



# **SPECIFICATIONS VOL. III**

**PROPERTIES & FACILITIES DEPT., OLD AIRPORT  
VOLUME III**

## FOREWORD

As one who worked for nearly three decades for civil works in Air India, I have immense pleasure in writing this "FOREWORD". The importance of a standard work on "Specifications", for any Engineering Organisation, needs no further emphasis. The work was begun when I was controller of Properties & Facilities Department, but could not be completed. It is voluminous work requiring dedicated attention. I was glad to be associated with this work, even after my retirement from Air India.

With the increased work load in Air India, this standard Reference Book will serve as uniform guidelines for all the connected Engineers, Architects, Contractors and would help in reducing ambiguities, disputes.

This work, of course, is not the end. With the new building materials and techniques coming up, this work would need to be constantly updated, with equal dedication, by all those associated with making and using this Standard Reference Book.

I congratulate the Staff and Officers associated with bringing out this excellent work, which would be treasured by many.

Sd/-

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# SPECIFICATIONS

## VOLUME III

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## ROADS, APRONS AND PAVEMENTS

### 1.0 INDIAN STANDARDS:

- |  |   |
|--|---|
| 1. IS : 1200 (Part I) – 1992                         | Method of measurement of Earthwork.   |
| 2. IS : 3764 – 1992                                  | Safety Code for excavation work.  |
| 3. IS : 9759 – 1981                                  | Guidelines for dewatering during construction.                                    |
| 4. IS : 269 – 1989                                   | Ordinary & Lowheat Portland cement. 33 grade                                      |
| 5. IS : 1489 – 1991 (Part I)<br>(Part II)            | Portland Pozzolana cement.  |
| 6. IS : 383 – 1970 Part II                           | Aggregates, coarse and fine from natural sources for concrete.                    |
| 7. IS : 2386 (Part I) – 1963                         | Methods of test for aggregates for concrete.<br>Part - I : Particle size & shape. |
| 8. IS : 2386 (Part II) – 1963<br>organic impurities. | Part – II Estimation of deleterious materials and                                 |
| 9. IS : 2386 (Part III) – 1963                       | Part – III : Specific gravity, density, voids,<br>absorption and bulking.         |
| 10. IS : 2386 (Part IV) – 1963                       | Part – IV : Mechanical Properties   |
| 11. IS : 2386 (Part V) – 1963                        | Part – V : Soundness  |
| 12. IS : 2386 (Part VII) – 1963                      | Part – VII : Alkali aggregate reactivity.   |
| 13. IS : 456 – 1978                                  | Code of practice for Plain and reinforced cement<br>concrete.                     |
| 14. IS : 516 – 1959                                  | Strength of concrete.   |
| 15. IS : 1199 – 1959                                 | Sampling & analysis of concrete.  |
| 16. IS : 10262 – 1982                                | Recommended guidelines for concrete mix<br>design                                 |
| 17. IS 73 – 1992                                     | Specification of paving bitumen. 2 <sup>nd</sup> Rev .                            |

18. IS : 2720 (Part II ) – 1973	Method of test for soils, - Determination of water content
19. IS : 1838 – (part I ) – 1982 (Part II) –1984	Preformed fillers for expansion joints in concrete non-extruding and resilient type (Bitumen impregnated fiber).
20. IS : 8887 – 1995	Bitumen emulsion for roads (cationic type ). 5 <sup>th</sup> Rev.
21. IS : 6241 – 1971	Method of test for determination of stripping value of road aggregates.

The above mentioned IS Specifications and Codes of practice have been indicated for general guidance.

However, these IS Specifications and Codes will be adopted only for those particular items in the contract where either the mode of measurement or detailed specifications are not laid down in the tender documents.

## **2.0 CLEANING THE SITE OF WORK :**

2.1 Before commencement of the work, accurate survey and levels of the area proposed to be developed shall be taken jointly by the Engineer-in-charge and the Contractor or his authorised representative, at 5.00 m center to center both ways. Proper record of the levels so taken and properly dimensioned drawings of such site survey shall be prepared by the contractor showing the bench marks, levels, site dimensions, etc. After checking for correctness, these shall be signed by both the EIC and the Contractor.

If the contractor or his authorised representative shall fail to be present at the time of surveying and taking of levels, the same shall be carried out by the EIC and the quantities worked out by him shall be binding on the contractor.

The levels and quantities obtained from these plans shall be final and binding upon the parties, but subject to the EIC's powers to vary the works, as and when found necessary.

The contractor shall provide suitable stones with flat tops and build the same in rubble masonry or concrete for temporary Bench marks and all pegs for setting out the work and fixing the necessary levels required for the execution of the work. These, if required by the EIC, shall likewise be built in masonry or cement concrete at such places and in such manner as the EIC may direct. The Contractor shall maintain without disturbance all such bench marks and reference stations during the course of execution of the work. The cost of performing the surveys, preparation of record of levels, drawings and the cost of setting out, constructing and maintaining bench marks, and reference stations shall be borne by the Contractor.

After the survey work as above is carried out, the existing natural ground shall be excavated to a depth of 20 cm to remove all the roots, shrubs, grass and other organic materials expect in the area where rock is met with. The complete area coming under cutting and refilling shall be cleared of shrubs, vegetation, grass, brushwood, trees, not exceeding 30 cms in girth (measured at one metre above ground level) and saplings and such other things should be totally removed by digging to the required depth. All excavated material, cut shrubs, trees, saplings, excavated roots shall be removed outside Air India premises as directed by the EIC.

The work also consists of allowing water accumulated in the area under development to drain out by digging temporary trenches, soak pits and/or constructing bunds and making area dry enough, freely accessible for movement of vehicles for bringing materials, as well as for carrying out survey work, leveling, excavation, filling, etc.

The Contractor shall provide suitable arrangement at his cost, if found necessary, to facilitate removal of accumulated surface or ground water to enable carrying out the leveling or filling work in fairly dry condition.

A standard deduction of 200 mm shall be effected from the levels from the survey taken in all areas except where rock is met with and fresh drawings shall be prepared with the revised levels so obtained and all further filling and excavation quantities shall be worked out on the basis of these revised levels.

The Contractor shall be responsible for the true and proper setting out of the works, for correctness of positions, levels, dimensions and alignments of all parts of the works and for the provision of all the necessary instruments, appliances, such as dumpy levels, theodolite, etc. and the labour in connection therewith. If at any time during the progress of works any error shall appear in the position, levels, dimensions or alignments of any parts of the works, the contractor on being required to do so, shall at his own expenses rectify such work.

Checking of any setting out or any line or level by the EIC's representative shall not in any way relieve the Contractor of his responsibility for ensuring the correctness thereof at his own cost.

Measurement :

The work completed as per the description and specifications shall be measured and paid in sq. m. correct to two places of decimals and the rate shall include all the work as described and specified.

The rate shall include the cost of all labour, materials, required for the operation for all the works as described and specified.

**3.0 EARTHWORK IN EXCAVATION :**

The excavation shall include careful removal of all sorts of soil, materials of whatever nature and whether dry or wet, necessary for the construction work, in accordance with lines, levels, grades and curves shown on the plans or as directed by the EIC. It shall be taken to the widths, levels and grades of the sub-grades level required prior to filling. The sides shall be left plumb, where the nature of the soil

permits it. Any shorting, strutting and timbering of cutting of extra widths required shall be done by the contractor at his own cost. Bottom shall be leveled or graded both longitudinally or transversely or stepped as directed.

Should any of the excavation be carried down to a level below the specified level, in the areas where filling is to be carried out, the Contractor shall fill in such excavation, at his own cost, with selected material of approved quality, consolidated with 8 to 10 M. Ton Power Roller as may be required to achieve 95% of Proctor Density at OMC until it is brought upto the proper level.

Any shoring, strutting and timbering required for protecting the sides of the excavation and for ensuring the safety of workman and equipment, existing structure, embankments, shall be done at the Contractor's own cost. The Contractor shall arrange for resisting side thrust and prevent slips, bows and damage to adjacent works and property. The shoring, strutting and timbering etc. shall be removed as directed after all the items of work for which it is required are completed. Adequate protective measures shall be taken to see that any excavation carried out does not effect or damage adjoining structures. All measures required to ensure safety of property and personnel shall be taken at Contractor's own cost and they shall be responsible for any injury to life or damage to property caused by negligence or accident due to constructional operations.

All material excavated (from the site) of whatever kind they may be, shall be placed at distance more than 1.50 M or as directed by the EIC away from the area being excavated or to be excavated. All excavated materials will remain the property of the corporation. The rate for excavation shall include the cost of sorting out useful materials and stacking them separately as directed. Materials suitable for filling or other use shall be sorted out and stacked at convenient places by the contractor at his own cost. Materials not useful in any way shall be disposed off as directed by the EIC at the Contractor's own cost. The rubble obtained during excavation shall be filled in nearby low lying areas and/or ponds, if required and as directed by EIC.

The site shall be kept clean of all debris at the completion of the work. All water which may be accumulated in excavation during the progress of the work, from seepage, springs, rains or other causes shall be bailed/pumped out or otherwise removed at no extra cost, till the work is completed and all such operations towards dewatering for the entire duration of the complete project, is included in lump sum rate quoted by the Tenderer for the item "dewatering" provided in the schedule of qualities. Pumping out water from any excavated area shall be done generally in such a manner so as to preclude the possibility of any damage to the excavated area, concrete or masonry of any adjacent structure.

The excavation shall be kept free from water in order to control the moisture content of the fill, and also during inspection and measurements.

The excavation in all sorts of soil shall include wet and dry soil, sand, gravel, soft and hard murrum, clay, silt, old rubble soling or metalling, small size stone, soft rock and similar other materials that can be excavated by ordinary spade, pick shovel, etc. without resorting to wedging, chiseling, etc.

The excavation in hard rock will include weathered rocks, solid rocks, which can only be removed by barring, wedging, chiseling, etc.

Measurement :

Measurements of excavation shall be in cubic metres correct to two places of decimal on the basis of the revised levels worked out after standard deduction of 200 mm as referred in para 2.0 above for "Clearing the site of work" and the levels taken after the excavation to the levels upto which the Contractor has been asked to excavate, has been carried out.

Nothing shall be paid for slope and/or slips due to falling of the sides or for the extra excavation carried out.

For measurements of excavation in hard rock, it shall be stack measurements with a deduction of 33 % for voids. Stacking the excavated rock materials should be at the places directed by the EIC.

Rate:

This shall include the following :

- a) Excavation, disposing of surplus excavated material/earth as specified.
- b) Stacking the useful materials at the places directed including sorting out.
- c) Setting out works properly etc.
- d) Bailing out and/or pumping out/removal of water in excavation, from rains, sub soil, water or springs, seepage, broken water mains or drains, etc.
- e) Protection and temporary supporting of existing services i. e pipes, water mains, cables, etc. met with in the course of excavation (care shall be taken not to disturb electric and communication cables), removal/diversion of such services, if necessary and directed.
- f) Forming or leaving steps in the side of trenches and their removal.
- g) Removing slips and falls in excavation.
- h) Fencing, putting danger signals, lighting and/or other suitable safety measures for protection against risk of accidents as approved and/or directed by the EIC.
- i) Excavation for working space for workers and for insertion of planking and strutting when required.
- j) Back filling with selected excavated materials and consolidating.
- k) Excavation and removal of soiling, metalling, etc. and stacking the materials at places directed after properly sorting out.

4.0 DISMANTLING OF PLAIN CEMENT CONCRETE, R.C.C., ASPHALT PAVEMENT, OLD FOUNDATIONS, ETC.

Dismantling implies breaking up and shall consist of demolishing whole or part of work all as specified and directed by EIC.

All serviceable materials shall be transported and carefully stacked at places including at AI stores in the manner as directed by the EIC. All unserviceable material & debris shall be carted to places directed, within



AI/IAAI premises shall be spread & leveled or if so directed by the EIC, shall be removed away from the AI premises at the contractor's own cost.

Measurement :

All work shall be measured net as follows :

i) Length, breadth and thickness shall be measured in metres correct to a cm.

ii) Area shall be measured in sq. m. correct to two places of decimal.

lii) Cubical contents shall be worked out in cu. M. correct to two places of decimal. Measurements of all work to be demolished/dismantled shall be taken before demolition except for concealed work & the same shall be signed by the EIC and the contractor.

5.0 ROLLING/COMPACTION OF SUB GRADE :

Before the commencement of the filling work, the sub grade shall be rolled out with 8 to 10 M. Ton Power Roller and consolidation with minimum 5 (Five) passes of the roller. All undulations, pot holes, depressions, shall be filled up with approved available materials. The sub grade shall be brought to the required camber and grade the surface fine dressed and consolidation completed. The area shall be sprayed with required quantity of water as directed by the EIC.

Measurement :

The measurement shall be in sq. m. correct to two places of Decimal.

Rate:

The rate shall include the cost of all labour, materials involved in all operations as described and specified.

6.0 SELECTED MATERIAL FOR FILLING :

Selected material for filling shall be free from roots, debris or other foreign matter. All clods of selected material shall be broken or removed. Where the excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 15 cm in size in any direction, and shall be mixed with fine materials consisting of decomposed rock or selected material as available, so as to fill up the voids as far as possible. Only when the selected material from excavation is not adequate or unsuitable for back filling, approved materials from outside will be used for the purpose with the prior concurrence of the EIC.

The approved material for filling shall be generally uniform in colour, hard, free from roots, bushes, other foreign matter or any organic impurities. It shall have coarse silicious grains, gritty to touch. The silt content i. e. fines passing through 75 micron sieve, shall not exceed 20 %. The area to be filled shall be first dewatered, cleared of all debris, brick bats, etc. and the entire area, excepting for that in pits, shall be consolidated to the satisfaction of the EIC.

The filling then shall be done in layers, not exceeding 20 cm each layer. Each layer in pits as well as in plinth shall be watered, well rammed and consolidated before the succeeding one is laid. The layers shall be rammed with butt end of crow bar, where the rammer cannot be used or by any other agreed method with the prior concurrence of the EIC.

