Contents **Page**

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12. SCOPE

This specification covers the general requirements for the materials and construction of soling, Water Bound Macadam (WBM) roads, bituminous/concrete surface treatment of roads and walkways and drains and culverts.

12.1 APPLICABLE CODES & SPECIFICATIONS

The following specifications, standards and codes are made a part of this specification. All standards, tentative specifications, specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revision. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

1.	IS: 73	:	Paving Bitumen
2.	IS:215	:	Road Tar
3.	IS:217	:	Cutback Bitumen
4.	IS:383	:	Specification for coarse and fine aggregate from natural sources for concrete.
5.	IS:458	:	Concrete pipes (with and without reinforcement)
6.	IS:460	:	Test sieves
7.	IS:1077	:	Common burnt clay building bricks
8.	IS:1124	:	Method of test for water absorption of natural building stones.
9.	IS:1195	:	Specification for Bitumen Mastic for flooring
10.	IS:1196	:	Code of Practice for laying Bitumen Mastic flooring
11.	IS:1834	:	Sealing compounds, hot applied, for joints in concrete.
12.	IS:2116	:	Sand for masonry mortars
13.	IS:2386 Parts I to VIII	:	Methods of test for aggregates for concrete
14.	IS:2720	:	
15.	IS:3102	:	Classification of burnt clay bricks
16.	IS:3495	:	Method of sampling and testing clay buildings bricks.
17.	IRC:16	:	Tentative specification for Priming of Base Course with Bituminous Primers.

18. IRC:17 : Tentative specification for Single Coat Bituminous Surface Dressing.
19. IRC:19 : Standard specifications and Code of Practice for Water Bound Macadam.
20. IRC:29 : Tentative specification for 4 cm Asphaltic Concrete Surface Course.
21. IRC:48 : Tentative specification for Bituminous Surface Dressing using Precoated Aggregates.
22. Ministry of Surface Transport (MOST) (Roads Wing) : Specification for Road & Bridge works.

12.1.2 Where the requirements of the above codes differ from UIL specification or other specifications forming a part of the bid document, the latter shall govern.

12.1.3 All earthwork and concrete work shall be according to component specifications "Earthwork" and "Concrete and Formwork" - respectively.

12.2 CONSTRUCTION SEQUENCE

12.2.1 It is the intent of this specification that the Waterbound Macadam (WBM) road be constructed first and surfaced with bituminous surfacing as specified hereunder. This shall then be opened to traffic, as directed by Owner/Engineer. After such period of time as decided by Owner/Engineer, when the major construction and/or erection activities within plant limits are over, Contractor shall rectify all defects, wear and tear, etc. and surface the road with bituminous treatment as specified hereunder.

12.3 MATERIALS

12.3.1 General

12.3.1.1 All materials shall be obtained from local sources and approval of Engineer shall be obtained prior to starting of work.

12.3.2 Soling Stone

12.3.2.1 It shall be clear, sound, dense, hard stone of uniform quality free from deleterious material, cracks, decay and weathering. Water absorption shall not be more than 5 percent. The height of the soling stone shall be equal to the specified thickness of soling. The length and breadth shall not exceed twice the specified thickness.

12.3.3 Stone Aggregate/Metal

12.3.3.1 Coarse aggregate, stone chippings shall consist of natural or crushed stone, clean, hard, tough, durable and free from excess of flat elongated, soft and disintegrated particles, dirt, salt, alkali, vegetable matter, adherent coatings, organic and other objectionable matter, conforming to IS:383 and shall satisfy the physical requirements of Tables 1 or 2 as applicable. Aggregate for bituminous wearing courses shall in addition have good hydrophobic properties i.e. capacity of retaining the film of bituminous material applied to the stone in all weather conditions and especially in wet conditions. Basalt, dolerite are good in this respect; granite, quartzite are comparatively poor.

TABLE - 1

PHYSICAL REQUIREMENT OF

COARSE AGGREGATE FOR WATER BOUND MACADAM

Sl.No.	Type of Construction	Test	Requirements	Test Method
1	Sub-base	Los Angeles Abrasion Value*	60 percent max.	IS:2386 (Part-IV)
		OR		
		Aggregate Impact Value*	50 percent max.	IS:2386 Part IV
2	Base	a) Los Angeles Abrasion Value*	50 percent max.	IS:2386 (Part-IV)
		OR		
		Aggregate Impact Value*	40 percent max.	IS:2386 (Part IV)
		b) Flakiness Index **	15 percent max.	IS:2386 (Part-I)

TABLE - 2

PHYSICAL REQUIREMENT OF AGGREGATES

FOR BITUMINOUS WEARING COURSE

Sl.No.	Test	Requirement	Test Method
a)	Los Angeles Abrasion Value * **OR** Aggregate Impact Value *	40 percent max. 30 percent max.	IS:2386 (Part-IV) IS:2386(Part-IV)
b)	Flakiness Index **	15 percent max.	IS:2386(Part-I)
c)	Stripping Value	25 percent max.	MOST***
d)	Water Absorption	1 percent max.	IS:2386(Part-III)

(*) Aggregates may satisfy requirements of either of two tests.

(**) Requirement of flakiness index shall be enforced only in case of crushed broken stone.

(***) Specification for Road & Bridge Works, Ministry of Surface Transport (roads wing).

12.3.3.2 The coarse aggregate for water bound Macadam shall conform to one of the gradings given in Table 3 below:

TABLE - 3

GRADING REQUIREMENTS OF COARSE AGGREGATES (IRC:19-1977)

Grading No.	Size Range	Sieve Designation Passing the Sieve	Percent by Weight
1	90mm to 45mm	125 mm 90 mm 63 mm 45 mm 22.4 mm	100 90-100 25 – 60 0 – 15 0 – 5
2	63mm to 45mm	90 mm 63 mm 53 mm 45 mm 22.4 mm	100 90 - 100 25 – 75 0 –15 0 – 5
3.	53mm to 22.4 mm	63 mm 53 mm 45 mm 22.4 mm 11.2] mm	100 95 - 100 65 - 90 0 - 10 0 - 5

12.3.3.3 The size of stone chippings for surface dressing shall be in accordance with Table-4.

TABLE - 4

SIZE REQUIREMENTS OF STONE CHIPPINGS

FOR SURFACE DRESSING

Sl.No.	Type of Construction	Nominal size of stone chipping	Specifications
1	Single coat Surface Dressing	12 mm	100 percent passing through 20mm seive and retained on 10mm sieve.

