

**Technical Specification – Internal Road Works**

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**Technical Specification – Internal Road Works****Doc. No: MLDL.TS.01.AM.13****Revision No.: R4****Revision Date: 22/12/16****DOCUMENT RELEASE AUTHORIZATION**

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## Technical Specification – Internal Road Works

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**History of Revisions**

<b>Revision No.</b>	<b>Revision issue date</b>	<b>Chapter/clause no. &amp; text affected</b>	<b>Reason for revision</b>
R1	01-04-2006		First Issue
R2	10-01-2012		Annual Review and Revision
R3	11-11-2013		Change of Logo and Consolidation
R4	22-11-2016		Third party review and validation

## Technical Specification – Internal Road Works

### 1. Scope & Application:

This specification is for all works associated with construction of internal roads. This specification addresses the general protocols involved in the construction of roads. Other activities such as detailed surveys, geometrical setting outs, cross drainage works etc are not covered under this document. This document is part of Contract Document for the proposed tender. This document has to be read in conjunction with the GFC drawings, Bill of Quantities, approved SOP / Method Statement, Tolerance criteria and the Contract document. In case of any discrepancy all the above documents should be read inter alia with each other and the most stringent condition will be followed for tolerance and acceptance criteria.

### 2. Standards & Codes:

All the specifications, standards and codes of practices mentioned herein are made a part of this specification and shall be of latest edition including all applicable official amendments and revisions. All work shall be carried out to meet the requirements of this Technical Specification of Mahindra Lifespaces and as per the relevant Indian Standards and Codes of Practices. In the absence of relevant Indian Standards, the applicable BS, ACI / any other international standards, of that order shall be referred. List given here under is not to be considered as exhaustive and is for reference and guidance only. Any discrepancies / conflict noticed shall be brought to the notice of Engineer for his / her direction / approval. In the event that state, city or other government bodies have requirements more stringent than those set forth in this specification, such requirements shall be considered part of this specification and shall supersede this specification where applicable.

Sr No	Relevant Code	Particulars
1	IS 73	Indian Standard specification for Paving bitumen.
2	IS 164	Ready mixed paint for road marking
3	IS 217	Indian standard Specification for cutback bitumen.
4	IS 269	Specification for Ordinary, Rapid Hardening and Low heat Portland cement.
5	IS 334	Glossary of terms relating to bitumen and tar
6	IS 383	Specification for coarse and fine aggregate from natural sources for Concrete
7	IS:456	Code of practice for plain and reinforced concrete

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8	IS:44,50,54,55,56,411	Specifications for Pigments of various colors
9	IS 516	Method of test for strength of concrete
10	IS 702	Specification for industrial bitumen
11	IS 1195	Indian Standard code of practice for Bitumen-Mastic for Flooring-Specification.

Sr No	Relevant Code	Particulars
12	IS 1196	Indian Standard code of practice for laying Bitumen-Mastic Flooring.
13	IS: 1200	Method of Measurement of Building Works.
14	IS 1203	Method of testing tar and bituminous material, determination of Penetration
15	IS 1208	Method of testing tar and bituminous material determination of Ductility
16	IS 1834	Specification for hot applied sealing compound for joint in concrete
17	IS:8112	Specification for 43 grade ordinary Portland cement
18	IS:12269	Specification for 53 grade ordinary Portland cement
19	IS:15658	Specification for Precast Concrete Blocks for Paving
20	IS 1838 (Pt.1)	Specification for performed fillers for expansion joint in concrete pavements and structures (non-extruding and resilient type/ bitumen impregnated fiber)
21	IS 1498	Indian standard Classification and identification of Soils for general engineering Purposes.
22	IS 2386	Indian standard specification for methods of test for aggregates for concrete.
23	IS 2720	Indian standard specification for methods for tests on Soil.
24	IS 3812	Specification for fly ash for use as pozzolana and admixture
25	IS: 3366	Specification for Pan Vibrators.
26	IS: 4656	Specification for form Vibrators for Concrete.
27	IS 5640	Method of test for determining aggregate impact value of soft coarse Aggregates
28	IS 6241	Method of test for determination of stripping value of road Aggregates
29	IS 8887	Indian standard Bitumen emulsion for roads (Cationic type).

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30	IRC: 16 - 1989	Specification for priming of base course with bituminous primer.
31	IRC 29	Specification for bituminous concrete for road pavements
32	MORTH (Ministry Of Road Transport & Highways.)	Specifications for Road and Bridge Works.
33	ACG.V.R0	Acceptance Criteria For Structural, Core & Shell And Finishing Works – Affordable & Mid-Premium (MLDL Document)
34	STDH.V.1.0	Standardisation Handbook (MLDL Document)

**Note:** In case of any conflict between the provision given in this technical specification of internal road works and the latest revision of MORTH, the latter shall prevail.

### 3. Basic Terminologies

The following terms and abbreviations shall have the specific meanings as described hereunder. For terms that are not described herein, the definitions as stated in the applicable Indian / International Standard Specifications shall apply.

The word 'Asphalt' should always be qualified by indication of its origin or nature.