## 7.0 SPECIFICATIONS FOR MURRUM FILLING :

### Quality of Murrum :

The murrum shall be naturally occurring material formed by disintegration of rock. It shall be obtained from recognized quarries and may be blended to suit specifications. It shall be free from vegetation, rubbish, or material of organic origin and salts deleterious to concrete and reinforced concrete, like chlorides and sulphates. Pieces of hard rock which do not get crushed under the roller shall not exceed 50 mm size. The grading of murrum shall generally conform to the following :

<b>Sieve Size</b>	<b>% passing by wt.</b>
80 mm	100
40 mm	80 – 100
10 mm	45 – 100
4.75 mm	25 – 085
600 microns	8 – 025
75 microns	0 – 015

All tests shall be carried out as per relevant parts of IS : 2720.

All pieces shall be broken down to less than 50 mm size. A representative sample shall be taken, soaked for 24 hours and washed to remove all fines. The wash water shall be filtered through 200 mesh. Not more than 20 % shall be retained on 200 mesh. The PL and LL shall not exceed 10 and 30 respectively.

### Filling :

Filling shall be permitted after removing vegetation, trees, roots, etc. in layers not exceeding 20 cm depth and manual consolidation will not be acceptable. Filling shall be done in 20 cm layers and every layer shall be power rolled with 8 to 10 tonne roller so as to achieve at least 95% of the Proctor density, with OMC. However, for the last four top layers of 20 cm, each layer shall be rolled to achieve 90% of the modified Proctor density at its OMC. Before start of work, the contractor shall supply three samples of murrum from each quarry to cover the variations expected in the supply. These samples shall be tested in a recognised laboratory by the Department in accordance with IS: 2720 for :

- i) Sieve analysis, silt and clay content.
- ii) Liquid limit and plastic limit
- iii) Moisture content and dry density relationship at Standard Proctor Density.
- iv) Moisture content and dry density relationship at modified Proctor density.
- v) CBR values after 48 hours soaking of the prepared samples consolidated to the maximum density at OMC indicated in items (iii) and (iv) (only for aprons for aircraft parking).

If found satisfactory, the quarry or quarries will be approved by the Department in writing. The Contractor will also supply a box with locking arrangement to hold a part of the sample and a clear bottle for each sample. The murrum samples shall be put into the bottle upto 20% of its capacity and then filled with water upto 80%. When well soaked, it shall be well shaken and allowed to stand in order to settle the particles. An approximate layer of silt and clay on top of the coarser material will be marked. During progress of the work, if any sample by colour, texture, smell or otherwise appears to the EIC to be outside the sample given or tested, a rough check can be performed by the site-in-Charge, using a test similar to the above site test. Till it is approved, the materials shall not be deposited at the site of filling. If either the contractor or the Department is not satisfied, laboratory tests as indicated above shall be done at the cost of the Contractor. The minimum CBR value acceptable shall be 17% in laboratory tests for the two top layers whenever filling work is done for aircraft parking.

#### Moisture Control :

The moisture content to be used where proctor density or modified proctor density is used shall be strictly controlled to within +/- 2% of the optimum moisture determined in accordance with IS : 2720 ( Part II ). Where the moisture is higher, the soil shall be raked and the moisture allowed to evaporate before rolling is commenced. Water shall always be sprayed and not poured. Ponding shall never be allowed. In wet weather, The work may have to be suspended for which no extras would be payable to the Contractor. Care shall be taken to see that moisture is uniformly spread throughout the layer and where necessary, mixing with harrows or rakes shall be done.

#### Quality Control :

The field density of the compacted soil shall be the dry density obtained by the sand replacement method as per IS : 2720 (Part XXVIII). Five samples shall be taken and values obtained. The average of these five shall be considered as one test value. For moisture determination an average of three samples shall be taken as one test. The following quality control tests at frequencies indicated shall be carried out.

<b>TEST</b>	<b>METHOD</b>	<b>FREQUENCY</b>	<b>ACCEPTANCE CRITERIA</b>
Natural Moisture Content	IS:2720 Part - II	1 Test for every 250 cu. M. for each type of murrum.	less than OMC
Moisture content Just before compaction	IS:2720 Part – II	2 tests for every 250 cu. M.	± 2%
Dry density of Compacted layer.	IS:2720 Part – II	1 test for every 500 sq. m. of layer.	Not less than 95% Of Proctor or Modified proctor density.

However, the EIC may vary the above frequency, if required.

Measurement :

Measurements shall be of the cubic contents of the compacted filling and shall be determined by taking level of testing ground and after final layer for each type of filling. All dimensions are for compacted thickness.

Ste Laboratory :

The list of equipment for site control laboratory :

<u>SR. NO.</u>	<u>NAME OF EQUIPMENT</u>	<u>QUANTITY</u>
1.	Indian standard sieve nos: 80 mm, 40 mm, 20 mm, 12.5 mm, 10 mm, 4.75 mm, 4.36 mm, 600 micron, 425 micron, 300 micron and 75 micron	1 Set
2.	Standard Proctor Compaction test apparatus.	1 Set
3.	Dry bulk density apparatus complete with sand pouring cylinder, trays, can, etc.	1 Set
4.	Core cutter apparatus 10 cm dia. 15 cm high for in situ density determination.	4 Nos.
5.	Physical balance, with weight box (capacity 100 gms)	1 No.
6.	Pan balance, capacity 5 kgs with weight box with least count 10 gms.	1 No.

7.	Pan balance 1 kg capacity with weight box with least count 0.1 gm	1 No.
8.	1000 ml measuring cylinder	1 No.
9.	Sand bath with stove	1 No.
10.	Speedy moisture meter	1 No.
11.	Enamel trays 30 cm x 35 cm	4 Nos.
12.	Stove	1 No.
13.	Misc. items such as measuring tapes, pestle, and mortar wooden (15 cm dia.) spatula, moisture content cans, cloth, bags, plastic bags, methylated spirit, enamel plates, porcelain) dish, glass apparatus (beakers, measuring cylinders, funnels, wash bottle, glass plate, steel rod-3.25 mm dia. And 15 cm long, chemicals, kerosene, petrol, etc.	

For carrying out quality control test, site laboratory shall be maintained by the Contractor, throughout the progress of the work.

No extra payment shall be made for maintaining the laboratory carrying out any test and supplementing equipment, fuel, samples, etc.

## 8.0 SUPPLYING & STACKING STONE AGGREGATE :

### Stone Aggregate :

Ground where stacks are proposed to be made shall be cleared, leveled or dressed to a uniform slope and all lumps, depressions, etc. shall be removed. The stacked metal shall be free from vegetation and foreign matter. Coarse aggregate stacks shall be made at places directed by the EIC. All rejected stone metal shall be removed from the site.

The aggregate shall be stacked in convenient units of one metre top width, 2.2 M bottom width, 450 mm to 750 mm height and of length in multiples of 3 M.

The stacks shall be uniformly laid, as directed and shall be serially numbered. The number shall be planted on each stack which shall be retained in position until the stack is used in the work. The register showing daily consumption of stacks shall be maintained at site of work. The collection of stone metal at one place shall be for complete length for each layer of WB Macadam or as directed by the EIC.

Measurement :

The length, breadth of top and bottom of stack and the height shall be measured correct to a cm. The volume shall be worked out by the formula :

$$V = \frac{A-1 + A-2 + \sqrt{A-1 \times A-2}}{3} \times h$$

Where A-1, A-2 are the surface areas of the top and bottom planes of the stack and 'h' is the vertical height and the quantity shall be reduced by 7.5% only for aggregates above 20 mm Nominal size, to arrive at the net quantity for payment.

Rate

The rate shall include the cost of all materials, labour involved for the operations to complete the work as directed.

Blinding Material :

Stone grit of 5 mm size and below shall be got approved from the EIC before the material in bulk is brought to the site.

Selected materials & grit shall be stacked in units of 1 cu.m. made with wooden boxes open at both ends of 2 M x 2 M X 0.25 M in dimensions.

Quantity for selected materials and stone grit shall be brought to the site for full length for each layer or as directed by the EIC in writing.

Measurement :

Measurement shall be in cu.m.

Rate

The rate shall include the of all materials and labour involved in all operations to complete the work as described.

9.0 WATER BOUND MACADAM WITH STONE AGGREGATE FOR SUB BASE, COARSE AGGREGATE FOR BASE/SUB BASE/WBM FOR AIRPORT PAVEMENTS/ROADS AND APRONS :

Stone metal aggregates for sub base/base shall be of naturally available stone from sources/quarries approved by the EIC and shall be machine crushed. It shall have sharp edges and corners and shall be free from dust, other foreign matter, laminations, unsound fragments and free from decay and weathered stuff. It shall be clean, sound and hard. Smaller stones for filling voids shall be of the quality not inferior to that of the larger stones. The metal shall be properly graded in sizes as described.

Physical requirements of course aggregate for W.B.M.:

TYPE OF CONSTRUCTION	TEST	REQUIREMENT PERCENTAGE
Sub base	L. A. Value or A.I.V	Max. 50% or 40%
Base with black Topping	L. A. Value or A. I. V. Flakiness Index	Max. 50% or 40% Max. 15%
Surface Course	L. A. Value Flakiness Index	Max. 40% Max. 15%

NOTE : L. A. Value = Los Angles Value  
L. A. V. = Aggregate Impact Value  
L. A. V. = Water Bound Macadam

Common Tests on Aggregate for W. B. M. :

Flakiness Index(IS:2386 Part – I) :

Flakiness Index of Aggregate is percentage by weight of aggregate particles whose least dimension/thickness is less than three fifth of their mean dimension.

Physical requirements of screening and binding materials :

SCREENINGS	BINDING MATERIALS
L. L. Max. 20 percent	P. I. Base Max. 6
P. I. Max. 6	Surfacing 4 – 9
Fraction passings 75 micron : Max. 10 percent	

Grading requirements of coarse aggregate and screening for W. B. M. :

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SIZE RANGE	SIEVE DESIGNATION	PERCENTAGE BY WEIGHT PASSING THE SIEVE
1) 90 to 45 mm	125 mm	100
	90 mm	90 – 100
	63 mm	25 – 60
	45 mm	0 – 15
	22.4 mm	0 - 5
2) 53 to 22.5 mm	63 mm	100
	53 mm	95 – 100
	45 mm	65 - 90
	22.4 mm	0 - 10
	11.2 mm	0 - 5
3) Screening 13.2 mm	13.2 mm	100
	11.2 mm	95 – 100
	5.6 mm	15 - 35
	180 micron	0 - 10
4) Screening 11.2 mm	11.2 mm	100
	5.6 mm	90 – 100
	180 micron	15 - 35

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Quantity of material for 10 sq. m. of w. b. m. of surface:

For 90 to 45 mm : For 100 mm compaction thickness, loose quantity of stone aggregate will be 1.21 to 1.43 cu. m. For 13.2 mm screening, loose quantity will be 0.27 to 0.30 cu. M. and blinding material 5 mm and below will be 0.08 to 0.10 cu. m.

For 53 to 22.5 mm : For 75 mm compacted thickness, loose quantity of stone aggregate will be 0.91 to 1.07 cu. m. For 11.2 mm screening, loose quantity will be 0.18 to 0.21 cu. M. and blinding material 5 mm and below will be 0.06 to 0.09 cu. m.



## 10.0 PREPARATION OF SUB-GRADE

The sub-grade shall be prepared and consolidated with 8 to 10 M Ton Power Roller. The roller shall pass a minimum of five runs and/or as directed by the EIC on sub-grade. The finished surface shall be uniform the confirm to the lines, grades, cross sections as per drawings. The tolerance of surface regularity shall be 24 mm max. permissible undulation when measured along the line parallel to centre line of the road with 3 M straight edge.

The traverse profile shall be checked with a set of three camber boards at interval of 10 mtrs. Maximum permissible variation from specified profile under camber template shall be 15 mm.

## 11.0 SUB-BASE: WATER BOUND MACADAM (W. B. M.) WITH STONE AGGREGATE FIRST LAYER OF STONE METALLING OF 100 MM COMPACTED THICKNESS

Stone aggregate of size 90 to 45 mm shall be used. This layer shall consist of clean crushed coarse aggregate mechanically interlocked by rolling with voids filled with screening or stone aggregate of size 13.2 mm and blinding material 5 mm and below as per item description and specification and as directed by the EIC and laid on a prepared sub-grade. The section of the sub- grade shall be as shown in the drawing.

### Preparation of Surface :

The surface shall be scarified and reshaped to the required grade, camber and shape as necessary. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for WBM.

### Spreading Aggregate:

The aggregate shall spread uniformly upon the prepared base with a twisting motion to avoid segregation. In no case the aggregate be dumped in heaps directly on the working space. Spreading uniformly shall be done by using templates placed across the road six metres apart. Where specified, approved mechanical devices may be used to spread aggregate uniformly so to minimise the need for minipulation by hand. The coarse aggregate shall normally not be spread in lengths exceeding three days average work, ahead of the rolling and blending of the preceeding section.

The surface of the aggregate spread shall be carefully checked with templates and trued up and all high or low spots corrected by removing or adding aggregate as may be required. The surface shall be checked form time to time during spreading and rolling of the coarse aggregate to ensure a finished surface with variation not greater than 12 mm when 3 metre long straight edge is laid parallel to the centre line of the road, at the middle of each traffic lane. The transverse profile shall be checked with a series of three camber boards at intervals of 10 M.

### Rectification of defective construction:

Where the surface irregularity of W. B. M. sub-base course exceeds the tolerance of 15 mm longitudinally or 12 mm in its cross profile, the layer to its full thickness shall be scarified over the affected areas, reshaped with added new material as applicable and recompacted. The areas treated in this manner shall not be less than 10 sq. m. In no case shall depression be filled up with a screening and blinding material.

### Rolling :

Immediately following the spreading of the coarse , aggregate it shall be compacted to the full width by 8 to 10 M. Ton Power Roller as required and directed.

The rolling shall begin from the edges with the roller forward and backward and until the edge is firmly compacted. The roller shall then progress gradually from edges to centre parallel to the centre line of the road and overlapping uniformly each proceeding rear wheel track by one half width and shall continue till the entire area of the course has been rolled by rear wheel.

Only slight sprinkling of water may be done during the rolling if required.

Rolling shall not be done when sub-base or sub-grade is soft and yielding or when rolling causes a wave motion. When rolling develops irregularities, the irregular surface shall be loosened and aggregates added to or removed from it as required and the areas rolled until it gives uniform surface conforming to desired cross section and grade. The use of stone grit to make up depressions shall not be permitted.