12.3.4 Screenings For Water Bound Macadam

12.3.4.1 Screenings to fill voids in the coarse aggregate shall consist of the same materials as the coarse aggregate. However, where permitted, predominantly non-plastic material such as murum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

12.3.4.2 Screenings shall conform to the gradings set forth in Table-5. Screenings of Type-A in Table-5 shall be used with coarse aggregates of grading 1 in Table-3. Screening of Types A or B, as specified, shall be used with coarse aggregates of grading 2. Type-B screenings shall be used with coarse aggregates of grading 3. For screenings like murrum and gravel, the gradings given in Table 5 shall not be regarded as binding.

TABLE - 5

GRADING REQUIREMENTS FOR SCREENINGS FOR W.B.M.

(IRC:19-1977)

Grading classification	Size of Screenings	Sieve Designation	Percentage by weight passing the sieve
A	13.2 mm	13.2 mm 11.2 mm 5.6 mm 180 microns	100 95 - 100 15 –35 10
B	11.2 mm	11.2 mm 5.6 mm 180 microns	100 90 – 100 15 – 35

This use of screenings may be omitted in the case of soft aggregates such as brick metal, kankar and laterite.

12.3.5 Binding Material

12.3.5.1 Binding material to prevent avelling of water bound Macadam shall comprise of a suitable material, approved by Owner/Engineer, having plasticity index value of less than 6 as determined in accordance with IS:2720 (Part-V). Binding material shall consist of a fine grained material passing 100 percent through 425 micron sieve.

12.3..5.2 Application of binding material may not be necessary, when the screenings used are of crushable type such as murum or gravel.

12.3.6 Murum/Kankar/Gravel/Sand

12.3..6.1 Murum shall be obtained from pits of weathered disintegrated rocks and shall contain silicious material and natural mixture of clay of calcarious origin. Murum shall be sound and hard, of a quality not affected by weather, to be screened at the quarry and free from all impurities. Only pure murum shall be received at the site of work. The large lumps must all be broken at the quarry and murum delivered at site must pass in every direction through a 63 mm

ring. Murum shall not contain more than 5% to 8% of fine sand passing through a 75 micron sieve.

12.3.6.2 Kankar shall be as tough as can be procured in the locality, having a blue, almost opalescent fracture. It shall not contain any clay in the cavities between the nodules. 100 percent shall pass through a square mesh of 63 mm.

12.3.6.3 Gravel shall be composed of large, coarse, silicious grains, sharp and gritty to the touch, thoroughly free from dirt, organic and deleterious matter. The gravel shall be hard, tough, dense and shall not contain particles bigger than 12 mm and more than 10 percent silt.

12.3.6.4 Sand used for building road surfaces shall be coarse, sharp, gritty, clean, granular material. Only material passing through 4.75 mm sieve and retained on 75 micron sieve shall be used. All material passing through a 75 micron sieve shall be rejected.

12.3.7 Bituminous Materials

12.3.7.1 Bituminous materials shall conform to IS:73, IS:215 or IS:217 as applicable and be of the grade specified in this specification.

12.4 SUPPLYING AND STACKING OF MATERIALS

12.4.1 The ground under the stacks shall be cleaned, levelled or dressed to a uniform slope and all humps, depressions, etc. shall be removed. The stacked material shall be free from vegetation and other foreign matter. Soling stone shall be stacked compactly in stacks. In case any stack shall be found loose and improperly made Owner/Engineer can direct the restacking of some or of all the stacks. The stacks for all materials shall be uniformly distributed along the road. The supply of material shall be completed for the entire work or for a complete length of one kilometre or as directed by Owner/Engineer. All rejected material shall be separated out and removed from site before recording measurements.

12.4.2 Soling stone shall be stacked in convenient units of 1 to 1.25 M height and of uniform width and length as directed by Owner/Engineer. Actual dimensions of stacks shall be recorded and total quantity shall be reduced by 15 percent to arrive at the net quantity for payment.

12.4.3 Stone aggregate/metal shall be stacked in convenient units of 1 M top width, 2.2 M bottom width, 60 cm height and length in multiples of 3 M. Template of wood or steel shall be used for making the stacks and shall always be kept at site for check measurements.

The section of the stacks shall be taken from the standard template used and length of the stack recorded to arrive at the contents. The total quantity so arrived at shall be reduced by 10% to arrive at the net quantity for payment.

12.4.4 Screenings, binding material, stone chippings, murum, kankar, gravel and sand shall be stacked in convenient units of one cu.m. The stacks shall be made with wooden boxes open at both ends and 2 x 2 x 0.25 M dimensions. These shall always be kept at site for stacking and check measurements. Materials shall be measured from the actual dimensions of the stacks. No deduction shall be made for voids to arrive at the net quantity for payment.

12.4.5 Bituminous material shall be brought to site of work in sealed original containers. Damaged containers shall not be allowed. All drums brought to site shall be serially numbered and used in the same order. Material shall be recorded as per standard weights of different type of content as intimated by manufacturers. The material shall be weighed where containers are found leaking.

12.4.6 The rates for supplying materials as per specification and stacking them as per the preceding clauses shall include the cost of all labour and materials involved in all the operations described above including transportation to the site of work along the alignment of the road as directed by Owner/Engineer.

12.4.7 Wherever separate items for supplying and stacking are not given the rate for the same shall be deemed to be included in the items for laying of wearing / bituminous course.

