SPECIFICATION FOR BITUMINOUS MACADAM

1. INTRODUCTION:
The Indian Roads Congress published the first specifications for Bituminous Macadam in the year 1967. The Flexible Pavement committee (EPC) in its meeting held on 10th February, 2001 decided to revise the specification to keep pace with the changes in the technology and improvements in the construction procedures as well as quality control expectations. The revised draft was prepared by Shri R.K. Pandey with input from Shri S.C. Sharma and Shri R.S. Shukla. Subsequently, the Flexible Pavement Committee in its meeting held on 22nd April, 2006 authorized Shri R.K. Pandey to finalize the draft with technical input from Prof. P.S. Kandhal. The finalized draft was sent to all EPC members for comments. The EPC in its meeting on 9th September, 2006 discussed all comments in detail. The FPC in its meeting of 5th May 2007 decided to publish the draft in Indian Highways to solicit comments from users at large.

2. SCOPE:
2.1 This specification deals with the basic outline for the design, construction and controls needed while laying bituminous macadam course for highways.

2.2 Bituminous macadam (BM) shall consist of mineral aggregate and appropriate binder, mixed in a hot mix plant and laid with a mechanized paver. It is an open graded mixture suitable for base course. It is laid in a single course or in a multiple layers on a previously prepared base. Thickness of the single layer shall be 50 mm to 100 mm.

2.3 Since the bituminous macadam is an open-graded mixture there is a potential that it may trap water or moisture vapour within the pavement system. Therefore, providing proper drainage outlet to the BM layer should be considered to prevent moisture-induce damage to the BM and adjacent bituminous layers.

Note to reviewers: All italicised comments in parentheses as under are for your information only to explain the revision and will not be part of this specification. These comments have been made by Prof. Kandhal.

Section 2.3 above has been added as a caution to the users of BM. Open graded mixture like the BM have 20-25% air voids and are used in foreign countries only as a drainage layer between sub-base and dense bituminous base course (like our DBM) in the so-called 2-layer drainage system. Since water seeks the least path of resistance, the water from the sub-base enters the drainage layer. Such drainage layers, therefore, are provided with positive drainage such as pavement edge drains or carrying the layer all the way to the edge of the embankment (day lightning). If no drainage is provided to such drainage layers, they act like a bath tub resulting in stripping in this layer as well the bituminous layer above it under the action of traffic. Water can come to this permeable layer through cracks in the top courses, from sides or through capillary action from lower layers, Prof. Kandhal has seen this phenomenon on many projects in the US and other countries while investigating premature failure of bituminous pavements. He has published papers on such failures. Therefore, in his opinion, the BM should not be used even as a profile correction course unless proper outlet is provided to the water, which can potentially accumulate in the BM. The usual reason
SPECIFICATION FOR BITUMINOUS MACADAM

given to use BM is that it is cheaper. That is not a technical reason. It is better to use impervious DBM to ensure better performance rather than the BM. DBM will also have more structural strength compared to open graded BM (in foreign countries the structural strength of BM type open graded mix is considered about half of DBM type dense mix). It is also argued that the BM being open graded resists propagation of reflection cracks. While this is true, the potential for damage from the trapped moisture in the BM is huge. We need a technical discussion on this point because it is a major policy issue. We cannot make a general statement that BM has worked well in the past without investigating and addressing the drainage outlet issue. May be it was an easy-to-produce mix in the past when mechanized hot mix plants were not readily available. Any way, at this point it appears difficult to take it out due to anticipated resistance from users. The least, which should be done is to caution the users about the potential problems associated with the use.

3. MATERIALS:

3.1.1 The bitumen shall be viscosity graded paving bitumen complying with Indian Standard Specification for paving bitumen, IS:73. The grade of bitumen to be used would depend upon the climatic conditions and the traffic. Guidelines for selection of viscosity grade of paving grade bitumen are given in Tables 1.1 and 1.2.

[Comments: BM is an un-designed, recipe type mix used for low traffic roads. It is not technically justified to use any modified bitumen in BM. It will be simply a waste of funds. Even if the BM is used on high traffic roads it will be too much below the road surface and therefore use of modified bitumen is unwarranted and has not been included. Modified bitumen is used to increase the stiffness of mix. BM being an open graded mix has very low stiffness by nature. If we intend to increase its stiffness we might as well use the dense graded DBM instead. Tables 1.1 and 1.2 have been revised to substitute viscosity grades (VG) in lieu of penetration grades.]

