

All materials and the completed installation shall comply with applicable standards promulgated pursuant to the State of Tennessee and City of Lakeland.

1.10 OPEN EXCAVATIONS

The Contractor shall completely backfill all excavations before stopping work for the day. No excavation (fenced or unfenced) shall be left open overnight, over a weekend, nor any period in which no work at that location is underway. The cost of reopening or re-excavation due to this provision will be borne by the Contractor.

1.11 CONSTRUCTION SURVEYING AND STAKING

In this project, lines and grades of replaced appurtenances shall match those existing. When new appurtenances such as drain lines, catch basins, curb, sidewalks, and new roadway crowns are to be installed, the Contractor will provide construction surveying and staking, unless otherwise noted.

1.12 CLEANING AND FINISHING

After completion of all work all debris and foreign material will be removed by the contractor. The project area, including staging areas, shall be clean and functional. This will include the restoration of any disturbed landscaping in the work area.

1.13 TRAFFIC CONTROL

A traffic control plan is required for repairs in areas affecting traffic. The Contractor is responsible for furnishing a traffic control plan to the City Engineer at least one week prior to the start of construction. Excavations which traverse a street shall be limited to one-half the width of the street at any one time, unless an emergency situation exists which requires the entire width of the street be excavated. The City Engineer's approval is required prior to traversing an entire street. The closure should not exceed forty-eight (48) hours and proper signage shall be installed detouring traffic and warning of construction.

END OF SECTION

SECTION 01551

TEMPORARY TRAFFIC CONTROLS

PART 1. Description

To establish uniform requirements for detours, signs and barricades, and traffic control plans associated with construction activities performed on or affecting City of Lakeland streets. The work in this article shall consist of furnishing, erecting, maintaining, relocating, and removing temporary traffic control devices at the locations specified on the drawings and as directed by the Engineer. All traffic control devices shall conform to the provision for construction signing as set forth in the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) latest edition.

PART 2 MATERIALS

2.01 Traffic Control Products

A. Sign Panels

1. Sign panels will be constructed of 3/4" plywood conforming to plywood sign panels and barricades of the standard specification for road and bridge construction; or 6061-T6 or 5052-H38 aluminum alloy sheeting conforming to ASTM B209.
2. Wood sign panels will be backed with metal backing angles; except that backing is not required for those sign panels 48" x 60" or smaller.
3. Aluminum sign panels will be 0.125" thick and backed with metal backing angles; except that those sign panels 48" x 60" or smaller may be:
 - i. 0.080" thick and backed with metal backing angles or 2 x 4 lumber; or,
 - ii. Unbacked, 0.125" thick.
4. Special signs which are unique to the project, i.e., signs not shown on the plans or included in part VI of the MUTCD, and signs shown on the plans which contain a message that is unique to the project, will be furnished by the contractor, as specified on the plans, and erected by the Contractor. Posts and hardware for fixed special sign installations, and all equipment for portable special sign installations will be furnished by the contractor. Post lengths will be specified by the Engineer. Upon removal, the special sign panels, posts, hardware, and portable installation equipment will remain the property of the Contractor.

- i. Special signs will be erected on fixed mountings unless portable mountings are authorized by the Engineer.
- B. Barrels will be plastic conforming to the MUTCD, with 6” wide reflective stripes.
- C. Temporary markings
 1. Temporary reflective pavement markings will be paint, preformed tape, or raised pavement markers, and will be suitable for use on either Portland cement concrete or asphalt pavements. Minimum acceptable standards are as follows:
 - i. Paint used for temporary markings will be commercially manufactured highway striping paint. The paint will be applied without dilution.
 - ii. All painted stripes will be 4” wide, and will be reflectorized by dropping or spraying glass beads onto the wet paint.
 - iii. The reflective beads will conform to AASHTO Specification M247, Type 1.
 2. Temporary reflective pavement striping tape will be 4” wide, pressure-sensitive tape manufactured for use as pavement striping.
 - i. Striping tape applied to finished pavement surfaces which will be returned to normal traffic use will be a removable type.
 - ii. Striping tape applied to temporary pavement surfaces which will be obliterated may be a non-removable type.
 - iii. Striping tape applied to the surface of intermediate lifts of asphalt pavement may be non-removable type, and may be let in place. If a removable type is used, it will be removed before placing the next lift.
 3. Temporary retro-reflective raised pavement markers manufactured by Astro Optics of Schaumburg, Illinois, Model No. TPM, or Stimsonite Products of Niles, Illinois, Model No. 66, or an approved equal will be acceptable.
 4. Temporary retro-reflective motorist guidance markers manufactured by Davidson Plastic Company of Ken, Washington, Model NO. TRPM, or TOM, or an approved equal will be acceptable.

PART 3 EXECUTION

3.01 Traffic Control Plans

- A. A complete traffic control plan shall be submitted to the Engineer and the Lakeland City Engineering office at least one week prior to the start of construction.
1. Traffic will be permitted to use the street at all times, unless a detour is specifically permitted on the drawings or by the Engineer. Access to all abutting residences and properties shall be maintained to the maximum extent possible.
 2. The Contractor shall construct and maintain temporary crossings, complete with flagmen, whenever necessary to expedite the work or to maintain traffic. The Contractor shall furnish not less than two flagmen at each location where loading or depositing of material requires the turning of the trucks on any highway or street and where the operation of construction equipment endangers traffic. Temporary crossings shall be of ample size to safely carry the load which comes upon them.
 - i. The Contractor shall maintain the streets in a passable condition. The work shall be conducted so as to create a minimum of inconvenience to traffic.
 - ii. Excavations which traverse a street shall be limited to one-half the width of the street at any one time, unless an emergency situation exists which requires that the entire width of the street be excavated. City Engineer's office approval is required prior to excavation traversing an entire street.
 3. The Contractor shall furnish sufficient signs and barricades to facilitate the directing of traffic. Unless directed otherwise by the Engineer, all signs and barricades shall conform to:
 - i. Within the "Manual on Uniform Traffic Control Devices (MUTCD), " latest edition.
 4. The Contractor shall have a sufficient number of barricades and signs on hand prior to the start of the construction
 - i. Each detour sign shall be reflectorized and shall be illuminated with two battery-powered blinkers with six-inch (6") amber lenses.
 - ii. All barricades shall have blinker lights on each end.
 - iii. It shall be the Contractor's responsibility to make necessary checks and inspections of all lights and barricades every day, including Sundays and holidays.
 5. Temporary suspension of work does not relieve the Contractor of the responsibility outlined in the above requirements.