12.5 PREPARATION AND COMPACTION OF SUBGRADE

12.5.1 The proper preparation of the sub-grade or road bed or formation for any road is of utmost importance before the road structure (pavement) is laid over it. The surface of the formation for a width equal to that of the sub-base course shall first be cut to a depth below the proposed finished level, equal to the combined depth of sub-base and wearing courses (due allowance being made for consolidation). Any over excavation made during the time of excavation is to be filled with good earth and compacted by Contractor at his own cost. Surplus excavated earth shall be disposed off beyond the road limit as directed by Owner. The surface shall then be cleaned of all foreign substances. Any ruts or soft yielding places that appear due to improper drainage conditions, traffic, hauling or from any other cause, shall be corrected. The sub-grade shall be consolidated with power road roller of 8 to 10 tonnes and dressed off true to profile.

The roller shall run over the sub-grade till the soil is evenly consolidated to 95% of standard Proctor density with 2% variation in optimum moisture content. Roller shall pass minimum of 5 runs on the sub-grade. Rolling shall commence at the edges and progress towards the centre longitudinally except that on super-elevated portions, it shall progress from the lower to the upper edge parallel to the centre line of the pavement. 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 camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding earth and sub-grade re-rolled.

12.5.2 The measurements shall be taken in sq.m. and the rate shall include the cost of all materials, labour, plant and equipment required for all the operations mentioned above.

12.6 SOLING COURSE:

12.6.1 Soling shall be used as a sub-base where specified in the Schedule of Quantities. The width and the compacted thickness of the soling shall be as shown on the drawings. Due allowance shall be made initially so that specified compacted thickness is finally achieved. Soling shall not be laid on a wet sub-grade.

12.6.2 The stones in soling shall be hand packed with greatest length across the road. The stones shall be laid closely in position on the sub-grade, with its broadest side downwards and to make up the specified thickness of the base with single stones to correct camber and grade. Soling shall not be laid in two layers. Projections in stones which would result in excessive voids shall be knocked off with a hammer and/or selected stones used to fit the shape of the stones already laid. The joints shall be staggered. All interstices between stones shall be wedged in with smaller stones of suitable size, well driven-in to enable tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of soling stone and shall not lag behind. All projecting corners above the surface of the level of the soling shall be snapped off with hammer to bring them in level. Gravel shall be spread in thin layers (to fill the remaining voids) and swept to assist the filling of voids. Spreading of gravel, sweeping and watering shall continue till interstices are completely filled.

At all times, only enough water shall be sprinkled to force the gravel into voids and never so much as to soften the sub- grade. The process of filling shall be accompanied by rolling with a power roller weighing not less than 10 tonnes. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass and the passes shall start from edge and proceed towards centre. The roller shall run over the same surface at least eight times. The surface shall be checked with templates of approved design (to be provided by Contractor) and high and low spots corrected by removing soling and re-packing.

12.6.3 Measurements shall be made for the finished work in square metres with due consideration of the net measurements of the stacks of soling stone used in the work. The rate shall include the cost of all materials, labour, plant and equipment required in all the operations described above.

12.7 WATER BOUND MACADAM COURSE USING HAND BROKEN METAL

12.7.1 The surface over which water bound Macadam is to be laid shall be prepared to the specified grade and camber and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Side shoulders upto a height equal to the uncompacted Macadam course shall be made along the outer edges of the Macadam course having a clear distance between them equal to the width to be metalled.

12.7.1.1 WBM SUB-BASE COURSE shall be provided in lieu of a soling course where specified in the Schedule of Quantities. The coarse aggregate for this shall normally conform to Grading 1 of Table-3 and screening to Type A of Table-4. The total consolidated thickness of the sub-base course shall be as specified in the Schedule of Quantities/drawings.

12.7.1.2 WBM BASE COURSE : The coarse aggregate for this shall normally conform to Grading 3 of Table-3 and screening to Type-B of Table-4. The total consolidated thickness of the base course shall be as specified in the Schedule of Quantities/drawings.

12.7.2 Spreading Coarse Aggregate

12.7.2.1 The coarse aggregate road metal is to be spread uniformly and evenly over the prepared base to a thickness of 115 mm and rolled dry to a 75 mm consolidated thickness. This compacted layer shall be sprinkled with water and continuously rolled to help interlocking of stone pieces. Another 115 mm thick layer of road metal shall be laid on previously consolidated layer and rolled dry to a consolidated thickness of 75 mm. Water shall then be sprinkled over the surface and rolling continued to get the proper interlocking. During rolling, the camber and grade of the road shall be maintained. The maximum compacted thickness of each layer shall not exceed 100 mm.

12.7.2.2 The spreading shall be done from stockpiles by raking the stacks with rakes so as to leave behind mud and dust. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over uncompacted or partially compacted base be permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregate shall not normally be spread more than 24 hours in advance of the subsequent construction operation of dry rolling. No traffic should be allowed to pass over the spread metal until the road is declared open to traffic.

12.7.3 Rolling

12.7.3.1 Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity. The weight of the roller shall depend upon the type of aggregate and shall be indicated by Owner/Engineer. Rolling shall begin from the edges and gradually progress towards the centre. On super-elevated portions the rolling shall proceed from inner edge to outer edge. First the edges/edge shall be compacted with roller running forward and backward and then move inwards parallel to the centreline of the road, in successive passes uniformly lapping preceding tracks by at least one half width. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-grade or sub-base. The rolled surface shall be checked transversely and longitudinally with templates and all undulations shall be corrected by loosening the surface, adding or removing necessary amounts of aggregate and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions.

12.7.4 Application of Screenings

12.7.4.1 After the coarse aggregate has been rolled in accordance with Clause 12.12.3 screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the

12.7.4.2

roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers. Screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate. Spreading, rolling and brooming of screening shall be carried out in only such length of the road which would be completed within one day's operation.

