

SECTION 02710

BOUND AGGREGATE BASE COURSES

PART 1 – Description

- 1.01 This section describes the work and materials associated with various aggregates, and binders to produce the following bound aggregate base courses: Cement Stabilized Aggregate Base, Portland Cement Concrete Base (Plain), Asphaltic Concrete (General), and Soil Cement, in accordance with these Specifications and in conformity with the lines, grades, thickness, and typical cross-section shown on the Plans or as directed by the Owner.

PART 2 – Materials

2.01. Submittals

- A. Before any soil cement aggregate base course or cement stabilized aggregate base are applied the following submittals shall be submitted for review to the Engineer: a geotechnical report describing and classifying the soil, previously prepared soil cement mix designs covering durability tests such as wet-dry and freeze thaw report which are less than one year old and which specify a recommended cement content by volume for the type of soil. In general ranges of cement content by volume shall be applied to differing types of soil (classified as per AASHTO) as follows:

Soil Groups A-1, A-2-4, A-2-5, and A-3 not over 14 percent
Soil Groups A-2-6, A-2-7, A-4 and A-5, not over 10 percent
Soil Groups A-6 and A-7, not over 7 percent.

Compressive strengths should increase both with age and with increases in cement content within the ranges of cement content producing results that meet requirements of the freezer-thaw and the wet-dry test. The 14 days unconfined compressive strengths shall be used to determine the design cement content. The design cement content shall produce a minimum unconfined compressive strength of 300 psi within fourteen (14) days.

- B. Pavement and Base Design Criteria

To facilitate the structure design process, several standard combinations of pavement and base courses are provided below.

Projected Traffic ADT	Pavement Type and Thickness	Bituminous Surfacing Course over Binder Course over Cement Treated Course Thickness
Under 1000	Dbl Bituminous Surface Tr	1 ½ inches over 2 inches over 6 inches
1000 to 2000	Dbl Bituminous Surface Tr	1 ½ inches over 2 inches over 8 inches
2000 to 4000	Dbl Bituminous Surface Tr	1 ½ inches over 2 inches over 8 inches

2.02 Materials

A. Cement Stabilized Aggregate Base

1. Aggregate

- a. Aggregates for Graded Aggregate Base Course shall be crushed stone or crushed or uncrushed gravel together with such material as manufactured sand or other fine materials naturally contained or added thereto as needed to conform with one of the three gradations shown in the table below, as specified

Grading Table for Graded Aggregate Base Course
Total Percent, by Dry Weight, Passing Each Sieve (U.S. Standard)

Size No.	2 ½ “	2”	1 ½ “	1”	3/8”	No. 40	Clay*
1	100	95-100			35-65	10-30	1-12
2		100	95-100		40-65	10-30	1-12
3			100	90-100	45-65	10-35	2-12

* Clay content shall be determined by the Hydrometer Test – AASHTO T 88 4. Clay content may exceed 12 percent with the written permission of the Owner.

- b. Mineral aggregate for graded aggregate base course shall consist of hard durable particles or fragments of stone or gravel and other finely divided mineral matter. Individual materials shall meet the requirements specified hereinafter.
 - i. Crushed Stone - Crushed stone shall be free of silt and clay. The coarse aggregate portion of the stone shall have a percentage of wear of not more than 50, and when subjected to five (5) alternations of the sodium sulfate soundness test, the weighted percentage of loss shall not exceed fifteen (15).

- ii. Gravel - Gravel shall be screened and all oversize material may be crushed and fed uniformly back over the screen. The coarse aggregate portion (retained on the No. 4 sieve) shall have a percentage of wear of not more than 50, and when subjected to five (5) alternations of the sodium sulfate soundness test, the weighted percentage of loss shall not exceed fifteen (15). The portion of the material passing the No. 40 sieve shall be nonplastic or shall have a liquid limit of not more than thirty (30) and plasticity index of not more than eight (8).
- iii. If fine aggregate, coarse aggregate, or binder, in addition to that present in the base material, is needed in order to meet the gradation or density requirements or for satisfactory bonding of the material, it shall be uniformly blended with the base course material at the mixing plant by a mechanical feeder to maintain a uniform flow on the belt to the mixer. Blending of materials on the stockpiles or in the pits by bulldozer, clamshell, dragline, or similar equipment will not be permitted. The composite gradation of aggregate shall be the grading specified.

2. Portland Cement

- a. Portland Cement shall comply with the latest specifications for Portland Cement, AASHTO M 85 or AASHTO M 240 for the type specified.

3. Water

- a. Water shall be free of injurious quantities of oil, salt, acid, alkali, sugar, vegetable matter, or other substances detrimental to hardening of the treated base.

4. Bituminous Material

- a. Bituminous material for curing shall be Emulsified Asphalt Type SS-1, RS-2, or Cut-Back Asphalt, Grade RC-250.

B. Soil Cement Base

1. Soil.

- a. Soil for soil-cement base shall be of such general character as to be classified as Group A-1 or A-2, AASHTO M 145. The material shall be of such size that all will pass the standard two (2) inch sieve. Samples shall be tested by the Owner before work is started for determination of cement application rates and optimum moisture content.

