

## **SPECIFICATION SECTION 06200 - ASPHALT CONCRETE BINDER AND SURFACE COURSES**

### **TABLE OF CONTENTS**

1.	DESCRIPTION .....	3
2.	REFERENCE STANDARDS .....	3
3.	MATERIAL FOR ASPHALT MIXTURES .....	5
3.1	Aggregates - general .....	5
3.2	Coarse Aggregate.....	6
3.3	Fine Aggregate .....	6
3.4	Mineral filler for Asphalt Mixtures .....	6
3.5	Bitumen for Asphalt Mixtures .....	7
3.6	Material Testing .....	9
3.7	Submittals.....	11
4.	EQUIPMENT USED FOR ASPHALT MIX WORK.....	12
4.1	Plant General .....	13
4.2	Hauling Equipment.....	17
4.3	Spreading and Finishing Equipment.....	18
4.4	Compacting Equipment .....	18
4.5	Manufacture and Production of Asphalt Mixtures .....	19
4.6	Job-Mix Formula .....	21
4.7	Trial Section .....	25
4.8	Production of Mixture.....	25
4.9	Placing and Compaction of the Mixture .....	27
4.10	Quality Control and Testing .....	30
4.11	Asphalt Concrete Tolerances for Acceptance.....	32
4.12	Rectification of Unsatisfactory Asphalt Mixtures .....	33
5.	MEASUREMENT AND PAYMENT .....	33
5.1	Method of Measurement .....	33
5.2	Basis of Payment .....	34



## **SPECIFICATION SECTION 06200 - ASPHALT CONCRETE BINDER AND SURFACE COURSES**

### **1. DESCRIPTION**

This Specification Section prescribes the supply, spreading and compaction of hot asphalt mixtures produced in a central mixing plant capable of providing dense durable binder and surface courses.

### **2. REFERENCE STANDARDS**

The most recent editions of the following Standards shall be applied to the Works covered by this Specification.

Vietnamese Standards:

TCVN 8819:2011	Technical Specifications for Construction and Acceptance of Hot Mix Asphalt Concrete Pavement
TCVN7504-2005	Test Method for Determination of Adhesion with Paving Stone
TCVN7572-2006	Aggregates Used for Concrete and Mortar
22TCN58-84	Specification for Testing Mineral Powder Used for ETN
TCVN8867-11	Flexible Pavement Standard Test Method for Determining the Elastic Modulus of Pavement Structure Using Benkelman Beam
22TCN345-06	Technology Process for Construction and Approval of the Thin Covering Layer of High Roughness Asphalt Concrete.
22TCN356-06	Specification for Construction and Acceptance of Asphalt Pavement Using Polymer Asphalt
22TCN319-04	Polymer Asphalt - Technical Requirement and Testing Method.
22TCN279-01	Technical Requirement and Testing Method of Solid Asphalt.
TCVN 8863-2011	Bituminous Surface Treatment – Specification for Construction and Acceptance.
TCVN 8865-2011	Method for Measuring and Assessment of Roughness by International Roughness Index (IRI).
TCVN 8866-2011	Standard Test Method for Measuring Pavement Macrottexture Depth Using a Volumetric Technique.
22TCN318-04	Testing Process for Determination of Abrasion of Aggregate by Los Angeles Method.

International Standards:

AASHTO M17	Mineral Filler for Bituminous Paving Mixtures
AASHTO M20	Penetration Graded Asphalt Cement
AASHTO M226	Viscosity Graded Asphalt Cement
AASHTO T11-05	Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing. ASTM C117-03
AASHTO T27-99	Sieve Analysis of Fine and Coarse Aggregates. ASTM C 136-96
AASHTO T44	Solubility of Bituminous Materials
AASHTO T47	Loss on Heating of Oil and Asphaltic Compounds
AASHTO T48	Flash and Fire Points by Cleveland Open Cup
AASHTO T49	Penetration of Bitumen
AASHTO T50	Float Test for Bitumen
AASHTO T51	Ductility of Bitumen
AASHTO T 53-96	(2004) Softening Point of Bitumen (Ring-and-Ball Apparatus). ASTM D36-95 (2000)
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and the Plasticity Index of Soils
AASHTO T96	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T151	Testing Drying Oils
AASHTO T164	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T165	Effect of Water on Cohesion of Compacted Bituminous Mixtures
AASHTO T166	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
AASHTO T168	Sampling Bituminous Paving Mixtures
AASHTO T170	Recovery of Asphalt from Solution by Abson Method
AASHTO T176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T179	Effect of Heat and Air on Asphalt Materials (Thin Film Oven Test)
AASHTO T182	Coating and Stripping of Bitumen-Aggregate Mixtures

AASHTO T209	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
AASHTO T228	Specific Gravity of Semi Solid Asphalt Materials
AASHTO T230	Method B. Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures
AASHTO T245	Resistance to Plastic Flow of Bituminous Mixtures using Marshall Apparatus
AASHTO T269	Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
AASHTO T305	Determinations of Drawdown Characteristics in Uncompacted Asphalt Mixtures
ASTM D3625	Standard Practice for Effect of Water on Bituminous Coated Aggregate Using Boiling Water
ASTM D4402	Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D5892	Standard Specification for Type IV Polymer Modified Asphalt Cement for Use in Pavement Construction
ASTM D6084	Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM E950	Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference
DIN 52015	Testing of Bituminous Binders
NFP 98-256	
American Asphalt Institute Manual MS-2	
The Policy for Draining A/C Surface Courses, Japan Road Association (JRA)	
Activities of Porous Asphalt on Expressways, Japan Highway Public Corporation.	

### **3. MATERIAL FOR ASPHALT MIXTURES**

#### **3.1 Aggregates - general**

- a) All sources of supply of aggregate and mineral filler shall be approved by the Engineer prior to the delivery of any materials. Samples of each material shall be submitted as directed.
- b) Aggregates to be used in the Works shall have a retained strength of not less than 75 % when tested for loss of cohesion resulting from the action of water in accordance with AASHTO T165 and AASHTO T245.

- c) Stockpiling and handling of materials shall be in accordance with the requirements in Subsection 2.3 of Specification Section 05100 Subbase and Base Courses.
- d) Fine aggregates shall be stored under cover to provide protection from rain.
- e) Aggregates of each type shall be fed into the mixing plant via a separate cold feed bin. The mixing of aggregates of different types or from different sources will not be permitted.
- f) The Contractor shall take into account the bitumen absorption properties of aggregates when selecting his proposed material sources.

### **3.2 Coarse Aggregate**

- a) The aggregate shall consist of clean, tough, durable crushed stone free from dirt or other objectionable matter. The aggregate shall have a percentage of wear of no more than 35% at 500 revolutions when tested in accordance with Vietnamese Standard 22TCN318-04.
- b) The aggregate shall have a weight loss not greater than 12% when subjected to five cycles of the sodium sulphate soundness test in accordance with AASHTO T104,
- c) The aggregate shall have a coated area of not less than 95% when subjected to coating and stripping tests in accordance with AASHTO T182,

### **3.3 Fine Aggregate**

- a) The aggregate shall be free from lumps or balls of clay and other objectionable materials and shall consist of clean, tough durable particles of natural sands or crushed stone screenings or suitable combinations thereof. If some crushed stone screenings (crusher dust) are used the dust shall be produced by crushing clean stone having no clay or silt content and shall be stockpiled separately from any natural sand to be used in the mix. When used in combination the crusher dust and natural sand components shall be fed into the mixing plant using separate cold bin feeds so that the ratio of sand to crusher dust can be properly controlled.
- b) The Contractor shall not be permitted to use in his asphalt mixes contaminated natural sands having more than 8% fines passing a No.200 sieve or having a sand equivalent value less than 50 as determined by AASHTO T176.