- 3.1 Asphalt:** A natural or artificial mixture in which bitumen is mixed with mineral matter. The word 'Asphalt' should always be qualified by indication of its origin or nature.
- 3.2 Asphaltic Macadam:** A mixture of bitumen (with or without filler) and mineral aggregate of a size larger than sand. It can be made by grouting or pre-mixed methods.
- 3.3 Ballast:** It is unscreened stone or gravel of irregular sizes which may contain smaller material and also sand.
- 3.4 Bank:** An earth slope formed or trimmed to shape.
- 3.5 Base coat:** An intermediate course between the base course and the wearing coat.
- 3.6 Base course:** The part of the construction resting upon the sub-grade, and through which the load is transmitted to the sub-grade or the supporting soil. A base course is the layer immediately under the wearing surface.
- 3.7 Berm:** It is a strip between side drains and the edge of the banks, over which the traffic may pass occasionally while crossing / overtaking. It is also called as 'shoulder'
- 3.8 Bitumen:** Is a by-product of the distillation or evaporation of crude petroleum either by natural process or in a refinery and is the basic constituent of asphalt.
- 3.9 Bitumen-Cutback:** Bitumen, the viscosity of which has been reduced by a volatile diluent such as kerosene or naptha type dilutent or fuel oil, is called, medium or rapid or slow curing cut.
- 3.10 Bitumen-Emulsion:** A liquid product in which a substantial amount of bitumen is suspended in a finely divided condition in an aqueous medium containing an emulsifier and stabiliser. The emulsion is termed 'Anionic' when the bitumen particles are negatively charged and the aqueous phase is alkaline. The emulsion is termed

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'cationic' when the particles are positively charged and the aqueous phase is acidic backs respectively.

- 3.11 Bitumen Mastic Filler:** Inorganic mineral material all of which will pass through specified IS sieve used in admixture with solid or semi-solid bituminous material.
- 3.12 Flash Point:** The lowest temperature at which the vapour of a substance can be ignited in air by a flame under specified condition of test. The substance itself does not continue to burn.
- 3.13 Camber:** It's a difference in level between the crown and the edge of the carriage way. This is also sometimes referred as cross fall.
- 3.14 Carpet:** A wearing surface obtained by laying bitumen or tar concrete in two or more coats in a thickness of more than 25mm.
- 3.15 Cutting:** The portion of the site of a road where the formation has been excavated below the existing ground level.
- 3.16 Embankment:** An earthwork raised above the existing level ground by the deposition of material to support construction at a higher level.
- 3.17 Filler:** Any fine mineral powder added to bituminous mixture in the course of manufacture and which has been ground to such degree of fineness that not less than 85 % by weight passes a 75 micron sieve.
- 3.18 Formation:** The surface of the ground in its final shape and level after completion of earthwork.
- 3.19 Levelling Course:** A course placed for the purpose of shaping old surface to proper cross section to receive a subsequent surface course.
- 3.20 Macadam:** Broken stone, road stone or road metal.
- 3.21 Mastic Asphalt:** Asphalt or bitumen heated and mixed with fine mineral fillers to form a coherent voidless impermeable mass.
- 3.22 Pavement:** Is the hard crust placed on the soil formation after the completion of the earthwork.
- 3.23 Prime Coat:** The initial application of a binder to an absorbent highway surface prior to the construction of wearing coat.
- 3.24 Sub grade / Formation:** It is the soil foundation that is the surface of a natural ground in its final shape after completion of earthwork, which supports the entire road structure.
- 3.25 Surfacing:** It is the uppermost part of the road structure. Its purpose is to provide the driveway / carriageway which minimize abrasion due to traffic, act as cushion between the wheel and the base and reduce the adverse effects of climate.
- 3.26 Tack Coat:** The initial application of binder to an existing surface given through bond between the new construction and the existing surface.
- 3.27 Actual Dimension** — Measured dimensions of a paver block.
- 3.28 Aspect Ratio** — Ratio of length to thickness of a paver blocks.
- 3.29 Bed Face** — Surface of a paver block which, when paved, comes in direct contact with the bedding material.

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**3.30 Interlocking/Dented/Inter-connected Paver** —Paver blocks which key into one another on some or all vertical faces, when paved in any pattern.

**3.31 Wearing Face** — that surface of a paver block which, when paved, faces the atmosphere and which is directly subjected to loading and movement of vehicle tires or pedestrian traffic.

**3.32 Wipe** — Fine cement mortar slurry applied to the upper face of a paver block or supplementary product.

### 4. Material Requirements:

#### 4.1 Materials for Sub grade:

##### 4.1.0 Earth for Embankment / Sub base:

4.1.0.1 Soil, Murrum, gravel, and a mixture of those or any other material approved by MLDL's Engineer shall be used in embankments, sub grades, earthen shoulders and miscellaneous backfills. These materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability and quality of the embankment/sub grade.

4.1.0.2 The following types of material shall be considered unsuitable for embankment:

- a. Materials from swamps, marshes and bogs
- b. Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or PT in accordance with IS: 1498.
- c. Materials susceptible to spontaneous combustion
- d. Clay having liquid limit exceeding 70 and plasticity index exceeding 45; and
- e. Materials with salts causing leaching in the embankment.

4.1.0.3 Materials used for the construction of the embankment and the sub grade should satisfy the density requirements given in **Table A**.

**Table A: Density Requirements of Embankment and Subgrade Materials**

Sr.	Type of Work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part 8)
i.	Embankments up to 3 meters height, not subjected to extensive flooding.	Not less than 15.2 kN/cum.
ii.	Embankments exceeding 3 meters height or embankments of any height subject to long periods of inundation	Not less than 16.0 kN/cum.
iii.	Sub grades and earthen shoulders / verges / backfill	Not less than 17.5 kN/cum.

#### 4.2 Granular Sub base:



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- 4.2.0** The material to be used for the work shall be natural sand, Murrum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in **Table B**.

**Table B: Grading for Close-Graded Granular Sub-Base Materials**

Sr.	IS sieve Designation	% by weight passing the IS sieve		
		Grade I	Grading II	Grading III
1.	75.0 mm	100	-	-
2.	53.0 mm	80-100	100	-
3.	26.5 mm	55-90	70-100	100
4.	9.50 mm	35-65	50-80	65-95
5.	4.75 mm	25-55	40-65	50-80
6.	2.36 mm	20-40	30-50	40-65
7.	0.425 mm	10-25	15-25	20-35
8.	0.075 mm	3-10	3-10	3-10
9.	CBR Value (Minimum)	30	25	20

- 4.2.1** While the grading in **Table B** are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding grading for the coarse-graded materials for each of the three maximum particle sizes are given at **Table C**. The grading to be adopted for a project shall be as specified in the Contract.