2. Portland Cement.

- a. Portland Cement shall comply with the latest specifications for Portland Cement, AASHTO M 85 or AASHTO M 240 for the type specified.

3. Water.

- a. Water shall be free of injurious quantities of oil, salt, acid, alkali, sugar, vegetable matter, or other substances detrimental to hardening of the treated base.
4. Bituminous Material.
- a. Bituminous material for curing shall be Emulsified Asphalt Type SS-1, RS-2, or Cut-Back Asphalt, Grade RC-250.
5. Hydraulic Cement
- a. Hydraulic Cement shall comply with the latest specifications for Hydraulic Cement, ASTM C1157 for the type specified.
- C. Portland Cement Concrete Base (Plain)
1. Concrete Material
- a. Concrete materials shall meet the requirements of Specification Section 03050, Portland Cement Concrete, for Class B concrete.
2. Curing Materials
- a. Curing materials shall conform to the applicable provisions of Specification Section 02750 Paragraph 2.03.
3. Chemical Additives
- a. Chemical additives shall conform to the applicable provisions of Specification Section 02750 Paragraph
- D. Asphaltic Concrete (General)
1. Aggregates, Filler, and Bituminous Material
- a. Aggregates, filler if required, and bituminous material for the various types of hot mix asphaltic concrete will be stipulated in the applicable Section of these Specifications.
 - b. Each size and type of aggregate shall be stocked in a separate bin or stall in a manner that will prevent segregation. The mineral aggregate will be accepted for quality in the stockpile and for gradation immediately preceding addition of bituminous material. This acceptance will be based on periodic samples of the various sizes of aggregate taken as they are weighed from the bins, of the combined aggregate as it is fed to the pugmill, or of batches to which the bituminous material has not been added. The bituminous material may be conditionally accepted at the source.
 - c. The plant mixed material will be accepted after blending and mixing at the plant.

E. Asphaltic Concrete Base (Black Base)

1. Asphalt Cement

- a. Asphalt cement for this construction shall be penetration grade AC-20 or AC-10, or as directed by the Owner if these grades are not available. The proportion by weight of asphalt cement to the total mixture shall be between 3.5 percent and 5.5 percent as approved by the Owner.

2. Course Aggregate

- a. Course aggregate (aggregate retained on the No. 4 sieve) shall be crushed limestone conforming to the quality requirements of AASHTO M 62 or washed gravel, as approved by the Owner.

3. Fine Aggregate

- a. Fine aggregate shall consist of natural sand consisting of hard, clean, tough grains which will have a maximum weight loss of twelve (12) percent when subjected to the sodium sulfate soundness test.

4. Aggregate Gradation

- a. The aggregate gradation for black base shall conform to the following master range:

Sieve Size	Total % Passing by Weight
2"	100
1-1/2"	75-100
3/4"	45-70
3/8"	30-55
No. 4	20-40
No. 8	10-30
No. 30	5-20

F. Equipment.

- 1. All equipment necessary for the satisfactory performance of this construction shall be on the Project and approved before work will be permitted to begin.

PART 3- Execution

3.01 Construction Requirements For Cement Stabilized Aggregate Base

A. Limitations

- 1. No cement shall be applied when the aggregate base is frozen or contains frost. Before beginning construction operations for the day, the ambient temperature

shall be at least 40° F in the shade and rising. Application of cement, mixing, application of water and moist mixing, compaction, and finishing shall be continuous, and surface finishing shall be completed in daylight hours. Mixing, application of water and moist mixing, and compaction inclusively shall be completed within 6 hours.

B. Preparation

1. Before other construction operations are begun, the area to be paved shall be graded and shaped in accordance with Section 02335 of these Specifications in order to construct the base in conformance with grades, lines, thickness, and typical cross-section shown on the Plans. Unsuitable materials shall be removed and replaced with acceptable aggregate. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

C. Spreading

1. After subgrade preparation is complete, aggregate base material shall be spread over the moistened subgrade. The placement shall be uniform in thickness and surface contour and in such quantity that the completed base will conform to the required grade and cross-section. Aggregate shall be placed and initially compacted to specified thickness before proceeding with pulverization and application of cement.

D. Moisture Content

1. The optimum moisture content of the graded aggregate cement mixture shall be considered to be ten (10) percent unless otherwise determined by laboratory testing by the Owner. The maximum percentage of moisture in the aggregate at the time cement is added shall not exceed the specified optimum moisture content for the aggregate cement mixture. When water application and mixing have been completed, the percentage of moisture in the mixture based on oven dried weights shall not be more than one (1) percentage point below or more than three (3) percentage points above the specified optimum moisture content and shall be such that the mixture will not become unstable during compacting and finishing. During finishing operations, the moisture content of the surface material shall be maintained at not less than the specified optimum moisture content.

E. Application of Cement

1. Before application of the cement, the aggregate shall be pulverized as directed by the Owner. Approved Portland Cement shall then be applied uniformly on the base at the rate as specified below for the type of soil. The Owner reserves the right to increase the rate of cement application where in his judgment additional

cement is desired. When bulk cement is used, adequate equipment for handling, weighing, and spreading the cement shall be provided.