### **3.4 Mineral filler for Asphalt Mixtures**

- a) Mineral filler for asphalt mixtures shall fully conform to the particular provisions of Vietnamese Standard TCVN 8819:2011.

- b) Mineral filler shall consist of; limestone dust, dolomite dust, Portland cement, fly ash, cement kiln dust or other hard mineral matter from sources approved by the Engineer. It shall be free from foreign or other objectionable material.
- c) Mineral filler shall be dry and free from lumps and when tested by wet sieving shall contain not less than 75% (preferably not less than 85%) by weight of particles passing a 75 micron sieve.

### 3.5 Bitumen for Asphalt Mixtures

- a) Normal bitumen shall be asphalt cement of 60/70 penetration grade, complying with the technical requirement and testing method of solid asphalt, Vietnamese Standard 22TCN279-01. Other asphalts will be permitted only with the prior approval of the Engineer.
- b) If necessary and subject to the approval of the Engineer an adhesion and anti-stripping agent shall be added to the bitumen. The additive shall be of a type approved by the Engineer and the required percentage of additive shall be thoroughly mixed with the bitumen in accordance with the manufacturer's instruction subject to the approval of the Engineer for such time as is necessary to produce a homogeneous mixture.

Table 1. Bitumen Properties Requirement (referred table 1 of 22TCN279-01)

No.	Properties	Unit	Grade 60/70	Testing method	Reference standard
1	Penetration at 25 °C	0.1mm	60 – 70	22TCN279-01	ASTM D5 AASHTO T49
2	Ductility at 25 °C	Cm	Min. 100	22TCN279-01	ASTM D113 AASHTO T151
3	Softening point (ring and ball method)	°C	46 - 55	22TCN279-01	AASHTO T53-96
4	Flash point	°C	Min. 230	22TCN279-01	ASTM D92 AASHTO T48
5	Loss on heating for 5 hours at 163 °C	%	Max. 0.8	22TCN279-01	ASTM D6 AASHTO T47
6	Ratio of penetration of residue after heating for 5 hours at 163 °C to one at 25 °C	%	Min. 75	22TCN279-01	ASTM D6/D5
7	Solubility in Trichloroethylene C <sub>2</sub> CL <sub>4</sub>	%	Min. 99	22TCN279-01	ASTM D2042 AASHTO T44
8	Specific gravity at 25 °C	g/cm <sup>3</sup>	1 – 1.05	22TCN279-01	ASTM D70 AASHTO T228
9	Effect of water on bituminous – coated	Grade	Min. 3 <sup>rd</sup> grade	22TCN279-01	ASTM D3625

	aggregate using boiling water				
10	Wax paraffin content	%	Max. 2.2	22TCN279-01	DIN-52015

c) Polymer Modified Binder (Anti-skid Asphalt Concrete Surface Course)

The asphalt concrete roughness layer shall conform with Vietnamese Standard 22TCN345-06. The asphalt concrete mixture for the concrete roughness layer will be produced by the hot mixing and spraying method with interrupted aggregate; the cohesive substance is polymer asphalt.

Polymer modified asphalt used for the asphalt concrete roughness layer shall be type PMB-I or PMB-II in accordance with Vietnamese Standard 22TCN319-04 as detailed in table 2 below (Table No.1 of Vietnamese Standard 22TCN319-04). Selection of PMB-I or II shall be based on test results for the proposed job mix and trial sections.

Table 2: Polymer Modified Binder (PMB) Requirements (table 1 of 22TCN319-04)

No.	Binder Properties	Unit	22TCN319-04		Testing method	Reference standard
			PMB-I	PMB-II		
1	Softening Point (Ring and Ball Method)	°C	Min. 60	Min. 70	22TCN279-01	ASTM D36 AASHTO T53
2	Penetration at 25°C	0.1mm	50 - 70	40 - 70	22TCN279-01	ASTM D5 AASHTO T49
3	Flash Point	°C	Min. 230		22TCN279-01	ASTM D92 AASHTO T48
4	Loss on Heating for 5 hours at 163°C	%	Max. 0.6		22TCN279-01	ASTM D6 AASHTO T47
5	Penetration of Residue after Heating for 5 hours at 163°C to Original	%	Min. 65		22TCN279-01	ASTM D6/D5
6	Solubility of Trichloroethylene C <sub>2</sub> Cl <sub>4</sub>	%	Min. 99		22TCN279-01	ASTM D2042 AASHTO T44
7	Specific Gravity at 25°C	g/cm <sup>3</sup>	1.00 – 1.05		22TCN279-01	ASTM D70 AASHTO T228
8	Effect of Water on Polymer Modified Bitumen – Coated Aggregate using Boiling Water	grade	Min. 4 <sup>th</sup> grade		22TCN279-01	-
9	Elastic Recovery at 25°C,	%	Min. 60	Min. 65	22TCN319-04	ASTM D6084

No.	Binder Properties	Unit	22TCN319-04		Testing method	Reference standard
			PMB-I	PMB-II		
	10 cm elongation					
10	Storage Stability for 48 hours at 163°C, Difference of Softening Point	°C	Max. 3.0		22TCN319-04	ASTM D5892
11	Dynamic Viscosity at 135°C (spindle 21, 18.6 s-1, Brookfield Viscometer)	Pa.s	Max. 3.0		22TCN319-04	ASTM D4402

### 3.6 Material Testing

All testing necessary to determine conformity with the requirements of this Specification and for purposes of acceptance shall be performed in accordance with Subsection 4.10 of this Specification Section.

The Contractor shall provide a one litre sample of all bitumen that he proposes to use together with a certificate confirming their source test data giving their properties both before and after a Thin Film Oven Test in accordance with AASHTO T179 and including:

- Penetration at 25 °C
- Penetration at 35 °C
- Ring and Ball softening point
- Viscosity at 60 °C
- Viscosity at 135 °C

Aggregates shall comply with the requirements of Table 3 below

Table 3. Requirement of Aggregate

No.	Properties	Standards 22TCN345-06 & TCVN 8819:2011			
		Anti Skid A/C surface course	Surface Course	Binder Course	Testing method
I	Coarse aggregate for asphalt mixtures				
1	Stable Compression limit of rock, Mpa - Aggregate of magmatic and metamorphic rock - Aggregate of sedimentary rock	Min.120	Min. 100 Min. 80	Min. 80 Min.60	TCVN 7572-06
2	Abrasion of aggregate by use of the Los Angeles machine (LA), %	Max. 25	Max. 30	Max. 35	22TCN318-04 AASHTO T96
3	Diamond-shaped grain content, %	Max. 12	Max. 15	Max. 15	TCVN 7572-06
4	General content of dust, mud and clay (percent by weight), %	Max. 2	Max. 2	Max. 2	TCVN 7572-06
5	Clay content (percent by aggregate weight), %	Max. 0.25	Max. 0.25	Max. 0.25	TCVN 7572-06
6	Fraction rate of crushed gravel is not		8	12	TCVN 7572-06