**Table C Grading for Coarse Graded Granular Sub-Base Materials.**

Sr.	IS Sieve Designation	Percent by weight passing the IS Sieve		
		Grading I	Grading II	Grading III
1.	75.00 mm	100	-	-
2.	53.0 mm	-	100	-
3.	26.5 mm	55-75	50-80	100
4.	9.50 mm	-	-	-
5.	4.75 mm	10-30	15-35	25-45
6.	2.36 mm	-	-	-
7.	0.425 mm	-	-	-
8.	0.075 mm	< 10	< 10	< 10
9.	CBR Value (Minimum)	30	25	20

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### 4.3 Wet mix Macadam Sub Base / Base:

#### 4.3.0 Aggregates:

##### 4.3.1 Physical Requirements:

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 % by weight of the gravel/shingle pieces retained on 4.75mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in **Table D** below.

**Table D:** Physical Requirements of Course Aggregates for Wet Mix Macadam for Sub-Base/Base Courses

Sr.	Test	Test Method	Requirements
a.	Los Angeles Abrasion value Or Aggregate Impact value	IS: 2386 (Part-4) IS: 2386 (Part-4) or IS: 5640	40 % (Max.) 30 % (Max.)
b.	Combined Flakiness and Elongation Indices (Total)	IS: 2386 (Part-1)	30 % (Max.)

Aggregate should satisfy requirements of the two tests mentioned in Table D.

**4.3.2** If the water absorption value of the coarse aggregate is greater than 2 %, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part-5).

**4.3.3** Grading Requirements: The aggregates shall conform to the grading given in Table E.  
**Table E Aggregate Grading**

IS Sieve Designation	% by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 mm	8-22
75.00 mm	0-8

### 4.4 Prime Coat over Granular Base:

#### 4.4.0 Primer:

The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16.

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### 4.4.1 Primer Viscosity:

- 4.4.2** The type and viscosity of the primer shall comply with the requirements of IS: 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table F.

**Table F Viscosity requirements and quantity of liquid**

Type of surface	Kinematic Viscosity of Primer at 60°C (Centistokes)	Quantity of Liquid Bituminous Material per 10 Sq. M. (kg)
Low porosity	30-60	6 to 9
Medium porosity	70-140	9 to 12
High porosity	250-500	12 to 15

### 4.5 Tack Coat:

#### 4.5.0 4.5.1 Binder:

- 4.5.1** The binder used for tack coat shall be bitumen emulsion complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of cutback bitumen as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

### 4.6 Dense Bitumen Macadam:

#### 4.6.1 Bitumen:

The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS: 73, and of the penetration indicated in **Table G** for dense bitumen macadam, or this bitumen as modified by one of the methods specified in **Clause 521 of MORTH**, or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

**Table G: Composition of dense graded bituminous macadam pavement layers**

Grading	1	2
Nominal aggregate size	40mm	25 mm
Layer Thickness	80-100 mm	50-75 mm
IS Sieve1 (mm) Cumulative % by weight of total aggregate passing		
45	100	-

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37.5	95 - 100	100
26.5	63 - 93	90 - 100
19	-	71 - 95
13.2	55 – 75	56 - 80
9.5	-	-
4.75	38 – 54	38 - 54
2.36	28 – 42	28 - 42
1.18	-	-
0.6	-	-
0.3	7 – 21	7 - 21
0.15	-	-
0.075	2 - 8	2 - 8
Bitumen content % by mass of total mix <sup>2</sup>	Min 4.0	Min 4.5
Bitumen grade (pen)	30 or 40	30 or 40

### 4.6.2 Coarse aggregates:

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, and durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping. The aggregates shall satisfy the physical requirements specified in **Table H**, for dense bituminous macadam.

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

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**Table H Physical requirements for coarse aggregate for dense graded bituminous macadam**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined)	Max 30%
Strength*	Los Angeles Abrasion Value Aggregate Impact Value	Max 35% Max 27%
Durability	Soundness: Sodium Sulphate Magnesium Sulphate	Max 12% Max 18%
Water Absorption	Water absorption	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Min 80%

Notes: \* – Aggregates may satisfy requirements of either of these two tests.

### 4.6.3 Fine aggregates:

Fine aggregates shall consist of crushed or naturally occurring mineral material or a combination of the two, passing the 2.36mm sieve and retained on the 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS: 2720 (Part 37).

### 4.6.4 Filler:

Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement as approved by the Engineer.

The filler shall be graded within the limits indicated in **Table I**.

**Table I Grading requirements of filler material**

IS Sieve (mm)	Cumulative per cent passing by weight of total aggregate
0.6	100
0.3	95-100

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0.075	85 - 100
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**4.6.5** The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel, 2 per cent by weight of total aggregate, shall be Portland cement or hydrated lime and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the limestone aggregate is used. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 8, then 2 per cent by total weight of aggregate, of hydrated lime shall be added without any additional cost to the Owner.

### 4.7 Bituminous Concrete:

#### 4.7.1 Bitumen:

The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500-18, for bituminous concrete, or this bitumen as modified by one of the methods specified in **Clause 521 of MORTH**, or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

#### 4.7.2 Coarse aggregates:

The coarse aggregates shall be generally as specified in **Clause 4.6.2** except that the aggregates shall satisfy the physical requirements of **Table J**.