3.1.2 Both the highest daily mean air temperature and the lowest daily mean air temperature mentioned in Table 1.2 can be obtained for the weather station nearest to the project site from the Indian Metrological Organization (IMO). The IMO has data on daily mean high temperature for all 365 days in a year for all weather stations based on historical records on the last 30-40 or more years. This daily mean high temperature on a specific day is the same as daily “normal” high temperature for that day as usually reported in some newspapers. The highest of the 365 daily mean high air temperatures (which usually occurs on some day in May or June) is used in Table 1.2. Likewise, the lowest daily mean air temperature (which usually occurs on some day in January) can also be obtained from the IMO. Since these are mean high temperatures based on the average of 30-40 years data, these temperatures are significantly lower than, the absolute maximum temperatures, which may have occurred in a specific year.

Table 1.1 Viscosity Graded (VG) bitumen and their General Applications

<table>
<thead>
<tr>
<th>Viscosity Grade (VG)</th>
<th>General Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>VG-40 (40-60 penetration)</td>
<td>Use in highly stressed areas such as those in intersections, near toll booths, and truck parking toll in lieu of old 30-40 penetration grade.</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR BITUMINOUS MACADAM

Viscosity Grade (VG) | General Applications
--- | ---
VG-30 (50-60 penetration) | Use of paving in most of India in lieu of old 60/70 penetration grade.
VG-30 (50-60 penetration) | Use of paving in most of India in lieu of old 60/70 penetration grade
VG-20 (60-80 penetration) | Use in cold climatic, high altitude regions of North India
VG-10 (80-100 penetration) | Use in spraying applications such as surface dressing and paving in very cold climatic region in lieu of old 80/10 penetration grade

Highest Daily Mean Air Temperature, C

<table>
<thead>
<tr>
<th>Lowest Daily Mean Air Temperature, C</th>
<th>Less than 20 C</th>
<th>20 to 30 C</th>
<th>More than 30 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than -10 C</td>
<td>VG-10</td>
<td>VG-20</td>
<td>VG-30</td>
</tr>
<tr>
<td>-10 C or lower</td>
<td>VG-10</td>
<td>VG-10</td>
<td>VG-20</td>
</tr>
</tbody>
</table>

*Comment: Ideally, selection of bitumen grade should be based on high and low pavement temperatures. However, it will be too complex for the field engineers to convert air temperatures to pavement temperatures. Therefore, from practical considerations selection should be based on air temperatures. In the Super-pave performance grade (PG) system for bitumen, the 7-day maximum pavement temperature (based on more than 20 years’ weather data) in the region is used for high temperature grade. The closest to that approach which we can use in India is the highest daily mean air temperature in the region. This data is available from the India Meteorological Organisation. Fortunately, the highest daily mean air temperature in India (usually in May-June) generally ranges from 31 to 42 C only from Punjab to Kanya Kumari and from Gujarat to Assam. For this range of high temperatures, VG-30 grade is suitable based on experience in other countries. Softer viscosity grades such as VG-20 and VG-10 are recommended for regions with highest daily mean air temperatures of 30 C and lower (such as cold climatic high altitude regions of North India). It is not advisable to use the highest air temperature ever recorded because rutting is not caused during one hot day but during sustained hot days.

The lowest daily mean air temperatures (which are also fairly close to pavement temperature) occur in India in January. They range from -2 C to 21 C from Kashmir to Kanya Kumari. Viscosity graded VG-30 bitumen is suitable down to -10 C (due to its controlled temperature susceptibility). At temperatures lower than -10 C we can use softer grades such as VG-20 and VG-10.

