

SUBSECTION 4.02 EARTHWORK

I. SCOPE

This item includes the required excavation within the project limits, placements and compaction of approved earth materials for embankment, the removal and disposal of all excavated materials not required, and the shaping and finishing of all the subgrade and in conformity with the required lines, grades, and cross sections.

II. MATERIALS

Excavated materials shall be used where possible within project limits.

III. EQUIPMENT

A. General: Unless otherwise provided, the Contractor shall furnish all machinery, tools, equipment, and qualified equipment operators for the proper prosecution and completion of the work.

All equipment shall be maintained in good repair and operating condition and shall be approved by the Engineer prior to use.

B. Earthwork Equipment:

1. **Motor Graders:** Motor Graders shall be self-propelled with dual or four-wheel drive; shall be equipped with pneumatic tires; shall have a blade of not less than twelve (12) feet in length; and shall have a wheelbase of not less than sixteen (16) feet. A scarifier of an approved type shall be provided.

2. **Scrapers:** Each scraper shall have not less than eight cubic yards capacity and shall be self-propelled. Each scraper shall be capable of self-loading to full capacity or additional necessary power equipment shall be provided to push or pull each scraper to load to full capacity.

3. **Tractors:** Each tractor shall have a bulldozer attachment. Where the duty scarifier or ripper is needed, such attachments designed for operation with the required tractor shall also be furnished. The tractor shall be either of the crawler type or rubber-tired tractor and have adequate tractive effort. The bulldozer attachment shall have a blade of not less than eight (8) feet in length.

C. Compaction Equipment:

1. **General:** Suitable and sufficient compacting equipment shall be provided to obtain the required densities and stabilities complete compaction of embankment and subgrade. Compaction equipment shall obtain the required densities and stabilities.

2. **Tramping Rollers:**

a. **Light:** The light-tramping roller shall consist of two metal rollers, drums or shells of forty (40) inches minimum diameter; each not less than forty-two (42) inches in length and unit-mounted in a rigid frame in such a manner that each roller may oscillate independently of the other; and each roller, drum, or shell be surmounted by metal studs with tramping feet projecting not less than seven (7) inches from the surface and spaced not less than six (6) inches nor more than ten (10) inches measured diagonally center to center; and the cross-section area of each tamping foot, measured perpendicularly to the axis of the stud, shall be not less five (5) nor more than five (5) nor more than eight (8) inches. The roller shall be supplemented with cleaning teeth to provide self-cleaning. The roller shall also be designed that by ballast loading, the load on each tamping foot may be varied uniformly from one-hundred twenty five (125) to not less than one hundred seventy five (175) pounds per square inch of cross-sectional area. The load per tamping foot will be determined by dividing the total weight of the roller by the number of tamping feet in one row parallel to or approximately parallel to the axis of the roller. The tamping roller shall be self-propelled.

b. **Heavy:** The heavy tamping roller shall consist of two or more metal drums, roller, or shell of sixty (60) inches minimum diameter. If the two-drum type is furnished, each drum shall be not less than sixty (60) in length. If the three-drum type is furnished, the roller shall consist of two forward drums and one rear drum, the drums to be so arranged that the rear drum will compact the space between the two forward rolls, and rollers of this type shall have an overall width of not less than ten (10) feet.

The drums shall be unit-mounted in a rigid frame in such manner that each drum may oscillate independently of the other.

Each drum shell be surmounted by metal studs with tamping feet projecting not less than seven (7) inches from the surface and shall be so spaced as to result in one tamping foot for each 0.65 to 0.7 square foot of drum area. The area of each tamping foot shall be approximately seven (7) inches, but shall be not less than six (6) nor more than eight (8) square inches. All rollers shall be provided

with cleaning teeth so designed and attached as to prevent the accumulation of material between the tamping feet.

The roller shall also be designed that by ballast loading, the load on each tamping foot may be varied to five hundred fifty pounds per square inch (550 psi) or cross-sectional area.

3. **Pneumatic Tire Roller:**

a. Light: The light pneumatic tire roller shall consist of not less than nine pneumatic tired wheels, running on axles where the rear group of tires will cover the entire gap between the adjacent tires of the forward group, and mounted in rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tire roller shall have an effective rolling width of approximately sixty (60) inches and shall be designed that by ballast loading, the total load may be varied uniformly from nine thousand (9,000) pounds to eighteen (18,000) pounds. The roller shall be equipped with tires that will afford ground contact pressures to forty-five (45) pounds per square inch or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart. The roller shall provide a uniform compression under all wheels. The light pneumatic tire roller shall be self-propelled.

b. Medium: The medium pneumatic tire roller shall consist of not less than nine pneumatic tired wheels, running on axles where the rear group, and mounted in a rigid frame and provided with the loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller width of approximately eighty-four (84) inches and shall be so designed that the ballast loading the total load may be varied uniformly from twenty-three thousand five hundred (23,500) pounds to fifty thousand (50,000) pounds. The roller shall be equipped with tires that will afford ground contact pressures to eighty pounds (80) per square inch or more. The operating load and tire air pressure shall be within range of the manufacturer's chart.

The medium pneumatic tire roller shall be self-propelled. The power unit shall have adequate tractive effort to properly move the operating roller at variable uniform speeds up to approximately five (5) miles per hours.

c. Heavy: The heavy pneumatic tire roller shall consist of not less than four pneumatic tire wheels, running on axles carrying not more

than two wheels, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.

The roller shall have a rolling width from eight (8) feet to ten (10) feet. By ballast loading, the gross load may be varied uniformly from twenty-five (25) tons to fifty (50) tons. The tires shall be capable of operating under the various loads with variable air pressure up to one hundred fifty (150) pounds per square inch. The operating load and tire air pressure shall be within the range of the manufacturer's chart. The heavy pneumatic tire roller shall be self-propelled.

There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of fifty (50) tons.

4. **Flat Wheel Rollers:** Rollers shall be the three-wheel or tandem, self-propelled type, weighing not less than required to obtain densities and stabilities.

D. Alternative Equipment: In lieu of the compaction equipment specified, the Contractor may operate other compacting equipment that will provide compaction in the same period of time as the specified equipment; its use shall be discontinued.

IV. CONSTRUCTION METHODS

A. Excavation: The Contractor shall excavate and fill to the lines and grades shown on the plans. All construction stakes set by the Engineering Department shall be maintained by the Contractor.

All excavated materials must be disposed of at the Contractor's expense. Should additional material be required for proper grade, the Contractor shall furnish and place same.

All rock, flexible paving, bushes, shrubs, trees, and other material not designed by a bid item in the project proposal shall be removed by the Contractor at the unit price bid for earthwork, or excavation and subgrade, or other similar bid item. Excavation will be unclassified. The Contractor is expected to satisfy himself as to the nature of the excavation expected.

B. Embankment: Prior to placing any embankment, all clearing operations shall have been completed. Clearing operations will consist of the removal and disposal of tree stumps, brush, roots, vegetation, logs, rubbish, and other objectionable materials. Stump holes or other small excavation shall be

backfilled with suitable material and thoroughly tamped by approved methods. The surface of the ground, including plowed, loosen ground, or surface roughened by small washes or otherwise, shall be restored to approximately its original slope by blading or other approved methods and where indicated on plans.

Where embankments are to be placed adjacent to or over existing subgrade, the existing subgrade shall be scarified and recompactd with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible layer depth. After the completion of the earthwork portion, it shall be continuously maintained to its finished section and grade until the project is accepted.

All embankment materials shall be approved by the Engineer.

Earth embankments shall be constructed in successive layers for the full width of the cross-section and in such length as are suited to the sprinkling and compaction methods utilized. Prior to compaction, the layers shall not exceed six (6) inches in depth where pneumatic tire rolling is to be used and shall not exceed eight (8) inches in depth for rolling with other types of rollers. Layers of embankment may be formed by utilizing scrapers or by other acceptable methods.

Each layer of embankment shall be uniform as to material and moisture content before beginning compaction. Where layers of unlike materials abut each other each other, each layer shall be featheredged for at least one hundred (100) feet or the material shall be so mixed as to prevent abrupt changes in the compacted soil. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, or similar methods. Water required for sprinkling to bring material to the optimum moisture content plus or minus two (2) percent necessary for compaction shall be evenly applied. The Contractor shall secure uniform moisture content throughout the layer necessary method. Each layer shall be compacted by rolling until ninety-five (95) percent of the specific material's Standard Proctor is obtained.

