

Name of Work :Resurfacing of Dagad Approach Road Ch. 0+000 to 0+360 Km, Ta. Manavadar Dist. Junagadh.

SPECIFICATIONS OF MATERLAIS

M 1 Water

- 1.1** Water shall not be salty or brackish and shall be clean, **reasonably clear and free from objectionable quantities** of silt and traces of oil and injurious alkalies, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S. 456 1978.
- 1.2** If required by Engineer in charge it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 269 1976. Any indication of unsoundness, change in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.
- 1.3** Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.
- 1.4** Hard and bitter water shall not be used for curing.
- 1.5** Potable water will be generally found suitable for curing mortar or concrete. **M 2. Lime**

- 2.1** Lime shall be hydraulic lime as per I.S. 712 1973. Necessary test shall be carried out as per I.S. 6932 (Parts I to X), 1973.
- 2.2** The following field tests for times are to be carried out:
 - (1)** A very rough idea can be formed about the type of lime by its visual examination i.e. fat lime bears pure white colour, lime in form of porous lumps of dirty white colour indicates quick lime, and solid lumps are unburnt lime stone.
 - (2)** Acid tests for determining the carbonate content in lime. Excessive amount of impurities
- 2.3** Storage shall comply with I.S. 712 1973. The slaked lime, if stored, shall be kept in a weather proof and damp proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any way shall be rejected and all rejected materials shall be removed from site of work.
- 2.4** Field testing shall be done according to I.S. 1624 1974 to show the acceptability of materials.

M 3. Cement

- 3.1** Cement shall be ordinary portland slag cement as per I.S. 269 1976 or Portland slag cement as per I.S. 455 1976.

M 4. White Cement

4.1 The white cement shall conform to I.S. 804112 E 1978.

M 5. Coloured Cement

5.1 Coloured cement shall be with white or gray portland cement as specified in the item of

5.2 The pigments used for coloured cement shall be of approved quality and shall not exceed 10% of cement used in the Mix. The mixture of pigment shall be properly grounded to have a uniform colour and shade. The pigments shall have such properties to provide for durability under exposure to sunlight and weather.

5.3 The pigment shall have the property such that it is neither affected by the cement nor detrimental to it. **M 6. Sand**

6.1 Sand shall be natural sand, clean, well graded, hard strong durable and gritty particle free from injurious amounts of dust clay, kankar nodules, soft or flaky particles shale, alkali, salts organic matter, loam, mica or other deleterious substance and shall be got approved from the Engineer in charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary the sand shall be washed to make it clean.

6.2 Coarse Sand:

The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse shall be as under.

L S. Sieve Designation	Percentage by Weight Passing sieve	I S. Sieve Designation	Percentage by Weight Passing through sieve
4.75 mm.	100	600 Micron	30-100
2.36 mm.	90 to 100	300 Micron	5-70
1.18 mm.	70-100	150 Micron	0-50

6.3 Fine Sand:

The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under:

L S. Sieve Designation	Percentage by Weight Passing sieve	I S. Sieve Designation	Percentage by Weight Passing through sieve
4.75 mm.	100	600 Micron	40-85
2.36 mm.	90 to 100	300 Micron	5-50
1.18 mm.	70-100	150 Micron	0-10

M 7. Stone Dust:

7.1 This shall be obtained from crushing hard black trap or equivalent. it shall not contain 'more than 8%" silt as determined by field test with measuring cylinder. The method of determining silt contents by field test is given as under:

7.2 A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such, that it fills the cylinder upto 100 mm. mark. The clean water shall be added upto 150 mm. Mark, The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

7.3 The height of silt visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below. The stone dust containing more than 8% silt shall be washed so as to, bring the silt content within the allowable limit.

7.4 The fineness modulus of stone dust shall not be less than 1.80.

M 8. Stone Grit

8.1 Grit shall consist of crushed or broken stone and be hard strong, dense, durable, clean, of proper gradation and free from skin or coating likely to prevent adhesion of mortar Grit shall generally be cubical in shape and as far as possible flaky elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383 1970. Unless special stone of particular quarries is mentioned, grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer in charge. The grit shall have no deleterious reaction with cement.

8.2 The grit shall conform to the following gradation as per sieve analysis

L S. Sieve Designation	Percentage by Weight Passing sieve	I S. Sieve Designation	Percentage by Weight Passing through sieve
12.5 mm.	100%	4.75 mm.	0-20%
10.00 mm.	80- 100 %	2.36 mm.	0-25%

8.3 The crushing strength of grit will be such as to allow the concrete in which it is used to built up the specified strength of concrete.

8.4 The necessary tests for 'grit shall carried out as per the requirements of I.S. 2386 (Parts I to VII) 1963, as per instructions of the Engineer in charge. The necessity of test will be decided by the Engineer-in charge.

M 9. Cinder:

9.1 Cinder is well burnt furnace residue which has been fused or sintered into lumps of varying sizes.

9.2 Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only. It shall be sound clean free from clay, dirt, ash or other deleterious matter.

9.3 The average grading for cinder aggregates shall be as mentioned below:

L S. Sieve Designation	Percentage by Weight Passing sieve	I S. Sieve Designation	Percentage by Weight Passing through sieve
20 mm.	10000%	4.75 mm.	70
10 mm.	86	2.36 mm.	52

M 10. Lime Mortar

- 10.1** Lime shall conform to specification M 2. Water shall conform to specification M 1.
Sand shall conform to specification M 6.

10.2 Proportion of Mix:

- 10.2.1** Mortar shall consist of such proportions of slaked lime and sand as may be specified in the item. The slaked lime and sand be measured by volume. 10. 3. Preparation of mortar:
10.3. 1. Lime mortar shall be prepared by wet process as per I.S. 1625 1971. Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in an even layer and ground for the 180 revolutions with a sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

10.4 Storage

- 10.4.1** Mortar shall always be kept damp, protected from sun and rain till used up, covering, it by tarpaulin or open sheds.

10.5 Use

- 10.5.1** All mortar shall be used as soon as possible after grinding. It should be used on the day on which it is prepared. But in no case mortar made earlier than 36 hours shall be permitted for use.

M 11. Cement Mortar

- 11.1** Water shall conform to specification M71. Cement shall conform to specification M 3.
Sand shall conform to

M 6. 11. 2. Proportion of Mix

- 11.2.1** Cement and sand shall be mixed to specified proportion, sand being measured by measuring box.
The proportion of cement will be by volume on the basis of 50 Kg./Bag of cement being equal to 0.0342
Cu.m. The mortar may be hand mixed or machine mixed as directed.

11.3 Preparation of mortar

- 11.3.1** In hand mixed mortar cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogenous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.
- 11.3.2** The mortar so prepared shall be used, within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

M 12. Stone Coarse Aggregate for Nominal Mix Concrete

- 12.1** Coarse aggregate shall be machine crushed stone of black trap or equivalent and be hard,

strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

- 12.2** The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below.

However in case (if reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6 mm. less than the cover, whichever is smaller.

I.S. Sieve Designation	Percentage passing for single sized aggregates of Nominalsize			I.S. Sieve Designation	Percentage passing for single sized aggregates of Nominalsize		
	40 mm	20 mm	16 mm		40mm	20mm	16mm
80 mm	-	-	-	12.5 mm	-	-	-
63 mm	100	-	-	10 mm	0.5	0.02	0.3
40 mm	85-100	100	-	4.75 mm	-	0.5	0.5
20 mm	0-20	85-100	100	2.35 mm	-	-	-
16 mm		-	85-100		-	-	-

Note: This percentage may be varied some what by Engineer in charge when considered necessary for obtaining better density and strength of concrete.

- 12.3** The grading test shall be taken in the beginning and at the change of source of materials. The necessary test indicated in I.S. 383 19710 and I.S. 456 1978 shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If the aggregates are covered with dust, they shall be washed with water to make them clean.

M 13. Black Trap or Equivalent Hard Stone Coares.

- 13.1 Aggregate For Design Mix Concrete :** Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard strong dense, durable clean and free from skin and coating likely to prevent proper adhesion of mortar.
- 13.2** The aggregates shall generally be cubical in shape, Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, black trap or equivalent hard stones as approved. Aggregate shall have no deleterious reaction with cement.
- 13.3** The necessary tests indicated in I.S. 383 1970 and I.S. 456 1978 shall have to be carried out to ensure the acceptability of the material.
- 13.4** If aggregate is covered with dust it shall be washed with water, to make it clean.

M 14. Brick Bats Aggregate

- 14.1** Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense brick. It shall be homogeneous in texture roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm. to 50 mm. size unless

otherwise specified in the item. The underburnt over burnt brick bats shall not be

14.2 The brick bats shall be measured by volume by suitable boxes or as directed.

M 15. Brick

15.1 The bricks shall be hand or machine moulded and made from suitable soils and klin burnt. They shall be free from crack and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colour.

The bricks shall be moulded with a frog of 100 mm. x 40 mm. and 10 mm. to 20 mm. deep on one of its flat sides. The bricks shall not, break when thrown on the ground from a height of 600 mm.

15.2 The size of modular bricks shall be 190 mm. x 90 mm. x 90 mm.,

15.3 The size of the conventional bricks shall be as under
(9" X 4.3/8" X 2.3/4") 225 X 110 X 75 mm.

15.4 Only bricks of one standard size shall be used on one work. The following tolerances shall be permitted in the conventional size adopted in a particular work.

Length + 1/81"(3.0 mm.) Width: + 1/1611 (1.50 mm.) Height: + 1/611 (1.50 mm.)

15.5 The crushing strength of the bricks shall not be less than 35 Kg./Sq.Cm. The average water absorption shall not be more than 20 percent by weight. Necessary tests for crushing strength and water absorption etc. shall be carried out as per I.S. 3495 (Part I to IV) 1976.