### Application of Screening:

After the coarse aggregate has been lightly rolled to required true surface, screening 13.2 mm and down gauge shall be spread gradually over the surface to completely fill up the interstices in three or more applications.

Dry rolling and brooming shall be continued during the spreading of screening material.

Screening shall not be dumped in heaps or piles on the working area. It shall be spread uniformly twisting motion or by mechanical spreader.

The spreading, rolling and brooming of screening shall be perform on sections which can be completed within one day's operation and shall continue until no more screening can be forced into the voids of coarse aggregate.

Damp and wet screening shall not be used under any circumstances.

After spreading the screening and rolling, the surface shall be continuously sprinkled withy water and swept and rolled. Hand broom shall be used to sweep the wet screening into voids and the brooming continued with addition of screening if required, until the coarse aggregate are well bonded and firmly set for the entire depth.

### Application of blinding material:

After the coarse aggregate has been lightly rolled to required surface, stone grit as specified shall be applied gradually over the surface to completely fill the interstices in three or more applications. Dry rolling and brooming shall be continued during the spreading of blinding material. Damp and wet blinding material shall not be used under any circumstances.

After spreading the blinding material and rolling, the surface shall be sprinkled with water, swept and rolled. Hand broom shall be used to sweep the wet screening into the voids and rolling and brooming continued with the addition of blinding material, if required, until the coarse aggregate are well bonded and firmly set for the entire depth. Care shall be taken to see that the sub-base sub-grade dose not gate damaged due to the addition of excessive quantity of water during compaction.

After the application of stone grit and rolling, a suitable blinding material shall be applied at a uniform and slow rate in two or more successive thin layers. The surface then shall be sprinkled with water and slurry swept in with hand brooms to fill the voids property.

The surface shall then be rolled with 8 to 10 M. Tom Power Roller, water being applied to the wheels in order to wash down the blinding material that may get stuck to the wheels.

Setting & Drying : After final compaction of the course, the area shall be allowed to cure over night. Early next day, defective spots shall be filled with screenings or blinding material, lightly sprinkled with water, if necessary and rolled. No traffic will be allowed till the macadam sets.

### Surface evenness of compacted WBM Sub-base:

In the longitudinal and transverse direction shall be as under:

<u>SIZE OF COARSE AGGREGATE</u>	<u>LONGITUDINAL PROFILE</u> <i>Max. permissible undulation when measured with 3 metre Straight edge.</i>	<u>CROSS PROFILE</u> <i>Max. permissible undulation when Measured with a Camber template</i>
90 to 45 mm	15 mm	12 mm

### Measurements:

The length and breadth shall be taken to the nearest centimeter and consolidated thickness to the nearest half centimeter by levels at every 3 metres. The cubical contents of the consolidated compacted layer shall be calculated in cu. m. correct to two places of decimals.

Rate:

The rate shall include cost of all labour and materials involved in all the operations described above excluding the cost of stone aggregate, screening, blinding stone grit or blinding material (selected material) for which separate payment shall be made under relevant item.

The rate shall include measures for the safety of traffic during construction and provide, erect and maintain such barricades, including warning signs, lights and flagmen as directed by the EIC.

The rate shall be payment in full for carrying out the required operations including full compensation for:

- a) Carrying out the work in part where directed by the EIC.
- b) All labour, tools, equipments and incidentals required to complete the work to the specifications.

12.0 BASE:WATER BOUND MACADAM (W. B. M. ) WITH STONE AGGREGATE:

Second layer of stone metalling of 75 mm compacted thickness.

The base course shall consist of stone aggregate of sizes 63 to 45 mm with clean crushed stone coarse aggregate mechanically interlocked by rolling, with voids in the aggregate filled with screening of stone aggregate 11.2 mm and blinding materials with the assistance of water and laid on prepared sub-base.

Preparation of sub-base:

Surface shall be scarified and reshapes to the required grad, camber and shape, as shown in drawing and/or directed by the EIC. Pot holes, depressions, unevenness, etc. shall be made good with suitable material before spreading the aggregate. Spreading operation shall be the same as for sub-base, except that this course shall be in one layer of 75 mm compacted thickness.

Rolling, application of screening and blinding material, sprinkling of water, etc. shall be as specified in sub-base.

Surface eveness:

The surface eveness of completed consolidated WBM course of compacted thickness of 75 mm in longitudinal and transverse direction shall be within 12 mm and 8 mm respectively when checked with 3 metre straight edge and with camber template respectively as for the sub-base course.

Checking of profile, rectification of defective construction, measurements and rates shall be similar to those specified in sub-base.

Where the W. B. M. is to be used for roads without any asphalt or concrete surfacing etc. the W. B. M. surface shall be finally finished with selected blinding material as for sub-base. If the surfacing is specified, the base shall not have final blinding material as specified earlier.

### 13.0 BITUMISED KRAFT PAPER AND POLYTHENE SHEET:

#### Materials

Bitumen laminated Kraft paper shall be of two ply laminated with bitumen conforming to Type I, waterproofing paper as per IS: 1398.

Kraft paper shall conform to IS: 1397 have substance of 50 to 70 g/sq.m.

Bitumen for lamination shall have a composition of Air blown grade having a softening point (Ring and Bell method ) of not less than 80°C.

The water proof Kraft paper shall be smoothly and uniformly spread throughout and shall not crack on folding the paper.

The paper shall be uniform in width and thickness and free from pin holes, air bubbles or cracks. The outer surface shall be smooth, clean and free from any stains or spots of bitumen.

Polythene sheet shall be of 200 gauge.

#### Laying

Kraft paper or polythene sheet shall be laid flat immediately prior to laying the concrete pavement on a broomed surface. Kraft paper shall have longitudinal and transverse overlap of 75 mm and 15 mm respectively. Polythene sheets shall have overlaps of 75 mm in either direction. The paper/sheet should butt against the side forms or adjacent concrete laid on either side without gaps.

Material which is torn or damaged shall not be used and care shall be taken to prevent tearing or damaged after laying. Material damaged in any way shall be removed and replaced with new material.

#### Measurement:

Two ply laminated Kraft paper, polythene sheet shall be measured flat as laid in sq.m correct to two places of decimal length and breadth being measured correct to a cm. No allowances will be made for overlap or butt joints specified.

#### Rate :

The rate shall include cost of all material and labour for all operations involved for completion of work in all respects, as described and specified.

#### 14.0 CEMENT CONCRETE :

##### Cement :

The different types of cement which may be used in the works are as follows:

- a) Ordinary Portland Cement
- b) Portland Pozzolana Cement.

##### Compressive Strength :

72  $\pm$  1 hour not less than 160 kg/sq. cm. for OPC &  
168  $\pm$  2 hours, not less than 220 kg/sq. cm. For both OPC & PPC.

- a) Volume of one bag of 50 kg of cement is taken 0.0347 m<sup>3</sup>.
- b) Cement samples taken from each consignment received at site shall be sent immediately for testing if an approved Laboratory and the certificate of test shall be obtained at Contractor's cost.

The following Cement Tests shall be carried out :

1. Soundness
2. Fineness
3. Setting time – Initial & Final
4. Compressive Strength

All cement shall be stored in a waterproof structure and prevented from damaged by moisture, by suitably covering the stacks with polythene sheets/tarpaulins, especially during damp weather. These structures shall be provide by the Contractor at his won cost and placed in locations approved by the EIC.

Provision for storage shall be ample enough to suit the time prescribed for completion of each shipment/ lot and to allow sampling at least 12 days before use.

The Contractor shall keep an account or accurate record of delivery of cement and its issue for use in the work, or when transferred. Copies of this record shall be supplied by him regularly to the EIC.

Cement shall be used in the sequence in which it is received. No. cement shall be unnecessarily stored for a long period.

Any cement which has deteriorated or which has been damaged, whether during transit to the site or at the site or otherwise, shall not be used and shall be immediately removed from the site and shall be replaced at the expense of the Contractor.

It shall be responsibility of the Contractor to ensure the quality of cement procured by the Contractor by direct payment to the Suppliers.

### Aggregate:

All aggregates shall generally conform to the requirements of IS: 383-1970 and the following in particular.

Fine the course aggregates shall be used only from sources of supply approved by the EIC. Any material which has deteriorated or has been contaminated shall not be used for concrete. All aspects of aggregate handling and storage are subject to the approval of the EIC, and shall be such as to minimise segregation and breakage and shall prevent contamination by grass, soil, wood, sawdust, oil, aggregates of other sizes or other foreign material and shall be such that adequate supplies of approved quality are available at site in advance of requirements. Each size of aggregate shall be stored on a separate platform or stock pile at locations to be approved by the EIC and such platforms for stock piles shall be sufficiently removed from each other to prevent the material at the edges of the piles from being intermixed. If a clean and hard surface for storage is not available, a platform of planks or a floor of bricks shall be prepared to receive the aggregates.

For both fine and coarse aggregates, tests shall be carried out when required for physical characteristics, limits of deleterious substances and soundness, prior to use and also whenever the source of supply is changes. All tests shall be conducted at the contractor's expense at a laboratory or in Facilities approved by the EIC.

### **SAND (FINE AGGREGATE)**

Sand shall be that aggregate most of which passes through 4.75 mm IS Sieve. Sand shall be of approved quality, clean, sharp and shall contain not more than 5% deleterious materials like mica, shells, soft flaky particles, shale, organic matter. Silt shall be considered as particle passing through 75 microns sieve. Silt percentage should not be more than 5 percent by weight, if ascertained in a recognized Laboratory. Silt upto 8% by volume shall be allowed, provided It is not of organic origin, when tested in field laboratory as under:

A sample of sand shall be filled in a measuring cylinder upto 100 ml mark and clean water shall be added upto 150 ml mark. Two pinches of common salt shall be added. The contents shall be well shaken and allowed to stand for three hours. The height of the silt shall be measured and expressed as percentage of the sand below:

Sand may be of fine gravel and river or pit sand or crushed stone or mixture of these in order to achieve the grading required as given hereinafter.

The sand shall be from source approved by the EIC and if required by him it shall be thoroughly washed, screened and graded by the Contractor at his own expenses to the satisfaction of the EIC.

It shall be within the range of grading Zone I, grading Zone II and grading Zone III as given below:

## **Grading of Aggregate:**

### **Fine Aggregate:**

Fine aggregate shall be within the limits given in the following table:

IS SIEVE DESIGNATION	PERCENTAGE PASSING FOR		
	GRADING ZONE I	GRADING ZONE II	GRADING 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 micron	15 - 34	35 - 59	60 - 79
300 micron	5 - 20	8 - 30	12 - 40
150 micron	0 - 10	0 - 10	0 - 10

**Note :** For crushed stone sands, the permissible limit on 150 micron IS Sieve is increased to 20 percent

Where the grading falls outside the limits of any particular grading zone of sieves other than 600 micron IS Sieve by a total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron IS Sieve or to percentage passing any other sieve size on the coarse limit of Grading Zone I.

Bulking of sand shall be allowed for (by adding sand) and ascertained as follows:

Sand from inside of stack shall be filled into a measuring box as usual and struck off flush with the top. The box shall be placed on the ground, flooded with water and tamped vigorously. The drop in level of sand shall be measured and made good by addition sand of the same height as the drop.

### **Coarse Aggregate:**

Coarse aggregate shall be obtained from natural source such as stone, gravel, etc. crushed or uncrushed or a combination thereof and from approved quarries. This shall consist of coarse material, most of which is retained on 4.75 mm IS Sieve. The whole of the ingredients of the coarse aggregate shall be hard, strong, dense, durable, clean and free from veins, adherent coatings. It shall be free from soft, friable, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall be clean and free from dirt and any other deleterious matter.

### **Supply :**

The coarse aggregate proposed to be used for the contract work shall be got approved from the EIC before the start of the work. all subsequent supplies shall preferably be obtained from the same source.



The aggregate (fine and coarse) shall not contain harmful organic impurities. The test for organic impurities, if required by the EIC, shall be carried out by the Contractor at his own cost and risk in a recognized / approved Laboratory.

If it is considered necessary, the EIC may instruct that the coarse aggregate to be washed, screened and graded at the contractor's expense.

Storage of Coarse Aggregate:

The material shall be stored so as to prevent contamination and segregation.

Grading of Coarse Aggregate:

Graded coarse aggregate shall be supplied in size conforming to the following grading:

<b>Sr. No.</b>	<b>Nominal Size</b>	<b>Grading Size</b>
1	10 mm	4.75 mm to 12.5 mm (100% passing through 20 mm)
2	20 mm	10.00 mm to 25 mm (100% passing through 40 mm)
3	40 mm	20.00 mm to 40 mm (100% passing through 80 mm)

Grading of coarse aggregates shall be such that not more than 10% shall be larger than the maximum grading size and not more than 10% shall be smaller than the minimum grading size.

In addition to sieve analysis, if required by the EIC, contractor shall carry out at his cost and risk, the following tests in a recognized / approved laboratory :

- a) Specific gravity and absorption
- b) Aggregate crushing value
- c) Aggregate impact value
- d) Aggregate Abrasion value
- e) Soundness of Aggregate

Water for mixing :

Generally potable water should be used. This is to ensure that the water is reasonably free from such impurities as suspended solids, organic matter and dissolved salts which may adversely affect the properties of the concrete, especially the setting, hardening, strength, durability, pH value etc.

The water shall be clean and shall not contain sugar, molasses or gur or their derivatives, or sewage, oils or organic substances. If the quality of water used for mixing is in doubt, cubes of 75 mm in cement mortar 1:3 mix with distilled water and with the water in question shall be made separately. The latter type of cubes should attain 90% of the 7 days' strength obtained in cubes with the same quantity of distilled water. Alternatively, the water shall be tested in an approved Laboratory for its use in preparing concrete / mortar.

For plain and reinforced cement concrete permissible limits for solids shall be as follows:

Organic matter	200 mg / ltr.
Inorganic matter	3000 mg / ltr
Sulphates (as SO <sub>4</sub> )	500 mg / ltr
Chlorides (as Cl)	a) 1000 mg / ltr. for RCC b) 2000 mg / ltr. for RCC
Suspended matter	2000 mg / ltr

#### Limits of Alkalinity :

To neutralize 200 ml of sample should not require more than 10 ml of 0.1 normal HCL using methyl orange as an indicator.

