SECTION NO. 12

SPECIAL PROJECT – PAVING SPECIFICATIONS

12-1 PURPOSE OF SPECIAL PROJECT SPECIFICATIONS: This project shall be in accordance with the STANDARD SPECIFICATIONS FOR PUBLIC WORKS AND TRANSPORTATION CONSTRUCTION (COG) as issued by the North Central Texas Council of Governments as it may be amended from time to time, which specifications, including the General Conditions of the Agreement therein contained, as specifically incorporated herein and made a part of this agreement the same as if written herein; provided that where any discrepancies occur between the SPECIAL PROVISIONS (Section No. 11), the SPECIAL PROJECT SPECIFICATIONS and the STANDARD SPECIFICATIONS, the governing order shall be:

1. SPECIAL PROVISIONS
2. SPECIAL PROJECT SPECIFICATIONS
3. STANDARD SPECIFICATIONS

The SPECIAL PROJECT SPECIFICATIONS are included herein for the purpose of including in the contract documents further specifications not covered by the STANDARD SPECIFICATIONS. (Rev. 3/12)

12-2 CONCRETE PAVEMENT:

A. DESCRIPTION: This item shall consist of a pavement of portland cement concrete, with reinforcement as shown on plans, with or without monolithic curbs, constructed as herein specified on the prepared subgrade or other base course in conformity with the thickness and typical cross-sections shown on plans and to the lines and grades established by the Engineer. Concrete shall be considered of satisfactory quality provided it is made (a) of materials accepted for the job, (b) in the proportions established by the Engineer and (c) mixed, placed, finished and cured in accordance with the requirements of this specification and meets the requirements herein specified. (Rev. 5/00)

B. MATERIALS:

1. **Cement**: The cement shall be Type 1 of a standard brand of portland cement. Type III cement shall be used when high early strength concrete is required by the plans or special provisions. If the use of high early strength cement is not specified, the Contractor desires to use it, he shall obtain written permission of the Engineer and shall assume all additional costs incurred by the use of such cement. Type I and Type III cement shall conform to the requirements of ASTM Designation: C 150. When Type III cement is used, the average strength of briquettes at the age of 7 days shall be higher than that attained at 3 days. Either the tensile or the compressive tests may be used for either type cement. In addition to the requirements of ASTM Designation C 150, the specific surface area of Type I cement shall not exceed 2,000 square centimeters per gram as measured by the Wagner Turbidimeter in accordance with Test Method Tex-310-D.

Bulk or sacked cement may be used, and a bag shall contain 94 pounds net. All bags shall be in good condition at the time of inspection. Bags varying more than 3 percent from the specified weight may be rejected and if the average net weight in any shipment as shown by weighing 50 bags taken at random is less than that specified, the entire shipment may be rejected. Bulk cement shall be weighed on approved scales as herein prescribed.

Any cement which has become partially set or which contains hard lumps or cakes, or cement salvaged from discarded or used bags, shall not be used. Any cement storage shall be suitable weather-tight building or bin which will protect the cement from dampness, and cement shall be so placed as to provide easy access for property inspection and identification of each shipment. (Rev. 11/87)

2. **Admixtures**: No admixtures shall be used in the concrete without prior approval, and all approved admixtures shall meet applicable AASHO, ASTM, and CSA requirements.

   Air-entraining agents shall have proven compatibility with all local concrete materials, including cement, and shall be capable of providing in the concrete the require air contents and an air-void system known to produce durable, scale-resistant concrete.

   Admixtures other than air-entraining agents shall not be used until trial mixes with job materials have shown them to be compatible at job temperatures. Trial mixes must also show that desired properties will be imparted to the fresh concrete without any subsequent loss of strength or durability in the hardened concrete. (Rev. 11/87)

3. **Coarse Aggregate**: Coarse aggregate shall consist of durable crushed limestone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter of other objectionable material, either free or as an adherent coating on the aggregate. 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 5.0 percent by weight of laminated and/or friable particles when tested in accordance with Test Method Tex-413-A.

   Coarse aggregate shall have a wear of not more than 38 percent when tested according to Test Method Tex-410-A, and when tested by standard laboratory methods shall meet the following grading requirements:

Retained on 1 3/4″ sieve.....			0%
Retained on 1½″ sieve	0	to	5%
Retained on 3/4″ sieve	30	to	65%
Retained on 3/8″ sieve	70	to	90%
Retained on No. 4 sieve	95	to	100%

Loss by Decantation Test
Method Tex-406-A .....1.0% Maximum

Where the coarse aggregate is delivered on the job in two or more sizes or types, each type and/or size shall be batched and weighed separately.

A supply of aggregate adequate for two (2) days paving shall be stockpiled at the concrete plant. All aggregates shall be handled and stored in such a manner as to prevent size segregation and contamination by foreign substances. When segregation is apparent, the aggregate shall be remixed. At the time of its use, the aggregate shall be free from frozen material and aggregate containing foreign materials will be rejected. Coarse aggregate that contains more than 0.5 percent free moisture by weight shall be stockpiled for at least 24 hours prior to use.

Adequate storage facilities shall be provided for all approved materials. The intermixing of nonapproved materials with approved materials either in stockpiles or in bins will not be permitted. Aggregates from different sources shall be stored in different stockpiles unless otherwise approved by the Engineer.

Aggregates shall be stockpiled in such a manner to prevent segregation and maintained as near as possible in a uniform condition of moisture.