M 16 Stone

16.1 The stone shall be of the specified variety such as Granite / Trap Stone / Quarzite or any other type of good hard stones. The stones shall be obtained only from the approved quarry and shall be hard, sound, durable and free from defects like cavities, cracks, sand holes, flaws, injurious veins, patches of loose or soft materials etc. and weathered portions and other structural defects or imperfections tending to affect their soundness and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5% of dry weight, when tested in accordance with I.S. 1134 1974. The minimum crushing, strength of the stone shall be 200 Kg./Sq.Cm. unless otherwise specified.

16.2 The samples of the stone to be used, shall be got approved before the work is started.

16.3 The Khanki facing stone shall be dressed by chisel as specified in the item "or khanki facing in required shape and size. The face of stone shall be so dressed that the bushing, on the exposed face shall not project by more than 40 mm. from the general wall surface and on face to be plastered it. shall not project by more than 19 mm. nor shall it have depressions more than 10.mm. from the average wall surface.

M 17. Laterite Stone

17.1 Laterite stone shall be obtained from the approved quarry. It shall be compacted in texture, sound, durable and free from soft patches. It shall have a minimum crushing strength of 100 Kg./Sq.Cm. in its dry condition. It shall not, absorb water more than 20% of its own weight when immersed for 24 hours in water. After quarrying the stone shall be allowed to weather for some time before using in work.

17.2 The stone shall be dressed into regular rectangular blocks so that all faces are free from

waviness and unevenness, edges true and square.

17.3 Those types of stone in which white clay occurs, should not be used.

M 18. Mild Steel Bars

18.1 Mild steel bars reinforcement for R.C.C. work shall conform to I.S. 432 (Part 11) 1966 and shall be of tested quality. It shall also comply with relevant part of I.S. 456 1978.

18.2 All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust at the time of placing.

18.3 For the purpose of payment, the bar shall be measured correct upto 100 mm. length and weight payable worked out at the rate specified below

1	6 mm	0.22 Kg/Rmt	8	20 mm	2.47 Kg/Rmt
2	8 mm	0.39 Kg/Rmt	9	22 mm	2.98 Kg/Rmt
3	10 mm	0.62 Kg/Rmt	10	25 mm	3.85 Kg/Rmt
4	12 mm	0.89 Kg/Rmt	11	28 mm	4.83 Kg/Rmt
5	14 mm	1.21 Kg/Rmt	12	32 mm	6.31 Kg/Rmt
6	16 mm	1.58 Kg/Rmt	13	36 mm	7.99 Kg/Rmt
7	18 mm	2.00 Kg/Rmt	14	40 mm	9.86 Kg/Rmt

M 19. High Yield Strength Steel Deformed Bars

19.1 High yield strength steel deformed bars be either cold twisted or hot rolled, shall conform to I.S. 11739 1966 and I.S. 11,39 1966 respectively.

19.2 Other provision and requirements shall conform to No. M 18 for Mild steel bars.

M 20 High Tensile Steel Wires

20.1 The high tensile wires for the use in prestressed concrete work shall conform to I.S. 2090 1962.

20.2 The tensile strength of the high tensile steel bars shall be as specified in the Item. In absence of the given strength, the minimum Strength shall be taken as per para 6.1 of I.S. 1785 1962. Testing, shall be done per I.S. requirements.

20.3 The high tensile steel shall be free from loose mill scale, rust oil, grease, or any other harmful matter. Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing or passing through a pressure box containing carborundum.

20.4 The high tensile wire shall be obtained from manufactures in coil having diameter not less than 350 times the diameter of wire its(If so that wire springs back straight on being uncoiled.

Name of Work :Resurfacing of Dagad Approach Road Ch. 0+000 to 0+360 Km, Ta. Manavadar Dist. Junagadh.

SPECIFICATIONS OF MATERLAIS (AS PER MORTH PROVISION)

GENERAL SPECIFICATION OF MATERIALS FOR INSTRUCTURES

as per Guidelines of the MORTH for road works

1001. GENERAL

Materials to be used in the work shall conform to the specifications mentioned on the drawings the requirements laid down in this section and specifications for relevant items of work covered under these specifications.

If any material, not covered in these specifications, is required to be used in the work, it shall conform to relevant Indian Standards, if there are any, or to the requirements specified by, the Engineer.

1002. SOURCES OF MATERIAL

The Contractor shall notify, the Engineer of his proposed sources of materials prior to delivery. If it is found after trial that sources of supply previously approved do not produce uniform and satisfactory products, or if the product from any other source proves unacceptable at any time, the Contractor shall furnish acceptable material from other sources at his own expense.

1003. BRICKS

Burnt clay bricks shall conform to the requirements of IS:1077, except that the minimum compressive strength when tested flat shall not be less than 8.4 MPa for individual bricks and 10.5 MPa for average of 5 specimens. They shall be free from cracks and flaws and nodules of free lime. The brick shall have smooth rectangular faces with sharp corners and emit a clear ringing sound when struck. The size may be according to local practice with a tolerance of ± 5 per cent.

1004. STONES

Stones shall be of the type specified. It shall be hard, sound, and free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used.

The stones, when immersed in water for 24 hours, shall not absorb water by more than 5 per cent of their dry weight when tested in accordance with IS:1124.

The length of stones shall not exceed 3 times its height nor shall they be less than twice its height plus one joint. No stone shall be less in width than the height and width on the base shall not be greater than three fourth of the thickness of the wall nor less than 150 mm.

1005. CAST IRON

Cast iron shall conform to IS:210. The grade number of the material shall not be less than 14.

1006. CEMENT

Cement to be used in the works shall be any of the following types with the prior

approval of the Engineer :

- a) Ordinary Portland Cement, 33 Grade, conforming to IS:269.
- b) Rapid Hardening Portland Cement, conforming to IS:8041.
- c) Ordinary Portland Cement. 43 Grade, conforming to IS:8112.
- d) Ordinary Portland Cement. 53 Grade, conforming to IS:12269.
- e) Sulphate Resistant Portland Cement, conforming to IS:12330.

Cement conforming to IS:269 shall be used only after ensuring that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 540 kg/cu.m. of concrete.

Cement conforming to IS:8112 and IS:12269 may be used provided the minimum cement content mentioned elsewhere from durability considerations is not reduced. From strength considerations, these cements shall be used with a certain caution as high early strengths of cement in the 1 to 28 day range can be achieved by finer grinding and higher constituent ratio of C₃S/C₂S, where C₃S is Tri-calcium Silicate and C₂S is Di-calcium Silicate. In such cements, the further growth of strength beyond say 4 weeks may be much lower than that traditionally expected. Therefore, further strength test% shall be carried out for 56 and 90 days to fine tune the mix design from strength considerations.

Cement conforming to IS:12330 shall be used when sodium sulphate and magnesium sulphate are present in large enough concentration to be aggressive to concrete. The recommended threshold values as per IS:456 are sulphate concentration in excess of 0.2 per cent in soil substrata or 300 ppm (0.03 per cent) in ground water. Tests to confirm actual values of sulphate concentration are essential when the structure is located near the sea coast, chemical factories, agricultural land using chemical fertilizers and sites where there are effluent discharges or where soluble sulphate bearing ground water level is high. Cement conforming to IS:12330 shall be carefully selected from strength considerations to ensure that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 540 kg/ cu.m. of concrete.

Cement conforming to IS:8041 shall be used only for precast concrete products after specific approval of the Engineer.

Total chloride content in cement shall in no case exceed 0.05 per cent by mass of cement. Also, total sulphur content calculated as sulphuric anhydride (SO₃) shall in no case exceed 2.5 per cent and 3.0 per cent when tri calcium aluminate per cent by mass is upto 5 or greater than 5 respectively.

1007. COARSE AGGREGATES

For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, coarse aggregate shall consist of clean, hard, strong, dense, non porous and durable pieces of crushed stone, crushed gravel, natural gravel or a suitable combination thereof or other approved inert material. They shall not consist of pieces of disintegrated stones, soft, flaky, elongated particles, salt, alkali, vegetable matter or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the steel reinforcement. Coarse aggregate having positive alkali-silica reaction shall not be used. All coarse aggregates shall conform to IS:383 and tests for conformity shall be carried out as per IS:2386, Parts I to VIII.

The contractor shall submit for the approval of the Engineer, the entire information indicated in Appendix A of IS:383.

Maximum nominal size of coarse aggregate for various structural components in PCC, RCC or PSC, shall conform to Section 1700.

The maximum value for flakiness index for coarse aggregate shall not exceed 35 per Cent.

The coarse aggregate shall satisfy the following requirements of grading :

TABLE 1000 1 : REQUIREMENTS OF COARSE AGGREGATE

IS Sieve Size	Per cent by Weight passing the Sieve		
	40mm	20mm	12.5mm
63mm	100	-	-
40mm	95-100	100	-
20mm	30-70	95-100	100
12.5mm	-	-	90-100
10mm	10-35	25-35	40-85
4.75mm	0-5	0-10	0-10

1008. SAND/FINE AGGREGATES

For masonry work, sand shall conform to the requirements of IS: 2 116.

For plain and reinforced cement concrete (PCC and RCC') or prestressed concrete (PSQ works, Fine aggregate shall consist of clean, hard, strong and durable pieces of crushed stone, crushed gravel, or a suitable combination of natural sand, crushed stone or gravel. They shall not contain dust, lumps, soft or flaky, materials, mica or other deleterious material's in such quantities as to reduce the strength and durability of the concrete, or to attack the embedded steel. Motorised sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali silica reaction shall not be used. All fine aggregates shall conform to IS:383 and tests for conformity shall be carried out as per IS:2386, (Parts 1 to VIII). The Contractor shall submit to the Engineer the entire information indicated in Appendix A of IS:383. The Fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5.