The preceding 2 tables have been formulated in view of the above discussion, Indian Meteorological Organisation climatic data, and practical considerations such as minimizing temperature ranges and viscosity grades.*

3.2 COARSE AGGREGATE:

3.2.1 The coarse aggregate shall consist of crushed rock, crushed gravel or other gravel or other hard material retained on 2.36mm sieve. It shall be clean, hard, durable and cubical shape, free from dust and soft organic and other
specification for bituminous macadam

deleterious substances. The aggregate shall satisfy and physical requirements specified in Table 2.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test</th>
<th>Requirement</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness</td>
<td>Grain size analysis</td>
<td>Max. 5% passing 0.075 micron</td>
<td>IS 2386 Part I</td>
</tr>
<tr>
<td>Particle shape</td>
<td>Flakiness &amp; Elongation Index (combined)</td>
<td>Max. 40%</td>
<td>IS 2386 Part I</td>
</tr>
<tr>
<td>Strength *</td>
<td>Los Angeles Abrasion Value</td>
<td>Max. 40%</td>
<td>IS 2386 Part IV</td>
</tr>
<tr>
<td></td>
<td>Aggregate Impact Value</td>
<td>Max. 30%</td>
<td>IS 2386 Part IV</td>
</tr>
<tr>
<td>Durability</td>
<td>Soundness (Sodium or Magnesium), 5 cycles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium Sulphate</td>
<td></td>
<td>Max. 12%</td>
<td>IS 2386 Part V</td>
</tr>
<tr>
<td>Magnesium Sulphate</td>
<td></td>
<td>Max. 18%</td>
<td>IS 2386 Part V</td>
</tr>
<tr>
<td>Water absorption</td>
<td>Water absorption</td>
<td>Max. 2%</td>
<td>IS 2386 Part III</td>
</tr>
<tr>
<td>Stripping **</td>
<td>Coating and Stripping of Bitumen Aggregate</td>
<td>Min Retained Coating 95%</td>
<td>IS 6241</td>
</tr>
</tbody>
</table>

Note:
* The coarse aggregate may satisfy either of the two strength tests.
** If the coarse aggregate fails this test, 2% hydrated lime shall be used in the mix.

3.2.2 Where crushed gravel is proposed for use as aggregate, not less than 90% by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces resulting from crushing operation.

3.3 FINE AGGREGATE:

Fine aggregate shall consist of crushed or naturally occurring mineral material, or a combination of two, passing 2.36 mm sieve and retained on 75 micron sieve. It shall be clean, hard, durable, free from dust and soft organic and other deleterious substances. The amount of rounded, natural sand in the total fine aggregate shall be limited to 10% if the BM is used within 100mm from the road surface and to 50% if the BM is used more than 100 mm below the road surface.

[Comment: Most agencies in the world limit the amount of natural sand (which has rounded particles) to 50% in the base courses and 10 or 20% in the binder and wearing courses (layers within 100mm of the road surface) to minimize rutting problem. Right now our specification is vogue and one can use 100% natural sand in all courses, which may get us into rutting problems.]

3.4 AGGREGATE GRADING AND BITUMEN CONTENT:

3.4.1 The combined grading of the coarse aggregate and fine aggregate, when tested in accordance with IS 2386 Part I, wet sieving method, shall conform to limits
SPECIFICATION FOR BITUMINOUS MACADAM

given in Table 3. The type and quantity of bitumen and appropriate thickness is also given in Table 3.

<table>
<thead>
<tr>
<th>Grading</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal maximum aggregate size*</td>
<td>40 mm</td>
<td>19 mm</td>
</tr>
<tr>
<td>Layer thickness</td>
<td>80-100 mm</td>
<td>50-75 mm</td>
</tr>
<tr>
<td>IS Sieve size (mm)</td>
<td>Cumulative % by weight of total aggregate passing</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>37.5</td>
<td>90-100</td>
<td></td>
</tr>
<tr>
<td>26.5</td>
<td>75-100</td>
<td>100</td>
</tr>
<tr>
<td>19</td>
<td>-</td>
<td>90-100</td>
</tr>
<tr>
<td>13.2</td>
<td>35-61</td>
<td>56-88</td>
</tr>
<tr>
<td>4.75</td>
<td>13-22</td>
<td>16-36</td>
</tr>
<tr>
<td>2.36</td>
<td>4-19</td>
<td>4-19</td>
</tr>
<tr>
<td>0.3</td>
<td>-</td>
<td>2-10</td>
</tr>
<tr>
<td>0.075</td>
<td>0-8</td>
<td>0-8</td>
</tr>
<tr>
<td>Bitumen content **</td>
<td>3.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>

* Nominal maximum aggregate size is one size larger than the first sieve, which retains more than 10% material.

** For regions where highest daily mean air temperature is 30°C or lower and lowest daily mean air temperature is -10°C or lower, the bitumen content may be increased by as much as 0.5%.