Each aggregate stockpile shall be reworked with suitable equipment at such times, as required by the Engineer to remix the material to provide uniformity of the stockpile. (Rev. 5/00)

4. **Fine Aggregate**: Fine Aggregate shall consist of sand or a combination of sands, and shall be composed of clear, hard, durable, uncoated grains. Unless otherwise shown on plans, the acid insoluble residue of the fine aggregate shall be not less than 28 percent by weight when tested in accordance with Test Method Tex-612-J. (Rev. 11/87)

5. **Fine Aggregate Exclusive of Mineral Filler**: Fine aggregate shall be free from injurious amounts of salt, alkali or vegetable matter. It shall not contain more than 0.5 percent of weight of clay lumps. It shall not contain manufactured sand. When subjected to the color test for organic impurities, Test Method Tex-408-A, the fine aggregate shall not show a color darker than the standard.

When the fine aggregate is tested in accordance with Test Method Tex-317-D, it shall have tensile strength of mortar equal to or greater than the strength of standard Ottawa sand mortar.

Unless specified otherwise, fine aggregate shall meet the following grading requirements:

Retained on 3/8″ sieve.....			0%
Retained on No. 4 sieve 0	to	5%
Retained on No. 8 sieve 0	to	20%
Retained on No. 16 sieve	15	to	50%
Retained on No. 30 sieve	35	to	75%
Retained on No. 50 sieve	70	to	90%
Retained on No. 100 sieve	90	to	100%
Retained on No. 200 sieve	97	to	100%

Fine aggregate will be subjected to the Sand Equivalent Test (Test Method Tex-203-F). The sand equivalent value shall not be less than 80, or less than the value shown on the plans, whichever is greater. A combination of manufactured sand and natural materials will be allowed. The acid insoluble residue of fine aggregate used in concrete subject to direct traffic shall be not less than 60 percent by weight when tested in accordance with Test Method Tex 612-J. (Rev. 5/00)

6. **Mineral Filler**: Mineral filler shall consist of clean stone dust, crushed sand, crushed shell or other approved inert material. When tested in accordance with Test Method Tex-401-A, it shall meet the following requirements:

Retained on No. 30 sieve			0%
Retained on No. 200 sieve 0	to	35%

Where fine aggregate is delivered to the job in two or more sizes or types, each type and/or size of material shall be batched and weighed separately. Where mineral filler is used, it shall be batched and weighed separately. At the time of its use, the fine aggregate shall be free from frozen material, and aggregate containing foreign material will be rejected.

All fine aggregate shall be stockpiled for at least 24 hours prior to use. (Rev. 11/87)

7. **Mixing Water**: Water for use in concrete and for curing shall be free from oil, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as C1. nor more than 1,000 parts per million of sulfates as SO4.

Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested before use in structural concrete. A sample of approximately one gallon will be submitted to Materials and Tests Division, Camp Hubbard, Austin, for test and approval.

Tests procedure shall be in accordance with AASHTO Designation: T 26.
(Rev. 11/87)

8. **Joint Filler**: Boards for expansion joint filler and for contraction and longitudinal joints shall be of the size, shape and type indicated on the plans.

Boards shall be obtained from redwood timber. They shall be sound heartwood and shall be 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. (Rev. 5/00)

9. **Joint Sealing Material**: Unless otherwise shown on the plans, joint sealing material shall conform to the requirements for one of the type listed herein. 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. (Rev.11/87)

10. **Hot Poured Rubber**: This sealer shall be a rubber asphalt compound which when heated shall melt to the proper consistency for pouring and shall solidify on cooling at atmospheric temperatures.

    The material when tested in accordance with Test Method Tex-525-C shall meet the following requirements:

    Penetration:
    32°F, 200 grams, 60 seconds..... .....not less than 0.28 cm
    77°F, 150 grams, 5 seconds..... .....0.45 to 0.75 cm

    Flow:
    5 hours, 140°F, 75° incline..... ..... not more than 0.5 cm

    Bond and Extension:
    15°F, 5 cycles There shall be no cracking of the joint sealing material or break in the bond between the joint material and the mortar pieces. (Rev. 11/87)

11. **Preformed Compression Seal**: The material furnished shall comply with the specification for "Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavement," ASTM Designation: D 2628 as hereafter modified.

    The compression set clamp described in ASTM Designation: D 395 shall measure approximately 7″ x 9″ x 11/32″ to permit the testing of large size seals. In lieu of spacers or shims, a double locknut adjustment may be used with the larger seals. Properly prepared thin sections may be "plied-up" to obtain the necessary thickness for specified tests.

    The preformed elastomeric joint sealer shall have a maximum Oil Swell of 60 percent when tested in accordance with ASTM Designation: D 471.

    Acceptance shall be based upon the manufacturer's certification in accordance with ASTM Designation: D 2628, Article 8.1.1A. Certification shall be supplied in all

cases, with the purchaser's option to accept or reject under Article 8.1.3, testing by the purchaser.

Use shall be made of a lubricant-adhesive in the installation of this seal. The lubricant-adhesive shall be compatible with the seal and with the concrete and shall be unaffected by the normal moisture in the concrete. It shall be a single-component compound containing only polychloroprene and soluble phenolic resins blended with antioxidants and acid acceptors in an aromatic hydrocarbon solvent mixture. It shall remain fluid in the manufactured conditions at temperatures between 5°F and 120°F and have a reasonable working life compatible with installation procedures.