12.7.5 Sprinkling and Grouting

12.7.5.1 After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly.

The sprinkling, sweeping and rolling operations shall be continued, with additional screenings applied as necessary, until the coarse aggregate has been thoroughly keyed, well bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the sub-grade on sub-base does not get damaged due to the addition of excessive quantities of water during construction. In case the sub-grade or sub-base gets damaged, the Contractor shall, without any extra compensation, rectify the damaged portion.

12.7.6 Application of Binding Material

12.7.6.1 After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After application, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms or mechanical brooms so as to fill the voids properly. This shall be followed by rolling with a 10T roller, during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These

operations shall continue until the resulting slurry after filling the voids, forms a wave ahead of the wheels of the moving roller.

12.7.7 Setting and Drying

12.7.7.1 After the final compaction of water bound Macadam course the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings of binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the Macadam has set.

The surface evenness of completed WBM course in the longitudinal and transverse directions shall be as specified hereunder:-

Longitudinal profile measured with a metre straight edge	Max. permissible tolerance 15 mm. Max. no. of undulations Permitted in any 300 M length Exceeding 12 mm : 30 Nos.
Cross profile	Max. permissible undulation when measured with a camber template : 12 mm

12.8 MULTIPLE LAYERED COURSE

When the total consolidated thickness of the water bound Macadam course is more than 100 mm, it shall be constructed in layers.

12.9 BITUMINOUS SURFACE TREATMENT

12.9.1 For this work stone chippings conforming to size given in Table-4 shall be used at the rate of 0.15 cu.m per 10 sq.m. of the road surface and binder which shall be straight run bitumen of 80/100 grade conforming to IS:73 at the rate of 18.0 Kg per 10 sq.m of the road surface for surface dressing.

12.9.2 Weather and Seasonal Limitations

12.9.2.1 The surface dressing work shall be carried out only when the atmospheric temperature in shade is 16 deg C or above. No bituminous material shall normally be applied when the surface of cover material is damp or when the weather is foggy or rainy or during dust storms.

12.9.3 Preparation of Base

12.9.3.1 The base on which surface dressing is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section by repairing all potholes or patches and ruts. The potholes shall be drained of water and cut to regular shape with vertical sides. All loose and disintegrated material shall be removed. The pothole shall then be filled either with (i) coarse aggregate and screenings and compacted with heavy hand rammers or approved mechanical tampers or (ii) premixed chippings (using 52 Kg of bitumen grade 80/100 with one cu.m of stone chippings) after painting the sides and bottom of the holes with a thin application of bitumen, or a combination of both (i) and (ii) as directed by Owner/Engineer.

12.9.3.2 The surface shall be thoroughly swept and scraped clean of dust and any other extraneous matter before the spraying of binder. The cleaning shall be done first with hand brushes, then with softer brushes and finally by blowing with sacks or gunny bags.

12.9.4 Application of Binder

12.9.4.1 Binder shall be heated to 150 deg C to 177 deg C, maintained at the temperature and sprayed on the dry surface in a uniform manner with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer through leakage or any other reason shall be suitably corrected before the stone chippings are spread.

12.9.5 Application of Stone Chipping

12.9.5.1 Immediately after the application of the binder, stone chippings in a dry and clean state shall be spread uniformly on the complete surface. If necessary the surface shall be broomed to ensure uniform spread of chippings. The surface shall be checked by means of a camber board laid across the road and a 3 metre straight edge laid parallel to the centre line of the road and undulations if any, shall be corrected by addition or removal of blindage.

12.9.6 Rolling

12.9.6.1 Immediately after the application of the cover material, the entire surface shall be rolled with a 8 to 10 tonne smooth wheeled roller. Rolling shall commence at the edges and progress towards the centre except in super-elevated portions where it shall proceed from the inner edge to the outer.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional material shall be spread by hand in whatever quantities required to make up for the irregularities. Rolling shall continue until all material is firmly bedded in the binder and presents a uniform closed surface. Generally five to six passes shall be made for thorough compaction of the surface or as directed by Owner/Engineer. Along kerbs, manholes at all places not accessible to roller, the rough compaction shall be secured by means of steel rammers or hand rollers.

12.9.7 Opening to Traffic

12.9.7.1 Traffic shall not be permitted to run on any newly surface dressed area for 24 hours.

12.9.8 Measurements and Rate

12.9.8.1 The measurements shall be taken for the finished work in sq.m. The rate shall include the cost of materials, labour, plant and equipment involved in all the operations described above.

12.10 PREMIX CARPET

12.10.1 This work shall consist of laying and compacting a premix carpet of 50 mm thickness in a single course composed of suitable small sized aggregates premixed with a bituminous binder on a previously prepared base.

The premix carpet may be made using standard paver machine.

12.10.2 Materials

12.10.2.1 Binder : This shall be 80/100 grade straight run bitumen conforming to IS:73. The quantity of bitumen for the tack coat and seal coat shall each be 0.75 kg/sq.m. and for the premixing it shall be 3 Kg per sq.m. of laid carpet. A proper record shall be kept to ensure that daily output of work is co-related with the quantity of bitumen used.

12.10.2.2 Aggregate : These shall satisfy the physical requirements set forth in Table-2. The aggregate shall be of 13.2 and 11.2 mm nominal size.

12.10.3 Weather and Seasonal Limitations

12.10.3.1 Premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 deg C or below.

12.10.4 Tack Coat

12.10.4.1 Binder shall be heated to 163 deg C to 171 deg C maintained at that temperature and sprayed on the base at 0.75 kg per sq.m. of road surface. It shall be applied uniformly with the aid of mechanical sprayers. Binder shall not be applied when the atmospheric temperature in shade is 4.5 deg C or less. The tack coat shall be applied just ahead of the spreading of the premix.