3.4.2 The combined aggregate grading shall not vary from the lower limit on one sieve to the higher limit on the adjacent sieve to avoid gap grading. The aggregate may be proportioned and blended to produce a uniform mix complying with the requirements in Table 3.

4. CONSTRUCTION

4.1.1 Cleaning of the surface: The surface shall be cleaned of all loose extraneous matter by means of mechanical broom, high-pressure air jet received from a compressor or any other approved equipment/method.

4.1.2 Filling up of potholes and sealing of cracks: Any potholes and/or cracks shall be repaired and sealed.

4.1.4 Profile corrective course: Depending upon site requirement, profile-corrective course for correcting the existing pavement profile shall be laid either as a separate layer or as a composite layer with varying thickness. Where the maximum thickness of the profile corrective course is less than 40mm, the profile corrective course shall be laid as an integral part of the overlaying layer. In other cases the profile corrective course shall be constructed as a separate layer. When it is laid as a separate layer, type of material for the use as the profile corrective course may differ.

4.1.5 Prime Coat: Prime Coat shall be as per IRC:16-2007 “Standard Specification and Code of Practice for Prime and Tack Coat”.  

INDIAN HIGHWAYS, AUGUST 2007
4.1.6 **Tack Coat:** Tack Coat shall be as per IRC: 16-2007 “Standard Specification and Coat of Practice for Prime and Tack Coat”.

4.2 **MIXING**

Bituminous macadam shall be prepared in a hot mix plant (HMP) of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregate. Essential features for HMP are given in Annexure I. The temperature range of bitumen and aggregate at the time of mixing for different grade and type of bitumen is given in Table 4. The difference in the temperature of aggregate and bitumen shall not exceed 15°C. In order to ensure uniform quality of mix the plan shall be calibrated from time to time.

4.3 **TRANSPORTATION**

Bituminous material shall be transported in clean insulated covered vehicles. An asphalt release agent such as soap or limewater, which does not adversely affect the bituminous mix, may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

<Comment: Most countries in the world do not allow application of diesel oil which can affect the bituminous mix making it soft and causing flushing. These days, asphalt release agents consisting of soap or limewater are available. We should be proactive and make this change now.}

4.4 **LAYING**

4.4.1 **Weather and seasonal limitations:** Bituminous macadam shall not be laid:

a) in presence of standing water on the surface,

b) when rain is imminent and during rains, fog or dust storm,

c) when the base /binder course is damp,

d) when the air temperature on the surface on which it is to be laid is less than 10°C,

e) When the wind speed at any temperature exceed the 40 km/h at 2-meter height.

4.4.2 **Preparation of the base:** Base shall be prepared by carrying out all or some of the operations as per Clause 4.1, depending upon the site conditions.

4.4.3 **Spreading:** Except in areas where paver cannot have access, bituminous mixture shall be spread, levelled and tamped by self-propelled hydrostatic paver finisher preferably equipped with sensor. As soon as possible after arrival at site the asphalt mix shall be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of paver and the method of operation shall be adjusted to ensure even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation.

Restricted areas (such as confined space, footways, irregular shape and varying thickness, approaches to expansion joints etc.) where paver cannot be
used, the material shall be spread, raked and levelled with suitable hand tool by trained staff.

When laying bituminous macadam near expansion joint, the machine laying shall be stopped about 300 mm short of joint. The remainder of the pavement up to the joint and the corresponding area beyond it shall be laid manually. The laying of bituminous macadam shall be completed before the mix temperature reaches the values specified in the Table 4.

Table 4. Mixing, Laying and Rolling Temperatures for Bituminous Macadam (Degree Celsius)

<table>
<thead>
<tr>
<th>Bitumen Viscosity Grade</th>
<th>Bitumen Temperature</th>
<th>Aggregate Temperature</th>
<th>Mixed Material Temperature</th>
<th>Laying Temperature</th>
<th>*Rolling Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>VG-40</td>
<td>160-170</td>
<td>160-175</td>
<td>160-170</td>
<td>150 Min</td>
<td>100 Min</td>
</tr>
<tr>
<td>VG-30</td>
<td>150-165</td>
<td>150-170</td>
<td>150-165</td>
<td>140 Min</td>
<td>90 Min</td>
</tr>
<tr>
<td>VG-20</td>
<td>145-165</td>
<td>145-170</td>
<td>145-165</td>
<td>135 Min</td>
<td>85 Min</td>
</tr>
<tr>
<td>VG-10</td>
<td>140-160</td>
<td>140-165</td>
<td>140-160</td>
<td>130 Min</td>
<td>80 Min</td>
</tr>
</tbody>
</table>

* Rolling must be completed before the mat cools to these minimum temperatures

Bituminous material, with temperature greater than 145°C shall not be laid or deposited on bridge deck, waterproofing system unless precautions against the heat damage have been taken.