The adhesive shall be stored at temperatures between 50°F and 80°F. The adhesive container shall be stamped with the date of manufacture and shall not be more than 9 months old when used. It shall be applied in accordance with the manufacturer's recommendations. (Rev. 11/87)

12. **Asphalt Board**: Asphalt board when used in accordance with plans shall be of required size and uniform thickness and when used in transverse joints, shall conform approximately to the shape of the pavement crown as shown on plans. Asphalt board shall consist of two liners of 0.016-inch asphalt impregnated paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout, and shall be sufficiently rigid to permit easy installation. Boards that crack or shatter during installing and finishing operations will not be acceptable. Board shall be furnished in lengths equal to one-half the pavement width or in lengths equal to the width between longitudinal joints and may be furnished in strips or scored sheet of the required shape. When tested in accordance with Test Method Tex-524-C the asphalt board shall not deflect from the horizontal more than ¾-inch in 3½ inches. (Rev. 11/87)

13. **Load Transmission Devices for Expansion and Contraction Joints**: Approved load transmission devices, if used in accordance with provisions of project and specifications, shall meet the requirements specified herein. (Rev. 11/87)

14. **Steel Dowel Bars**: Smooth steel bar dowels, if used in accordance with provisions of project plans, shall be of the size and type indicated on plans and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the mechanical properties specified for grade 60 in ASTM Designations: A 615. The free end of dowel bars shall be smooth and free of shearing burrs.

When required by plans, one end of each dowel bar shall be encased in an approved cap having an inside diameter of 1/16 inch greater than the diameter of the dowel bar. The cap shall be of such strength, durability and design as to provide free movement of the dowel bar and shall be approved by the Engineer prior to use. One end of the cap shall be filled with a soft felt plug or shall be void in order to permit free movement of the dowel bar for a distance equivalent to 150 percent of the

width of the expansion joint used. The dowel caps and dowel bars shall be held securely in place by bar ties as shown on plans, or an approved equivalent thereof. (Rev. 11/87)

15. **Metal Installing Devices for Joint Assembly**: Metal installing devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes, and marker channels, channel caps, etc.) shall be as shown on plans or may be similar devices of equivalent or greater strength, approved by the Engineer, that will secure the joint assembly in correct position during the placing and finishing of concrete. Load transmission devices used in joint assemblies shall be secured in position by a transverse metal brace of the type and design shown on plans, or may be secured by other approved devices of equivalent or greater strength that will provide positive mechanical connection between the brace and each unit (other than by wire tie) and prevent transverse movement of each load transmission device. (Rev. 11/87)

16. **Steel Reinforcement**: Unless otherwise shown on the plans, steel reinforcing bars as required including the tie bars shall be open-hearth, basic oxygen or electric-furnace new billet steel or Grade 60 or Grade 40 for concrete reinforcement. Bars that require bending shall be Grade 40 conforming to requirements of ASTM Designation: A-615.

    High yield reinforcing steel shall be either (1) open hearth, basic oxygen or electric-furnace new billet steel conforming to the requirements of ASTM Designations: A-615 Grade 60 or (2) rail steel bars for concrete reinforcement, conforming to the requirements of ASTM Designation: A-616 Grade 60. (Bars produced by piling method will not be accepted.) High yield reinforcing steel bars shall be further identified by a special marking rolled into each bar. Unless otherwise designated on plans, all reinforcing steel shall be deformed bars conforming to the requirements of pertinent ASTM Specifications. (Rev. 11/87)

17. **Membrane Curing Compound**: The membrane curing compound shall comply with the requirements of the Item, "Membrane Curing," Type 2 white pigmented. (Rev. 11/87)

C. EQUIPMENT: All equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer and shall conform to Item 360.4 "Equipment" of the 1993 Texas Highway Department Standard Specifications for Construction of Highways, Streets, and Bridges. (Rev. 5/00)

D. PROPORTIONING CONCRETE:

1. **Concrete Control**: The City shall furnish at its expense continuous plant control of the concrete by having full time a commercial laboratory at concrete plants to make the following test and inspection:
   a. Check incoming aggregates, fine and coarse, for gradations, specific gravity, unit weight, abrasion wear, etc.

b. Determine moisture contents of the aggregates to adjust bin weights to comply with designs.

c. Make all concrete designs in accordance with Specifications.

d. Check scales as needed for accuracy.

e. Help maintain proper slumps, as specified.

f. Send inspection reports for each day's operations.

The laboratory providing plant control shall cast field specimens and perform related tests for every 100 cubic yards of concrete manufactured, or any portion thereof, at the City's expense. Each set of beams shall consist of 3 beams. (Rev. 5/00)

2. **Concrete Mix Design**: The concrete shall be composed of Normal Portland Cement or High-Early-Strength Portland Cement, coarse aggregate, fine aggregate and water. The coarse aggregate cannot be less than sixty percent (60%) of the total combination of aggregates by volume. High-Early-Strength Portland Cement may be used only when specifically approved by the Engineer in writing and the concrete made therewith shall be subject to all applicable provisions of these specifications.

Within a period of not less than ten (10) days prior to the start of concreting operations, the Contractor shall submit to the Engineer a design of the concrete mix he proposes to use together with samples of all materials to be incorporated into the mix and a full description of the source of supply of each material component. The design of the concrete mix shall conform to the provisions and limitation requirements of these specifications. When the design mix has been approved by the Engineer, there shall be no change or deviation from the proportions thereof or sources of supply except as hereinafter provided. <u>No concrete may be placed on the job site until the mix design has been approved by the Engineer in writing to the contractor.</u>

It is the intent of this specification to develop and use an economical mix design with the proportion of fine aggregate in the concrete mix near the upper limit of the range that permits proper placing, finishing, and texturing and which will fulfill all requirements of this specification when using acceptable materials as furnished by the Contractor. Where hand finishing is permitted, the addition of one-half sack of cement (6 sacks total) per cubic yard shall be required. (Rev. 11/96)

The concrete mix design shall have an entrained air content of 4.5 percent, ±1.5 percent. (Rev. 1/2016)

After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by

compressive strength test specimens, or flexural strength test specimens, made, cured and tested as provided in THD Bulletin C-11. Modifications of the mix design will be made by the Engineer on the basis of the conformity of the strength of these test specimens with the requirements and intent of this specification.