C. Concrete Removal and Disposal: Concrete pavement, curbs, gutter, valleys, alley, aprons, sidewalks, and driveways shall be removed to neatly sawed edges with saw cuts made to minimum depth of one and one-half (1 ½) inches. Saw cuts are to be made as shown on the plans. The Contractor may remove to a scored or construction joint further away from the designated saw cut with the additional slab removal and replacement at his expense.

When the concrete slab is cracked or broken other than along the saw cut the additional concrete removal and replacement will not be any cost to the City.

D. Subgrade Preparation: Subgrade whether in a cut or fill shall be scarified at least six (6) inches deep. All unstable or otherwise objectionable material shall be removed and replaced with approved material. All holes, ruts, and depressions shall be filled with approved material. The subgrade shall be thoroughly wetted, reshaped, and rolled to place subgrade in an acceptable condition to receive the next course and/or curb and gutter. The subgrade shall be finished to line and grade shown on the plans, and any deviation in the excess of one-half (1 / 2) inch shall be corrected by loosening, adding, or removing materials, reshaping, and compacting to ninety-five (95) of the subgrade material Standard Proctor density. Water required to bring the material to the optimum moisture content or plus or minus two (2) percent shall be evenly applied. Sufficient subgrade shall be prepared in advance of other operations.

E. Utilities: The Contractor shall determine the location of all utilities within the project and shall use every precaution in protecting them. The Contractor shall work around, protect, and repair, if damaged any utilities lines. The Contractor shall notify the respective utility in sufficient time so that they may remove, lower, replace, and/or do any other adjustment to their facilities and/or properties.

F. Protection of Private or Public Property: The Contractor shall use every precaution possible for the protection of all property. Exclusive of other properties mentioned herein to be protected, it is the Contractor's responsibility to protect trees, plants, grass, shrubbery, drainage structures, and any or all other properties in or near the project. The Contractor is responsible for all damage due to his work occurred to any or all properties.

G. Clean Up and Backfill: Where the existing ground elevation is higher than the top of curb elevation, the embankment shall be back on the slope shown on the plans.

Where the existing ground elevation is lower than the top of the curb elevation, the space behind the curb shall be backfilled behind the curbs shall be backfilled on a maximum slope of six to one from the top of curb unless otherwise shown on the plans.

H. Disposal of Excess Material: Excess material excavated shall be disposed of properly by the Contractor. Contractor shall use top soil in the backfill behind the curbs. The Contractor shall not dispose on any material in any "Flood Hazard Area" within the City limits or its extraterritorial jurisdiction. The Contractor shall be familiar with "Flood Hazard Area" limits.

V. MEASUREMENT

The work shall be measured either by the square yard of surface of area or by the cubic yard of excavation. Measurement by either method will be calculated as shown on the plans. The method also will be shown by item and unit measure in the project proposal.

Trees over six (6) inches in diameter will be measured for payment if required to be removed. All shrubbery, brush, and smaller diameter trees will not be measured for payment, but shall be considered subsidiary to appropriate earthwork item.

VI. PAYMENT

In the square yard measurement method, the unit price shall be full compensation for excavating, hauling, compacting, shaping, fine grading, wetting, rolling, removal of trees, shrubs, and existing pavement, and all other work required in the excavation and embankment operation.

In the cubic yard measurement method, the appropriate excavation and embankment items will be in the proposal.

The work performed and material furnished shall be paid for at the unit price bid for the appropriate bid item. This unit price shall be full compensation for securing and furnishing all materials involved; for all processing required; for loading, hauling, delivering, placing, and spreading for blading, shaping, and compacting to the specified grade; for all manipulation, labor, tool, and incidentals necessary to complete the work.

SUBSECTION 4.05 FLEXIBLE BASE

I. SCOPE

This item includes a foundation course for an asphaltic concrete surface course or other base courses; shall be composed of either caliches, crushed stone, gravel, or other material approved by the Engineer, and shall be constructed as herein specified in one or more courses in conformity with the typical sections shown on plans and to the lines and grades as established by the Engineer.

II. MATERIALS

A. General: The materials shall be crushed or uncrushed as necessary to meet the requirements specified, and shall consist of durable coarse aggregate particles mixed with approved binding materials. The materials shall be approved by the Engineer at the source. All acceptance testing shall be performed prior to the materials being delivered to the project. Additional quality control testing may be performed after delivery to a project at the discretion of the Engineer.

B. Types of Flexible Bases:

Type F: Type F material shall consist of argillaceous limestone, calcareous, or calcareous clay particles, with or without stone, conglomerate, gravel, sand, and other granular materials. All the acceptable shall be screened, and the oversize shall be crushed and returned to the screened material again in such a manner that a uniform product will be produced. The Contractor shall furnish test results no older than one year from project bid date. The City will take samples for independent testing as necessary from the material stockpile.

1. **Grade 1:** When tested by TX DOT standard laboratory methods, the base material shall meet the following requirements:

Passing 1 3/4 sieve	100%
Retained on No. 4 sieve	45 to 75%
Retained on No. 40 sieve	50 to 85%

Material passing the No. 40 sieve shall be known as "Soil Binder" and shall meet the following requirements when prepared in accordance with TXDOT Test Method TXDOT-101-E procedure:

The liquid limit shall not exceed	35
The plasticity index shall not exceed	12
The bar linear shrinkage shall not exceed	2%
The wet ball mill value shall not exceed	45

The material shall be in Class 2 or higher in quality as determined in TXDOT 117-E Triaxial Compression Test for Base Materials.

2. **Grade 2:** The grading, soil constants and/or triaxial requirements and other specification data for Type F Grade 2 material shall be as shown on the plans.

Type B: Type B material shall consist of durable particles of gravel mixed with approved binding material. The binder may be added and incorporated by approved methods as herein specified. All the acceptable material shall

be screened, and the oversize shall be crushed and returned to the screened material again in such a manner that a uniform product will be produced.

1. **Grade 1:** When properly slaked and tested by TXDOT standard laboratory methods, the base material shall meet the following requirements:

Retained on 1 3/4" sieve0%
Retained on 3/8" sieve20 to 60%
Retained on No. 440 to 75%
Retained on No. 4065 to 85%

Materials passing the No. 40 shall be known as "Soil Binder" and shall meet the following requirements when prepared in accordance with Test Method TXDOT-101-E procedure:

The liquid limit shall not exceed 35
The plasticity index shall not exceed12
The wet ball mill value shall not exceed50

The materials shall be in Class 2 or higher as determined in TXDOT 117-E, Triaxial Compression Tests for Base Materials.

2. **Grade 2:** The grading, soil constants and/or triaxial requirements and other specifications data for Type B Grade 2 base material shall be as shown on the plans.

Type A: Type A material shall be crushed and shall consist of durable particles of stone mixed with approved material.

1. **Grade 1:** When properly slaked and tested by TXDOT standard laboratory methods, the flexible base material shall meet the following requirements:

Retained on 1 3/4 "sieve0%
Retained on No. 4 sieve45 to 75%
Retained on No. 40 sieve60 to 85%

Material passing the No. 40 sieve shall be known as "Soil Binder" and shall meet the following requirements when prepared in accordance with Test Method TXDOT-101-E procedure:

The liquid limit shall not exceed 35
The plasticity index shall not exceed12
The wet ball mill value shall not exceed50

The material shall be in Class 2 or higher as determined in TXDOT 117-E, Triaxial Compression Tests for Base Materials.

2. **Grade 2:** The grading soil constants and/or triaxial requirements and other specification data for type A Grade 2 base material shall be shown on the plans.

Type FA: Type FA material shall consist of processed fly ash. The material shall be approved by the Engineer at the source. All the acceptable shall be screened, and the oversize shall be crushed and returned to the screened material again in such manner that a uniform product will be produced. Testing the material shall be done prior to the compaction operations. The Contractor shall furnish test results no older than one year from project bid date. The City will make such independent tests as necessary while the stockpile is being produced to determine that the material is acceptable.

1. **Grade 1:** When tested by TXDOT standard laboratory methods, the base material shall meet the following requirements:

Passing 1 3/4" sieve	100%
Retained on No. 4 sieve . . . . .	.45 to 75%
Retained on No. 40 sieve	60 to 85%

Material passing the No. 40 sieve shall be known as "Soil Binder" and shall meet the following requirements when prepared in accordance with TXDOT-1901-E procedure:

The liquid limit shall not exceed	35%
The plasticity index shall not exceed	12%
The bar linear shrinkage shall not exceed	2%
The wet ball mill value shall not exceed	45%

The material shall be in Class 2 or higher as determined in TXDOT 117-E, Triaxial Compression Tests for Base Materials.