3.02 Permits

- A. The Contractor shall obtain all necessary permits from the City Engineer's office for any closure of any street or portion thereof, as provided in the Lakeland Municipal Code. Along with the permit application, the Contractor shall provide a sketch showing traffic routing and traffic control devices to be used. The construction traffic control sketch shall be approved by the City Engineer's office before the permit is issued.

3.03 Street Closure

- A. The City Engineer may permit the closing of streets to all traffic for a period of time prescribed by the office if, in the City Engineer's Opinion, it is necessary.

END OF SECTION

SECTION 02340

GEOTEXTILE FABRICS AND MEMBRANES

PART 1 - Description

This section covers furnishing and placing geotextiles as shown on the plans or directed, in accordance with these specifications. The geotextile usage will determine the applicable specifications and the corresponding pay item.

PART 2 - Materials

A. The geotextile shall consist only of woven or non-woven, long-chain polymeric filaments or yarns such as polyethylene, polyester, polypropylene, polyamide, or polyvinylidene chloride formed into a stable network such that the filaments or yarns retain their relative positions to each other.

B. Membrane Requirements

Geotextile and Impermeable Plastic Membrane Specifications								
Fabric and Membrane Property	Test Method	Drainage And Filtration	Erosion Control	Silt Fence	Separation & Stabilization		Embankment & Retaining Wall Reinforcement	Impermeable Plastic Membrane
					Woven	Non-Woven		
*EOS (mm)	ASTM D4751	40-70	40-100	40-100	30-50	40-100	30-70	----
Thickness, Mils (mm)	ASTM D5199	----	----	----	----	----	----	12 (0.305)
Permittivity, cm/sec	ASTM D5199	1.0	1.0	0.1	0.05	1.0	0.05	<10 ⁻⁷ cm/sec
Grab Tensile Strength	ASTM D4632	90	180	90	200	160	300	150
Elongation at Failure% Min	ASTM D4533	40	40	50	15	40	15	20
Trap Tear Strength, lbs	ASTM D4833	40	70	50	65	60	110	50
Puncture Strength, lbs	ASTM D4632	50	90	60	90	80	110	60

*Equivalent or Apparent Opening Size, U.S. Standard Sieve (mm)

PART 3 – Execution for Stabilization Fabric

3.01 Equipment

- A. Equipment loads when placing and compacting the material placed over the stabilization geotextiles shall comply with the following:
 - 1. Maximum wheel load shall be 9,945 pounds (4500 kg), or as specified.
 - 2. Maximum contact pressure shall be 60 psi (400kPa). The contact pressure is calculated from the applied wheel load in newtons and the resulting contact area in square meters.
 - 3. Rutting in excess of three inches (3”) (75mm) will not be allowed. Equipment loads are to be lightened if this occurs. Ruts shall be repaired by filling the ruts with additional material.

3.02 Construction Requirements.

- A. The geotextile shall be lapped at the ends and sides of adjoining sheets unless shown otherwise on the plans or described herein. Geotextile that is joined by sewing shall have strength properties at the seam equal to the specified strength requirements of the geotextile. All seams shall be exposed for ease of inspection. High-strength polyester, polypropylene or kevlar thread shall be used for sewn seams. Nylon threads shall not be used. Overlapping J seams and double sewing are required for field seams.
- B. Gravel, pit run base course, sand, or other specified material shall be placed on the geotextile so that it is not torn, punctured, or shifted. Maximum pile heights of materials shall be limited to prevent geotextile distortion. Any geotextile that is torn or punctured shall be repaired. The repair shall consist of a patch of the same type of geotextile placed over the ruptured area and overlapped a minimum of three feet (3’) (1m) from the edge of any part of the rupture, or a sewn patch with the same requirements for seam strength as that of the geotextile being repaired.
- C. Pegs or pins, as approved by the Engineer, may be used to hold the geotextile for embankment erosion control in place until the specified cover material has been placed. Pegs or pins shall not be used for other types of geotextile installations without approval of the Engineer. If such approval is given, pegs or pins shall be used only at locations that are not detrimental to the finished product.
- D. When geotextile is used for foundation stabilization, the following criteria shall govern:
 - 1. The cover material shall be placed over the geotextile in 1-foot (0.3m)+/- lifts.
 - 2. Equipment shall not be operated directly on the geotextile. The minimum lift thickness shall be maintained at all times.

3. The cover material shall be compacted with a roller or other equipment as approved by the Engineer.
 4. Prior to the installation of geotextile, the subgrade shall be leveled and smoothed to remove ruts, depressions, or humps, which exceed four inches (4") (100mm). The surface also shall be free of rocks, stumps, roots, brush, limbs, or other objects that might tear or puncture the geotextile or result in geotextile wear.
- E. During periods of shipment and storage, the geotextile shall be enclosed in heavy duty wrapping to protect it from direct sunlight, ultraviolet rays, temperatures greater than 140°F (60°C), mud, dirt, dust, and debris. Any geotextile left unprotected shall be removed from the project.
- F. The product name, type of material and the lot or batch identification shall be clearly labeled on each roll.
- G. Except for geotextile used for erosion control and silt fence, the cover material shall be placed over the fabric within five (5) days.
- H. Test results, with a certification by the manufacturer showing the geotextile performance in regard to the material requirements of this specification, shall be submitted to the Engineer. At least two weeks before the use of any geotextile, a sample six feet (6') (2 m) in length by the full width of the roll shall be submitted to the Engineer. The sample shall be labeled with the product name, machine direction, the lot and batch number, date of sampling, project number, and certification of compliance with the material specifications. If sewing is specified, a seam sample also shall be submitted to the Engineer. The sample sewn section shall be six feet (6') (2 m) by three feet (3') (1 m) with the seam in the center and parallel to the six feet (6') (2 m) length.

3.03 Installation

- A. The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Adjacent geotextile rolls shall be overlapped, sewn, or joined as required in the plans. Overlaps shall be in the direction as shown on the plans. See table below for overlap requirements.