[Comment: Ranges of mix temperatures have been revised in view of the new viscosity grades. The laying temperatures are 10°C less than the mix production temperatures, which will account for some cooling in the transport.]

4.5 COMPACTATION

4.5.1 Compaction shall commence as soon as possible after laying and shall be completed before the temperature falls below the range specified in Table 4. Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, the rolling shall commence at the edge and progress towards the centre longitudinally except at sections with unidirectional camber, where it shall progress from lower edge to upper edge parallel to centreline of the pavement.

4.5.2 All deficiencies in the surface after laying shall be made good by the attendant behind the paver, before initial rolling is commenced. The initial or breakdown rolling shall be done with an 8 to 10 tonnes dead weight or vibratory steel wheel roller. The intermediate rolling shall be done with 8 to 10 tonnes dead weight or vibratory roller with an amplitude 0.3mm to 0.8 mm and frequency between 30 to 50 hz. or with a pneumatic roller of 12 to 15 tones, with a tire pressure of at least 0.56 M Pa. The finished rolling shall be done with 6 to 8 tonnes smooth wheel roller. Rolling shall continue until at least 98% of the lab density obtained in the Marshall mould made using approved gradation and bitumen content is achieved. The number of roller passes should be established on a control strip prior to starting the main work. The mixtures with a maximum aggregate size upto 25 mm shall be compacted in a 4-inch Marshall mould with 50 blows on each side. The mixtures with a
SPECIFICATION FOR BITUMINOUS MACADAM

maximum aggregate size of more than 25 mm shall be compacted in a 6-inch Marshall mould with 75 blows on each side in accordance with the Asphalt Institute MS-2 (Sixth Edition). For smaller works where no density is specified rolling shall continue until there is no further movement under roller.

[Comment: Since the BM is not really designed using the Marshall method, we do not have any idea what kind of air voids we have in this open graded mix. Therefore, we cannot use the percentage of maximum theoretical density (Gmm) to control the compaction in the field. We can simply compact the field produced mix in the Marshall mould and obtain the lab density for that day and try to achieve 98% of the lab density in the field. Since BM is generally not used for high traffic road and it is an open graded mix, 50 blows for 4-inch Marshall and 75 blows for 6-inch Marshall will be more than sufficient based on experience with such open mixes. Increased number of blows will simply break the stone particles.]

4.5.3 The bitumen macadam shall be rolled in the longitudinal direction with the roller as close to the pave as possible. The overlap on successive passes should be at least one-third of the width of the rear roll or in the case of pneumatic wheeled rollers, at least the nominal width of 300mm. The roller should move at a speed of no more than 5 km/hour. The roller shall not be permitted to stand on pavement, which has not been fully compacted. All precautions shall be taken to prevent dropping of oil, grease, petrol or other foreign material on the pavement. The wheel of the rollers shall be kept moist with the water or spray system provided with the machine to prevent the mixture from adhering to the wheels. Minimum moisture to prevent adhesion between wheels and mixture shall be used and surplus water shall not be allowed to stand on the partially completed pavement.

4.6 JOINTS

Where joints are made in bitumen macadam, the material shall be fully compacted and joint made flush in one of the following ways:

a) All joints shall be cut vertical to the full thickness of the previously laid mix. All loosened material shall be discarded and the vertical face be coated with any viscosity grade bitumen, or cold applied emulsified bitumen. While spreading the material along the joint the material spread shall over 25 mm to 30 mm on the previously laid mix beyond the vertical face of the joint. The thickness of the loose overlap material should be approximately a quarter more than the final compacted thickness. The overlapped mix should be bumped back with a lute just across the joint so that the excess material on the hot side can be pressed to obtain a high joint density.

b) By using two or more pavers in echelon, where this is practicable and in sufficient proximity for adjacent width to be fully compacted by continuous rolling.

c) By heating the joints with an approved infrared joint heater when the adjacent width is being laid, but without cutting back or coating with the binder. The heater shall raise the temperature of the full depth of material, to minimum rolling temperature for a width of 75 mm. The temperature shall not exceed the maximum allowed temperature.
SPECIFICATION FOR BITUMINOUS MACADAM

For transverse joints method a) above can apply. In multi-layer construction the joint in one layer shall offset the joint in the underneath layer by about 150mm.

