 coarse aggregates shall be used for exposed aggregate finishes for sidewalks, driveways and/or medians.

411.8 Measurement and Payment

No direct measurement or payment will be made for the work to be done, the equipment or materials to be furnished under this item, but shall be considered subsidiary to the particular items required by the plans and the contract.

End

Ref.: [409](#)

**ITEM NO. 413
CLEANING AND/OR SEALING JOINTS
AND CRACKS (PORTLAND CEMENT CONCRETE)**

413.1 Description

This item shall govern the cleaning and/or sealing of joints and cracks in either new or existing Portland cement concrete pavements and bridge decks in conformance with the requirements herein and the details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

413.2 Submittals

The submittal requirements of this specification item include:

- A. Sealant Type (Rubber-Asphalt, Polymer Modified Emulsion, Low Modulus Silicone or Polyurethane), Class and method of application (crack sealing, joint sealing, etc),
- B. Manufacturer recommendations concerning the use of primer and backer rod
- C. Manufacturer recommended equipment and procedures for preparation, dispensing, application, curing, etc. of the sealant
- D. Manufacturer certification that the product to be supplied meets or exceeds the specifications,
- E. Listing of the equipment proposed for the Work.

413.3 Materials

Joints and/or cracks shall be sealed with the type and/or class of materials indicated on the Drawings. The materials shall conform to the requirements of TxDOT Specification [Item No. 433](#), "Joint Sealants and Fillers" and TxDOT Departmental Materials Specification No. DMS-6310, "Joint Sealants and Seals".

Primers, if required, shall be as recommended by the manufacturer of the sealant. Backer rods, when required, shall be compatible with the sealant and shall not react with or bond to the sealant.

The sealing compound shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the sealer, the manufacturer's batch number or lot, the pouring temperature, and the safe heating temperature.

413.4 Equipment

All equipment shall be in accordance with the sealant manufacturer's recommendations. Air compressors shall be equipped with appropriate filters for removing oil and water from the air.

Any equipment, that damages dowels, reinforcing steel, Portland cement concrete, base, subbase or subgrade in the process of cleaning the joints and/or cracks, shall be discontinued and the joint and/or crack shall be cleaned by other methods approved by the Engineer or designated representative, which do not cause such damage.

413.5 Construction Methods

Equipment, tools and machinery recommended for proper prosecution of the Work shall be on the project and shall be approved by the Engineer or designated representative prior to the initiation of the joint and/or crack cleaning and sealing operations.

A. Joint and Crack Preparation.

The bonding surface of cracks and joints shall be cleaned of infiltrated material, saw cuttings or other foreign material. All material removed from joints and cracks shall be removed from the paved surface of the roadway.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer or designated representative.

1. Joint Preparation.

The joints shall be cleaned with filtered compressed air or other methods approved by the Engineer or designated representative. Unless noted otherwise on the Drawings, hand tools, air guns, power routers, abrasive equipment or other equipment may be used to clean the joints. Where indicated on the Drawings, the joint sealant space shall be resized by sawing to the width and depth shown on the Drawings to accommodate the type of sealant specified.

2. Crack Preparation.

Unless indicated otherwise on the Drawings, the crack shall be grooved initially at the surface so that a reservoir of rectangular cross section is provided for the sealant. The grooves shall be cut to the dimensions shown on the Drawings. The devices that are used for grooving, such as diamond blade random cut saws, random-crack grinders, etc., shall be capable of following the path of the crack without causing excessive spalling or other damage to the concrete.

B. Joint and Crack Sealing

The sealant shall be installed in accordance with the manufacturer's recommended procedure. The joint and/or crack surfaces shall be surface dry unless recommended otherwise by the manufacturer of the sealant.

The surface temperature at the time of the sealing operation shall not be less than 40°F (4.5°C).

The minimum depth of sealant shall be ½ inch (12.5 mm) or a depth recommended by the sealant manufacturer and the top of the sealant shall be located 1/8 to ¼ inch (3 to 6.5 mm) below the adjacent pavement surface.

1. Primer.

If required, the primer shall be applied as soon as possible after cleaning is accomplished. The primer shall be applied uniformly at the rate recommended by the sealant manufacturer. The primer shall be applied to exposed metal surfaces before new corrosion begins and shall be allowed to cure for a minimum of thirty (30) minutes, but no longer than eight (8) hours prior to the application of the sealant, unless sealant manufacturer recommendations indicate otherwise.

2. Backer Rods.

Backer rods shall be used to prevent a fluid type sealant from flowing through the joint and crack and to retain the sealant at its required elevation. The application and use of backer rod shall be as recommended by the sealant manufacturer and approved by the Engineer or designated representative.

413.6 Measurement

Accepted work performed under this item shall be considered subsidiary to other pay items and will not be measured and paid for unless a separate pay item is provided in the contract documents.

If a pay item is included in the contract documents, acceptable work for "Cleaning and/or Sealing Joints and Cracks" shall be measured by the lineal foot (meter: 1 meter equals 3.281 feet) of sealant in place.

If a pay item is included in the contract documents, acceptable work "Cleaning and/or Sealing Joints and Cracks" shall be measured by the pound (kilograms: 1 kilogram equals 2.205 pounds).

413.7 Payment

When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 413.6, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, grooving and/or sawing the crack/joint; furnishing, hauling and placing primer and backer rod, if necessary; furnishing, heating, hauling, and placing the crack/joint sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

- _____ Sealer Per Lineal Foot.
- _____ Sealer Per Pound of Sealer Used.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 413, "CLEANING AND/OR SEALING JOINTS AND CRACKS (PORTLAND CEMENT CONCRETE)"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 433	Joint Sealants and Fillers
Item No. 438	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)

Texas Department of Transportation: Departmental Materials Specifications

<u>Designation</u>	<u>Description</u>
DMS 6310	Joint Sealants and Seals

RELATED CROSS REFERENCE MATERIALS

Specification Item 413, "CLEANING AND/OR SEALING JOINTS AND CRACKS (PORTLAND CEMENT CONCRETE)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions
Item No. 313	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 300	Asphalts, Oils and Emulsions
Item No. 352	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)

ITEM NO. 414 CONCRETE RETAINING WALLS

414.1 Description

This item covers precast or cast-in-place retaining walls composed of Portland Cement concrete and reinforcing steel, constructed in conformity with the lines, grades and details indicated on the Drawings or as directed by the Engineer. This item shall also include any pumping, bailing, drainage and [Item No. 509](#), "Trench Safety Systems" for trench walls, when indicated.

414.2 Materials

(1) **Concrete**

Cast-in-place concrete shall conform to Class C Concrete, [Item No. 403](#), "Concrete For Structures". Precast concrete shall conform to [Item No. 403](#), "Concrete for Structures" and shall have a minimum 28 day compressive strength of 4500 psi.

(2) **Reinforcing Steel**

Reinforcing steel shall conform to [Item No. 406](#), "Reinforcing Steel".

(3) **Joint Sealants and Fillers**

Preformed Bituminous Fiber Material shall meet the requirements of ASTM D 1751. Joint sealant shall be a non-sag low-modulus silicone.

(4) **Membrane Curing Compound**

Membrane curing compound shall conform to [Item No. 409](#), "Membrane Curing".

(5) **Filter Fabric**

Filter fabric shall conform to Item No. 620, "Filter Fabric".

(6) **Select Backfill**

Select backfill shall conform to [Item No. 210](#), "Flexible Base".

(7) **Waterstops**

Waterstops, if shown on the Drawings, shall conform to [Item 416](#), "Waterstops".

(8) **Pipe Underdrains**

Pipe Underdrains, if shown on the Drawings, shall conform to [Item 551](#), "Pipe Underdrains".

414.3 Construction Methods

All excavation shall be done in accordance with [Item No. 401](#), "Structural Excavation and Backfill".

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to [Item No. 410](#), "Concrete Structures". Retaining walls shall be constructed in one continuous vertical pour from the top of the footing to the top of the wall unless intermediate horizontal construction joints are shown on the Drawings.

The height of the wall will be determined by grades set or as directed by the Engineer and shall be such that water will not be trapped on private or public property.

Unless shown otherwise on the Drawings, vertical control joints shall be constructed in the retaining wall stem (the vertical portion of the wall) to create planes of weakness to control cracking. These joints shall be constructed at a spacing not to exceed 20 feet and at abrupt changes in wall height. They shall be formed by placing triangular chamfer strips to create grooves in both faces of the wall to a depth of at least ten percent of the wall thickness. Wall reinforcement shall extend through the joint. Control joints shall be sealed, on the backfilled side of the retaining wall, with a non-sag low-modulus silicone sealant, or, alternatively, the joint may be covered with a waterproofing material consisting of an 18-inch wide strip of self-adhering polyethylene having a rubberized asphalt mastic, as approved by the Engineer.

Vertical expansion joints shall conform to the applicable section of [Item 410](#), "Concrete for Structures". These joints shall be constructed at a spacing not to exceed 60 feet, unless shown otherwise on the Drawings. They shall extend the full height and width of the wall, including the wall footing, and shall consist of sleeved dowels and ½-inch thick preformed bituminous fiber material. The edges and corners of the joints shall be formed by triangular chamfer strips measuring ¾ inch on each side. The concrete on the two sides of an expansion joint shall be placed in two separate pours unless approved otherwise by the Engineer.

Construction joints shall conform to the applicable section of [Item 410](#), "Concrete for Structures". Wall reinforcement shall extend through the construction joint unless shown otherwise on the Drawings,

Reinforcement for the wall shall be as indicated on the Drawings. The Contractor shall provide dowel bars of the proper size, shape and spacing, as indicated.

Devices to release the hydrostatic head shall be installed as indicated.

All exposed corners and edges shall be filleted with triangular chamfer strips measuring ¾ inch on each side. Exposed horizontal surfaces shall be level and flat, and exposed vertical surfaces shall be plumb and flat, unless shown otherwise on the Drawings.

Waterstops shall be provided in construction and expansion joints in retaining walls where water-tightness is essential to the function of the structure, as in detention, retention, or water quality ponds or flood walls.

414.4 Measurement

Accepted cast in place work as prescribed by this item will be measured by the cubic yard for concrete and by the pound for reinforcing steel, complete in place. In case reinforcing steel is not a separate pay item in the bid, measurement will be per cubic yard for reinforced concrete retaining wall, complete in place. All concrete quantities will be based on the dimensions indicated.

414.5 Payment

The cast in place work performed as prescribed by this item will be paid for at the unit price bid per cubic yard for "Concrete Retaining Wall", which price shall be full compensation for all excavation, forms, concrete, curing, finishing, backfilling, sloping and for all labor, tools, materials, equipment and incidentals necessary to complete the work and at the unit price bid per pound for "Reinforcing Steel", complete in place or as included in the proposal and contract.

Payment will be made under one of the following:

Concrete Retaining Walls - Per Cubic Yard.

Concrete Retaining Wall, Including Reinforcement - Per Cubic Yard.

Precast Concrete Retaining Wall - Per Cubic Yard.

End

Ref: [210](#), [401](#), [403](#), [406](#), [408](#), [409](#), [410](#), [416](#), [509](#), [551](#), [620](#)

ITEM NO. 416 WATERSTOPS

416.1 Description

This item shall govern the furnishing and installation of waterstops in accordance with the details shown on the Drawings and the requirements of this item.

416.2 Materials

- (1) **General:** Except where otherwise shown on the Drawings, waterstops may be manufactured from either natural or synthetic rubber or from polyvinyl chloride (PVC) as specified below.
 - (a) **Natural Rubber.** Natural rubber waterstops shall be manufactured from a stock composed of a high-grade compound made exclusively from new plantation rubber, reinforcing carbon black, zinc oxide, accelerators, anti-oxidants and softeners. This compound shall contain not less than 72 percent by volume of new plantation rubber.

Physical properties of the natural rubber for waterstops shall be as shown in [Table A](#) below.
 - (b) **Synthetic Rubber.** Synthetic rubber water stops shall be manufactured from a compound made exclusively from neoprene or butadiene styrene rubber (GRS), reinforcing carbon black, zinc oxide, polymerization agents and softeners. This compound shall contain not less than 70 percent by volume of neoprene or GRS.

Physical properties of the synthetic rubber for waterstops shall be as shown in [Table A](#) below.
 - (c) **Polyvinyl Chloride.** Polyvinyl chloride (PVC) waterstop material shall conform to the Corps of Engineers Specification Number CRD-C-572-60.
- (2) **Manufacturer's Certification:** The manufacturer shall furnish test reports certified by a nationally known testing laboratory for each batch or lot of waterstops furnished under this contract, indicating compliance with this specification.
- (3) **Manufacturing Requirements:** Natural and/or synthetic rubber waterstops shall be manufactured with an integral cross section which shall be uniform within plus or minus 1/8 inch in width. The web thickness or bulb diameter cross section shall be within plus 1/16 and minus 1/32 inch. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured so that any cross section shall be dense, homogeneous and free from all porosity. All junctions in the special connections shall be full-molded.

Requirements for PVC waterstops shall be the same as for natural or synthetic rubber waterstops except that splicing of PVC shall be done by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic.

TABLE A
Physical Properties for Rubber for Waterstops

	Natural (Plain) Rubbe	Synthetic (Neoprene or GRS) Rubber
Original Physical Properties:		
Hardness, ASTM D676 (Durometer)	60 ± 5	55 ± 5
Tensile Strength, Min. psi, ASTM D412	3500	2500
Elongation at Break, Min. percent	550	425
Accelerated Tests to Determine Aging Characteristics (Alternate tests):		
(1) After 7 days in air at 158° ± 2° F, ASTM D573, or;		
(2) After 48 hours in oxygen at 158° ± 2° F and 300 psi pressure, ASTM D572:		
Tensile Strength, percent change, max.	35	35
Maximum Elongation, percent change, max.	35	—

416.3 Construction Methods

Waterstops shall be of the size and shape shown on the Drawings. They shall be installed in the locations as shown on the Drawings.

The waterstops shall be accurately located in the forms and firmly held in place, both before and during concrete placement, to prevent displacement.

No field splices shall be permitted unless otherwise indicated on the Drawings. Field splices shall be either vulcanized; mechanical, using stainless steel parts; or made with a rubber splicing union of the same stock as the waterstop. All finished splices shall have a tensile strength not less than 50 percent of the unspliced material.

416.4 Measurement and 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 shall be considered subsidiary to the various bid items of the contract

End

ITEM NO. 420 DRILLED SHAFT FOUNDATIONS

420.1 Description

This item shall govern the construction of foundations consisting of "Reinforced Concrete Drilled Shafts" and/or "Nonreinforced Concrete Drilled Shafts", with or without concrete bell footings. Concrete shafts shall be placed in a drilled excavation when the shafts are without bell footings and in a drilled and underreamed excavation when shafts are with bell footings. Foundations shall be constructed in accordance with this item and in conformance with the details and dimensions indicated. Any required test loading of shafts shall be in accordance with standard foundation test loading procedures used by TXDOT or by other procedures approved by the Engineer.

420.2 Materials

All concrete and materials shall conform to [Item No. 403](#), "Concrete for Structures" and the requirements herein. Concrete shall be Class A. The maximum size coarse aggregate shall be 1½ inches for cased shafts. A retarder or water reducing agent will be required in all concrete when casing is used. Reinforcing steel shall conform to [Item No. 406](#), "Reinforcing Steel".

420.3 Construction Methods

(1) Excavation

The Contractor shall perform the excavation required for the shafts and bell footings, through whatever materials encountered, to the dimensions and elevations indicated or required by the site conditions.

Shaft alignment shall be within a tolerance of 1 inch per 10 feet of depth.

Bells shall be excavated to form a bearing area of the size and shape indicated. Bell outlines varying slightly from those indicated are permissible provided the bottom bearing area equals that specified.

Bells may be excavated either by hand or by mechanical methods. Blasting will not be used except with written permission of the Engineer and shall be controlled to avoid disturbance of the formations below or outside the limits of the proposed shaft.

The plans indicate the expected depths and elevations where satisfactory bearing material will be encountered. This information will be used as a basis for the contract. If satisfactory material is not encountered at plan elevation, the footing may be raised or lowered as determined by the Engineer. Alteration of plan depth shall be made to satisfactorily comply with the design requirements. Casing will be required when necessary to prevent caving of the material or when necessary to exclude seepage water. Casing shall be metal of ample strength to withstand handling stresses, the pressure of concrete and of the surrounding earth or backfill materials and shall be watertight. The outside diameter of casing shall not be less than the specified size of shaft; otherwise, the size of casing and

the size of drilled excavation in which it is to be placed will be left to the discretion of the Contractor, except as noted below. No extra compensation will be allowed for concrete required to fill an oversize casing or oversize excavation.

Where caving conditions and/or excessive ground water is encountered, no further drilling will be allowed until a construction method is employed which will prevent excessive caving that will make the excavation appreciably larger than the size of casing to be used. Drilling in a mud slurry or other method which will control the size of excavation, will be required.

If the elevation of the top of shaft is below ground level at the time of concrete placement, an oversize casing from ground elevation to a point below the top of the shaft will be required to control caving of any material into the freshly placed concrete.