Changes in the water-cement ratio and the mix design, including an increase in cement factor, if necessary, will be made when the average 7-day flexural strength of the concrete, as indicated by the last 10 flexural strength values (modulus of rupture) obtained from tests of beams made from concrete of the same water-cement ratio, departs from the desired minimum average strength of more than 4 percent.

The Engineer, at his option, may reject as non-representative any individual flexural strength value in each group of ten where strengths more than 10 percent above or below the average for the group are indicated and compute the average flexural strength on the basis of the remaining values. When the concrete fails to meet any of the requirements for workability, the Engineer will attempt to correct this condition by changing the mix design or by requiring the use of mineral filler. In case it is necessary to change aggregates, to use an additional aggregate or to use admixtures, preliminary strength tests will be required. Should tests representing 3 days production consistently indicate a considerable departure from the minimum specified strength, even though within the above limits, appropriate changes in the water-cement ratio and mix proportions will be made.

All concrete shall be designed for a minimum compressive strength at 28 days of three thousand six hundred pounds per square inch (3,600 psi) and a minimum flexural strength of five hundred seventy-five pounds per square inch (575 psi) at the age of seven (7) days when Type I Portland Cement is used. If Type III cement is used, a flexural strength at seven (7) days of six hundred pounds per square inch (600 psi) will be required. Flexural strength will be determined as a simple beam with center point loading (A.S.T.M. Designation C 293). While concreting operations are in progress, beam and cylinder specimens shall be made by the City's independent laboratory according to the STANDARD SPECIFICATIONS FOR PUBLIC WORKS AND TRANSPORTATION CONSTRUCTION AS ISSUED BY THE NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS. All concrete having a minimum compressive strength at 28 days of 3,600 psi and a minimum flexural strength of 575 psi at 7 days shall have a minimum cement content of 5.5 sacks per cubic yard. (Rev. 11/96)

If the concrete fails to meet the strength requirements, as shown by the failure of any flexural or compressive test specimen on two out of three consecutive day's tests, the engineer shall require the cement factor increased in increments of one half (½) sack of cement per cubic yard of concrete until the strength requirements are met and also require the contractor to redesign the mix. No increased compensation will be allowed the contractor for a necessary increase in the cement factor. Failure of all test specimens, either flexural or compressive on any day's run of concrete, may be cause for rejection of that particular section of pavement and

become mandatory upon the engineer to terminate all concreting operations and require the contractor to submit a redesign of the concrete mix. (Rev. 1/95)

3. **Workability**: Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing machine has been over a given area twice. Workability shall be obtained without producing a condition such that free water appears on the surface of the slab when being finished as specified. Where water appears on the surface of the concrete after finishing and this condition cannot be corrected by reasonable adjustment in the batch design, the bleeding will be immediately corrected by one of the following measures or a combination of two or more of the following listed measures:

   a. Redesign of the batch.

   b. Addition of mineral filler to fine aggregate.

   c. Increase of cement content.

   d. Use of an approved admixture.

   The mix will be designed with intention of producing concrete which will have a slump of 1½ inches when tested in accordance with the STANDARD SPECIFICATIONS FOR PUBLIC WORKS AND TRANSPORTATION CONSTRUCTION AS ISSUED BY THE NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS. The maximum slumps shall be as follows.

   a. Slipform placement – 2 inches maximum

   b. Machine placement other than slipform – 3 inches maximum

   c. Hand placement – 4 inches maximum (Rev. 5/00)

E. <u>SUBGRADE AND FORMS</u>:

1. **Preparation of Subgrade**: Where stabilized subbase is not provided the subgrade shall be excavated as required, all unstable or otherwise objectionable material removed, and all holes, ruts and depressions filled with approved material. Rolling and sprinkling shall be performed when and to the extent directed, and the roadbed shall be completed to or above the plane of the typical sections shown on plans and the lines and grades established by the Engineer. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes, and any additional material required for the completion of the sections shall be secured from sources approved by the Engineer. Drainage of the roadbed shall be maintained at all times. Sealed or treated subgrade cut in the preparation of the subgrade or setting of pavement forms shall be resealed or the subgrade restored to the original condition as directed by the Engineer.

The subgrade planer shall be operated from approved forms immediately ahead of paving operations, and the subgrade shall be finished to the exact section of the bottom of the pavement as shown on plans. Where traveling form pavers are used the subgrade planer shall operate on a prepared track grade or be controlled by electronic sensors operating from a stringline that established line and grade. It shall be tested with the approved template, operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the pavement is placed and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to ensure its being in a firm and moist condition for at least 2 inches below the prepared surface. Sufficient subgrade shall always be prepared in advance to ensure satisfactory prosecution of the work. No equipment or hauling shall be permitted on the prepared subgrade except by special permission of the Engineer, which will be granted only in exceptional cases and only where suitable protection in the form of two-ply timber mats or other approved material is provided. (Rev. 8/89)

2. **Placing and Removing Forms**: The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width, and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable materials, place, sprinkled and rolled as directed. Forms shall be staked with at least three pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used. Forms shall be set for sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet ahead of the mixer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete, and all necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked.

   In exceptional cases, the Engineer may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated thereon and to withstand its vibration without springing or settlement shall be required. If forms settle and/or deflect over 1/8 inch under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.

   Forms shall remain in place for not less than 8 hours after the concrete has been placed. They shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned, and any honeycombed areas pointed up with approved mortar. In cases of severe honeycomb, the pavement will be removed. (Rev. 5/00)

Immediately after pointing is complete, the form trench, if used, shall be filled with earth from the shoulders in such a manner as to shed water from rainfall or curing away from the edge of the pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed in condition to maintain drainage.