#### Limits of Acidity:

To neutralize 200 ml sample of water should not require more than 2 ml of 0.1 normal (NaOH) (Caustic Soda).

The pH value of water shall generally be not less than 6.

#### PLAIN CEMENT CONCRETE:

This shall be prepared by mixing grade stone of nominal size specified with fine aggregate and cement in specified proportions with required quantity of water.

The concrete can be specified in two ways :

- a) by Proportioning of the constituents / ingredients (Nominal mix)
- b) By required strength (Design mix)

#### MIXING

It shall be done in a mechanical mixer. Mixing by hand shall be employed only in specific cases with the specific prior permission of EIC.. Stone aggregate shall be washed with the water to remove dirt, dust or any other foreign material.

### MACHINE MIXING:

The mixer drum shall be flushed clean with water. Measured quantity of dry coarse aggregate shall be placed first in the hopper. This shall be followed with measured quantity of the aggregate and then cement. In case damp sand is used, add half of the quantity of coarse aggregate and dry materials slipped into the drum. The dry materials shall be mixed for at least four turns of the drum, after which the correct quantity of water shall be added gradually while the drum is in motion, to ensure even distribution with the dry materials. The total quantity of water for mixing shall be introduced before 25% of the mixing time has lapsed and shall be regulated to achieve the specified water cement ratio. The complete contents of the mixed concrete shall be emptied before recharging. When the mixer is closed down for the day or at any time exceeding 20 minutes, the drums shall be flushed clean..

### MIXING TIME:

The materials shall be mixed for a period of not less than 2 minutes and until a uniform colour and consistency are obtained. The time shall be counted from the moment all the materials have been put into the drum.

### HAND MIXING:

Hand mixing shall be done on a smooth, clean and water tight platform of suitable size of the following manner

- a) Measured quantity of sand shall be spread evenly.
- b) The cement shall be dumped on the sand and distributed evenly.
- c) The sand and cement shall be mixed intimately with spade, turning the mixture over and over again, until it is of even colour throughout and free from streaks.
- d) The sand cement mixture shall be spread out and measured quantity of coarse aggregate shall be spread on its top. Alternatively, the measured quantity of coarse aggregate shall be spread out and the sand cement mixture shall be spread on its top.
- e) This shall be mixed at least three times by shovelling and turning over by twist from centre to side, then back to the centre, and again to the site
- f) A hollow shall be made in the middle of the mixed
- g) Three quarts of the total quantity of water required shall be added while the materials are turned in towards the centre with spades. The remaining water shall be added by a water can fitted with a rose head, slowly turning the whole mixture over and over again, until a uniform colour and consistency is obtained throughout the pile.
- h) The mixing platform shall be washed at the end of the day.
- i) 5 percent extra cement shall be added, when hand mix concrete is produced

### CONSISTENCY:

The quantity of water for cement concrete 1:3:6 (nominal mix) shall be 34 litres for each mix of 50 kg cement to give the required consistency. In case the concrete is vibrated, the limit specified may be suitably reduced to avoid segregation. The quantity of water shall be regulated by carrying out a slump test.

### TRANSPORTING:

Concrete shall be conveyed from the place of mixing to the place of final deposit as rapidly as practicable before the commencement of initial set, by methods which will prevent the segregation or loss of ingredients and in no case more than 30 minutes shall elapse between mixing & consolidation in its final position. It shall be transported in such a way as to receive minimum amount of handling and consequent loss of the fine material. Under no circumstances shall concrete that has obtained its initial set be used.

Concrete shall not be dropped or tipped from a height which shall result in segregation of ingredients, but it shall be deposited as far as possible in layers of suitable thickness. The maximum height from which the concrete may be dropped shall not exceed 2.4 m. The concrete shall be conveyed by mechanical arrangement for buildings with ground and three or more upper floors. The plant shall be of such size and design as to ensure practically a continuous flow concrete.

### PLACING / LAYING & COMPACTING:

Before the concrete is actually placed in position, the insides of the forms shall be inspected to ensure that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns, to permit the removal of all sawdust, wood shavings, cigarette ends and dirt. Openings shall be so placed that the water used to flush the forms will be drained away. No water shall be left in the forms.

The entire concrete used in work shall be laid gently (not thrown) in layers not exceeding 200 mm and shall be thoroughly vibrated by means of mechanical vibrators till a dense concrete is obtained. The EIC may, however, relax the conditions at his discretion in the case of certain locations or certain items depending upon the thickness of the members and feasibility of vibrating the same and permit hand compaction. The hand compaction shall be done with the help of tamping rods, so that the reinforcement, around the embedded fixtures, and into the corners of the form work. The layers of concrete shall be so placed that the bottom layer does not finally set before the top layer is placed. The vibrators shall maintain the whole of concrete under treatment in an adequate state of agitation, such that desertion and effective compaction is attained at a rate commensurate with the supply of concrete from the mixers. The vibration shall continue during the whole period occupied by placing of concrete, the vibrators being adjusted so that the centre of vibrations approximates to the entire of the mass being compacted at the time of placing.

Concrete shall be judged to be properly compacted, when the mortar fills the spaces between the coarse aggregates and beings to cream up to form an even surface. When this conditions has been attained, the vibrator used shall be stopped in case of vibrating tables and external vibrators. Needle vibrators shall be withdrawn slowly so as to prevent formation of loose pockets. In case both internal and external vibrators are being used, the internal vibrators shall first be withdrawn slowly after which the external vibrators shall be stopped so that no loose packet is left in the body of the concrete. Specific instructions of the make of the particular type of vibrator used shall be strictly complied with. Shaking of reinforcement for the purpose of compaction should be avoided. Compaction shall be completed before the initial setting starts i.e. within 30 minutes of addition of water to the dry mixture.

#### FORMWORK:

For centering and shuttering required. For concrete work, the rate shall include the same in the rate for concrete work mentioned in the schedule of items.

#### CURING :

Green concrete work shall be protected from rain, such, drying, winds by a suitable covering. The work should also be suitably protected from damage by rain during construction, for example, Concrete steps shall be adequately protected at least one week in addition to curing period.

When required, the contractor shall provide and use enough tarpaulins or other suitable materials to cover completely or enclose all freshly finished concrete at his own cost.

Within 12 hours of laying of concrete, the surface shall be cured by flooding with water or by covering with wet absorbent materials. The curing shall be done for a minimum period of 10 days. In special cases, curing may have to be done for more than 10 days as required and directed by the EIC.

The water used for curing shall not produce any objectionable stains or unsightly for deposit on concrete surface.

### **15.0 CONCRETE APRON & PAVEMENT FOR AIRCRAFTS/TRACTOR MOVEMENT**

Formwork shall be provided for all expansion, contraction, constructions and longitudinal joints as well as for all outer edges. The forms shall be of steel. All forms shall be of a depth equal to thickness of the apron or pavement slabs.

Steel forms shall be of the required section and lengths. These shall generally be of steel section and shall be perfectly straight, have a broad base and be of sufficient stiffness to withstand w without displacement or distortions, the impacts due to placing and compaction of concrete . If more than one channel is used for required depth of concrete, the joining shall be with tack welds or nuts and bolts or steel clamps as approved by the EIC.

The formwork shall be set to the exact grade and alignment and shall be extended by 300 mm beyond the point of depositing concrete and checked with a levelling instrument. It shall be secured with the necessary struts and spikes to avoid displacement during construction. Generally the width of any bay shall not be more than 4 m. The form works shall be cleaned and oiled before and after each use. It shall be periodically checked for straightness and corrected if necessary. No form shall be removed until 48 hours have elapsed after the concrete has been placed against them.

The concrete shall be laid to such depth above the base, that when consolidated and finished, the slab thickness required will be obtained at all points. Hand mixing shall not be allowed.

The full thickness of concrete apron / pavement shall be cast in one operation. Similarly, the entire length of concrete from one expansion joint to the next expansion joint shall be completed in one continuous operation. The consolidation of concrete shall be initially done with needle vibrators and then with screed vibrators of approved type. The vibrations of the screed vibrators shall be of a frequency not less than 3500 impulses per minute. Internal vibrators may also be used for compaction of portion of the slab along the edges, corners and joints. The top of concrete shall be finished with straight edges to its correct level and profile. After vibrating the concrete and finishing as above, it shall be allowed to dry slightly and then it shall be further finished with approved type of brushes with long handles or canvass belts, by moving the same to and fro across the panel till a uniform texture finish is obtained. The size and layout arrangement of panels shall be as per drawing.

The water cement ratio, aggregate cement ratio, aggregate grading, slump test, mixing, consistency, etc. shall be according to the mix design as approved by the EIC. The concrete mix design shall be worked out to ensure a minimum flexural beam strength of 34.00 kg / sq.cm at 28 days and shall be of strength not less than M-325 concrete, unless otherwise specified.

Quality control tests on the materials as well as the frequency of testing shall be as indicated below:

<b>MATERIAL</b>	<b>TEST</b>	<b>TEST METHOD</b>	<b>MINIMUM DESIRABLE FREQUENCY OF TESTING</b>
1 Cement	Physical & Chemical tests	IS:260/1076	Once for each source of supply and occasionally when called for in case of long and / or improper storage.
2 Coarse & Fine aggregates	i) Gradation	IS : 2386	One test for 15 m <sup>3</sup> of each fraction of coarse aggregate and fine aggregate.
	ii) Deleterious Constituents	IS : 2386 (Part II)	- do -

	iii) Moisture Content	IS : 2386 (Part III)	Regularly as required subject to a minimum of one test / day for coarse aggregate and two tests / day for fine aggregate.
	iv) Bulking of fine aggregate (for volume batching)	- do -	Once for each source for deriving the moisture content bulking relationship
3	Coarse Aggregate	i) Los. Angles Abrasion Value/ Aggregate Impact Test	IS : 2386 (Part IV) Once for each source of supply and subsequently when warranted by changes in the quality of aggregate.
		ii) Soundness	IS: 2386 (Part V) As required
		iii) Alkali aggregate reactivity	IS 2386 (Part VII) - do -
4	Water	Chemical tests	IS : 3025 Once for approval of source of supply, subsequently only in case of doubt.

**NOMINAL MIX CONCRETE** *(by proportion of constituents)*

Nominal Mix concrete shall be prepared by mixing graded stone aggregate, fine aggregate and cement in specified proportions with required quantity of water. The grading and quality of aggregate (stone aggregate and fine aggregate), water for consistency and the requisite minimum strength shall be as given below:

<b>CONCRETE MIX</b>	<b>COMPRESSIVE STRENGTH (KG. PER SQ. CM)</b>	
	<b>7 DAYS</b>	<b>28 DAYS</b>
1:1:2	180	275
1: 1 ½ : 3	150	225
1:2: 4	120	180

The maximum water cement ratio shall not exceed 0.55 in case of Reinforced Cement Concrete and 0.60 in case of Plain Cement concrete. The water cement ratio shall be decided for requisite consistency, for different type of work and condition.

The proportioning may be done by volume. Boxes of suitable sizes shall be used for measuring sand and aggregate. The internal dimensions of the boxes shall generally be 350 mm x 250 mm x 400 mm or as otherwise approved. The unit of cement shall be a bag of 50 kg and this shall be taken as 0.0347 cu.m. While measuring the aggregate, shaking, ramming or hitting shall not be done. The proportion of sand shall be on the basis of its dry volume. Suitable allowances shall be made in case of sand with inherent moisture.

### **SAMPLING :**

The frequency of sampling of concrete of each grade shall be minimum one number of sample (made of 6 companion cubes) upto 30 cu.m. of concrete. Additional samples shall be collected if required for additional quantity of 30 cu.m. concrete or part thereof. However, once the control of concrete is established, the samples shall be taken at random as directed by the EIC.

### **ACCEPTANCE CRITERIA:**

The concrete shall be deemed to comply with the strength requirement if:

- a) Every sample has test strength not less than the characteristic value. OR
- b) If the concrete does not meet the strength required in (a) , then 0.80, times the characteristic value at the discretion of the Designer shall be accepted as being structurally adequate. However, a rebate of 10% shall be taken over the quoted item rate.
- b) Concrete of each grade shall be assessed separately.
- c) Concrete is liable to be rejected if it is porous or honey combed, not in verticality, level or of required size and shape.

## **16.0 DESIGN MIX CONCRETE:**

Design Mix Concrete shall be designed with the help of IS : 10262-1982 or any other competent authority. It shall comply with the requirements of IS : 456 – 1978 and IS : 1348 – 1980 in general and the following in particular:

- a) Design Mix Concrete shall be specified in various grades designated as M-15, M-20, M-25, m-30, M-35, M-40, etc. in SI units. The letter “M” refers to the mix and the number to the specified characteristic compressive strength of 15 cm cube at 28 days expressed in N /mm<sup>2</sup>.
- b) Design Mix Concrete shall be designed as to provide an average compressive strength sufficiently high to restrict the probability of not more than 1 test result out of 20 test results of test samples as failing below the specified characteristic strength. This is target Average Compressive Strength denoted by fav.



Reinforced Cement Concrete : The minimum cement concrete for RCC Work shall be 290 kg / m<sup>3</sup> and Maximum water / cement rate shall be 0.55.

Plain Cement Concrete : the minimum cement content for PCC work shall be 250 kg/ m<sup>3</sup> and maximum water / cement ratio shall be 0.60.

**DATA FOR MIX DESIGN :**

The EIC will approve the following information required to produce Mix Design of required grade:

- a) Characteristic Compressive strength of concrete at 28 days (fck).
- b) Degree of workability desired depending upon consistency for type of concrete (vibrated / non-vibrated), place of concrete (slab, columns, thin section, pre-cast or cast-in-situ and the slump / compaction factor desired.
- c) Limitations on the water – cement ratio and minimum cement content to ensure adequate durability.
- d) Type and size of aggregates to be used.
- e) Degree of Control : Generally the degree of control for the initial mix design shall be taken as “Fair”. After evaluation, the mix design may be revised.

<b>Degree of Control</b>	<b>Conditions of Production</b>
Very Good	Fresh cement from single source and regular tests weigh batching of all materials, aggregates supplied in single sizes, control of aggregate grading and moisture content, control of water added, frequent supervision, regular workability and strength tests and field laboratory facilities.
Good	Carefully stored cement and periodic tests, weigh batching of all materials, controlled water, graded aggregate supplied, occasional grading and moisture tests, periodic check of workability and strength, intermittent supervision and experienced workers.
Fair	Proper storage of cement, volume batching of all aggregates, allowing for bulking of sand, weigh batching of cement, water content controlled by inspection of mix and occasional supervision and tests.