Sand/fine aggregate for structural concrete shall conform to the following grading requirements :

TABLE 1000 2

IS Sieve Size	Per cent by Weight Passing the Sieve		
	Zone I	Zone II	Zone III
10mm	100	100	100
4.75mm	90-100	90-100	90-100
2.36mm	60-95	75-100	85-100
1.18mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-30	12-40
150 micron	0-10	0-10	0-10

1010. WATER

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete. Mixing and curing with sea water shall not be permitted. As a guide, the following concentrations represent the maximum permissible values

- (a) To neutralise 200 ml sample of water, using phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normal NaOH.
- (b) To neutralise 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCl.
- (c) The permissible limits for solids shall be as follows when tested in accordance with IS:3025 :

	Permissible (max)	Limits
Organic	200 mg/lit	
Inorganic	3000 mg/lit	
Sulphates (SO)	500 mg/lit	
Chlorides (Cl)	500 mg/lit*	
Suspended matter	2000 mg/lit	

* In case of structures of lengths 30m and below, the permissible limit of chlorides may be increased upto 1000 mg/lit

All samples of water (Including potable water) shall be tested and suitable measures taken where necessary to ensure conformity of the water to the requirements stated herein

- (d) The pH value shall not be less than 6.

1012. CONCRETE ADMIXTURES

1012.1 General

Admixtures are materials added to the concrete before or during mixing with a view to modify one or more of the properties of concrete in the plastic or hardened state.

Concrete admixtures are proprietary items of manufacture and shall be obtained only from established manufacturers with proven track record, quality assurance and full fledged laboratory facilities for the manufacture and testing of concrete.

The contractor shall provide the following information concerning each admixture after obtaining the same from the manufacturer :

- (a) Normal dosage and detrimental effects, if any, of under dosage and over dosage.
- (b) The chemical names of the main ingredients in the admixtures.
- (c) The chloride content, if any, expressed as a percentage by the weight of the admixture
- (d) Values of dry material content, ash content and relative density of the admixture which can be used for Uniformity Tests.

(e) Whether or not the admixture leads to the entrainment of air when used as per the manufacturers recommended dosage, and if so to what extent

(f) Where two or more admixtures are proposed to be used in any one mix, confirmation as to their compatibility.

(g) There would be no increase in risk of corrosion of the reinforcement or other embedment as a result of using the admixture.

1012.2. Physical and Chemical Requirements

Admixtures shall conform to the requirements of IS:9103. In addition, the following conditions shall be satisfied :

(a) "Plasticizers" and "Super Plasticizers" shall meet the requirements indicated for "Water reducing Admixture".

(b) Except where resistance to freezing and thawing and to disruptive action of deicing salts is necessary, the air content of freshly mixed concrete in accordance with the pressure method given in IS:1199 shall not be more than 2 per cent higher than that of the corresponding control mix and in any case not more than 3 per cent of the test mix.

(c) The chloride content of the admixture shall not exceed 0.2 per cent when tested in accordance with IS:6925. In addition, the maximum permissible limit of chloride content of all the constituents as indicated in Section 1700 shall also be observed.

(d) Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch at different times.

The tests that shall be performed along with permissible variations in the same are indicated below:

- Dry Material Content : to be within 3 per cent and 5 per cent of liquid and solid admixtures respectively of the value stated by the manufacturer.
- Ash content : to be within 1 per cent of the value stated by the manufacturer.

Relative Density (for liquid admixtures) : to be within 2 per cent of the value stated by the manufacturer.

(e) All tests relating to the concrete admixtures shall be conducted periodically at an independent laboratory and compared with the data given by the manufacturer.

1014. STORAGE OF MATERIALS

1014.1 General

All materials may be stored at proper places so as to prevent their deterioration or intrusion by foreign matter and to ensure their satisfactory quality and fitness for the work. The storage space must also permit easy inspection, removal and restorage of the materials. All such materials even though stored in approved godowns/places, must be subjected to acceptance test prior to their immediate use.

1014.3 Aggregates

Aggregate stockpiles may be made on ground that is denuded or vegetation is hard and

well drained. If necessary the ground shall be covered with 50 mm plank.

Coarse aggregates, unless otherwise agreed by the Engineer in writing, shall be delivered to the site in separate sizes (2 sizes when nominal size is 25 mm or less and 3 sizes when the nominal size is 32 mm or more). Aggregates placed directly on the ground shall not be removed from the stockpile within 30 cm of the ground until the final cleaning up of the work, and then only the clean aggregate will be permitted to be used.

In the case of fine aggregates, these shall be deposited at the mixing site not less than 8 hours before use and shall have been tested and approved by the Engineer.

1014.4 Cement

Cement shall be transported, handled and stored on the site in such a manner as to avoid deterioration or contamination. Cement shall be stored above ground level in perfectly dry and watertight sheds and shall be stacked not more than eight bags high. Wherever bulk storage containers are used their capacity should be sufficient to cater to the requirement at site and should be cleaned at least once every 3 to 4 months.

Each consignment shall be stored separately so that it may be readily identified and inspected and cement shall be used in the sequence in which it is delivered at site. Any consignment or part of a consignment of cement which has deteriorated in any way, during storage, shall not be used in the works and shall be removed from the site by the Contractor without charge to the Employer.

The Contractor shall prepare and maintain proper records on site in respect of delivery, handling, storage and use of Cement and these records shall be available for inspection by the Engineer at all times.

The Contractor shall make a monthly return to the Engineer on the date corresponding to the interim certificate date, showing the quantities of cement received and issued during the month and in stock at the end of the month.

1014.5 Reinforcement /Untensioned Steel

The reinforcement bars, when delivered on the job, shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected from mechanical injury and from deterioration by exposure.

1014.6 Prestressing Materials

All prestressing steel, sheathing, anchorages and sleeves or coupling must be protected during transportation, handling and storage. The prestressing steel, sheathing and other accessories must be stored under cover from rain or damp ground and protected from the ambient atmosphere if it is likely to be aggressive. Storage at site must be kept to the absolute minimum.

- (A) Tendon : Wire stand and bar from which tendons are to be fabricated shall be stored about 300mm above the ground in a suitably covered and closed space so as to avoid direct climatic influences and to protect them from splashes from any other materials and from the cutting operation of an oxy acetylene torch or arc welding process in the vicinity. Under no circumstances, tendon material shall be subjected to any welding operation or on site heat treatment or metallic coating such as galvanising. Storage facilities and the procedures for transporting material into or out of store, shall be such that the material does not become kinked or notched. Wire or strand shall be stored in

large diameter coils which enable the tendons to be laid out straight. As a guide, for wires above 5 mm dia, coils of about 2m dia without breaks or joints shall be obtained from manufacturer and stored. Protective wrapping for tendons shall be chemically neutral. All prestressing steel must be provided with temporary protection during storage.

- (B) Anchorage Components :** The handling and storing procedures shall maintain the anchorage components in a condition in which they can subsequently perform their function to an adequate degree. Components shall be handled and stored so that mechanical damage and detrimental corrosion are prevented. The corrosion of the gripping and securing system shall be prevented. The use of correctly formulated oils and greases or of other corrosion preventing material is recommended where prolonged storage is required. Such protective material shall be guaranteed by the producer to be non aggressive and non degrading.

Prestressing steel shall be stored in a closed store having single door with double locking arrangements and no windows. Also the air inside the store shall be kept dry as far as possible by using various means to the satisfaction of the Engineer. Also instrument measuring the air humidity shall be installed inside the store. This is with a view to eliminating the possibility of initial rusting of prestressing steel during storage. The, prestressing, steel shall be coated with water solvable grease. The prestressing steel should be absolutely clean and without any signs of rust.

All prestressing steel shall be stored at least 30 cm above ground level and it shall be invariably wrapped by protective cover of tar paper or polythene or any other approved material.

The Contractor should see that prestressing steel shall be used within 3 months of its manufacture. He should chalk out his programme in this respect precisely, so as to avoid initial corrosion before placing In position.

1014.7 Water

Water shall be stored in containers/tanks covered at top and cleaned at regular intervals in order to prevent intrusion by foreign matter or growth of organic matter. Water from shallow, muddy or marshy surface, shall not be permitted. The intake pipe shall be enclosed to exclude silt, mud grass and other solid materials and there shall be a minimum depth of 0.60 m of water below the intake at all times.

1015 TESTS AND STANDARD OF ACCEPTANCE

All materials, even though stored in an approved manner shall be subjected to an acceptance test prior to their immediate use.

Independent testing of cement for every consignment shall be done by, the Contractor at site in the laboratory approved by the Engineer before use. Any cement with lower quality than those shown in manufacturer's certificate shall be debarred from use. In case of imported cement, the same series of tests shall be carried out before acceptance.

1015.1. Testing and Approval of Material

The Contractor shall furnish test certificates from the manufacturer/ supplier of materials along with each batch of material(s) delivered to site.

The Contractor shall set up a field laboratory with necessary equipment for testing of all materials, finished products used in the construction as per requirements of conditions of contract and the relevant specifications. The testing of all the materials shall be carried out by the Engineer or his representative for, which the Contractor shall make all the necessary arrangements and bear the entire cost.

Tests which cannot be carried out in the field laboratory have to be got done at the Contractor's cost at any recognised laboratory / testing establishments approved by the Engineer.

1015.2. Sampling of Materials

Samples provided to the Engineer or his representatives for their retention are to be in labelled boxes suitable for storage.

Samples required for approval and testing must be supplied well in advance by at least 48 hours or minimum period required for carrying out relevant tests to allow for testing and approval. Delay to works arising from the late submission of samples will not be acceptable as a reason for delay in the completion of the works.

If materials are brought from abroad, the cost of sampling/testing whether in India or abroad shall be borne by the Contractor.

1015.3. Rejection of Materials not conforming to the Specifications

Any stack or hatch of material(s) of which sample(s) does not conform to the prescribed tests and quality shall be rejected by the Engineer or his representative and such materials shall be removed from site by the Contractor at his own cost. Such rejected materials shall not be made acceptable by any modification.

1015.4. Testing and Approval of Plant and Equipment

All plants and equipment used for preparing, testing and production of materials for incorporation into the permanent works shall be in accordance with manufacturer's specifications and shall be got approved by the Engineer before use.

Name of Work :Resurfacing of Dagad Approach Road Ch. 0+000 to 0+360 Km, Ta. Manavadar Dist. Junagadh.