2. **Grade 2:** The grading, soil constants and/or triaxial requirements and other specification data for Type FA Grade 2 base material shall be as shown on the plans.

Type S: Type S material shall consist of salvaged base material within the project limits. The Contractor shall receive explicit permission from the project inspector prior to using this material unless otherwise required by particular bid items. The existing base material must primarily be one of the preceding types of base materials. Any oversize material remaining from pulverization process shall be crushed and returned to the salvaged material again in such manner that a uniform product will be produced. The

Contractor shall furnish test results prior to any Type S material being allowed to be incorporated into the project. The City will take samples for independent testing as necessary from the salvaged material stockpile.

1. **Grade 1:** When tested by TXDOT standard laboratory methods, the salvage base material shall meet the following requirements:

Passing 1 3/4" sieve 100%
Retained on No. 40 sieve 50 to 85%

Material passing the No. 40 sieve shall be known as "Soil Binder" and shall meet the following requirements when prepared in accordance with TXDOT Test Method TXDOT-101-E procedure:

The liquid limit shall not exceed 35%
The plasticity index shall not exceed 12%
The bar linear shrinkage shall not exceed 2%
The wet ball mill value shall not exceed 45%

The material shall be in Class 2 or higher as determined in TXDOT 117-E, Triaxial Compression for Base Materials.

2. **Grade 2:** The grading, constants and/or triaxial requirements and other specification data for Type S Grade 2 base material shall be as shown on the plans.

C. Material Sources: If the Contractor produces the specified type of base material from local pits, the material shall be approved by the Engineer. The pits, as utilized, shall be opened up in such a manner as to immediately expose the vertical faces of all the various strata of acceptable material, and unless otherwise directed, the material shall be secured in successive vertical cuts extending through all of the exposed strata, in order that a uniformly mixed material will be secured.

The processed material shall not be hauled directly to the project, but shall be stockpiled. The stockpile shall be made up of layers approximately one (1) foot thick or as otherwise directed by the Engineer. After a sufficient stockpile, has been constructed as specified, the Contractor may proceed with loading from the stockpile for delivery to the project. In loading from the stockpile for delivery to the project, the material shall be loaded by making successive vertical cuts through the entire depth of the stockpile.

Salvaged base material shall be first removed from its original location to an acceptable stockpile location if processing in place cannot be performed satisfactorily to the project inspector. Depending on the particular bid items in

each project, the subgrade shall be exposed to allow proper compaction and moisture content.

III. EQUIPMENT

The equipment of Subsection 4. 02 "Earthwork" shall apply.

IV. CONSTRUCTION METHODS

A. Subgrade Preparation: Subsection 4. 02 "Earthwork" shall apply.

Base material shall not be laid upon frozen subgrade. Curb and gutter shall be constructed and cured sufficiently prior to base material placement. The curb and gutter shall not be damaged during base material placement. The condition of the subgrade shall be approved by the Engineer prior to placing of base material.

B. Number of Courses: Flexible base material shall be laid and compacted in courses of equal depth of either four (4) inches, five (5) inches, or six (6) inches as follows:

Thickness of Base Material	Number of Courses
6"	one 6" courses
8"	two 4" courses
10"	two 5" courses
12"	two 6" courses

For any base thickness of greater than twelve (12) inches, the courses shall be of equal thickness with no single course of a thickness less than four (4) inches and no greater than six (6) inches.

1. **First Course:** Immediately prior to placing of the base material, the subgrade shall be checked. The base material shall be delivered in approved vehicles. Base material deposited upon the subgrade shall be spread and shaped in the same day. If inclement weather or other unforeseen circumstances render impractical the spreading of the base material during the first twenty-four (24) hour period, the base material shall be later scarified and spread as directed by the Engineer. The base material shall be sprinkled, bladed, processed, and shaped to conform to typical sections as shown on the plans. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded.

The base material shall be sprinkled as required and compacted to the extent necessary to provide not less than one hundred (100) percent of Standard Proctor density. The moisture content shall not vary more

than two (2) percent from optimum moisture content. In addition to the requirements specified for density, the full depth of flexible base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, tests as necessary will be made by the engineer. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. In no event will the density be less than one hundred (100) percent of Standard Proctor.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical sections shown on the plans and to the established lines and grades. In that area on which pavement is to be placed, any deviation in excess of one-fourth (1/4) inch in cross section, and in a length of sixteen (16) feet measured longitudinally shall be corrected by loosening, adding or removing base material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable base material as required, reshaping and recompacting by sprinkling and rolling. Should the first course, due to any reason or cause, lose the required stability, density, or finish before the surfacing is complete, it shall be recompacted and refinished at the contractor's expense.

On projects where eight (8) inches or more base material is specified, the material shall extend under the curb and gutter to the back of curb. The amount of base under the curb and gutter will be the thickness of the total base course, less six (6) inches, but in no case less than four (4) inches.

2. **Succeeding Courses:** Prior to placing the final surfacing on the completed base material, the base material surface shall be primed with low viscosity liquid asphalt such as MC-30, MC-70, MC-250, at an application rate of 0.20 to 0.50 gallons per square yard. The prime coat shall be allowed to penetrate the prepared surface. If the bituminous materials fails to penetrate within an allowable time period and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb the excess prime coat.

C. Addition to Existing Flexible Base: Any required additional base material that is to be added to an existing flexible base conform with the typical sections shown on the plans and to the lines and grades, as established by the Engineer, shall be properly bonded to the existing base and fine graded to the proper section.

V. MEASUREMENT

Work and accepted material as prescribed for flexible base will be measured by one of two methods. The first method of measurement will be by a unit of surface area (square yard or as stated in the proposal) of the flexible base, in place, for a specified thickness and shall be measured from toe of gutter to toe of gutter. On projects where there is flexible base below the curb and gutter it will be measured for payment at its specified thickness. The second method of measurement will be computed in place between the original subgrade or subbase surfaces and the lines, grades, and sections established by the Engineer by the method of average end areas.

VI. PAYMENT

The work performed and material furnished as prescribed by this item and measured as provided will be paid for at the unit price per square yard bid for "Flexible Base" of the thickness specified or by the cubic yard of "Flexible Base", complete in place.

The unit prices bid shall each be full compensation for shaping and fine grading the subgrade; for securing and furnishing all material including all royalty and freight involved; for additives, if required, for loosening, blasting, excavating, screening, crushing, and temporary stockpiling; for loading, hauling, and delivering all materials; for spreading, mixing, blading, processing, sprinkling, compacting, shaping, finishing, and priming; and for all manipulation, labor, tools, and incidentals necessary to complete the work.

SUBSECTION 4.09

CONCRETE SEPARATE CURB, CURB AND GUTTER, SIDEWALKS, DRIVEWAYS, VALLEY, ALLEY APRONS, MEDIANS, ISLANDS AND ALLEYS

I. SCOPE

This item includes Portland cement concrete separate curb, curb and gutter, sidewalks, driveways, valley, alley aprons, medians, islands and alleys with or reinforcing steel as required, constructed on an approved subgrade, sand, flexible base, or other foundation. The construction shall conform to the lines and grades established on the plans. The project drawings shall provide details of all concrete work.

II. MATERIALS

A. General: Unless otherwise specified on the plans, materials shall conform to the requirements as specified in the Subsection.

The cement shall be Type II Portland cement. Type III cement shall be used when high-early strength concrete is required by the plans or special provisions. The Contractor shall obtain written permission of the Engineer, and shall assume all additional cost incurred by his use of another type cement. Cement shall conform to ASTM C 150. When Type III cement is used, the average strength of briquettes at the age of seven (7) days shall be higher than that attained at three (3) days. Either the tensile or the compressive tests may be used for either type cement.

Any cement storage shall be a 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 proper inspection and identification of each shipment.

The concrete shall be Class A, consisting of Portland cement, mineral aggregate, and water. When required, the air-entraining agent shall be used in such an amount as will affect the entrainment of between three (3) and seven (7) percent of air, by volume, of the concrete as discharged by the mixer. Other admixtures or blends may be used with the approval of the Engineer.