Depending upon the data for mix design a somewhat higher target average compressive strength for mix design shall be calculated so that not more than one test result in 20 test results of samples may fall below the characteristic strength as per the formula given below:

$$f_{av} = f_{ck} + t \times s$$

where  $f_{av}$  = target average compressive strength at 28 days  
 $f_{ck}$  = characteristic compressive strength at 28 days  
 $s$  = standard deviation as per IS : 10262 – 1982 ( to be used if established standard deviation is not available)  
 $t$  = statistical constant

The “t” statistical constant shall be taken as 1.65.

### **EVALUATION OF DESIGN MIX CONCRETE :**

Initially the samples for testing shall be collected at a faster rate to check and establish the laboratory Design Mix.

At least 3 and preferably 4 samples shall be obtained per mix per shift of 8 working hours. Each sample shall consist of 6 cubes, half of which shall be tested at 7 days and the remaining half at 28 days.

Efforts shall be made to collect test results of 30 samples or at least test results of 15 samples as early as possible to evaluate the design mix.

The design mix concrete shall be evaluated periodically with the help of standard deviation. The Standard deviation shall be computed as under:

$$\text{Standard deviation} = \sqrt{\frac{\sum \Delta^2}{\eta - 1}}$$

where

$\Delta$  = deviation of the individual test strength from the average strength of  $\eta$  samples.

$\eta$  = number of sample test results.

Concrete of each grade shall be analyzed separately to determine its standard deviation.

When significant changes are made in the production of concrete batches (for example changes in the materials used, mix design, equipment or technical control), the standard deviation value shall be separately calculated for such batches of concrete.

Attempt shall be made to obtain 30 test results at an early date and the standard deviation shall be calculated. In works where number of test samples are not expected in large numbers, the standard deviation shall be calculated from 15 test results.

The average of all the samples so far tested (i.e. either 30 or 15) shall not be less than :

$$f_{ck} + 1.65 \cdot \frac{1.65}{\sqrt{\text{no. of samples}}} \times \text{calculated standard deviation}$$

If there is significant difference in the above, necessary modifications to the Design Mix shall be made.

### **SAMPLING:**

After the initial period, i.e. after evaluation and establishing the mix design, subject to the acceptance by the EIC, the frequency at which cubes shall be made, may be reduced to 6 cubes for each major concreting or every 40 cu.m.

### **MANUFACTURE**

The mix required to produce, place and compact the specified grade of concrete shall be designed by the contractor and details thereof submitted to the EIC for his records alongwith the results of (1) Cement (2) Sieve analysis of aggregate, water / cement ratio, aggregate / cement ratio, compressive strength of test cubes, all calculations, tabulations, graphs etc. and such other tests of cement, aggregates and water or on concrete as the EIC may require. Mix design shall be the contractor's sole and ultimate responsibility. No concreting of M-15 and above shall be carried out at site till the mix design is accepted by the EIC. These details shall then be scrupulously followed for subsequent concreting operations at site till a variation in the degree of quality control necessitates a change in the mix. Full details of such changes shall be submitted to the EIC for his record.

All ingredients shall be proportioned and measured by weight. The contractor with the consent of the EIC may suitably convert weight of the aggregates only to equivalent volumetric batching by adopting suitable boxes. The Contractor shall provide platform type weighing scale of a capacity not less than 200 kgs to weigh each bag of cement and for every tenth batch of aggregates to ensure correctness of weight. Unit of measurement for cement shall be 50 kgs by weight.

The proportioning of sand shall be on the basis of its dry volume and in case of wet sand, allowance for bulking shall be made.

If the aggregates are wet, necessary reduction in water shall be made.

## ACCEPTANCE CRITERIA:

- I. The Concrete shall be deemed to comply with the strength requirements, if:
- a) Every sample has a test strength not less than the characteristic value; or
  - b) The strength of one or more samples though less than the characteristic value, is in each case not less than the greater of:
    - i) the characteristic strength minus 1.35 times the standard deviation and
    - ii) 0.80 times the characteristic strength: and the average strength of all samples is not less than the characteristic strength plus

$$\left\{ 1.65 - \frac{1.65}{\sqrt{\text{no. of samples}}} \right\}$$

- II. The concrete shall be deemed not to comply with the strength requirement if:

- a) The strength of any sample is less than the greater of:
  - i) The characteristic strength minus 1.35 times the standard deviation; and
  - ii) 0.80 times the characteristic strength; or
- b) The average strength of all the samples is less than the characteristic strength plus

$$\left\{ 1.65 - \frac{3}{\sqrt{\text{no. of samples}}} \right\}$$

- III. Concrete which does not meet the strength requirements as specified in I, but has a strength greater than that required by II, may, at the discretion of the designer, be accepted as being structurally adequate without further testing.

IV. If the concrete is deemed not to comply pursuant to II above, then that portion of concrete shall be totally rejected, and the contractor shall, at his risk and cost, dismantle, remove the debris and make good damages, if caused during dismantling. The scheme for dismantling / breaking etc. shall be got approved from EIC / Designer. In the event, if it is found not possible to carry out dismantlement of the defective work, then suitable modifications to ensure safety to the structure shall be carried out at the contractor's risk and cost.

V. Concrete of each grade shall be assessed separately.

VI. Concrete shall be assessed daily for compliance.

VII. Concrete is liable to be rejected if it is porous or honey-combed its placing has been interrupted without providing a proper construction joint; the reinforcement has been displaced beyond the tolerance specified; or construction

tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the EIC.

VIII. Where the value of the average strength of the tests (preferably 30 tests or 15 tests) is less than

$$f_{ck} + \left( 1.65 - \frac{1.65}{\eta} \right) \times s$$

then, the EIC may, at his option, accept the concrete, but only at a reduced rate equal to the rate quoted less 5%

#### MEASUREMENTS:

The measurement shall be in cubic metre correct to two places of decimal; length and breadth being measured correct to a centimeter. The depth shall be measured by levels taken at 3 metres before and after the concrete is laid and compacted, correct to 0.5 cm.

#### RATES:

The rate shall be for cost of all materials, labour, shuttering form work etc. involved in all the operations described above, including testing, use of all equipment required, laying, consolidating, any protective devices, curing, making good, honey combing or other defects etc. complete as directed by the EIC though these may not be mentioned or described in the item.

### 17.0 JOINTS IN CEMENT CONCRETE PAVEMENT:

#### Transverse Expansion Joint:

Expansion Joint fillers shall be pre-moulded and 18 mm wide. Expansion joints shall be constructed at right angles to the centre line of pavement and shall extend to the full depth of pavement. The spacing of the joints shall be 30 m or as directed or as indicated in the layout drawings. Expansion joints shall also be provided all along the edge of any existing concrete apron. Pre-moulded joint filler shall conform to ISI 1838-1961.

The side of concrete panel of the expansion joint shall first be treated with primer, non extruding pad fixed in position. A wooden beading of suitable section shall be used to leave a gap at the top panel which is later filled by a sealing compound and the same shall not be paid for extra. The non-extruding pad / sealing compound used shall be of approved make.

#### Contraction Joint / Dummy Joint:

In case of contraction joints, the depth shall be 75 mm and width 10mm. The contraction joints are provided as the concreting is in progress, in locations as directed and indicated in the layout drawing. The lower mass of concrete below 75 mm depth will be continuous and monolithic.

The contractor is free to provide contraction joints (dummy joints) in the panels using cutting by machine. However, care must be taken to retain the specified depth and width of the joint, as specified. Further, no extra payments will be made by the Corporation, for carrying out such cutting of joints by machine. The dummy joints shall be staggered as shown on the drawing or as directed by the EIC at site.

Construction Joints : (*Transverse and Longitudinal*)

These joints shall be made at the junction of the panels and at the end of each day's run or where an unavoidable interruption of more than 30 minutes occurs in the concreting operations. It shall be 10 mm wide and 20 mm deep.

The depth shall be filled up with polysulphide sealing compound or Shalijet sealing compound.

Measurements :

Expansion joints shall be measured in sq.m being the product of length, correct to a cm. along the joint and depth of 'Shalijet' pad measured correct to 0.5 cm. The areas shall be worked out to the nearest 0.01 sq.m.

Contraction joints shall be measured in running metres of the length of joints provided, correct to the nearest cm.

**18.0**      **BITUMEN** :

Bitumen Grades:

A range of grades from a very soft to a very hard consistency, can be produced by varying the temperature and the rate of flow during the distilling process. It shall conform to IS:73-1961 and IS:8887-78. Grades of Bitumen for different uses are as follows:

	<b>GRADE</b>	<b>TEMPERATURE TO WHICH IT SHALL BE HEATED</b>
--	--------------	--

- |      |  |  |
|------|--|--|
| I    | <u>For surface dressing / painting</u>       |  |
| i)   | Paving of bitumen from Assam Petroleum A-190 | 150 <sup>0</sup> C      to      177 <sup>0</sup> C |
| ii)  | Paving bitumen from other sources S-90       | 150 <sup>0</sup> C      to      177 <sup>0</sup> C |
| iii) | Bitumen Emulsion min. 50% bitumen content    | Cold Application                                   |
| II   | <u>For Premix Carpeting</u> :                |  |

- |     |   |                    |    |                    |
|-----|---|--------------------|----|--------------------|
| i)  | Paving Asphalt 30/40 or 80/100 heated and then mixed with solvent at atmospheric temperature @ 70 gms of solvent per kg. of Asphalt | 150 <sup>0</sup> C | to | 177 <sup>0</sup> C |
| ii) | Bitumen Emulsion of min.60% of bitumen contents   | Cold Application   |    |                    |

Supplying & Stacking – Binder :

Specified binder shall be brought to the site in sealed original containers in adequate quantities to last for at least two week requirements and stacked in fenced enclosures. The drums shall be serially numbered. These should be purchased from reputed firms or their authorised dealers. The drums should be handled and stored in such a way that the bitumen does not leak out.

The material should be kept in the joint custody of the Contractor and the representative of EIC. Empty drums shall not be removed from the site of work till the written permission is obtained from the EIC.

Measurements :

The materials shall be recorded as per standard weight of different types of container as intimated by Manufacturer.

Rate:

The rate shall be included in the respective items of schedule.

19.0 TACK COAT / PRIMING WITH BITUMINOUS PRIMERS:

The work shall consist of application of single coat of low viscosity liquid bituminous material to an existing road surfaces as well as new WBM surface, preparatory to further bituminous construction.

Materials:

Binder used for tack coat shall be bitumen of suitable grade as directed by the EIC and conforming to IS:73 as applicable or any other approved cut back.

Preparation of base surface:

The surface on which the tack coat is to be applied shall be swept clean, free from dust, dirt, or any other deleterious matter by hand brushing with wire brushes, brooms. Large irregularities, pot holes, depressions, etc. shall be repaired before priming.

Application of binder / bituminous primer :

The binder shall be heated to the temperature as specified in Clause 18.0 to permit the primer to be sprayed through the pressure sprayer to cover the surface effectively. The temperature should be appropriate to the grade of bitumen used. It shall be sprayed uniformly longitudinally along the length of the road on the prepared dry surface at the rate specified below:

The rate of spread in terms of straight run bitumen shall be as hereunder:

TYPE OF SURFACE		BITUMEN QUANTITY IN KG. PER 10 SQ.M. AREA
i)	Normal Bituminous surface	5 to 5.5
ii)	Dry & hungry bituminous surface	6 to 7.5
iii)	Granular surfaces treated with primer	6 to 7.5
iv)	Granular base (not primed)	10

Further treatment over tack coat such as pre-mix carpet etc. shall be applied after a lapse of 24 hours. Spots with excess primer shall be blotted with sand and wherever necessary, additional quantity shall be applied.

20.0 BITUMINOUS MACADAM : (Hot Mix Dense Bitumen macadam) as Base Course:

The Base course may consist of either :

- a) Water Bound Macadam with stone aggregate as specified earlier or
- b) Bituminous Macadam (Hot Mix Dense Bitumen Macadam)

Bituminous Macadam as base course shall consist of construction in single course of 50 mm / 75 mm thick as specified, compacted, crushed aggregates, pre-mixed with bituminous binder laid immediately after mixing on a sub-base prepared previously.

The aggregate for bituminous macadam shall be as follows:

SIEVE DESIGNATION IS	PERCENTAGE BY WEIGHT PASSING THE SIEVE	
	For 75 mm compacted thickness	For 50 mm Compacted thickness
45 mm	100	---
26.5 mm	75 - 100	100
22.5 mm	60 - 95	75 - 100
11.2 mm	30 - 55	50 - 80
5.6 mm	15 - 35	20 - 40
2.8 mm	5 - 20	5 - 20
75 microns	0 - 5	0 - 5



### Proportioning of Materials:

The quantity of binder for pre-mixing shall be 4.0% by weight of the total mix.

The quantities of aggregates shall be adequate for obtaining the specified thickness after compaction.

The Contractor shall ensure proportioning and obtaining a uniform mix. a variation of  $\pm 0.3\%$  by weight in the quantity of binder in the total mix is permissible.

### Preparation of surface of sub-base:

Bituminous macadam shall be laid on tack coat (which is paid separately as per specifications for tack coat above).

### Preparation of Mix:

Hot mix plant of adequate capacity and capable of producing a proper and uniform quality mix shall be used. The plant may be batch type or continuous one. It shall have a set of essential units such as a dryer for heating the aggregates, device for batching / feeding (by weight or volume) the aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for thorough mixing of the binder and aggregate.

The temperature of the binder at the time of mixing shall be in the range of  $150^{\circ}\text{C}$  –  $165^{\circ}\text{C}$  and of aggregate in the range of  $125^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ . The difference in temperature of aggregates and binder shall not be more than  $25^{\circ}\text{C}$ . Mixing shall ensure uniform coating of aggregates and a homogenous mixture. The discharge temperature of the mix shall be between  $130^{\circ}\text{C}$  to  $160^{\circ}\text{C}$ .