902. CONTROL OF ALIGNMENT, LEVEL AND SURFACE REGULARITY

902.1 General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer, subject to the permitted tolerances described herein-after:

902.2 Horizontal Alignment

Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 10 mm there from. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 25 mm.

902.3 Surface Levels

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 900-1.

TABLE 900-T. TOLERANCES IN SURFACE LEVELS

1.	Subgrade	+20MM -25MM
2.	Sub-base + 10 mm	-20MM
	(a) Flexible pavement	+6MM
	(b) Concrete pavement	-10MM
	[Dry clean concrete or Rolled concrete]	
3.	Base-course for flexible pavement	+6MM
	(a) Bituminous course	-6MM
	(b) Other than bituminous	+10MM
	(i) Machine laid	-10MM +15M
	(ii) Manually laid	-15MM
4.	Wearing course for flexible pavement	+6MM
	(a) Machine laid	-6MM
	(b) Manually kid	+10MM -10MM
5.	Cement concrete pavement	+5MM -6MM*

* This may not exceed - 8 mm at 0 - 30 cm from the edges.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than 6mm for flexible pavements and 5 mm for concrete pavements.

For checking compliance with the above requirement for subgrade, sub-base and base courses, measurements of the surface levels shall be taken on , a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

For checking the. compliance with the above requirement for bituminous wearing courses and concrete pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25 m along the length and at 0.5 m from the edges and at the centre of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

902.4 Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 metre long straight edge/moving straight-edge as desired by the Engineer at the middle of each traffic lane along a line parallel to the centre line of the road.

The maximum permitted number of surface irregularities shall be as per Table 900-2.

TABLE 900-2. MAXIMUM PERMITTED NUMBER OF SURFACE IRREGULARITIES

Irregularity Length(m)	Surfaces of carriageways paved shoulders				Surfaces of laybys, service areas and all bituminous base and courses			
	4 MM		7 MM		4 MM		7 MM	
	300	75	300	75	300	75	30	75
National Highways/ Expressways	20	9	2	1	40	18	4	2
Roads of lower category*	40	18	4	2	60	27	6	3

* Category of each section of road as described in the Contract

The maximum allowable difference between the road surface and underside of a 3 m straight-edge when placed parallel with, or at right angles to the centre line of the road at points decided by the Engineer shall be:

for pavement surface (bituminous and cement concrete)	3 mm
for bituminous base courses	6 mm
for granular sub-base/ base courses	8 mm
for sub-bases under concrete pavements	10 mm
Quality Control for Road Works	

902.5 Rectification

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances, the Contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

- (i) **Subgrade:** Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and

fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of Clause 305.

(ii) Granular Sub-base: Same as at (i) above, except that the degree of compaction and the type of material to be used shall conform to the requirements of Clause 401.

(iii) Lime/Cement Stabilized Soil Sub-base: For lime/cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material is less than 2 hours, the surface shall be scarified to a depth of 50 mm supplemented with freshly mixed materials as necessary and recompacted to the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material to Specification. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

(iv) Water Bound Macadam/Wet Mix Macadam Sub-base/Base: Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompacted to Clause 404. This shall also apply to wet mix macadam to Clause 406.

(v) Bituminous Constructions: For bituminous construction oilier than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat if needed and recompacting to specifications. Where the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3-5 m in width.

(vi) Dry Lean Concrete Sub-base/Rolled Cement Concrete: The defective length of the course shall be removed to full depth and replaced with material conforming to Clauses 601 or 603, as applicable. The area treated shall be at least 3 m long, not less than 1 lane wide and extend to the full depth. Before relaying the course, the disturbed subgrade or layer below shall be corrected by levelling, watering and compacting.

(vii) Cement concrete pavement: The defective areas having surface irregularity exceeding 3 mm but not greater than 6 mm may be rectified by bump cutting or scrubbling or grinding using approved equipment. When required by the Engineer, areas which have been reduced in level by the above operation(s) shall be retextured in an approved manner either by cutting grooves (5 mm deep) or roughening the surface by hacking the surface. If high areas in excess 6 mm or low areas in excess of 3 mm occur, exceeding the permitted numbers and if the Contractor cannot rectify, the slab shall be demolished and reconstructed at the Contractor's expense and in no case the area removed shall be less than the full width of the lane in which the irregularity occurs and full length of the slab.

If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerances shall

112. ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

112.1. General

The Contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the highway. The Contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

112.2. Passage of Traffic along a part of the Existing Carriageway under Improvement

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 m and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length, in which such work shall be carried out, would be limited normally to 500 m at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20 m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.

In case of widening existing two-lane to four-lane, the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However, in case where on the request of the Contractor, work on existing two-lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in Para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled, the debris disposed of and the area cleared as per the direction of the

112.3. Passage of Traffic along a Temporary Diversion

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 m carriageway and 2.5 m earthen shoulders on each side (total width of roadway 12 m) with the following provision for road crust in the 7 m width:

- (i) 200 mm (compacted) granular sub base;
- (ii) 225 mm (compacted) granular base course; and
- (iii) Premix carpet with Seal Coat/Mix Seal Surfacing.

The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

112.4. Traffic Safety and Control

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs,

markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of. Traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120m away. The signs shall be of approved design and of reflectory type, if so directed by the Engineer.

112.5. Maintenance of Diversions and Traffic Control Devices

Signs, lights, barriers and other traffic control devices, as well as the riding surface of diversions shall be maintained in a satisfactory condition till such time they are required as directed by the Engineer. The temporary travelled way shall be kept free of dust by frequent applications of water, if necessary.

901. GENERAL

- 901.1** 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 Control work per Specifications and/or as directed by the Engineer. The internal layout of the laboratory shall be as per Clause 121 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
- 901.2** 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.
- 901.3** 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.
- 901.4** 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 here in under. Additional tests may also, be conducted where, in the opinion of the Engineer, need for such tests exists.

- 901.5** The Contractor shall provide necessary co-operation and assistance in obtaining the samples for tests and carrying out the field tests required by the Engineer from time to time. This may include provision of labour, attendants, assistance in packing and despatching and any other assistance considered necessary in connection with the tests.
- 901.6** For the work of embankment, subgrade and pavement, construction of subsequent layer of same or other material over the finished layer shall lie 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.
- 901.7** 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.
- 901.8** 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 rate item in the Bill of Quantities for setting up of a laboratory and installing testing equipment, such work shall be paid for separately.
- 901.9** For testing of 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.
- 901.10** For cement, bitumen, mild steel, 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 samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor. He shall also furnish the test certificates to the Engineer.
- 901.11** For testing of cement concrete at site during construction, arrangements for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and number of tests specified in the Handbook of Quality Control for Construction of Roads and Runways (IRC :SP 11) and relevant IS Codes or relevant clauses of these Specifications, the cost of which shall be borne by the Contractor.
- 901.12** 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 MOST 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.

901.13 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.

901.14 Defective Materials

All materials which the Engineer/his representative has determined as not conforming to the requirements of the Contract shall be rejected whether in place or not; they shall be removed immediately from the site as directed. Materials, which have been subsequently corrected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any order of the Engineer/his representative, given under this Clause, the Engineer/his representative shall have authority to cause the removal of rejected material and to deduct the removal cost thereof from any payments due to the Contractor.

901.15 Imported Materials

At the time of submission of tenders, the Contractor shall furnish a list of materials/finished products manufactured, produced or fabricated outside India which he proposes to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant Specifications of the Contract. In case where materials/ finished products are not covered by the Specifications in the Contract, the details of Specifications proposed to be followed and the testing procedure as well as laboratories/ establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified to the lot of materials shall be furnished at the Contractor's cost.

Item No 1.

Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials (A) By manual means in area of light jungle

201.1 GENERAL :-

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 300mm in thickness, rubbish etc. which in the opinion of the engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage, structure and such other areas as may be specified by the Engineer. It shall include necessary excavation, back-filling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Cleaning and grubbing shall be performed in advance of earthwork, operations and in accordance with the requirement of this specification.

201.2 Preservation of property / Amenties :-

Road side trees, shrubs and other plants, pole, lines, fences, signs, monuments, buildings, pipe lines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The contractor shall provide and install at his own expense suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the contractor shall take all adequate precautions against soil erosion, water pollution etc. and where required undertake additional works to that effect as per Clause 306 of MORTH specification booklet for Roads and Bridge. Before start of operations, the contractor shall submit the engineer for approval, his work plan including the procedure to be followed for disposal of waste materials etc., and the schedule for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3 of MORTH specification booklet for Roads & Bridges.

201.3 Methods, Tools and Equipments :-

Only such methods, tools and equipments as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the work. If there is thick vegetation / roots / trees a crawler or pneumatic tyred dozer adequate capacity may be used for clearance purpose. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps etc. falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500mm of the sub-grade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment / sub-grade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

All excavation below the general ground level arising out of the removal of trees, stumps etc. shall be filled with suitable materials and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several

metres shall be suitably treated.

201.4 Disposal of materials :-

All materials arising from clearing and grubbing operation shall be the property of the government and shall be disposed by the Contractor as herein after provided or as directed by the Engineer-in-charge.

Trunks, branches and stumps of trees shall be cleared of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction, shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc. shall be done at specified spots with all lead and lifts.

All products of clearing and grubbing which in the opinions of the Engineer, cannot be used or auctioned shall be cleared away from the road sides in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant of embankment, sub-grade and road construction.

201.5 Measurement for payments :-

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of **Hectares**. Cutting of trees upto 300mm in girth and removal of their stumps, including removal of stumps upto 300mm in girth left over after trees have been cut by any other agency and trimming of branches of trees extending above the roadway and back filling to the required compaction shall be considered incidental to the clearing and grubbing operations. Clearing and grubbing of borrow areas shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same

Ground levels shall be taken prior to and after clearing and grubbing. Levels taken prior to clearing and grubbing shall be the base level and will be accordingly used for assessing the depth of clearing and grubbing and computation of quantity of any unsuitable material which is required to be removed. The levels taken subsequent to clearing and grubbing shall be the base level for computation of earthwork for embankment.