4.7 ARRANGEMENT FOR TRAFFIC

It shall be ensured that the bituminous macadam surface is covered with the next pavement coarse within a maximum of 48 hours until which no traffic shall be applied. In case of delay, the course may be covered with the seal coat in accordance with the appropriate IRC standard prior to opening to traffic.

5. CONTROLS

5.1 SURFACE FINISH

5.1.1 The levels of the bituminous macadam shall not vary from those calculated with reference to longitudinal and cross profile of the roads as per the Contract beyond 6 mm over 3 m length when tested with a template and straight edge.

5.1.2 For checking the compliance with the above requirement measurements of the surface level shall be taken on a grid of points spaced 6.25 m along the length and 0.5 m from the edges and at the centre of the pavement. The compliance shall be deemed to have been met for the final surface only if the tolerance given above is satisfied for any point on the surface.

5.1.3 In case where surface level fall outside the specified tolerance, the Contractor shall be liable to rectify these by replacing the full depth of layer. In all cases of replacement the area treated shall not be less than 5m length and not less than 4.5 m in width.

5.2 SURFACE EVENNESS

5.2.1 The measurement and checking of surface evenness shall be done by a 3-m straight edge in accordance with the procedure in IRC:SP16-2004.

5.2.2 The maximum permissible surface evenness using longitudinal profile 3-m straight edge shall be 6 mm. The maximum permissible evenness using transverse profile camber shall be 4 mm.

5.2.3 The maximum permissible frequency of surface evenness in 300 m length in longitudinal profile shall be as per Table 5.

Table 5. Maximum Permissible Frequency of Evenness

<table>
<thead>
<tr>
<th>Type of layer</th>
<th>Evenness, mm</th>
<th>NH/SH</th>
<th>MDr and Lower Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bituminous Macadam</td>
<td>4-6</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>

5.2.4 Where the surface evenness falls outside the tolerance, the Contractor shall be liable to rectify these in the manner described below:

When surface is low the deficiency shall be corrected by adding fresh materials after applying tack coat if needed and re-compacting to
SPECIFICATION FOR BITUMINOUS MACADAM

specification. When the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to the specification.

5.3 QUALITY CONTROL DURING CONSTRUCTION

The material supplied and the work shall conform to the specifications prescribed in the preceding Clauses. To ensure the quality the material and the works shall be subjected to tests described hereunder. The tests and minimum frequency for each test in indicated in the Table 6.

5.4 ACCEPTANCE CRITERIA

The acceptance criteria for test on density (N=3) shall be subjected to the condition that the mean value of N samples is not less than the specified value plus \([1.65 – \frac{1.65}{\text{No of samples}^{0.5}}]\) x standard deviation.

<table>
<thead>
<tr>
<th>Sl</th>
<th>Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quality of bituminous binder</td>
<td>As per number of samples and tests per lot specified in IS 73</td>
</tr>
<tr>
<td>2</td>
<td>Aggregate impact value/Los Angles Abrasion value</td>
<td>One test per 50 m³ of the aggregate</td>
</tr>
<tr>
<td>3</td>
<td>Flakiness &amp; Elongation Index</td>
<td>One test per 50 m³ of the aggregate</td>
</tr>
<tr>
<td>4</td>
<td>Soundness test (Sodium or Magnesium Sulphate test)</td>
<td>1 test for each method for each source and when ever there is change in the quality of aggregate</td>
</tr>
<tr>
<td>5</td>
<td>Water absorption aggregate</td>
<td>1 test for each source and when ever there is change in the quality of aggregate</td>
</tr>
<tr>
<td>6</td>
<td>Percent of fractured faces</td>
<td>When crushed gravel is used as aggregate one test per 50m³ of aggregate</td>
</tr>
<tr>
<td>7</td>
<td>Mix grading</td>
<td>One set for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant</td>
</tr>
<tr>
<td>8</td>
<td>Stripping (IS:6241)</td>
<td>1 test for each mix design and whenever there is change in the source or quality of coarse aggregate</td>
</tr>
<tr>
<td>9</td>
<td>Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction</td>
<td>At regular interval</td>
</tr>
<tr>
<td>10</td>
<td>Binder content</td>
<td>One set for each 400 tonnes of mix subject to minimum of two tests per day per plant</td>
</tr>
<tr>
<td>11</td>
<td>Rate of spread of mix material</td>
<td>At regular interval</td>
</tr>
<tr>
<td>12</td>
<td>Density of compacted layer</td>
<td>One test per 250m² area.</td>
</tr>
</tbody>
</table>
Annexure-I