The mix shall be transported from mixing plant to the point of use in clean and suitable vehicles with arrangement not to have the mix contaminated with dust or foreign matter and to prevent loss of heat. Adequate precaution shall be taken on transit to cover the materials to prevent loss of heat, particularly in cold weather.

### Spreading the Mix:

The hot mix shall be spread by means of a self propelled mechanical pavers with suitable screeds capable of spreading, tamping and finishing the mix true to specified grade, lines and cross sections. The temperature at the time of laying shall be in the range of  $120^{\circ}\text{C}$  to  $135^{\circ}\text{C}$ .

Longitudinal joints and edges shall be constructed true to line and parallel to the centre line of the road. Longitudinal joints shall be off-set by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen.

### Compaction:

Rolling shall be by 8 to 10 M.Ton Power Roller. Rolling shall be started from the edges and shall progress towards the centre longitudinally.

After one rolling operation, any high spots, depressions shall be corrected by removing or adding fresh material. The rolling shall continue till the mix is fully compacted and no roller marks are left on the surface. The roller wheels shall be kept moist to prevent bituminous materials from sticking and being picked up. No fuel lubrication oil shall be used for this purpose.

### Quality Control:

The tests and their frequency shall be as follows:

TEST	METHOD OF TEST	FREQUENCY OF TEST
1 Quality of binder	IS:73	As required
2 Aggregate impact value / Los Angles Abrasion	IS : 2386 (Part IV)	One per 50- 100 cu.m. of aggregate
3 Flakiness Index of aggregate	IS : 2386 (Part I)	One per 50 -100 cu.m. of aggregate
4 Stripping Value	IS : 6241	One per 50 -100 cu.m. of aggregate
5 Grading of aggregates	IS : 2386 (Part I)	Two test per day per plant on individual constituents and mixed aggregate from dryer.
6 Binder Content		Min. 2 tests per day per plant.
7 Control of Temp. of binder & aggregate for mixing and of mix at the time of laying and rolling		At close intervals
8 Rate of spread of mixed material		Regular control through check on layer thickness

### Surface Evenness:

Longitudinally maximum permissible undulation shall be 10 mm when measured with 3 metres straight edge.

Transversely maximum permissible variation shall be 6 mm from specified profile when checked with a camber template.

Longitudinal profile will be checked at the middle of each traffic lane along a line parallel to the centre line of the road,. Transverse profile shall be checked with 3 camber boards at 10 m intervals.

Measurements:

The length and breadth shall be taken to the nearest centimetre. The volume shall be in cu.m. correct to two places of decimal.

Rate:

The rate shall include the cost of materials and labour involved in all the operations described and specified above.

**21.0 PRE-MIX CARPET WITH HOT BITUMEN:**

This treatment is suitable for roads where motor traffic is of medium intensity and for internal and service roads in colonies. The consolidated thickness shall be 20 mm or 25 mm as specified.

This treatment shall consist of a tack coat on prepared base, immediately followed by spreading aggregate pre-coated with specified binder to camber and consolidated. Tack coat shall be laid at 10 kg per 10 sq.m as per the specifications and shall be measured and paid separately.

This treatment shall not be laid during rainy weather or when the base course is damp.

Quantities of Materials:

CONSOLIDATED THICKNESS OF PREMIX CARPET	BINDER HOT BITUMEN	STONE CHIPPINGS IN CU.M PER 10 SQ.M	
		13.2 mm nominal size	11.2 mm nominal size
20 mm	52 kg / cum of 13.2 mm size ^ 56 kg. per cu.m of 11.2 mm size stone chipping	0.18	0.09
25 mm	- do -	0.225	0.112

**PREMIX :**

The binder shall be heated in boilers of type approved by the EIC to temperature approximate to the grade of bitumen.

The aggregate shall be dry and heated before placing in the mixer to facilitate mixing with the binder. Dry mixing shall be done for about 15 seconds and the heated binder mixed with the aggregate at the rate specified. The mixing shall be continued till the aggregate is uniformly mixed and coated with the binder and the mix immediately transported to the site of work in clean and covered vehicles or wheel barrows as directed or required.

## **APPLICATION & CONSOLIDATION :**

The mix shall be spread to required thickness with rakes or with drag spreader. When sufficient length has been covered, the mix shall be with 8 to 10 M. Ton Power Roller of suitable type, beginning at the edges longitudinally, progressing towards the centre, parallel to the centre line of road/pavement. In each pass, the roller shall overlap 1/3 rd width covered previously. The rolling shall continue till compaction when the roller marks are eliminated. Fuel or lubricating oil shall not be used for preventing the mix adhering to wheels.

The edges of the previously laid and compacted carpet along and transverse, shall be cut to full depth to expose fresh surface which shall be painted with thin coat of binder.

### **Surface Finish :**

The tolerance in longitudinal and transverse directions shall be as follows :

- a) In the longitudinal profile, maximum permissible undulation shall not exceed 10mm, when measured with 3 meter straight edge.
- b) In cross profile, maximum permissible variation from the specified profile, shall not exceed 6mm when measured with camber template.

The longitudinal profile will be checked at the middle of each traffic lane parallel to the centre line of road. The cross profile at intervals of 10 meters with a set of three camber boards.

When the above tolerance is exceeded, the Contractor shall rectify the same by adding fresh material and re-compacting where the surface is low and by removing the layer and replacing with fresh material where the surface is high and compacting till the entire surface is compacted within the permissible tolerances.

### **Measurements:**

The length and breadth of the finished work shall be measured correct to a centimetre and the area worked correct to two places of decimals of sq. meter.

### **Rate:**

The rate shall include the cost of materials and labour involved in all the operations described and specified above.

## **22.0 SEMI-DENSE CARPET (Surface Course):**

This shall consist of a single course of a semi-dense carpet as a surface course on a prepared base. This is used where traffic intensity is moderate to heavy. The Consolidated thickness shall be 25mm.

Gradation of the aggregate shall be as follows :

<u>SIEVE</u>	<u>PERCENTAGE OF WEIGHT PASSING THE SIEVE</u>
25 mm	100
20 mm	70 – 100
10 mm	35 – 60
4.75 mm	15 – 35
2.36 mm	5 – 20
75 micron	0 – 4

Proportioning of Materials :

The binder content shall be 5.5% by weight of the total mix, unless otherwise fixed by job mix formula.

The contractor shall ensure proper proportioning of materials in accordance with job mix formula and for obtaining a uniform mix. A variation in binder content of  $\pm 0.3\%$  by weight of total mix shall be permissible.

This shall be laid on tack coat laid as per specifications. The tack coat will have hot bitumen at 1.00 kg per sq.m. for untreated WBM road surface and at 0.5 kg per sq.m. for existing bitumen treated surface. Tack coat shall not be necessary when laying of the carpet is carried soon after laying of bituminous base. Tack coat shall be measured and paid separately.

Preparation of Mix:

A hot mix plant of required capacity and capable of producing uniform quality mix shall be used. It may be batch type or a continuous one, with co-ordinated set of units like dryer for heating aggregates, a device for batching/feeding by weight or volume the aggregate; a binder heating and control unit for metering out the correct quantity of heated binder with a paddle mixer for thorough mixing binder and aggregate.

At the time of mixing, the temperature of the binder shall be between  $150^{\circ}\text{C}$  and  $177^{\circ}\text{C}$  and of aggregates  $155^{\circ}\text{C}$  and  $163^{\circ}\text{C}$ . The difference in temperature of binder and aggregate shall not exceed  $14^{\circ}\text{C}$ .

In transportation arrangement shall be made to avoid segregation, prevent contamination from dust or foreign matter and loss of heat.

Spreading the Mix : Same as in Clause 20.0

Compaction : As described in Clause 20.0

Quality Control Test :

The following tests shall be carried out on site :

SR. NO.	TEST	METHOD	FREQUENCY
1.	Los Angles abrasion value/aggregate impact value	IS:2386 (part IV)	On test per 50 – 100 cu.m. of aggregate.
2.	Flakiness Index of aggregate	IS:2386 (Part I)	-DO-
3.	Stripping value	IS:6241 (Part I)	-DO-
4.	Mix grading	IS:2386 (Part I)	One set of tests on individual constituents & mixed aggregate from dryer for each 100 T. of mix subject to two tests per day per plant.
5.	Control of Temp. of binder in boiler, aggregate in dryer & mix at the time of laying and rolling		At regular intervals
6.	Control of binder content		One test for each 100 T of mix subject to a minimum of 2 tests per day per plant.
7.	Rate of spread of mixed materials.		Regular control through Checks on layer thickness.

Measurements:

The length and width of finished work shall be measured correct to a centimetre along the finished surface of the road. The area shall be worked out in sq.m. correct to two places of decimal.

Rate:

The rate shall include the cost of materials and labour involved in all the operations described and specified above.

**23.0**      **ASPHALTIC CONCRETE USING HOT MIX PLANT & PAVER EQUIPMENT:**

This is used as standard surfacing for heavy duty roads and airfields. It provides a resilient, waterproof, dust free, smooth riding and a heavy duty surface because of its higher load dispersing characteristics.

Materials:

Binder shall be straight run bitumen of suitable grade satisfying the requirements of IS:73. The actual, grade of the binder to be used shall be decided by the EIC.

Coarse aggregate shall consist of crushed stone, crushed gravel or other stones. These shall be clean, strong, durable, of fairly cubical shape, free from disintegrated particles, soft or flaky pieces and organic or other deleterious and adherent coatings.

Physical properties of coarse aggregates :

<u>TEST</u>	<u>REQUIREMENT PERCENTAGE</u>
L.A. Value or	Max. 40
A.I. Value	Max. 30
Flankiness Index	Max. 15

Fine aggregate shall consist of crushed run screening natural sand or mixture of both. These shall be clean, hard, durable, uncoated, dry and free from impurities soft or flaky pieces and organic or deleterious substances.

Filler:

The filler, where specified, shall be a material, the whole of which passes through a 600 micron sieve, at least 90% passing through a 150 micron sieve and not less than 70% passing through a 75 micron sieve. The filler shall be stone dust or any other non plastic mineral matter approved by the EIC.

Aggregate Gradation:

The aggregate including the filler, shall be so graded or mixed as to conform to the grading shown below :

SIEVE SIZE	PERCENTAGE PASSING ( <i>by weight</i> )	
	25-40 mm thickness	25-50mm thickness

20mm	--	100
12.5 mm	100	80 – 100
10 mm	80 – 100	70 - 90
4.75 mm	55 – 75	50 - 70
2.36 mm	35 – 50	35 - 50
600 micron	18 – 29	18 - 29
300 micron	13 – 23	13 - 23
150 micron	8 – 16	8 - 16
75 micron	4 – 10	4 – 10

#### Design of Mix:

The binder content and the final aggregate gradation and job mix shall be worked out in the laboratory as per the Marshal Test Procedure and the optimum density determined. The gradation, binder content, void ration and density constitute the design mix, i.e. aggregate plus bitumen will be termed as binder content percentage. The binder content shall be 5% to 7.5% by weight of the total mix.

#### Proportioning of Material:

The quantities of aggregate shall be sufficient to yield the specified thickness after compaction. The contractor shall get the design mix formula for the mix approved by the EIC before commencement of the work.

The contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved design mix formula and producing a uniform mix. A variation in binder content of  $\pm 0.3\%$  by weight of total mix shall be permissible.

The Contractor shall intimate to the EIC in writing at least 10 days before the start of work. The design mix formula proposed to be used by him and shall give the following details :



- i) The source and location of all materials.
- ii) Proportions of all materials expressed as follows where each is applicable :

a) Binder : as percentage by weight of total mix

b) Coarse aggregate }  
 c) Fine aggregate } as percentage by weight of total aggregate including mineral filler  
 d) Mineral filler }

- iii) A single definite percentage passing each sieve for the mixed aggregate.
- iv) The results of test enumerated in 23.1 as obtained by the contractor.
- v) Test results of physical characteristics of aggregates to be used.

While working out the design mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of specifications.

Approval of the design mix formula shall be based on independent testing by the EIC for which samples of all ingredients of mix shall be furnished by the contractor as required by the EIC.

23.1 Mix Design:

Apart from conformity with the grading and quality requirements of individual ingredients, the mix shall meet the requirements given below :

DESCRIPTION	REQUIREMENTS
1. Marshal stability (ASTM Designation D 1559) determined on Marshal Specimens, compacted by 50 compaction blows on each end	340 kg. minimum
2. Marshal flow (0.25 mm)	8 – 16
3. Percent voids in mix	3 – 5
4. Percent voids in mineral aggregate filled with bitumen	75 – 85
5. Binder content percent by weight of total mix	5 – 7.5

## 23.2 Construction Operations:

Asphaltic Concrete surface shall not be laid during the rainy weather or when the base course is damp or wet.

A tack coat shall be applied over the base as specified. Application of tack coat, however, shall not be necessary when the laying of concrete follows soon after the provision of bitumen base / levelling course.

### Preparation of Mix:

Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may be either a batch type or a continuous one having a co-ordinated set essential units such as dryer for heating the aggregates to the desired extent; device for batching/grading the aggregate by weight or volume, a binder heating and control unit for material out the correct quantity of heated binder and a paddle mixer for intimate mixing of the binder and aggregates. A fine feeder for incorporation of correct quantity of filler is also as a necessary auxiliary.

### Bitumen (Binder) :

The bitumen used shall be straight run bitumen of penetration value 60/70 conforming to the relevant IS Standard and free from paraffin waxes.

The temperature of binder at the time of mixing shall be in the range of 150°C - 177°C and of aggregate in the range of 155°C - 163°C. At no time shall the difference in temperature of the aggregate and of the binder exceed 14°C.

Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles, so as not to become contaminated with dust or foreign matter and to prevent loss of heat.

### Spreading the Mix:

The mix shall be carried from the mixer by tipper trucks to the work site and spreading done by means of a self propelled mechanical paver with suitable floating screeds capable of spreading, tamping and finishing the mixture to grade, line and cross section. The temperature of the mix at the time of laying shall be in the range of 121°C - 163°C. Longitudinal joints and edges shall be constructed true to line and parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the base course, if any. All joints shall be cut vertically to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing the fresh material.

### Compaction :

The mix after spreading shall be thoroughly compacted by rollers, moving a speed not more than 5 km per hour. The initial or breakdown rolling shall be with 8 to 10 M. Ton three wheel roller and finished with 8 to 12 tonne tandem roller.

