Section 02711

HOT MIX ASPHALT BASE COURSE

PART 1 GENERAL

1.01 SUMMARY

This Section includes foundation course of compacted mixture of coarse and fine aggregates, and asphalt binder.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for hot mix asphalt base is on a per square yard basis.

2. Payment for hot mix asphalt base for transitions and base repairs is on a per square yard basis.

3. Payment for hot mix asphaltic base for temporary driveway, roadway shoulders, etc., is on a per square yard basis.

4. Measurement for utility projects:

   a. Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Plans.

   b. Include installed hot mix asphalt base course material that extends one foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common edge with existing pavement section.

5. Refer to Section 01270 – “Measurement and Payment” for unit price procedures.

6. Refer to Paragraph 1.02-C. for unit price adjustments.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

C. UNIT PRICE ADJUSTMENT

1. Make unit price adjustments for in-place depth determined by cores as follows:

   a. Adjusted Unit Price is ratio of average thickness determined by cores to thickness bid upon, times unit price bid.

b. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price bid.

c. Average depth below 90 percent but greater than 80 percent will be accepted at adjusted Unit Price of:

Unit Price Bid - [2 (1- ratio) x Unit Price Bid].

d. Average depth below 80 percent will be rejected

1.03 REFERENCES

A. AASHTO T201 - Standard Method of Test for Kinematic Viscosity of Asphalts (Bitumens).

B. AASHTO T202 - Standard Method of Test for Viscosity of Asphalts by Vacuum Capillary Viscometer.

C. ASTM C 33 - Standard Specification for Concrete Aggregate.

D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

E. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

F. ASTM D 4402 - Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer.

G. TxDOT Tex-106-E - Calculating the Plasticity Index of Soils.

H. TxDOT Tex-126-E - Molding, Testing, and Evaluating Asphalt Black Base Material.

I. TxDOT Tex-200-F- Sieve Analysis of Fine and Coarse Aggregates.

J. TxDOT Tex-203-F - Sand Equivalent Test.

K. TxDOT Tex-204-F - Design of Bituminous Mixtures.

L. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.

M. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.

N. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 – “Submittal Procedures”.

B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.

C. Submit proposed mix and test data for each type of base course in Work.

D. Submit manufacturer's description and characteristics of mixing plant to Project Manager for approval by Engineer.

E. Submit manufacturer's description and characteristics of spreading and finishing machine to Project Manager for approval by Engineer.

1.05 RELATED REQUIREMENTS

A. Section 01270 – "Measurement and Payment"

B. Section 01330 – "Submittal Procedures"

C. Section 01454 – " Testing Laboratory Services"

D. Section 02315 – "Roadway Excavation"

E. Section 02321 – "Cement Stabilized Sand"

F. Section 02330 – "Embankment"

G. Section 02336 – "Lime-Stabilized Subgrade"

H. Section 02337 – "Lime/Fly-Ash Stabilized Subgrade"

I. Section 02338 – "Portland Cement Stabilized Subgrade"

J. Section 02713 – "Recycled Crushed Concrete Base Course"

1.06 – 1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. MATERIALS

1. Coarse Aggregate:

a. Use crushed gravel or crushed stone, or combination retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious material occurring either free or as coating on aggregate. Conform aggregate to ASTM C 33 except for gradation. Furnish rock

or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.

b. Reclaimed asphalt pavement (RAP) or reclaimed Portland cement concrete pavement (RPCCP) are permitted as aggregates for hot mix asphalt base course if combined aggregate criteria, gradation, and mixture properties are met.

2. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Conform aggregate to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other deleterious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by TxDOT Tex-106-E. Sand equivalent shall have minimum value of 45 when tested by TxDOT Tex-203-F.

3. Composite Aggregate: Conform to following limits when graded in accordance with ASTM C 136. Provide either coarse or fine aggregate where designated on the Plans.