**Table J Physical requirements for coarse aggregate for bituminous concrete pavement layers**

Property	Test	Specification
Cleanliness	Grain size analysis.	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index (Combined).	Max 30% (Combined) <sup>2</sup>
Strength*	Los Angeles Abrasion Value Aggregate Impact Value.	Max 30% Max 24%
Polishing	Polished Stone Value.	Min 55
Durability	Soundness: Sodium Sulphate Magnesium Sulphate.	Max 12% Max 18%

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Water Absorption	Water absorption.	Max 2%
Stripping	Coating and stripping of Bitumen Aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity**	Retained Tensile Strength.	Min 80%

(All tests mentioned in above Table J shall be conducted as per the procedure mentioned in IS / AASHTO / ASTM codes)

Notes: \* - Aggregate may satisfy requirements of either of these two tests

\*\* - The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

### 4.7.3 Fine aggregates:

The fine aggregates shall be all as specified in **Clause 4.6.3**.

### 4.7.4 Filler:

Filler shall be generally as specified in **Clause 4.6.4**. Where the aggregates fail to meet the requirements of the water sensitivity test in **Table 500-16 of MORTH** then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

### 4.7.5 Aggregate grading and binder content:

When tested in accordance with IS: 2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in **Table G** for grading 1 or 2 as specified in the Contract.

## 4.8 Paver Blocks:

**4.8.1** Thickness and grade of concrete for paver block shall be as per Table K indicated below (as per IS: 15658) with minimum thickness being 50 mm and minimum grade of concrete being M 30. However, strength of individual paver block shall not be less than 85 percent of the specified strength.

**Table K**

S. No	Traffic Category	Concrete Grade	Minimum Thickness (mm)	Areas of usage
1	Non-traffic	M-30	50	Building Premises, Landscapes, parks, domestic drives, paths and patios.

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2	Light traffic	M-35	60	Pedestrian plazas, shopping complexes ramps, car parks, office driveways, residential roads.
3	Medium traffic	M-40	80	City streets, low volume roads, small and medium market roads.
4	Heavy traffic	M-50	100	Bus terminals, service station.

The recommended dimensions and tolerances for paver blocks shall be as per Table L indicated below (as per IS 15658).

**Table L**

Sr. No.	Dimensions	Recommended Values	Tolerance Limit for Paver Block	
			Thickness < 100 mm	Thickness ≥ 100 mm
1	Width	To be specified by Manufacturer	± 2 mm	± 3 mm
2	Length (L)	To be specified by Manufacturer	± 2 mm	± 3 mm
3	Thickness(T)	50 to 120 mm	± 3 mm	± 4 mm
4	Aspect Ratio (L/T)	4.0 maximum	± 0.2	± 0.2
5	Chamfer	Min 5 mm, Max 7mm	± 1 mm	± 1 mm
6	Thickness of wearing layer	Minimum 6 mm	+ 2 mm -0 mm	+ 2 mm -0 mm
7	Plan Area	Maximum 0.03 sq.m	+0.001 sq. m	+0.001 sq. m
8	Wearing Face Area	Minimum 75 % of plan area	-1 %	-1 %
9	Square-ness	Nil	± 2 mm	± 3 mm

**4.8. 2** The water absorption, being the average of three units, when determined in the manner described in Annexure C of IS: 15658, shall not be more than 6 % by mass and for any individual samples, the water absorption shall not exceed 7 %



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### 5. Technical Requirements & Procedure:

#### 5.1.1 Construction of Embankment and Sub grade:

##### 5.1.2 Setting out:

The setting out work shall be carried out after the site has been cleared. The limits of embankment/sub grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment / subgrade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is of the desired density and in position specified and conforms to the specified side slopes.

##### 5.1.3 Dewatering:

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it shall be feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property.

##### 5.1.4 Stripping and storing topsoil:

In localities where most of the available embankment materials are conducive to plant growth, or when so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Top soil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

##### 5.1.5 Compacting ground supporting Embankment / Sub grade:

When necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, lacerated, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in **Table M** below.

**Table M Compaction Requirements for Embankment and Sub grade**

Sr.	Type of work/ material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
1.	Sub grade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95

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3.	Expansive Clays	Not allowed for any part of road works
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- 5.1.5.1 In case where the difference between the sub grade level (top of the sub grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density as given in **Table M**, the ground shall be loosened up to a level 0.5 meter below the sub grade level, watered and compacted in layers to not less than 97 percent of dry density as given in **Table M**.
- 5.1.5.2 Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.
- 5.1.5.3 Embankment or sub grade work shall not proceed until the foundations of embankments/sub grade have been inspected by the Engineer for satisfactory condition and approved.
- 5.1.6 Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer.
- 5.1.7 The embankment and sub grade material shall be spread in layers of uniform thickness not exceeding 300mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in **Table M** and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.
- 5.1.8 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such construction, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surfaces but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, cubing or harrowing until and uniform moisture content is obtained throughout the depth of the layer.
- 5.1.9 If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

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- 5.1.10** Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1% above to 2% below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS: 2720 (Part 8) as the case may be. Expansive clay shall not be allowed anywhere for the road works.
- 5.1.11** After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer unit the layer is uniformly wet.
- 5.1.12** Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub grade.
- 5.1.13** Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.
- 5.1.14** Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.
- 5.1.15** Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched prior to the placing of subsequent fill.
- 5.1.16** All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.
- 5.1.17 Compaction:**
- 5.1.17.1** Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic type, sheep foot or pad foot rollers, etc., of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.
- 5.1.17.2** The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

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- 5.1.17.3 Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.
- 5.1.17.4 Each layer of the material shall be thoroughly compacted to the densities specified in **Table M**. Subsequent layers shall be placed only after the finished layer has been tested according to **Clause 903.2.2 of MORTH** Specifications for Roads and Bridge Works (III Revision) and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture / density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identified to that obtained from tests in accordance with **IS:2720 (Part 28)**. A record of the same shall be maintained by the Contractor.
- 5.1.17.5 When density measurements reveal any under-compacted areas in the embankment / sub grade / earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that if specified compaction is not achieved, the material in the such areas shall be removed and replaced by approved material, compacted to the density requirements and to the satisfaction of the Engineer.