Stabilization Fabric

Soil CBR	Method of Joining
Greater than 3	300 - 450 mm (12 - 18 in) overlap
1 - 3	600 - 1000 mm(24 - 40 in) overlap
0.5 - 1	1000 mm (40 in) overlap or sewn
Less than 0.5	Sewn
All roll ends	1000 mm (40 in) overlap or sewn

- B. On curves, the geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock.
- C. Prior to covering, the geotextile shall be inspected by a certified inspector of the Engineer to ensure that the geotextile has not been damaged during installation. Damaged geotextiles, as identified by the Engineer, shall be repaired immediately. Cover the damaged area with a geotextile patch which extends an amount equal to the required overlap beyond the damaged area.
- D. The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed subbase aggregate. On soils with $CBR > 3$, most rubber-tired vehicles can be driven at slow speeds, less than 10 mph (16 km/h) and in straight paths over the exposed geotextile without causing damage to the geotextile. Sudden braking and sharp turning should be avoided. Tracked construction equipment should not be operated directly upon the geotextile. A minimum fill soil thickness of 6 in (15cm) is required prior to operation of tracked vehicles over the geotextile. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geotextile. Turning of vehicles shall not be permitted on the first lift above the geotextile.
- E. On subgrades having a CBR value of less than 1, the subbase aggregate should be spread in its full thickness as soon as possible after dumping to minimize the potential of localized subgrade failure due to overloading of the subgrade.
- F. Any ruts occurring during construction shall be filled with additional subbase material, and compacted to the specified density.
- G. If placement of the backfill material causes damage to the geotextile, the damaged area shall be repaired as previously described above. The placement procedure shall then be modified to eliminate further damage from taking place.

END OF SECTION

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 or 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

SECTION 02741

ASPHALTIC CONCRETE PAVEMENT

PART 1 – Description

This work shall consist of an asphaltic concrete pavement constructed in one or more layers for surface course(s) and binder course(s). The binder course may also be used as a leveling or bushing course. Binder course shall consist of a hot mixture of aggregate and asphalt prepared in a hot bituminous mixing plant. The binder course shall be constructed on a prepared subgrade, subbase, or base conforming to the lines, grades, thicknesses, and cross-sections shown on the Plans or as directed by the Engineer. The surface course shall consist of an asphaltic concrete pavement composed of a mixture of coarse aggregate, fine aggregate, mineral filler, and asphalt cement, constructed on a prepared roadbed in conformity with the lines, grades, thicknesses, and cross-sections shown on the Plans or directed by the Owner.

PART 2 – Materials And Equipment

2.01 MATERIALS

- A. Asphalt Cement. Asphalt cement shall conform to the requirements of ASSHTO M 226, Table 2, for the grade specified. Unless otherwise directed, asphalt shall be Viscosity Grade AC-20, PG64-22, or PG 64-28. The type and grade of bituminous material may be changed one step by the Engineer during construction, at now change in unit price.
- B. Course Aggregate. Course aggregate (aggregate retained on the No. 4 sieve) shall be crushed stone meeting the quality requirements of ASTM D 692 with the following exceptions:
 - 1. Crushed limestone shall have a sodium sulfate soundness loss not exceeding 9 percent.
 - 2. For Mix No. 1, material retained on the No. 4 sieve shall have a maximum of 20 percent elongated pieces (length greater than five times the average thicknesses).
 - 3. For Mix No. 2, the aggregate shall contain no more than 5 percent soft or nondurable particles.
 - 4. For Mix No. 3, the aggregate shall contain no more than 5 percent soft or nondurable particles.
- C. Fine Aggregate. The fine aggregate shall consist of natural sand consisting of hard, clean, tough grains which will have a maximum loss of 12 percent when subjected to the sodium sulfate soundness test.
- D. Composition of Mixtures

1. Asphaltic Concrete Surface, Mix No. 1, shall be laid in one course to the thickness shown on the Plans.
2. Asphaltic Concrete Binder, Mix No. 2, shall be laid in one or more courses to the thicknesses shown on the Plans. Mix No. 2 may also be used as a leveling course or bushing course.
3. Asphaltic Concrete Binder, Mix No. 3 shall be laid in one or more courses to the thickness shown on the plans.
4. The composition of the mixes shall be as follows:

Sieve Size	Total Percent Passing by Weight		
	Mix No. 1	Mix No. 2	Mix No. 3
2"	100	100	100
1-1/2"	100	100	90 - 100
3/4"	100	100	65 - 90
3/8"	76 - 96	65 - 95	-----
No. 4	51 - 76	45 - 70	30 - 55
No. 8	36 - 60	25 - 50	20 - 45
No. 30	16 - 40	12 - 30	8 - 25
No. 100	3 - 12	2 - 12	2 - 12
No. 200	2 - 8	1 - 6	1 - 6

5. The proportions of the total mixture, in percent by weight, shall be as follows:

Courses	Combined Mineral Asphalt	Aggregate Cement
Mix No. 1, Surface(Limestone)	92.0 - 96.0	4.0 - 8.0
Mix No. 2, Binder	93.0 - 97.5	2.5 - 7.0
Mix No. 3, Binder	93.0 - 97.5	2.5 - 7.0

6. It is the intent of this Section of the Specifications that the above described mixes shall conform to the following mixtures specified in the Tennessee Department of Transportation Standard Specifications for Road and Bridge construction.

Mix No. 1 - Section 411, Asphaltic Concrete Surface (Hot Mix), Aggregate Grading E.
 Mix No. 2 - Section 307, Bituminous Plant Mix Base (Hot Mix), Aggregate Grading C.

Mix No. 3 – Section 307, Bituminous Plant Mix Base (Hot Mix),
Aggregate Grading B.

7. For multiple layer construction, succeeding layers shall not be laid until the previous layer has cooled sufficiently to support the construction equipment
8. When Mix No. 1 is to be used as a surface for traffic lanes, the mineral aggregate shall be composed of not less than 50 percent nor more than 80 percent crushed limestone and not more than 50 percent nor less than 20 percent natural sand. When Mix No. 1 is used for surfacing of shoulders or other non-traffic lane construction, the mineral aggregate may be composed entirely of limestone, including screening and manufactured sand, but in no case shall the mineral aggregate for this construction consist of less than 50 percent limestone. The natural sand shall be so graded that not more than 5 percent will be retained on the No. 4 sieve.

2.02 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of this construction shall be on the Project and approved of before work will be permitted to begin. The equipment shall meet the requirements of Specification Section 02710.

PART 3 – Execution

3.01 General

- A. The general construction requirements for surface and binder courses shall be as prescribed in the applicable portions of Specification Section 02710

3.02 Preparation of Base or Existing Surface

- A. The designated surface upon which asphalt concrete courses are to be placed shall meet the applicable requirements of Specification 02710 and be thoroughly cleaned of all dirt and other foreign or loose matter prior to the application of the Tack Coat or Prime Coat, as specified in TDOT Specification Sections 402 and 403.

3.03 Thickness And Surface Requirements

- A. Thickness shall be controlled during the spreading operations by frequent measurements taken of freshly spread mixture to establish a relationship between the un-compacted and compacted material. This thickness shall remain in conformity with that specified on the Plans. The surface of all courses 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 1/4 inch for Mix No. 1 or 3/8 inch for Mix No. 2 and Mix No. 3.