12.10.5 Preparation of Premix and Laying

12.10.5.1 The stone aggregate shall be surface dry and contain not more than 2 percent moisture before use. It shall be first screened of dust and measured in boxes, suitably heated to a temperature as directed by Owner/Engineer and then loaded into the drum mixer according to the capacity of the mixing drum in the proportion specified. The binder shall be heated to 150 deg C to 177 deg C in boilers and maintained at that temperature. The heated binder shall be drawn from the boiler into a suitable container or in bucket gauged to show the weight of Bitumen in it.

12.10.5.2 The premixed material shall be spread on the road surface with rakes to a thickness sufficient to achieve after consolidation the specified thickness, without any undue loss of time. The consolidated thickness shall in no place be less than the specified thickness. The camber shall be checked by means of a camber board and inequalities evened out. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 6 to 9 tonne power rollers, preferably of smooth wheel tandem type or other approved plant. The edges along and transverse to the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

12.10.6 Rolling

12.10.6.1 Rolling shall begin at the edges and progress towards the centre longitudinally, except that on the super-elevated portions it shall progress from the lower to upper edge parallel to the centreline of the pavement. When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled and compacted and all the roller marks eliminated.

In each pass of the roller, preceding track shall be overlapped uniformly by at least one third of the track made in the preceding pass. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Excessive rolling shall be avoided.

12.10.7 Seal Coat

12.10.7.1 A seal coat shall be applied to the surface immediately after laying the carpet and rolled. The Bitumen for the premix seal coat shall be at the rate of 1.2 kg/sq.m. In low rainfall areas (i.e. less than 150 cm. Per year), a premixed sand seal coat mixed preferably in a mechanical mixer after heating the sand, should be applied. Medium coarse sand of 0.06 M^3 per 10 sq.m. of road surface shall be used. In high rainfall areas (i.e. over 150 cm. per year), a liquid seal coat preferably with chippings should be applied. Coarse aggregates – 6.7 mm size, passing IS 11.2 mm mesh, retained on IS 2.8 mm mesh – 0.09 M^3 per 10 sq.m. of road surface shall be used. The longitudinal profile of the finished surface, when tested with a 3 M straight edge, shall have no undulation greater than 10 mm and in any 300 m length the number of undulations of 6 mm size shall not exceed 30. The cross profile, when checked with a camber template, shall not show a variation of more than 6 mm from the specified profile. No traffic shall be allowed on the road till the seal coat has been placed.

12.10.8 Opening to traffic

12.10.8.1 Traffic shall be allowed on the road after a lapse of minimum 24 hours.

12.10.9 MODE OF MEASUREMENT & RATE

12.10.9.1 The measurement shall be taken for the finished work in sq.m. The rate shall include the cost of all materials, labour, plant and equipment involved in all the operations described above.

12.11 BITUMINOUS CONCRETE

12.11.1 This work shall consist of constructing a single layer of 50 mm thick Bituminous concrete wearing course to the following specifications on a previously prepared base.

12.11.2 Materials

12.11.2.1 Binder : This shall be 80/100 grade straight run bitumen conforming to IS:73. The quantity of bitumen for tack coat shall be 0.75 kg/sq.m. and for the bituminous concrete it shall be 56 kg/cu.m. of coarse aggregate and 128 kg/cu.m of fine aggregate. A proper record shall be kept to ensure that daily output of work is correlated with the quantity of bitumen used.

12.11.2.2 Aggregates : These shall be as per Clause 12.4 and satisfy the physical requirements set forth in Table-2. The quantity of coarse aggregate for 50 mm thick asphaltic concrete shall be 4.8 cu.m./100 sq.m. The gradation of aggregate shall be as defined in Table-6 below:

TABLE - 6

NOMINAL SIZE OF AGGREGATE

Sieve	Coarse Aggregate
26.5 mm	100
22.4 mm	82-98
13.2 mm	60 - 83
11.2 mm	55 - 77
5.6 mm	45 – 65
2.36 mm	40 - 55
600 micron	20 – 30
300 micron	15 – 25
150 micron	10 – 20
75 micron	6 – 9

12.11.2.3 Fine Aggregates : the fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve consisting of crusher run screenings, natural sand or mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or deleterious substances. The quantity of sand shall be 2.40 cu.m. per 100 sq.m.

12.11.2.4 Quantities of materials are given as a guide. Actual proportions shall be determined by a job mix formula prior to the start of work, unless otherwise directed by Engineer. The mix as designed and laid shall satisfy the requirements given in Table 7 below based on Marshall method of design.

Table 7 : REQUIREMENTS OF BITUMINOUS CONCRETE MIX

Sl.No.	Description	Requirement
1.	Marshall stability (ASTM Designation: D 1559) determined on Marshall specimen, compacted By 750 compaction blows on each end, in kg. (minimum)	650
2.	Marshall flow (mm)	2 - 4
3.	Per cent voids in mix	3 – 5
4.	Per cent voids in mineral aggregate filled with bitumen	75 – 85
5.	Per cent voids in mineral aggregate (VMA)	13 – 16
6.	Binder content per cent by weight of total mix (to be decided on Marshall design method)	5 – 7

Notes:

1. It is suggested that higher stability values consist with other requirements should be achieved as far as possible.
2. At bus stops, parking areas and round abouts, stability of 750 kg. And near minimum flow value should be adopted.
3. The attempt should be to have well graded aggregate and the per cent voids in the mix closer to the lower limit.
4. The binder content in the case of slag is likely to exceed the limit indicated in the Table.

12.11.3 Weather and Seasonal Limitations

12.11.3.1 Bituminous concrete shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 10°C or less.

12.11.4 Preparation of Base

12.11.4.1 The base on which bituminous concrete is to be laid shall be prepared as per Clause 12.9.3.

12.11.5 Tack Coat

12.11.5.1 Clause 12.10.4 shall apply.

12.11.6 Preparation of Mix and Laying

12.11.6.1 The stone aggregate shall be surface dry and contain not more than 2 percent moisture before use. It shall be first screened of dust and measured in boxes, heated to 155°C to 163°C and then loaded into the drum mixer according to the capacity of the mixing drum in the proportion specified. The binder shall be heated to 149°C to 177°C in boilers and maintained at that temperature. At no time shall the difference in temperature between the aggregate and binder exceed 14°C. The heated binder shall be drawn from the boiler into a suitable container or in a bucket gauged to show the weight of bitumen in it.