No.	Properties	Standards 22TCN345-06 & TCVN 8819:2011			
		Anti Skid A/C surface course	Surface Course	Binder Course	Testing method
	higher than, %				
7	Fraction rate from crushed material of oven slag - Type - Not higher than, %		1 15	2 25	
8	Broken rate of gravel by weight is not higher than (%)		100	80	
9	Crushed rate of Gravel $R_c = D_{min}/D_{max}$ is not higher than		4	4	By visual observation and percent passing sieve method
10	Glueyness of aggregate and bituminous, class		Min. 3	Min. 3	TCVN 7504-05
II	Physical properties of sand				
	Sand type	Crushed (selected) sand	natural sand, crushed (selected) sand		
1	$M = 0.01(A_{2.5}+A_{1.25}+A_{0.63}+A_{0.315}+A_{0.14})$	Min. 2	Min. 2		TCVN 7572-06
2	Sand Equivalent Coefficient (ES), %	Min. 50	Min. 80 (natural sand) Min. 50 crushed (selected) sand		AASHTO T176-02
3	Content of dust, mud, clay by weight, %	Max. 3	Max. 3 (natural sand) Max. 7 crushed (selected) sand		TCVN 7572-06
4	Content of clay by weight, %	Max. 0.5	Max. 0.5		TCVN 7572-06
III	Physical properties of mineral filler				
1	Sieve Designation (mass percent passing ), %  0.6mm 0.3mm 0.075mm	  100 95 – 100 70 – 100	  100 95 – 100 70 – 100		22TCN58-84
2	Moisture, % by weight	Max. 1	Max. 1		22TCN58-84
3	Expansively of mixture between mineral filler with polymer asphalt, % by vol		Max. 2.5		22TCN58-84
4	Plasticity index , %	Max. 4	Max. 4		AASHTO T89, 90
5	Compressive limit daN/cm2	Min. 200	Min. 200		
6	Void by weight, %		≤ 35		22TCN58-84
7	Required filler quantity which can abshop 15gram-bituminuos at grade 60/70		≥ 40g		NFP 98-256
8	Improvement of BT hardness supported		$10^0 \leq \Delta TNDM$		22TCN279-

No.	Properties	Standards 22TCN345-06 & TCVN 8819:2011			
		Anti Skid A/C surface course	Surface Course	Binder Course	Testing method
	by the filler (discrepancy of liquid BT temperature limit between a mixture of BT and Filler (at rate of 4 and 6 by weight respectively for BT and Filler) and BT grade 60/70 only.		$\leq 20^{\circ}\text{C}$		01

Notes: A<sub>2.5</sub> is retain accumulation on sieve size of 2.5mm

### 3.7 Submittals

#### 3.7.1 General Matters

The Contractor shall submit to the Engineer for his approval the following:

- a) A detailed schedule for materials submissions and testing, the preparation of a job mix design for each type of asphalt concrete layer and the construction of trial sections. This schedule shall be submitted well before the Contractor's programmed start for this work and shall allow for all source materials to be approved prior to the start of job mix design.
- b) Samples of all materials approved for use. These samples will be retained by the Engineer for reference purposes.
- c) A bitumen sample and an appropriate certificate for each delivery of bitumen to the Site subject to approval of the Engineer;
- d) Written reports containing all the test results for each material in accordance with the requirements of subsection 3 Materials for Asphalt Mixtures and subsection 4.5 Manufacture and Production of Asphalt Mixtures of this Specification Section;
- e) A method statement for Asphalt Concrete Binder and Surface Courses;
- f) A written report for all job mix formula together with supporting test data in accordance with the requirements of subsection 4.5 Manufacture and Production of Asphalt Mixtures and subsection 4.9 Placing and Compaction of the Mixture of this Specification Section;
- g) A written report for all surface test measurements in accordance with Subsection 4.10 Quality Control and Testing of this Specification Section;
- h) Written reports on the density of the placed mixtures, as specified in subsection 4.10 Quality Control and Testing of this Specification Section;
- i) Checking the calibration and accuracy of the weigh scales and of the laboratory testing equipment and procedures;
- j) Laboratory and field test data as specified in Subsection 4.10 Quality Control and Testing of this Specification Section for daily control of mix batching and mix quality, in written report form;

- k) Written records of layer thickness and pavement dimension measurements as specified in subsection 4.11 Asphalt Mixture Tolerances of this Specification Section;
- l) In addition, when changing the job mix formula or in any event from time to time as directed by the Engineer, additional samples of (i) to (iv) shall be taken to enable determination of the bulk specific gravity of the hot bin aggregates and the maximum theoretical density of the bituminous mixture (AASHTO T209).

### 3.7.2 Particular Matters

The Contractor may use Novachip technology for the provision of the anti skid asphalt concrete pavement, providing that it complies with the Interim Regulation on Construction Technology and Acceptance for Thin Rough Overlay on Highway issued with Decision No.3278/QD-BGTVT dated 29/10/2008 of MOT.

If the Contractor wishes to avail himself of this option during the construction of the Works he shall make an application to the Engineer to do so. This application shall, inter alia, (1) contain a full specification for the Novachip technology anti skid pavement the Contractor intends to provide, (2) demonstrate that the specification he has chosen for Novachip technology anti skid pavement is equal to or superior to that specified in this Specification Section and (3) contain an undertaking that the Contractor will not seek additional payment for the provision of a Novachip anti skid pavement.

Notwithstanding the Contractor's compliance with the above provisions the Contractor shall not apply the Novachip anti skid pavement unless he has received the express written agreement of the Engineer. The Accepted Contract Amount is deemed to include the anti skid asphalt concrete pavement foreseen in this Specification Section and on the Drawings.

## 4. EQUIPMENT USED FOR ASPHALT MIX WORK

- a) Equipment and plant used for the production, placing and compacting of the asphalt binder and surface courses shall be fit for purpose and in sound condition. All equipment shall be operated by trained and experienced operators and work shall be carried out by skilled and experienced labour.
- b) Unsatisfactory work produced as a consequence of inadequate equipment and labour shall be rejected. Work will not be allowed to proceed until such time as the Contractor provides suitable equipment and experienced labour and operators able to produce satisfactory work in accordance with this specification. In such case the Engineer may at his discretion instruct the Contractor to carry out further trial sections to demonstrate the capabilities of the replacement equipment and labour.

## 4.1 Equipment

The mixing plant of weigh batching type and shall have a capacity sufficient to ensure the finisher(s) can without interruption when spreading the asphalt mix at a normal speed and the required thickness. The plant shall be capable of producing a mixture within the job mix tolerances.

The mixing plant shall be provided with automatic or computer controlled batching systems able to print records for each batch. The plant must comply with applicable environmental standards of Vietnam and the requirements for the Contractor's environmental management plan given in Section 01300 of the Specification.

The Contractor shall ensure that at all times the process of mixing asphalt material is carried out in a safe manner. The Contractor shall provide and maintain adequate fire prevention and control measures and first aid supplies and facilities at the Site of the mixing plant.

The Contractor shall provide safe and secure access to all inspection, sampling and measuring points on the mixing plant and for the sampling and checking of materials contained in the delivery trucks.

### 4.1.1 Equipment

- a) Scales for all weigh boxes or hoppers shall be of; the springless dial type, load cell, or equivalent subject to the approval of the Engineer and shall be of standard make accurate to within 0.5% of the maximum expected load and shall be located so that they are in plain view of the operator at all times. The value of the minimum graduation shall not be greater than one kilogram.
- b) Pointers on dial scales shall be set close to the face of the dial to avoid excessive parallax.
- c) Dial scales shall be provided with adjustable pointers for marking the weight of each material included in the batch.
- d) Scales for weighing the bitumen shall conform to the specifications for scales for aggregate.
- e) The calibration of all scales shall be checked in accordance with the manufacturer's recommendations or, subject to the approval of the Engineer, when it is apparent that the scales are in error. The Contractor shall keep on Site such equipment as may be necessary for calibrating the scales.