Any grade revisions shall be established by the Engineer. No additional payment over the contract unit price will be made for any pavement of a thickness exceeding that required on the plans. (Rev. 11/87)

F. CONCRETE MIXING AND PLACING:

1. **Mixing Methods**: The concrete shall be mixed in a mixer conforming to the requirements of Texas Department of Transportation 1993 Standard Specifications for Construction of Highways, Streets and Bridges Subarticle Item 360.4(3). Ready-Mix concrete may be used for curbs, irregular sections and/or small placements such as turnouts and leaveouts.

2. **Mixing**: The aggregates, mineral filler, if required, cement and water shall be measured separately, introduced into the mixer, and mixed for a period of not less than 50 seconds nor more than 90 seconds, measured from the time the last aggregate enters the drum to the time discharge of the concrete begins. The required water shall be introduced into the mixing drum during the first 15 seconds of mixing. The entire contents of the drum shall be discharged before any materials of the succeeding batch are introduced.

   The Engineer may increase the minimum mixing time to that necessary to produce thoroughly mixed concrete based on inspection or appropriate uniformity tests. The mixing time may be varied at any time as necessary to produce acceptable concrete.

   If a central mixer is used, the concrete shall be discharged into the specified hauling equipment and delivered to the road site. If truck agitators are used, the concrete shall be continuously agitated at not less than one nor more than six rpm as directed by the Engineer.

   The maximum size of the concrete batch, absolute volume, shall not exceed 120 percent of the rated size of the mixer (40.8 cubic feet maximum batch for the 34 cubic foot paver). Spilling of material from the mixer drum shall be corrected by reducing the size of the batch. Retempering or remixing of concrete will not be permitted.

   The initial batch of concrete mixed after each time the mixer is washed out shall be enriched by additional mortar. The additional mortar shall be one sack of cement and three parts sand. (Rev. 4/94)

3. **Weather Conditions**: All weather temperatures will be based on readings forecasted by WBAP broadcasting station (817-787-1111) (Rev. 12/11)

Except by specific written authorization of the Engineer, concrete shall not be placed when the temperature is below 40°F and falling but may be placed when the temperature is above 35°F and rising, the temperature being taken in the shade and away from artificial heat.

When such permission is granted, the Contractor shall furnish an approved enclosure, such as canvas-covered framework, to enclose and protect all pavement so placed, and shall maintain the temperature of the air surrounding the concrete at not less than 50°F for not less than 5 days. When concrete is being placed in cold weather, other than under the conditions stated above, the Contractor shall have available a sufficient supply of an approved covering material to immediately protect concrete if the air temperature falls to 32°F, or below, before concrete has been placed 4 hours. Such protection shall remain in place during the period the temperature continues below 32°F or for a period of not more than 5 days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at his expense.

4. **Placing Concrete:** Concrete shall be placed only on approved subgrade or subbase, and unless otherwise indicated on plans, the full width of the pavement shall be constructed monolithically. The concrete shall be rapidly deposited on the subgrade in successive batches and shall be distributed to the required depth and for the entire width of the pavement by shoveling or other approved methods. Rakes shall not be used in handling concrete. Workmen will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes.

   The placing operation shall be continuous. At the end of the day, or in case of unavoidable interruption or delay of more than 30 minutes, a transverse construction joint shall be placed at the point of work stoppage, provided the point at which work has been suspended is not less than eight feet (8') from the last regularly established joint. If the length is less than eight feet (8'), the concrete shall be removed back to the last regularly established joint.

   When the concrete is to be placed in separate lanes, the junction line shall not deviate from the true line more than 1/2 inch at any point and shall be finished as shown on plans.

   Concrete shall be distributed to such depth that when consolidated and finished, the slab thickness required by plans will be obtained at all points and the surface shall not, at any point, be below the established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids.

If a central mixer is used, the Contractor shall provide a system satisfactory to the Engineer for determining that concrete delivered to the road meets the specified requirements for mixing and time of placing. (Rev. 5/00)

5. **Time**: Concrete shall not be placed before the time of sunrise and shall not be placed later than shall permit the finishing of the pavement during sufficient natural light.

Temperature/Time Requirements

Concrete Temp (At Point of Placement)	Max Time (No Retarding Agent) Minutes	Max Time [1] (With Retarding Agent) Minutes
Non-Agitated Concrete		
All temperatures	30	45
Agitated Concrete		
Above 90F	45	75
Above 75F thru 90F	60	90
75F and Below	90	120

[1]Normal dosage of retarder

Any concrete not placed as herein prescribed within the time limits specified will be rejected. (Rev. 5/00)

7. **Hot Weather Concrete Placing:** Concrete with a temperature of 85°F or higher will require a retarding agent admixture.

The maximum temperature of concrete at the time of placement will not exceed 100°F. All concrete that exceeds this temperature limit will be rejected.

It shall be the Contractor's and/or his supplier's responsibility to take steps to control the temperature below 100°F. (Rev. 5/00)

8. **Reinforcing Steel and Joint Assemblies**: All reinforcing steel, including steel wire fabric reinforcement, tie bars, dowel bars, and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details shown on plans. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer, and at all splices, and shall be securely wired to each dowel intersected. When wire fabric is used, it replaces only the longitudinal and transverse bars and shall be securely wired together at all splices and to each dowel intersected. Tie bars shall be installed in the required position by the method and device shown on plans or by approved method and device equivalent thereto. Bar coatings required by plans, and of material specified, shall be completed and the

bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete.

Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will not longer meet the physical requirements for the size and grade of steel specified.

Where plans require an assembly of parts of pavement joints, the assembly shall be completed, placed at required location and elevation, and all parts rigidly secured in required position by the method and devices shown on plans or by approved method and devices equivalent thereto. Dowel bars shall be accurately installed in joint assemblies in accordance with plans, each parallel to the pavement surface and to the center line of the pavement, and shall be rigidly secured in required position by such means (as shown on plans, or approved equivalent thereto) that will prevent their displacement during placing and finishing of the concrete. Unless specifically authorized by the Engineer in writing, the load transmission devices, shall be accurately installed in joint assemblies in accordance with plans, each unit vertical with its length parallel to the center line of the pavement, and all units shall be rigidly secured in required position by such means (as shown on plans, or approved equivalent thereof) that will prevent their displacement during placing and finishing of the concrete. Header boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission device. All load transmission devices shall be free to rust and clean when installed in the concrete.