2. The percentage of moisture in the aggregate at the time of cement application shall not exceed the quantity that will permit a uniform mixture of aggregate and cement during mixing operations.

F. Mixing

1. After the cement has been applied it shall be mixed with the aggregate so that the base material shall be a homogeneous aggregate cement mixture. Water shall be added and mixing shall continue until the mixture is sufficiently blended to prevent the formation of cement balls when additional water is added. Aggregate cement mixture shall not remain undisturbed for more than thirty (30) minutes.

G. Application of Water and Moist Misting

1. Immediately after the initial mixing operation, required water shall be applied uniformly and incorporated into the mixture, and excessive concentration of water on or near the surface shall be avoided. A water supply shall be provided that will assure the application within three (3) hours of all water required. After all water has been applied, mixing shall continue until a uniform mixture of aggregate, cement, and water has been obtained.

H. Compaction

1. Prior to the beginning of compaction, the mixture shall be in a loose condition for sufficient depth to produce the specified finished thickness. Compaction will be obtained by use of a sheeps-foot roller which will be followed by rolling with pneumatic-tire rollers or other types of rollers as required to thoroughly compact the base for its full thickness. Shaping may be required to obtain uniform compaction. The aggregate cement mixture shall be compacted to ninety-five (95) percent of maximum density as determined by the applicable method of ASTM D698.

I. Finishing

1. After compaction is completed, the surface of the base shall be shaped to the lines, grades, and typical cross-sections shown on the Plans. During shaping operations, the surface shall be scarified as necessary to loosen any imprints left by the compacting or shaping equipment. The resulting surface shall then be compacted to the specified density with steel wheel or pneumatic tire rollers or both. Rolling may be supplemented by broom dragging if required.
2. Surface compaction and finishing shall be done in such a manner as to produce, within two (2) hours, a smooth, dense surface free of surface compaction planes,

cracks, ridges, or loose material. Any approved surface finishing method may be used provided the above final results are produced.

J. Curing

1. After finishing is completed, the aggregate cement shall be protected against drying for seven (7) days by the application of bituminous material as specified or allowed by the Owner. The bituminous material shall be applied as soon as possible, but no later than two (2) hours after finishing is completed. The finished aggregate cement shall be kept moist until the bituminous material is placed. The bituminous material shall be uniformly applied at the rate of approximately 0.2 gallons per square yard with approved heating and distributing equipment.
2. The exact rate and temperature will be specified by the Owner.
3. During application, the surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. If necessary, water shall be applied in sufficient quantity to fill any surface voids immediately before the bituminous material is applied.
4. The curing material shall be maintained by the Contractor during the seven (7) day protection period so that all of the aggregate cement will be covered effectively, and should it be necessary for construction equipment or any other traffic to use the bituminous covered surface before it has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use as directed by the Owner. Finished portions of aggregate cement that are traveled on by equipment or other traffic for any reason shall be protected in such a manner as to prevent marring or damaging the completed work.
5. When the ambient temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the aggregate cement for seven (7) days after finishing is completed.

K. Construction Joints

1. At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material.
2. Aggregate cement for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Owner. Straight longitudinal joints shall be formed at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

L. Manhole Adjustments

1. Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Sections 02530 and 02632 of these specifications. Manholes, valve boxes, and other utility structures not owned by the City but within the right-of-way of the Project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

M. Traffic and Maintenance

1. Completed portions of the base may be immediately opened to construction equipment or local traffic and to all traffic after the seven (7) day curing period, provided the base has hardened sufficiently to prevent damage and provided curing is not impaired.
2. The Contractor shall be required to maintain the base in good condition and in a manner satisfactory to the Owner from the time work first starts until all work has been completed and accepted. Maintenance shall include immediate repairs to any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. This work shall include immediate repairs to any defects that may occur in a manner that will ensure restoration of a smooth, uniform surface and durability of the area repaired. Any faulty work shall be replaced to the full depth of the treatment, rather than adding a thin layer of material to the completed work.

3.02 Construction Requirements For Soil Cement Base

A. Limitations.

1. No soil-cement shall be processed that will not be covered with the succeeding stage of base or pavement during the same construction season. No cement shall be applied when the soil is frozen or contains frost. Before beginning construction operations for the day, the ambient temperature shall be at least 40° F in the shade and rising. All operations shall be continuous, and all operations but final surface finish shall be completed within four (4) hours from the time cement is applied. No uncompacted soil cement mixture shall be left undisturbed for more than thirty (30) minutes.

B. Preparation.

1. Before other operations are begun, the roadbed, including depth of soil for the soil-cement base, shall be graded and shaped in accordance with Section 02335 of these Specifications. After grading operations are complete and approved, any

work and material required to regrade the roadbed to finished grade shall be at the Contractor's expense. The area to receive treatment shall be thoroughly scarified and pulverized for sufficient depth and width to give, after treatment and compaction, the cross-sections shown on the Plans.

C. Moisture Content

1. The optimum moisture content should be established by soil tests or as designated by the Owner on the Plans. The maximum percentage of moisture in the soil at the time cement is added shall not exceed the specified moisture content of the soil-cement mixture by more than three (3) percentage points. When water application and mixing have been completed, the percentage of moisture in the mixture, based on oven dried weights, shall not be more than one (1) percentage point below or more than three (3) percentage points above the specified optimum moisture content and shall be such that the mixture will not become unstable during compacting and finishing. During finishing operations, the moisture content of the surface material shall be maintained at not less than the specified optimum moisture content.