Where casing is not required, any excavation for the bells or shafts beyond the lines indicated shall be filled with Class A concrete at the Contractor's expense. Where casings are used, the Contractor will be permitted to backfill around the upper portions of the casing with pea gravel or other granular material, but space shall be provided to allow for escape of muck, slurry or water displaced by the concrete.

When casing is used, it shall be smooth and well oiled and shall extend approximately to the top of the shaft.

Under normal operations, the removal of the casing shall not be started, until all concrete placement is completed in the shaft. Movement of the casing for short pulls of a few inches, rotating, exerting downward pressure and tapping it to facilitate extraction will be permitted. When unusual conditions warrant, the casing may be pulled in partial stages. A sufficient head of concrete shall be maintained above the bottom of the casing to overcome hydrostatic pressure. Casing extraction shall be at a slow uniform rate with the pull in line with the center of the shaft.

The elevation of the top of the steel cage shall be carefully checked before and after casing extraction. Generally any upward movement of the steel not exceeding 2 inches or any downward movement thereof not exceeding 6 inches per 20 feet of shaft length will be acceptable. Any upward movement of the concrete or displacement of the steel beyond the above limits will be cause for rejection.

The minimum length of steel required for lap with column steel shall be maintained. Dowel bars may be used if the proper lap length is provided both into the shaft and into the column.

Placing of drilled shaft concrete under water shall not be done without the permission of the Engineer. If permission is granted, the concrete shall be placed conforming to [Item No. 410](#), "Concrete Structures" and shall be placed with a closed tremie. Provisions shall be made for a sump or other approved method to channel displaced water away from the shaft.

Material excavated from shafts and bells, including drilling mud, not used in the backfill around the completed bents or piers shall be disposed of properly and shall not impair the efficiency or appearance of the structure or other parts of the work.

At the time concrete is placed, the excavation shall be free from accumulated seepage water. All loose material shall be removed from the bottom of the excavation prior to placing concrete.

The Contractor shall provide suitable access and lighting for proper inspection of the completed excavation, to check the dimensions and alignment of shafts and underreamed excavation.

Any required lighting shall be electric. Any mechanical equipment used within the excavation shall be operated by air or electricity. The use of gasoline driven engines within the excavation for pumping or drilling will not be permitted.

In order that the Engineer may judge the adequacy of a proposed foundation, the Contractor, if requested, shall make soundings or take cores at his expense to determine the character of the supporting materials. The depth of such soundings or cores will not be required to exceed 5 feet below the proposed footing grade. It is the intent of this provision that soundings shall be made or cores taken at the time the excavation in each foundation is approximately complete.

When shafts in abutment bents are indicated, the embankment at the bridge ends shall be completed to grade and thoroughly compacted prior to drilling.

(2) **Reinforcing Steel**

The cage of reinforcing steel, consisting of longitudinal bars and spiral reinforcement, lateral ties or horizontal bands, shall be completely assembled and placed as a unit immediately prior to concrete placement.

If the shaft is lengthened and the plans require full depth reinforcement, a minimum of $\frac{1}{2}$ the longitudinal bars required in the upper portion of the shaft shall be extended to the bottom, with proper lateral reinforcement. These bars may be lap spliced, spliced by welding or unspliced bars of the proper length. Any splices required shall be in the lower portion of the shaft.

Where spiral reinforcement is used, it shall be tied or tack welded to the longitudinal bars at a spacing not to exceed 12 inches. Unless otherwise indicated welding will not be permitted within the top 15 feet of the steel cage.

Horizontal steel bands shall be placed and welded as indicated.

The cage shall be supported from the top by some positive method, to minimize its slumping downward during concrete placement and/or extraction of the casing. The support shall be concentric with the cage to prevent racking and distortion of the steel. A minimum of ½ of the vertical bars shall be supported.

In uncased shafts, concrete spacer blocks or steel chairs shall be used at sufficient intervals to insure concentric spacing for the entire length of the cage. In cased shafts, concrete spacer blocks shall not be used. Metal "chair" type spacers or bent pieces of steel bars shall be placed at sufficient intervals around the steel cage to insure concentric spacing inside the casing.

(3) **Concrete**

The work shall be performed conforming to [Item No. 410](#), "Concrete Structures", details indicated and with the requirements herein.

Concrete shall be placed as soon as possible after all excavation is complete and reinforcing steel placed and shall be of such workability that vibrating or rodding will not be required.

Concrete placing shall be continuous in the shaft to the construction joint indicated. The height of free fall of concrete shall be limited to 3 to 4 feet, preventing segregation.

Concrete shall be placed through a suitable tube or tremie to prevent segregation of materials. The tube or tremie shall be made in sections to provide proper discharge and permit raising it as the placement progresses. A non-jointed pipe may be used if sufficient openings of the proper size are provided to allow for the flow of concrete into the shaft.

The elapsed time from the beginning of concrete placement in the cased portion of the shaft, until extraction of the casing is begun, shall not exceed 1 hour.

Where a cap or tie beam is required to be placed monolithically with the shaft, a time interval will be allowed for placing the required form and reinforcing after casing removal.

A riser block of equal diameter as the column and of a maximum height of 6 inches may be cast at the top of the completed shaft.

The top surface shall be cured and any construction joint area shall be treated as prescribed in [Item No. 410](#), "Concrete Structures".

420.4 Test Holes

When indicated or when ordered by the Engineer in writing, test holes will be required to establish elevations for "belling", to determine elevation of ground water or other soil characteristics.

The diameter and depth of test hole or holes shall be as indicated or as directed by the Engineer.

420.5 Test Bells

When indicated or when ordered by the Engineer in writing, the reaming of bells on specified test holes will be required to establish the feasibility of belling in a specific soil strata.

The diameter and shape of the test bell shall be as indicated or as approved by the Engineer in writing.

420.6 Measurement

Acceptable drilled shafts (of the specified diameter), complete in place, will be measured by the linear foot. Shafts for interior bents and piers will be measured from a point approximately 6 inches below the ground elevation at the center of shaft unless specific elevations or dimensions are indicated or unless the Engineer directs otherwise to meet unusual conditions. (The bent height indicated is for estimating purposes only and does not control the top of shaft measurement.) For grade separations and railroad underpasses, the ground elevation used will be the completed subgrade section under the structure. At stream crossings and at railroad overpasses, the existing ground elevation at the time drilling begins will be used. For abutment bents and retaining walls, the length of shaft shall be measured from the bottom of footing or cap elevation. For sign structures and illumination towers, the elevation of top of shaft will be shown either as a dimension above ground or as a dimension to the bottom of footing.

Drilled shafts used with commercial designs of overhead sign bridges will not be measured for payment but will be considered as subsidiary to the overhead sign support.

The quantity for acceptable bell footings placed will be measured by the cubic yard, computed by using dimensions and shape indicated or as revised in diameter by the Engineer. The bell shall consist of the volume outside the plan or authorized dimensions of the shaft, which will extend to the bottom of the bell for the purpose of measurement.

Test holes of the specified diameter will be measured from the elevation of the ground at the time drilling begins, by the linear foot of acceptable test hole drilled.

Test bells will be measured by the cubic yard of material excavated, computed from the dimensions indicated or those authorized by the Engineer in writing.

420.7 Payment

Drilled shafts will be paid for at the unit price bid per linear foot of "Drilled Shaft" or "Drilled Shaft (Nonreinforced)", of the specified diameter, subject to the following limitations for overruns authorized by the Engineer.

- (1) Payment for individual completed shaft lengths up to and including 5 feet in excess of the maximum plan length shaft, as defined herein, will be made at the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (2) Payment for that portion of individual completed shaft length in excess of 5 feet and up to and including 15 feet more than the maximum plan length shaft, as defined herein, will be made at a unit price equal to 115 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (3) Payment for that portion of individual completed shaft length in excess of 15 feet and up to and including, 25 feet more than the maximum plan length shaft, as defined herein, will be made at a unit price equal to 125 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (4) Payment for that portion of individual completed shaft length, over 25 feet in excess of the maximum plan length shaft, as defined herein, will be made at a unit price equal to 150 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (5) For extra depth drilling at interior bents and piers, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any interior pier or bent of any bridge included in the contract.
- (6) For extra depth drilling for abutment bents and retaining walls, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any abutment bent of any bridge or of any retaining wall included in the contract.
- (7) For extra depth drilling for sign structures, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any sign structures included in the contract.
- (8) For extra depth drilling for illumination towers, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any illumination tower included in the contract.

If a 20 percent limitation is referred to elsewhere in the Contract, the limitation will not apply to overruns due to extra depth of drilled shafts.

Bell footings, constructed to the specified dimensions or to the altered dimensions authorized by the Engineer, will be paid for at the contract unit price bid per cubic yard for "Bell Footings". Authorized increase in bell footing diameter beyond 3 times the specified shaft diameter, unless indicated, shall be considered as beyond the scope and intent of these specifications. Payment for such increased bell footing quantity shall conform to provisions contained elsewhere in the Contract.

Test holes, of the specified diameter, when included in the contract as a bid item, will be paid for at the contract unit price bid per linear foot for "Test Hole".

Test bells of the diameter and shape specified, when included in the contract as a bid item or authorized by the Engineer, will be paid for at the contract unit price bid per cubic yard of "Test Bells".

The foregoing unit prices shall be full compensation for making all excavations, for drilling all test holes and test bells, for doing any necessary pumping; for furnishing, placing and removing any required casings, for furnishing and placing all concrete and reinforcing steel, for all backfilling and for furnishing all tools, labor, equipment and incidentals necessary to complete the work. When the bottom of any drilled shaft is ordered to be placed at an elevation below plan grade and a splice of reinforcement is required, no payment will be made for the extra reinforcement required, but it shall be considered subsidiary to the price bid per foot of shaft. No extra payment will be made for casings left in place.

No partial estimates will be allowed for "Bell Footing" or for "Drilled Shaft" until the concrete has been placed, except that partial payments will be made for reinforcing steel materials delivered on the job if allowed for elsewhere in the Contract.

Payment will be made under one of the following:

Drilled Shaft, Dia. - Per Linear Foot.

Drilled Shaft, Nonreinforced, Dia. - Per Linear Foot.

Bell Footings - Per Cubic Yard.

Test Bells, Dia. - Per Cubic Yard.

Test Holes, Dia. - Per Linear Foot.

End

Ref: [403](#), [406](#), [410](#)

ITEM NO. 424

PRESTRESSED CONCRETE PLANKS

424.1 Description

This item shall consist of furnishing materials, the construction and erection of precast prestressed concrete members in accordance with the details indicated on the Drawings, reviewed shop drawings and these specifications.

424.2 Materials

(1) Concrete

Concrete shall be Class H and conform to Item No. 403, "Concrete for Structures". The minimum release strength shall be 3500 psi.

(2) Reinforcement

Reinforcing steel shall conform to Item No. 406, "Reinforcing Steel".

(3) Prestressing

Prestressing shall conform to the most current version of TxDOT Item No. 426, "Prestressing". The prestressing steel shall be 1/2 inch diameter 270K 7 wire stress relieved, high tensile steel strand conforming to ASTM A 416.

424.3 Construction Methods

(1) Curing

Careful attention shall be given to the proper curing of concrete. The Contractor shall inform the Engineer or designated representative regarding the methods and procedures proposed for curing, shall provide the proper equipment and necessary materials and have approval of the Engineer or designated representative of such methods, equipment and materials prior to placing concrete.

Inadequate curing facilities or lack of attention to the proper curing of concrete shall be cause for the Engineer or designated representative to stop all construction until approved curing is provided. Inadequate curing may be cause for rejection of the member.

Curing shall be commenced prior to the formation of surface shrinkage cracks but in no case delayed longer than 1 hour after the concrete has been placed in forms.

An approved water or membrane cure, when permitted, shall be used as an interim measure prior to elevated temperature or other methods of curing.

Concrete shall be cured continuously except as provided for form removal, until the concrete strength as indicated by compressive test of cylinders cured with the members, has reached the "Release Strength" or "Handling Strength" indicated. Members shall be covered to prevent rapid drying for a period of 72 hours after release of stress or after reaching handling strength. All members shall be protected from freezing during the above period.

A period not to exceed 4 hours will be permitted for removal to a storage area prior to resuming the balance of curing and protection required.

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 for colder days, if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F for the entire 24 hours.

All concrete shall be steam or water cured, except that membrane curing may be used as interim curing on the top surface of concrete piling. Only Type 1 membrane curing compound will be permitted for interim curing.

(a) Water Curing

All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as specified in Item No. 403, "Concrete for Structures". Seawater will not be permitted. Water, which stains or leaves an unsightly residue, shall not be used.

Water curing will be permitted as follows:

1. Wet Mat Method

For water curing by wet mat method, cotton mats, polyethylene sheeting or polyethylene burlap blankets may be used.

The mats, sheets or blankets shall not be placed in contact with prestressed concrete member until such time that damage will not occur to the surfaces.

The mats, sheets or blankets shall be adequately anchored and weighted to provide continuous contact with all concrete surfaces. Any concrete surfaces, which cannot be cured by contact, shall be enclosed by mats, adequately anchored, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all of the surfaces of the concrete wet for the required curing time.

2. Water Spray Method

For water curing by the water spray method, overlapping sprays or sprinklers shall be used so that all concrete surfaces are kept wet continuously.

(b) Elevated Temperature Curing

Curing by elevated temperatures will be permitted as follows:

1. Steam Curing

(Steam curing is defined as use of steam above 85°F for curing.)
When steam curing of concrete is provided, the temperature inside the curing jacket at the surface of the concrete shall not exceed 165°F for more than 1 hour during the entire steam-curing period. Concrete exposed to temperatures exceeding 180°F will not be accepted.

Sufficient moisture shall be provided inside the curing jacket so that all surfaces of the concrete are wet.

An unobstructed air space of not less than 6 inches shall be provided between all surfaces of the concrete and the curing jacket. Steam outlets shall be positioned so that live steam is not applied directly on the concrete, reinforcing steel or tendons.

The location of steam lines, location of control points for discharge of steam into the curing jacket, and the number and type of openings for steam distribution within the curing jacket shall be arranged so that temperature variation between any points in the enclosure shall not exceed 20°F.

Steam curing shall not commence until the concrete has been in place a minimum of 3 hours.

During the application of steam, the temperature inside the curing jacket shall be raised uniformly at a rate not to exceed 40°F per hour.

Temperature decrease at the end of the curing operation shall not exceed the same rate.

When elevated temperature curing is used, members shall remain protected until the differential between the temperature inside the curing jacket and the outside air is not more than 25°F.

2. Alternate Methods

Other methods of elevated temperature curing may be permitted by the Engineer provided temperature maximums, rate of temperature variation, humidity control, etc. are in accordance with the requirements for steam curing. Permission shall be obtained from the Engineer, in writing, for use of any alternate method.

424.4 Handling, Hauling and Erection

The Contractor and his Fabricator shall be responsible for proper handling, lifting, storing, hauling and erection of all members so that they may be placed in the structure without damage.

Unless approved on erection and/or shop drawings, prestressed members shall be maintained in a flat position at all times and shall be picked up and supported near the ends of the member in such a way to prevent torsion. Members may be lifted by other methods approved by the Engineer in writing.

No member shall be moved from the casting yard until all requirements for curing and strength requirements have been attained.

424.5 Defects and Breakage

Failure of individual wires in a 7 wire strand or of wires in a parallel wire tendon is acceptable provided the total area of wire failure is not more than 2 percent of the total cross sectional area of tendons in any member. Failure of entire strand will be subject to structural review.

Fine hair cracks or checks on the surface of the member which, as determined by the Engineer, do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Diagonal cracks, which indicate damage from torsion, will be subject to a structural review prior to acceptance. Vertical or horizontal cracks, which are 1/16 inch or less to the concrete, are acceptable. Cracks in excess of this are subject to review prior to acceptance.

Cracks, which extend into the plane of the reinforcing steel and/or prestressed tendons, but are acceptable otherwise, shall be repaired by sealing with a latex-base adhesive, grout or with epoxy.

Small damaged or honeycombed areas, which are purely surface in nature, (not over 1 inch deep) may be repaired. Damage or honeycomb in excess of this will be tentatively rejected, but will be subject to structural review.

424.6 Workmanship

Concrete shall be placed in the forms and spaded, tamped or vibrated until thoroughly compacted and until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a camel hairbrush or wood float to a gritty texture. The outer edges and joints shall be rounded with approved tools to the radius indicated.

424.7 Measurement

The work performed and the materials furnished as indicated will be measured by the square foot of top surface area of concrete.

424.8 Payment

The work performed as indicated will be paid for at the unit price bid per square foot for "Prestressed Concrete Planks", which price shall be full compensation for furnishing and placing all materials, including all reinforcing steel, furnishing and tensioning prestressing steel, for grouting holes and for any other materials, manipulation, transporting, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Prestressed Concrete Planks _____ Inch x _____ Inch
Per Square Foot.

End

Ref: Item No.: [403](#), [406](#); TxDOT Item No.: [426](#)

**ITEM NO. 425
PRESTRESSED CONCRETE STRUCTURES**

425.1 Description

This item shall consist of the construction and erection of precast, prestressed concrete members, as indicated, with approved shop and/or working drawings and with these specifications.