### 5.1.18 Drainage:

The surface of the embankment / sub grade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

### 5.1.19 Finishing operations:

- 5.1.19.1 Finishing operations shall include the work of shaping and dressing the shoulders / verge / road bed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the Drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.
- 5.1.19.2 The topsoil, removed and conserved earlier (**Clause 301.3.2 and 305.3.3 of MORTH**) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.
- 5.1.19.3 When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

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### 5.2 Construction of Granular Sub base:

#### 5.2.0 Preparation of Subgrade:

- 5.2.0.1 Immediately prior to the laying of sub-base, the subgrade already finished as per the clause 5.1 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

#### 5.2.1 Spreading and compacting

- 5.2.1.1 The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of mortar grade of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.
- 5.2.1.2 When the sub-base materials consist of combination of materials mentioned in Clause 4, mixing shall be done mechanically by the mix-in-place method.
- 5.2.1.3 Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.
- 5.2.1.4 Moisture content of loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 % above to 2 % below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotators until the layer is uniformly wet.
- 5.2.1.5 Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer up to 225 mm the compaction shall be done with the help of vibratory roller of minimum 80 to 100 kN static weights with plain drum or pad foot drum or heavy pneumatic tired roller of minimum 200 to 300 kN weight having a minimum tire pressure of 0.7 MN/m<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and

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super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides.

5.2.1.6 Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

5.2.1.7 Rolling shall be continued till the density achieved is at least 98 % of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

### 5.2.2 Surface Finish

5.2.2.1 The surface finish of construction shall conform to the requirements of **Section 902 of MORTH** Specifications for Road and Bridge Works (III Revision).

### 5.3 Wet mix macadam / Base:

#### 5.3.0 Surface Preparation:

The surface on which the WMM (Wet mix macadam) rests is nothing but the granular sub base. The preparation of the same can be referred from **clause no. 5.2**.

#### 5.3.1 Provision of lateral confinement of aggregates:

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in **Clause 407.4.1 of MORTH**.

#### 5.3.2 Preparation of mix:

5.3.2.1 Wet mix macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pug mill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.

5.3.2.2 Optimum moisture for mixing shall be determined in accordance with **IS: 2720 (Part-8)** after replacing the aggregate fraction retained on 22.4 mm sieve with material of



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4.75 mm to 22.4 mm size while adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than limits specified by MLDL. The mixed material should be uniformly wet and no segregation should be permitted.

### **5.3.3 Spreading of mix :**

5.3.3.1 Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

5.3.3.2 The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

### **5.3.4 Compaction**

- 5.3.4.1 After the mix has been laid for the required thickness, grade and camber/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 KN weight may be used. For a compacted single layer up to 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.
- 5.3.4.2 In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.
- 5.3.4.3 In portions in camber, rolling should being at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding tracks by at least one-third width until the entire surface has been rolled.
- 5.3.4.4 Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.
- 5.3.4.5 Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

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- 5.3.4.6 Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions.
- 5.3.4.7 Rolling shall be continued till the density achieved is at least 98 % of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).
- 5.3.4.8 After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose segregated or otherwise defective areas shall be made good to the full thickness of the layer and compacted again.

### 5.3.5 Setting and drying

- 5.3.5.1 After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

## 5.4 Prime coat over Base:

### 5.4.0 Preparation of road surface:

The surface to be primed shall be prepared in accordance with **Clauses 501.8. & 902 of MORTH** as appropriate. Immediately prior to applying the primer disturb the interlocked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

### 5.4.1 Application of bituminous primer:

The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. Where a geo-synthetic is proposed for use, the requirements of **Clauses 703.2.2 and 703.4 of MORTH** shall apply. The bituminous primer shall be sprayed uniformly in accordance with **Clause 501 of MORTH**. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

### 5.4.2 Curing of primer and opening to traffic:

A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course. A very thin layer of



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clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

### 5.4.3 Construction of Tack coat :

### 5.4.4 Preparation of base:

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of **Section 902 of MORTH** as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

### 5.4.5 Application of tack coat:

The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in **Table 12**.

**Table 1 Rate of application of Tack Coat**

Sr.	Type of Surface	Quantity of Liquid bituminous Material in Kg per sq. m. Area
i)	Normal bituminous surfaces	0.20 to 0.25
ii)	Dry and hungry bituminous surfaces	0.25 to 0.30
iii)	Granular surfaces treated with primer	0.25 to 0.30
iv)	Non bituminous surfaces Granular base (not primed)	0.35 to 0.40

### 5.4.6 Temperature for a bituminous emulsion shall be 20°C to 70°C and for a cutback, 50°C to 80°C if RC-70/MC-70 is used. Where a geo-synthetic is proposed for use, the provisions of **Clauses 703.3.2 and 703.4.4 of MORTH** shall apply. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Where the material to receive an overlay is a freshly laid bituminous layer that has not been subjected to traffic or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

### 5.4.7 Dense Bitumen Macadam:

Preparation of base:

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with **Clauses 501 and 902 of MORTH** as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed air. In locations where-mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

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### 5.4.8 Geo-synthetic:

Where Geo-synthetic is specified in the Contract this shall be in accordance with the requirements stated in **Clause 703 of MORTH**

### 5.4.9 Stress absorbing layer:

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of **Clause 522 of MORTH**.

### 5.4.10 Prime coat:

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of **Clause 5.4**, or as directed by the Engineer.

### 5.4.11 Tack coat:

Where the material on which the dense bituminous macadam is to be placed is bitumen bound surface, a tack coat shall be applied as specified, in accordance with the provisions of **Clause 5.5**, or as directed by the Engineer.

### 5.4.12 Mixing and transportation of the mixture:

The provisions as specified in **Clauses 501.3 and 501.4 of MORTH** shall apply.

### 5.4.13 Spreading:

The provisions of **Clauses 501.5.3 and 501.5.4 of MORTH** shall apply.