Gradation of Composite Aggregate Percent Passing by Weight or Volume		
Sieve Size	**Type A Coarse Base**	**Type B Fine Base**
1½"	98.0 – 100.0	—
1¼"	—	—
1"	78.0 – 94.0	98.0 - 100.0
3/4"	64.0 – 85.0	84.0 – 98.0
½"	50.0 – 70.0	—
3/8"	—	60.0 – 80.0
#4	30.0 – 50.0	40.0 – 60.0
#8	22.0 – 36.0	29.0 – 43.0
#30	8.0 – 23.0	13.0 – 28.0
#50	3.0 – 19.0	6.0 – 20.0
#200	2.0 – 7.0	2.0 – 7.0
VMA % Minimum	12.0	13.0
*2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.		

4. Asphalt Binder: Moisture-free homogeneous material meeting following requirements:

Performance Grade (PG)	
SPECIFICATION	**PG 64 - 22**
Average 7-day Maximum Pavement Design Temperature, degrees C[a]	<64

Performance Grade (PG)	
SPECIFICATION	**PG 64 - 22**
Minimum Pavement Design Temperature, degrees C[a]	>-22
Original Binder	
Flash Point Temperature, T48, Minimum degrees C	230
Viscosity, ASTM D 4402, [b] Maximum 3 Pa.s (3000cP), Test Temperature, degrees C	135
Dynamic Shear, TP5; [c] G*/sine[], Minimum, 1.00kPa Test Temperature @ 10rad/sec, degrees C	64
Rolling Thin Film Oven (T240) or Thin Film Oven (T179) Residue	
Mass Loss, Maximum, %	-1.00
Dynamic Shear, TP5; G*/sine[], Minimum, 2.20 kPa Test Temperature @ 10rad/sec, degrees C	64
Pressure Aging Vessel Residue (PPI)	
PAV Aging Temperature, degrees C [d]	100
Dynamic Shear, TP5; G*/sine[], Maximum, 5000 kPa Test Temperature @ 10rad/sec, degrees C	25
Physical Hardening [e]	Report
Creep Stiffness, TP1; [f] S, Maximum, 300 Mpa; m-value, Minimum, 0.300 Test Temperature @ 60 sec, degrees C	-12
Direct Tension, TP3; [f] Failure Strain, Minimum, 1.0%; Test Temperature @ 1.0 mm/min, degrees C	-12

Notes:

[a] Pavement temperature can be estimated from air temperatures using algorithm contained in TxDOT testing procedures.

[b] The requirement may be waived at discretion of Project Manager if supplier warrants that asphalt binder can be adequately pumped and mixed at temperatures that meet applicable safety standards.

[c] For quality control of unmodified asphalt cement production, measurement of viscosity of original asphalt cement may be substituted for dynamic shear measurements of G*/sine [ ] at test temperature where asphalt is Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary of rotational viscometry (AASHTO T 201 or T202).

[d] The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures: 90°C, 100°C, or 110°C. The PAV aging temperature is 100°C for PG64 and PG70.

[e] Physical Hardening - TP 1 is performed on a set of asphalt beams according to Section 13.1, except conditioning time is extended to 24 hours plus or minus 10 minutes at 10 C above minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.

[f] If creep stiffness is below 300 MPa, the direct tension test is not required. If creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of creep stiffness requirement. The m-value requirement must be satisfied in both cases.

a. Use specified grades of asphalt at locations designated on Plans.

b. Reclaimed asphalt pavement may be used with PG70-22 binder at a rate no greater than 17 percent.

B. EQUIPMENT

1. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, the plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.

2. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

   a. Cold aggregate bins and proportioning device

   b. Dryer

   c. Screens

   d. Aggregate weight box and batching scales

   e. Mixer

   f. Asphalt storage and heating devices

   g. Asphalt measuring devices

   h. Truck scales

3. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. One cold feet bin per stockpile is required.

2.03 FABRICATION

A. MIXES

1. Employ certified testing laboratory to prepare design mixes.

   a. Test in accordance with TxDOT Tex-126-E, TxDOT Tex-204-F, TxDOT Tex-208-F, and TxDOT Tex-227-F.

   b. Verify mixture design properties for plant-produced mixture. Demonstrate that asphalt plant is capable of producing mixture meeting design volumetric and stability requirements before placement begins.