425.2 General

Prior to the beginning of casting, the Contractor shall give the Engineer ample notice as to the location of the casting site and the date on which the work will begin. The Contractor shall furnish an inspection laboratory at the casting site for use by the Owner's/Developer's testing personnel.

The Contractor shall submit to the Engineer a proposed sequence of erection by structure and span or unit number with the approximate date that the members are to be erected. Shop plans shall be submitted following this proposed sequence.

Shop plans for precast prestressed members shall be submitted for approval in accordance with these specifications and shall consist of the following:

Erection Plan - 7 Copies
Index Sheet - 6 Copies
Bearing Sheet - 6 Copies
Fabrication Sheet - 6 Copies

When fabrication is to be at more than one casting plant, two additional sets of Shop Plans will be required for each additional casting location. Index sheets shall reflect the plant locations where each member is to be fabricated.

After completion of fabrication, a corrected set of final record drawings shall be submitted by the Contractor for inclusion in the final contract plans.

Submission of the above Shop Plans shall be to the Owner's/Developer's Project Manager.

A Casting Schedule shall be prepared on a form, approved by the Engineer, and submitted to the Engineer or his duly authorized representative, prior to stressing.

The design of casting beds and facilities for pretensioned construction indicated, shall be done by a Professional Engineer registered in the State of Texas and shall bear his or her seal. The Contractor (Fabricator) shall furnish a certificate bearing his signature or that of a responsible Officer of the Company, that the bed, facilities and hardware have been constructed in accordance with the above plans and specifications. The Contractor (Fabricator) shall specify the maximum loading for which the bed is to be used. Prior to approval for that loading, the facilities shall be proofloaded to a minimum 10 percent overload for 8 hours. Additional proof loads shall be performed every 12 months at a 10 percent overload for 4 hours, if deemed necessary by the Engineer.

Minor changes in facilities will not require proofloading but will require submission of the details of changes accompanied with design calculations.

425.3 Materials

Materials required for use under this item shall conform to the following:

Concrete for Structures	Item No. 403
Reinforcing Steel (Non Prestressed)	Item No. 406
Prestressing	TxDOT Item 426
Elastomeric Materials	Item No. 438

425.4 Construction Methods

Prestressing shall be in accordance with the most current version of TxDOT Item 426, "Prestressing".

Reinforcing steel shall be fabricated and placed conforming to [Item No. 406](#), "Reinforcing Steel" and as indicated.

The construction of forms and the placing, curing and finishing of concrete shall be in accordance with the provisions contained herein and requirements of the plans.

(1) Forms

All side and bottom forms for precast prestressed concrete construction shall be constructed of steel unless otherwise noted on the plans. End headers and inside forms may be of other materials as approved on the shop drawings.

Forms shall be of sufficient thickness with adequate external bracing. Holding devices in forms will not be permitted if such would remain in the finished prestressed member. Joints shall be maintained reasonably mortar tight.

The grade and alignment of forms shall be checked each time they are set and shall be maintained during the casting of concrete.

Metal forms shall be reasonably free from rust, grease or other foreign material. All forms shall be cleaned thoroughly prior to each casting operation.

The soffit for casting members shall be constructed and maintained to provide not more than ¼ inch variation in any 50 foot length of the bed from the theoretical plane of the bottom of the member.

Forms for internal voids in the members shall be anchored securely to prevent movement or misalignment during the placing of concrete. For forming internal voids with a mandrel, special attention shall be given to maintaining the correct position and alignment of the mandrel throughout the casting operation.

The facing of all forms shall be treated with form oil or other bond breaking coating prior to placing of concrete. The oil or other materials used for this purpose shall be of a consistency and composition to facilitate form removal. Materials which appreciably stain or react with the concrete will not be permitted.

All forms shall be constructed to facilitate removal without damage to the concrete. At the Contractor's option, forms for piling may be constructed with a 1/8 inch draft to permit ease of removal.

(2) **Placing Concrete**

All concrete shall be placed during daylight hours unless the fabrication plant or site is provided with an approved lighting system.

The method of concrete placement shall avoid segregation of the aggregate or displacement of the reinforcing steel, prestressing steel or conduit. Concrete shall be deposited as near as possible in its final position in the forms. Depositing large quantities of concrete at one location in the forms and running or working it along the forms will not be permitted.

Special attention shall be directed toward working the coarse aggregate back from the face of the concrete and to forcing the concrete under and around the reinforcing steel, prestressing steel or conduit.

Placement of concrete in large members shall be subject to approval of the Engineer. Concrete may be placed in beams and girders in one lift or in multiple continuous horizontal layers. In the latter case the thickness of the first layer shall be slightly above the juncture of the bottom flange and web. Not more than one hour shall elapse between the placing of the successive layers. Vibration of subsequent layers of concrete shall extend into the previously placed layers.

When casting concrete piling or concrete slab units, the concrete shall be placed in one continuous horizontal layer.

Concrete shall not be placed at outdoor casting beds during inclement weather or when weather conditions may result in rainfall or low temperature during the casting operation which might impair the quality of the finished member. In case rainfall should occur after placing operations are underway, the Contractor shall provide adequate covering to protect exposed concrete. The completion of a member being cast will be permitted, provided adequate provisions are made to prevent damage to the concrete.

(a) **Placing Concrete in Cold Weather**

When members are produced in a fabricating plant which has adequate provisions to protect the concrete when placed and which has approved elevated temperature curing facilities, concrete may be placed under any low temperature conditions provided:

The temperature of the concrete is not less than 50°F nor more than 85°F when placed in the forms.

The framework and covering are in place and heat is provided for the concrete and forms within one hour after the concrete is placed. This shall not be construed to be one hour after the last concrete is placed but that no concrete shall remain unprotected and unheated for longer than one hour.

The air surrounding the concrete shall be kept between 50°F and 85°F for a minimum of three hours prior to beginning the temperature rise which is required for elevated temperature curing. The temperature of the concrete shall not be less than 50°F at any time after all materials are added and mixing commences.

For central fabricating plants or job site casting operations which do not provide facilities necessary to accomplish the above provisions, concrete may be placed when the atmospheric temperature is 35°F or greater. The temperature of the concrete at the time of placement shall not be less than 50°F or more than 85°F. The concrete shall not be placed in contact with any material having a temperature less than 32°F or any material coated with frost.

Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum temperature specified above, the aggregate and/or the water shall be heated uniformly in accordance with the following:

Water shall be heated to a temperature not to exceed 180°F. The equipment furnished shall be capable of heating the aggregate uniformly to eliminate overheated areas in the stockpile which might cause flash set of the cement. The temperature of the mixture of the aggregates and water shall be between 50°F and 85°F before introduction of the cement.

Protection shall be provided to maintain the temperature of the concrete at all surfaces above 50°F for the required total curing time as specified in this Item.

Protection shall consist of providing additional covering and, if necessary, supplementing such covering with artificial heating. When weather conditions indicate the possibility of the need for such temperature protection, all necessary heating equipment and covering material shall be on hand ready for use before permission is granted by the Engineer to begin placement of concrete.

(b) **Placing Concrete in Hot Weather**

When concrete is to be placed during hot weather, it shall be placed without the addition of more water to the concrete than required by the design (slump and consistency) and it shall be finished properly without adding water to the surface. Control of the initial set of concrete and lengthening the time for finishing operations, under adverse wind, humidity and hot weather conditions, may be accomplished with the use of an approved retarder conforming to [Item No. 403](#), "Concrete for Structures".

The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature (Whichever is Higher)	Maximum Time (Addition of Water or Cement to placing in Forms)
Nonagitated Concrete	
Over 80°F	15 Minutes
50°F to 79°F	30 Minutes
Agitated Concrete	
90°F to Above	45 Minutes
75°F to 80°F	60 Minutes
80°F to 90°F	
50°F to 74°F	90 Minutes

The use of an approved retarder in the concrete will permit the extension of each of the above temperature time maximums by 30 minutes, except that for nonagitated concrete, the maximum time shall not exceed 30 minutes.

Under conditions of extreme temperature, wind or humidity, when the specified temperature-time maximums are excessive, the Engineer may require the use of an approved retarder or may suspend concrete placing operations, if quality concrete is not being placed.

The value which govern for minimum concrete strengths during different phases of construction shall be shown on approved shop drawings.

For Class H Concrete, the control of the concrete shall be by compressive tests of cylinders. An adequate number of cylinders will be made for each pertinent strength test required. Tests for determining "Release Strength" and/or "Handling Strength" of members, will be the average of the breaking strength of two cylinders.

All test specimens, beams or cylinders representing tests for removal of forms and/or falsework and for "Release Strength" shall be cured under the same conditions, be subjected to the same curing materials and to the same weather conditions as the concrete represented.

"Design Strength" cylinders for acceptance of members shall be cured with the member which the cylinders represent until release of stress or until partial tensioning strength is obtained. These cylinders shall then be cured for the remainder of the test period in accordance with TxDOT Test Method Tex-704-I.

(3) **Vibration of Concrete**

All concrete shall be compacted and the mortar flushed to the surface of the forms by continuous working with approved high frequency mechanical vibrators, operating at a minimum of 7,000 impulses per minute. Use of external vibrators in conjunction with internal vibrators will be permitted when the forms are of steel.

At least one stand-by vibrator shall be provided for emergency use to avoid delays.

The vibrators shall be inserted systematically into the concrete immediately after deposit, thoroughly consolidating and working the concrete around the reinforcement and into the corners and angles of the forms until it has been reduced to a plastic mass. When the concrete is placed in more than one layer, the vibrator shall be operated so that it will penetrate the previously placed layer of concrete. The vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of the reinforcing steel and prestressed tendons, but not so excessive as to result in segregation. Vibration shall be supplemented by hand spading, if necessary, to insure the flushing of mortar to the surface of all forms.

(4) **Finishing of Concrete**

Top surface of prestressed members against which cast-in-place concrete will be placed later shall be screeded or rough floated to bring grout to the surface and cover all aggregate. At the approximate time of initial set, the surface shall be roughened by brushing, brooming or other approved methods. Sound concrete shall not be removed or aggregate loosened. Fresh concrete shall be removed from exposed reinforced steel.

The top surfaces of beams which panels are to be placed shall be finished smooth from the reinforcing bar out to the outside edges. The center portion of these beams shall be roughened.

Top surfaces of members which will be the riding surface in the finished structure, shall be finished conforming to [Item No. 360](#), "Concrete Pavement". Roadway surfaces which are to be given an additional wearing course, shall be screeded and given a wood float finish.

Erection holes (lifting eyes, form anchors, etc.) in exterior beams shall be filled with mortar and made flush with the surrounding surface. Holes in interior beams need not be filled unless steel is exposed. Erection of fabrication holes in the bottom of all beams shall be filled with nonstain, nonshrink mortar and made flush with the surrounding surface.

Form marks in excess of that permitted in [Item No. 425](#), "Prestressed Concrete Structures" and all fins and rough edges along chamfer lines shall be removed in an acceptable manner.

Unless otherwise indicated, strands shall be removed flush with the end of the member or recessed approximately 3/8 inch. In either case, the ends of the strands and a minimum of 1 inch around each strand shall be cleaned and coated with approximately 10 mils of an acceptable commercial grade epoxy or epoxy grout.

After slab placement, the outside and bottom surfaces of exterior beams or members shall be given the grade of surface finish specified for the structure. Other members shall be given the grade or class of finish required by the plans.

(5) **Curing of Concrete**

Careful attention shall be given to the proper curing of concrete. The Contractor shall inform the Engineer regarding the methods and procedures proposed for curing; shall provide the proper equipment and necessary materials; and shall have approval of the Engineer of such methods, equipment and materials prior to placing concrete.

Inadequate curing facilities or lack of attention to the proper curing of concrete shall be cause for the Engineer to stop all construction until approved curing is provided. Inadequate curing may be cause for rejection of the member.

Side forms may be removed at the discretion of the Contractor at any time after the concrete has reached sufficient strength to prevent physical damage to the member. Weight supporting forms shall remain in place until the concrete has reached the "Handling Strength" shown on the plans. Removal of the forms shall be done in such a manner that curing is not interrupted on any member by more than 30 minutes.

Curing shall be commenced prior to the formation of surface shrinkage cracks but in no case delayed longer than one hour after the concrete has been placed in the forms.

An approved water or membrane cure (when permitted) shall be used as an interim measure prior to elevated temperature or other methods of curing.

Concrete shall be cured continuously except as provided for form removal, until the concrete strength as indicated by compressive test of cylinders cured with the members, has reached the "Release Strength" or "Handling Strength" designated on the plans or shop drawings. Riding surfaces of members shall be cured an additional four curing days. Concrete piling shall be steam or water cured for an additional three curing days. Other members shall be covered to prevent rapid drying for a period of 72 hours after release of stress or after reaching handling strength. All members shall be protected from freezing during the above period.

A period not to exceed four hours will be permitted for removal to a storage area prior to resuming the balance of curing and protection required.

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 for colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F for the entire 24 hours.

All concrete shall be steam or water cured except that membrane curing may be used as interim curing on the top surface of concrete piling. Only Type 1 membrane curing compound will be permitted for interim curing.

(a) Water Curing

All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as specified in [Item No. 403](#), "Concrete for Structures". Sea water will not be permitted. Water which stains or leaves an unsightly residue shall not be used.

Water curing will be permitted as follows:

1. Wet Mat Method

For water curing by the wet mat method, cotton mats, polyethylene sheeting or polyethylene burlap blankets may be used.

The mats, sheets or blankets shall not be placed in contact with the prestressed concrete member until such time that damage will not occur to the surfaces.

The mats, sheets or blankets shall be adequately anchored and weighted to provide continuous contact with all concrete surfaces. Any concrete surfaces which cannot be cured by contact shall be enclosed by mats, adequately anchored, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside to keep all of the surfaces of the concrete wet for the required curing time.

2. Water Spray Method

For water curing by the water spray method, overlapping sprays or sprinklers shall be used so that all concrete surfaces are kept wet continuously.

(b) Elevated Temperature Curing

Curing by elevated temperatures will be permitted as follows:

1. Steam Curing

(Steam curing is defined as use of steam above 85°F for curing.) When steam curing of concrete is provided, the temperature inside the curing jacket at the surface of the concrete shall not exceed 165°F for more than one hour during the entire steam curing period. Concrete exposed to temperature exceeding 180°F will not be acceptable.

Sufficient moisture shall be provided inside the curing jacket so that all surfaces of the concrete are wet.

An unobstructed air space of not less than 6 inches shall be provided between all surfaces of the concrete and the curing jacket. Steam outlets shall be positioned so that live steam is not applied directly on the concrete, reinforcing steel or tendons.

The location of steam lines, location of control points for discharge of steam into the curing jacket and the number and type of openings for steam distribution within the curing jacket shall be arranged so that temperature variation between any points in the enclosure shall not exceed 20°F.

Steam curing shall not commence until the concrete has been in place a minimum of three hours.

During the application of steam, the temperature inside the curing jacket shall be raised uniformly at a rate not to exceed 40°F per hour.

Temperature decrease at the end of the curing operation shall not exceed the same rate.

When elevated temperature curing is used, members shall remain protected until the differential between the temperature inside the curing jacket and the outside air is not more than 25°F.

2. Alternate Methods

Other methods of elevated temperature curing shall be permitted by the Engineer provided temperature maximums, rate of temperature variation, humidity control, etc., are in accordance with the requirements for steam curing. Permission shall be obtained from the Engineer, in writing, for use of any alternate method.

425.5 Handling, Hauling and Erection

The Contractor (Fabricator) shall be responsible for proper handling, monitoring, hauling and erection of all members so that they may be placed in the structure without damage.

Unless approved on erection and/or shop drawings, prestressed members shall be maintained in an upright position at all times and shall be picked up and supported near the ends of the member in such a way to prevent torsion. Members may be lifted with the lifting devices on the reviewed shop plans or by other methods approved by the Engineer as indicated.

No member shall be removed from the casting yard until all requirements for tensioning (when pertinent), curing and strength requirements have been attained.

All concrete beams or girders, placed over a traveled roadway or railroad, shall be securely tied and/or braced to prevent over-turning until diaphragms capable of providing lateral stability are permanently in place. When railroads or roadway traffic must be maintained beneath girders or beams already placed, traffic shall be protected against falling objects during the erection of diaphragms and other structural members, during the placing of cast-in-place concrete and during the erection and dismantling of forms thereof. The protection shall consist of safety nets (1 inch mesh maximum) or a flooring with openings not larger than 1 inch.

425.6 Defects and Breakage

Failure of individual wires in a 7 wire strand or wires in a parallel wire tendon is acceptable provided the total area of wire failure is not more than 2 percent of the total cross-sectional area of tendons in any member. Failure of entire strand will be subject to structural review.

Fine hair cracks or checks on the surface of the member which, as determined by the Engineer, do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Diagonal cracks, which indicate damage from torsion, will be subject to a structural review prior to acceptance. Vertical or horizontal cracks, which are 1/16 inch or less in width and which tend to close upon transfer of stress to the concrete, are acceptable. Cracks in excess of this are subject to review prior to acceptance.