### 5.4.14 Rolling:

The general provisions of **Clauses 501.6 and 501.7 of MORTH** shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

### 5.4.15 Bituminous Concrete :

Weather and seasonal limitations: The provisions of **Clause 501.5.1 of MORTH** shall apply. The composition of the bituminous concrete pavement layers shall be as mentioned in table N

**Table N Composition of bituminous concrete pavement layers**

Grading	1	2
Nominal aggregate size	13 mm	10 mm
Layer Thickness	35-40 mm	25-30 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing.	
45		
37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88

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4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-37	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix <sup>2</sup>	5.5	5.5
Bitumen grade (pen)	30/40	30/40

### Notes:

- The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.
- Determined by the Marshall method.

**Table 'O' Requirements for bituminous pavement layers**

Minimum stability (kN at 60 Degree Celsius)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-6
Per cent voids in mineral aggregate (VMA)	See Table 3.14 below
Per cent voids filled with bitumen (VFB)	65-75
Loss of stability on immersion in water at 60°C (ASTM D 1075)	Min. 75 per cent retained strength

### 5.4.16 Preparation of base:

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with **Clauses 501 and 902 of MORTH** as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

### 5.4.17 Geo-synthetic:

Where Geo-synthetic is specified in the Contract this shall be in accordance with the requirements stated in **Clause 703 of MORTH**:

### 5.4.18 Stress absorbing layer:

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of **Clause 522 of MORTH**.

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### 5.4.19 Tack coat:

Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of **Clause 3.5**.

### 5.4.20 Mixing and transportation of the mixture:

The provisions as specified in **Clauses 501.3 and 501.4 of MORTH** shall apply.

### 5.4.21 Spreading:

The general provisions of **clauses 501.5.3 and 501.5.4 of MORTH** shall apply.

### 5.4.22 Rolling:

The general provisions of **clauses 501.6 and 501.7 of MORTH** shall apply, as modified by the approved laying trials.

## 5.5 For laying Paver Blocks

**5.5.1** The sub base for laying paver blocks shall be properly cleaned, levelled and prepared to lay the paver blocks. **(Refer the section for the Preparation of sub base in this document)**

**5.5.2** The blocks shall be fixed between the kerb stones or walls as the case may be and as per the approved design, pattern and drawings. It must be ensured that the paver blocks are confined on all sides by rigid walls / edges.

**5.5.3** The blocks shall be installed over a bed of 50 mm thick loose sand (clean, well graded passing through 4.75 mm sieve) and levelled as required.

**5.5.4** The interlocking blocks shall be fixed by skilled and experienced labourers only.

**5.5.5** Necessary cutting of blocks as required at the edges, ends of walls, kerb stones and as per site conditions shall be done.

**5.5.6** After laying the blocks, the finished job shall be thoroughly compacted /vibrated by means of mechanical vibrator. If any settlement /dislocation are found after vibration, the same shall be rectified and made good by the Contractor without any extra cost.

**5.5.7** After vibration, the excess sand shall be removed and the pavements shall be made neat and clean.

**5.5.8** No extra cost shall be paid for any wastage on account of cutting of paver blocks or damage during installation.

## 6. Quality Management System Requirements:

**6.1.1** All materials to be used, all methods adopted and all works performed shall be strictly in accordance with the requirements of these Specifications. The Contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality

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Control work as per Specifications and/or as directed by the Engineer. The list of equipment and the facilities to be provided shall be got approved from the Engineer in advance.

- 6.1.2** The Contractor's laboratory should be manned by a qualified Materials Engineer/Civil Engineer assisted by experienced technicians, and the set-up should be got approved by the Engineer. The Contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method and or frequency of tests for any item, the instructions of the Engineer shall be followed.

For satisfying himself about the quality of the materials and work, quality control tests will also be conducted by the Engineer (by himself, by his Quality Control Units or by any other agencies deemed fit by him), generally to the frequency set forth herein under. Additional tests may also be conducted where, in the opinion of the Engineer, need for such tests exist.

- 6.1.3** The Contractor shall provide necessary co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendants, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.
- 6.1.4** For the work of embankment, subgrade & pavement, construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items of works prior to proceeding with the next stage of construction.
- 6.1.5** The Contractor shall carry out modifications in the procedure of work, if found necessary, as directed by the Engineer during inspection, Works falling short of quality shall be rectified/redone by the Contractor at his own cost, and defective work shall also be removed from the site of works by the Contractor at his own cost.
- 6.1.6** The cost of laboratory building including services, essential supplies like water, electricity, sanitary services and their maintenance and cost of all equipment, tools, materials, labour and incidentals to perform tests and other operations of quality control according to the Specification requirements shall be deemed to be incidental to the work and no extra payment shall be made for the same. If, however, there is a separate item in the Bill of Quantities for setting up of a laboratory and installing testing equipment, such work shall be paid for separately.
- 6.1.7** For testing in NABL accredited Third Party Labs, the samples of soils/soil mixes, granular materials, and mixes, bituminous materials and mixes, aggregates, cores etc., samples in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost.

For bitumen, and similar other materials where essential tests are to be carried out at the manufacturer's plants or at laboratories other than the site laboratory, the cost of

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samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor. He shall also furnish the test certificates to the Engineer.

- 6.1.8** The method of sampling and testing of materials shall be as required by the “Handbook of Quality Control for Construction of Roads and Runways” (IRC SP: 11), and these specifications. Where they are contradicting, the provision in these Specifications shall be followed. Where they are silent, sound engineering practices shall be adopted. The sampling and testing procedure to be used shall be as approved by the Engineer and his decision shall be final and binding on the Contractor.
- 6.1.9** The materials for embankment construction shall be got approved from the Engineer. The responsibility for arranging and obtaining the land for borrowing or exploitation in any other way shall rest with the Contractor who shall ensure smooth and uninterrupted supply of materials in the required quantity during the construction period. Similarly, the supply of aggregates for construction of road pavement shall be from quarries approved by the Engineer. Responsibility for arranging uninterrupted supply of materials from the source shall be that of the Contractor.