12.11.6.2 Mixing shall be done in two stages. The coarse aggregate of the correct standard size and proportion shall be fed into the Mixer to which 2/3rd of the total specified quantity of bitumen heated to the appropriate temperature shall be added. When the coarse aggregate is well coated, the fine aggregate in the specified proportion followed by the balance 1/3rd quantity of total bitumen shall be fed into the mixer. Mixing shall be continued until a homogeneous mix is produced and all particles are uniformly coated with bitumen.

12.11.6.3 The hot mix shall be discharged from the mixer, carried to the road surface and spread to specified lines and levels immediately after applying the tack coat, to a thickness sufficient to achieve after consolidation the specified thickness. The consolidated thickness shall in no place be less than the specified thickness.

Temperature of the mix at the time of laying shall be in the range of 121°C - 163°C. Rakes and spade or drag spreaders shall be used for spreading the mixture. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centreline of the road. Longitudinal joints shall be offset by at least 150mm from those in the binder course (tack coat). All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

12.11.7 Rolling

12.11.7.1 Immediately after the spreading of mix it shall be thoroughly compacted by rolling preferably with vibratory roller. The roller speed shall not exceed 5 km per hour. Any high spots or depressions which become apparent shall be corrected by addition or removal of mix material. The roller shall uniformly overlap not less than a third of the track made in the preceding pass.

The wheels of the roller shall be moistened with gunny bags to prevent the mix sticking to the wheels while rolling, but in no case shall fuel/lubricating oil be used for this purpose. Rolling shall be continued till the mix is thoroughly compacted and all roller marks are eliminated.

12.11.8 Opening to Traffic

12.11.8.1 Traffic shall be allowed on the road after a lapse of minimum 24 hours, preferably 48 hours after laying as directed by Owner/Engineer.

12.11.9 Measurements and Rates

12.11.9.1 The measurement shall be taken for the finished work in sq.m. The rate shall include the cost of all materials, labour, plant and equipment involved in all the operations described above.

12.12 Seal Coat

12.12.1 This work shall consist of application of a seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and camber. It shall comprise of an application of a layer of bituminous binder followed by a cover of stone chippings.

12.12.2 Materials

12.12.2.1 Binder : This shall be 80/100 grade straight run bitumen conforming to IS:73. The quantity of bitumen shall be 1.5 kg per sq.m. of the road surface.

12.12.2.2 Stone Chippings : These shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They should be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matter. Stone chippings shall be of 10 mm size defined as 100 percent passing through 12.5 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 1.05 cu.m per 100 sq.m.

12.12.3 Preparation of Base

12.12.3.1 The seal coat shall be applied immediately after the laying of bituminous course which is required to be sealed. Before application of seal coat materials the surface shall be cleaned free of any dust or other extraneous matter.

12.12.4 Construction of Seal Coat

12.12.4.1 The binder shall be heated in boilers to a temperature of 163°C to 171°C and the seal coat applied and the surface rolled. Traffic shall be allowed after 24 hours. After a period of seven days, surplus grit shall be swept and collected and shall be used for binding the spots where bleeding occurs.

12.12.5 Measurements and Rate

12.12.5.1 Clause 12.11.9 shall apply.

12.13 SEMI-GROUTED METAL COURSE OVER SOLING SUB-BASE MATERIAL

12.13.1 Metal

12.3.1.1 The metal shall be angular, hard, tough, sound clean, dry and durable and of approved quality. The size of the stones shall be 38 mm to 75 mm. Metal having more than 5% rounded of flaky stone chip shall not be accepted. The

sample of metal shall be got approved before bringing on site. This metal may be generally hand-broken.

12.13.1.2 Stone chips to be used over grouted surface

They shall be free from dust, organic impurities etc. The size of the stone chips shall be 6 mm down and it should be retained on 4.75 mm sieve and should pass through 6.7 mm sieve. If the size of the grit chips does not conform to above standard, same shall be got screened on the site. The sample shall be got approved before collection.

12.13.1.3 60/70 Maxphalt

Asphalt required for this work shall be Maxphalt 60/70 or equivalent from approved manufacturer as per specific standard.

12.13.2 Mixing and Laying

The metal shall be cleaned, filled in baskets, conveyed to the place where it is required and spread evenly on the prepared surface of soling by giving a twisting motion to the basket at the time of spreading. The stone metal shall then be carefully hand packed and the interstices filled with downgraded metal. The surface shall be brought to the required camber which shall be checked at regular intervals of 5 meters by means of templates. Before and after rolling, the metal shall be dressed accurately to camber. The loose metal shall be rolled dry with 10 to 12 ton road roller until well compacted to thickness of 115 mm thick. Excessive dry rolling shall be avoided. Compacted layer shall be pressure grouted with 60/70 hot Maxphalt at the rate of 5 kg/M^2 of surface throughout and then this course covered with stone grit applied uniformly at 0.1 Cu.m. per to 10 M^2 of road surface to fill the surface voids between large stones. The surface then shall be rolled with 8 to 10 tonne road roller so that the resulting surface is evenly smooth in perfect line, level and camber to the satisfaction of Engineer and as per drawing.

12.13.4 Mode of Measurement

The payment shall be on M^2 basis of finished area as per drawings.

The rate shall include for all materials, laying, rolling and compacting etc. as specified.

12.14 BITUMINOUS SHEET

This type of treatment shall be provided for walkways, drives etc. with light intensity traffic. It shall consist of a mixture of coarse sand and stone chippings with bituminous binder, spread and consolidated to a thickness of 25 mm on a prepared surface after the application of a tack coat.