Cracks which extend into the plane of the reinforcing steel and/or prestressed tendons, but are acceptable otherwise, shall be repaired by sealing with a latex-base adhesive, grout or with epoxy.

Small damaged or honeycombed areas which are purely surface in nature (not over 1 inch deep) may be repaired. Damage or honeycomb in excess of this will be tentatively rejected, but will be subject to structural review.

425.7 Workmanship and Tolerance

Reinforcing steel required to extend outside of the member shall not project by more than 1/2 inch or less than 3/4 inch from plan dimension unless otherwise approved by the Engineer. In the plan of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch or 1/12 of the spacing between bars, whichever is greater. 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.

Allowable tolerance from the dimensions and configuration shown on the approved shop drawings shall be as follows:

	Beams (inches)	Boxes (inches)
Length	$\pm \frac{3}{4}$	$\pm \frac{1}{2}$
Width	$+ \frac{3}{4}, - \frac{1}{4}$	$\pm \frac{1}{4}$
Depth	$+ \frac{1}{2}, - \frac{1}{4}$	$\pm \frac{1}{4}$
Top Slab or Flange Thickness	$+ \frac{1}{2}, - \frac{1}{4}$	$\pm \frac{1}{2}$
Thickness Bottom Slab or Flange Thickness	$+ \frac{1}{2}, - \frac{1}{4}$	$+ \frac{1}{2}, - \frac{1}{8}$
Web or Wall Thickness	$+ \frac{3}{4}, - \frac{1}{4}$	$+ \frac{3}{8}$
Horizontal Alignment-Upon release of stress	$\pm \frac{1}{8}$ per 10' of length	$\pm \frac{1}{4}$
Deviation of Ends From Shop Plan	$\pm \frac{1}{4}$	$\pm \frac{1}{4}$ per 1' of depth
Horizontal Skew Vertical Better	$\pm \frac{1}{8}$ per 1' of depth	$\pm \frac{1}{4}$ per 1' of depth

continued			
		Beams (inches)	Boxes (inches)
Bearing Surfaces:	Normal to Vertical Axis Deviation from Plane	$\pm 1/8$ $\pm 1/16$	N/A $+ 1/8$
Anchor Hole Location:	From End of Member Longitudinal Spacing Transverse Location	$+ 3/4, - 1/4$ $\pm 3/4$ $\pm 1/4$	$\pm 1/4$ $\pm 1/2$ $\pm 1/4$
Diaphragm or Lateral Tie Holes		$\pm 1/2$	$\pm 1/2$
Longitudinal Position of Void		N/A	± 1
Position of Strands		$\pm 1/4$	$\pm 1/4$
Position of Hold-Down Points		± 6	± 6
Position of Handling Devices		± 6	± 6

Where sections of forms are to be joined, an offset of 1/16 inch for flat surfaces and 1/8 inch for corners and bends will be permitted. Offsets between adjacent and header sections shall not exceed 1/4 inch.

Variations greater than specified above shall be corrected to within these tolerances or be subject to structural review. Horizontal alignment (sweep) beams and girders only, which may increase at a later time over that shown in the table, will be acceptable if the member can be hauled, erected and aligned to within the above tolerance without being damaged.

Tolerances for concrete piling shall not exceed 1/8 inch per 10 feet for the maximum sweep (curvature along the axis of the pile).

Tolerances for post-tensioned segmental members shall conform to [Item No. 403](#), "Concrete for Structures".

The head of the pile shall not be out of square by more than 1/8 inch.

Small, damaged or honeycombed areas which are purely surface in nature (not over 1 inch deep) may be repaired. Damage or honeycomb in excess of this will be tentatively rejected, but will be subject to structural review.

When piling are cast with internal voids, the position of the void shall be within $\pm 1/2$ inch.

Piling cracked in the process of fabrication, handling, hauling or driving will be subject to the following provisions:

Piling which have one or more cracks transverse to the main reinforcement or strand which are 1/16 inch or greater in width shall be rejected if the crack(s) occur in a portion which will be below ground or water level after driving. If the crack(s) herein described will be located above ground or water level when driving is completed, the piling may be used provided it is cut back to the crack and rebuilt to grade. No additional payment will be made for this build-up.

Piling which have one or more cracks as described above, that are less than 1/16 inch in width may be used if the crack(s) is sealed with a Type VII epoxy, conforming to Item No. 867, "Epoxy Adhesive".

The cracks shall be grooved a minimum of ¼ inch in width and depth and the epoxy shall be applied in the groove and extend over an area not less than 1 inch on each side of the crack. The area to which the epoxy is to be applied shall be clean and dry. If during driving, cracks develop in the portion which will be below ground, driving operations shall be stopped and the required epoxy material applied before driving continues.

Piling with one or more cracks parallel or diagonal to the main reinforcing steel or strand which extend to the plane of reinforcement as determined by the Engineer, will be cause for rejection. If these piling are found to be acceptable, proper repair shall be made, conforming to the above requirements.

Fine hair cracks or surface checks, which do not extend to the plane of the nearest reinforcing steel, as determined by the Engineer, will not generally require repair and will not be cause for rejection.

425.8 Measurement

Precast, prestressed concrete beams or girders of the type specified, cast and stressed as required by the plans, will be measured by the linear foot, as established on reviewed shop drawings. Other precast, prestressed concrete members of the size and type specified, cast and stressed as required by the plans will be measured by the linear foot or each as indicated.

Precast, prestressed concrete spans of the size and type specified, cast and stressed as required by the plans will be measured as each prestressed span is complete in place.

Cast-in-place structures (or structures where the Contractor has the option of casting-in-place) will be measured in accordance with the provisions of TxDOT Item 426, "Prestressing".

425.9 Payment

Precast, prestressed concrete beams or girders will be paid for at the unit price bid per linear foot for "Prestressed Concrete Beams" of the type specified.

The above price shall be full compensation for constructing the members, furnishing and tensioning prestressing steel; conduit, when required; furnishing and placing reinforcing steel, bearing plates and bearing pads; all bars, anchorage plates and appurtenances which become an integral part of the structure; for grouting of holes; for any necessary repair and for any special treatment of end anchorages and shoes as indicated and for furnishing all materials, tools, equipment, labor and incidentals necessary to fabricate, transport and erect the members in the structure as indicated.

Payment will be made under:

Prestressed Concrete Beams, Type , Size _____ - Per Linear Foot.

Prestressed Concrete Beams, Type , Size _____ - Per Each.

End

Ref: Item No.: [360](#), [403](#), [406](#), [425](#), [438](#), [867](#)

TxDOT Item No.: 426

ITEM NO. 430
P.C. CONCRETE CURB AND GUTTER

430.1 Description

This item shall govern Portland Cement (p.c.) concrete curb or p.c. curb and gutter with reinforcing steel as required, that is constructed in accordance with this specification on an approved subgrade and base in conformity with the lines, grades, section indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

430.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. P.C. Concrete Curb and Gutter or P.C. Concrete Curb) and construction details (i.e. base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

430S.3 Materials

- A. Concrete

The Portland cement (p.c.) concrete shall conform to Class A Concrete, Section 403.7 (Table 4) of Standard Specification [Item No. 403](#), "Concrete for Structures" or Sections 360.4 and 360.6 of Standard Specification [Item No. 360](#), "Concrete Pavement" when curb and gutter is to be constructed integral with the pavement.

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification [Item No. 406](#), "Reinforcing Steel".

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification [Item No. 408](#), "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification [Item No. 409](#), "Membrane Curing".

- E. Flexible Base

Aggregate shall conform to Standard Specification [Item No. 210](#), "Flexible Base".

430.4 Construction Methods

A. Subgrade and Base Preparation

Subgrade for curb and gutter shall be excavated and prepared to depth and width requirements indicated on the Drawings, including a minimum of 18 inches (450 mm) behind the curb, unless a greater width is indicated on the Drawings. The subgrade shall be shaped to the line, grades, cross section and dimensions indicated on the Drawings. A minimum of 4 inches (100 mm) of flexible base shall be spread, wetted and thoroughly compacted under curb and gutter as specified in Standard Specification [Item No. 210](#), "Flexible Base". If dry, the base shall be sprinkled lightly with water before p.c. concrete is deposited thereon.

B. C & G Forms

Forms shall be of metal, well-seasoned wood or other approved material. The length of the forms shall be a minimum of 10 feet (3 meters). Flexible or curved forms shall be used for curves of 100-foot (30 meter) radius or less. Wood forms for straight sections shall be not less than 2 inches (50 mm) in thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, of the depth required and clean, straight, free from warp and, if required, oiled with a light form oil. All forms shall be securely staked to line and grade and maintained in a true position during the placement of p.c. concrete.

C. Reinforcing Steel

The reinforcing steel, if required, shall be placed as shown on the typical section of the Drawings. Care shall be exercised to keep all steel in its proper location during p.c. concrete placement.

D. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch (19 mm) in thickness, shall be provided at intervals not to exceed 40 feet (12 meters) and shall extend the full width and depth of the p.c. concrete. Weakened plane joints shall be made 3/4 inch (19 mm) deep at 10-foot (3 meters) intervals. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, 1/2 inch (12.5 mm) in diameter and 24 inches (600 mm) in length, shall be installed at each expansion joint. Sixteen inches (400 mm) of one end of each dowel shall be thoroughly coated with hot oil, asphalt or red lead, so that it will not bond to the concrete. The dowels shall be installed with a dowel sleeve on the coated end as indicated on the Drawings or equivalent method as directed by the Engineer or designated representative.

E. P.C. Concrete Placement and Form Removal

Concrete shall be placed in the forms and properly consolidated. Within 1 hour after p.c. concrete placement, a thin coating, that is no more than 1/2 inch (12.5 mm) nor less than 1/4 inch (6.25 mm) thick of finish mortar, composed of 1 part Portland Cement to 2 parts fine aggregate, shall be worked into the exposed

faces of the curb and gutter by means of a "mule". After the p.c. concrete has become sufficiently set, the exposed edges shall be rounded by the use of an edging tool to the radii indicated. The entire exposed surface of the curb and gutter shall be floated to a uniform smooth surface, and then finished with a camel hairbrush to a gritty texture. The forms shall remain in place a minimum of 24 hours unless approved otherwise by the Engineer or designated representative.

After removal of the forms, any minor honeycombed surfaces shall be plastered with a mortar mix as described above. Excessively honeycombed curb and gutter, as determined by the Engineer or designated representative, shall be completely removed and replaced when directed.

F. Curing

Immediately after finishing the curb, concrete shall be protected by a membrane curing conforming to Standard Specification [Item No. 409](#), "Membrane Curing".

After a minimum of 3 days curing and before placement of the final lift of the base course, the curb shall be backfilled to the full height of the p.c. concrete, tamped and sloped as directed by the Engineer or designated representative. The upper 4 inches (100-mm) of backfill shall be of clean topsoil that conforms to Standard Specification [Item No. 130](#), "Borrow" and is free of stones and debris.

G. Seeding in Turf Areas

When turf is to be established, preparation of the seedbed shall conform to [Item No. 604](#), "Seeding for Erosion Control".

430.5 Measurement

Accepted work as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of p.c. concrete curb and gutter and/or p.c. concrete curb, complete in place.

430.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "P.C. Concrete Curb and Gutter" or P.C. Concrete Curb. The price shall include full compensation for all work as set forth and described under payment Method A and/or B.

A. Method A : with Excavation

This payment method shall include all the work performed for "P.C. Concrete Curb and Gutter" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

B. Method B : with Fine Grading

This payment method includes all the work performed for "P.C. Concrete Curb

and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

C. Method C : with Excavation

This payment method includes all the work performed for " P.C. Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, furnishing and placing all base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

D. Method D : with Fine Grading

This payment method includes all the work performed for "P.C. Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, finishing placing reinforcing steel, dowels, expansion joint material, curing material, backfill and for other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

P.C.Concrete Curb and Gutter (Excavation) Per Lineal Foot.

P.C. Concrete Curb and Gutter (Fine Grading) Per Lineal Foot.

P.C.Concrete Curb (Excavation) Per Lineal Foot.

P.C.Concrete Curb (Fine Grading) Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item No. 430, "P.C. CONCRETE CURB AND GUTTER"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No 130	Borrow
Item No 210S	Flexible Base
Item No. 360	Concrete Pavement"
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 430, "P.C. CONCRETE CURB AND GUTTER"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 606	Fertilizer
Item No. 301	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 360	Concrete Pavement
Item No. 431	Machine Laid PCC Curb and Gutters
Item No. 433	P.C. Concrete Driveways
Item No. 434	P.C. Concrete Medians and Islands
Item No. 436	P.C. Concrete Valley Gutters

ITEM NO. 431
Machine Laid PCC Curb and Gutter

431.1 Description

This item shall govern Portland cement (p.c.) concrete curb and gutter and reinforcing steel dowels, constructed in accordance with this specification on an approved base in conformity with the lines, grades, sections as indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

431.2 Submittals

The submittal requirements of this specification item include:

- A. Class I p.c. concrete mix design,
- B. Type of Installation (i.e. P.C. Concrete Curb and Gutter or P.C. Concrete Curb) and construction details (i.e. base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

431.3 Materials

- A. Portland Cement Concrete (PCC)

The Portland Cement Concrete shall conform to Class I Concrete, Section 403.7 (Table 4) of Standard Specification [Item No. 403](#), "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification [Item No. 406](#), "Reinforcing Steel".

- C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification [Item No. 408](#), "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification [Item No. 409](#), "Membrane Curing".

- E. Flexible Base

Flexible base material shall conform to Standard Specification [Item No. 210](#), "Flexible Base".

F. Stabilized Base

A stabilized base identified as a Type A or B shall conform to the requirements of Standard Specification [Item 340](#), "Hot Mix Asphaltic Concrete Pavement". If an asphalt stabilized base is indicated on the Drawings it shall conform to Standard Specification [Item No. 206](#), "Asphalt Stabilized Base (Plant Mix)".

431.4 Construction Methods

A. Subgrade and Base Preparation

Subgrade for curb and gutter shall be excavated and prepared to depth and width requirements indicated on the Drawings, including a minimum of 18 inches (450 mm) behind the curb, unless a greater width is indicated on the Drawings. The subgrade shall be shaped to the line, grade, cross section and dimensions indicated on the Drawings. A minimum thickness of 4 inches (100 mm) of flexible base (Standard Specification [Item No. 210](#)) or stabilized base shall be placed, spread, wetted (flexible base only) and thoroughly compacted. If dry, the flexible base shall be sprinkled lightly with water before p.c. concrete is deposited thereon.

B. PCC Curb and Gutter Extrusion

The pcc curb shall be laid by a curb extrusion machine approved by the Engineer or designated representative. The line for top of curb shall be maintained from a guideline or guide rails, set by the Contractor. Curb outline shall strictly conform to the details indicated on the Drawings. The forming tube of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine, to provide required variable height of curb necessary to conform to the established grade line. If a guideline is used, a pointer or gage shall be attached to the machine in such a manner that a comparison can be made between the curb and the guideline in order to provide a continual check on the curb grade. Other methods may be used if approved in writing by the Engineer or designated representative.

C. P.C. Concrete Placement and Finish

The p.c. concrete shall be fed into the machine in such a manner and at such consistency that the finished curb will present a well-compacted mass with a surface free from voids and honeycomb and true to established shape, line and grade.

Any additional surface finishing indicated on the Drawings and/or required by the Engineer or designated representative shall be performed immediately after placement. Weakened plane joints shall be cut to a depth of 3/4 inch (19 mm) at 10-foot (3 meters) intervals or as directed by the Engineer or designated representative.

Whenever the curb end abuts a p.c. concrete structure a 3/4-inch (19-mm) pre-molded expansion joint conforming to the curb section shall be placed between the 2 concrete surfaces.

Whenever extrusion is suspended long enough to produce a cold joint, 1/2-inch (12.5 mm) smooth dowel bars, 24 inches (600 mm) long, shall be embedded 12 inches (300 mm) into the completed curb, 1/4 curb height from top and bottom. The end of the curb at the point of suspension of extrusion shall be cut back until all remaining p.c. concrete is of a dense, well-compacted nature.

Any addition of concrete to the extruded curb is to be applied and finished before the extruded curb has achieved its initial set. The final finish shall have a gritty surface approved by the Engineer or designated representative.

D. Curing

When finishing operations are completed the curb shall be cured conforming to Standard Specification [Item No. 409](#), "Membrane Curing".

When the curb has cured a minimum of 3 days and prior to placement of the final lift of base course, it shall be backfilled to the full height of the p.c. concrete, tamped and sloped to drain as directed by the Engineer or designated representative.

In turf areas, the upper 4 inches (100-mm) of backfill shall be of clean topsoil, that conforms to Standard Specification [Item No. 130](#), "Borrow" and shall be free of stones and debris.

E. Seeding in Turf Areas

When turf is to be established, the preparation of the seedbed shall conform to Standard Specification [Item No. 604](#), "Seeding for Erosion Control".

431.5 Measurement

Machine Laid PCC Curbs will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of completed and accepted curb, complete in place.

431.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "Machine Laid PCC Curb and Gutter". The unit bid price shall include full compensation for all work as set forth and described under payment Method A, B or C below.