D. Application of Portland or Hydraulic Cement.

1. Before application of the cement, the aggregate shall be pulverized as directed by the Owner. Approved Portland or Hydraulic Cement shall then be applied uniformly on the base at the rate as specified by previously approved mix submittals. The Owner reserves the right to increase the rate of cement application where in his judgment additional cement is desired. When bulk cement is used, adequate equipment for handling, weighing, and spreading the cement shall be provided.
2. Approved Portland Cement shall be applied uniformly on the in-place soil at the rate shown on the Plans or established by the Owner, based on tests of the soil performed before work is begun. The Owner reserves the right to increase the rate of cement where in his judgment additional cement is desired. When bulk cement is used, adequate equipment for handling, weighing, and spreading the cement shall be provided.

E. Mixing.

1. After the cement has been applied it shall be mixed with the soil so that the specified thickness of base shall be a homogeneous soil-cement mixture. Water shall be added and mixing shall continue until the mixture is sufficiently blended to prevent the formation of cement balls when additional water is added.

F. Application of Water And Moist Misting.

1. Immediately after the soil and cement have been mixed, water shall be applied uniformly and incorporated into the mixture. Excessive concentration of water on or near the surface shall be avoided. A water supply and pressure distributing equipment that will assure the application within three (3) hours of all water required. After all water has been applied, mixing shall continue until a uniform and intimate mixture of soil-cement and water has been obtained.

G. Compaction.

1. Prior to the beginning of compaction, the mixture shall be in a loose condition for a depth to produce the specified finished thickness. As a continuation of mixing operations, the loose mixture then shall be uniformly compacted to ninety-five (95) percent of maximum density as determined by ASTM D698 with two (2) hours. Initial compaction shall be obtained by use of a sheeps-foot roller of adequate weight to thoroughly compact the base for the full thickness. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross.

H. Finishing.

1. After the mixture has been compacted, the surface of the soil-cement shall be shaped, if necessary, to the required lines, grades, and cross-sections shown on the Plans. During shaping operations, the surface shall be lightly scarified as necessary to loosen any imprints left by the compacting or shaping equipment. The resulting surface shall then be compacted to the specified density with steel wheel or pneumatic tire rollers or both. Rolling shall be supplemented by broom dragging if required.
2. Surface compaction and finishing shall be done in such a manner as to produce, within two (2) hours, a smooth, dense surface free of surface compaction planes, cracks, ridges, or loose material. Any approved surface finishing method may be used provided the above final results are produced.

I. Curing.

1. After the soil-cement has been finished as specified herein, it shall be protected against drying for seven (7) days by the application of bituminous material as specified or allowed by the Owner. The bituminous material shall be applied as soon as possible, but no later than two (2) hours after finishing is completed. The finished soil-cement shall be kept continuously moist until the bituminous material is placed.
2. The bituminous material shall be uniformly applied at the rate of approximately 0.2 gallons per square yard with approved heating and distributing equipment. The exact rate and temperature of application to give complete coverage without excessive run-off will be specified by the Owner.

3. At the time the bituminous material is applied the soil-cement shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. Water shall be applied in sufficient quantity to fill any surface voids immediately before the bituminous material is applied.
4. The curing material shall be maintained by the Contractor during the seven (7) day protection period so that all of the soil-cement will be covered effectively.
5. Should it be necessary for construction equipment or any other traffic to use the bituminous covered surface before it has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use as directed by the Owner. Finished portions of the soil-cement that are traveled on by equipment or other traffic for any reason shall be protected in such a manner as to prevent marring or damaging the completed work.
6. When the ambient temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the soil-cement for seven (7) days after finishing and until it has hardened.

J. Construction Joints.

1. At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material.
2. Soil-cement for large, wide areas shall be built in a series of parallel lanes of convenient lengths and width meeting the approval of the Owner. Straight longitudinal joints shall be formed at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

K. Manhole Adjustments.

1. Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Sections 02530 and 02632 of these specifications. Manholes, valve boxes, and other utility structures not owned by the City but within the right-of-way of the Project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

L. Traffic And Maintenance.

1. Completed portions of the soil-cement may be opened immediately to construction equipment and local traffic, and to all traffic after the seven (7) day curing period, provided the soil-cement has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic and provided curing specified above is not impaired.
2. The Contractor shall be required to maintain the soil-cement in good condition and in a manner satisfactory to the Owner from the time work first starts until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. This work shall include immediate repairs to any defects that may occur in a manner that will ensure restoration of a smooth, uniform surface and durability of the area repaired. Any faulty work shall be replaced to the full depth of treatment, rather than adding a thin layer of material to the completed work.

3.03 Construction Requirements For Portland Cement Concrete Base (Plain)

A. Proportioning

1. The proportioning of materials for Portland cement concrete base shall be in accordance with the provision of Specification Section 03050 Portland Cement Concrete, for Class B concrete.