The roller wheels shall be kept moist while rolling to prevent the mix adhering to the wheels. Rolling shall commence longitudinally from the edges and progress towards the centre. Except that on super elevated portions it shall progress from the lower to the upper edge, parallel to the centre line of the pavement. The rolling shall continue till the mix is fully compacted and no roller marks are left on the surface.

Rolling operations shall be conducted when the mix is neither too hot nor too cold, so that shoving or hair cracks may be eliminated. The finished surface shall be tested with a straight edge 3 M long and irregularity greater than 6mm in the longitudinal direction and 4mm in transverse direction shall be corrected.

The degree of compaction achieved after rolling at sites shall be tested with a minimum 3 samples for one field test, per working day for every 500 sq.m. The work shall be accepted if the average field density of every set of samples is not less than 98% laboratory density. If the density is less than 98%, but more than 95%, the payment for the area will be paid at a reduced rate in the ratio of the actual field density to design laboratory density.

If the field density is below 95% of Laboratory density, further rolling shall be done to improve the density and if the field density is still less than 95%, the work is liable to be rejected, at the discretion of the EIC. If such work is not rejected, payment shall be made at such reduced rates as may be fixed by the EIC.

### Quality Control Test:

A sieve analysis of the aggregate after the binder is extracted, shall be done and the gradation determined. The permissible variation on the individual percentage of the various ingredients in the actual mix, from the design mix, shall be within the limits specified below :

<u>SIEVE</u>	<u>PERMISSIBLE VARIATION BY WEIGHT OF TOTAL MIX PERCENTAGE</u>
4.75 mm	± 5.00
2.36 mm	± 4.00
600 micron	± 3.00
75 micron	± 1.00
Binder	± 0.30

Measurements:

Asphaltic concrete/Bituminous mix laid, consolidated and finished, shall be measured in cu. meters to the nearest two places of decimals. The length and breadth shall be measured to the nearest centimetre and thickness to the nearest 5 mm.

Before commencement of laying asphaltic concrete, levels shall be taken jointly by the EIC or his representative and the contractor, at 3 M intervals or closer, both ways, as directed by the EIC. These levels shall be recorded on the plan as well as in the level book and the record shall be signed by the contractor. Levels of the consolidated bituminous mix shall again be taken jointly at the corresponding points and plotted on plan and recorded in the level book. These shall be again signed by the Contractor. The thickness shall be the difference of the existing levels before laying of the mix and final levels of the consolidated bituminous surfacing.

The cubical contents for payment shall be the theoretical quantity arrived at by multiplying the total surface area by the theoretical thickness specified in the contract or the actual quantity based on actual finished levels, whichever is lower.

Rates:

The rate shall include the cost of materials and labour involved in all the operations described and specified above, including the cost of cleaning the previous base and tools, equipments and incidentals to complete the work to the specifications.

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## ROADS, APRONS AND PAVEMENTS

### Common Test on Materials at Work:

A large number of tests are required to be conducted on materials incorporated and work performed. Outlines of some of the commonly used tests are given below. These outlines are intended to draw the attention of the Site Engineers and not to serve as the procedure for such test. For the detailed procedure of the individual test, the reference should be made to the relevant standards of ISI or other authorities as applicable.

### Determination of Moisture content of Soils (IS:2720 Part II)

The method consists of drying sample of soil in the oven at  $105^{\circ}\text{C} - 110^{\circ}\text{C}$  for a period (normally not more than 24 hours) till the dry weight of the soil becomes constant.

In the field the alcohol method, though less accurate can be used as a quick test. It consists of taking the soil specimen in an evaporating dish, pouring over it methylated spirit at the rate of about one millilitre for each gram of soil, mixing the two materials and igniting the spirit. After burning away of the spirit, the dish is cooled and weighed.

### Liquid Limit (LL), & Plastic Limit (PL) IS:2720 Part V and Plasticity index (PI):

The Liquid Limit tests is conducted on the standard instrument with soil specimens at various moisture contents. The Liquid Limit is taken as that moisture content where the standard groove made on its surface will close under an impact of 25 blows.

The Plastic Limit is the water content at which the soil will begin to crumble when rolled into a thread of 3 mm in diameter. The Plasticity Index (PI) is taken as difference between Liquid Limit and Plastic Limit.

### Moisture – Density Relationship (IS: 2720 Part VII & VIII)

Two degrees of compaction, Light Compaction (IS:2720 Part VII) and Heavy Compaction (IS:2720 Part VIII) are usually specified. the former compaction also goes by the term Standard Proctor Compaction.

In the light of compaction, the wet soil is compacted in three equal layers by the rammer of weight 2.6 kg and free fall 31 cm with 25 evenly distributed blows on each layer. In heavy compaction, rammer weighs 4.89 kg and the free fall is 45 cm. Compaction is done in 5 equal layers, each being given 25 blows.

The procedure is to compact the soil with different moisture contents and drawing a moisture density curve to find out the maximum dry density and the corresponding moisture content {Optimum Moisture Content (OMC)}.

### Laboratory C.B.R. (California bearing Ratio ) : IS:2720 Part XVI

The apparatus consists of a mould 15 cm diameter with a base plate and collar, a loading frame with cylindrical plunger of 5 cm diameter and dial gauges for measuring the expansion on soaking and the penetration values. Briefly, the test consists of causing the plunger to penetrate the compacted specimen in the mould at 1.25 mm per minute. The load for 2.5 mm or 5mm penetration is recorded. This load is expressed as a percentage of the standard load at the respective deformation level to obtain the C.B.R. values

The standard load for 2.5 mm and 5 mm penetration are 1370 kg and 2055 kg respectively. The load penetration graph is plotted and the load corresponding to 2.5 mm and 5 mm penetration values are found. The C.B.R. usually selected is at 2.5 mm penetration. For this test, only the material passing 20 mm sieve is used.

### Field C.B.R. (IS:2720 Part XXXI)

The method consists of preparing the surface on which the test is to be carried out, applying load gradually and noting down the penetration values. To reproduce the actual surface conditions, it may be necessary to soak the surface to be tested, to the desired degree.

Truck, tractor, truss or any other suitable equipment is used for providing reaction for loading. A mechanical screw loading jack with swivel head is used for applying the load to the penetration piston for loading. The procedure is more or less the same as for the Laboratory C.B.R. determination.

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## FENCING

### 1.0 INDIAN STANDARDS:

1. IS : 278 – 1978 - Specification for galvanised steel barbed wire for Fencing – (3<sup>rd</sup> Revision)

The above mentioned IS Specifications & Code of Practice has been indicated for general guidance.

However, this IS Specification & Code will be adopted only for those items in the contract, where either the mode of measurement or detailed technical specifications are not laid down in the tender.

### 2.0 BARBED WIRE FENCING :

#### Materials:

Barbed wire shall be of galvanised steel and shall conform to IS: 278 – 1969. The bared wire shall be of steel with sulphur and phosphorous contents not exceeding 0.065%. The galvanised steel barbed wires shall be of two types :

TYPE A (Iowa Type) : The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around both the line wires, making altogether four complete turns.

TYPE B (Glidden Type) : The barbs shall have four points and shall be formed by twisting two point wires, each of two turns, tightly around one line, making altogether four complete turns.

#### Physical Properties of barbed wire:

<i>Nominal Dia. of Wire</i>		<i>Weight of completed barbed wire</i>		<i>Distance bet. two barbs</i>
<i>Line Wire</i>	<i>Point Wire</i>	<i>Max. g/m</i>	<i>min. g/m</i>	<i>mm</i>
2.5 mm 12 gauge	2.0 mm 14 gauge	103	89	150 ± 12

The number of twists between two consecutive barbs shall vary between 2 and 7.

#### Tensile Properties :

<i>Size of Line Wire</i>	<i>Tensile Strength of Line Wire</i>	<i>Min. breaking load of completed barbed wire</i>
2.5 mm (12 gauge)	40 kgf to 60 sq.m	375 kgf

The barbed wire shall be formed by twisting together two line wires, one or both containing the barbs. The size of the line and point wires and the spacing of the barbs shall be as specified. The permissible deviation from the nominal diameter of the line wire and the point wire shall not exceed + 0.08 mm. The line and point wires shall be uniformly galvanised. The line wires shall be in continuous lengths and shall not contain any welds other than those in the rod before it is drawn.

The spacing between two successive splices shall not be less than 15 meters.

The number of reels to be selected at random for check tensile properties are:

Sampling Criteria :

<i>No. of Reels in the lot</i>	<i>No. of Reels to be selected</i>
Upto 25	3
26 - 50	4
51 - 150	5
151 - 300	7
301 and above	10

RCC Posts & Struts:

All RCC posts and struts shall be of size as specified. These shall be cast in Cement Concrete 1:2:4 nominal mix (1 cement : 2 coarse sand : 4 graded stones of 12.5 mm nominal size) with reinforcement as shown in drawing. The post / struts shall be finished smooth with cement mortar 1:2 (1 cement : 2 sand). The specifications for RCC work shall apply. The posts shall be free from cracks, twists and other defects.

Design of RCC Posts / Struts :

For clear height of 1.2 metres:

The total height shall be 1.80 metres. The bottom 750 mm of the post shall be of 165 mm size. The top height of 1.05 metres shall be tapering from 150 mm x 150 mm at bottom to 1000 mm x 100 mm at top end.

The reinforcement for the post shall be 4 verticals of 8 mm diameter torsteel and stirrups of 8 mm diameter torsteel at 250 mm centres.

The struts shall be of uniform cross section 100 mm x 100 mm and of 2.0 metres length. The reinforcement shall be 4 verticals of 8 mm diameter torsteel and stirrups of 8 mm diameter torsteel at 250 mm centres.



For clear height of 1.80 metres :

The total height of post shall be 2.40 metres. The bottom 750 mm of post shall be of 200 mm x 200 mm size. The top height of 1.65 metres shall be tapering from 180 mm x 180 mm at bottom to 100 mm x 100 mm at the top end.

The reinforcement for the post shall be 4 verticals of 10 mm diameter torsteel with 8 mm diameter torsteel stirrups at 250 mm centres.

The struts shall be 2.7 metres long and of uniform cross section of 125 mm x 125 mm with 4 verticals of 8 mm diameter torsteel and 8 mm diameter torsteel stirrups at 250 mm centres.

For clear height of 2.40 metres :

The total height of post shall be 3.40 metres. The bottom 1.0 metre of post shall be of 225 mm x 225 mm size. The top height of 240 metres shall be tapering from 200 mm x 200 mm at bottom to 125 mm x 125 mm at the top end.

The reinforcement for the post shall be 4 verticals of 12 mm diameter torsteel with 8 mm diameter torsteel stirrups at 150 mm centres.

The struts shall be 3.3 metres long and of uniform cross section of 150 mm x 150 mm with 4 verticals of 10 mm diameter torsteel and 8 mm diameter torsteel stirrups at 250 mm centres.

For clear height of 3.0 metres :

The total height of post shall be 4.0 metres. The bottom 1.0 metre of post shall be of 265 mm x 265 mm size. The top height of 3.0 metres shall be tapering from 250 mm x 250 mm at bottom to 150 mm x 150 mm at the top end.

The reinforcement for the post shall be 4 verticals of 12 mm diameter torsteel with 8 mm diameter torsteel stirrups at 250 mm centres.

The struts shall be 4.0 metres long and of uniform cross section of 175 mm x 175 mm. The reinforcement shall be of 4 verticals of 10 mm diameter torsteel and 8 mm diameter torsteel stirrups at 250 mm centres.

For clear height of 3.4 metres :

The total height of post shall be 4.4 metres. The bottom 1.0 metre of post shall be of 265 mm x 265 mm size. The top 3.4 metres shall be tapering from 250 mm x 250 mm at bottom to 150 mm x 150 mm at the top end.

The reinforcement for the post shall be 4 verticals of 12 mm diameter torsteel with 8 mm diameter torsteel stirrups at 250 mm centres.

The struts shall be 4.35 metres long and of uniform cross section of 175 mm x 175 mm. The reinforcement shall be of 4 verticals of 10 mm diameter torsteel and 8 mm diameter torsteel stirrups at 250 mm centres.

The slant portion of the posts shall be of uniform size as in the top end of the post with the same reinforcement carried through and with the same spacing of stirrups as in the posts.

#### Balli Posts & Struts:

The timber balli shall be of good quality, reasonably straight and free from decay and cracks. The length of the post shall be as specified or as shown in the drawing. The struts shall be as specified or as shown in the drawing.

The spacing of the balli posts shall be 2.5 metres centres. The visible and embedded portion of the balli shall be coat tarried in two coats before fixing. The struts shall be fixed to the posts by means of spikes of suitable size. The barbed wire shall be fastened to the balli post by means of GI staples driven into the posts.

#### MS Angle Posts:

MS Angles of size 50 mm x 50 mm x 6 mm shall be used as posts as well as for struts.

#### Spacing of RCC / MS Angle Posts & Struts:

The spacing of MS angle posts / RCC pre-cast posts shall be 3.0 metres centre unless otherwise specified or as directed by the EIC. Every 10, last but one end post and corner posts shall be strutted on both sides. The end posts shall be strutted on one side only.

#### Fixing of Posts & Struts:

Pits of 450 mm x 450 mm and 600 mm deep or as shown in the drawing, shall be excavated true to line and level to receive the posts.

Pits of 1070 mm x 450 mm and 770 mm deep or as shown in the drawing, shall be excavated true to line and level to receive the struts.

The Pits shall be first filled with a layer of 150 mm thick cement concrete 1:3:6 nominal mix (1 cement : 3 coarse sand : 6 stone aggregate of 40 mm nominal size). The posts and struts shall be placed in the pits with projection (clear height above the ground level as specified in the description of the item), true to line and position. Cement concrete 1:3:6 nominal mix shall then be filled in upto ground level for posts and struts. The concrete shall be cured for minimum seven days. The excavated material shall be disposed off as directed by the EIC.

When the excavation of pits is carried out in concrete or asphalt pavement, etc., the surface surrounding the foundation concrete shall be made good in cement concrete 1:3:6 (nominal mix) flush with ground level and to a minimum depth of 150 mm.

MS angle posts and struts shall be painted with a coat of red oxide zinc Chromate primer and two coats of synthetic enamel paint after necessary preparation of surface.