Concrete for pavement, alley aprons, valleys, drives, walks, alleys, retaining walls, curbs and gutter, concrete manholes, inlets, and other structures shall be used in such proportions that the twenty-eight (28) day compressive strength shall be 3,000 psi or greater. Concrete for no-joint pipe of cast-in-place non-reinforced pipe sections shall be of such proportions of Portland cement, fine and coarse aggregate, and water that the twenty-eight (28) day compressive strength of the concrete shall be 3,500 psi or greater.

B. Types: Portland cement shall conform to one of the types in ASTM c 150 "Portland Cement."

C. Admixtures: Unless otherwise provided in the plans or special requirements, approved types of admixtures to minimize segregation, to improve workability, or to reduce the amount of mixing water may be used in the rate of dosage specified by the Engineer. The following types of admixtures are generally used:

1. **Air-Entraining Admixtures:** Air-entraining admixtures shall conform to ASTM C 260 "Air Entraining Admixtures for Concrete." An air entraining agent shall be used in all concrete for concrete paving, alley aprons, concrete valleys, drives, walks, retaining walls, curb and gutter, concrete manholes, inlets, and other exposed structures. The

air-entraining agent shall be between four (4) and seven (7) percent of air, by volume, of the concrete as discharged by the mixer.

2. Chemical Admixtures: Accelerating, retarding, and water-reducing admixtures, if used, shall conform to ASTM C 494 "Chemical Admixtures for Concrete." Calcium chloride, if used, shall not exceed two (2) percent by weight of the cement.

3 Pozzolan Admixtures: Fly ash and other pozzolans, when used as an admixture shall conform to ASTM C 618 "Fly Ash and Raw Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

D. Coarse Aggregate: Coarse aggregate shall consist of durable particles of gravel, or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or 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, or no more than 1.0 percent by weight of shale more than 5.0 percent by weight of laminated and/or friable particles.

Coarse aggregate shall have a wear of not more than forty (40) percent when tested according to AASHTOT 96, and when tested by standard laboratory methods shall meet the following gradations:

Aggregate Grade No.	Nominal Size	2-1/2 Inch	2 Inch	1-1/2 Inch	1 Inch	3/4 Inch	1/2 Inch	3/8 Inch	No. 4	No. 8
1	2 1/2	0	0-20	15-50		60-80			95-100	
2 (467)*	1 1/2		0	0-5		30-65		70-90	95-100	
3	1		0	0-5		10--40	40-75		95-100	
4 (57)*	1			0	0-5		40-75		90-100	95-100
5 (67)*	3/4				0	0-10		45-80	90-100	95-100
6 (7)*	1/2					0	0-10	30-60	85-100	
7	3/8						0	5--30	75-100	
8	No. 4						0	0-5	35-60	90-100

* Numbers in parenthesis indicate that these gradations conform to corresponding ASTM gradation from ASTM 33. The numbers ranges are the percentages retained on individual sieves.

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 re-mixed. At the time of 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 twenty-four (24) hours prior to use.

E. Fine Aggregate: Fine aggregate shall consist of sand or combination of sand, and shall be composed of clean, hard, durable, uncoated grains.

1. **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 by weight of clay lumps. When subjected to the color test for organic impurities, TXDOT Bulletin C-11, the fine aggregate shall not show a color darker than the standard.

When the fine aggregate is mixed with Type III cement in the proportion of 1:3, the average strength of not less than three (3) standard mortar briquettes at the age of three (3) days shall be equal to or greater than the strength than the strength of Ottawa sand mortar briquettes of the same proportions and consistency when tested at the age of three (3) days.

Fine aggregate when tested in accordance with TXDOT Bulletin C-11 shall meet the following gradation:

Material	Percentage by Weight
Retained on 1/4" sieve . . . . .	.0%
Retained on No. 4 sieve . . . . .	.0 to 5%
Retained on No. 20 sieve . . . . .	.15 to 50%
Retained on No. 100 sieve . . . . .	.85 to 100%

Material removed by decantation when tested in accordance with TXDOT Bulletin C-11, shall not exceed 4.0 percent by weight.

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.

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 twenty-four (24) hours prior use.

2. **Mineral Filler:** Mineral filler shall consist of clean stone dust, crushed sand, crushed shell, or other approved inert material. When tested in accordance with TXDOT Bulletin C-11, it shall meet the following requirements:

Material	Percentage by Weight
Retained on No. 30 sieve . . . . .	.0%
Retained on No. 200 sieve . . . . .	.0 to 35%

Where material filler is used, it shall be batched and weighed separately.

F. Water: Water shall be reasonably clean and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Potable water may be accepted for use. If the water is of questionable quality, it shall be tested in accordance with AASHTO T 26.

G. Concrete Mortar: Mortar shall consist of one (1) part cement, two (2) parts finely graded sand and sufficient water to make the mixture plastic.

H. Curing Materials:

1. **Burlap:** Burlap shall be made from jute or hemp and, at the time of using shall be in good condition, free from holes, dirt, clay, or any other substances which interferes with its absorptive quality. It shall not contain any substance which would have a deleterious effect on the concrete. Burlap shall be of such quality that it will absorb water readily when dipped or sprayed and shall weigh not less than seven (7) ounces per square yard when clean and dry. Burlap made into mats may be used if care in handling is exercised to avoid marring the finished surface of the concrete.

2. **Cotton Mats:** Cotton mats for curing concrete shall conform to the requirements of AASHTO M 73 "Cotton Mats for Curing Concrete."

3. **Waterproof Paper:** Paper and impermeable sheets for curing concrete shall conform to the requirements of ASTM C 171 "Sheet Materials for Curing Concrete."

4. **Liquid Membrane-Forming Compounds:** Liquid membrane-forming compounds shall conform with the requirements of ASTM C 309 "Liquid Membrane-Forming Compounds for Curing Concrete."

I. Metal Reinforcement:

1. **Welded Wire Fabric:** Welded wire fabric shall conform to the requirements of ASTM A 185 "Steel Welded Fabric, Plain, for Concrete Reinforcement."

2. **Bars, Tie Bars, Dowels and Sleeves:** All bars shall conform to ASTM A 615 "Deformed and Plain Steel Bars for Concrete Reinforcement" Grade 60. Joint hook bolts may be used as an alternative to tie bars. Such bolts shall not be less than one-half (1/2) inch in diameter and should be equipped with threaded couplings. Dowel bars shall not be burred, roughened, or deformed out of round in such a manner as to affect slippage in the concrete. When metal sleeves are used, they shall cover the ends of dowels for not less than two (2) inches and no more than three (3) inches. The sleeve shall be closed at one end and shall have a suitable stop to hold the end of the bar at least one (1) inch from the closed end of the sleeve. It shall be of such rigid design that the closed end will not collapse during construction.

3. **Supports:** Chairs for holding tie rods, bars, and other structural members in correct position while the concrete is being placed shall be made of material approved by the Engineer prior to use.

4. **Stakes:** Stakes used to support expansion joint fillers shall be channel or U-shaped metal, three-fourth (3/4) inches wide, three-eighth (3/8) inches deep, and not less than sixteen (16) gauge (Manufacturer's standard gauge for steel sheets) in thickness. They shall be a minimum of fifteen (15) inches in length or longer in necessary to provide proper bearing support.

J. Fiber Reinforcement:

1. **Types:**

- a. Stainless, alloy, or carbon steel
- b. Alkali resistant glass
- c. Synthetic fiber

2. **Compliance:** All fiber reinforcement shall conform to ASTM C 1116 "Fiber-reinforced Concrete and Shotcrete."

K. Expansion Joint Material: Performed fiber expansion joint material shall be of the dimensions shown on the plans. The material may be the following types unless specifically noted otherwise on the plans. Performed bituminous fiber material shall conform to ASTM D 1751 "Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and resilient bituminous types)." Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction."

L. Joint Sealing Material: Unless otherwise shown on the plans, joint sealing material shall conform to the requirements for one on the classes

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 materials shall not crack or break when exposed to low temperatures.

Class 1 (Synthetic Polymer):

- a. Two Liquid Component-Synthetic Polymer Type: This sealer shall be a two-liquid component, cold-extruded, synthetic polymer, which will form an effective seal against water and incompressibles. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles.
- b. Two Components, Liquid & Solid, Synthetic Polymer Type: This sealer shall be a two-component (liquid or solid) cold-poured synthetic polymer, which will form an effective seal against water and incompressibles. Curing is to be by polymerization and not by evaporation or solvent of fluxing of harder particles.