A. Method A: With Excavation

This payment method includes all the work performed for "Machine Laid PCC Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all base material, reinforcing steel, dowels, expansion joint materials, curing material, backfill and all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

B. Method B: With Fine Grading

This payment method includes all the work performed for "Machine Laid PCC Curb and Gutter", complete, at the unit bid price. The unit bid price shall include

full compensation for fine grading, furnishing and placing reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

C. Method C: Subsidiary or Incidental Work

This method provides for payment for subsidiary or incidental work relating to "Machine Laid PCC Curb and Gutter" as may be detailed and noted on the Drawings or included and described in the "Special Provisions" of the Standard Contract Documents.

Payment will be made under one of the following:

- | | |
|---|------------------|
| Machine Laid Curb and Gutter (Excavation) | Per Lineal Foot. |
| Machine Laid Curb and Gutter (Fine Grading) | Per Lineal Foot. |
| Machine Laid Curb and Gutter (Subsidiary/Incidental Work) | Per Lineal Foot. |

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item No. 431, "MACHINE LAID PCC CURB AND GUTTER"
--

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130	Borrow
Item No. 210	Flexible Base
Item No. 206	Asphalt Stabilized Base (Plant Mix)
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 360	Concrete Pavement
Item No. 430	P.C. Concrete Curb and Gutter
Item No. 433	P.C. Concrete Driveways
Item No. 434	P.C. Concrete Medians and Islands
Item No. 436	P.C. Concrete Valley Gutters
Item No. 606	Fertilizer

ITEM NO. 432S
P. C. CONCRETE SIDEWALKS

432.1 Description

This item shall govern the construction of Portland cement concrete sidewalks, as herein specified, on an approved subgrade and in conformance with the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

432.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

432.3 Materials

- A. Portland Cement Concrete
Portland cement concrete shall be Class A conforming to Specification Item No. 403, "Concrete for Structures".
- B. Reinforcement
Reinforcement shall conform to Specification Item No. 406, "Reinforcing Steel".
- C. Expansion Joint Materials
Expansion joint materials shall conform to Specification Item No. 408, "Expansion Joint Materials".
- D. Membrane Curing Compound
Membrane curing compound shall conform to Specification Item No. 409, "Membrane Curing".

432.4 Construction Methods

The subgrade shall be excavated in accordance with Specification Item No. 111, "Excavation", prepared in accordance with Specification Item No. 201, "Subgrade Preparation", shaped to the lines, grades and cross section as indicated on the Drawings or as directed by the Engineer or designated representative and thoroughly compacted in accordance with Specification Item No. 201. A granular cushion of a minimum thickness of 2 inches (50 mm) but maximum thickness of 5 inches (125 mm),

composed of crusher screenings, gravel and sand, crushed rock or coarse sand, shall be spread, wetted thoroughly, tamped and leveled. The granular cushion shall be moist at the time the Portland cement concrete is placed.

If the subgrade is undercut by more than 4 inches (100 mm) or the elevation of the natural ground is more than 4 inches (100 mm) below "top of subgrade", then a necessary backfill/embankment layer of an approved material shall be placed 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 (50 mm) cushion need not be used. The Engineer or designated representative will determine if the subgrade meets the above requirements.

Sidewalk forms shall be constructed of metal or well-seasoned wood not less than 2 inches (50 mm) in thickness, with a section satisfactory to the Engineer or designated representative. The forms shall be clean, straight, and free from warp with a depth equal to the thickness of the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the deposition of Portland cement concrete. Before p.c. concrete is placed, the forms shall be thoroughly oiled with a light form oil.

Expansion joint material 3/4 inch (19 mm) 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 p.c. concrete. Maximum spacing of expansion joints shall be 40 feet (12 meters) as indicated on the Drawings or as directed by the Engineer or designated representative. Weakened plane joints shall be spaced at 5 feet (1.5 meters) on center. Normal dimensions of the weakened plane joints shall be 1/4 inch wide and 3/4 inch deep (6 mm wide and 19 mm deep). All joints shall be constructed perpendicular (90 degrees) to the centerline of walk and shall match any previously placed concrete joints.

Reinforcement for sidewalks shall consist of 1 layer of 6 x 6 – W2.9 x W2.9(150 x 150 – MW19 x MW19) wire fabric or #3 (10M) bars, placed not more than 18 inches (450 mm) on center both directions. All reinforcement shall be placed equidistant from the top and bottom of the p.c. concrete. Care shall be exercised to keep all steel in its proper position during placement of the p.c. 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 (150 mm) will be permitted. Splices in the #3 (10M) bars shall have a minimum lap of 12 inches (300 mm).

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

Portland cement concrete shall be placed in the forms and spaded, tamped and thoroughly consolidated until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface; then finished with a broom or wood float to a gritty texture unless indicated otherwise on the Drawings or as directed by the Engineer or designated representative. The outer edges and joints shall be rounded with approved tools to a 1/4-inch (6 mm) radius. Care will be

exercised to prevent loss of dummy joints or rounded edges when applying the brush finish.

Portland cement concrete sidewalk ramps shall be stamped or formed to produce a finished surface with detectable warnings in accordance with the requirements of the American Disabilities Act and Texas Accessibility Standards (TAS), including Sections 4.29.2 and A4.29.2. The p.c. concrete sidewalk ramps shall be constructed in accordance with appropriate City of Round Rock Standard Details.

Detectable warning for the ramps shall consist of raised truncated domes with a diameter of nominal 0.9 inch (23 mm), a height of nominal 0.2 inch (5 mm) and center-to-center spacing of nominal 2.35 inches (60 mm) and shall contrast visually with adjoining surfaces, either light on dark or dark-on-light. The material used to provide contrast shall be an integral part of the walking surface.

When indicated on the Drawings or as directed by the Engineer or designated representative, the construction of the sidewalk ramp shall include the installation of interlocking concrete paving units (Standard Specification Item No. 480, "Concrete Paving Units"). The concrete paving units shall be constructed in accordance in accordance with Standard Specification Item No. 485, "Concrete Paving Units for Sidewalk Ramps" and appropriate City of Round Rock Standard Details.

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent or by wetted cotton or burlap mats, and cured in accordance with Item No. 410 "Concrete Structures". The sides of the p.c. concrete shall be cured in the forms. If the forms are removed during the curing process, the curing shall be continued by the placement of fill against the exposed concrete edges or by other procedures conforming to Item No. 410, "Concrete Structures". The top 4 inches (100 mm) of fill shall be clean topsoil conforming to Item No. 604, "Seeding for Erosion Control".

Existing sidewalk that is scheduled for removal and replacement shall be removed and the underlying material shaped to the lines, grades and cross section as indicated in the drawings or as directed by the Engineer or designated representative. The removal and/or relocation of obstructions, including but not limited to signs, trash cans and benches on concrete pads, abandoned manholes, sprinkler control valves and landscaping, shall be performed, as indicated on the drawings, in a manner acceptable to the Engineer or designated representative. Removal and/or relocation of obstructions will be considered incidental work to this item and will not be paid for directly.

Existing PVC pipe drains in and behind curb shall be removed and replaced as required in new sidewalk and/or curb and gutter. In areas of proposed sidewalk construction, where curb and gutter is to remain in place, existing PVC pipe shall be cut far enough behind the back of curb to allow sufficient room for joint fittings to connect to new or salvaged PVC pipe.

The Contractor shall be responsible for removing and replacing mailboxes that are located in the construction area, while assuring that mail delivery will not be interrupted as a result of the construction activities. Mailboxes shall not be laid on the ground.

All necessary excavation, filling and grading of the slopes adjacent to the completed concrete sidewalks will be considered incidental work pertaining to this item and will not be paid for directly. The adjacent excavation and grading of the slopes shall be done in a manner acceptable to the Engineer or designated representative.

432.5 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of surface area of "Concrete Sidewalk". Accepted work performed as prescribed by "Sidewalk Ramps" will be measured per each for the type of ramp indicated on the Drawings.

432.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "Concrete Sidewalk" and/or "Sidewalks Reconstruction" or per each for "Concrete Sidewalk Ramps". The unit bid price shall include full compensation for excavating and/or removal of existing sidewalk and other obstructions, relocating obstructions, replacing PVC drain pipe, re-vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

Payment will be made under one of the following:

New Sidewalks

New P.C. Concrete Sidewalks, 4 Inch thickness	Per Square Foot.
New P.C. Concrete Sidewalks, 5 Inch thickness	Per Square Foot.
New P.C. Concrete Sidewalks, 6 Inch thickness	Per Square Foot.
New P.C. Concrete Sidewalks, 7 Inch thickness	Per Square Foot.

Sidewalks Reconstruction

Reconstruct Concrete Sidewalks to 4 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Reconstruct Concrete Sidewalks to 5 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Reconstruct Concrete Sidewalks to 6 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Reconstruct Concrete Sidewalks to 7 Inch thickness, including removal of existing sidewalk	Per Square Foot.

Ramps

- P.C. Sidewalk Curb Ramp with Pavers (Type I) Per Each.
- P.C. Sidewalk Curb Ramp with Pavers (Type IA) Per Each.
- P.C. Sidewalk Curb Ramp with Pavers (Type IB) Per Each.
- P.C. Sidewalk Curb Ramp with Pavers (Type IC) Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification 432, "P. C. CONCRETE SIDEWALKS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 111	Excavation
Item No. 201	Subgrade Preparation
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 407	Fibrous Concrete
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 410	Concrete Structures
Item No. 480	Concrete Paving Unit
Item No. 485	Concrete Paving Units for Sidewalk Ramps
Item No. 604	Seeding for Erosion Control

American Disabilities Act, Federal Register; Volume 56, No. 144; July 26, 1991

ADA Accessibility Guidelines For Building And Facilities

<u>Designation</u>	<u>Description</u>
Section 4.29	Detectable Warnings on Walking Surfaces
Section A4.29.2	Detectable Warnings on Walking Surfaces

Architectural Barriers; Texas Civil Statutes, Article 9102; June 14, 1995

Texas Accessibility Standards (TAS)

<u>Designation</u>	<u>Description</u>
Section 4.29	Detectable Warnings on Walking Surfaces
Section A4.29.2	Detectable Warnings on Walking Surfaces

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 432, "P. C. CONCRETE SIDEWALKS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102	Clearing and Grubbing
Item No. 104	Removing Concrete
Item No. 110	Street Excavation
Item No. 132	Embankment
Item No. 203	Lime Treatment for Materials In Place
Item No. 204	Portland Cement Treatment for Materials In Place
Item No. 230	Rolling (Flat Wheel)
Item No. 232	Rolling (Pneumatic Tire)
Item No. 234	Rolling (Tamping)
Item No. 236	Rolling (Proof)
Item No. 360	Concrete Pavement
Item No. 402	Controlled Low Strength Material
Item No. 404	Pneumatically Placed Concrete
Item No. 405	Concrete Admixtures
Item No. 411	Surface Finishes for Concrete
Item No. 436	P.C. Concrete Valley Gutters
Item No. 602	Sodding for Erosion Control
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 642	Silt Fence

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)

RELATED CROSS REFERENCE MATERIALS- continued

Specification 432, "P. C. CONCRETE SIDEWALKS"

American Disabilities Act, Federal Register; Volume 56, No. 144; July 26, 1991
ADA Accessibility Guidelines For Building And Facilities

<u>Designation</u>	<u>Description</u>
Section 4.3	Accessible Route
Section 4.3.6	Surface Texture
Section 4.3.7 & 4.7.2	Slope
Section 4.3.8 & 4.5.2	Changes in Levels
Section 4.7	Curb Ramps
Section 4.8	Ramps

Architectural Barriers; Texas Civil Statutes, Article 9102; June 14, 1995
Texas Accessibility Standards (TAS)

<u>Designation</u>	<u>Description</u>
Section 4.3	Accessible Route
Section 4.3.6	Surface Texture
Section 4.3.7 & 4.7.2	Slope
Section 4.3.8 & 4.5.2	Changes in Levels
Section 4.7	Curb Ramps
Section 4.8	Ramps

Item No. 433
P. C. Concrete Driveways

433.1 Description

This item shall govern construction of Portland Cement (p.c.) concrete driveways, as herein specified, on an approved subgrade, in conformity with the lines, grades and cross section indicated on the Drawings, or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

433.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. Type I, Flared Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

433.3 Materials

- A. Concrete

The Portland cement Concrete shall conform to Class A, Section 403.7 (Table 4) of Standard Specification [Item No. 403](#), "Concrete for Structures."

- B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification [Item No. 406](#), "Reinforcing Steel".

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification [Item No. 408](#), "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification [Item No. 409](#), "Membrane Curing".

- E. Cushion Layer

The Cushion layer shall consist of crusher screenings, gravel or coarse sand.

433.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification [Item No. 410](#), "Concrete Structures".

A. Subgrade Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross sections indicated on the Drawings or as directed by the Engineer or designated representative. The subgrade shall be thoroughly compacted in accordance with Standard Specification [Item No. 201](#), "Subgrade Preparation". A 2-inch (50-mm) minimum compacted thickness cushion shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the p.c. concrete is placed.

If the subgrade is undercut or natural ground is located below the top of subgrade, the necessary backfill material shall conform with Standard Specification Item 130, "Borrow" and shall be compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade material consists of gravel or includes 70 percent of rock, the 2-inch (50-mm) cushion layer may not be required. The Engineer or designated representative will determine if the subgrade meets the above requirements.

B. Forms

Forms shall be of metal, well-seasoned wood or other approved material of a section satisfactory to the Engineer or designated representative. Wood forms shall not be less than 2 inches (50 mm) nominal thickness for straight runs and 1-inch (25-mm) nominal thickness for curved runs. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of a depth equal to the thickness of the finished work.

All forms shall be securely staked to line and grade and maintained in a true position during the placement of p.c. concrete.

C. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch (19 mm) thick, shall be provided where the new construction abuts existing sidewalks or driveways or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the p.c. concrete. Similar expansion material shall be placed around all obstructions protruding through the driveway. Weakened plane joints shall be located on 10-foot (3-meter) centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane groove joints shall be 1/4-inch (6.25-mm) wide and 3/4 inch (19 mm) deep.

D. Reinforcement

Reinforcement for driveways shall consist of 1 layer of 6 x 6 by W 2.9 x W 2.9 (150 x 150 by MW19 x MW19) wire fabric or No. 3 (10 M) bars placed no more than 18 inches (450 mm) on center, both directions.

All reinforcements shall be placed equidistant from the top and bottom of the p.c. concrete slab. Care shall be exercised to keep all steel in its proper position

during the placement of p.c. 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 (150 mm) will be permitted. Splices in the No. 3 (10 M) bars shall have a minimum lap of 12 inches (300 mm).

E. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms and spaced, tamped and thoroughly compacted until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a broom or wood float to a gritty texture unless otherwise indicated on the Drawings. The outer edges and joints shall be rounded with approved tools to a 1/4-inch (6.25 mm) radius. Care shall be exercised to prevent loss of dummy joints or rounded edges when applying the broom finish.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent in conformance with Standard Specification [Item No. 409](#), "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or approved representative.

Traffic shall be barricaded from using the driveway for a minimum of 4 days after initial placing and may be opened to traffic only with approval of the Engineer or designated representative.

G. Incidental Work

All necessary excavation, filling and grading adjacent to the completed pcc driveways, will be considered incidental work pertaining to this item and will not be paid for directly.

The adjacent excavation and grading shall be done with topsoil conforming to Standard Specification [Item No. 130](#), "Borrow". When turf is to be established, the preparation of the seedbed shall conform to Standard Specification [Item No. 604](#), "Seeding for Erosion Control", in a manner acceptable to the Engineer or designated representative.

433.5 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meters: 1 square meter equals 10.764 square feet) of surface area of the specific type of p.c. concrete driveway.

433.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "Concrete Driveways". The unit bid price shall include full compensation for preparation of the subgrade; furnishing and placing all materials, including cushion layer, all reinforcing steel and expansion joint materials; and any other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

P.C. Concrete Driveway

Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item No. 433, "P.C. CONCRETE DRIVEWAYS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130	Borrow
Item No. 201	Subgrade Preparation
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 410	Concrete Structures
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 433, "P.C. CONCRETE DRIVEWAYS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 430	P.C. Concrete Curb and Gutter
Item No. 431	Machine Laid PCC Curb and Gutter
Item No. 432	Concrete Sidewalks
Item No. 434	P.C. Concrete Medians and Islands
Item No. 436	P.C. Concrete Valley Gutters
Item No. 470	Curb Cuts for Sidewalk Ramps and Driveways
Item No. 606	Fertilizer

Item No. 434S

P.C. Concrete Medians and Islands

434.1 Description

This item shall govern construction of Portland cement concrete traffic islands and medians in accordance with these specifications and in conformity to the lines, grades, sections and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

434.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. Median or Island) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),

434.3 Materials

- A. Portland Cement (p.c.) Concrete

The p.c. concrete shall conform to Class A Concrete, Section 403.7 (Table 4) of Standard Specification [Item No. 403](#), "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification [Item No. 406](#), "Reinforcing Steel".

- C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification [Item No. 408](#), "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification [Item No. 409](#), "Membrane Curing".