### 4.1.2 Equipment for Storage of Bitumen

- a) Tanks for storage of bitumen shall be equipped with heaters with effective and positive control capable of keeping the bitumen within the temperature range specified at all times.
- b) The circulating system for the bitumen shall be capable of ensuring proper and

continuous circulation during the entire operating period. Suitable means shall be provided, either by steam jackets or other insulation, for maintaining the specified temperature of the bitumen in the pipe lines, meters, weight buckets, spray bars, and other containers in the flow lines. Subject to the approval of the Engineer, bitumen may be partially heated in the tanks and brought to the specified temperature by means of booster heating equipment between the tanks and the mixer.

- c) The total storage of the tanks shall be sufficient to provide 10 hours of full operation of the asphalt mixing plant. If more than one storage tank is used, they shall be so connected to the circulatory system that each tank can be isolated without interference to the circulation of bitumen to the mixer.

#### 4.1.3 Bins

The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity.

- a) Bins shall be divided into at least four compartments and shall be arranged to ensure separate and adequate storage of appropriate sizes of the aggregate excluding mineral filler.
- b) Each compartment shall be provided with an overflow pipe that shall be of such size and at such location as to prevent any backing up of material into other bins.
- c) Bins shall be so constructed that the gates do not leak and samples can be readily obtained.

#### 4.1.4 Feeder for Drier

- a) A separate feeder shall be provided for each aggregate to be used in the mix.
- b) The walls to the cold feed bins shall be of sufficient height and width to prevent intermingling of materials from adjacent bins.
- c) All feeders shall be calibrated and the gate opening and speed settings for each approved job mix clearly indicated on the gates and on the plant control panel. Once established the feeder settings shall not be altered without the approval of the Engineer.
- d) A system of “No Flow” switches shall be installed on each aggregate feeder to stop the plant if no material is flowing from the feed bin after 30 seconds.

#### 4.1.5 Drier

A rotary drier of any satisfactory design for drying and heating the mineral aggregate shall be provided.

#### 4.1.6 Screen

Screens shall ensure that the aggregate deposited in any bin shall not contain more than 1.0 percent of oversized or undersized materials.

#### 4.1.7 Weigh Box or Hopper

- a) The equipment shall include a means to accurately weigh each aggregate size and be large enough to hold a full batch without hand raking or running over.
- b) There shall be sufficient clearance between hoppers and their supports to prevent accumulations of foreign materials.
- c) The discharge gate of the weigh box shall be so hung that the aggregate will not be segregated when dumped into the mixer and shall close tightly when the hopper is empty so that no material is allowed to leak into the batch being mixed during the process of weighing aggregate for the next batch.

#### 4.1.8 Mixer

- a) The batch mixer shall be of a twin pug mill type.
- b) The mixer capacity shall be not less than a one ton batch and shall be so constructed as to prevent leakage of contents. If not enclosed the mixer box shall be equipped with a dust hood to prevent loss of dust by dispersion.
- c) The design shall permit visual inspection of the mix.
- d) It shall be heat jacketed with steam, hot oil, or other means subject to the approval of the Engineer.
- e) The mixer shall have an accurate time clock to control the operation of a complete mixing cycle and shall be capable of locking the weigh box gate between the charging of the mixer and the closing of the mixer gate at the completion of the cycle.
- f) Timing control shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles of up to 3 minutes. A mechanical batch counter shall be installed as a part of the timing device.
- g) The mixer blades clearance shall have a clearance from all fixed and moving parts not exceeding 2 cm.

#### 4.1.9 Bituminous Control Unit

- a) The metering device shall be designed and constructed to automatically measure the required amount of liquid asphalt into each batch within a tolerance of 0.4%.
- b) The meter shall have a capacity of at least 10% in excess of the volume of bitumen used in any batch.
- c) If an automatic volumetric meter is used it shall be constructed so that any dial

setting may be locked and it will automatically reset after the addition of bitumen into each batch.

#### 4.1.10 Thermometric Equipment

- a) An armored thermometer reading from 100°C to 200°C shall be fixed in the bituminous feed line at a suitable location near the discharge valve into the mixer unit.
- b) A thermocouple or resistance bulb shall be mounted near the bottom of the fine aggregates bin to measure the temperature of the material before it enters the mixer.
- c) The thermocouple used for discharge and for the fine aggregate bin shall be wired to a temperature recording apparatus. Charts showing time and temperature from the temperature recording device shall be provided to the Engineer daily.
- d) The plant shall be further equipped with either an approved dial scale mercury thermometer or an electric pyrometer or other approved thermometric instrument at the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates.
- e) The burner to the drier for aggregates shall be equipped with automatic temperature controls.

#### 4.1.11 Dust Collector

The plant shall be equipped with a dust collector capable of storing dust to be disposed of as waste or returning dust uniformly to the elevator.

#### 4.1.12 Control of Mixing Time

The plant shall be equipped with a positive means to control and consistently maintain the mixing time unless a change to the timing has been approved by the Engineer.

#### 4.1.13 Electronic Weight System with Automatic Ticket Print Out

##### a) General

The asphalt plant shall be equipped with electronic weight systems capable of automatically printing a delivery ticket. The ticket shall contain the information below as a minimum, subject to the approval of the Engineer and a copy of each ticket shall be provided to the Engineer.

- i) Sequential load number,
- ii) Date and time,
- iii) Name or location of plant,
- iv) Type of mix,
- v) Truck number,

- vi) Gross, tare, net weight or batch weight (as applicable),
  - vii) Accumulated total of mix (for that day, the year to date or total for job subject to the approval of the Engineer),
  - viii) Temperature of mix at the plant and site (may be hand recorded),
  - ix) Pavement layer,
  - x) Location (chainage or station) of placing mix,
  - xi) Signatures subject to the approval of the Engineer.
- b) Automatic Printer System for Batch Plant
- i) The batch plant's automatic printer system shall print the individual weight of aggregate and bitumen delivered to the pug mill and the total weight of batches contained in a truckload.
  - ii) The automatic printer system shall be used only in conjunction with automatic batching and mixing control systems which have been approved by the Engineer.
  - iii) In the event of a printer or other equipment failure the approval of the Engineer will be required for the delivery hot mix to Site. In no case shall this continue for more than 12 hours.
- c) Truck Scales Weight House
- The weight house shall be of sufficient size, shall be completely enclosed and weatherproof and shall be equipped with air a conditioner/heater.

#### 4.1.14 Accessibility

- a) Access shall be provided to all sampling, measuring and inspection points on the mixing plant.
- b) Access to the top of truck bodies shall be provided by means of a platform built to the length and height of the truck's dump body to enable the Engineer to obtain samples and mix temperatures.
- c) The Contractor shall provide all necessary facilities to enable the safe collection and lifting of samples and the safe collection of other data as necessary from all sampling, measuring and inspection points on the mixing plant.
- d) Ample and unobstructed space shall be maintained at all times in and around the truck loading space and this space shall be kept free from materials spills and other waste materials.

## 4.2 Hauling Equipment

- a) Trucks for hauling bituminous mixtures to Site shall have tight, clean and smooth metal beds that have been sprayed with a minimum amount of soapy water, vegetable oil, or lime solution to prevent the mixture from adhering to

the beds. Fuel or oil shall not be used for this purpose.

- b) Any truck which due to its condition causes excessive segregation of material, spills materials or has leaks of oil or other fluids detrimental to the work not be used for the hauling bituminous mixtures until such conditions have been corrected.
- c) All loads shall be covered with a canvas or other suitable material sufficient to entirely cover the mixture and protect it from the weather. The cover shall be securely fixed to the truck body during hauling.