Features of Hot Mix Plants & Pavers for Bituminous Construction:

Hot mix plant shall be of suitable capacity of batch mix type. Total system for crushing of stone aggregates and feeding of aggregate fractions in required proportions to achieve the desired mix, must be capable of meeting the overall specification requirements under stringent quality control. The plant shall have the following essential features:

A – General.

(a) The plant shall have a coordinated set of essential units capable of producing uniform mix as per the job mix formula.

(b) Cold aggregate feed system with minimum 4 bins having belt conveyer arrangement for initial proportioning of aggregates from each bin in the required quantities. In order to have free flow of fines from the bin, bin should be fitted with vibrator to intermittently shake it.

(c) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyer for measuring the flow of aggregates.

(d) Dryer unit with the burner capable of heating the aggregate to the required temperature without any visible un-burnt fuel or carbon reside on the aggregate and reducing the moisture content of the aggregate to the specified minimum.

(e) The plan shall be fitted with suitable type of thermometric instruments at appropriate places so as to indicate or record/register the temperature of heated aggregate, bitumen and mix.

(f) Bitumen supply unit capable of heating, measuring/metering and spraying of bitumen at specific temperature with automatic synchronization of bitumen and aggregate feed in the required proportion.

(g) A filler system suitable to receive bagged or bulk supply of filler material and its incorporation to the mix in the correct quantity wherever required.

(h) A suitable built-in dust control system for the dryer to contain /recycle permissible fines into the mix. It should be capable of preventing the exhaust of fine dust into atmosphere for environmental control wherever so specified by the Engineer.

(i) The plant should have centralized control panel/cabin capable of presetting, controlling/synchronizing all operations stating from feeding of cold aggregates to the discharge of the hot mix to ensure proper quality of mix. It should have indicators for any malfunctioning in the operation.

(j) Every hot mix plant should be equipped with siren or horn so that the operator may use the same before starting the plant every time in the interest of safety of staff.
SPECIFICATION FOR BITUMINOUS MACADAM

B – For a Batch Type Plant.
(i) Gradation control unit having minimum four decks vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance of cost and for better environmental condition.
(ii) Proper arrangement for accurate weighing of each size of hot aggregate from the control panel before mixing.
(iii) Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

C – For Continuous Type Plant.
(i) Gradation control unit having vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.
(ii) There should be appropriate arrangement for regulating and volumetric condition of the flow of hot aggregate from each bin to achieve the required proportioning.
(iii) Paddle mixer unit shall be capable of producing a homogenous mix with uniform coating of all particles of the mineral aggregate with binder.

D – For Drum Mix Plant.
(i) It is pre-requisite that only properly screened and graded materials are fed to the bins. If required, a vibratory screening unit shall be installed at the plant site to ensure the same. A primary 4-deck vibratory screening unit shall be installed before the multiple bin cold fed system for screening the aggregates and grading the same.
(ii) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor in the main conveyer for measuring the flow of aggregate.
(iii) There should be arrangement to measure moisture content of the aggregate(s) so that moisture correction may be applied for working out requirements of binder and filler.
SPECIFICATION FOR BITUMINOUS MACADAM

E – Paver Finisher.

(a) Loading hoppers and suitable distribution mechanism.

(b) All drives having hydrostatic drive/control.

(c) The machine shall have a hydraulically extendable screed for appropriate requirement.

(d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface. It shall have adjustable amplitude and variable frequency.

(e) The pave shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

(f) The paver shall be fitted with an electronic sensing device for automatic levelling and profile control within the specified tolerances.

(g) The screed shall have an internal heating arrangement.

(h) The paver shall be capable of laying either 2.5 to 4.0 m width or 4.0 to 7.0 m width as stipulated in the Contract.

(i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operations.