### **For Paver Blocks**

- 6.1.10** The contractor shall put in place a comprehensive Quality management plan to ensure that the work is carried out as per specifications and compliance to all requirements are established and demonstrated through comprehensive documentation. The contractor shall engage a qualified Quality Manager to implement the quality plan. The contractor proposes to adopt his own ITP; the same shall be submitted for the approval of the Engineer. Any dilution of the testing frequency, acceptance criteria from the standardized ITP shall have to be supported by well-articulated arguments.
- 6.1.11** The blocks shall be procured from an approved manufacturer only. The paver blocks, after manufacturing shall be inspected by the Engineer before dispatching them to the site. The Contractor shall get the paver blocks tested at his cost at an approved testing laboratory as specified by the Engineer. Testing shall be carried out in accordance with IS: 15658 (Latest revision). The blocks approved by the Engineer, after due testing, at approved laboratory, shall only be dispatched to the site
- 6.1.12** Contractor shall procure and provide paver block conforming to IS specified and shall comply with all physical, chemical and mechanical tests. Paver block without “ISI” / identification marking shall not be brought to site.
- 6.1.13** Any paver block brought to site shall not be used in the works unless its characteristics are tested and found complying with the requirements of the applicable specifications. Till such time the paver block is not permitted to be used in work, it shall be separately stored and identified to preclude its use.
- 6.1.14** Paver blocks shall be inspected after installation to ascertain that the Paver blocks are not damaged or displaced from their original position and the desired level & a dimension has been achieved.
- 6.1.15** Acceptance criteria: - Obligatory Requirements: (For Paver Blocks)

6.1.15.1 The lot shall be considered as conforming to the requirements of this specification if the conditions mentioned in clauses 6.1.15.2 & 6.1.15.3 (mentioned in same document) are satisfied.



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6.1.15.2 The sampled blocks tested for dimensions, aspect ratio, chamfer, plan area, wearing face area, deviation from squareness and, in the case of two layer blocks, thickness of wearing layer shall meet the tolerance limit specified in Table L.

6.1.15.3 For water absorption, the mean value of 3 samples determined shall be not more than the maximum limit specified in 4.8.2 in this same document.

### **Submittals:**

The contractor shall maintain a comprehensive record of the road works as per the approved ITP. All records shall be in hard copy, signed by the Engineer, unless electronic records are permitted by the Engineer.

The following documents shall be submitted to the Engineer for approval and record:

- 1 Detailed good for construction drawings. In case external development design consultant is appointed by the contractor then the geometric designs calculation also have to be submitted.
- 2 Construction plan for each single stretch of the Road including indications of diversions.
- 3 Manufacturer's test certificate for all materials brought to site.
- 4 Record and results of tests performed on following materials.
  - Soil / Earth.
  - Water.
  - Coarse aggregates.
  - Fine aggregates.
  - Bitumen.
  - Admixtures (if any).
- 5 Records of site survey / Field books.
- 6 Schedules of construction.
- 7 Detailed methodology for carrying out repairs of any defects.
- 8 Records for correction / repairs carried out.
- 9 Post construction inspection records of construction of each layer.

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**10** If required by the Engineer, contractor shall maintain and submit photographs indicating compliance to various requirements of this specification.

### **For Paver Blocks:**

The contractor shall maintain a comprehensive record of the paver block works as per the approved ITP. All records shall be in hard copy, signed by the MLDL's Quality manager, unless electronic records are permitted by the Engineer.

Contractor shall submit product data of paver block and specific paving system suggested in the relevant IS code of practice.

Manufacturer's confirmation that the material supplied meets IS requirements and his application instructions.

### **Completion and Delivery:**

Work related to Internal Road Construction shall not be deemed as complete till such time all the following conditions are fulfilled:

- All the signaling sign boards of roads denoting speed breaker, rambler, turns, U turns etc. are erected at desired locations.
- Post construction survey records are submitted.
- There are no defects in each layer of road or all defects are repaired to the satisfaction of the Engineer.
- All quality tests, inspection records and submittals mentioned under 'Submittals' in this document are furnished to the Engineer.

### **For Paver Blocks:**

A work related to paver block construction shall not be deemed as complete till such time all the following conditions are fulfilled:

- There are no defects in the paver block work or defects have been rectified to the satisfaction of the Engineer. Specifically, the compaction, level, slope & alignment required for the paver blocks should have been achieved as per permissible tolerances, as seen after the completion of paving.

All quality documents, test certificates have been submitted

## **7. Safety Management System Requirements:**

Refer MLDL EHS plan for Safety Management Requirements.



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### **8. Mode of Measurement:**

**8.1** Concrete as actually done shall be measured for payment, subject to the following tolerances. Any work done extra over the specified dimensions shall not be measured for payment.

**8.1.0** Length and width shall be measured to the nearest 0.01 meter and the thickness shall be measured nearest 0.00s meter or nearest to specified tolerances whichever is less.

**8.1.1** Areas shall be worked out to the nearest 0.01 sq. m.

**8.1.2** Cubic contents shall be worked out to the nearest 0.01 cum.

### **8.2 Measurement:**

**8.2.0** Subgrade and Sub base:

Excavation and earthwork necessary to bring the road alignment to proper level making embankment, drains and site clearance shall be measured as specified in the specification of earthwork or the reference for the same shall be taken from IS 1200 (Part 1) : 1974.

**8.2.1** Wet mix Macadam:

Wet mix macadam shall be measured as finished work in position in Cum.

**8.2.2** Prime coat:

Priming surface of Wet Mix Macadam, prior to surface dressing shall be measured separately in Sq. m.

**8.2.3** Tack coat:

Tack coat shall be measured in terms surface area of application in of Sq. m depending upon the rate of spread specified.