12.14.1 Materials

12.14.1.1 Clause 12.10.2.1 shall apply except that the quantities of materials shall be as given below. Bitumen for tack coat shall be 0.75 kg/cu.m. and for the bitumen sheet it shall be 56 kg/cu.m. of stone chipping and 128 Kg/cu.m. of sand (fine aggregate). The quantity of stone chipping shall be 1.65 cu.m. and 40% of 10 mm nominal size. The nominal size shall be as defined in Table-8 below:

TABLE - 8

NOMINAL SIZE OF STONE CHIPPINGS

Sieve	Stone Chipping Size	
	12.5 mm	10 mm
	Percentage Passing	
20 mm	100	-
12.5 mm	85 – 100	100
10 mm	0 – 45	85 - 100
4.75 mm	0 – 10	0 - 20
2.36 mm	-	0 - 5

The quantity of fine aggregate (sand) shall be 1.65 cu.m. per 100 sq.m. of road surface.

12.14.2 Preparation of Base

Clause 12.9.3 shall apply.

12.14.3 Tack Coat

Clause 12.10.4 shall apply.

12.14.4 Preparation of Mix and Laying

Clause 12.11.6 shall apply.

12.15 BITUMEN MASTIC

12.15.1 This type of treatment shall be provided for flooring of industrial buildings, warehouses, grain storage structures, surfacing of bridge decks, roads, footpaths etc. It shall consist of a mixture of bitumen binder with aggregate. The thickness and grade of flooring as per IS:1195 shall be as indicated in the item nomenclature.

12.15.2 Materials

12.15.2.1 Binder : The physical properties of the bitumen used shall conform to IS:1195.

12.15.2.2 Aggregate: The fine and coarse aggregate shall comply with the requirements of IS:1195.

12.15.2.3 The composition of the bitumen mastic mix shall conform to the range specified by IS:1195.

12.15.3 Preparation of Base

12.15.3.1 Clause 12.9.3 shall apply.

12.15.4 Tack Coat

12.15.4.1 Clause 12.10.4 shall apply.

12.15.5 Preparation of Mix and Laying

12.15.5.1 The aggregate shall be measured in boxes, heated to 175°C to 205°C and then loaded into a drum mixer according to the capacity of the mixing drum in the proportion specified. The binder shall also be heated to the same temperature in boilers and maintained at that temperature. The heated binder shall be drawn from the boiler into a suitable container or in a bucket gauged to show the weight of bitumen in it.

12.15.5.2 The fine aggregate in specified proportion shall be fed into the mixer and then 2/3rd of the total specified quantity of heated bitumen added. When the fine aggregate is well coated, the coarse aggregate followed by the balance 1/3rd quantity of total bitumen shall be fed into the mixer. Mixing shall be continued until a homogenous mix is produced and all particles are uniformly coated with bitumen. The material shall be mixed continuously for a period of not less than one hour before laying is begun, and mixing shall be continued until laying operation is completed, so as to maintain the coarse aggregate in suspension. At no stage during the mixing process, shall the temperature exceed 205°C.

12.15.5.3 The hot mix shall be discharged from the mixer, carried to the surface on which it is to be laid and spread to specified lines and levels immediately after applying to the tack coat to a thickness sufficient to achieve the specified thickness after floating with a heavy wooden float. The surface shall be free from roughness and imperfections. If 'blowing' occurs the bubbles shall be punctured and the affected area carefully made good while the mastic is still hot. At junctions between new and previously laid sections of work the contact edge shall be cleaned and warmed by additional applications of hot mastic before striking off so as to obtain an absolutely clean joint.

12.15.6 Surface Finish

12.15.6.1 The type of surface finish shall be as specified.

a) Matt finish : The surface shall be rubbed in with sand during the final floating operation. The sand shall be clean and free from foreign matter. All surplus material shall be removed after rubbing is completed.

b) Polished finish : The surface shall be finished with a float in a manner similar to that used for a matt-finish but without the use of an abrasive.

12.15.7 Opening to Traffic

12.15.7.1 The mastic flooring shall not be subjected to traffic until the material has cooled throughout to the temperature of the surrounding atmosphere.

12.15.8 Measurements and Rate

12.15.8.1 Clause 12.10.9 shall apply.

12.16 FLAT BRICK PITCHING FOR DRAINS

Providing and laying flat brick pitching using best quality locally available kiln burnt bricks of approved brand, make and size as per the drawing, including all scaffolding, plant, labour and materials etc. complete in all respects.

a) Materials : All bricks shall be of table moulded, well burnt bricks and shall conform to IS:1077. The nominal size shall be 230 mm x 115 mm x 75 mm and approved make. No un-burnt or over-burnt bricks shall be used.

b) Workmanship : Just prior to the start of the work, the soil base shall be thoroughly cleaned of all dirt, loose soil and rubbish and well washed and consolidated. All bricks shall be thoroughly soaked in a vessel containing water. The practice of dipping the bricks in water just before use or watering the brick-stack shall not be allowed. The work shall be carried out in a workmanlike manner, true to slope, level and gradient. All vertical joints shall be laid flat with the frog

face at its bottom, and firmly bedded into the soil by tamping. Mixing and preparation of cement mortar and filling the joints shall be as that specified for brickwork. The entire work shall be cured for at least seven days. Brickbats shall not be used unless used as closers.

12.17 BRICK ON EDGE SOLING

It shall be laid on edge, the bricks touching each other. Soling shall be closely packed leaving no interstices or gaps. Appropriate filler bricks shall be used to make up dimensions which are part of a whole brick.

12.18 CEMENT CONCRETE PAVEMENT FOR WALKWAYS, DRIVES

12.18.1 The pavement shall consist of cement concrete of grade M15 or richer mix as specified, laid on the prepared base including compaction and curing. All concrete work shall be in accordance with the specification for "Concrete and Allied Works".