Cutting of trees, excluding removal of stumps and roots of trees of girth above 300 mm shall be measured in terms of number according to the girth sizes given below:-

- (i) Above 300 mm to 600 mm
- (ii) Above 600 mm to 900 mm
- (iii) Above 900 mm to 1800 mm
- (iv) Above 1800 mm

Removal of stumps and roots including back filling with suitable material to required compaction shall be a separate item and shall be measured in terms of number according to the sizes given below:-

- (i) Above 300 mm to 600 mm
- (ii) Above 600 mm to 900 mm
- (iii) Above 900 mm to 1800 mm
- (iv) Above 1800 mm

For this purpose of cutting of trees and removal of roots and stumps, the girth shall be measured at a height of 1 metre above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

201.6 Rates :-

The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300mm girth excavation and back-filling to required density, where necessary and handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads. Clearing and grubbing done in excess of 150 mm by the Contractor shall be made good by the Contractor at his own cost as per Clause 301.3.3 to the satisfaction of the Engineer prior to taking up earthwork. Where clearing and grubbing is to be done to a level beyond 150 mm, due to site considerations, as directed by the Engineer, the extra quantity shall be measured and paid separately.

The Contract unit rate for cutting trees of girth above 300 mm shall include handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

The Contract unit rate for removal of stumps and roots of trees girth above 300 mm shall include excavation and backfilling with suitable material to required compaction, handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

The Contract unit rate is deemed to include credit towards value of usable materials, salvage value of unusable material and off-set price of cut trees and stumps belonging to the forest Department. The off-set price of cut trees and stumps belonging to the Forest Department shall be deducted from the amount due to the Contractor and deposited with the State Forest Department. In case the cut trees and stumps are required to be deposited with the Forest Department the Contractor shall do so and no deduction towards the off-set price shall be effected. The offset price shall be as per guidelines I estimates of the state Forest Department.

Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earthwork items and the Contract unit prices for the same shall be considered as including clearing and grubbing operations.

The Payment shall be made on ONE HECTOR basis.

Item No 2.

Providing and Laying 50mm thick Bituminous Macadam (B.M.) in one layers on the existing B.T. surface using stone chips as per gradation and using VG-30 for tack coat at rate of 2.5 kg/ 10 sq.m. on B.T. surface and Bitumen VG-30 34KG/MT by weight of total mix by using stone chips as per MORT & H specification including heating asphalt and aggregates by Drum mix plant and spreading by paver finisher to the required grade, level and alignment and rolled including consolidation with vibratory road roller as per clauses 501.6 and 501.7 to achieve the desired compaction and providing, operating plant machineries, equipments, tools, plants, oil fire wood, kerosene and all labour charges etc.complete.

The work shall be carried out using DRUM mix Plant and spreading the same with Paver Finisher and consolidation with vibratory road roller

The Bitumen Macadam 50mm thick shall be laid in ONE layers using VG-30 Grade Bulk bitumen for mixing at a rate of 34.00 Kg./M.T. and for Tack coat using Emulsion RS-1- grade bitumen at 2.5 Kg./10-Sqm. and spreading the same with paver finisher and consolidation with Vibratory road roller with all lead and lift as directed

504.1. Scope

This work shall consist of construction in a single course having 50 mm to 100 mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Since the bituminous macadam is an open-graded mix, there is a potential that it may trap water or moisture vapour within the pavement system. Therefore, adjacent layer (shoulders) should have proper drainage quality to prevent moisture-induced damage to the BM.

504.2. Materials**504.2.1. Bitumen:**

The bitumen shall be viscosity graded paving bitumen complying with Indian Standard Specification for paving bitumen, IS:73 or as specified in the Contract. The type and grade of bitumen to be used would depend upon the climatic conditions and the traffic. Guidelines for selection of bitumen are given in Table 500-1.

504.2.2. Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. It shall be clean, hard, durable and cubical shape, free from dust and soft organic and other deleterious substances. The aggregate shall satisfy the physical requirements specified in Table 500-6. Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces resulting from crushing operation. Before approval of the source, the aggregates shall be tested for stripping. 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 approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment.

504.2.3. Fine Aggregates

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

Natural sand shall not be used in the binder course.

TABLE 500-6. Physical Properties of Coarse Aggregate

Property	Test	Specification	Method of Test
Cleanliness	Grain size analysis	Max 5% passing	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either: Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Water	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95 %	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min. 80%	AASHTO 283

* If the minimum retained tensile strength falls below 80 percent, use of anti stripping agent is recommended to meet the minimum requirements.

504.2.4. Aggregate Grading and Binder Content

The combined grading of the coarse aggregates and fine aggregates, when tested in accordance with IS:2386 Part 1, wet sieving method, shall conform to limits given in Table 500-8. The type and quantity of bitumen and appropriate thickness is also given in Table 500-7.

504.2.5. Proportioning of Material

The combined aggregate grading shall not vary from the lower limit on one sieve to the higher limit on the adjacent sieve to avoid gap grading. The aggregate may be proportioned and blended to produce a uniform mix complying with the requirements in Table 500-7. The binder content shall be within a tolerance of ± 0.3 percent by weight of total mix when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

504.3. Construction Operation

504.3.1. Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply

Table 500-7 : Aggregate Grading and Bitumen Content

Grading	1	2
Nominal maximum aggregate size*	40 mm	19 mm
Layer thickness	80 - 10 mm	50 - 75 mm
IS Sieve size (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	90 - 100	
26.5	75 - 100	100
19	-	90 - 100
13.2	35 - 61	56 - 88

4.75	13 - 22	16 - 36
2.36	4 - 19	4 - 19
0.3	2 - 10	2 - 10
0.075	0 - 8	0 - 8
Bitumen content ** percent by mass of total mix	3.3**	3.4**

* Nominal maximum aggregate size is the largest specified sieve size upon which any of the aggregate material is retained.

** Corresponds to specific gravity of the Aggregate being 2.7. In case aggregates have specific gravity more than 2.7, bitumen content can be reduced proportionately. Further, for regions where highest daily mean air temperature is 30°C or lower and lowest daily mean air temperature is -10°C or lower, the bitumen content may be increased by 0.5 percent.

504.3.2. Preparation of the Base

The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clauses 501.8 and 902.3 as appropriate, and a prime coat, shall be applied in accordance with Clause 502 where specified, 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 get access, other approved methods shall be used as directed by the Engineer.

504.3.3. Tack Coat

A tack coat in accordance with Clause 503 shall be applied as required under the Contract or as directed by the Engineer.

504.3.4. Preparation and Transportation of the Mix

The provisions of Clauses 501.3 and 501.4 shall apply.

504.3.5. Spreading

The provisions of Clause 501.5.3 shall apply.

504.3.6. Rolling

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.

504.4. Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902. For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

504.5. Protection of the Layer

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, by the Contractor the course shall be covered by a seal coat to the requirement of Clause 512 before opening to any traffic. The seal coat in such cases shall

shall be considered incidental to the work and shall not be paid for separately.

504.6. Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

504.7. Measurement for Payment

Bituminous macadam shall be measured as finished work in cubic metres, or by weight in metric tonnes, where used as regulating course, or square metres at the specified thickness as indicated in the Contract or shown on the drawings, or as otherwise directed by the Engineer.

504.8. Rate

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include cost for all components listed in Clause 501.8.8.2.

Item No 3.

Providing and laying 20 mm thick average Mix seal surface using stone chips dust as per gradation and using bitumen for mixing VG-30 at the rate of not less than 50.90 Kg / M.T.i.e. 5.09% on BT surface using stone chips as per M.O.R.T.H specification including heating the asphalt and aggregates by Hot Mix Plant and spreading the same by paver finisher including consolidation with Vibratory Roller and providing, operating plant machineries, equipment, tools, plants, oil, fire wood, kerosene and all labour charges etc. complete.

512.1. Scope

512.1.1 This work shall consist of the preparation, laying and compaction of a close graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface in accordance with the requirements of these Specifications, to serve as a wearing course.

512.1.2. Close graded premix surfacing shall be of Type A or Type B as specified in the Contract

512.2. Materials

512.2.1. Binder : The binder shall be bitumen of a suitable viscosity grade VG-30 as specified in the Contract, or as directed by the Engineer, and satisfying the requirements of IS: 73.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2006

Characteristics	VG - 10	VG-20	VG-30	VG-40
Absolute Viscosity 60°C, poises, min	800	1600	2400	3200
Kinematics Viscosity 135°C CSI, min	250	300	350	400
Flash point, C, min	220	220	220	220
Solubility in trichloroethylene, % min	99.0	99.0	99.0	99.0
Penetration at 25°C	80-100	60-80	50-70	40-60
Softening point, C min	40	45	47	50
Test on residue from thin film oven test / RTFOT:				
(A) Viscosity ratio at 60°C, max	4.0	4.0	4.0	4.0
(B) Ductility at 25°C, cm, min after thin film over test	75	50	40	25

512.2.2 Coarse aggregates : **504.2.2.1.** The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as per Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

Sr. No.	Test	Test Method	Requirement
1	Log Angeles Abrasion Value*	IS 2386 (Part-4)	40 percent Maximum
2	Aggregates Impact Value*	IS 2486 (Part-4)	30 percent Maximum

3	Flakiness and Elongation	IS 2386 (Part-1)	30 percent Maximum
4	Coating and Stripping of Bitumen Aggregate mixtures.	I.S. 6241	Minimum retained coating 95 per cent.
5	5 Soundness (1) Loss with Sodium Sulphate 5 cycles. (2) Loss with Sodium Magnesium 5 cycles.	IS 2386 (Part-V)	12 percent Maximum 18 percent Maximum
6	Water Absorption	IS 2386 (Part-3)	1 percent Maximum.

*** Aggregates may satisfy requirements for either of the two tests.**

Note : If crushed slag is used, Clause 404.2.3 shall apply.