- E. Admixtures

Admixtures shall conform to Standard Specification [Item No. 405](#), "Concrete Admixtures".

- F. Aggregate Cushion

Cushion layer shall consist of crusher screenings, gravel, sand, crushed stone or "Flexible Base" materials (Standard Specification [Item No. 210](#)) approved by the Engineer or designated representative.

434.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification [Item No. 410](#), "Concrete Structures".

A. PCC Mix Design

The p.c. concrete shall conform to an approved design mix for a Class A p.c. concrete on file with the City or proposed Class A mix designs with the necessary test data may be submitted for approval by the Engineer or designated representative.

High range water reducing admixtures conforming to Standard Specification [Item No. 360](#), "Concrete Pavements" may be used when approved by the Engineer or designated representative.

B. Subgrade and Base Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross section indicated on the Drawings or as directed by the Engineer or designated representative, and shall be thoroughly compacted conforming to Standard Specification [Item No. 201](#), "Subgrade Preparation". A cushion layer, 2 inches (50 mm) minimum thickness, shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the p.c. concrete is placed.

C. Forms

Forms shall be of metal, well-seasoned wood or other approved material. When forming edges that will be 10 feet or more in length, the length of each component of the forms shall be a minimum of 10 feet (3 meters) in length, unless otherwise approved by the Engineer or designated representative. When forming edges less than 10 feet, the form shall be continuous (one piece) for said edge unless otherwise approved by the Engineer or designated representative. Flexible or curved forms shall be used for curves of 100-foot (30-meter) radius or less. Wood forms for straight sections shall be not less than 2 inches (50 mm) nominal thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, and shall be clean, free from warp, and of a depth equal to the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the placement of the p.c. concrete and, if required, forms shall be thoroughly oiled with a light form oil prior to p.c. concrete placement. If the adjacent existing asphalt pavement is damaged during construction, it shall be restored to its original condition.

D. Reinforcement

Reinforcement shall conform to the details indicated on the Drawings or the directions of the Engineer or designated representative. Care shall be exercised to keep reinforcement in its proper position during the placement of the p.c. concrete.

E. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch (19 mm) in thickness, shall be placed as indicated on the Drawings with a maximum spacing of 40 feet (12 meters) or as directed by the Engineer or designated representative. Expansion joints shall be placed on the same alignment when adjacent to a Portland Cement concrete pavement. Weakened plane joints shall be made 3/4 inch (19 mm) deep and equally spaced, normally at 5 foot (1.5 meters) on centers or as directed by the Engineer or designated representative. Expansion joints shall be required between the curb and median p.c. concrete.

F. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms to the depth indicated on the Drawings, and properly consolidated and until mortar entirely covers the surface and forms a monolithic finish. If a vibrator is used, care shall be taken not to leave it in one location long enough to induce segregation. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a camel hairbrush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii indicated on the Drawings.

When the ambient air temperature is above 85°F (30°C), an approved retarding agent will be required in all p.c. concrete. The maximum temperature of all p.c. concrete placed shall not exceed 95°F (35°C), unless High Range Water Reducer Admixtures are used.

G. Curing

Immediately after finishing the p.c. concrete median or island, the pcc surface shall be protected by a membrane-compound curing agent conforming with Standard Specification [Item No. 409](#), "Membrane Curing". The curing procedures shall be acceptable to the Engineer or designated representative.

434.5 Measurement

Accepted work as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area of p.c. concrete medians and/or p.c. concrete island, complete in place.

434.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "P.C. Concrete Medians and Islands". The unit bid price shall include full compensation for preparation of the subgrade; finishing and placing all materials, including all reinforcing steel, welded wire fabric; and any other materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

___ Inch P.C. Concrete Medians and Islands Per Square Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item No. 434, "P.C. CONCRETE MEDIANS AND ISLANDS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 201	Subgrade Preparation
Item No. 210	Flexible Base
Item No. 403	Concrete for Structures
Item No. 405	Concrete Admixtures
Item No. 406	Reinforcing Steel
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 410	Concrete Structures

RELATED CROSS REFERENCE MATERIALS

Specification Item No. 434, "P.C. CONCRETE MEDIANS AND ISLANDS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 430	P.C. Concrete Curb and Gutter
Item No. 431	Machine Laid PCC Curb and Gutter
Item No. 432	P.C. Concrete Sidewalks
Item No. 433	P. C. Concrete Driveways
Item No. 434	P.C. Concrete Medians and Islands
Item No. 436	P.C. Concrete Valley Gutters
Item No. 470	Curb Cuts for Sidewalk Ramps and Driveways

Item No. 435
P.C. Concrete Steps

435.1 Description

This item shall govern construction of Portland Cement (p.c.) concrete steps (with or without reinforcing steel as required) on approved subgrade and in conformity with the lines, grades, sections and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

435.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p. c. concrete mix design,
- B. Construction details (i.e., reinforcing steel, curing membrane, etc.),

435.3 Materials

- A. Concrete

The p.c. concrete shall be Class A Concrete, Section 403.7 (Table 4) of Standard Specification [Item No. 403](#), "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification [Item No. 406](#), "Reinforcing Steel".

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification [Item No. 408](#), "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification [Item No. 409](#), "Membrane Curing".

435.4 Construction Methods

All excavation, including removal of existing steps or sidewalks and backfill, shall conform to Standard Specification [Item No. 401](#), "Structural Excavation and Backfill".

All forms and forming, placement of reinforcement when required, placement of concrete, form removal, finishing and curing shall conform to Standard Specification [Item No. 410](#), "Concrete Structures".

The height of the steps will be determined by the existing grade or as directed by the Engineer or designated representative. The tread width is normally 10 inches (250 mm) and the riser is normally 7 1/2 inches (190 mm), but these dimensions may be varied to

fit existing conditions as directed by the Engineer or designated representative. Step width will match the existing sidewalk, but not less than 3 feet (0.9 meter).

Reinforcement for the steps, when required, shall be as indicated on the Drawings.

Expansion joints shall be placed along the lower and upper tread and along each side when abutting p.c. concrete.

The steps shall be constructed monolithically. The p.c. concrete shall be placed in the forms and properly consolidated until it covers the area. The top surface shall be floated and troweled to a smooth surface, then finished with a camel hairbrush or wood float to a gritty texture and neat appearance. The outer edges and joints shall be rounded with approved tools with a 1/4-inch (6.25 mm) radius.

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent conforming to Standard Specification [Item No. 409](#), "Membrane Curing" or by wetted cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative.

435.5 Measurement

Accepted work as prescribed by this item will be measured by the cumulative width in feet (meters: 1 meter equals 3.281 feet) of individual steps (treads) including the bottom step.

435.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "P.C. Concrete Steps". The unit bid price shall include full compensation for all excavation, forms, concrete, reinforcement, curing, backfill, sloping; all labor, tools, materials, equipment; and incidentals necessary to complete the work.

Payment will be made under:

P.C. Concrete Steps Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item No. 435, "P.C. CONCRETE STEPS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 201	Subgrade Preparation
Item No. 210	Flexible Base
Item No. 401	Structural Excavation and Backfill
Item No. 403	Concrete for Structures
Item No. 405	Concrete Admixtures
Item No. 406	Reinforcing Steel
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 410	Concrete Structures

RELATED CROSS REFERENCE MATERIALS

Specification Item No. 435, "P.C. CONCRETE STEPS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 430	P.C. Concrete Curb and Gutter
Item No. 431	Machine Laid PCC Curb and Gutter
Item No. 432	P.C. Concrete Sidewalks
Item No. 4332	P.C. Concrete Driveways
Item No. 434	P.C. Concrete Medians and Islands
Item No. 436	P.C. Concrete Valley Gutters
Item No. 470	Curb Cuts for Sidewalk Ramps and Driveways

Item No. 436
P.C. Concrete Valley Gutters

436.1 Description

This item shall govern the construction of Portland cement (p. c.) concrete valley gutters on an approved subgrade in conformity to the lines, grades, and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

436.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p. c. concrete mix design,
- B. Construction details (i.e., reinforcing steel, curing membrane, etc.),

436.3 Materials

- A. Portland Cement Concrete

The Portland cement concrete shall be Class A Concrete, Section 403.7 (Table 4) of Standard Specification Item No. 403, "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408, "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409, "Membrane Curing".

436.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410, "Concrete Structures".

- A. Subgrade Preparation

Where a stabilized subbase is not provided, the subgrade shall be excavated in accordance with Standard Specification Index No. 111, "Excavation" to remove all unstable or otherwise objectionable material and all holes, ruts and depressions shall be filled with approved material.

Rolling shall be performed in accordance with Standard Specification Item No. 230 or 232, to the extent indicated on the Drawings or directed by the Engineer or designated representative. The roadbed shall be completed to the plane of the typical sections indicated on the Drawings and the lines and/or grades established by the Engineer or designated representative. All work shall conform to Standard Specification Item No. 201, "Subgrade Preparation".

If the subgrade is dry, the valley gutter area shall be sprinkled lightly immediately before the Portland cement concrete is placed.

Unless otherwise specified on the Drawings, all necessary excavation, filling and grading of the subgrade will be considered incidental work pertaining to this item, and will not be paid for directly.

B. Forms

Forms shall be of metal, well-seasoned wood or other approved material. Wood forms for straight sections shall be not less than 2 inches (50 mm) nominal thickness. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of a depth equal to the thickness of the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the placement of concrete and, if necessary, forms shall be oiled with a light form oil, prior to placement of p.c. concrete.

C. Reinforcing Steel

Reinforcement for Portland cement concrete valley gutters shall conform to the details indicated on the Drawings or as directed by the Engineer or designated representative. Care shall be exercised to keep the reinforcement in its proper position during the placement of Portland cement concrete.

D. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material 3/4 inch (19 mm) thick shall be provided as indicated on the Drawings or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the Portland cement concrete. Weakened plane joints shall be provided on 10 foot (3 meter) centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane joints shall be 1/4 inch (6.25 mm) wide and 3/4 inch (19 mm) deep.

E. Placement and Finishing

The Portland cement concrete shall be placed in the forms and properly consolidated until it entirely covers the surface and has a monolithic finish. The top surface shall be screeded and floated to a uniform smooth surface, then finished with a wood float to a gritty texture. The outer edges shall be rounded with approved tools to a 1/4-inch (6.25 mm) radius.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane-curing compound conforming to Standard Specification Item No. 409, "Membrane Curing" or by wetted cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative. Traffic shall be securely barricaded from using the Portland cement concrete valley gutter for a minimum of 4 days after initial placement and may be opened to traffic only with the approval of the Engineer or designated representative.

436.5 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area of Portland cement concrete placed. The square foot measurement shall include the reinforced monolithic curb placed at the ends of the valley gutter.

436.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "P. C. Concrete Valley Gutters". The unit bid price shall include full compensation for preparation the subgrade; furnishing and placing all materials, including reinforcing steel and expansion joint materials; any other materials, manipulations, labor, tools, equipment, barricading and all incidentals necessary to complete the work.

Payment will be made under:

P. C. Concrete Valley Gutters Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item No. 436, "P.C. CONCRETE VALLEY GUTTERS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 111	Excavation
Item No. 201	Subgrade Preparation
Item No. 230	Rolling (Flat Wheel)
Item No. 232	Rolling (Pneumatic)
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing
Item No. 410	Concrete Structures

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 436, "P.C. CONCRETE VALLEY GUTTERS"
--

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 110	Street Excavation
Item No. 130	Borrow
Item No. 236	Proof Rolling
Item No. 360	Concrete Pavement
Item No. 405	Concrete Admixtures
Item No. 430	P.C. Concrete Curb and Gutter
Item No. 431	Machine Laid PCC Curb and Gutter

ITEM NO. 438 ELASTOMERIC MATERIALS

438.1 Description

This item shall govern for the materials, testing, fabrication and placement of elastomeric materials, except as otherwise covered in other specifications or on the plans.

438.2 Materials

(1) Elastomeric Bearings

When specified on the plans, structural members shall be seated on elastomeric bearings.

These bearings may be either "plain" (consisting of elastomer only) or "laminated" (consisting of alternating individual layers of elastomer and nonelastic laminates) as indicated. Elastomeric bearings shall be specified on the plans by hardness (durometer), size and configuration and, in the case of laminated bearings, by the thickness of the individual layers of elastomer and the size and position of special connection members, if any, required to be vulcanized with the bearing.

(a) General

Unless otherwise indicated, the elastomer for bearings shall be formulated from previously unvulcanized 100 percent virgin polychloroprene or 100 percent virgin polyisoprene rubber polymers. Rubber-like polymers employed in the elastomer formulation shall be exclusively of the polychloroprene or natural polyisoprene type. Bearings will not be acceptable if the elastomer employed contains previously vulcanized rubber (natural or synthetic) or other synthetic rubber-like polymers.

Nonelastic laminates shall be 1/16 inch (-0 inch, +1/16 inch) thick steel strip or sheet. Metal for special connections shall conform to ASTM A 36, unless otherwise shown on the plans.

(b) Physical Properties of the Elastomer

Elastomer formulated from polychloroprene shall meet the requirements shown in [Table A](#). Elastomer formulated from polyisoprene shall meet the requirements of [Table B](#). Material tests shall be made in accordance with the test methods stipulated except that all tests shall be made on the finished product and standard laboratory test slabs will not be utilized for this purpose. The values shown in Tables A and B pertain to tests performed on samples taken from the finished product. The apparatus employed in preparing test specimens from the finished product shall be in accordance with ASTM Designation: D 15, as pertains to "Sample Preparation for Physical Testing of Rubber Products".

Compression set test specimens shall be taken from the finished product.

In bearing thicknesses exceeding ½ inch or elastomer layers in laminated bearings exceeding ½ inch, the full thickness of the bearing or elastomer layer shall be utilized. The 25 percent compression shall be employed and obtained through the utilization of appropriate thickness of space bar and/or shims. Beveled or wedge shaped bearings or elastomer layers in laminated bearings shall have the compression set specimens selected from sections of the bearings or layers which have been properly cut or ground so that the top and bottom surfaces of the circular compression set specimens will have essentially parallel surfaces. The maximum permissible thickness of such bearings or layers, after rendering the upper and lower surfaces parallel, will be used as a source for the cutting of the cylindrical test specimens employed in the compression set test in accordance with ASTM D 395, as modified herein.

(c) Formulation Prequalification and Certification

All bearings furnished by the Contractor shall be produced by a bearing manufacturer who has previously submitted the required prequalification test samples and certification and whose elastomer formulation has been initially approved for use by the Engineer. Each elastomer formulation produced by a manufacturer must be approved by the Engineer prior to its first use on City of Round Rock projects. To prequalify and obtain initial approval of a particular formulation, the bearing manufacturer shall submit to the Engineer, well in advance of anticipated use of his product, certified test results of actual test values obtained when the physical properties of the elastomer to be furnished were tested for compliance with the pertinent specifications.

The bearings manufacturer shall certify that all of the samples submitted are of the same basic elastomer formulation and of equivalent cure to that used in the finished products to be furnished on City of Round Rock projects.

The Producer may be required to perform the complete prequalification testing procedure again during later production should the Engineer require such retesting.

(d) Manufacturing Requirements

All components of a "laminated" bearing shall be molded together to form an integral unit free of voids or separations in the elastomer or between the elastomer and the nonelastic laminates or special connections unless specifically required or permitted by the plans or these specifications. The elastomer between laminates or special connections and on the outer surfaces of the bearing shall be well vulcanized, uniform and integral such that it is incapable of being separated by any mechanical means into separate, definite, well-defined elastometric layers. Evidence of this layered construction, either at the outer surfaces or within the bearing, shall be cause for rejection of such laminated bearing shipments.

All edges of nonelastic laminates shall be covered by a minimum of 1/8 inch of elastomer, except that exposure of the laminates will be permitted at approved laminate restraining devices and around holes that will be entirely enclosed in the finished structure. Unless otherwise indicated, all laminates shall be parallel with the bottom surface of the bearing, subject to the tolerances that follow.

Plain bearings may be molded individually, cut from previously molded strips or slabs, molded to the full thickness of the finished bearings or extruded and cut to length. The finished bearings shall have no voids or separations detectable either at the bearing surfaces or within the bearing unless specifically required or permitted by the plans or these specifications. Plain elastomeric bearings shall be well vulcanized, uniform and integral units of construction such that the bearing is incapable of being separated by any mechanical means into separate, definite and well-defined elastomeric layers.

Evidence of layered construction, either at the outer surfaces or within the bearing, shall be cause for rejection of such bearing shipments.