3.04 Manhole Adjustments

- A. 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 Section 02530 or 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.

3.05 Traffic And Maintenance

- A. The Owner will determine when the surface course has sufficient compaction and has cured sufficiently to allow construction equipment, slow moving local traffic, or normal traffic to use the completed surface.

END OF SECTION

SECTION 02745

FULL DEPTH RECLAMATION (FDR) OF FLEXIBLE PAVEMENT

PART 1 - Description

This work consists of the Full Depth Reclamation (FDR) process to reclaim existing flexible pavement by pulverizing the bituminous asphalt layers, mixing the pulverized material with the existing base and subgrade layers, and adding a specified amount of cement and water to achieve a homogeneous mixture of reclaimed material. The reclaimed material shall be constructed to the lines and grades as specified in the plans and/or as directed by the Engineer

PART 2 – Materials and Equipment

2.01 MATERIALS

Provide materials as specified in:

- Asphalt Concrete PavementSection 02741
- Portland Cement ConcreteSection 03050
- Water.....Section 03050 2.02 D

2.02 EQUIPMENT

A. Cement Spreader

Provide a self-propelled mechanical cement spreader that has an adjustable/metered rate of flow and will uniformly distribute the cement at the required rate. Cement spreader must be equipped with a digitally controlled rate which adjusts for RPM.

B. Mechanical Reclaimer

Provide a self-propelled mechanical reclaimer capable of pulverizing and mixing the existing pavement, base, sub-grade, and cement uniformly. The reclaimer shall be equipped with a reclaiming drum. A soil stabilization drum is unacceptable. Provide a reclaimer that is equipped with a metered water additive system which uniformly adds water in the mixing chamber. Equipment that requires the application of water separate of the mixing operation is not acceptable.

If the depth of reclamation specified in the contract plans exceed the ability to provide a consistent pulverized material, then a milling machine may be used to mill off a portion of the

existing asphalt pavement leaving the gates open so the asphalt material is left in place, as approved in writing by the Engineer.

C. Rollers

Provide a minimum of two rollers having a capacity to compact the reclaimed material to 100% MDD as determined in accordance with AASHTO T 134. Provide suitable compaction equipment as follows:

1. Perform initial compaction of the reclaimed material using a sheepsfoot roller.
2. Perform finish compaction using a pneumatic tire roller.

D. Motor Grader

Provide a motor grader with an electronic grade/slope control system or provide other means to control the roadway profile and slope. Alternate methods shall be approved in writing by the Engineer.

PART 3 - EXECUTION

3.01 Limitations

- A. Only apply cement to reclaimed material that is not frozen, between April 1 through October 31, and when the air temperature in the shade is 35°F and rising. Construction of reclaimed material shall not proceed during periods of high wind, in the rain, when the forecasted chance for rain exceeds 50%, or if the weather forecast predicts freezing temperatures within 7 days of the planned date of application, unless approved by the Engineer.

Limit the application of cement to an area that will allow for continuous completion of the FDR process, clipping, finishing, and final compaction, within 3 hours from the time the cement is applied. Do not leave any uncompacted reclaimed material undisturbed for more than 30 minutes. If the uncompacted reclaimed material is wetted by rain and exceeds the average moisture content above the specified tolerance, reconstruct the entire section.

3.02 Pulverizing

- A. Pulverize the existing pavement structure and uniformly mix with existing base, and/or subgrade to the depth and width specified in the plans such that 100% passes a 3-inch sieve and 95% passes a 2-inch sieve prior to the application of cement. Verify particle size in the presence of the Engineer initially and periodically during the process of work.

3.03 Cement Application, Spreading and Mixing

- A. Uniformly spread the required quantity of cement on the pulverized material and immediately blend the cement until evenly distributed. Thoroughly mix water, cement, and

the pulverized materials until the water and cement are uniformly distributed throughout the reclaimed material. Maintain moisture content in the range of $\pm 2.0\%$ of OMC during final mixing. Measure the moisture content after final mixing and prior to initial compaction using a nuclear gauge by direct transmission method in accordance with AASHTO T 310.

3.04 Initial Compaction

- A. Begin compaction immediately after cement and water has been incorporated and thoroughly blended with the reclaimed material. Compact the reclaimed materials using approved sheepsfoot roller(s) to 100% of MDD specified in the mix design. Maintain the moisture content prior to breakdown rolling in the range of $\pm 2\%$ OMC. If the reclaimed mixture becomes too wet for initial compaction, adjust moisture content as directed by the Engineer. Compact the entire area using uniform passes of compaction equipment as determined from the test strip, ensuring that uniform density is achieved.

3.05 Shaping

- A. After mixing and initial compaction, shape the surface of the reclaimed material to the required lines, grades, and cross-sections using an approved motor grader. If no lines or grades are provided, maintain the existing profile and provide correction to noticeable imperfections and cross slopes as instructed by the Engineer. Sprinkle the surface until it is damp, but not wet, and clip with a motor grader as directed by the Engineer. Dispose of the material removed by clipping. Intermediate and Final Compaction Following shaping, perform intermediate compaction using a pneumatic tire roller and then seal the surface with a self-propelled steel wheel roller in static mode. At no time shall the finish roller be operated in vibratory mode.

The centerline must be maintained with a max crown of 2.0% in each direction. Any materials not used shall be hauled offsite and incidental to the cost of reclamation.

3.06 Construction Joints

- A. At the beginning of each day's construction, form a straight transverse construction joint by cutting back into the previously completed work a minimum of 5 feet to form a true vertical face, free of loose or shattered material. Straightedge the transverse joints using a 12-foot straightedge during final grading.

If longitudinal joints between adjacent stabilization passes are necessary, the joints shall be overlapped 2 to 4 inches in a neat straight line. Pre-determined cut lines shall be marked in a manner visible to the operator. The overlap cut width should be confirmed before starting a new cut sequence.

The longitudinal joint shall be offset at least 6 inches with the succeeding layer of HMA or surface treatment.

3.07 Surface Tolerances

- A. After finishing and final compaction of the reclaimed material, test the entire reclaimed surface with a 12-foot straightedge applied parallel to the centerline of the pavement. The deviation of the surface from the testing edge of the straightedge shall not exceed 1/2 inch. Any areas failing to meet the surface tolerances shall be corrected at no additional expense to the City.

3.08 Curing

- A. The Contractor is required to proof roll the compacted material. The reclaimed mixture should be allowed to cure for the specified time as in the approved full depth reclamation mix design. Curing is the Contractor's responsibility, who should consider all factors, including the weather limitations and restrictions.