(Rev. 11/87)

9. **Construction Joints**: Intentional stoppage of the placing of the concrete shall be at either an expansion joint or at a weakened plane joint. The following provisions shall govern for each type of joint at which the placing of concrete is stopped.

   a. When the placing of concrete is stopped at an expansion joint, the complete joint assembly shall be installed and rigidly secured in required position as shown on plans. A bulkhead of sufficient cross-sectional area to prevent deflection, accurately notched to receive the load transmission devices or dowels, as the case may be, and shaped accurately to the cross-section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and in accordance with plan requirements. The back-up bulkhead shall remain in place until immediately prior to the time when concrete placing is resumed, when it shall be carefully removed in such manner that no element of the joint assembly will be disturbed. The exposed portion of the joint assembly shall be free to adherent concrete, dirt or other material at the time placing of the concrete is resumed.

b. When placing of concrete is stopped at a weakened plane joint, all applicable provisions of paragraph (a) above shall apply in addition to the following requirements:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half section of the joint assembly and shall be shaped to form the slab end at the center of the joint as shown on the plans. The half-width of joint seal-space may be formed by a strip of required section placed and removed in accordance with plan requirements for construction of transverse contraction joints. The Contractor shall have available a bulkhead shaped to the section of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint and shall be of sufficient section and strength to prevent deflection.

Immediately upon the unintended stoppage of the placing of concrete, the Contractor shall place the available concrete to a line and install the above described bulkhead at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed. When placing of the concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be rodded with the first. An edge created by a construction joint of this type shall have a joint seal space and shall be sealed as required for contraction joints. (Rev. 11/87)

G. JOINTS:

1. **General**: All transverse and longitudinal joints when required in the pavement shall be of the type or alternate type shown on plans and shall be constructed at required location, on required alignment, in required relationship to tie bars and joint assemblies, and in accordance with details shown on the plans. Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Where concrete base is overlaid by asphaltic concrete the joints shall be prepared as specified herein, but joint sealing will not be required unless specified on plans.

If necessary for proper installation of the sealer, excessive spalling of the joint groove shall be repaired to the satisfaction of the Engineer in the manner which he prescribes.

Careful workmanship shall be exercised in the construction of all joints, to ensure that the concrete sections are completely separated by an open joint or by the joint materials and to ensure that the joints will be true to the outline indicated. (Rev. 11/87)

2. **Expansion Joints**: Transverse expansion joints shall be formed perpendicular to the centerline and surface of the pavement and shall be constructed in accordance with the sequence of operations shown on plans. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in position of the filler and shall install the joint seal space form in accordance with plans. After removal of the joint seal form as required by plans, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed in accordance with plans. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete overhangings.

(Rev. 11/87)

3. **Weakened Plane Joints**: Weakened plane joints shall consist of transverse contraction joints and longitudinal joints and shall be sawed as specified on the plans. The saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete, and shall be capable of performing the work. Saw blades shall be designed to make a clean smooth cut having a width and depth of cut as detailed on the plans. Tracks adequately anchored, chalk, string line or other approved methods shall be used to provide true alignment of the joints. The concrete saw shall be maintained in good operating condition and the Contractor shall keep a stand-by power saw on the project at all times when concrete operations are under way.

   If membrane curing is used, the portion of the seal which has been disturbed by sawing operations shall be restored by the Contractor by spraying the areas with additional curing seal.

   a. Contraction joints: Transverse contraction joints shall be sawed joints perpendicular to the centerline and the surface of the pavement and shall be constructed by the method, and in sequence of operations, as shown on plans. Where sawed joints are used, contraction joints at intervals shown on the plans shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, the exact time to be approved by the Engineer. The remaining contraction joints shall be sawed in a uniform pattern as directed by the Engineer, and they shall be completed before uncontrolled cracking of the pavement takes place. All joints shall be completed before placing concrete in succeeding lanes and before permitting traffic to use the pavement.

b. Longitudinal Joints: Longitudinal joints shall be of the type or alternate types shown on plans and shall be constructed of specified materials in accordance with provisions of the plans. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint, and the pavement surface over and adjacent to the joint shall be finished as specified.

Longitudinal joints shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, the exact time to be approved by the Engineer. Sawing shall not cause damage to the pavement and the groove shall be cut with a minimum of spalling. No traffic (including construction traffic) shall be permitted on the pavement until the longitudinal joint is cut. (Rev. 5/00)

4. **Joint Sealers**: Joint sealers shall be either of the types shown below:

Hot Poured Rubber: This material shall be melted in an approved oil-bath kettle equipped with temperature indicators and continuously operated mechanical agitators. The material shall not be heated above 450°F and any material heated above that temperature will be rejected.

For placement in vertical joints (curb faces, etc.) either of the following procedures may be used.

a. An amount of the mixed material may be set aside until partial curing has taken place and carefully trowelled into the joint with a suitable tool.

b. The portion of the joint in the roadway shall be poured and cured. The vertical curb faces shall then be taped or formed and the material poured into the vertical joint from the top.