#### **4.3 Spreading and Finishing Equipment**

- a) Paving equipment for the spreading and finishing of asphalt layers shall be approved mechanical, self powered pavers, capable of spreading and finishing the mixture true to the lines, grades, levels and cross sections given on the Drawings or as subject to approval by the Engineer.
- b) The pavers shall be equipped with screed controls which can be adjusted for manual, semi automatic and fully automatic operation to ensure that a smooth asphalt surface can be placed within the required tolerances regardless of irregularities in the surface being paved. The screed controls shall be capable of detecting the required grades and levels from either a taut piano wire guideline or a sliding ski of a sufficient length and subject to the approval of the Engineer.
- c) Pavers shall be equipped with activated screeds of either the tamping or vibrating type and devices for heating the screeds to the temperature required for the laying of the mixture without tearing, pulling, shoving or gouging the mixture.

#### **4.4 Compacting Equipment**

- a) The Contractor shall provide equipment capable of compacting asphalt mixtures to the requirements of subsection 4.5 Manufacture and Production of the Asphalt Mixture and 4.9 Placing and Compaction of the Mixture of this Specification Section. The Contractor shall provide the following minimum equipment for each paving operation:
  - (i) One tandem steel wheel roller for breakdown rolling weighing 4.5 to 11 tons.
  - (ii) One pneumatic tired roller for secondary rolling weighing 5 to 11 tons.  
This roller will have at least 7 smooth tread tires of equal size and diameter.
  - (iii) One tandem steel wheel roller for finish rolling weighing 7 to 11 tons.
- b) All rollers shall be equipped with a watering system to prevent sticking of the asphalt mixture to the pneumatic or steel wheels.
- c) All rollers must be self propelled.

- d) The Contractor may use less compaction equipment or other equipment types subject to their use in satisfactory trial sections completed to the approval of the Engineer.
- e) The method for compaction of the surface course shall be confirmed by the results of compaction obtained in the trial sections. Compaction shall be based on the following two methods:
  - (i) Two or three passes of tandem steel wheel rollers only with a weight of 6 to 10 tons;
  - (ii) Two stage compaction methods specified in The Policy for A/C Surface Courses, Japan Road Association (JRA). First Stage: steel wheel rollers weighing 8 to 11 tons; and Second Stage: tandem pneumatic tired rollers of 7 to 11 tons.

## **4.5 Manufacture and Production of Asphalt Mixtures**

### **4.5.1 Asphalt Mixture Types**

The type of hot asphalt mixture shall be as indicated on the Drawings or as directed by the Engineer.

Table 4: Asphalt Mixture Types

Anti skid asphalt concrete surface layer	The top layer of pavement that comes into contact with the traffic.
Asphalt Concrete surface course (Fine aggregate)	The layer lies between the anti-skid asphalt concrete layer and the binder course laid on a tack coat sprayed on the binder course.
Asphalt Concrete binder course (Coarse aggregate)	The layer laid on the crushed aggregate base course sprayed with a prime coat.

#### 4.5.2 Required Mix Properties

- a) The bituminous mixture shall conform to the requirements given in Table 5 and Table 6.

Table 5. Properties of Bituminous Mixture

Properties		Binder course	Surface course
% Asphalt cement of total mix by weight (%)	Min.	4,8%	5,2%
	Max.	5,8%	6,2%
Asphalt cement to be absorbed	Max.	1,7%	1,7%
Marshall specimen			
Number of compaction blow on specimen's surface	Min.	75	75
Stability	Min.	8,0KN	8,0KN
Flow	Min.	2mm	2mm
	Max.	4mm	4mm
Residual voids	Min	3%	3%
	Max	6%	6%
Retained Marshall Strength (AASHTO-T165)	Min.	75%	75%
Aggregate voids (corresponding to Residual voids) (%)	Min.	13	15

Marshall specimen shall have flow value equal to 70% of its asphalt cement and have a minimum elongation of 40cm according to AASHTO-T49 and T51.

Asphalt cement shall be separated from the mixture in accordance with AASHTO T-164. The fine fraction shall be separated by centrifuge from a condensed volume of 200ml. The separation of fine fraction shall be considered acceptable when dust content (by burning) of total collected asphalt cement is less than 1 % by weight. Asphalt cement shall be collected in accordance with AASHTO-T170.

Table 6. Properties of Bituminous Mixture (Table 6 of Vietnamese Standard 22TCN345-06)

No.	Properties	Anti-skid A/C Surface layer	Testing method
1	Number of compaction blow	50x2	AASHTO T245-97 (2001)
2	Stability at 60 <sup>0</sup> C, kN	Min. 6	
3	Flow, mm	2 – 4	
4	Residual stability (having soaked at 60 <sup>0</sup> C for 24 hour) comparing with initial stability, %	Min. 75	
5	Air Voids, %	12 – 16	AASHTO T269-97
6	Aggregate Voids, %	Min. 22	
7	Draindown Characteristic, %	Max. 0.2	AASHTO T305-97
8	Asphalt content of total mixture by weight, %	4.8 – 6.2	AASHTO T164-01

#### 4.6 Job Mix Formula

- The Contractor shall submit all proposed job mix formulae to the Engineer for approval well before work is programmed to start on Site.
- For each proposed job mix the formula shall stipulate; the aggregate source, a combined grading showing the percentage of each material to be used in the mix expressed as percentages by weight of the total mix, the temperature at which the mixture is to be emptied from the mixer and the temperature at which the mixture is to be delivered at the laying site. These parameters shall fall within the specified ranges of the general composition and temperature limits.
- Each proposed job mix formula shall be supported by laboratory trial mix testing data. In approving the job mix the Engineer may request the Contractor to perform additional trial mix tests or to investigate alternative aggregates.
- Approval of proposed job mix formulae shall subsequently be confirmed by the preparation and testing of trial sections as specified in subsection 4.7 of this Specification Section.

##### 4.6.1 Aggregate Component Proportions

Aggregate for hot asphalt mixtures shall conform to Table 7 and Table 8 and be subject to approval by the Engineer.

Table 7: Aggregate for asphalt (Table No. 1 of Vietnamese Standard TCVN 8819:2011)

Sieve Size (mm)	Percent Passing by Weight			
	Surface Course		Binder Course	
	MIN.	MAX.	MIN.	MAX.
25,000				
19,000	-	-	100	100
12,500	-	-	90	100
9,500	100	100	71	86
4,750	90	100	58	78
2,360	55	80	36	61
1,180	36	63	25	45
0,600	25	45	17	33
0,300	17	33	12	25
0,150	12	25	8	17
0,075	9	17	6	12
	6	10	5	8

Table 8: Aggregate Proportion for Anti Skid Asphalt Concrete Surface Layer (Table No.5 of Vietnamese Standard 22TCN345-06)

Square mesh sieve size	Roughness course
25	
19	
12.5	100
9.5	80 – 100
6.3	35 – 60
4.75	22 – 40
2.36	20 – 36
1.18	12 – 27
0.6	8 – 17
0.3	6 – 13
0.15	
0.075	4 – 8

#### 4.6.2 Mineral Filler Content

- Mineral filler (particles passing the sieve No.200) may be added to the nominal mix to meet the criteria contained in this Specification Section, subject to approval by the Engineer.
- On no account shall the ratio of filler to total bitumen exceed 1:1 for Asphalt Concrete Surface Course and 1:4 for Asphalt Concrete Binder Course.

- c) If the mix strength does not meet the specified requirements with a filler/bitumen ratio within these ranges the strength shall be adjusted by changing the aggregates.