SECTION 03050

PORTLAND CEMENT CONCRETE

Part 1-Description.

The work covered in this section includes the classification, materials, proportioning of materials, equipment, mixing requirements, and testing for Portland Cement Concrete to be used for curbs, curb and gutter, and sidewalks, streets, bridges, and miscellaneous structures.

Part 2 - Materials

2.01. Classes of Portland Cement Concrete. Portland cement concrete used for construction of the various items specified elsewhere in these Specifications shall be classified by usage as follows:

A. Class A.

Class A concrete shall be used as specified for such items as directed by the Engineer and other uses as noted in the Special Provisions.

B. Class AS.

Class AS concrete shall be used for storm and sanitary structures, concrete curb, curb and gutter, valley gutters, sidewalks, ditch paving, and similar structures unless otherwise noted in the Special Provisions.

C. Class B.

Class B concrete shall be used for roadway base, soil cement, and pavement.

D. Class C.

Class C concrete shall be used as specified for such items as concrete cradles, encasements, embankment slope paving at bridge abutments, and other low strength applications.

E. Class P.

Class P concrete shall be used for cast-in-place box culverts and precast and precast-prestressed concrete structures or structural members. High-early-strength concrete shall be as specified in Specification Section 03050 Paragraph 6.05.

2.02 Materials.

A. Portland Cement.

1. Type I or Type I-SM cement shall be used unless otherwise specified. Different types of cement shall not be mixed. Portland Cement shall conform to all requirements of the "Standard Specifications for Portland Cement," AASHTO M 85. M. Specification C150

for Class Type I, except that for high early strength concrete, Type III cement may be used.

B. Fine Aggregate.

1. Fine aggregate for concrete shall consist of sand and shall conform to the following ASSHTO M6 with the following exceptions.

i. General Composition. Concrete sand shall be composed of clean (washed), hard, durable, uncoated grains, free from injurious amounts of clay, dust, soft flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate shall not contain appreciable materials which have unsatisfactory expansive properties when combined with Portland Cement and water.

ii. Sieve Analysis. Fine aggregate shall be graded within the following limits:

Sieve	% Passing by Weight	
	Min.	Max.
3/8" (9.5mm)	100	---
No. 4 (4.75mm)	95	100
No. 8 (2.36mm)	80	100
No. 16 (1.18mm)	50	90
No. 50 (330um)	5-30	
No. 100 (150um)	0	10
No. 200 (75um)	0	3

Deleterious Substances. The fine aggregate shall not contain more than the following maximum amounts of deleterious substances:

	Max. % of Weight
Clay lumps.	0.5
Coal, lignite, or shale.	0.5
Material passing the No. 200 Sieve.	3.0
Other deleterious substances such as Shale, alkali, mica, coated/grains soft and flaky particles.	3.0

If the fine aggregate is manufactured from limestone or dolomite and if the material finer than the No. 200 sieve consists of dust of fracture, essentially free from clay or shale, this limit may be increased from 3% to 5%

iv. Organic Impurities. Fine aggregate subjected to the colorimetric test as per ASTM C40 for organic impurities and producing a color darker than the standard shall be rejected unless it passes the mortar strength test as specified herein, Organic Impurities ASTM

C40.

C. Coarse Aggregate. Coarse aggregate for concrete shall consist of crushed stone or gravel or crushed or uncrushed gravel and shall conform to the following requirements:

1. Coarse aggregate for Class A, Class B, or Class C concrete shall be furnished in two sizes: Size No. 4 and Size No. 67 as shown hereinafter in the attached Table Coarse Aggregate Gradation Table.

2. The two sizes shall be manufactured, within the specified limits, to produce Size No. 467 when combined in the proper proportions at the batching plant. If the supplier provides a proper stockpile to prevent segregation, then a combined Size No. 467 can be used in lieu of blending Size No. 4 and Size No. 67.

3. Coarse aggregate for Class AS concrete shall be Size No. 57. Only limestone coarse aggregate will be used for Class AS concrete; gravel coarse aggregate will not be permitted.

4. Coarse aggregate for Class P concrete shall be size No. 57 or Size No. 67 as may be specified or directed. Only limestone coarse aggregate shall be used for Class P concrete; gravel coarse aggregate will not be permitted.

5. Coarse aggregate for concrete curbing placed by machine extrusion methods shall be Size No. 57 or Size No. 67.

6. The coarse aggregates shall otherwise conform to the requirements of AASHTO M 80 and ASTM C 33 with the following exceptions and stipulations:

a. Deleterious Substances. The coarse aggregate shall not contain more than the following maximum amounts of deleterious substances:

	<u>Max. % of Weight</u>
Clay lumps	0.25
Material passing No. 200 sieve	1.0
Coal or Lignite	1.0
Other deleterious substances such as	
friable, thin, elongated, or laminated pieces	10.00
Other Local deleterious substances	1.00
Soft or nondurable fragments (fragments which	
Are structurally weak such as shale, soft	
Sandstone, limonite concretions, gypsum,	
Weathered schist, or cemented gravel.	3.0

7. The sum of the above, excepting thin or elongated pieces, shall not exceed 5% by weight.

8. Soundness. When subjected to 5 cycles of the soundness test, as set forth in ASTM C88, the loss in weight of coarse aggregate weighted in accordance with the grading of a sample complying with the grading requirements specified, shall not exceed nine (9) percent for sodium sulfate.
9. Abrasion. The coarse aggregate shall not have an abrasive loss greater than 40% as determined by AASHTO T96.
10. In the case of crushed aggregate, if all the material finer than the 200 mesh sieve consists of the dust of fracture essentially free of clay or shale, Item 4, Maximum Per Cent by Weight, may be increased to 1.5.

COARSE AGGREGATE GRADATION TABLE
Amounts Finer than Each Lab. Sieve (Sq. Opening), %By Weight

SIZE NO.	2"	1-1/2"	1"	3/4"	1/2"	3/8"	NO. 4	NO. 8
4	100	90-100	20-55	0-15	-----	0-5	----	----
467	100	95-100	-----	35-70	-----	10-30	0-5	----
57	-----	100	95-100	----	25-60	----	0-10	0-5
67	----	----	100	90--100	----	20-55	0-10	0-5

- D. Water for Concrete. The water shall be clean and free from objectionable amounts of oil, acid, alkali, organic matter, or other deleterious materials and shall not be used until the source of supply has been approved. If at any time the water from an approved source becomes of unsatisfactory quality or insufficient quantity, the Contractor will be required to provide satisfactory water from another source. Water of questionable quality shall be subject to the acceptance criteria of Table I, as specified in ASHTO T26.
- E. Air-Entraining Admixture. The Contractor shall use a regular Portland Cement with the addition of an air-entraining admixture meeting requirements of AASHTO M 154. Air-entraining admixtures to be used in air-entrained concrete shall be Darex AEA, Neutralized Vinsol Resin, and Protex, or any other air-entraining agent meeting the approval of the Engineer. Air-entraining admixtures shall contain no chlorides. The air-entraining characteristics of the admixture, in suitable proportions in combination with Portland Cement, fine aggregate and water, within the limits of the proportion specified, shall be such that the resulting concrete will have a satisfactory workability, and the total air content shall be as provided below in the following table.