2. Density, Stability, and Air Voids Requirements. Select asphalt binder content for base courses to result in 3 to 5 percent air voids in laboratory molded specimens, while meeting minimum VMA requirement for selected mixture classification.

Percent Density		Percent Optimum	HVEEM Stability Percent Not Less Than	Percent Asphalt Content	
Min.	Max.			Min.	Max.
94.5	97.5	96	35	3.5	7

2.04 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 GENERAL / MANUFACTURER(S)

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Verify lines and grades are correct.

C. Prepare subgrade in accordance with requirements of Section 02330 – "Embankment" and Section 02315 – "Roadway Excavation" or Section 02336 – "Lime-Stabilized Subgrade" and Section 02337 - Lime/Fly-Ash Stabilized Subgrade, and 02338 – "Portland Cement Stabilized Subgrade". Subgrade preparation may also refer to Section 02321 – "Cement Stabilized Sand" or Section 02713 – "Recycled Crushed Concrete Base Course".

D. Correct subgrade deviations in excess of plus or minus ¼ inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

3.03 ERECTION/INSTALLATION APPLICATION AND/OR CONSTRUCTION

A. Placement

1. Place base when surface temperature taken in shade and away from artificial heat is above 40 degrees F and rising. Do not place asphalt base when temperature of surface to receive base course is below 50 degrees F and falling.

2. Haul prepared and heated asphalt base mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

3. Place hot mix asphalt base course in compacted lifts no greater than 4 inches thick, unless permitted in writing by Engineer.

4. Place courses as nearly continuously as possible. Place material with approved mechanical spreading and finishing machine of screeding or tamping type. Spread lifts to attain smooth course of uniform density to section, line, and grades as indicated on Plans.

5. In areas with limited space where use of paver or front-end loader is impractical, spread by hand and compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix; do not broadcast material. Remove lumps that do not break down readily

B. Joints

1. Transverse Joints. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When Work is resumed, cut back placed material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

2. Existing pavement. When new asphalt is laid against existing asphalt pavement, saw cut existing asphalt to full depth creating vertical face. Clean joint and apply tack coat before placement

C. Compaction

1. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids. Prepare test strip at least 500 feet in length, comparable to placement and compaction conditions for Project.

2. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair line cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water; do not use petroleum by-products.

3. Compact surface thoroughly and uniformly with power-driven equipment capable of obtaining required compaction. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 175 degrees F.

4. Along walls, curbs, headers, similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

5. Compact base course to density between 91 percent and 95 percent of maximum theoretical density (TxDOT Tex-227-F), or between 5 and 9 percent air voids.

D. Tolerances

1. Pavement Repairs.

a. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed ¼ inch.

b. Completed surface, when tested with 10 foot straight edge laid parallel to center line of pavement, shall show no deviation in excess of ¼ inch in 10 feet. Correct surface not meeting this requirement

3.04 REPAIR/RESTORATION (NOT USED)

3.05 FIELD QUALITY CONTROL

A. Perform testing under provisions of Section 01454 – "Testing Laboratory Services".

B. For in-place depth and density, take minimum of one core at random locations for each 1,000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de-sac or streets are less than 500 feet, minimum of 2 cores (one per lane) shall be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings shall be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process shall continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.

C. Determine in-place density in accordance with TxDOT Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Project Manager.

D. Request, at option, three additional cores within a 5-foot radius of core indicating nonconforming in-place depth at no additional cost. In-place depth at these locations shall be average depth of four cores.

E. Fill cores and density test sections with new compacted asphalt base or cold patch material.

F. Nonconforming Pavement

1. Replace pavement sections not meeting specified densities with new asphaltic concrete material.

2. Remove and replace areas of asphalt base found deficient in thickness by more than 10 percent. Use new asphalt base of thickness shown on Plans.

3. Replace or correct nonconforming pavement sections at no additional cost.

3.06 – 3.08 NOT USED

3.09 PROTECTION

A. Do not open base to traffic until 12 hours after completion of rolling, or as shown on Plans.

B. Maintain asphalt base in good condition until completion of Work.

C. Repair defects immediately by replacing base to full depth

3.10 SCHEDULES (NOT USED)

END OF SECTION