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

It shall cure sufficiently in three hours so that it will not pick up under wheels of traffic.

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

Penetration, 77° F.	
150 gms. Cone, 5 sec., max.-cm . . . . .	.090
Bond and Extension 75%, 0° F, 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 I – a material only	
Cold Flow (10 min.)	None

Class 2 (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 TXDOT-525-C, shall meet the following requirements:

- Penetration:
 - 32° F., 200 grams, 60 secondsnot less than 0.28 cm
 - 77° F., 150 grams, 5 seconds 0.45 to 0.75 cm
- Flow:
 - 5 hours, 140° F., 75° inclinenot more than 0.5 cm
- Bond and Extension
 - 15° F., 5 cycles

Cracking of the joint sealing material or break bond between the joint materials and the mortar pieces.

Class 3 (Ready-Mixed Cold-Applied Joint and Crack Sealer): This sealer shall consist of a homogenous blend of asphalt, rubber, inert filler, and a suitable solvent, or solvents. The material shall be a resilient, adhesive compound capable of effectively sealing properly cleaned joints against the infiltration of moisture throughout repeated cycles of contraction and expansion and which shall not be picked up by vehicle tires, particularly at summer temperatures.

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

- Penetration:
 - At 77° F: (As received) 150 grams, 5 secondsnot less than 2.75 cm
 - (After evaporation of solvent) 150 grams, 5 seconds . . .not more than 2.20 cm
 - At 32° F: (After evaporation of solvent) 200 grams, 60 seconds . . . not less than 1.00 cm
- Flow: Not more than 0.5 cm
- Bond: There shall be no cracking of the material failure in bond between the material and the mortar test blocks during or at the end of five (5) cycles.

III. EQUIPMENT

The equipment requirements of the remaining subsections shall apply.

IV. CONSTRUCTION METHODS

A. Subgrade Preparation: Subgrade shall be excavated and shaped to line, grade, and cross section. If dry, the subgrade shall be sprinkled lightly immediately before concrete placement.

The subgrade shall be excavated to the correct elevation. Any fill required shall be furnished by the Contractor and approved by the Project Representative. The subgrade in fill areas shall be brought to correct elevation by placing like soil or flexible base in layers not to exceed four (4) inches depth. Each layer shall be brought to \pm two (2) layers percent of optimum moisture and compacted to a density of ninety five (95) percent of Standard Proctor in the upper six (6) inches of subgrade. In alleys the Contractor shall excavate around and take precautions to protect all existing improvements. All obstructions and improvements that must remain where concrete pavement is placed shall be wrapped with two (2) layers of fifteen (15) pound roofing felt to the level of the top surface of the slab. Any damage to an existing improvements caused by the Contractor shall be repaired.

Excavated material from alley apron construction shall be removed within twenty-four (24) hours after subgrade preparation.

B. Forming: Forms shall be of wood or metal, of a satisfactory section, free from warp, and of a depth equal to the thickness of the finished work. They shall be securely staked to line and grade and maintained in a true position during concrete placement. Inside forms for the curb shall be of approved material and shall be of such design as to provide the curb required and shall be rigidly attached to the outside forms. Face forms on curb radii may be omitted if a true section and an accurate flow line can be obtained by other methods.

Forms shall remain in place at least twelve (12) hours after placement of concrete. Forms shall be oiled with light oil before each use and forms which are to be re-used shall be cleaned immediately after use and maintained in good condition.

C. Reinforcing: The reinforcing steel bars and/or dowel shall be of the correct size and dimension and shall be placed and secured in position as shown on the plans.

Where welded wire mesh reinforcement is specified, the mesh shall lap not less than seven (7) inches and shall be securely tied. All wire mesh shall be nearly cut to the shape of the construction and to fit around all obstructions. Reinforcing bars at proper spacing may be substituted for welded wire mesh.

D. Concrete: Concrete shall be satisfactorily mixed, placed in the forms to the depth specified, spaded, and tamped until thoroughly compacted. The top surface shall be finished with a wooden float to a gritty texture.

Should a chute be used in placing concrete, the slope of the chute and the delivery end of the chute shall be such that the concrete will flow without separation. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each run. The flushing shall discharge outside forms.

All concrete surfaces shall be reasonably true and even, free from pockets, depressions or projections, and given a steel trowel finish and then a light brush finish.

An edging tool with a radius of approximately one quarter of an inch (1/4) shall be used along each edge of a sidewalk, the top back edge of the curb, along the front edge of the gutter, and along each side of each expansion joint.

All concrete shall be properly cured by being kept moist for three (3) days with wetted burlap or mats, or by an approved process. Concrete may be cured by applying a liquid membrane coating (curing compound) to all exposed surfaces.

The curb and gutter shall be backfilled to the full height of the concrete, tamped and sloped as directed.

Concrete shall be deposited that requires minimum rehandling and obtain a uniformly dense section, free of honeycombs, and conforming to line, grade, and cross section.

In general, the consistency of the concrete mixture shall be such that:

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

6. The surface of the concrete will be free from laitance or a surface film or free water.

7. Slump shall not exceed four (4) inches.

Other concrete placement methods such as a slip form machine for curb and gutter is allowable if the concrete can meet these specifications.

E. Shrinkage Crack Control: Concrete shall be below the allowable temperature as determined by the Contractor by using the accompanying ACI 305 chart (modified). The rate of evaporation of water from the concrete shall not exceed 0.15 lbs. per square foot per hour. The Contractor shall keep a log of air temperature, relative humidity's, wind velocities, and allowable concrete temperature for each day he places concrete. The log shall be readily available for review by the Project Representative.

Air Temp.	Relative Humidity	5 mph	WIND 10 mph	SPEED 15 mph	20mph	25mph
50	10	86	72	63	58	52
60	10	87	73	64	59	53
70	10	88	74	66	60	56
80	10	89	75	68	61	58
90	10	90	77	70	63	60
100	10	91	79	71	65	61
50	30	89	76	68	61	58
60	30	90	78	70	63	60
70	30	92	80	72	68	63
80	30	93	82	75	71	68
90	30	96	85	79	75	71
100	30	99	89	83	80	78
50	50	90	78	70	65	61
60	50	92	80	74	70	67
70	50	95	83	78	73	70
80	50	98	88	82	79	76
90	50	100	92	88	84	82
100	50	100	97	93	90	88
50	70	89	80	72	69	65
60	70	95	83	78	72	70
70	70	98	88	81	78	75
80	70	100	91	87	84	81
90	70	100	98	93	90	89
100	70	100	100	100	97	96

For air temperature, relative humidity's, and wind speeds other than what is listed, the next highest temperature shown, next lowest relative humidity, and next highest wind velocity interval shall be used to determine acceptable concrete temperature.

Contractor is to inform the concrete supplier of the temperature requirements prior to delivery to the project. The concrete temperature limit shall not be exceeded at least until fifteen minutes after surface finishing. Appropriate curing

methods shall be used to prevent shrinkage cracks in conjunction with these concrete temperature requirements.

An example for concrete determination is with an air temperature of eighty-three degrees (83°), relative humidity of twenty (20) percent and wind velocity of 18 mph, the chart would be read at ninety degrees (90°) air temperature, ten (10) percent of relative humidity and twenty (20) mph wind velocity and a resultant maximum concrete temperature of sixty-three (63°).

Concrete shall not be poured when wind or weather conditions are such that dirt, sand, or debris enters the concrete. No concrete will be placed when wind speeds exceed twenty-five (25) miles per hour. The concrete shall be protected to maintain temperatures of not less than fifty degrees (50°) F for five (5) days after placement. If aggregate and water are heated, they shall not be heated above one hundred and seventy-five degrees (175°) F. Concrete shall not be placed when ambient temperatures are less than forty (40°) F. It shall be the responsibility of the Contractor to anticipate as nearly as possible changes in weather conditions which would affect the placement and protection of the concrete and to be prepared freshly placed concrete when sudden changes in the weather make such protection necessary.

F. Sidewalks: All sidewalks and step treads shall have a minimum transverse slope of one quarter (1/4) inch per foot and a maximum transverse slope of one half (1/2) inch per foot. Care shall be exercised to match the grade of sidewalk to the top of curb (where applicable) and to the grade of driveways, if any. Care shall also be taken to ramp sidewalk to tie flush with alley paving.