#### 4.6.3 Bitumen Content of the Mix

- a) The laboratory trial mixes shall be prepared according to Marshall Mix Design procedures.
- b) For each mix variant to be tried, at least three samples shall be prepared and tested by the Marshall testing method and the mix properties of each trial shall be calculated on forms subject to approval by the Engineer.
- c) The Contractor may optimize the mix proportions for economic reasons provided the bitumen content is within the allowable limits specified in Tables 5 and 6 of subsection 4.5.2 of this Specification Section.
- d) The percentage of bitumen actually added to the mix will depend on the percentage absorbed by the aggregates. The estimated amount of bitumen absorbed by the combined aggregates in the nominal mix will be assumed to be 50% of the measured water absorption. The value of the measured water absorption will be based on test data supplied by the Contractor. The absorbed bitumen so calculated shall be taken into consideration in establishing the total bitumen content for the trial mixes which shall be not less than the minimum value specified in Tables 7 and 8 and shall be subject to approval by the Engineer.

#### 4.6.4 Application of Job Mix

- a) Formula and Allowable Tolerance:

All mixtures supplied to the Site shall conform to the job mix formulae approved by the Engineer subject to the tolerances specified below:

Table 9. Asphalt binder and surface layers.

Passing aggregate mixture 12,5mm and more	+/- 8% according to mixture weight
Passing aggregate mixture 9,5mm and 4,75	+/- 7% according to mixture weight
Passing aggregate mixture 2,36mm and 1,18mm	+/- 6% according to mixture weight
Passing aggregate mixture 0,6mm and 0,3mm	+/- 5% according to mixture weight
Passing aggregate mixture 0,15mm and 0,075mm	+/- 3% according to mixture weight
Asphalt content tolerance	0.2% according to total mixture quantity
Temperature tolerance of mixture at the plant	+/- 10 °C
Temperature tolerance of mixture when laying	+/- 10 °C

Table 10. Allowable Tolerances for the Manufacturing of Anti Skid Asphalt Concrete Surface Layer (Table Nos. 7 & 8 of Vietnamese Standard 22TCN345-06)

Criteria		Allowable Tolerance
Aggregate		
Sieve Passing (mm)	- 12.5	0%
	- 9.5	± 5%
	- 6.3; 4.75; 2.36	± 4%
	- 1.18; 0.6; 0.3	± 3%
	- 0.075	± 2%
Difference sieve passing of two sieve sizes 4.75mm and 2.36mm ≤ 4%		
Asphalt content		± 0.2%
Mixture temperature (°C)(approved temperature shall be based on data provided by the polymer asphalt manufacturer and approved by the Engineer)	Mixing asphalt concrete in hot bin at the plant	
	Discharge mixture from hot bin to the truck	
	Unloading mixture from the truck to paver	
	Paving mixture	
	Compaction	
	<ul style="list-style-type: none"> <li>- Starting</li> <li>- Finishing</li> </ul>	
	Specimen testing	
		<ul style="list-style-type: none"> <li>- Mixing Marshall Mix Specimen</li> <li>- Compacting Marshall Mix Specimen</li> <li>- Marshall separation</li> </ul>

b) Continuous Control:

Samples shall be taken of the materials and mixture each day as outlined in subsection 4.10 Quality Control and Testing of this Specification Section or as considered necessary by the Engineer for checking the required uniformity of the mixture.

4.6.5 Adjusting Mix Proportions by Trial Mixes

- a) The Contractor shall demonstrate the suitability of all proposed job mix formulae by making and testing trial mixes in the Laboratory and by testing trial mixes in the mixing plant immediately prior to laying of the mix.
- b) Laboratory trial mix testing shall be carried out in accordance with the Marshall Mix Design method defined by AASHTO or in the Asphalt Institute Manual MS-2.
- c) A nominal mix recipe appropriate to the proposed theoretical job mix formulae shall be determined. The nominal aggregate blending proportions, bitumen content and added filler content shall be used as the basis for the mix variations investigated in the laboratory trials.
- d) The calculation of the nominal mix batching recipe from the design mix components shall be recorded as directed by the Engineer.

- e) Trial mixes shall be made under the same conditions as those applied in the mixing plant immediately prior to batching. For weigh batching plants, this means using aggregate samples taken from the plant hot bins.
- f) Job mix formulae confirmed by laboratory trials shall be submitted to the Engineer for his approval.
- g) Should a change in a material be encountered or should a change in a source of material be made a new job mix formula shall be submitted and approved before the mixture containing the new material is produced and delivered. Job materials will be rejected if they are found to have voids, or other characteristics, requiring greater bitumen content or less than the specified range.

#### **4.7 Trial Section**

- a) Following approval of the proposed job mix formula by the Engineer the Contractor shall carry out a trial section for each pavement layer in accordance with his proposed method statement.
- b) The test section shall allow the laying of at least 100m in length and of at least 02 strips of spreader in width after the paver has reached a stable condition and shall be in a location subject to the approval of the Engineer. The trial section may be included in the permanent works subject to satisfactory testing and subject to the approval of the Engineer.
- c) The trial section shall be tested in detail and in accordance with the requirements of this specification.
- d) If the trial section fails to conform to the Specification in any respect, necessary adjustments shall be made and the trial repeated. Permanent paving work shall not commence until a satisfactory trial has been made and the Engineer has approved the final job mix formula. Where an unsatisfactory trial section has been laid in the area of the permanent works it shall be removed entirely and the surface on which it was laid shall be reinstated to the satisfaction of the Engineer all to the cost of the Contractor.
- e) Testing for acceptance of trial sections for the surface course shall include measurements of the International Roughness Index (IRI) along several sections in order to determine the representative average index of the entire trial section.

#### **4.8 Production of Mixture**

##### **4.8.1 Minimum Rate for Mixing Plant Capacity**

There shall be no batching when there is insufficient hauling, or spreading, or finishing equipment, or labor to assure progress at a rate of not less than 60 percent

of the capacity of the mixing plant.

#### 4.8.2 Preparation of Bitumen

- a) The following temperatures shall be applied:

Table 11. Temperatures for Preparation of Bitumen

	60/70 Bitumen	PMB (Polymer Modified Bitumen)
Bulk Storage	120 °C - 130 °C	Specified temperature shall be based on data provided by the polymer asphalt manufacturer subject to approval by the Engineer (Table No.8. 22TCN345-06)
Mixing Temperature	150 °C - 160 °C	
Laying Temperature	130 °C - 140 °C	

- b) Where bitumen is kept in bulk storage for periods exceeding 8 hours before use storage temperature may be reduced to 30 °C - 40 °C.
- c) Local overheating shall be avoided and the bitumen shall be continuously fed to the mixer at a uniform temperature.
- d) There shall be at least one full day's supply of heated bitumen ready for supply to the mixer before any mixing operation begins. However, bitumen shall not be stored for a period longer than 30 days between manufacture and placing.

#### 4.8.3 Preparation of Mineral Aggregates

- a) Mineral aggregates for the mixture shall be dried and heated. Burner flames shall be adjusted to avoid damaging the aggregate and to avoid forming a coating of soot on the aggregate.
- b) At the time of mixing with bitumen the aggregate shall be dry and within the temperature range specified for the bitumen but not more than 14 °C above the temperature of the bitumen.
- c) Additional mineral filler, if required to meet the grading requirements, may be added separately from a small hopper mounted directly over the mixer.

#### 4.8.4 Preparation of Mixture

- a) The combined mineral aggregate shall be thoroughly mixed before the bitumen is measured and introduced into the mixer.
- b) The “dry” and “wet” mixing times of shall be subject to the approval of the Engineer and regulated by a suitable timer.
- c) The temperature of the mixture when emptied from the mixer shall be within the limits indicated in Table 12. No tolerance shall be permitted.