Nominal Max Size of Coarse Aggregate	Total Air Content Percentage by Volume Concrete
3/8 inch	6 to 10
1/2 inch	5 to 9
3/4 inch	4 to 8
1 inch	3 1/2 to 6 1/2
1 1/2 inch	3 to 6
2 inch	2 1/2 to 5 1/2
3inch	1 1/2 to 4 1/2

- F. Chemical Admixtures. Chemical admixtures shall conform to ASTM C494, except TYPE C accelerating admixtures shall contain no chlorides, shall be non-toxic after thirty (30) days, and shall be compatible with air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
- G. Pozzolan Admixture. Pozzolan admixture shall conform to the requirements of ASTM C311 and ASTM C618-85 (including Table IA) for either Class C or Class F. Class C fly ash may be used as a replacement for Portland cement if approved in writing by the Owner. The maximum amount of cement being replaced by fly ash shall not exceed 15 percent. When a specific air content has been required and fly ash is being used, the air content shall be tested on each truck load of concrete at the batch plant and the tested value shall be indicated on the ticket.
- H. Fiber-Reinforced Concrete shall conform to ASTM C1116 material requirements and classifications. Concrete containing fibers (steel, glass fibers, or synthetic fibers) shall conform to the manufacturers addition rate and shall be included in the mix design approved by the Engineer. Glass Fiber and synthetic fiber reinforced concrete shall not be used to replace structural reinforcement, and shall be added at the batch plant.

PART 3 – Execution

3.01 Sampling and Testing and Storage of Materials.

- A. Cement. Cement may be accepted on the basis of mill tests and the manufacturer's certification of compliance with the specifications, provided the cement is the product of a mill with a record for production of high quality cement. Certificates of compliance shall be furnished the Engineer by the Contractor, for each lot of cement furnished prior to use of cement in the work. This requirement is applicable to cement for job- mixed, ready-mixed, or transit-mixed concrete. Cement proposed for use where no certificate of compliance is furnished, or where,

in the opinion of the Engineer, the cement furnished under certificate of compliance may have become damaged in transit or deteriorated because of age or improper storage, will be sampled at the mixing site and tested for conformance to the specifications.

1. Cement will be approved for use if it satisfactorily passes the fineness, soundness, and time of set test requirements specified, provided the general run of materials has been satisfactorily meeting the 28-day strength requirements. Any approved cement failing to pass the 28-day strength requirements, if unused, shall be rejected. If, in the judgement of the Engineer, it is considered necessary, other lots of shipments from the same mill may be held for the results of tests before being used.
 2. If cement is supplied from a new source or from a source of unknown quality, it may be held for the results of strength test before being approved.
- B. Fine and Coarse Aggregate. At least two (2) weeks in advance of the beginning of concrete work the Contractor shall submit to an approved materials testing laboratory approximately five hundred pound (500#) (225kg) samples of each concrete aggregate proposed for use unless otherwise waived by the Engineer in writing. All tests which are necessary to determine the compliance of the concrete materials with these specifications shall be performed on these samples. These samples shall also be used by the laboratory as the basis for a concrete mix design. The results of all tests and the concrete mix design shall be submitted to and approved by the City Engineer prior to the start of any concrete work. Standards shall conform to the latest applicable codes. The sampling and testing shall conform to the following standard procedures:
- C. Cement. The Contractor shall provide adequate protection for the cement against dampness. No cement shall be used that has become caked or lumpy. Accepted cement which has been held in storage more than 90 days after shipment from the mill shall be retested, and if failing to meet the requirements specified herein shall be rejected.
1. Accepted cement which has been stored in approved sealed bins at the mill for not more than six (6) months may be used without further testing unless a retest is specifically requested by the Engineer.
- D. Aggregate. Aggregates shall be handled and stored in separate piles at the site in such manner as to avoid a separation of the coarse and fine particles and contamination by foreign materials. Sites for stockpiles shall be prepared and maintained in such a manner as to prevent the mixing of deleterious materials with the aggregate. The Contractor shall deposit material in stockpiles at the batching plant site until the moisture content becomes uniform. Stockpiles shall be built in layers not to exceed three feet (3') (1m) in height, and each layer shall be completed before beginning the next one.

1. Coning or building up stockpiles by depositing the materials in one place will not be permitted. The storing of aggregates in stockpiles, or otherwise, upon the subgrade or shoulders will not be permitted.

3.02 Concrete Mixture Requirements.

- A. The concrete shall meet the following requirements as outlined in the Concrete Classification Table attached to the end of this Section.
 1. If it is found impossible to produce concrete having the required air content with the materials and mixing procedures that are being used, the Contractor shall make such changes in the materials or mixing procedures, or both, as may be necessary to insure full compliance with the requirements of air content in the concrete.
 2. The total weight of aggregates per sack of cement and the relative proportions of coarse and fine aggregate shall be determined by yield tests made during the progress of the work. The Engineer may, at his discretion, adjust the laboratory mix design to obtain the proper yield, and consistency of concrete.
 3. The Contractor shall receive written permission from the Engineer prior to adding Pozzolan admixture to Portland Cement Concrete.
 4. Any combination of aggregates which requires the use of more than six and one-half gallons (6.5g) (25l) of water per sack of cement to produce a workable mixture, with the brand of cement used will be considered as being unsatisfactory, and all such combinations of aggregate will be rejected.
 5. Concrete shall be uniformly plastic, cohesive, and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface. Workability shall be obtained without producing a condition such that free water appears on the surface when finished. The consistency of the mixture shall be that required for the specified conditions and methods of placement; however, the previously determined maximum water cement ratio shall not be exceeded.