B. Mixing Limitations and Placing Concrete

1. Limitations of mixing of concrete due to weather shall be in accordance with limitations specified herein and in Section 03050.
2. The concrete shall be unloaded into an approved spreading device, or deposited on the subgrade or subbase, and spread in such manner as to prevent segregation of the materials. As deposited, the mixture shall be placed where it will require as little re-handling as possible.
3. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other approved tools. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or other foreign substances.
4. Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that lane shall meet the requirements for opening to traffic stipulated in Specifications elsewhere. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 7 days.

5. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than 5 seconds in any one location.
6. The use of hand operated vibrators will be permitted. Vibrators mounted on a machine shall be operated only while the machine is in motion.
7. Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.
8. Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately

C. Preparation and Construction Procedures

1. The subgrade shall be prepared in accordance with the provisions of Specification Section 02335.

D. Surface Finish And Tolerances

1. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 12 foot steel straightedge provided by the Contractor or other specified device. When the straightedge is placed parallel to the centerline of the pavement, the surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch, but not exceeding 1/2 inch in 12 feet, shall be marked and immediately ground down with an approved grinding tool to an elevation where the area will not show surface deviations in excess of 1/8 inch when tested with a 12 foot straightedge.
1. When a bituminous concrete surface is specified, the surface of the base shall be rolled prior to initial set with a roller having projections that will form grooves in the surface approximately one (1) inch wide and one-half (1/2) inch deep at intervals of approximately five (5) inches. These grooves shall form an angle of approximately 60° with the pavement centerline. A tamping device may be used which will produce the same general results.

E. Traffic And Maintenance

2. The Owner will determine when the concrete base has cured sufficiently for the application of bituminous concrete surface material or when local traffic or construction equipment will be allowed on the base.

F. Tolerance In Base Thickness

1. The owner will determine the thickness of the base by average measurements taken at the frequency he determines to be sufficient. When the finished base thickness is not deficient by more than one-quarter (1/4) inch from the Plan thickness, full payment will be made. When concrete base is determined to be deficient by more than one-quarter (1/4) inch, the Contractor shall remove and replace the deficient base at his expense.

G. Manhole Adjustments

1. Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Specification Sections 02530 and 02632 respectively. Manholes, valve boxes, and other utility structures not owned by the City but within the right-of-way of the project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

3.04 Construction Requirements For Asphaltic Concrete Pavement (General)

A. Composition of Mixtures

1. The bituminous plant mix shall be composed of a job-mix formula of aggregate, filler if required, and bituminous material approved by the Owner. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job-mix formula. The job-mix formula shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature at which the mixture is to be discharged from the plant. All mixtures shall continually conform to the job-mix formula within tolerances established by Subsection 407.03 of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. When unsatisfactory results or other conditions make it necessary, the job-mix formula may be adjusted by the Owner.

B. Equipment

1. Bituminous Mixing Plants

- a. Bituminous mixing plants, regardless of type, shall conform to the current requirements of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, Subsection 407.04.

- b. At any time and without notice, the Owner shall have free access to any plant producing hot mix asphaltic concrete for the City of the purpose of checking equipment, materials, scales, or plant mixed material for compliance with these Specifications. He shall be furnished whatever assistance he requests in checking the plant, including the provision of testing equipment to check the mix and materials.
- 2. Trucks
 - a. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds.
 - b. The beds shall have been coated with an approved material not harmful to the mixture to prevent adherence to the beds. Each truck shall have a canvas cover to protect the mixture from the weather, and when necessary to control temperature, truck beds shall be insulated and covers securely fastened.
- 3. Bituminous Pavers
 - a. Bituminous pavers shall be self-contained units, provided with an activated screed or strike-off assembly equipped to be heated and capable of spreading and finishing courses of plant mix material in lane widths according to the typical sections and thicknesses shown on the Plans. Materials for shoulders and similar construction shall be placed by any mechanical spreading equipment approved by the Owner.
 - b. Bituminous pavers shall be equipped with a receiving hopper of sufficient capacity to ensure a uniform spreading operation. The hopper shall be equipped with a distribution system which prevents “cold spots” and which will place the mixture uniformly in front of the screed. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. When laying mixtures, the paver shall be capable of forward speeds consistent with satisfactory laying of the mixtures.
 - c. All asphalt paving machines shall be equipped with automatic grade and slope controls which shall be in good working order at all times. In the event of mechanical failure of any of the automatic controls, the Contractor will be permitted to complete only the current day’s work using manual controls.
- 4. Rollers

- a. Rollers shall be self-propelled and of the steel-wheel, pneumatic tire, and/or vibratory type. Rollers shall be in good condition, capable of reversing without backlash and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. All rollers shall be equipped with devices to moisten and clean the wheels as required.
- b. The steel wheel roller shall weigh a minimum of eight tons and may be a three-wheel or tandem type.
- c. The pneumatic tire roller shall meet the requirements of Specification Section 02335.
- d. The use of vibratory rollers will be permitted only after being specifically approved by the Owner.
- e. All required rollers shall be on the job, inspected, and approved before paving operations will be permitted to begin.

5. Platform Truck Scales

- a. Platform truck scales shall meet the requirements of Subsection 109.01 of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

6. Small Tools

- a. The Contractor shall provide all necessary small tools and suitable means for keeping them clean and free from accumulations of bituminous materials.