Preformed Compression Seal: After the joints in the hardened concrete have been repaired (if necessary) and cleaned to the satisfaction of the Engineer, the material shall be installed into each joint by means of an appropriate hand or power operated installation device using the lubricant-adhesive specified. The seal shall be installed in a compressed condition and shall be free of an objectionable amount of curling and twisting during installation in the joint groove. It shall be of such material and so installed that it will effectively seal joints in concrete against water, dirt, and stones throughout repeated cycles of expansion and contraction. Stretching of the compression seal during installation in the joint will not be permitted. (Rev. 11/87)

5. **Asphalt Board**: Premolded materials, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B & S gage. Such anchorage shall be sufficient to overcome the tendency of the material to fall out of the joint. (Rev. 11/87)

6. **Curbs**: The curb shall be constructed in lengths equal to the adjoining pavement slab lengths, and expansion joints shall be provided in the curb opposite each transverse expansion joint in the pavement. Expansion joint material shall be of the same thickness, type and quality as specified for the pavement and shall be of the section as shown for the curb. All expansion joints shall be carried through the curb.

   Transverse contraction joints shall be sawed across the curb at the same location and at the same time as sawing of the transverse contraction joints in the pavement are sawed.

   A finish coat of mortar shall be applied on the exposed surfaces of the monolithic curbs. The mortar shall be composed of one part of portland cement and two parts of fine aggregate. A mortar coat will not be required for extruded curbs.

   The curb face, lower radius and top of curb shall be plastered with the sand-cement mortar. The mortar shall be applied with a template or "mule" made to conform to the curb dimensions shown on plans. All exposed surfaces of the curb shall be finished with steel trowel and brushed to a smooth and uniform surface. The mortar finish as required shall be subsidiary to the Item, "Concrete Pavement." (Rev. 11/87)

H. SPREADING AND FINISHING:

1. **Machine Finishing**: All concrete pavement shall be finished mechanically with approved power-driven machines, except as herein provided. Hand finishing will be permitted on the transition from a crowned section to a superelevated section without crown on curves, and on straight line superelevation sections less than 100 feet in length. Hand finishing will also be permitted on that portion of a widened pavement outside the normal pavement width, on sections where the pavement width is not uniform, or required monolithic widths are greater than that of available finishing machines.

   Machine finishing of pavement shall include the use of power-driven spreaders, power-driven vibrators, power-driven transverse strike-off, and screed, or such alternate equipment as may be substituted and approved under Texas Department of Transportation 2004 Standard Specifications for Construction of Highways, Streets and Bridges Subarticle 360.10(1). Further, any machine finishing equipment that rides on previously placed forms will be prohibited on any roadway with a total width of more than 28’, nor will they be allowed on any divided roadway of any width.

   All concrete pavement shall be consolidated by a mechanical vibrator. As soon as the concrete has been spread between the forms, the approved mechanical vibrator shall be operated to consolidate the concrete and remove all voids. Hand manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit.

After finishing is complete and the concrete still workable, the surface shall be tested for trueness with an approved 10-foot steel straightedge. The straightedge shall be operated from the side of the pavement, placed parallel to the pavement centerline and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than one-half its length. Practically perfect contact of the straightedge with the surface will be required, and the pavement shall be leveled to this condition, in order to ensure conformity with the surface test required below after the pavement has fully hardened. Any correction of the surface required shall be accomplished by adding concrete, if required, and by operating the longitudinal float over the area. The surface test with the straightedge shall then be repeated.

For one-lane pavement placement and uniform widening, the equipment for machine finishing of concrete pavement shall be as directed by the Engineer, but shall not exceed the requirements of these specifications.

After completion of the straightedge operation, the first pass of the baker broom shall be made as soon as construction operations permit and before the water sheen has disappeared from the surface. This shall be followed by as many passes as required to produce the desired texture depth satisfactory to the engineer. There shall be no unnecessary delays between passes. The baker broom shall be free from encrusted mortar. (Rev. 5/00)

2. **Hand Finishing**: Hand finishing shall be resorted to only upon specific authorization by the Engineer. Six sacks of cement per cubic yard shall be required for all hand finish concrete.

   When hand finishing is permitted, the concrete shall be struck off with an approved strike-off screed to such elevation that when consolidated and finished the surface of the pavement shall conform to the required section and grade. (Rev. 5/00)

3. **Emergency Procedures**: The Contractor shall have available a conventional garden spray type can containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.

   After completion of dragging and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished as directed by the Engineer, and the pavement shall be left smooth and true to line. (Rev. 11/87)

4. **Surface Testing**: After the concrete has been placed 12 hours or more, the Engineer will test the surface of the pavement with a 10 foot straightedge. Unless specified otherwise, the surface shall not vary from the straightedge by more than 1/8 inch between any two (2) contacts, when measured longitudinally or transversely. Any high spots causing a departure from the straightedge in excess of

that specified shall be ground down by the Contractor to meet the surface test requirements. Where the texture of the pavement is removed by extensive grinding, the texture shall be restored by grooving the concrete to meet the surface finishing requirements. (Rev. 8/96)

I. CURING: All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. Newly laid concrete base to be overlaid by asphaltic concrete shall not be cured by "Membrane Curing," and surfaces not to be overlaid by asphaltic concrete shall not be cured by "Asphalt Curing." In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material of the type the Contractor elects to use, failure to maintain saturation in wet curing methods, lack of water to adequately take care of both curing and other requirements, or other failures to comply with curing requirements shall be cause for immediate suspension of concreting operations and removal of any sections which are improperly cured. The covering material used in curing shall be removed as necessary to saw joints or to comply with the requirements for "Surface Test." The concrete surface shall be maintained wet with a water spray, if required, and the covering material replaced immediately on completion of sawing and testing and any required surface correction. (Rev. 11/87)

J. PROTECTION OF PAVEMENT AND OPENING TO TRAFFIC:

1. **Protection of Pavement**: The Contractor shall erect and maintain the barricades required by plans and such other standard and approved devices as will exclude public traffic and traffic of his employees and agents from the newly placed pavement for the periods of time hereinafter prescribed. Portions of the roadway, or crossings of the roadbed required to be maintained open for use by traffic, shall not be obstructed by the above required barricades. Crossings of the pavement required by plans, or by construction sequence, during the period prior to opening to traffic as herein specified, shall be provided with an adequate and substantial bridge, approved by the Engineer. (Rev. 11/87)

2. **Opening Pavement to Traffic**: The pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least 7 days old and has attained a minimum average modulus of rupture as required under Section 4, Subarticle "Concrete Strength," of these specifications. This period of closure to all traffic may be extended if, in the opinion of the Engineer, weather or other conditions make it advisable to provide an extension of the time of protection.