512.2.3 Fine aggregates : The fine aggregates shall consist of crushed rock quarry sands, natural gravel / sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious

512.2.4 Aggregate gradation.: The coarse and fine aggregates shall be so graded or combined as to conform to one or the other grading shown in Table 500-26, as specified in the contract.

TABLE 500-26. AGGREGATE GRADATION

IS Sieve Designation (mm)	Cumulative percent by weight of Total aggregate passing	
	Type A	Type B
13.2 mm	--	100
11.2 mm	100	88 - 100
5.6 mm	52 - 88	31 - 52
2.8 mm	14 - 38	5 - 27
0.090mm	0 - 5	0 - 5

512.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per 10 square metre area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.40 kg per 10 Square metre area for Type A and Type B surfacing respectively.

512.3. Construction Operations

501.5.1. Weather and seasonal limitations: Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain, the bituminous surface, prime or tack coat, be blown off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start Laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 100C or when the wind speed at any temperature exceeds 40 km/h at 2m height unless specifically approved by the Engineer.

501.5.2. Cleaning of surface: The surface on which the bituminous work is to be laid shall be cleaned of all loose and extraneous matter by means of a mechanical broom or any other approved equipment / method as specified in the contract. The use of a high pressure air jet from a compressor to remove dust or loose matter shall be available fall time on the site, unless otherwise specified in the Contract.

501.5.3. Spreading: Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, leveled and tamped by an approved self-propelled paving machine. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay.

The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of the paver and its of operations, shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space where a mechanical paver cannot be used, the material shall be spread, raked and levelled with suitable hand tools by experienced staff, and compacted to the satisfaction of the Engineer.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these Specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300mm short of the joint. The remainder of the pavement up to the joint and the corresponding area beyond it shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material with a temperature greater than 1450C shall not be laid or deposited on bridge deck waterproofing systems, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre-mixed bituminous materials shall only be permitted in the following circumstances:

- (i) For laying regulating courses of irregular shape and varying thickness.
- (ii) In confined spaces where it is impracticable for a paver to operate.
- (iii) For footways.
- (iv) At the approaches to expansion joints at bridges, viaducts or other structures.
- (v) For laying mastic asphalt in accordance with Clause 515.
- (vi) For filling of potholes.
- (vii) Where directed by the Engineer.

Manual spreading of pre-mixed wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level, shall only be permitted in the following circumstances:

- (i) At the edges of the layers of material and at gullies and manholes.
- (ii) At the approaches to expansion joints at bridges, viaducts or other structures.
- (iii) As directed by the Engineer.

501.5.4. Cleanliness and overlaying: Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run on bituminous material to be overlaid shall be that engaged in laying and compacting the next course or, where a binder course is to be sealed or surface dressed, that engaged on such surface treatment. Should any bituminous material become contaminated the Contractor shall make it good to the satisfaction of the Engineer, in compliance with Clause 501.8.

Binder course material shall not remain uncovered by either the wearing course or surface treatment, whichever is specified in the Contract, for more than three consecutive days after being laid. The Engineer may extend this period, by the minimum amount of time necessary, because of weather conditions or for any other reason. If the surface of the base course is subjected to traffic, or not covered within three days, a tack coat shall be applied, as directed by the Engineer.

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Excessive traffic speeds should not be permitted.

512.7. Measurements for Payment

Close graded premix surfacing, Type A or B shall be measured as finished work, for the area specified to be covered, in square metres at a specified thickness. The area will be the net area covered, and all allowances for wastage and cutting of joints shall be deemed to be included in the rate.

The measurement shall be all measures for finished work on weight base in Metric Tonne.

512.8. Rate

The contract unit rate for close graded premix surfacing, Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2. (i) to (xi).

501.8.8. Rate for premixed bituminous material: The contract unit rate for premixed

2. bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to:

- (i) Making arrangements for traffic to Clause 112 except for initial ant to verge. shoulders and construction of diversions;
- (ii) Preparation of the surface to receive the material.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.
- (iv) Mixing, transporting, laying and compacting the mix, as specified.
- (v) All labour, tools, equipment, plant including installation of drum mix plant power supply units and all machinery, incidental to complete the work to these Specifications;
- (vi) Carrying out the work in part widths of the road where directed;
- (vii) Carrying out all tests for control of quality and
- (viii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and payment will be adjusted accordingly.
- (ix) The rates for premixed material are to include for all wastage in cutting of joints etc.
- (x) The rates are to include for all necessary testing, mix design, transporting and testing of samples, and cores. If there is not a project specific laboratory, the Contractor must arrange to carry out all necessary testing at an outside Laboratory, approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the
- (xi) The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed to be included in the Contractor's rates for the material.

Item No 4.

Earthwork for embankment including breaking clods, dressing with all lead and lift(excluding watering and consolidation)© From borrow area within 1.0 km lead.

305. EMBANKMENT CONSTRUCTION

305.1 General:

305.1.1 Description:

These Specifications shall apply to the construction of embankments including sub grades, earthen shoulders and miscellaneous backfills with approved materials obtained from roadway and drain excavation, borrow pits or other sources. All embankments, sub grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

305.2 Materials and General Requirements.

305.2.1 Physical requirements :

305.2.1.1 The materials used in embankments, sub grades, earthen shoulders and miscellaneous backfills shall be soil, murrum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment sub grade.

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; and soil that classifies as OL,OI, OH or Pt in
- (c)** Materials susceptible to spontaneous combustion;
- (d)** Materials in a frozen condition;
- (e)** Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and
- (f)** Materials with salts resulting in leaching in the embankment.

305.2.1.2 Expansive clay exhibiting marked swell and shrinkage, properties ("free swelling index" exceeding 50 percent when tested as per IS:2720-Part 40) shall not be used as a fill material. Where an expansive clay with acceptable "free swelling index" value is used as a fill material, sub grade and top 500mm portion of the embankment just below sub grade shall be non-expansive in nature.

305.2.1.3 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO₃) per liter when tested in accordance with BS:1377 Part-3, but using a 2:1 water-soil ratio shall not be deposited within 500 mm or other distance described in the Contract), permanent works constructed out of concrete, cement bound materials or other cementations materials.

Materials with a total sulphate content (expressed as SO₃) exceeding 0.5 per cent by mass, when tested in accordance with BS: 1377, Part 3 shall not be deposited within 500 mm or other distances described in the contract, of metallic items forming part of the Permanent

305.2.1.4 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm when being placed in the embankment and 50 mm when placed in the sub grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the

placement of fill material and its compaction to the requirements of these specifications. The maximum particle size shall not be more than two-thirds of the compacted layer thickness.

- 305.2.1.5** Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the sub grade.

TABLE 300-1. DENSITY REQUIREMENTS OF EMBANKMENT AND SUBGRADE MATERIALS

S.No.	Type of work	Maximum laboratory dry unit weight when tested as per IS:2720(Part 8)
1	Embankments upto 3 metres height, not subjected to extensive flooding.	Not less than 15.2 kN/cu.m.
2	Embankments exceeding 3 metres height or embankments of any height subject to long periods of inundation.	Not less than 16.0 kN/cu.m.
3	Subgrade and earthen shoulders/ Verges/backfill	Not less than 17.5 kN/cu.m.

- Notes:** (1) This Table is not applicable for lightweight fill materials e.g. cinder, fly ash etc.
(2) The materials to be used in sub grade shall be non-expensive and shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clause 403 and 404 or by any stabilization method approved by the Engineer shall be followed.

- 305.2.1.6** The materials to be used in sub grade shall conform to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available materials fails to meet the requirement of CBR, use of stabilization methods in accordance with Clause 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Association Committee shall be followed.

- 305.2.1.7** The materials to be used in high embankment construction shall satisfy the specified requirements of strength parameters.

305.2.2 General Requirements:

- 305.2.2.2** The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the sub grade and the embankment portion just below the sub grade.

305.2.2.2 Borrow materials:

The arrangement for the source of supply of the materials for embankment and sub grade and compliance with the guidelines, and environmental requirements, in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300m. Small drains shall be cut through the ridges to facilitate drainage.

The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width of a minimum of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or sitting of temporary buildings or structures.

305.2.2.3 Fly-Ash

User of fly-ash shall conform to the Ministry of Environment and Forest guidelines. Where fly-ash is used the embankment construction shall conform to the physical and chemical properties and requirements of IRC:SP:38-2001, "Guidelines for Use of Flyash in Road Construction". The term fly-ash shall cover all types of coal ash such as ponds ash, bottom ash or mound ash.

Embankment constructed out of fly ash shall be properly designed to ensure stability and protection against erosion in accordance with IRC guidelines. A suitable thick cover may preferably be provided at intervening layers of pond as for this purpose. A thick soil cover shall bind the edge of the embankment to protect it against erosion. Minimum thickness of such soil cover shall be 500mm.

305.2.2.4 Compaction Requirements

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the sub grade material when compacted to the density requirements as in Table 300-2 shall yield the design CBR value of the sub grade.

TABLE 300-2. COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUBGRADE.

S.No.	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%
3	Expansive Clays	
	a) Sub grade and 500mm portion Just below the sub grade.	Not allowed.
	b) Remaining portion of embankment	Not less than 90-95%

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval :

- (i) The values of maximum dry density and optimum content obtained in accordance with IS:2720 (Part 8), appropriate for each of the fill materials he intends to use.
- (ii) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer, it shall form the basis for compaction.

305.3 Construction Operations :

305.3.1 Setting Out

After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1. 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/sub grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to be desired density and the position specified and conforms to the specified side slopes.

305.3.2 Dewatering

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is 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. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair./restore it to original condition or compensate the damage at his own

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

305.3.3 Stripping and Storing topsoil

In localities where most of the available embankment materials are not 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. Topsoil 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.