Table 12: Specified Limits for Bitumen Asphalt Mix Temperatures

Construction Procedures	Asphalt Mix Temperature (°C)
-------------------------	------------------------------

	Mixes Using AC-20 Bit. (Approx. equiv. to 60/70 Pen)	Mixes Using PMB. (Approx. range 40 to 70 Pen)
Mixing Marshall Mix Specimen	155	160
Compacting Marshall Mix Specimen	140	150
Maximum Mixing Temperature	< 165	< 170
Discharging mix into Truck	> 135	> 140
Delivery to Paver	150 – 120	155 – 130
Breakdown Rolling (Steel Drum)	125 – 110	135 – 90
Secondary Rolling (Rubber Tire)	110 – 95	135 – 90
Finishing Rolling (Steel Drum)	95 – 80	100 – 85

#### 4.8.5 Transportation and Delivery to Site

- a) The mixture shall be delivered to the paver at the temperature indicated in Table 12 above.
- b) The Contractor shall obtain the written approval of the Engineer whenever it is needed to send the material to carry out the spreading and the compaction works out of the normal working hours.

### 4.9 Placing and Compaction of the Mixture

Placing and compaction of the asphalt layers shall be carried out using the methods and procedures used for the approved trial sections.

#### 4.9.1 Preparation of Surface to be Covered

- a) The surface to be covered shall meet the requirements of Specification Section 06100 Prime Coat and Tack Coat, as applicable.
- b) Immediately before placing the bituminous mixture the surface shall be cleaned of loose or deleterious material.
- c) If rain commences at the paving location during the paving operation the batching and lying of further material shall cease until the rain stops. Subject to the approval of the Engineer, material already batched and loaded may be delivered and placed provided that there is no freestanding water on the surface to be paved.

#### 4.9.2 Spreading and Finishing

- a) Before the start of paving operations the screed of the paver shall be heated to the correct working temperature.
- b) Care should be taken to prevent the mixture from collecting and cooling at the sides of the hopper or elsewhere in the paver.
- c) The paver shall be operated at a speed which does not cause surface cracks,

tearing, or any other irregularities in the surface.

- d) If any segregation, tearing or gouging of the surface occurs the paver shall be stopped and the cause determined and remedied before paving restarts. Patches of rough or segregated material may be corrected by spreading fines and gentle raking, however raking shall in general be avoided.
- e) General correction to the surface by the spreading or casting of material shall not be permitted.
- f) The maximum depth of a single layer of Asphalt Binder or Surface Course shall not be greater than 8 cm subject to the approval of the Engineer.

#### 4.9.3 Compaction

##### Asphalt Binder and Surface Courses

- a) Compaction shall be in accordance with the Contractor's approved method statement confirmed by the completion of satisfactory trial sections and is expected to be within the requirements given below.
- b) Immediately after the mixture has been spread and struck off the surface shall be checked and any inequalities adjusted. The temperature of the loose laid mix shall be monitored and rolling shall be carried out within the temperature limits given in Table 5 above.
- c) It is expected that rolling of the mix shall consist of three separate operations as follows:

	<u>Time after laying</u>
Preliminary rolling	0 - 10 min
Secondary or intermediate rolling	10 - 20 min
Final or finish rolling	20 - 45 min

- d) The preliminary rolling and the final or finish rolling shall be carried out with steel wheeled rollers. The breakdown roller shall operate with the drive roll nearest the paver.
- e) The secondary or intermediate rolling shall be carried out with a pneumatic tired roller rolling and shall follow as closely as practical behind the breakdown rolling.
- f) The initial transverse joint shall be rolled first in a transverse direction using boards of the required thickness at the edge of the pavement to provide for off the pavement movement of the roller. Where the initial transverse joint is to be made next to a previously paved lane, the first pass shall be made for a short distance along the longitudinal joint.
- g) Rolling shall be carried out longitudinally and parallel with the road centerline starting at the joint followed by the outside edge and subsequently moving

towards the center of the pavement. However on super elevated sections rolling shall begin at the low side and progress toward the high side. Successive passes of the roller shall overlap by at least one half of the width of the roller and passes shall not terminate at points within one meter of the end points of previous passes.

- h) The speed of the rollers shall not exceed 4 kilometers per hour for steel wheeled rollers and 15 kilometers per hour for pneumatic tired rollers. There shall be no sudden changes in direction or reversals in the line of rolling.
- i) Rolling shall progress continuously while the mixture is in workable condition to obtain uniform compaction and until all roller marks and other irregularities are eliminated.
- j) The roller wheels shall be kept properly moistened to prevent adhesion of the mixture. Excess water shall not be permitted.
- k) Heavy equipment or rollers shall not be permitted to stand on the finished surface until it has thoroughly cooled and set.
- l) Pavements contaminated by spills or leaks of any petroleum products from the Contractor's equipment shall be removed and replaced at the Contractor's expense, subject to the approval of the Engineer.
- m) Surfaces after compaction shall be smooth and true to the required lines levels and grades. Any high spots, high joints and depressions shall be corrected in accordance with methods approved by the Engineer.
- n) Surfaces that are loose, broken or contaminated or which are defective in any way, shall be removed and replaced with fresh hot mixture, which shall be compacted immediately to conform to the surrounding area.
- o) All edges shall be trimmed neatly to line while the surface is being compacted and finished. Any excess material shall be cut off square after final rolling.
- p) 150 millimeter diameter core samples shall be taken from the compacted pavement according to Method B, AASHTO T230. Core holes shall be filled with asphalt concrete and duly compacted immediately after core extraction is completed. The cores shall be used for routine testing to monitor specific gravity; thickness; compaction; bituminous content; particle composition and such other tests as may be approved by the Engineer. Compaction shall be not less than 98 percent of the density of laboratory compacted specimens composed of the same materials

#### 4.9.4 Compaction

Anti skid Asphalt Concrete Surface Course: Material workmanship and testing for the layer shall comply with requirements in Vietnamese Standard 22TCN319-04 "Polymer Asphalt - Technical Requirement and Testing Method."

Additional particular requirements for the roughness layer are given below.

- a) The optimal number of passes for compaction shall be determined from the results of compaction of the trial sections. However it is expected that compaction will be by at least two roller passes using only tandem steel wheel rollers.
- b) Crushing or breaking of aggregate particles during compaction shall not be permitted.
- c) Cooling with water will not be permitted;
- d) Additional equipment and tools for keeping the steel wheel rollers permanently clean shall be provided until completion of compaction work.
- e) After compaction has been completed all traffic or load application on the paved surface will not be permitted at least during 24 hours.

#### 4.9.5 Joints

- a) Both longitudinal and transverse joints in successive courses shall be staggered.
- b) Longitudinal joints shall be arranged so that the final longitudinal joints in the top surface shall be at the location of the line dividing the traffic lanes.
- c) Transverse joints shall be staggered by a minimum of 25 centimeters.
- d) Previously completed surfacing at all joints shall be cut back to a vertical face. A brush coat of prime coat shall be applied to the cut vertical face before the adjacent surface is laid.

#### 4.9.6 A/C Surface Course for Bridges

The Asphalt Concrete Surface Course for bridges shall be placed in one or two layers based on the finishing conditions of the concrete slab and subject to the approval of the Engineer.

### 4.10 Quality Control and Testing

#### 4.10.1 Mixture Sampling and Quality Control

The following samples of shall be taken daily at the mixing plant subject to the approval of the Engineer. Records of all daily sampling and testing shall be kept and submitted to the Engineer on the following day.