TABLE A
Interpolate Between Values Shown for Other Hardness Values

Hardness	50	60	70	80	90
ORIGINAL PHYSICAL PROPERTIES					
Hardness ASTM D 2240, Type A	50±5	60±5	70±5	80±5	90±5
Durometer	2250	2250	2250	1800	1800
Tensile Strength, Minimum psi ASTM D 412	450	360	270	135	90
Elongation at Break, minimum percent					
ACCELERATED TESTS TO DETERMINE LONG-TERM AGING CHARACTERISTICS OVEN AGED 70 HR at 212 F ASTM D 573					
Hardness, points change, maximum	0 to ±15 -15	0 to ±15 -15	0 to ±15 -15	0 to ±15 -15	0 to ±15 -15
Tensile Strength, % change maximum					
Elongation at break, % change maximum	40	40	40	40	40
OZONE: 100 PPHM IN AIR BY VOLUME 20% STRAIN AT 100± 2 F — ASTM D 1149*					
100 hours	No Cracks	No Cracks	No Cracks	No Cracks	No Cracks
COMPRESSION SET-22 HRS AT 158 F ASTM D 395 (Method B)**					
% Maximum	25	25	25	25	25
LOW TEMPERATURE RESISTANCE ASTM D 746 PROCEDURE B, Brittleness at 26 C					
	No Failure	No Failure	No Failure	No Failure	No Failure
ADHESION (PREQUALIFICATION ONLY)					
For laminated bearings, bond between the elastomer and laminates will be qualitatively evaluated by the procedure outlined in the SDHPT Manual of Testing Procedures, Test Method Tex-601-J.					
* Samples to be solvent wiped before test to remove traces of surface impurities.					
** Modified in that test is performed on specimens of essentially full bearing or layer thickness with the 25 percent compression obtained through the use of appropriate spacer bars and/or shims.					

TABLE B
Interpolate Between Values Shown for Other Hardness Values

Hardness (Durometer)	50	60	70	80	90
ORIGINAL PHYSICAL PROPERTIES					
Hardness ASTM D 2240, Type A Durometer	50±5	60±5	70±5	80±5	90±5
Tensile Strength Minimum psi ASTM D 412	2250	2250	2250	1800	1800
Elongation at Break, minimum percent	405	360	270	135	90
ACCELERATED TESTS TO DETERMINE LONG-TERM AGING CHARACTERISTICS OVEN AGED — 70 HR AT 158 F					
ASTM D 573	0 to +10	0 to +10	0 to +10	0 to +10	0 to +10
Hardness, points change, maximum	-25	-25	-25	-25	-25
Tensile Strength, % change maximum	-25	-25	-25	-25	-25
Elongation at Break, % change maximum					
OZONE: 25 PPHM in AIR BY VOLUME 20%					
STRAIN AT 100± 2 F — ASTM D 1149* 48 Hours	No Cracks	No Cracks	No Cracks	No Cracks	No Cracks
COMPRESSION SET — 22 HR at 158 F					
ASTM D 395 (Method B)** % Maximum	25	25	25	25	25
LOW TEMPERATURE RESISTANCE					
ASTM D 746, PROCEDURE B Brittleness at 26 C	No Failure	No Failure	No Failure	No Failure	No Failure
ADHESION (PREQUALIFICATION ONLY)					
For laminated bearings, bond between the elastomer and laminates will be qualitatively evaluated by the procedure outlined in the SDHPT Manual of Testing Procedures, Test Method Tex-601-J					
* Samples to be solvent wiped before test to remove traces of surface impurities.					
** Modified in that test is performed on specimens of essentially full bearing or layer thickness with the 25 percent compression obtained through the use of appropriate spacer bars and/or shims.					

The finish of cut surfaces shall be ANSI Number 250 or smoother. The batch or lot number and the dimensions or piece mark shall be marked on each bearing and they shall remain legible until placement in the structure.

(e) Appearance and Dimensions

Flash tolerance, finish and appearance shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturers Association, Inc.; MA-F3-T.063 for molded bearings and RMA-F2 for extruded bearings.

For both plain and laminated bearings, the permissible variation from the dimensions and configuration required by the plans and these specifications shall be as follows:

1. Overall Vertical Dimensions:
 - Average Total Thickness 1¼ inch or less -0,+1/8 inch
 - Average Total Thickness Over 1¼ inch.....-0,+ ¼ inch
2. Overall Horizontal Dimensions-0,+ ¼ inch
3. Thickness of Individual Layers of Elastomer
(Laminated Bearings Only).....±1/8 inch
4. Variation from a Plane Parallel to the Theoretical Surface:
 - Top.....1/8 inch
 - Sides..... ¼ inch
 - Individual Nonelastic Laminates.....1/8 inch
(As determined by measurements at the edges of the bearing)
5. Position of Exposed Connection Member1/8 inch
6. Edge Cover of Embedded Laminates or Connection members.....
.....-0,+1/8 inch
7. Size of Holes, Slots or Inserts-0,+1/8 inch
8. Position of Holes, Slots or Inserts.....-0,+1/8 inch
9. Thickness of Nonelastic Laminates-0,+1/16 inch

(f) Routine Inspection, Sampling and Testing

After prequalification approval, the inspection, sampling and testing of actual bearing production will be as outlined below:

Plain Bearings

A minimum of one plain bearing will be taken by a representative of the Engineer from each project or from each batch or lot in case the same batch or lot is used for more than one project.

Routine tests for compliance with the requirements of [Table A](#) or [Table B](#), whichever is applicable, will be performed by the Engineer. Samples will not be returned.

Laminated Bearings

Each laminated bearing shall be subjected, by the manufacturer, to an average compression of 1,000 psi or to lower average compression if so indicated in the plans or approved by the Engineer. This compression test will be performed in the presence of a representative of the Engineer who will perform visual inspections and accept or reject the bearings at that time. The performance of each bearing will be considered satisfactory, provided there is no visible evidence of bond failure or other damage to the bearing because of this loading and provided the finished bearing meets all other pertinent portions of this specification. Samples of laminated bearings may be taken if the quality of the plant production becomes questionable. If samples are taken, they shall be taken and tested as outlined for plain bearings.

The manufacturer shall furnish certified laboratory test results on the elastomer properties of each batch or lot of compound used in the manufacture of bearings, both plain and laminated.

(2) **Waterstops**

Waterstops shall be furnished and installed in accordance with the details indicated. Except where otherwise indicated on the plans, waterstops may be manufactured from either natural (plain) or synthetic rubber or from polyvinyl chloride (PVC) as specified below:

(a) **Materials**

1. Natural (plain) rubber waterstops shall be manufactured from a stock composed of a high-grade compound made exclusively from new plantation rubber, reinforcing carbon black, zinc oxide, accelerators, antioxidants and softeners. This compound shall contain not less than 72 percent by volume of new plantation rubber.
2. Synthetic rubber waterstops shall be manufactured from a compound made exclusively from neoprene or GRS, reinforcing carbon black, zinc oxide, polymerization agents and softeners. This compound shall contain not less than 70 percent by volume of neoprene or GRS.
3. Physical properties of natural or synthetic rubbers for waterstops shall be as shown in [Table C](#) below:

TABLE C

	Natural (Plain Rubber)	Synthetic (Neoprene GRS) Rubber
Original Physical Properties: Hardness — ASTM D 676 (Durometer) Tensile Strength, Minimum psi ASTM D 412 Elongation at Break, Minimum percent	60±5 3500 550	55±5 2500 425
Accelerated Tests to Determine Long-term Aging Characteristics: either - after 7 days in air at 158 (±2)F (ASTM D 573) or after 48 hours in oxygen (ASTM D 5722) at 158 (±2)F and 300 psi pressure Tensile Strength, % change, Maximum Elongation, % change, Maximum	35 35	35 —

4. Polyvinyl Chloride (PVC). Unless otherwise specified on the plans, the material shall conform to the Corps of Engineers Specification Number, CRD-C-572-60.

(b) Manufacturer's Certification

The manufacturer shall furnish certified test results indicating compliance with this specification for each batch or lot of waterstop furnished under this contract. In case of doubt of the quality furnished, the burden of proof shall be on the manufacturer and the decision of the Engineer shall be final.

(c) Manufacturer's Requirements

1. Rubber Waterstops

Waterstops shall be manufactured with an integral cross section which shall be uniform within $\pm 1/8$ inch in width and the web thickness or bulb diameter, within $+ 1/16$ and $1/32$ inch. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured so that any cross sections shall be dense, homogeneous and free from all porosity. All junctions in the special connection pieces shall be full-molded. During the vulcanizing period, the joint shall be securely held by suitable clamps.

2. PVC Waterstops

Requirements shall be as in 1 above for rubber waterstops, except that splicing of PVC shall be done by heat sealing the adjacent

surfaces in accordance with the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic.

3. Elastomeric Pads

When so specified on the plans, rail posts, rail members, metal shoes or minor structural members shall be insulated, leveled, shimmed or otherwise protected by elastomeric pads, sheets or washers.

Such bearings may be any elastomeric material, plain, fibered or laminated, having a hardness(durometer) between 70 and 100 as certified by the manufacturer to the Engineer.

Acceptance testing will not be required.

4. Other Elastomeric Products

Other elastomeric products shall be in accordance with the requirements on the plans.

438.3 Construction Methods

Elastomeric Bearings

Unless otherwise indicated, concrete bearing seats shall be float finished to the required elevation. Variation from a level plane shall not exceed 1/16inch within the limits of the bearing.

After erection of members on steel structures only, the horizontal distortion of the bearings shall be measured, corrected for temperature and adjusted if necessary, so that the horizontal displacement between top and bottom of bearings at 70 F does not exceed 15 percent of the elastomer thickness.

Welding in the vicinity of the bearings shall be done with care to avoid injury to the elastomer.

Waterstops

Waterstops shall be installed as indicated, to prohibit the flow of liquid through a joint in the concrete.

Field splices shall be either vulcanized, mechanical, using stainless steel parts or made with a rubber splicing union of the same stock as the waterstop, at the option of the Contractor. All finished splices shall have a tensile strength not less than 50 percent of the unspliced material.

438.4 Measurement

Elastomeric bearings or waterstops used with concrete units will not be measured for payment but will be considered subsidiary to the various pertinent bid items in the contract.

End

ITEM NO. 439

PARKING LOT BUMPER CURBS

439.1 Description

This item shall consist of parking lot bumper curbs, composed of precast concrete and reinforcing steel for placement on gravel, asphalt and concrete surfaces as indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

439.2 Submittals

The submittal requirements of this specification item include:

- A. Type A Portland cement concrete design mix.
- B. Reinforcing steel details.

439.3 Materials

- A. **Concrete.** All precast concrete shall be Class A Concrete conforming to Specification [Item No. 403](#), "Concrete for Structures".
- B. **Reinforcing Steel.** All reinforcing steel shall be #3 (10M) bar conforming to Specification [Item No. 406](#), "Reinforcing Steel".

439.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Specification [Item No. 410](#), "Concrete Structures".

Reinforcement shall conform to the details indicated on the Drawings. Care shall be exercised to keep reinforcement in its proper position during the depositing of concrete.

Concrete shall be placed in the forms to the depth indicated and vibrated until thoroughly compacted. Care shall be taken during vibration to insure that a vibrator is not held too long at one location that segregation is produced. The top surface of the concrete shall be floated and troweled to a uniform smooth surface, and then finished with a camel hair brush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii shown on the Drawings.

When the ambient air temperature is above 85°F (30°C), an approved retarding agent will be required in all concrete unless moist curing procedures are employed. The maximum temperature of all concrete placed shall not exceed 95°F (35°C).

439.5 Measurement

Parking Lot Bumper Curbs shall be measured per each, complete and in place.

439.6 Payment

The work performed as prescribed by this Specification Item will be paid for at the unit

bid price per each. The unit bid price shall include full compensation for: all materials, including all reinforcing steel, placing and the concrete curb, and all labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Parking Lot Bumper Curbs - Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item No. 439, "PARKING LOT BUMER CURBS"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 410	Concrete Structures

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification Item No. 439, "PARKING LOT BUMER CURBS"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 405	Concrete Admixtures
Item No. 409	Membrane Curing
Item No. 411	Surface Finishes for Concrete

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Item 427	Surface Finishes for Concrete
Item 437	Concrete Admixtures
Item 440	Reinforcing Steel

American Society for Testing and Materials

<u>Designation</u>	<u>Description</u>
A-496	Standard Specification for Steel Wire, Deformed for Concrete Reinforcement
A-615/615M	Standard Specification for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement

ITEM NO. 461 TRASH AND LITTER COFFINS

461.1 Description

This item shall consist of the furnishing and placing of concrete trash coffins and their foundations to the details indicated. Unless otherwise indicated, the Contractor shall have the option of furnishing cast in place or precast coffins.

461.2 Materials

(1) **Concrete**

Concrete shall be Class A Concrete conforming to [Item No. 403](#), "Concrete for Structures".

(2) **Aggregate**

Gravel used shall be Colorado River Gravel, ½ inch to 3/8 inch in size.

(3) **Reinforcement**

Reinforcement shall conform to 6 x 6 - W 2.9 x W 2.9 [Item No. 406](#), "Reinforcing Steel".

(4) **Seeding**

Seeding shall conform to [Item No. 604](#), "Seeding for Erosion Control".

(5) **Flexible Base**

Aggregate base materials shall conform to [Item No. 210](#), "Flexible Base (Crushed Stone)".

461.3 Construction Methods

Concrete trash coffins shall be placed on 4 inch, reinforced concrete pad constructed and installed by the Contractor at the locations indicated.

Excavation and backfill for concrete pads shall conform to [Item No. 401](#), "Structural Excavation and Backfill" to the lines and grades indicated.

Bedding shall conform to [Item No. 210](#), "Flexible Base (Crushed Stone)".

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to [Item No. 410](#), "Concrete Structures".

The coffins will be of a permanent and durable construction and shall be constructed to withstand all handling and installation. The ends of each coffin shall have a reinforced 1 inch diameter hole through which a device may be inserted for lifting the coffin and securing the trash cans in the coffin. The following are dimensions and quantity requirements:

The single size coffins shall have inside dimensions of 1 foot 7 inches wide x 1 foot 7 inches long x 2 foot 4 inches tall. No top or bottom is required.

The double size coffins shall have inside dimensions of 1 foot 7 inches wide x 3 foot 3 inches long x 2 foot 4 inches tall. No top or bottom is required.

The triple size coffins shall have inside dimensions of 1 foot 7 inches wide x 4 foot 6 inches long x 2 foot 4 inches tall. No top or bottom is required.

Note: All of the above dimensions are inside dimensions. The coffin walls shall be 3 inches in thickness of reinforced concrete.

The Contractor shall revegetate the disturbed area conforming to [Item No. 604](#), "Seeding for Erosion Control".

461.4 Measurement

Work and acceptable material for "Trash and Litter Coffins" will be measured by each of the type required, complete in place.

461.5 Payment

The work performed and the materials furnished and measured as provided under "Measurement" will be paid at the unit price bid for "Trash and Litter Coffins", which price shall be full compensation for excavation, flexible base, concrete pad, all materials, labor, tools, equipment and incidentals necessary to complete and install the coffins.

Payment will be made under one of the following:

Trash and Litter Coffins, Single -	Per Each.
Trash and Litter Coffins, Double -	Per Each.
Trash and Litter Coffins, Triple -	Per Each.

End

Ref: [210](#), [410](#), [403](#), [406](#), [410](#), [604](#)

ITEM NO. 470

CURB CUTS FOR SIDEWALK RAMPS AND DRIVEWAYS

470.1 Description

This item governs horizontal and vertical curb saw cuts, which are undertaken on existing or newly placed Portland cement concrete curb, in order to accommodate the construction of new concrete sidewalk ramps and/or driveways at the locations indicated on the Drawings or as directed by the Engineer or designated representative. The curb cutting operation shall be conducted from the street side of the existing or newly placed curb.

This specification is optional and is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

470.2 Materials

A diamond-blade-cutting saw shall be utilized for all required curb sawing/cutting. The saw shall be capable of cutting existing or newly placed curb material into the shape of a ramp and/or driveway; leaving a smooth, accurate top face. The saw shall be specifically designed for this purpose and shall be approved by the Engineer prior to the start of any curb cut work.

A diamond-grinding wheel shall be used for rounding the sawed concrete edges.

470.3 Construction Methods

The curb shall be sawn in accordance with the Drawings or as directed by the Engineer or designated representative. The sawing shall be made along neat lines and shall result in smooth edges and top faces. The length of curb face, which must be removed in order to conform to the proposed sidewalk ramp or driveway, shall be sawn full depth at the bottom of the curb face using a diamond saw blade.

The saw cutting of the curb face shall be initiated at an elevation $\frac{1}{2}$ inch (12.5 millimeters) above the existing gutter and extended at an angle of $\frac{3}{4}$ inch per foot (60 mm per meter) upwards and away from the gutter pan to conform with the new sidewalk ramp or driveway grade. End cuts shall be sawn full depth on an angle so that the saw cut face provides a dimension of 55 to 60 inches (1.4 to 1.5 meters) for ADA ramps and 18 inches to 20 inches (450 mm to 500 mm) for driveways. The corners of the tops of the end cuts shall be ground using a diamond-grinding wheel to a radius of $\frac{1}{4}$ inch (6 mm).

Special care shall be taken to insure that there is no disturbance or damage to the existing roadway pavement, sidewalk pavement or curbs scheduled to remain. Any damage to remaining pavements, sidewalks and/or curb due to the Contractor's operations shall be repaired at the Contractor's sole cost and expense.

The work under this specification item shall also include the disposal of all concrete curb materials removed during the curb cutting operation. Disposal shall conform to the requirements of Standard Specification Item No. [401](#), "Structural Excavation and Backfill".