305.3.4 Compacting ground supporting embankment/Sub grade:

Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling in accordance with Clause 305.3.5 and 305.3.6 so as to achieve minimum dry density as given in Table 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 per cent relative compaction with respect to the dry density as given in Table 300-2, the ground shall be loosened up to a level 0.5m below the sub grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to achieve dry density not less than 97 percent relative compaction as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation (500mm portion just below the sub-grade) shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

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. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 305.2.1, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

305.3.5 Spreading material in layers and bringing to appropriate moisture content

305.3.5.1 The embankment and sub grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250mm when vibratory roller / vibratory soil compactor is used and not more than 200 mm when 80-100 kN static roller is used. 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 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

305.3.5.2 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 constructions, 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 surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by balding, dicing or barrowing until a uniform moisture content is obtained throughout the depth of the layer.

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 can not be reduced to the required amount by the above procedure, compaction work shall be

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 per cent above to 2 per cent below the optimum moisture content determined in accordance with IS:2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

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 until the layer is uniformly wet.

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.

305.3.5.3 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.

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.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cutting, another fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

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.

305.3.6 Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three wheeled roller, self propelled single drum vibratory roller, tandem vibratory roller, pneumatic type roller, pad foot roller 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.

The compaction shall be done with the help of self propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 kN static weight or heavy pneumatic type roller of adequate capacity capable of achieving the required compaction. The contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trails. The procedure to be adopted for these site trials shall be submitted to the Engineer for approval.

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.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density guage used in accordance with agreed procedure and the guage is calibrated to provide results identical to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankments / subgrade / earthen shoulders, further compaction shall be carried out as directed by the Engineer. If inspite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller,

double drum walk behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

305.3.7 Drainage

The surface of the embankment/subgrade 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.

305.3.8 Repairing of damages caused by rain/spillage of water :

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

305.3.9 Finishing operations:

Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. 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.

The topsoil, removed and conserved earlier (Clause 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moisture slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the top soil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of Clause 308.

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.

305.4 Construction of Embankment and subgrade under special conditions.

305.4.1 Earthwork for widening existing road embankment :

When an existing embankment and/or subgrade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment/subgrade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment/subgrade. However when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers/plate compactors/power rammers or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

305.4.2 Earthwork for embankment and subgrade to be placed against sloping ground

Where an embankment /subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/subgrade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping

Where the contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and subgrade work as approved by the Engineer.

305.4.3 Earthwork over existing road surface:-

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:-

(i) If the existing road surface is of granular or bituminous type and lies within 1 m of the new formation levels, it shall be scarified to a depth of 50mm or as directed so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

(ii) If the existing road surface is of bituminous type or cement concrete type and lies within 1 m of the new formation level, the bituminous or cement concrete layer shall be removed completely.

(iii) If the level difference between the existing road surface and the new formation level is more than 1 m. the existing surface shall be roughened after ensuring that the minimum thickness of 500mm of subgrade is available.

305.4.4 Embankment and subgrade around structures :-

To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures upto a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS: 2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in IRC: 78. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2504 unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

305.4.5 Construction of embankment over ground incapable of supporting construction equipment.

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract, will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

305.4.6 Embankment construction under water and Water logged areas

305.4.6.1 Embankment construction under water

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall be of GW, SW, GP, SP as per IS:1498 and consist of graded, hard durable particles with maximum particle size not exceeding 75mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

305.4.6.2 Embankment construction in waterlogged and Marshy Areas :

The work shall be done as per IRC:34.

305.4.7 Earthwork for high embankment :-

The material for high embankment construction shall conform to Clause 302.2.1.7. In the case of high embankments (more than 6 m), the Contractor shall normally use fly ash in conformity with Clause 305.2.1.1 or the material from the approved borrow area.

Where provided, stage construction of embankment and controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of surcharged fill results in any surcharging fill results the Contractor shall bring the resultant level upto formation level with acceptable materials for use in fill.

305.4.8 Settlement period

Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc. or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the contract or as directed by the Engineer.

305.5 Plying of Traffic

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or subgrade without the prior permission of the Engineer. Any damage arising out of such use shall, however be made good by the Contractor at his own expense as directed by the Engineer.

305.6 Surface Finish and Quality Control of Work

The surface finish of construction of subgrade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

305.7 Subgrade Strength

It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfies the requirements of design CBR.

Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on remoulded samples, compacted to the field density at the field moisture content and tested for soaked / unsoaked condition as specified in the contract.

305.8 Measurements for Payment

305.8.1 Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals given in Sub-section 113.3 after completion of clearing and grubbing and after completion of embankment / sub-grade. The volume of earthwork in cubic metres by the method of average end areas.

305.8.2 The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cum. of suitable material brought to site from road and drainage excavation forms one cu.m. of compacted fill and all bulking or shrinkage shall be ignored.

305.8.3 The embankment constructed with fly ash will be measured in cum, separately for the fly ash portions and for the soil cover and intervening layers of soil, unless otherwise specified in the contract.

- 305.8.4** Construction of embankment under water shall be measured in cu.m.
- 305.8.5** Construction of high embankment with specified material and in specified manner shall be measured in cu.m.
- 305.8.6** Stripping including storing and reapplication of topsoil shall be measured in cu.m.
- 305.8.7** Work involving loosening and recompacting of ground supporting embankment / subgrade shall be measured in cu.m.
- 305.8.8** Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measured in Cu.m.
- 305.8.9** Scarifying existing granular/bituminous road surface shall be measured in Square metres.
- 305.8.10** Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.
- 305.8.11** Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu.m.

305.9 RATES:

The Contract unit rates for the items of embankment and subgrade construction shall be payment in full for carrying out the required operations including full compensation for :

- (i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided other wise in the contract.
- (ii) Setting out;
- (iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved;
- (iv) Scarifying or cutting continuous horizontal benches 300mm wide on side slopes of existing embankment and subgrade as applicable;
- (v) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;
- (vi) Spreading in layers, bringing to appropriate moisture content and compacting to specification requirements;
- (vii) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;
- (viii) Restricted working at sites of structures;
- (ix) Working on narrow width of embankment and subgrade,
- (x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the contractor.
- (xi) All labour, material, tools, equipment and incidentals necessary to complete the work to the Specifications;
- (xii) Dewatering, and
- (xiii) Keeping the embankment/completed formation free of water as per Clause 311.
- (xiv) Transporting unsuitable excavated material for disposal with all leads and lifts.

- 305.9.2** Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil and of reapplication of topsoil.

- 305.9.3** Clause 301.9.2 shall apply as regards Contract unit rate for the item of loosening and recompacting the embankment / subgrade foundation.
- 305.9.4** Clauses 309.1.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material respectively.
- 305.9.5** The Contract unit rate for scarifying existing granular/bituminous road surface shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals, necessary to complete the work. This will also comprise of handling, giving credit towards salvage value and disposal of the dismantled materials with all leads and lifts or as otherwise specified.
- 305.9.6** Clause 202.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.
- 305.9.7** The Contract unit rate for providing and laying filter material behind abutments shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.
- 305.9.8** The Contract unit rate for providing and compacting backfill material behind abutments and retaining walls shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.
- 305.9.9** Clause 305.4.6 shall apply as regards Contract unit rate for construction of embankment under water.
- 305.9.10** Clause 305.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

In case the Contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the contract for construction of embankment and subgrade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

Measurement shall be taken and paid in Cu.m.

Item No 5.

Providing and fixing pre-cast Rubber Dye / steel Dye inter locking concrete block 60mm thick with grade of concrete M300 pneumatic compressed / vibrated mechanically and as per approved design Confirming to IS 15658 : 2006 including 35 mm Sand layer for levelling and filling the joint with sand in proper line and level as per guidelines of IRC : SP 63-2018 etc. Complete.

General

This work shall consist of providing and laying **precast Rubber dye / steel dye inter locking concrete block 60 mm thick with grade of concrete M-300 pneumatic compressed / vibrated mechanically and as per approved design confirming to IS 15658 : 2006 including 35 mm thick layer** of sand of the shape and dimensions shown on the drawings and conforming to these specifications or as approved by the Engineer in charge.

1. MATERIAL

Water shall conform to M-1. Cement shall conform to M-3.

1. Precast Rubber dye / steel dye inter locking concrete block

Precast Rubber dye / steel dye inter locking concrete block shall be of approved size brand and make as approved by Engineer in charge.

- 1.1** The size shape and design of **precast Rubber dye / steel dye inter locking concrete block** shall generally be as per manufacturers product or as directed by the Engineer in charge and Architect.
- 1.2** The **precast Rubber dye / steel dye inter locking concrete block** shall satisfy the tests as regards compress strength transverse strength resistance to wear and water absorption.
- 1.3** The colour size shape and design of the **precast Rubber dye / steel dye inter locking concrete block** shall be directed by Engineer or Architect.
- 1.4** The **precast rubber dye / steel dye inter locking concrete block** shall be of best quality as approved by the Engineer In charge. They shall be flat and true to shape. They shall be free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

2. SAND

- 2.1** Sand shall be natural sand, clean well graded, hard strong durable and gritty particular free from immures amounts of dust, clay, kankar modules.
- 2.2** For masonry works sand shall confirm to the requirements of IS: 2116.
- 2.3** For plain and reinforced cement concrete (PCC and RCC) or pre stressed concrete (PSC) works fine aggregates shall consist of clean, hard strong and durable prices of crushed stone, crushed gravel or suitable combination of natural sand crushed stone or gravel, They shall not contain dust lumps soft or flaky materials mica or other deleterious materials in such quantities as to reduce the strength and durability of concrete, or to attack the embedded steel. Motorized sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS L 383 and tests for conformity shall be carried out as per IS : 2386 (Part I to VIII) The contractor shall submit to the Engineer in charge the entire information indicated in Appendix A of IS : 383. The fineness modulus

of fine aggregate shall neither be less than 2.00 nor greater than 3.5.

2.4 Sand fine aggregates for structural concrete shall conform to the following grading requirements as shown in the table below.