C. Weather Limitations

1. Bituminous plant mix may be placed on properly constructed and accepted subgrade, base, previously applied layers of asphaltic concrete, or concrete pavement provided the following conditions are met:
 - a. The area to be paved is not in a frozen condition and is free from snow, ice, and excessive moisture.
 - b. Plant production and paving operations shall be so coordinated that a uniform continuity of operation is maintained.
 - c. The bituminous plant mix shall be placed in accordance with the following:

1. when the compacted thickness of the mix is less than 1-1/2 inch, the minimum air or surface temperature shall be 50°F
2. when the compacted thickness of the mix is 1-1/2 inch or more, the minimum air or surface temperature shall be 40° F.

D. Conditioning of the Existing Surface

1. When bituminous mixes are to be placed upon an existing concrete pavement, with or without a bituminous overlay, all loose or excess bituminous material shall be removed from joints and cracks. Sections of existing pavement that are broken and pumping under traffic shall be removed to subgrade as directed by the Owner. Unsatisfactory subgrade material encountered when existing pavement is removed shall also be removed as directed by the Owner. Materials removed from existing pavement, including base and subbase, and from subgrade shall be replaced with asphaltic concrete Mix No. 2, as specified in Specification Section 02741
2. B. When the bituminous mixture is to be placed upon an existing bituminous pavement, any areas having excess bitumen and any failures in the existing surface and base shall be removed to subgrade as directed by the Owner. Unsatisfactory subgrade material encountered when existing pavement is removed shall also be removed to subgrade as directed by the Owner. Materials removed from existing pavement, including base and subbase, and from subgrade shall be replaced with asphaltic concrete Mix No. 2, as specified in Specification Section 02741, to the level of existing pavement surface or as directed by the Owner. Payment for removal and replacement shall be made as defined for in Specification Section 02741.

E. Prime or Tack Coats

1. A prime coat shall be applied to Graded Aggregate Base Course, Cement-Stabilized Aggregate Base, and Soil-Cement Base uniformly at the rate of 0.25 gallons per square yard. Prime coat shall be grade MC-30. Bituminous material for tack coat shall be applied to concrete or asphaltic concrete bases or surfaces to provide bond for superimposed courses. Tack coat shall be emulsified asphalt, grade SS-1, applied at a uniform rate not to exceed 0.05 gallons of residual bitumen per square year.

F. Preparation of Bituminous Material

1. The bituminous material for hot mixes shall be heated to a temperature between 275° F and 325° F in a manner that will avoid local overheating and provide a continuous supply to the mixer at a uniform temperature at all times.

G. Preparation Of Aggregates

1. The aggregates for hot mixes shall be dried and heated to a uniform temperature between 225° F and 325° F. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate.
2. B. On all plants requiring screens, the hot dried aggregate shall be screened into two (2) or more fractions as specified. The separated fractions shall then be conveyed into separate compartments ready for batching and mixing with bituminous material.

H. Mixing

1. The dried aggregates shall be combined within the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.
2. After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured. Wet-mixing time shall be determined by the Owner for each plant and for each type of aggregate used, but in no case shall the wet-mixing time be less than twenty-five (25) seconds for batch type plants and forty (40) seconds for continuous mix plants.
3. For hot-mix bituminous pavement, the temperature of the completed mixture, determined at the time it is dumped from the mixer, shall be not less than 275° F, except that the temperature of mixtures made with aggregates containing absorbed moisture which causes foaming or boiling in the completed mixtures at these higher temperatures shall be not less than 225° F.
4. Hot-mix bituminous mixtures may be stored in surge or storage silos provided that the mixture as used from the silos meets all the specification requirements for the particular mix involved. When the use of surge or storage silos is permitted, the following additional requirements shall apply:
 - a. The surge and storage systems shall be of such design that there are no appreciable differences between material being discharged from the silo and material being discharged directly from the pugmill.
 - b. The surge and storage silos must be equipped with low and high mix level indicators. The low level indicator shall be placed at a location on the silo that has been predetermined to prevent segregation of the mix.

- c. The conveyor system used with the surge or storage silos shall be arranged in such a manner that samples of the mix or dry material may be conveniently taken from the pugmill.
- d. Storage silos shall be closed, insulated, and heated in such a manner that localized heating (hot spots) does not occur. The storage system shall be capable of sealing the bin to prevent oxidation of the mixture.
- e. Surge silos shall be equipped with a rain cover capable of preventing water from entering the mix in the silo.
- f. Approval of a surge or storage system will be dependent upon inspection and tests which indicate that the system is capable of conveying, retaining, and delivering the bituminous mixture within the tolerance ranges as set forth on the job, mix formula without segregation, and without balling or hardening.
- g. Approval of a surge or storage system may be withdrawn if tests and/or inspections indicate that the system is having a detrimental effect on the bituminous mixture.
- h. Any bituminous mix which, in the judgment of the Owner, is damaged in any way by the use of a surge or storage system will be rejected.
- i. Platform truck scales meeting the requirements of Specification Section 02710 shall be mounted under the loading hopper and shall be capable of recording tare and gross weight.
- j. The storage or surge bin shall be emptied when directed by the Owner in order to check material quantities.
- k. Hours of plant operation, whether for storage or direct shipment to the road, shall be limited to reasonable working hours in order that normal inspection of plant operations may be performed.
- l. Bituminous material in a surge silo must be removed on the same day in which it is placed.
- m. Samples of the stored material may be taken following the period of storage.
- n. Material stored will be subject to the temperature, segregation, and laying requirements as required for normal un-stored plant production.
- o. Excessive segregation, lumpiness, or stiffness of the mix shall be sufficient cause for rejection by the Owner.
- p. Surge and storage silos shall be located in a position that enables the top of the truck bed to be visible to the load operator during the loading operation.