3.03 Proportioning of Materials.

All materials shall be separately and accurately measured by weight, and each batch shall be uniform. The coarse and fine aggregates shall be weighed separately. A sack of cement shall weigh ninety-four pounds (94#) (43kg). When bulk cement is used, ninety-four pounds (94#) (43kg) shall be considered as one sack. The Contractor shall furnish and use approved weighing devices, which, in operation, will give the exact quantity of materials required for the class of concrete. When the cement is in contact with the aggregate, it shall not remain more

than forty-five (45) minutes before being deposited into the mixer.

3.04 Measurement of Aggregate.

- A. Where sack cement is used, the quantities of aggregate for each batch shall be exactly sufficient for one or more sacks of cement. No batch requiring a fraction of a sack of cement will be permitted. All measurements shall be by weight, upon approved weighing scales and shall be such as will insure separate and uniform proportions. Scales shall be of either beam or springless dial types, and shall be suitable for supporting the hopper or hoppers. They shall be set accurately in substantial mountings which will insure a permanent spacing of the knife edges under all conditions of loading and use. They shall be so designed and maintained that they will at all times be accurate to within one-half (1/2) of one (1) percent throughout the entire weight range. Clearance shall be provided between the scale parts and the hopper or the bin structure to prevent displacement of the scale parts due to vibrations, accumulations, or any other cause. The value of the minimum gradations on any scale shall not be greater than five pounds (5#) (2.3kg). The weighing beam or dial shall be so placed that it will be in full view of the operator during the operation of the gate which delivers the material to the hopper. Scales shall be protected from air currents that may affect the accuracy of weighing.
- B. Separate hoppers shall be provided for weighing fine and coarse aggregate. They shall be of suitable size and tight enough to hold the aggregate without leakage, and shall be supported entirely upon the scales. Suitable provisions shall be made for removal of overload from the hopper by the operator while he operates the bin gates.
- C. The Contractor shall provide a sufficient number of fifty-pound (50#) (23kg) standard test weights for calibrating the weighing equipment.
- D. The volume of concrete mixed per batch shall not exceed the manufacturer's guaranteed capacity of the mixer.
- E. When the aggregates are delivered to the mixer in trucks, each batch shall be in a separate compartment of the capacity required by the Engineer. Suitable covers shall be provided for the batch compartments of the trucks to protect the cement from the wind. All trucks, truck bodies, bulkheads, and compartments used in proportioning and transporting to the mixer of concrete materials shall be so designed and operated to insure the charging of the mixer, batch by batch, with the proper amounts of each material without overspillage, intermixing of batches or wastage. Any units which, in the opinion of the Engineer, do not operate satisfactorily, shall be removed from the work until properly rebuilt and corrected.

3.05 Mixing Concrete.

- A. Consistency. The quantity of water to be used shall be determined by the Engineer and shall not be varied without his consent. The Contractor shall furnish and use with the mixer an

approved adjustable, water measuring device which will prevent excess water flowing into the mixer, in order that the consistency may be under positive control and that all batches may be of the same consistency.

1. In general, the minimum amount of water shall be used which will produce the required workability. The mortar shall cling to the coarse aggregate and shall show no free water when removed from the mixer.
- B. Mixer. The mixing machine used shall be of an approved type known as a batch mixer, and of a design having a suitable device attached for automatically measuring the proper amount of water accurate to one percent (1%) and for automatically timing each batch of concrete so that all materials will be mixed together for the minimum time required. Such device shall be easily regulated and controlled to meet the variable conditions encountered. If the time device becomes broken or fails to operate, the Contractor will be permitted to continue the balance of the day without the timing device while the same is being repaired, provided that each batch of concrete is mixed two (2) minutes.
1. The normal mixing time for each batch shall be one (1) minute, and the measuring of this period shall begin after all the materials are in the drum. During this mixing period, the drum shall revolve at the speed for which the mixer is designed, but shall make not less than fourteen (14) nor more than twenty (20) revolutions per minute.
 2. No materials for a batch of concrete shall be placed in the drum of the mixer until all of the previous batch has been discharged therefrom. The discharge of water into the drum shall commence with the flow of the aggregates, but shall not be started before the entrance into the drum of part of the aggregates. The discharge of all of the mixing water for any batch shall be completed within ten (10) seconds after all of the aggregates are in the drum. The inside of the drum shall be kept free from hardened concrete.
 3. The use of mixers having a chute delivery will not be permitted except by permission of the Engineer. In all such cases the arrangement of chutes, baffle plates, etc., shall be such as will insure the placing of fresh concrete without segregation.
 4. Ready-mixed concrete from a central mixing plant delivered at the work ready for use, will be permitted, provided the mixture is transported to the job site in an agitating truck having the concrete contained in a revolving drum and provided there is no segregation of the mixture at the point of placing. Ready-mixed concrete from a central batching plant and mixed in transit will be permitted; however, the mixing and transporting equipment will be subject to the special approval of the Engineer. Any ready-mixed concrete shall comply with all of the requirements of these specifications.
 5. The time elapsing from the time the water is added to the mix until the concrete is deposited in place at the site of the Work shall not exceed 30 minutes when hauled in non-agitating

trucks, not 60 minutes when hauled in truck mixers or truck agitators. In addition, the total revolutions at mixing speed shall not be less than 70 nor more than 100. When truck mixers are used on hauls in excess of 1 hour, the cement shall be added at the site of the work. The concrete must be of workable consistency when placed. No mixer which has a capacity of less than a two-sack batch shall be used.

- i. Hand mixing will not be permitted except with the permission of the Engineer and then only in very small quantities or in case of an emergency.
6. Retempering concrete by adding water or by other means will not be permitted; however, a portion of the mixing water may be withheld from transit mixers and added at the work site provided the delivery ticket indicates the amount withheld. The batch shall be mixed for 30 revolutions at mixing speed after adding the water. Water cannot be added to a partial load of concrete mix. Concrete that is not within the specified slump limits at time of placement shall not be used.
7. In using air-entraining admixtures, the mixer shall be equipped with a suitable automatic dispensing device which will proportion the air entraining admixture accurately to each batch of concrete. The device shall be calibrated and adjusted to deliver to each batch of concrete the quantity of admixture required to produce the specified air content in the concrete.
8. The manufacturer of the concrete shall furnish to the purchaser with each batch of concrete before unloading at the site, a delivery ticket. The purchaser shall provide the Engineer with one (1) copy of each delivery ticket.

3.06 Forms.

- A. Forms shall be made of wood or metal. Forms shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. The top and face of forms shall be cleaned and oiled prior to the placing of concrete.

3.07 Placing Concrete.

- A. The concrete shall be unloaded into an approved spreading device, or deposited on the base, and spread in such a manner as to prevent segregation of the materials. As deposited, the mixture shall be placed where it will require as little rehandling as possible. No concrete shall be placed on frozen grade.
- B. 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 in earthen or

other foreign substances.