All sidewalks constructed at a location designated on the plans shall be not less than four (4) feet in width.

G. Expansion Joints and Scoring: Expansion joints shall be placed at intervals not to exceed thirty (30) feet in the sidewalk and in the curb and gutter and at such other locations as may be shown on the plans. Expansion joints shall be placed vertically and at right angles to the longitudinal axis of the sidewalk or curb and gutter. Forethought shall be used in the spacing of expansion joints and also in the spacing of the scoring so as to have approximately equal spaces and so that no short or long spaces will exist.

Where a sidewalk or curb and gutter are being constructed adjacent to or abutting existing concrete construction, an expansion joint shall be placed between the new and existing concrete. Expansion material shall also be placed around all obstructions protruding through sidewalks or driveways.

All expansion joints shall be premolded expansion joint monolithic with that of the gutter portion of the curb and gutter and shall be cut true to shape so that the

edge of the expansion joint will be approximately one quarter (1/4) inch below the face and the top of the curb. Those expansion joints in sidewalk shall be placed in the same manner.

Scoring shall be placed in sidewalks and curb and gutters by the use of approved jointing tools. They are both being constructed or if only a sidewalk is being constructed, the spacing of the scoring shall be equal to the width of the sidewalk. If only curb and gutter is being constructed, the spacing of the scoring shall be ten (10) feet or less.

H. Steps: All steps shall have a tread of not less than twelve (12) inches and a riser of not more than seven (7) inches. Where more than one step is constructed at a location, treads and risers of each shall be of equal dimension.

I. Horizontal and Vertical Control: The Contractor shall follow and preserve all lines, grades, marks, and stakes, when proper request were not given by the Contractor.

All forms for concrete work shall be inspected and checked by the Project Representative to ensure their compliance with established lines and grades before any concrete is poured. The Contractor shall notify the appropriate department at least four hours prior to pouring of any concrete to have forms checked. No concrete is to be poured until the Project Representative accepts the forms, foundation conditions, amount, size, and location of reinforcement.

J. Protection: Contractor shall provide and maintain all necessary barricades and sufficient lights, signals, signs, watchmen, and any and all other things necessary for the protection of the work and for the safety for the public.

The Contractor must protect his work against, weather, vandals, and any and all things that may mar the finish, surface, or the appearance of the concrete. Any damage to the surface is cause for rejection of all concrete. Any damage to the surface is cause for rejection of all concrete between expansion joints on either side of the damaged surface.

K. Backfill and Repair of Damaged Concrete in Alley Pavement: The area between the alley slab and the property line shall be filled and or shaped as required to obtain the specified cross section and to provide a smooth, even slope from the edge of the alley slab to the property line. Backfill between the alley slab and the property line shall be compacted density at least that of the adjacent undisturbed soil. No blading will be permitted on the concrete alley pavement.

Only damage of a very minor nature shall be required by approved patching. Any substantial damage to the concrete alley pavement is cause for rejection of that section of pavement between expansion joints on either side of the damage

area, and the damage shall be repaired at the Contractor's expense to the satisfaction of the Engineer.

V. MEASUREMENT

Concrete separate curb and concrete curb and gutter will be measured by the linear foot, complete in place. Work and acceptable material as prescribed for sidewalks, driveways, islands, medians, alleys, and similar concrete construction will be measured by a unit of surface area installed complete.

VI. PAYMENT

The work performed and materials furnished as prescribed by this item and measured as provided will be paid for at the unit bid price. The prices shall be full compensation for preparing the subgrade; for furnishing and placing all materials, including all reinforcement and expansion joint material; for furnishing, placing, shaping, and tamping backfill; for all manipulation, labor, tool, equipment, and incidentals necessary to complete work.

SUBSECTION 4. 13 HOT-MIX ASPHALTIC CONCRETE

I. SCOPE

This item includes a base course, a leveling-up course, a surface course or any combination of these courses as shown on the plans. Each course is to be composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the previously complete and approved subgrade, base, existing pavement, or prepared concrete slab and in accordance with the project plans.

Unless otherwise specified on the project plans, materials, and proportions of hot-mix asphaltic concrete pavement used in construction under this item shall conform to these requirements.

II. MATERIALS

A. Mineral Aggregate: The mineral aggregate shall be composed of a coarse aggregate and a fine aggregate, and if required, a mineral filler. Samples of coarse aggregate, fine aggregate, and mineral filler shall be submitted for approval of materials and their other sources prior to delivery.

In lieu of initial testing, test results from other projects may be submitted. The submitted test results shall not be over one year old from this project bid date, otherwise materials shall be tested. The test results must be received prior to hot-mix asphaltic concrete placement. The combined aggregate sand equivalent value shall be not more than forty-five (45) when test in accordance with Test Method TXDOT-203-F.

1. **Coarse Aggregate:** The coarse aggregate shall be the aggregate retained on a No. 10 mesh sieve; shall consist of clean, tough, durable fragments of stone, or gravel, of uniform quality and be practically free from clay, organic, or other injurious matter occurring either free or as coating on the aggregate. Material removed by decantation (Test Method TXDOT-217-F) shall not be more than two (2) percent. The coarse aggregate shall have an abrasion of not more than forty (40) when subjected to the Los Angeles Abrasion Test (Test Method TXDOT-410-A).

Unless otherwise shown on the project plans, gravel shall be crushed to have a minimum of eighty-five (85) percent of the particles retained on the No. 4 sieve with more than one crushed face, as determined by Test Method TXDOT –413-A (Particle Count).

2. **Fine Aggregate:** The fine aggregate shall be the aggregate passing the No. 10 mesh and sieve and shall consist of sand or stone screening or a combination of sand and stone screenings. Sand shall be composed of sound, durable stone particles free from injurious foreign matter. Screenings shall be of the same or similar material as specified for coarse aggregate. The plasticity index of that part of the fine aggregate passing the No. 40 sieve shall exceed six (6) when tested by Test Method TXDOT-106-E.

3. **Mineral Filler:** The mineral filler shall consist of thoroughly dry stone dust, Portland cement, or other approved mineral dust. The mineral filler shall be free from foreign and other injurious matter when

tested by the method outlined in TXDOT Bulletin C-14. It shall meet the following grading requirements:

	Percentage by Weight
Passing a No. 30 sieve . . . . .	.95 to 100
Passing a No. 80 sieve	75
Passing a No.200 sieve . . . . .	.55

B. Asphaltic Materials:

- 1. Asphalt for Paving Mixtures: Asphalt for the paving mixture shall be of the types shown in Item 300 Asphalts, and Emulsions of the latest edition of TXDOT Standard Specifications and meet the requirements contained therein. The various grades of asphalt and mix design test results shall be submitted prior to delivery to the project.

- 2. Tack Coat: The asphaltic material for tack coat shall meet the requirements for emulsified asphalt.

C. Paving Mixtures:

- 1. Types: The paving mixtures shall consist of a uniform mixture of coarse aggregate, fine aggregate and asphaltic material. The grading of each constituent of the mineral aggregate shall be such as to produce, when properly proportioned, a mixture, which when tested in accordance with TXDOT Bulletin C-14, will conform to the following limitations.

Sieve Size	A Course Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
1-1/2"	100				
1-1/4"	95-100				
1"		100			
7/8"	70-90	95-100	100		
5/8"		75-95	95-100		
1/2"	50-70			100	
3/8"		60-80	70-85	85-100	100
1/4"					95-100
No. 4	30-50	40-60	43-63	50-70	
No. 10	20-34	27-40	30-40	32-42	32-42
No. 40	5-20	10-25	10-25	11-26	9-24
No. 80	2-12	3-13	3-13	4-14	3-13
No. 200	1-6*	1-6*	1-6*	1-6*	1-6*
VMA % minimum	11	12	13	14	15

2. Tolerance: The Engineer may designate the exact grading of the aggregate and asphalt content to be used in the mixture. The paving mixture produced shall not vary from the designated grading and asphalt content by more than the tolerance allowed herein and shall remain within the limitations of the master grading specified in the submitted mix design. The respective tolerances, based on the percent by weight of the mixture, are listed as follows:

**Tolerance,
Percent by Weight**

Passing the 1 1/4" sieve to No. 10 sieve plus or minus 5
Passing the No. 40 to No. 200 sieve plus or minus 3

B. Compaction Equipment: Suitable and sufficient compacting equipment shall be provided. Compaction equipment shall be approved types to obtain the required densities and stabilities.