12.18.2 Preparation of Base

12.18.2.1 Concrete shall be laid directly on top of the soling course which shall be prepared, shaped and conditioned to the specified lines, grades and cross - section by repairing all potholes or patches and ruts, if any, excepting that areas inaccessible to power rollers shall be compacted with vibratory rollers. At edges of foundations, trenches, re-entrant corners, etc. hand tamping shall be done with steel rammers.

12.18.3 Formwork

12.18.3.1 Formwork shall be provided for all joints and other edges. All forms shall be of a depth equal to the thickness of the slab.

12.18.4 Placing and Compacting

12.18.4.1 The sub-base shall be thoroughly watered before laying the concrete. Mixing and placing of concrete shall be as per specifications for 'Concrete and Allied Works'. The width of any panel shall not exceed 6 metres.

12.18.4.2 Concrete after laying shall be compacted by hand tamping with 75 mm wide tamper made of selected timber, shod with steel plate, the tamper shall weigh not less than 10 kg/m and shall be 450 to 600 mm longer than and not more than 50 kg/m the proposed width of slab. The tamper shall rest on side forms and shall be drawn forward with a swinging motion in combination with a series of lifts and drops alternately with lateral shifts of about 25 mm. Compaction by tamping shall be continued till the mortar in the mix just works up to the surface. Compaction shall be done by vibrators where so directed by Owner/Engineer.

12.18.5 Surface finish

12.18.5.1 Float Finish : This finish shall be produced by smoothening board or wooden floats after compaction is complete.

12.18.5.2 Belt Finish : The belt shall consist of a piece of canvas 150 mm wide and 1000 mm longer than the width of the slab, having wooden handles at each end. In the preliminary stage the belt shall be drawn slowly across by a series of long strokes and finally by short strokes with rapid advance.

12.18.5.3 Brush finish : This finish shall be carried out by stiff fibre brush having a long handle attached to it, drawing it transversely across the slab standing either on a platform bridging the slab or across half width from either side of slab. This finish shall be carried out after the surface is slightly set.

12.18.6 Joint Filler

12.18.6.1 Joints between panels shall be filled with approved sealing compound Grade-A (normal) after the curing is over. At expansion joints a 25 mm thick pre-moulded joint filler with sealing compound shall be provided.

12.18.7 Measurements and Rate

12.18.7.1 The measurement shall be in of finished concrete pavement. The rate shall include the cost of materials and labour involved in all the operations described above but excluding preparation of base and joint filler which shall be paid for separately.

12.19 ROAD LANE MARKING

12.19.1 Road lane marking shall be done for all roads having 2 or more traffic lanes. The paints used for lane marking shall be special "Road Lane Marking Paints" of approved make and brand and shall be applied as per the manufacturer's recommendations. The road surface shall first be cleaned thoroughly with a brush and then wiped with a cloth lightly soaked in kerosene oil. Paint shall be applied only after the kerosene has dried. Traffic shall not be allowed to pass on the lane markings until it has completely dried and hardened. No painting shall be done in a dusty atmosphere or when the road is wet. The work shall be measured in metres. The rate shall include the cost of all materials and labour involved.

12.20 PIPE CULVERTS

12.20 Material

12.20.1.1 The pipes shall be with or without reinforcement as required and of the class as specified. They shall conform to IS:458. The reinforced cement concrete pipes shall be manufactured by centrifugal or spun process while un-reinforced cement concrete pipes by spun (or pressure process). All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from improper grading of the aggregate, mixing or moulding. The un-reinforced and reinforced non-pressure pipes (non-pressure pipes) shall withstand a test pressure equivalent to 0.7 Kg/sq.cm (7 M head) of water. Concrete and reinforcement used for the manufacture of pipes and collars shall be as specified in IS:458. The maximum size of aggregate shall not exceed one third the thickness of the pipes or 20 mm whichever is smaller. Sampling and testing of pipes shall be done as per IS:458.

12.20.2 Laying of Pipes

12.20.2.1 Loading, transporting and unloading of concrete pipes shall be done with care, avoiding impact. All pipes and collars shall be inspected carefully before being laid in position. Broken or defective pipes/collars shall not be used. Pipes shall be line true to lane and grade as specified.

12.20.2.2 Pipes bedded on soil shall be ensured to have even and firm backing of soil. This shall be done by excavating the bottom of trench to fit the curve of pipe or by compacting the earth under and around the pipe to form an even bed. The bed shall be suitably rounded to fit the lower part of the pipe, prior to laying the pipe. The cost for this operation shall be included in the rate for laying the pipe itself.

12.20.2.3 Where the pipes are to be bedded in a concrete cradle, the pipe shall be laid before the concrete has set.

12.20.2.4 Pipes shall not be laid directly on any hard material such as rock, shale, hard clay etc. Concrete, sand or compacted earth bed shall be provided over the hard materials.

12.20.3 Jointing of Pipes

12.20.3.1 If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collar shall be slipped on or before the next pipe is laid. The two adjoining pipes shall be adjusted in correct position and the annular space filled with a stiff mixture of cement mortar 1:2 (cement : 2 fine sand) and the same rammed with a caulking tool. Any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

12.20.4 Backfilling

12.20.4.1 Trenches shall be back-filled immediately after pipes have been laid and jointing material has hardened. Backfill soil shall not contain boulders, vegetable or any other objectionable matter and shall be approved by Engineer. Back-filling shall be done in layers not exceeding 150 mm, care being taken not to damage the pipe while compacting. Unequal pressures shall not be allowed to occur.

12.20.5 Opening to Traffic

12.20.5.1 No traffic shall be allowed unless at least 0.6 metre of earth filling is provided over the pipe unless directed otherwise by Engineer.

12.20.6 Measurement and Rate

12.20.6.1 Pipe culverts shall be measured along their centre line between inlet and outlet ends in metres. The rate shall include the cost of pipe including loading, unloading, hauling, handling, storing, laying in position and jointing complete including erecting safety protection for traffic and providing for traffic diversion. Ancillary works such as excavation, back-filling concrete work shall be paid for, separately.

END