470.4 Measurement

Accepted work as prescribed by this item shall include the removal and disposal of all sawn material and shall be measured by the number of lineal feet (lineal meters: 1 meter is equal to 3.281 feet) of sawcutting from top of curb cut at beginning to top of curb cut at ending for each proposed sidewalk ramp location that are completed in accordance with the Drawings, Standard Detail or as directed by the Engineer or designated representative.

470.5 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot of "Curb Cuts" for sidewalk ramps and driveways. The bid price shall include full compensation for the cost of all labor, materials and equipment necessary to complete the Work, the removal and disposal of the curb cut, and the cost of any repairs necessitated from damage produced during the Contractor's operations.

Curb Cuts for Driveways - Per Linear Foot.

Curb Cuts for Sidewalk Ramps - Per Linear Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item No. 470, "CURB CUTS FOR SIDEWALK RAMPS AND DRIVEWAYS"
--

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 401	Structural Excavation and Backfill

RELATED CROSS REFERENCE MATERIALS

Specification Item No. 470, "CURB CUTS FOR SIDEWALK RAMPS AND DRIVEWAYS"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 104	Removing Concrete
Item No. 110	Street Excavation
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 360	Concrete Pavement
Item No. 480	Concrete Pavers
Item No. 485	Concrete Pavers for Sidewalk Ramps
Item No. 403	Concrete for Structures
Item No. 410	Concrete Structures
Item No. 430	Concrete Curb and Gutter
Item No. 431	Machine Laid Curb and Gutter
Item No. 432	Concrete Sidewalks
Item No. 433	Concrete Driveways
Item No. 434	Concrete Median and Islands
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 104	Removing Concrete
Item No. 420	Concrete Structures

ITEM NO. 480 CONCRETE PAVING UNITS

480.1 Description

This item shall govern furnishing and installing interlocking concrete paver units, manufactured for the construction of sidewalks, constructed as herein specified on an approved base or subgrade in conformity to the lines, grades and details indicated on the Drawings, Standard Detail or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

480.2 Submittals

The submittal requirements of this specification item may include:

- A. Samples for initial selection from manufacturer color charts showing the full range of colors, textures and patterns for each type of paver unit indicated on the Drawings,
- B. Shop drawings indicating locations of color changes, pattern orientation and cross-section details,
- C. Product data including sieve analysis of sand bedding material and compaction test results on subgrade, subbase and base courses,
- D. Manufacturer Certification that the Interlocking Paver Units meet or exceed all the requirements of ASTM C-936 and this specification item.

480.3 Materials

- A. Base Course

Base Course shall be constructed of either a Class J Portland cement concrete (Standard Specification Item No. 403, "Concrete For Structures") or a cement treated material (Standard Specification Item No. 204, "Portland Cement Treatment for Materials In Place").

- B. Concrete Paver Units

Paver units shall be modular concrete pavers conforming to ASTM Designation: C-936 "Solid Concrete Interlocking Paving Units" and the requirements specified in this Item. The paver units shall be made using normal weight aggregates conforming to ASTM C-33.

- C. Pigments

Pigments used in concrete paver units shall be synthetic iron oxide and shall be alkali-resistant, light fast, water insoluble, chemically inert and weather resistant.

D. Bedding Sand

Bedding sand shall conform to the requirements of a concrete sand Grade No. 1 as indicated in Table 2, Standard Specification Item No. 403, "Concrete for Structures" with the exception of the Fineness Modulus and aggregate gradation requirements.

The aggregate gradation shall be in compliance with the following gradation:

Sieve Designation/Size		% Passing By Weight (Mass)
U. S.	S. I.	
3/8"	9.5 mm	100
No. 4	4.75 mm	85-100
No. 100	150 μ m	10-30

The bedding sand shall be free from frozen material or injurious amounts of deleterious soluble salts, vegetable matter or other contaminants likely to cause efflorescence or contribute to reduced skid resistance and shall contain no more than 0.5 percent by weight (mass) of clay lumps.

The bedding sand shall be of uniform moisture content from 3 to 7 percent when spread and shall be protected against rain when stockpiled on site prior to spreading.

E. Grout Mix

When required in conjunction with a bedding layer for the concrete paver units or with paver closure units, the grout mix shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), parts of concrete sand equal to 2-1/2 to 3 times the sum of the volumes of the cement and lime used, and sufficient water to make the mixture plastic

480.4 Physical Requirements

The general shape of the concrete paver units shall be similar to that indicated on the Drawings. The concrete paver units shall be of the color and laid in the pattern as specified or as approved in writing by the Engineer or designated representative.

All units shall be sound and free of defects that would interfere with the appearance or proper placement of the unit or impair the strength or longevity of the final structure. Any units, which are structurally damaged during the work, shall be immediately removed and replaced.

480.5 Construction Method

A. Preparation Of Subgrade, Subbase And Base Layers

The subgrade, subbase or base course shall be shaped to the lines, grades and cross sections as indicated on the Drawings or as directed by the Engineer or designated representative and shall be thoroughly compacted. Any unsuitable material encountered in the subgrade shall be removed and replaced by a

suitable material and compacted to a uniform grade. When subgrade stabilization has been specified, the subgrade shall be prepared accordingly.

If the subgrade is undercut by more than 4 inches (100 mm) or the natural ground is below "top of subgrade" by more than 4 inches (100 mm), the necessary backfill shall be made with an approved material and compacted with a mechanical tamper. Hand tamping will not be permitted.

B. Bedding Sand Installation

An uncompacted sand bed base shall be screeded over the compacted base to a minimum thickness of 1 inch (100 mm) but no more than 1 1/2 inches (38 mm). This assumes that after placement and vibration of the paving units the thickness of the compacted sand bed will be approximately 1/2 inch (12.5 mm) lower. Bedding sand shall not be used for leveling the base course.

The spread sand shall be carefully maintained in a loose condition and protected against precompaction both prior to and following screeding. Any precompacted sand or screeded sand left overnight shall be loosened before other units are placed. Sand shall be lightly screeded in a loose condition to the predetermined depth, slightly ahead of placement of the paving units. Under no circumstances shall the sand be screeded more than 1/2 hour in advance of the placement of paving units.

Screeded sand must be fully protected against accidental precompaction including compaction by rain or dew. Any screeded sand, which is precompacted prior to placement of units, shall be removed and brought back to profile in a loose condition.

C. Paver Unit Installation

Concrete paver units shall be placed on the uncompacted screeded sand bed and/or grout bedding in the laying pattern indicated on the Drawings. Concrete paver units shall be bedded in a 1 inch (25 mm) thick mortar bed or a 1 inch (25 mm) sand layer placed on top of a 4 inch (100-mm) thick layer of Class J Portland Cement Concrete (Standard Specification Item No. 403, "Concrete For Structures") or cement treated material (see Standard Specification Item No. 204, "Portland Cement Treatment for Materials In Place").

The Contractor shall exercise particular care to maintain the specified laying pattern throughout the job. Paver units shall be placed to achieve gaps nominally 1/8 inch (3.2 mm) wide between adjacent units to insure that all joints are correctly aligned.

The first row shall abut an edge restraint with a gap of 1/8 inch (3.2 mm) and shall be laid at a suitable angle to the edge restraint to achieve the required visual orientation of paver units in the completed pavement.

The first two rows of concrete paver units adjacent to edge restraints, building walls, openings in the sidewalk layout for meter boxes, meter vaults, valve access pipe, light/traffic poles and light fixtures, curb and gutter, external stairs and any other projections in the sidewalk shall be set in a 1 inch (25 mm) thick

grout layer. As an alternative to grouting the first two layers of concrete paver units, a Portland cement concrete (Class A, "Concrete for Structures") band, that is a minimum of 6inch (150 mm) wide and 4inch (25 mm) deep with a # 3 (10M) rebar, may be constructed adjacent to edge restraints, building walls, projections through the sidewalk and other conditions indicated.

In each row, all full units shall be placed first. Closure units shall be cut and fitted subsequently. In no case shall a closure unit consist of less than 25 percent of a full unit. Areas with closure units less than 25 percent of a full unit shall be filled solid with mortar. Units may be cut using a mechanical or hydraulic cutter or by power sawing. A grout mix shall be used to fill larger edge spaces.

Any foot or wheelbarrow traffic during the construction shall use boards overlaying paver units to prevent disturbance of units prior to mechanical compaction. No other traffic shall be allowed on the pavement at this stage of construction.

D. Paver Unit Compaction

After placement of the paver units on the uncompacted screeded sand layer, consolidation of the sand bedding and the design levels and profiles of the paver units shall be obtained by not less than two and preferably three passes of a suitable flat plate compactor. Any grouted concrete paver units that are damaged or displaced during the compaction process shall be replaced and regrouted.

The compactor shall be a high frequency, low-amplitude mechanical flat plate vibrator with a plate area sufficient to cover a minimum of 12 paver units. The compactor shall be capable of producing 3,500 to 5,000 pounds (15.5 to 22.2 kiloNewton) centrifugal compaction force. The flat plate compactor shall be equivalent to Model P-22 manufactured by Koehring, Master Division of Dayton, Ohio.

Compaction shall proceed as closely as possible following placement and shall be completed prior to the acceptance of any construction traffic.

Compaction shall not be attempted, however, within 3 feet (.9 meter) of the laying face of the paver units. Compaction shall continue until lipping has been eliminated between adjoining units. Joints shall be filled and compacted again as herein described.

All work extending to within 3 feet (.9 meter) of the laying face must be left fully compacted at the completion of each day's placement. Compaction of the remaining surface will be completed after sufficient units are laid in place.

As soon as practical after compaction and in any case prior to the termination of work on that day and acceptance of construction traffic, the bedding sand for joint-filling shall be spread over the pavement and allowed to dry. When dry, the filling sand shall be swept to fill the joints. At least one pass of the plate vibrator will be used to achieve compaction of the joint filling sand.

As soon as possible after filling the joints, light construction traffic should be encouraged to use the pavement to assist in the development of the paver unit lockup. Such traffic should traverse the greatest possible area of the pavement. After traffic has been allowed on the street, joints shall be refilled with dry sand periodically until no additional sand will be accepted in the joints.

480.6 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.76 square feet) of surface area of "Concrete Paver Units".

480.7 Payment

The work performed as prescribed by this item and measured as provided under section 480.6, "Measurement", will be paid for at the unit bid price per square foot for "Concrete Paver Units". The Unit Bid Price shall include full compensation for preparing the subgrade, when not included as a separate item; for furnishing and placing all materials, and all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

All necessary excavation, filling and grading of the slopes adjacent to the completed concrete paver units will be considered subsidiary to this item, unless included as a separate pay item in the Contract.

Payment will be made under:

Concrete Paver Units for Sidewalks, mm Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item No. 480, "CONCRETE PAVER UNITS FOR SIDEWALKS"
--

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 204	Portland Cement Treatment for Materials In Place
Item No. 403	Concrete for Structures
Item No. 407	Fibrous Concrete

American Society for Testing and Materials, ASTM

<u>Designation</u>	<u>Description</u>
ASTM C-33	Standard Specifications for Concrete Aggregates
ASTM C-936	Specifications for Solid Concrete Interlocking Paving Units

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 480, "CONCRETE PAVER UNITS FOR SIDEWALKS"
--

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 201	Subgrade Preparation
Item No. 485	Concrete Paver Units For Sidewalk Ramps

ITEM NO. 485
CONCRETE PAVING UNITS FOR SIDEWALK RAMPS

485.1 Description

This item shall govern furnishing and installing interlocking concrete paver units, manufactured for the construction of paved sidewalk ramps, constructed as herein specified on an approved base or subgrade in conformity to the lines, grades and details indicated on the Drawings, Standard Detail or as established by the Engineer or designated representative.

485.2 Submittals

The submittal requirements of this specification item may include:

- A. Samples for initial selection from manufacturer color charts showing the full range of colors, textures and patterns for each type of paving unit indicated on the Drawings,
- B. Shop drawings indicating pattern orientation and cross section details,
- C. Manufacturer Certification that the Interlocking Paving Units meet or exceed all the requirements of ASTM C-936 and this specification item.

485.3 Materials

- A. Base Course

Base Course shall be constructed of either a Class J Portland cement concrete (Standard Specification Item No. 403, "Concrete For Structures") or cement treated material (Standard Specification Item No. 204, "Portland Cement Treatment for Materials In Place").

- B. Concrete Paver Units

Paving units shall be modular concrete pavers conforming to ASTM Designation: C 936, "Solid Concrete Interlocking Paving Units" and the requirements specified in this Item. The paver units shall be made using normal weight aggregates conforming to ASTM C-33.

- C. Pigments

Pigments used in concrete paver units shall be synthetic iron oxide and shall be alkali-resistant, light fast, water insoluble, chemically inert and weather resistant.

- D. Grout Mix

When required in conjunction with a bedding layer for the concrete paver units or with paver closure units, the grout mix shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), parts of concrete sand equal to 2-1/2 to 3 times the sum of the volumes of the cement and lime used, and sufficient water to make the mixture plastic.

485.4 Physical Requirements

The general shape of the concrete paver units shall be similar to that indicated on the Drawings. The concrete paver units shall be of the color and laid in the pattern as specified or as approved in writing by the Engineer or designated representative.

All units shall be sound and free of defects that would interfere with the appearance or proper placement of the unit or impair the strength or longevity of the final structure. Any units, that are structurally damaged during the work shall be immediately removed and replaced.

485.5 Construction Method

A. Preparation of Subgrade, subbase and base layers

The subgrade, subbase or base course shall be shaped to the lines, grades and cross sections as indicated on the Drawings or as directed by the Engineer or designated representative and shall be thoroughly compacted. Any unsuitable material encountered in the subgrade shall be removed and replaced by a suitable material and compacted to a uniform grade. When subgrade stabilization has been specified, the subgrade shall be prepared accordingly.

If the subgrade is undercut by more than 4 inches (100 mm) or the natural ground is below "top of subgrade" by more than 4 inches (100 mm), the necessary backfill shall be made with an approved material and compacted with a mechanical tamper. Hand tamping will not be permitted.

B. Paver Unit Installation

Concrete paver units shall be bedded in a 1 inch (25 mm) thick mortar bed placed on top of a 4 inch (100-mm) thick layer of Class J Portland Cement Concrete (Standard Specification Item No. 403, "Concrete for Structures") or cement treated material (see Standard Specification Item No. 204S, "Portland Cement Treatment for Materials In Place"). The concrete paver units shall be placed in conformance with Standard Detail Series 432 to the laying pattern indicated on the Drawings. The Contractor shall exercise particular care to maintain the laying pattern throughout the job. Paving units shall be placed to achieve gaps nominally 1/8 inch (3.2 mm) wide between adjacent units to insure that all joints are correctly aligned.

The first row shall abut an edge restraint with a gap of 1/8 inch (3.2 mm) and shall be laid at a suitable angle to the edge restraint to achieve the required visual orientation of paving units in the completed sidewalk.

In each row, all full units shall be placed first. Closure units shall be cut and fitted subsequently. In no case shall a closure unit consist of less than 25 percent of a full unit. Areas with closure units less than 25 percent of a full unit shall be filled solid with mortar. Units may be cut using a mechanical or hydraulic cutter or by power sawing. A grout mix shall be used to fill larger edge spaces.

Any foot or wheelbarrow traffic during the construction shall use boards overlaying paver units to prevent disturbance of units prior to final set. No other traffic shall be allowed on the pavement at this stage of construction.

As soon as practical after placement of pavers in the mortar bed, and in any case prior to the termination of work on that day, and prior to the acceptance of construction traffic, bedding sand for joint-filling shall be spread over the sidewalk and allowed to dry. When dry, the filling sand shall be swept to fill the joints. After traffic has been allowed on the pavers, joints shall be refilled with dry sand periodically until no additional sand will be accepted in the joints.

485.6 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.76 square feet) of surface area of "Concrete Paver Units for Sidewalk Ramps".

485.7 Payment

The work performed as prescribed by this item and measured as provided under Section 485S.6, "Measurement", will be paid for at the unit bid price per square foot for "Concrete Paver Units for Sidewalk Ramps". The Unit Bid Price shall include full compensation for preparing the subgrade when not included as a separate item; for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work.

All necessary excavation, filling and grading of the slopes adjacent to the completed concrete paver units will be considered subsidiary to this item, unless included as a separate pay item in the Contract.

Payment will be made under:

Concrete Paver Units for Sidewalk Ramps, mm - Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 485, "CONCRETE PAVER UNITS FOR SIDEWALK RAMPS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 204	Portland Cement Treatment for Materials In Place
Item No. 403	Concrete for Structures

American Society for Testing and Materials, ASTM

<u>Designation</u>	<u>Description</u>
ASTM C-33	Standard Specifications for Concrete Aggregates
ASTM C-936	Specifications for Solid Concrete Interlocking Paving Units

RELATED CROSS REFERENCE MATERIALS

Specification Item 485, "CONCRETE PAVER UNITS FOR SIDEWALK RAMPS"

City of Round Rock Standard Specifications

Designation

Description

Item No. 201

Subgrade Preparation

Item No. 480

Concrete Paver Units For Sidewalks