1. Tamping, Pneumatic Tire, and Flat Roller Wheels: The rollers shall comply where applicable, to the Compaction Equipment portion of Subsection 4.02 "EarthWork."

2. Tandem Rollers:

a. Two-Axle Tandem Roller: This roller shall be an acceptable power-driven two-axle tandem roller weighing not less than eight (8) tons.

b. Three-axle Tandem Roller: This roller shall be acceptable power-driven three-axle tandem not less than ten (10) tons.

3. Trench Rollers: This roller shall be an acceptable power-driven trench roller equipped with sprinkler for keeping the wheels wet and adjustable road wheel so that roller may be kept level during rolling. The drive wheel shall not be less than twenty (20) inches wide.

The roller, under working conditions, shall produce three hundred twenty-five (325) pounds per linear inch of roller width and be so geared that a speed of 1.8 miles per hour is obtained in low gear.

4. Alternative Equipment: In lieu of the compaction equipment specified, the Contractor may, operate other compacting equipment that will produce compaction in the same period of time as the specified equipment. If the alternative equipment fails to produce compaction within the same time period as the specified equipment, its use shall be discontinued.

C. Asphaltic Concrete Equipment:

1. Mixing Plants:

a. General: Mixing plants will consistently produce a mixture meeting all of the requirements of these specifications.

Mixing plants may be the weight-batching type, the continuous mixing type or the drum mix type. All types of plants shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors and shall consist of the specified pieces of equipment.

2. Weight-Batching Type:

a. Cold Aggregate Bin and Proportions Device: the number of compartments in the cold aggregate bin shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bin shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material of one bin to that of another bin. The proportioning device shall be such as will provide a uniform and continuous flow of aggregate in the desired proportion in a separate compartment.

b. Dryer: the dryer shall be of the type continually agitates the aggregate during heating and in which the temperature can be so controlled that aggregate will not be injured in the necessary drying and heating operations required to obtain a mixture of the specified temperature.

c. Screening and Proportioning: the screening capacity and size of the bin shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity.

d. Aggregate Weight Box and Batching Scales: The aggregate weigh box and batching scales shall be of sufficient capacity to hold and weigh a complete batch of aggregate.

e. Asphaltic Material Bucket and Scales: The asphaltic material bucket and scales shall be of sufficient capacity to hold and weigh the necessary asphaltic material for one batch.

f. Mixer: The mixer shall be of the pug mill type and shall have a capacity of not less than three thousand (3,000) pounds in a single batch. The number of blades and the position of same shall be such as to give a uniform and complete circulation of the batch in asphaltic material quickly throughout the mixer. Any mixer that segregates the mineral aggregate or does not thoroughly and uniform mix shall not be used. All mixers shall be provided with an automatic time lock that will lock the discharge doors of the mixer for the required mixing period. The dump door to doors and the shafts seals of the mixer shall be tight enough to prevent the spilling of aggregate or mixture from the pug mill.

3. Continuous Mixing Type:

- a. Cold Aggregate Bin and Proportioning Device: Same as for weighing-batching type of plant.
4. Dryer: Same as for weighing-batching type of plant.
 - a. Screening and Proportioning: Same as for weighing batching type plant.
 - b. Hot Aggregate Bin: The hot bins shall be so constructed that oversize and overloaded material will be discharged through a discharge chute. Hot bins that become deficient in material shall activate a switch that automatically stops the plant until the proper adjustments are made in the aggregate gates.
 - c. Hot Aggregate Proportioning Device: The hot aggregate proportioning device shall be so designed that when properly operated a uniform and continuous flow of aggregate will be maintained.
 - d. Asphaltic Material Spray Bar: The asphaltic material spray bar shall be so designed that the asphalt will spray uniformly and continuously into the mixer.
 - e. Asphaltic Material Meter: An accurate asphaltic material recording meter shall be placed in the asphaltic line leading to the spray bar so that the cumulative amount of asphalt used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the meter output. The asphalt meter and line to the meter shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line and meter at near that temperature specified for the asphaltic material. The temperature of the asphaltic material entering the recording meter shall be maintained at plus or minus ten degrees (10°) F. of the temperature at which the asphaltic metering pump was calibrated to set.
 - f. Mixer: The mixer shall be of the pug mill continuous type and shall have a capacity of not less than forty (40) tons of mixture per hour. Any mixer that segregates the mineral aggregate or does not thoroughly and uniformly mix shall not be used. The dam gate at the discharge end of the pug mixer and pitch of the mixing paddles shall be so adjusted to maintain a level of mixture in the pug mixer between the paddle shaft and the paddle tips except at the discharge end.
5. Drum Mix Type: Unless otherwise shown on the plans, the Contractor may use the drum-mixing process in the mixing of asphaltic concrete material. The plant shall mix aggregates and asphalt in the drum mixer without preheating the aggregates. The plant shall be

equipped with satisfactory conveyors, power units, aggregate-handling equipment and feed controls and shall consist of the following essential pieces of equipment.

a. Cold-Aggregate Bin and Feed System: The number of compartments in the cold aggregate bin shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bin shall be sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one compartment to another. The feed system shall provide a uniform and continuous flow of aggregate in the desired proportion to the drum mixer.

The system shall provide positive weight measurement of the combined cold-aggregate feed by use of belt scales or other approved devices. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device as required. When a belt scale is used, mixture production shall be maintained so that the scale normally operates between fifty (50) percent and one hundred (100) percent of its rated capacity. Belt scale operation below fifty (50) percent of the rated capacity may be allowed by the Engineer if accuracy checks show the scale to meet all requirements, at the selected rate and it can be satisfactorily demonstrated to the Engineer that mixture uniformity and quality have not been adversely affected.

b. Scalping Screen: A scalping screen shall be required, unless otherwise shown on the plans, and shall be located ahead of any weighing device.

c. Asphaltic Material Measuring System: An asphaltic material measuring device shall be placed in the asphalt line leading to the drum mixer so that the cumulative amount of asphalt used can be accurately determined. Provisions of the permanent nature shall be made for checking the accuracy of the measuring device output. The asphalt measuring device and line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line and measuring device near the temperature specified for the asphaltic material. Unless otherwise shown on the plans the temperature of the asphaltic material entering the measuring device shall be maintained at ten (10°) F. of the temperature at which the asphalt measuring device was calibrated and set.

d. Synchronization Equipment for Feed-Control Systems: The asphaltic material feed-control shall be coupled with the total aggregate weight measuring device in such manner as to automatically

vary the asphalt feed rate as required to maintain the required proportion.

e. **Drum Mix System:** The drum mix system shall be the type that continually agitates the aggregate and asphalt mixture during heating and in which the temperature can be so controlled that aggregate and asphalt will not be damaged in the necessary drying and heating operations required to obtain a mixture of the specified temperature. A continuously recording thermometer shall be provided which will indicate the temperature of the mixture as it leaves the drum mixer.

f. **Surge-Storage Systems:** A surge-storage system will be required when required. It shall minimize the production interruptions during operations and can be constructed to minimize segregation. A device such as a gob hopper or other similar approved devices to prevent segregation in the surge-storage bin is required.

g. **Scales:** Scales may be standard platform truck scales, belt scales or other equipment such as weigh hopper (suspended) scales. If truck scales are used, they shall be placed at an approved location. If other weighing equipment is used weight checks by truck scales are required for the approval of the other equipment.

D. Asphaltic Material Heating Equipment: Asphaltic material heating equipment shall heat the asphaltic material required to the desired temperature. Asphaltic material may be heated by steam coils which shall be absolutely tight. The heating apparatus shall be equipped with a recording thermometer with a twenty-four (24) hour chart that will record the temperature of the asphaltic material at the highest temperature.

F. Spreading and Finishing Machine: The spreading and finishing machine shall be of an approved type that produces a surface that meets requirements. When the mixture is dumped directly into the finishing machine, it shall have adequate power to satisfactorily propel the delivery vehicles. The finishing machine shall be equipped with a flexible spring and / or hydraulic type hitch sufficient in design and capacity to maintain contact between the rear wheels of the delivery vehicles and the pusher rollers of the finishing machine while the mixture is being unloaded.

No vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel will be allowed. Vehicles of the semi-trailer type are specifically prohibited from dumping directly into the finishing machine while in contact with the finishing machine. Vehicles dumping directly or indirectly into the finishing machine shall be so designed and equipped that

unloading into the finishing machine can be mechanically and / or automatically operated in such a manner that overloading the finishing machine cannot occur and the required lines and grades will be obtained without resorting to hand finishing.

Automatic screed control is required on all projects. The method for control shall be acceptable prior to any asphaltic concrete being laid on the project.

G. Alternative Equipment: When permitted by the Engineer in writing, equipment other than the specified, which will consistently produce satisfactory results, may be used.

H. Straightedges and Templates: The contractor shall provide acceptable both ten (10) foot or sixteen (16) foot straightedges, as required, for surface testing. Satisfactory templates shall be provided by the contractor.

IV. Construction Methods

A. General: The prime coat, tack coat, or the asphaltic concrete mixture shall not be placed when the air temperature is below fifty degrees (50°) F. and is falling. They may be placed when the air temperature is forty degrees (40°) F. and is expected to rise above fifty degrees (50°) F. for a period of four (4) or more hours. The air temperature shall be taken in the shade away from artificial heat. The prime coat, tack coat, or asphaltic mixture shall be placed only when the humidity, general weather conditions, temperature, and moisture condition of the base or foundation are suitable. During the application of tack and / or prime coats, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures.

If the temperature of the asphalt mixture of a load or any part of a load become more than thirty degrees (30°) F. less than the selected temperature all or any part of the load may be rejected. Payment will not be made for the rejected material.

B. Prime Coat: If a prime coat is required, it shall be applied on flexible or stabilized base at the rate and locations as specified.

Tack coat or asphaltic concrete shall not be applied on a previously primed base has completely cured.

The prime coat also shall not be left uncovered long enough to permit dusting. The prime coat has accumulated an unsatisfactory amount of dust, the base material shall be either reprimed or a tack coat applied.

The prime coat shall be applied by spraying in the amount of not less than 0.20 or not more than 0.50 gallons per square yard of base surface. If the prime shall penetrate the prepared surface of the base to the acceptable depth.

C. Tack Coat: Before the asphaltic concrete mixture is laid, the surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat. The tack coat shall be applied with an approved sprayer at a rate not to exceed 0.50 gallons per square yard of surface. Where the mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures, all joints, and in places where the distributor bars cannot reach, will have the tack coat applied by a hand sprayer. Hand spray methods shall give the surface a very light application of the tack coat.

No more tack coat should be placed than is necessary for a day's operation. All nonessential traffic shall be kept off the tack coat.

Projects with rejuvenating agents may not require a tack coat.

D. Transporting: The asphaltic concrete mixture shall be delivered in clean, tight vehicles. The dispatching of the vehicle shall be arranged so that all the material delivered may be placed, and all rolling shall be completed during daylight hours. In cool weather, marginal wind and cloud conditions or for long hauls, canvas covers and insulating of the truck bodies is required when the previously required temperature differential may be exceeded. The inside of the truck body may be given a light coating of oil, lime slurry, or other acceptable material to prevent mixture from adhering to the body.

E. Placing: The asphaltic concrete mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine, in such manner that when properly compacted, the finished pavement will be smooth, of uniform density and will meet the requirements of the typical cross sections and the surface tests.

When the asphaltic concrete mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated provided a satisfactory surface can be obtained by other approved methods.

Adjacent to flush curbs, gutters, liners, and structures, the surface shall be finished uniformly high so that when compacted it will be slightly above the edge of the curb and flush structure unless otherwise required.

F. Compacting: The mixture shall be compressed thoroughly and uniformly with approved rollers. The Contractor may operate other compacting equipment that will produce acceptable compaction. If alternative compaction equipment fails to produce the desired compaction, its use shall be discontinued.

G. Rolling: Rolling shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheel. Alternate trips of the roller shall be slightly different in length. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated.

The motion of the rollers shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixtures where required. Any roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water. Excess water off the rollers will not be permitted. All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease, or other foreign matter on the pavement. Rolling with the trench-type roller will be required on widening areas in trenches and other limited areas where satisfactory compaction cannot be obtained.

H. Hand Tamping: The edges of the placed asphaltic concrete along curbs, headers, and similar structures inaccessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

I. Surface Finish: The pavement surface, after compaction, shall be smooth and true to the established line, grade, and cross section. When tested with a ten (10) foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent and acceptable means the maximum deviation shall not exceed one-eighth (1/8) inch in ten (10) feet. Any point in the surface not meeting the requirement shall be corrected.

J. Opening to Traffic: The pavement shall be opened to traffic when safely possible. All construction traffic allowed on pavement open to the public will be subject to the State laws governing traffic.

If the surface ravel, it will be the Contractor's responsibility to correct this condition at his expense.

K. In-Place Density: In-place density is required and it is the intent of this specification that the material be placed and compacted to ninety-six (96) percent of the maximum density as determined by ASTM D1559 or as specified on the plans. The maximum density shall be determined from material sampled from

the mixing plant and molded in accordance with ASTM D979. Procedures and methods outlined in ASTM D1188 or ASTM D2950 shall also be used in determining the in-place density. The field specimens utilized for the in-place density testing may be either cores or sections of hot-mix asphaltic concrete tested according to ASTM D1188 or D2950. In-place density tests are intended for control tests. If the in-place density of the mixture produced has a value lower than that specified and in the opinion of the Engineer is not due to a change in the quality of the material, production may proceed with subsequent changes in the mix and / or construction operations until the in-place density equals or exceeds the specified density. Regardless of the method of compaction control followed, all rolling shall be completed before the mixture temperature drops below one hundred seventy-five degrees (175°) F.

V. Measurement:

Work and accepted material as prescribed for "Hot-Mix Asphaltic Concrete" will be measured by a unit of surface area (square yard or as stated in the proposal) of the hot-mix asphaltic concrete pavement, in place and accepted, for the specified thickness.

VI. Pavement

The work performed and materials furnished as prescribed by this and measured as provided will be paid for at the unit prices bid for "Hot-Mix Asphaltic Concrete" of the thickness specified. The prices shall each be full compensation for quarrying, furnishing all materials, prime coat, and freight involved; for all heating, mixing, hauling, cleaning the existing base and course or pavement, placing hot mix asphaltic concrete pavement, rolling and finishing; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.

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SUBSECTION 4.14
CONSTRUCTION PAVEMENT MARKINGS

I. SCOPE

This item includes the placement, maintenance, and prompt removal of pavement markings when required during construction operations.

II. MATERIALS

The material used in construction areas shall be distinctively visible when dry from a minimum distance of three hundred (300) feet in daylight conditions and a minimum of one hundred sixty (160) feet when illuminated by automobile low-beam headlights at night. Visibilities are to be measured when viewed from an automobile traveling on the roadway.

The day color as well as the nighttime reflected color of the markings shall be distinctly white or yellow as required and shall conform to appropriate color requirements. The markings shall exhibit uniform retroreflective characteristics.

III. Equipment

The Contractor shall use such equipment to properly place the pavement marking materials.

IV. Construction Methods

A. Placement and Maintenance: Streets which are closed to traffic during construction should be marked with standard pavement markings in accordance with Texas MUTCD prior to traffic returning. Streets open to traffic during construction shall be properly marked at the end of each day's work in accordance with Texas MUTCD Standards in order to replace those markings that may have been covered or obliterated during the day's operation.

Traffic may be permitted on new pavement surfaces for a period of forty-eight (48) hour before markings are required. The Contractor shall maintain markings to the satisfaction of the Project Representative.

The Contractor shall diligently place and maintain the markings as long as they are required for traffic operations through construction areas. Markings which fail to meet these requirements shall be replaced immediately by the Contractor.

B. Removal: When construction requires altering of any pavement marking, the Contractor shall provide for the covering or complete obliteration of any conflicting markings. Prior to placement of any marking material that will require subsequent removal during construction, the Contractor will demonstrate the removability of the material to the Project Representative. Removal of the markings shall leave no discernible evidence of the marking ever having been placed.

V. MEASUREMENT

Construction Pavement Markings will be measured by a unit as specified in the proposal, complete and in place. Certain projects that require pavement markings may not allow measurement for payment.

VI. Payment

The work performed and materials furnished as prescribed by this item, measured as provided under "Measurement" , shall be paid for at the unit price bid for "Construction Pavement Markings" of the various sizes, shapes, and colors as specified, which price shall be full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to place, maintain, and remove all markings as required.

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