I. Spreading and Finishing

1. Unless otherwise specified or permitted, bituminous mixtures shall be and spread on the roadway in ample time to secure thorough compaction during daylight hours. Its temperature at the time of depositing in the paver hopper shall be not more than 25° F less than the temperature at which it is discharged from the mixer. The mixture shall be laid upon an approved surface to which the appropriate tack coat or prime coat has been applied and spread and struck off to the established line, grade, and elevation by means of approved asphalt paving machines in echelon or by one (1) paver when echelon paving is not permitted. Echelon paving will not be permitted on two (2) lane projects where traffic is being maintained. Alignment of the outside edges of the pavement shall be controlled by preset control string lines. Where multicourse pavements are placed, the longitudinal joint in one (1) layer shall offset that in the layer immediately before by approximately one (1) foot; however, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two (2) lanes of width or at lane lines if the roadway is more than two (2) lanes in width.
2. Automatic screed controls utilizing either the string line or ski type grade reference systems will be required on all work regardless of the paver width. The string line reference system may be required on new construction. In the event the base has been finished with equipment having automatic grade controls or the Contractor demonstrates that an alternate method of spreading and finishing will result in a satisfactory riding surface, the Owner may conditionally waive the string line requirement and authorize use of the ski type reference system. In any event, the Owner may at any time require the use of a string line reference system even though it may have previously been waived, if in his opinion the use of the string line will result in a superior riding surface. Where the ski type system is used, the ski shall have the maximum practical length and in no case shall it be less than forty (40) feet in length. Pavement lanes previously placed with automatic controls or to form grade may serve as longitudinal control reference for laying adjacent lanes by utilizing a ski or joint matching shoe.
3. The string line reference system shall consist of suitable wire or twine supported by approved devices which will be compatible with the type of automatic paver control systems used. The string line and supports shall be capable of maintaining the line and grade designated by the Plans at the point of support while withstanding the tensioning necessary to prevent sag in excess of ¼ inch between supports spaced fifty (50) feet apart. Additional supports shall then be installed to provide a minimum spacing of twenty-five (25) feet, or less, as directed by the Owner and to remove and deviation of the string line from Plan grade.
4. The Owner will furnish sufficient control reference stakes to enable the Contractor to establish the string line reference system. The Contractor shall furnish all materials, equipment, labor, and incidentals required to construct the string line reference system as described herein and shall maintain same until its use is no longer required.

5. The string line reference system shall be complete in place at least 300 feet in advance of the point where the pavement is being place.
6. Automatic screed controls will not be required on sections of projects where service connections and other conditions interfere with their efficient operation.
7. The cost of erecting and maintaining the string line reference system shall be included in the unit price bid for other items of construction.
8. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be taken from the hopper of the spreading machine and shall be distributed immediately into place by means of suitable shovels and other tools and spread with rakes and lutes in a uniformly loose layer of such depth as will result in a completed course having the required thickness.

J. Compaction

1. After the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly compacted. The method employed must be approved by the Owner and capable of compacting the mixture to the desired density while it is in a workable condition. When no density requirements are specified, a system of compaction for roadway pavements shall be employed which has previously produced required bituminous pavement densities. A control strip and random density samples may be employed to aid the Owner in evaluating the system.
2. In general, compaction shall be accomplished by the use of a combination of the equipment designated in Specification Section 02710. The following are minimum roller requirements; however, the number of rollers shall be increased if the required results are not being obtained.
 1. For each paver up to sixteen (16) feet wide, two (2) rollers shall be required.
 2. For each paver over sixteen (16) feet wide, three (3) rollers shall be required.
3. The minimum number of rollers listed above may, with the approval of the Owner, be reduced to one roller of either the steel-wheel or vibratory type on the following types of construction:
 1. on shoulder construction
 2. on incidental construction such as bridge approaches, driveways, etc.
 3. on projects containing less than 10,000 square yards of bituminous pavement

4. Unless otherwise directed, rolling shall begin at the low side and proceed longitudinally parallel to the road centerline. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. When paving in echelon, rollers shall not compact within six (6) inches of an edge where an adjacent lane is to be placed. Rollers shall move in a slow uniform speed with the drive wheels nearer the paver and shall be kept as nearly as possible in continuous operation. Rolling shall continue until all roller marks are eliminated.
5. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. An excess of liquid shall not be used.