**8.2.4** Dense Bitumen Macadam:

Bituminous mix macadam with binder course shall be measured as finished work in Cum. The work of filling potholes not exceeding 0.005 cum shall be included in the description of item and shall not be measured separately.

**8.2.5** Bituminous Concrete:

Bituminous concrete shall be measured as finished work in cum.

### **8.3 Rates:**

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**8.3.0** The unit rate for road work shall include the cost of all materials, labour, tools and plant required for mixing, placing in position and compacting, finishing as per directions of the Engineer, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications.

All expenses likely to be incurred by the contractor in transporting materials to the site of works, the expenses incurred in improving the quality of materials to acceptable levels (such as screening, washing, etc.) and expenses incurred in proper storage of materials as directed by the Engineer, expense incurred in testing, supervision, Quality, Safety and Environment management, repairs etc. are to be included in the unit rate

### 9. Acceptance Criteria & Tolerances:

Item Description	Tolerances & Standards	
<b>Internal Roads</b>		
<b>Embankment and Sub grade construction</b>		
Stripping depth of topsoil from all areas of cutting and from all areas to be covered by embankment foundation	Not exceeding 150 mm.  Stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired.	
<b>Compaction Requirements for Embankment and Sub grade</b>		
<i>Type of work/ material</i>	<i>Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)</i>	
Sub grade and earthen shoulders	Not less than 97%	
Embankment	Not less than 95%	
Expansive Clays	Not allowed	
Level upto which ground shall be loosened and compacted in case where difference between sub grade level and ground level is less than 0.5 m and ground does not have 97 percent relative compaction with respect to dry density as given in table above	0.5 meter below the sub grade level, watered and compacted in layers to not less than 97 percent of dry density as given in table above	
Thickness of uniform layers in which embankment and sub grade material shall be spread	Not exceeding 100 mm compacted thickness	

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Moisture content of each layer of soil that at time of compaction	Of 1% above to 2% below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS: 2720 (Part 8) as the case may be.	
Size of clods or hard lumps of earth after broken	75 mm when being placed in embankment and a maximum size of 50 mm when being placed in the sub grade.	
Static weight of vibratory roller for compaction	80 to 100 KN	
Depth of topsoil during finishing operations to sustain plant growth	75 mm to 150 mm.	
<b>Construction of Granular Sub base</b>		
Moisture content of loose material of sub-base at the time of compaction	From 1 % above to 2 % below the optimum moisture content corresponding to IS: 2720 (Part 8)	
Rolling of subgrade already finished	By 2 passes of 80-100 kN smooth wheeled roller	
Weight of smooth wheeled roller to be used for compaction if thickness of compacted layer does not exceed 100 mm	80 to 100 KN weight may be used.	
Weight of vibratory roller for a compacted single layer up to 225 mm the compaction	Minimum 80 to 100 kN static weights with plain drum or pad foot drum or heavy pneumatic tired roller of minimum 200 to 300 kN weight having a minimum tire pressure of 0.7 MN/m <sup>2</sup> or equivalent capacity roller	
Speed of roller	Not exceed 5 km per hr.	
Density to be achieved by rolling	At least 98 % of the maximum dry density for the material determined as per IS: 2720 (Part 8).	
<b>Wet mix macadam / Base:</b>		
Compaction		
1. Wheel roller of weight to be used if the thickness of single compacted layer does not exceed 100 mm 2. Wheel roller of weight to be used for compacted single layer up to 200 mm 3. Speed of roller	1. 80 to 100 KN weight may be used. 2. Minimum static weight of 80 to 100 KN or equivalent capacity roller. 3. Shall not exceed 5 km/h.	
Irregularities during rolling for which surface should be loosened and premixed material added or removed as required	Which exceed 12 mm when tested with a 3 m straight edge	

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Density to be achieved by continued rolling	At least 98 % of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).	
Time for which road shall be allowed to dry after final compaction of wet mix macadam course	For 24 hours.	
<b>Prime coat over Base</b>		
Curing of primer	At least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid.	
Application of Tack coat		
Rate of application of Tack coat:		
<i>Type of Surface</i>	<i>Quantity of liquid bituminous material in Kg per sq.m. area</i>	
1. Normal bituminous surfaces	0.20 to 0.25	
2. Dry and hungry bituminous surfaces	0.25 to 0.30	
3. Granular surfaces treated with primer	0.25 to 0.30	
4. Non bituminous surfaces Granular base (not primed)	0.35 to 0.40	
Temperature for a bituminous emulsion and cutback	20°C to 70°C and 50°C to 80°C if RC-70/MC-70 is used, respectively	
Composition of bituminous concrete pavement layers:		
<i>Grading</i>	<i>1</i>	<i>2</i>
Nominal aggregate size	13 mm	10 mm
Layer Thickness	35-40 mm	25-30 mm
<i>IS Sieve 1 (mm)</i>	<i>Cumulative % by weight of total aggregate passing.</i>	
45	-	-
37.5	-	-
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-37	26-38

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0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix <sup>2</sup>	5.5	5.5
Bitumen grade (pen)	30/40	30/40
Requirements for bituminous pavement layers		
Minimum stability (kN at 60 Degree Celsius)	9.0	
Minimum flow (mm)	2	
Maximum flow (mm)	4	
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen	
Per cent air voids	3-6	
Per cent voids in mineral aggregate (VMA)	See Table 3.14 below	
Per cent voids filled with bitumen (VFB)	65-75	
Loss of stability on immersion in water at 60 Deg C (ASTM D 1075)	Min. 75 per cent retained strength	

Item Description	Tolerances & Standards
<b>Paver Blocks</b>	
<b>Sand bed thickness for paver block installation</b>	50 mm thick loose sand (clean, well graded passing through 4.75 mm sieve) and levelled as required / as per approved method statement.

### 10. Annexures:

- WPM.B.20 - SOP for Road Works