   At the end of the 7 day period and as long thereafter as ordered by the Engineer, and if so desired by the Contractor, the pavement may be opened for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles does not exceed 14,000 pounds. Such opening, however, shall in no manner relieve the

Contractor from his responsibility for the work. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and earth placed against the pavement edges before permitting vehicles thereon.

After the concrete in any section is 14 days old, or as long thereafter as ordered by the Engineer, such section of pavement may be opened to all traffic as required by plans or when so directed by the Engineer. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned, earth placed against the pavement edges and all other work performed as required for the safety of traffic. Such opening, however, shall in no manner relieve the Contractor from his responsibility for the work.

When High Early Strength Concrete resulting from the use of Type III cement as required by plans or special provisions is used, the pavement may be opened to all traffic after the concrete is 7 days old, or as long thereafter as ordered by the Engineer, subject to the same provisions governing the opening after 14 days as above prescribed.

Where the Contractor desires to move any equipment not licensed for operation on public highways, on or across any pavement opened to traffic, he shall protect the pavement from all damage by means of two-ply timber mats of 2 inch stock or runways of heavier material laid on a layer of earth, all as approved by the Engineer. (Rev. 11/87)

3. **Emergency Opening to Traffic**: The Engineer may require the opening of pavement to traffic prior to the minimum time specified above under conditions of emergency which in his opinion require such action in the interest of the public. In no case shall the Engineer order opening of the pavement to traffic within less than 72 hours after the last concrete in the section is place. The Contractor shall remove all obstructing materials, place earth against the pavement edges and perform other work involved in providing for the safety of traffic as required by the Engineer in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer in writing. (Rev. 11/87)

K. PENALTY FOR DEFICIENT PAVEMENT THICKNESS: Refer to Council of Governments Specification 5.8.6.

No additional payment over the contract unit price will be made for any pavement of a thickness exceeding that required by the plans. (Rev. 7/90)

L. MEASUREMENT: When provided by plans and proposal, concrete pavement will be measured by the square yard of the surface area of completed and accepted work. The surface area will be so construed to also include that portion of the pavement slab extending beneath the curb. When concrete pavement is to be measured by the square yard and monolithic curb is required, monolithic curb will be subsidiary to the item for reinforced concrete pavement. (Rev. 11/87)

M. 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 Reinforced Concrete pavement, or the adjusted unit price for pavement for deficient thickness as provided under "Penalty for Deficient Pavement Thickness," which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints, and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required, and wire and devices for placing, holding and supporting the steel bars, load transmission devices and joint filler material in proper position, for coating steel bars where required by plans, and for manipulations, labor, equipment, appliances, tools, traffic provisions and incidentals necessary to complete the work.

Excavation required by this item in the preparation of the subgrade and for the completion of the shoulders and slopes will be measured and paid for in accordance with the provisions governing the Items of "Unclassified Roadway Excavation."

Sprinkling and rolling required for the compaction of the rough subgrade in advance of fine grading will be measured and paid for as indicated in the governing items of excavation. Maintenance of a moist condition of the subgrade in advance of fine grading and concrete placing will not be paid for directly but shall be considered subsidiary work, as provided above. (Rev. 11/87)

12-3 MEMBRANE CURING:

A. DESCRIPTION: This item shall consist of curing concrete pavement, concrete pavement (base), curbs, gutters, retards, sidewalks, driveways, medians, islands, concrete rip-rap, cement stabilized rip-rap, concrete structures, and other concrete as indicated on the plans by impervious membrane method. (Rev. 11/87)

B. MATERIALS: The membrane curing compound shall comply with the "Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete," ASTM Designation: C 309, Type 1 clear or translucent, or Type 2 white pigmented. The material shall have a minimum flash point of 80°F when tested by the "Pensky-Martin Closed Cup Method."

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.

The compound shall produce a firm, continuous, uniform moisture impermeable film free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. It shall, when applied to the damp concrete surface, at the rate of coverage specified herein, dry to touch in not more than 4 hours and shall adhere in a tenacious film without running off or appreciably sagging. It shall not disintegrate, check peel or crack during the required curing period.

The compound shall not peel or pick up under traffic and shall disappear from the surface of the concrete by gradual disintegration.

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 Test Method Tex-219-F. 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 (Rev. 11/87)

C. 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 applications of the compound.

The compound shall be thoroughly agitated during its use and shall be applied by means of approved power pressure sprayers. The sprayers shall be equipped with satisfactory atomizing nozzles. Only on small miscellaneous items will the Contractor be permitted to use hand-powered spray equipment.

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 application of membrane by fogging or mist application. Sprinkling or coarse spraying will not be allowed.

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 ensure proper coverage, the Engineer shall inspect all treated areas after application of the compound for the period of time designated in the governing specification for curing, either for membrane curing or for other methods. Dry areas are identifiable because of the lighter color or 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 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.

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 this contract. (Rev. 5/00)

D. MEASUREMENT AND PAYMENT: Work and materials prescribed herein will not be paid for directly but shall be included in the unit price bid for the items of construction in which these materials are used. (Rev. 11/87)

END OF SECTION