- C. 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.

3.08 Protection.

- A. It shall be the responsibility of the Contractor to protect from damage all freshly poured concrete regardless of the location or type of structure for a minimum period of seven (7) days or for such longer period as the Engineer may direct. Any concrete which is damaged shall be repaired to the satisfaction of the Engineer prior to acceptance of the completed work.

3.09 Quality Control Testing.

- A. The Owner or Consultant will employ a testing laboratory to perform test and submit test reports. Test reports will be reported in writing to Consultant, Owner, and Contractor as soon as possible upon completion of tests.

- 1. Compressive Strength Tests. Concrete test cylinders will be made by a qualified technician from a certified material testing laboratory.
- 2. The cylinders shall be made and tested in accordance with ASTM C39.
- 2. Tests may be required for each day's run or according to the following schedule:

<u>Total Cubic Yards of Concrete Placed (m³)</u>	<u>Minimum Number of Tests* (3 cylinders each)</u>
0 – 100(0-75)	One for 7 days, two at 28 days
100 – 1000 (75 -750)	One for each 50 cu. Yds. (38m ³)
1000 – 2000 (750 – 1500)	One for each 125 cu. Yds. (100m ³)
2000 and Over (1500)	One for each 175 cu. Yds. (125 m ³) One for each 250 cu. Yds. (200 m ³)

*One test per pour minimum.

- iii. Results of all tests shall be furnished to the Engineer as soon as they are available.
- 2. Slump. Slump test shall be conducted in accordance with ASTM C172. A test shall be performed for each day's pour of each type of concrete and for each set of compressive strength test.

2. Air Content. Air content shall be tested in accordance with ASTM C143 or ASTM C231. Air content test shall be performed for each set of compressive strength tests of each type of air-entrained concrete.

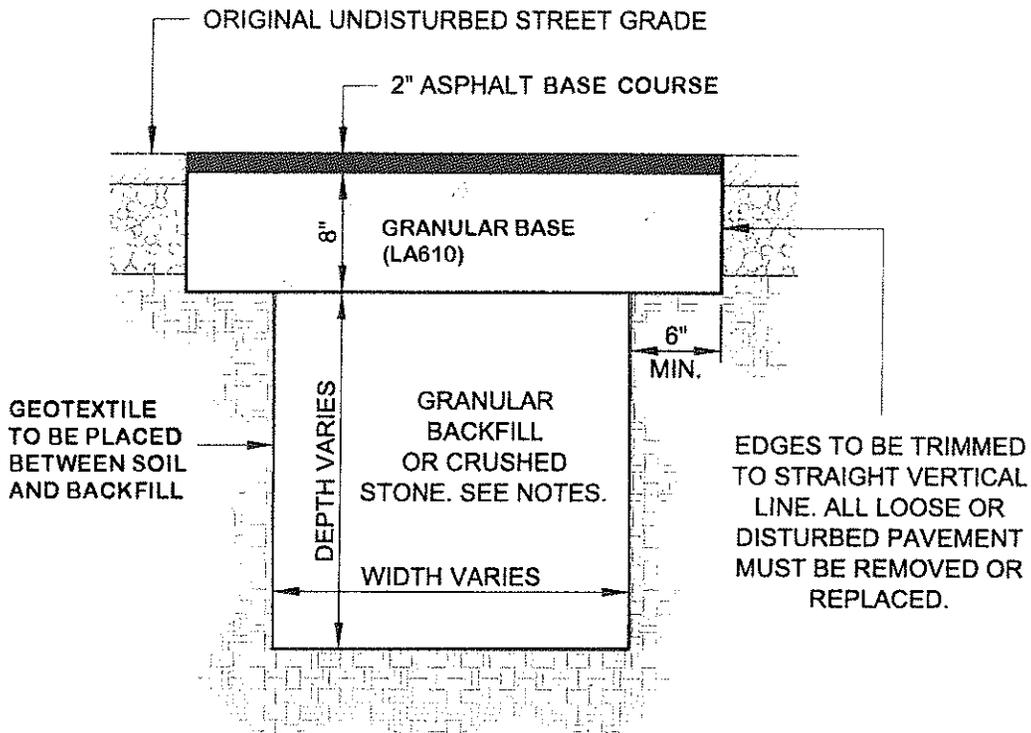
CONCRETE CLASSIFICATION TABLE

Class of Concrete	Min. 28 day Compressive Strength (psi)	Slump in Inches	Min Cement–Sacks//CY (3)		Min Cement–#/CY (3)		Net Water Max. Gal/CY (3)		Net Water Max-#/CY (3)	
			Gravel Course Aggregate	Limestone Course Aggregate	Gravel Course Aggregate	Limestone Course Aggregate	Gravel Course Aggregate	Limestone Course Aggregate	Gravel Course Aggregate	Limestone Course Aggregate
A	3000	3-5	6.0	5.5	564	517	36	33	300	275
AS	4000	3-5	(2)	6.2	(2)	583	(2)	37.2	(2)	310
B	3500(1)	1-2.5	6.2	5.8	583	545	34.1	31.9	284	266
C	2500	2-4	5.0	4.5	470	423	34	30.6	283	255
P	5000	1-3	(2)	7.0	(2)	658	(2)	35	(2)	292

Notes:

- (1) Minimum compressive strength at 14 days. Minimum flexural strength at 14 days of 550 psi per AASHTO T 22
- (2) Gravel Coarse Aggregate not permitted.
- (3) Tabulated values are for Type I cement conforming to the requirement of AASHTO M 85 only.

END OF SECTION



NOTES:

1. SAND MAY BE USED AS BACKFILL MATERIAL IN TRENCHES 6' DEEP OR LESS.
2. ANY TRENCH GREATER THAN 6' IN DEPTH SHALL BE REQUIRED TO BE BACKFILLED WITH CR610 CRUSHED STONE OR AS DIRECTED BY THE CITY ENGINEER.
3. CEMENT TREATED BASE MUST BE PLACED AND COMPACTED WITHIN 3 HOURS OF DISPATCH.
4. GRANULAR BACKFILL MATERIAL SHALL BE COMPACTED TO 95% MAXIMUM DRY DENSITY.

TYPICAL PAVEMENT REPAIR DETAIL

NOT TO SCALE

*CITY OF LAKELAND
ENGINEERING DIVISION*

TYPICAL PAVEMENT REPAIR DETAIL

REV.	DESCRIPTION	DATE
1	ORIGINAL ISSUE	8/2008