2.5 Fine Sand: The fineness module shall not exceed 1.0 the sieve analysis of fine sand be as under:

IS. Sieve Designation	% by wt. passing		
	Zone I	Zone II	Zone III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 MC	15-34	35-59	60-79
300 MC	5-20	8-30	12-40
150 MC	0-10	0-10	0-10

☯ **Coarse Sand:** The fineness modules of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand be as under:

☯ **Coarse Sand:** The fineness modules of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand be as under:

Measurements for Payment

Rate will be made on sq. metres.

Item No 6.**Hazard Marker**

Hazard Marker Sign :-Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for eachleg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

(B) Class-B Type-4 Retro Reflective sheeting

A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting .

An amount equivalent to 10% of the Item amount shall be kept in Deposit for 10 years and shall be released on completion of 10 years after certified date of completion.

The Hazard Marker boards shall be made out of 2mm thick aluminium sheet/4mm thick ACP using phospheting process and one coat of epoxy primer and two coats of best quality epoxy paint. The fixing shall be done in C.C. 1:2:4 blocks of 45x45x60cms.

The board shall be of Class - (B) Class-B Type-4 Retro Reflective sheeting .

1. SCOPE :

The work shall consist of providing and fixing in C.C. 1:2:4 (size of block 45 x 45 x 60 cm.) the road sign boards as per specification as under as directed by Engineer – in – charge.

2. MATERIALS :

The boards shall be made from 4mm. aluminum sheet. The sheet shall be of good quality approved by Engineer - in - charge. Stand post and frames should be made of M.S. angle of 75 x 75 x 6 mm size. Epoxy paint and epoxy primer shall be approved quality and shade as approved by Engineer – in – charge shall be encapsulated lens type. **The board shall be prepared 90x30 cms. rectangular .**

3. TRAFFIC SHINS HAVING RETRO REFLECTIVE SHEETING :**4. GENERAL REQUIREMENTS :**

The retro-reflective sheeting used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has the property of retroreflective over its entire surface. It shall be weather resistance and show colour fastness. It shall be new and unused and shall shown no evidence of cracking scaling pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory by the manufacture of the sheeting. The reflective sheeting shall be either or Engineering Grade material with enclosed lens or of high intensity grade with encapsulated lens/ micro prismatic type. The type of sheeting to be used would depend upon the type functional hierarchy and importance of the road.

5. High Intensity grade sheeting

The board shall be of Class-(B) Class-B Type-4 Retro Reflective sheeting.

The sheeting shall be of enclosed lens type consisting of microscope lens elements embedded beneath the surface of a smooth transparent, water-proof plastic resulting in a non exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro reflection (determined in accordance with ASTM standard E-810) (As indicated in Table 800 – 2)

Table 800 - 2
ACCEPTABLE MINIMUM COEFFICIENT OF RETRO REFLECTION FOR
ENGINEERING GRADE SHEETING (CANDAL AS PER LUX PER SQUARE METER)

Observation angle	Entrance angle	White	Yellow	Orange	Green	Red	Blue
0.2°	-4	70.0	50.0	2.5	9.0	14.5	4.0
0.2°	30	30.0	22.0	7.0	3.5	6.0	1.7
0.5°	-4	30.0	25.0	13.5	4.5	7.5	2.0
0.5°	30	15.0	13.0	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall not show less than 90% of the values, of retro-reflective indicated in Table 800 – 2 at the end of 5 years, the sheeting shall retain at least 50% of its original retro-reflective.

Message (legends, letters, numerals etc.) and borders shall either be screen printed or of cut – outs screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut outs shall be of materials as specified by the sheeting manufacturer and shall be bounded with the sheeting in manner specified by the manufacturer.

For screen printed transparent coloured areas on white sheeting the coefficient of retro-reflective shall not be less than 50% (fifty) of the value of corresponding colour in table 800.1 (a), 800.1(b) and 800.2 as applicable. Cut out and borders, wherever used shall be made out of retro-reflective sheeting (as per clause 801.3.2 of 801.3.3 as applicable) except those in black which shall be of non – reflective sheeting.

6. COLOUR :

Unless otherwise specified, the general colour scheme shall be as stipulated in IS 5 colour or ready mixed paints.

Blue	IS	Colour No. 166 French Blue.
Red	IS	Colour No. 537 Single Red.
Green	IS	Colour No. 284 Indian Green
Orange	IS	Colour No. 591 Deep Orange.

The colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

7. Adhesives

The sheeting shall either have a pressure sensitive adhesive of the aggressive tack type requiring no heat, solvent or other preparation for adhesion to a smooth clear surface or a tack free adhesive activated by heat, applied in a heat vacuum applicator in a manner recommended by the sheeting manufacture. The sheeting shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of materials of the base plate used for the sign. The adhesive shall form a durable bond to smooth corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one place by use of sharp instrument. In case of pressure sensitive adhesive sheeting the sheeting shall be applied in accordance with the manufacturer's specification. Sheetting with adhesive requiring use of solvents or other preparations for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

11. Refurnishment

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of materials used for the sign and should thoroughly bond with that material.

Alternatively, the aluminium blank shall be recycled to a finished condition and new sheeting's put on in an approved manner.

12. Fabrication

Surface to be refabricated shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/ dust removed to obtain a smooth plain surface before the application of retro-reflective give sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled except by suitable divide or clean canvas gloves between all cleaning and preparation operation and application of reflective sheeting primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

- 12.0.2** Complete sheets or the materials shall be used on the sign except where it is unavoidable, at splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5mm sheeting with heat activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75mm where screen printing with transparent colours is proposed, only butt joining shall be used. The materials shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer

13. WARRANTY AND DURABILITY:

For each lot of sheeting's procured the contractor shall obtain from the manufacturer a 10 years warranty for satisfactory field performance including stipulated retro-reflective of the sheeting of high intensity grade and 10 years warranty for the Engineering Grade and submit the same to the Engineer. In addition, a 10 years and five years warranty for satisfactory in field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printing or cut

out letter/legends and their ponding to the retro-reflective sheeting shall be obtained from the contractor/supplier and passed on the Engineer. The contractors/Supplier shall also furnish a certification that the signs and materials supplied against the assigned work meeting all the stipulated requirements and carry the stipulated warranty. All signs shall be dated during fabrication with indelible markings to indicate the start of warranty. The warranty shall also cover the replacement obligation by the sheeting manufacturer as well as contractor for replacement/repair/restoration of the retro-reflective efficiency.

14. Installation

- 14.0.1** Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally signs with an area upto 0.9 sqm. Shall be mounted on a single post and for greater area two or more supports shall be provided. Sign supports may be of mild steel reinforced concrete or galvanized iron (G.I.) posts end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.
- 14.0.2** All components of signs and supports other than the reflective portion and G.I. posts shall be thoroughly descaled, cleaned, primed, with two coats of epoxy paint. Any part of mild steel (M.S) post below ground shall be painted with three coat of red lead paint.
- 14.0.3** The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G.I. posts. After the nuts have been tightened the tails of the bolts shall be furred over with a hammer to prevent

15. MEASUREMENT FOR PAYMENT

The measurement for standard cautionary, mandatory and information signs shall be in number of different types of sign supplied and fixed. Direction and place identification signs, also shall be measured in numbers of different type of sign supplied and fixed.

- 16.** The contract unit rate shall be payment in full for the cost making the road sign including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

17. Unit rate for payment of this item shall be per 1-No. basis

SPECIAL TERMS AND CONDITIONS OF CONTRACT FOR SIGN BOARDS

1. Warranty certificate for seven years for respective grades of signs from the sheeting manufacturer should be attached with the bid.
2. A certificate of authorization from the sheeting manufacturer shall be submitted with the
3. The responsibility for handling, upkeep and safety of the boards lies with the contractor until the completion of work and final payment are released.
4. The contract is valid for three months from the date of work order. The required quantity has to be supplied and fixed as and when intimated by the Division.
5. The measurement for payment will be done only after fulfilling condition up to the satisfaction of Executive Engineer. The 100% quantity of supply and fixing will be checked by Deputy Executive Engineer and at least 10% quantity of supply and fixing will be checked by the Executive Engineer to ensure quality and workmanship, before passing for. The contractor will have to ensure how he is going to arrange repair or replacement of defective boards after intimation from the Division.

Item No 7.**Cautionary Warning Sign**

Cautionary Warning Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bands. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

(B) Class-B Type-4 Retro Reflective sheeting

A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting .

An amount equivalent to 10% of the Item amount shall be kept in Deposit for 10 years and shall be released on completion of 10 years after certified date of completion.

<p>This item shall be carried out for Cautionary Warning Sign Sign boards as per Detailed Specification of Item No. 6 as above except the size of the board shall be 90 x 90 x 90 cms. equilateral triangle as per Design and shall be fixed on C.C. Block of 45x45x60cm.s as above.</p>

Item No 8.

Direction sign (Junction board)

Direction (Junction) Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 244x122 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr (2Nos.) long stand post of Iron Angle 75 x 75 x 6mm /65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50x50x5mm; paintedwith bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for eachleg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

(B) Class-B Type-4 Retro Reflective sheeting

A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting .

An amount equivalent to 10% of the Item amount shall be kept in Deposit for 10 years and shall be released on completion of 10 years after certified date of completion.

<p>This item shall be carried out for Direction sign (Junction board) Sign boards as per Detailed Specification of Item No. 6 as above except the size of the board shall be 244x122 cms Rectangle as per Design and shall be fixed on C.C. Block of 45x45x60cm.s as above.</p>
--

Item No 9.

Village name Sign

Village name Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90x60 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

(B) Class-B Type-4 Retro Reflective sheeting

A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting .

An amount equivalent to 10% of the Item amount shall be kept in Deposit for 10 years and shall be released on completion of 10 years after certified date of completion.

<p>This item shall be carried out for Village name Sign Sign boards as per Detailed Specification of Item No. 6 as above except the size of the board shall be 90 x 60 cms. rectangle as per Design and shall be fixed on C.C. Block of 45x45x60cm.s as above.</p>