Table 13. Mixture Sampling and Quality Control

Samples from		Frequency
Each cold bin	Grading by wash method	2 times a day
Hot bin aggregates		
Combined aggregate		
	Temperature	once per hour

Loose bituminous mixture	Extraction of bitumen (AASHTO T164)	every 200 tons
	Grading	
Compacted sample At Plant lab.	Marshall Stability	
	Density	
Mixture from Mixer	Temperature	once per hour / truck

Bitumen content and the Marshal Stability Test shall be determined from samples taken at the mixing plant and before compaction. Core samples shall not be used.

#### 4.10.2 Testing Frequencies

Testing frequencies shall be in accordance with Vietnamese Standard: 22TCN 356-06; TCVN 8819:2011; 22TCN 345-06 or other international standard subject to equivalence being demonstrated by the Contractor to the satisfaction of the Engineer:

Table 14. Frequency of Tests

Item	Test Description	Test Frequency	Remark
1	22TCN 356-06: Polymer asphalt concrete surface - Code of Execution and Acceptance Procedure.		
a	Material testing & preparation work before construction: (for material & quarries approval)		
	Article 7.3.1		
	+ Crushed aggregate, sand, fine sand, filler for polymer asphalt		
	+ For polymer Bitumen		
	Article 7.3.2	Table 9	
b	During construction period:		
	Article 7.4 : At asphalt mixing plant :	Table 10	
	Article 7.5 : During construction period	Table 11	
c	After construction period: (For acceptance of construction works)		
	Article 7.6 : After construction period (for acceptance)	Table 12	
2	TCVN 8819:2011: Asphalt Concrete Pavement – Specifications for Construction and Acceptance.		
a	Material testing & preparation work before construction: (for material & quarries approval)		
	Article 9.2 : Check the site before construction		
	Article 9.3.1 : Material testing before deliver to construction site		
	Article 9.3.2 : Material testing during production of Asphalt concrete mixing	Table 10	
	Article 9.4 : Checking at mixing plant	Table 11	
b	During construction period:		

	Article 9.5 : Checking during construction period	Table 12	
c	After construction period: (For acceptance of construction works)		
	Article 9.6		
3	22TCN 345-06 : Standard Specification for Thin Covering Layer of High Roughness Asphalt Concrete - Code of Construction and Acceptance Standard		
a	Material testing & preparation work before construction: (for material & quarries approval)		
	Article 6.3.1		
	+ Crushed aggregate, sand, fine sand, filler for polymer asphalt		
	+ For polymer Bitumen		
b	During construction period:		
	Article 6.3	Table 9	
	Article 6.4	Table 10	
	Article 6.5	Table 11	
c	After construction period: (For acceptance of construction works)		
	Article 6.6		

#### 4.10.3 Surface Test of the Pavement

During and after final rolling, the smoothness of the course shall be checked and any irregularity of the surface exceeding the limits and any area defective in texture, compaction or composition shall be corrected.

Within 14 days of completing the surface course, the roughness of the surface shall be measured. For this purpose the Contractor shall provide equipment similar or equivalent to a multi purpose profiling system (including all necessary ancillary equipment, hardware and software) for calculation of the International Roughness Index (IRI).

The Benkelman Beam Method shall be used to check the designed elastic modulus of the pavement structure in accordance with TCVN8867-2011.

#### 4.10.4 Core Sampling of the Pavement at Site

The Contractor shall take core samples at Site after the compaction of Asphalt Concrete. The spacing and location of the cores in any section shall be subject to the approval of the Engineer and in accordance with requirements of this Specification Section. The method of sampling shall be in accordance with AASHTO T168.

### 4.11 Asphalt Concrete Tolerances for Acceptance

Acceptance of surface course and binder course shall be based on the total evaluation results of the items shown in Table 15, which shall be certified through

quality control and acceptance test process.

Lot size shall be proposed by the Contractor's QC plan.

Table 15: Tolerances of Items

Parameters	Binder Course	Normal Surface	Anti-skid A/C surface
Center-side Location	± 10 mm	± 5 mm	
Surface levels	± 5 mm	± 5 mm	
Width	± 20 mm	± 10 mm	
Thickness by Site Core Sample	± 8mm	± 5mm	-2mm
Density by Site Core Samples** (AASHTO T166)	Min. 98%	Min. 98%	Min. 98%
Density by Plant Samples**	100%±4%	100%±3%	100%±5%
Marshal stability by Plant Sample**	100%± 8%		
Bitumen Contents by Plant Sample **	± 0.3%	± 0.3%	± 0.3%
Surface Irregularity by 3m straight edge	± 5 mm	± 3 mm	
IRI values ( m /km)		Max. 2.00	
Permeability (cm/sec)			Min. 0.01

\*\* means the basic value shall be taken as that confirmed by the Contractor in trials subject to the approval of the Engineer.

#### 4.12 Rectification of Unsatisfactory Asphalt Mixtures

Areas of unsatisfactory binder or surfacing course will not be paid for until rectified by the Contractor. Rectification may include removal and replacement of the layer, adding of a supplementary layer or any other measure, which may be necessary subject to the approval of the Engineer. No payment will be made for any additional work necessary to correct the unsatisfactory work.

All holes made as a result of taking cores or other test procedures shall be filled with asphalt concrete without delay and compacted to the density and surface tolerance requirements of this specification all at the Contractor's own cost.

### 5. MEASUREMENT AND PAYMENT

#### 5.1 Method of Measurement

- a) Asphalt Concrete Courses shall be measured for payment in square meters from the Drawings or the Contractor's approved shop drawings upon acceptance of the work by the Engineer. The measurement shall be conducted on plan over the top surface of the Binder and Surface Courses. The area of the Binder and Surface Courses, which form a triangle along the side of the Binder and Surface Courses shall not be measured for payment; the cost of the work in the triangles shall be deemed included in the unit rates.

- b) The Asphalt Concrete Binder and Surface Courses provisions, material for asphalt mixtures and equipment used for asphalt mix work identified in this Specification Section shall be measured for payment in pay items 06200-01, 06200-02, 06200-03, 06200-04 and 06200-05.
- c) Any Asphalt Concrete Binder and Surface Courses Works not specifically identified in this Specification Section but which are necessary for the performance of the Works shall be deemed to be included in pay items 06200-01, 06200-02, 06200-03, 06200-04 and 06200-05.

## 5.2 Basis of Payment

The work under this Specification Section shall be paid for in accordance with the applicable unit prices as indicated in the Bill of Quantities and given below. Payment shall constitute full compensation for performing the requirements of the Contract for the items of work specified including furnishing all necessary labor, materials, tools, equipment and incidentals including furnishing, producing, mixing and placing all materials, tests and trial sections, and for furnishing all labor, materials, tests, tools, equipment and any incidentals to complete the work as shown on the Drawings and as required by this Specification Section, and/or as directed by the Engineer.

Payment for the Asphalt Concrete Surface Course for bridges shall be deemed to include all the necessary requirements to keep the waterproof membrane (measured separately) applied to the concrete surface of the deck free from damage during all surfacing work.

<u>Pay Item</u>	<u>Description</u>	<u>Unit</u>
<b>06200</b>	<b>Asphalt Concrete Binder and Surface Courses</b>	
06200-01	Anti Skid Asphalt Concrete Surface Course, thickness=3cm	m <sup>2</sup>
06200-02	Asphalt Concrete Surface Course, thickness =5cm	m <sup>2</sup>
06200-03	Asphalt Concrete Binder Course, thickness =7cm	m <sup>2</sup>
06200-04	Asphalt Concrete Surface Course, thickness=7cm	m <sup>2</sup>
06200-05	Asphalt Concrete Binder Course, thickness =8cm	m <sup>2</sup>