K. Density Requirements

1. Asphaltic Concrete Surface Course, Mix No. 1 as specified in Specification Section 02741, shall be compacted to 93 percent of laboratory density as determined by the Marshall Method, 75 blow.
2. Asphaltic Concrete Binder Course (Leveling or Bushing), Mix No. 2 as specified in Specification Section 02741, shall be compacted to 90 percent of maximum theoretical density.
3. Asphaltic Concrete Base (Black Base), as specified in Specification Section 02710, shall be compacted to 90 percent of maximum theoretical density.
4. It is intended that acceptance density testing will be accomplished while the bituminous mixture is hot enough to permit further densification if such is shown to be necessary.
5. If the density does not conform to the requirement stated herein above, the Contractor shall continue his compactive effort until the required density is obtained.
6. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be compacted thoroughly with hot hand tampers, smoothing irons, or with mechanical tampers. On depressed areas, a trench roller of cleated compression strips may be used to compact the mix.
7. Any mixture that becomes loose or broken, mixed with dirt, or is in any way defective shall be repaired with rakes and the addition of fresh mix or shall be removed and replaced with fresh mix which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced.

L. Density by Control Strips

1. When approved by the Owner, the required density may be determined by the control strip method. The target density obtained by the control strip method shall be used in lieu of theoretical or laboratory densities.
 - a. When this method is used, the density of all paving shall be at least 96 percent of the density obtained on the control strip. Construction of the control strip shall be as follows:
 - a. The base course or other pavement structure course upon which a control strip is constructed shall have been approved by the Owner prior to the construction of the control strip.
 - b. Equipment proposed for use in the compaction of control strips meet the requirements set forth in Specification Section 02710.
 - c. To determine the target density, a control strip shall be constructed at the beginning of work on the pavement course. New control strips shall be required when
 1. a change in the Job Mix Formula is necessary
 2. a change in the source of materials occurs
 3. a change in the material from the source is observed
 4. a change in the paving or rolling equipment occurs
 5. there is reason to believe that the control strip density is not representative of the bituminous mixture being placed
2. With the approval of the Owner, the Contractor may be permitted to construct additional control strips.
3. Each control strip shall be constructed with approved bituminous mixture and shall remain in place as a section of the completed work. Each control strip shall be one paver width wide and have an area of at least 400 square yards and shall be of the depth specified for the pavement structure course concerned.
4. Compaction of the control strip shall commence immediately after placement of the bituminous mixture and be continuous and uniform over the entire control strip.
5. The compaction of the control strip shall be continued until no appreciable increase in density (1.0 lbs/ft³) can be obtained by additional roller coverage.
6. During the rolling process, the density of the control strip will be determined by the Owner from randomly selected tests within the control strip.

M. Surface Requirements

1. The surface shall be tested with a twelve (12) foot steel straightedge, furnished by the Contractor, applied parallel to the centerline of the pavement. The deviation of the surface from the testing edge of the straightedge shall not exceed that specified for the respective types of bituminous construction as follows:
 - a. Surface Courses shall not deviate more than 1/4"
 - b. Base Courses shall not deviate more than 3/8"
2. The Contractor shall be required to repair all straightedge deviations as approved by the City Engineer.
3. The transverse slopes of tilted pavements shall be tested with a string line and string level applied at right angles to the centerline of the pavement and the percent of slope, when computed for the full width of the pavement, shall not deviate more than one-half (1/2) of one percentage point from that specified on the Plans.
4. The crown in crowned pavements shall be tested with a string line applied at right angles to the centerline of the pavement, and the crown shall not deviate more than one-half (1/2) inch from that specified on the Plans.
5. Deviations greater than the specified tolerances shall be corrected by methods best suited for the purpose. Pavement that cannot be corrected to comply with the specified tolerances shall be removed and replaced at the Contractor's expense.

N. Blotting Sand

1. When directed by the Owner in order to control tracking of excess bituminous material from curing of base materials or from application of prime coat, a protective cover of blotting sand shall be spread over the bituminous material at a rate specified by the Owner, but not to exceed ten (10) pounds per square yard. Application of blotting sand shall be considered incidental to the work and no separate payment will be made.

3.04 Construction Requirements For Asphaltic Concrete Base (Black Base)

A. General

1. The general construction requirements for black base shall be as prescribed in the applicable portions of Specification Section 02710.

B. Preparation of Subgrade or Surface

The surface upon which black base is to be placed shall meet the requirements of Specification Section 02335 or 02710, whichever is applicable. Black base shall be placed only upon a surface that is dry and cleaned of all loose particles.

C. Thickness and Surface Requirements

1. Thickness shall be controlled during the spreading operations by frequent measurements taken of the freshly spread mixture to establish a relationship between the uncompacted and compacted material. This thickness shall remain in conformity with that specified on the Plans. The surface of the base shall meet the requirements specified under Specification Section 02710 and when tested in accordance with the provisions of Specification Section 02710, the deviation of the surfaces from the testing edge of the straightedge shall not exceed 3/8 inch.

D. Manhole Adjustments

1. Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Specification Sections 02530 and other utility structures not owned by the City but within the right-of-way of the Project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

E. Traffic And Maintenance

1. The Owner will determine when the base has sufficient compaction and has cured sufficiently to allow construction equipment, local traffic, and/or normal traffic on the base.

END OF SECTION