#### Fixing of Barbed Wire:

The barbed wire shall be stretched and fixed in specified number of rows and two diagonals. The bottom most row shall be 140 mm above ground level and the rest shall be at 125 mm centres.

The diagonals shall be stretched between adjacent posts from top wire of one post to the bottom wire of the second post. The diagonal wire shall be interwoven with horizontal wires. The barbed wire shall be held to the M.S. angle posts by means of G.I. binding wires tied to 6 mm dia. MS ribs welded to them. In case of RCC pre-cast posts, the barbed wire shall be held by means of GI staples fixed to wooden plugs or GI binding wire tied to 6 mm diameter M.S. bar ribs fixed while casting the post. Turn buckles and straining bolts shall be used at the end posts.

### 3.0 Chain Link Fencing:

Chain link fabric shall be out of 10 gauge (3.15 mm diameter) G.I. Steel wire interwoven to form a diagonal mesh of 50mm size and shall be of approved make and quality.

While casting the RCC posts of chain link fencing 6 mm dia. hook insert shall be kept at 800 mm centres and a 6 mm diameter vertical bar shall be passed through the eye of the insert, as shown in the drawing. This vertical bar and eye of the insert shall be on the inside face of the fencing post.

Four nos. 10 mm diameter horizontal stiffener bars shall be interwoven through the Chain link fabric.

### 4.0 Measurements:

The length of the barbed wire / chain link fencing shall be measured correct to a cm for the fencing carried out as above and at centre to centre of posts. The rate shall include cost of labour and materials involved in all operations described above, including cost of posts, struts, binding wire, spikes, staples, turn buckles, straining bolts, excavation, plain cement concrete 1:3:6 (nominal mix for foundation, disposal of excavated materials, making good of surface around Plain Cement Concrete foundation, etc. complete as specified and described. It also includes the GI guide bars in the case of chain link fencing.

The barbed wire item when specified separately shall be measured in length as fixed straight between centre to centre of posts for horizontal rows and diagonal correct to a cm. The rate shall include all labour and materials involved in all the operations described above, including cost of turn buckles, straining bolts, binding wire, spikes, staples, etc.

The chain link fabric where specified separately shall be measured in area worked out correct to two places of decimal by multiplying the length of the fabric measured centre to centre of posts correct to a cm and the height of the fabric. Rate shall include the cost of all labour and materials involved in all operations described including the cost of straining bolts, turn buckles, binding wires, spikes, staples, GI guide bars, etc. complete.

The posts and struts where specified separately shall be measured in numbers and the cost shall include the cost of all labour and materials involved in all operations described, including the cost of excavation, Plain Cement Concrete foundation, disposal of excavated material, making good of area surrounding the Plain Cement Concrete foundation, etc. as directed by the EIC. In case of MS angle posts and struts, the rate includes painting with a coat of red oxide Zinc Chromate primer and two coats of synthetic enamel paint. In case of balli, the rate includes painting of 2 coats of coal tar for the posts and struts.

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## **DEMOLITION, DISMANTLING & MISCELLANEOUS BUILDING REPAIRS**

### **1.0 INDIAN STANDARDS:**

1. IS : 1200 (Part XVIII) – 1974 : Method of measurement of building & Civil Engineering Works (Part XVIII – Demolition & Dismantling) 3<sup>rd</sup> Revision

The above mentioned IS Specification & Code of Practice has been given for general guidance.

However, this IS Specification and Code will be adopted only for those particular items in the contract, where either the mode of measurement or detailed technical specifications are not laid down in the tender documents.

### **2.0 DISMANTLING:**

Dismantling implies careful removing without damage and shall consist of dismantling one or more parts of a building as specified and directed by the EIC.

### **3.0 DEMOLITION:**

Demolition implies breaking up and shall consist of demolishing the whole or part of a work as specified and directed by EIC.

### **4.0 PRECAUTIONS TO BE TAKEN DURING DISMANTLING & DEMOLITION:**

All materials obtained from dismantling or demolition shall be kept in safe custody until handed over to the EIC. All serviceable materials shall be transported and carefully stacked at the places including at Air India's stores and in the manner as directed by the EIC. All serviceable materials and debris shall be carted to the places directed, within Air India premises and shall be spread and levelled, or if so directed by the EIC, shall be removed away from Air India premises.

The scheme for demolishing and / or dismantling shall be planned and got approved from the EIC prior to commencement of the work.

Necessary propping, shoring and /or under pinning shall be provided for the safety of the adjoining property, before dismantling and demolishing work is commenced. Care shall be taken to ensure that no damage is caused to adjoining property during demolition / dismantling.

Attention shall be drawn to any necessary precautions to be taken for the protection of the public and the owner's property.

Temporary shoring for the safety of portions not required to be pulled down or of adjoining property and temporary enclosures or partitions shall be included in the main item..

If precautions are required to be taken to keep down dust, nuisances etc. it shall be so stated.

All valuable materials, antiques, etc. found during demolition / dismantling will be the property of Air India and the same shall be deposited with the EIC.

**DISMANTLING SHALL BE CARRIED OUT SYSTEMATICALLY:**

Materials likely to be damaged by dropping from height during demolition of roofs, masonry, etc. shall be removed carefully first. The dismantled material shall be passed by hand and lowered to the ground and not thrown, where necessary.

Where the demolished / dismantled material debris etc. is required to be removed from a height more than 4.5 m, should be removed by the chute and/or hoist, which the contractor shall erect for the purpose. The design and construction of the chute / hoist be got approved from the EIC.

Dismantled materials should be lowered down to the ground as quickly as possible. However, if circumstances do not permit their immediate lowering down, then the dismantled materials should be stacked on terrace / floor slabs under the directions of the EIC. Under not circumstances should the terrace / floor slabs be subjected to stress due to concentrated loading of dismantled materials.

Where fixing is done by nails, screws, bolts, rivet, etc., dismantling shall be done with proper tools and not by tearing or ripping off.

The contractor shall maintain the essential services (for the portion of the building which is to be retained) and then only disconnect pipes, drainage pipes, cables, etc.

**5.0 MEASUREMENTS:**

All work shall be measured net in decimal system as follows:

- a) Length, breadth, thickness shall be measured in metres correct to a cm.
- b) Areas shall be measured in sq.m. correct to two places of decimal.
- c) Cubical contents shall be worked out in cubic meters, correct to two places of decimal.

Demolished or dismantled parts of work shall be measured separately.

Measurements of all work to be demolished and dismantled shall be taken before demolition, except for concealed work.

Works to be measured separately:

Works executed in the following conditions shall be measured separately:

- a) Work in or under water.
- b) Work in liquid mud
- c) Work in or under foul conditions

### Measurement in Stages:

Work shall be measured under the following categories in convenient stages stating the height or depth :

- a) below ground / datum level &
- b) above ground / datum level

NOTE : The ground / datum level shall be defined in each case.

### **6.0 RATES:**

The rates shall include the cost of all labour involved, tools, equipments, etc. used in demolishing and dismantling, scaffolding, chute /or hoist, sorting out and stacking useful serviceable materials at places directed, including Air India Stores and carting away the unserviceable materials to places directed within Air India premises, spreading and levelling properly or outside Air India premises as directed by the EIC. The damage caused to walls, floors, ceiling, during the process of dismantling and demolition and repairs shall be made good.

The rate shall include for temporary shoring of portions not to be pulled down or of adjoining property.

### **7.0 ROOFS:**

- a) Cement based Water proofing :

Dismantling of cement based water proofing treatment shall be measured in sq.m. The average thickness of cement based water-proofing is 150 mm. Nothing shall be deducted for less thickness and nothing extra shall be paid for thickness exceed 150 mm. The measurement shall be the area as on plan and no separate measurements shall be taken of the roundings.

Dismantling shall include the removal of the brick bat concrete above the roof slab, layer of slurry and cement mortar, Indian patent stone or china mosaic or any other finish above the rounding along vertical walls.

- b) Tarfelt Water proofing;

Dismantling of Tarfelt water proofing treatment shall be measured in sq. metres. The dismantling item shall include removal of all materials, carting away from AI premises, cleaning the RCC slab.

- c) Roof Coverings:

Dismantling of roof coverings such as Asbestos Cement sheets, plain or corrugated or semi-corrugated, galvanised steel / iron sheets, etc. shall be measured flat as laid on roof with no allowance being made for laps. Dismantling includes removal of all bolts, nuts, etc. and stacking carefully along with the roof sheets.

d) Wooden roofing Members:

Dismantling of wooden roofing members such as rafters, purlins, beams, joists, trusses, etc. shall be measured in cubic metres.

e) Steel Roofing Members:

Dismantling of steel roofing members shall be measured in metric tonnes. Weight of bolts, nuts, welds, etc. shall be excluded.

f) RCC & Brick / Stone Members:

Dismantling of RCC and brick / Stone masonry work shall be measured in cubic metres. In measuring dimensions, the thickness of plaster or any finish over it shall be excluded.

Steel reinforcement shall be separated, scraped, cleaned and stacked properly and shall be transported and stacked in Air India Stores or Scrap yard or any other place as directed by the EIC. This work is included in the demolition / dismantling of RCC and no separate measurement shall be taken of reinforcement.

Dismantlement of brick masonry includes removal of doors, windows, frames, etc. transporting and stacking them carefully at Air India Stores or at any place as directed by the EIC.

g) Partitions, Panels & Ceilings:

All panels to be dismantled of wooden boarding, glazing, weld mesh, expanded metal fabric, plain asbestos cement sheets, plywood, hardboard, particle board, plaster of paris sheets, insulex or soft boards, shall be measured in sq.m. They will be removed along with their battens, fillets, beadings, etc. and these shall not be measured. Dismantling of partition, panels, including battens, fillets, beading etc. and removal of false ceiling framework shall be measured in sq.m. Height above floor level, exceeding 3.5 m shall be paid for separately. Stripping of ceiling shall be measured in sq. metres.

h) Walls & Piers :

Walls, independent piers, columns and their footings and foundation of brick, stone or concrete shall be measured in cubic meters. All copings, corbels, cornices and other projections shall be included with the wall measurements.

Dismantling of brick, stone, concrete masonry work includes removal of doors, windows, frames, etc., transporting and stacking them carefully at Air India Stores or at any place as directed by the EIC.

In measuring the thickness of plastered walls, the thickness of the plaster or any finish / skirting / dado shall be excluded.



Ashlar face stones, dressed stone work, pre-cast concrete articles, etc., if required to be taken down intact, shall be so stated and measured separately in cubic meters.

Honeycomb work and hollow block walling of bricks, stone or concrete shall be measured as solid.

Cleaning of bricks and stacking them for measurements, including all extra handling and removal and disposal of rubbish as stated, shall be measured in thousands of cleaned bricks.

The dismantling includes cleaning of stone obtained from demolished / dismantled stone masonry of any description, including Ashlar facing, dressed stonework, stone slabs or pre-cast concrete blocks including all extra handling and disposal of debris.

i) Flooring & Paving:

Cement concrete flooring and paving work to be dismantled shall be measured in cubic meters. Tile work in plain, terrazzo, pre-cast cement tiles, glazed tiles, etc. and natural stone slabs, etc. shall be measured in sq. meters.

j) Steel Work & Iron Work :

All steel work shall be measured in Metric Tonnes. The weights shall be worked out from standard tables. The work shall include removing of bolts, nuts, cutting rivets / welding, lowering down in required, transporting and stacking at places including Air India Stores / Scrap yard as directed by the EIC. The weight of the nuts, bolts, welds, etc. shall not be measured.

Riveted work, where rivets are required to be cut shall be measured separately.

Structural steel required to be re-erected shall be measured separately.

In framed steel gates, the weight of any covering material or filling such as iron sheets and expanded metal, shall be added to the weight of the main article, if such covering is not ordered to be taken out separately.

k) Doors & Windows:

Dismantling of doors, windows, ventilators, etc. with or without grills, whether done separately or along with removal of wall shall be measured in sq. meters. The length and breadth shall be measured out to out of shutters, where only shutters are dismantled.

The item shall include removing frames, grills, architraves, holdfasts and other attachments, fixtures, fittings and transporting and stacking them in orderly fashion and at places as per directions of the EIC. Where required by EIC, the masonry from which doors, windows, etc. have been removed shall be made good.

The M.S. doors & windows, with or without grills, ventilators, rolling shutters, collapsible gates, sliding shutters shall be measured in sq.m. The measurement for windows, ventilators shall be from out to out of framework. For MS door measurement shall be from out to out of frame for width and from top of finished door to bottom of finished surface of the lintel. In the case of rolling shutters and collapsible gates, the measurement shall be of the clear opening in the walls on which these are provided. The items shall include removing of frame guides, covers, attachments, fixtures, fittings, grills, etc., transporting the same to places directed by the EIC to Air India Stores / Scrap yard.

l) Plaster, Tiles, Skirting, dado :

Where plaster, skirting, dado is to be removed from wall or concrete surface, this shall be measured in sq. metres. This shall include removing carefully, plaster, dado, skirting, raking out the masonry joints, wire brushing the R.C.C./ masonry surface, salvaging the tiles as far as possible, transporting & stacking at places directed or Air India Stores and removing the debris as directed by the EIC.

m) Posts, Struts :

Posts, struts, in wood, steel or R.C.C. (including taking out embedded portion, demolishing the bed block, etc. as described) shall be measured in numbers.

n) Fencing :

Dismantling of barbed wire will be measured in running metre of the wire. Chain link fabric, steel wire mesh, etc. in fencing shall be measured in sq.mtrs. The item shall include making rolls, transporting and stacking at Air India Stores or at places directed by the EIC.

o) Road Work :

Different types of road surfaces shall be measured separately. Road paving shall be measured in sq.mtrs. Concrete paving shall be measured as already stated above.

p) Pipes & Sewer Lines :

Water pipe lines, rain water pipe lines, sewer lines, etc. shall be measured along the centre line, in running metres, inclusive of joints. They shall be dismantled carefully along with clamps, joints, fittings, specials, etc. They shall be transported and stacked diameter wise at Air India Stores or at places directed by the EIC.

q) Sanitary ware, Plumbing :

Removal of wash basins, flushing cisterns, shall include removal of all attachments, supports, fittings, transporting and stacking carefully at Air India Stores or at places directed, plugging the openings in Plumbing pipes cut off, making good damages, if any. Measurements will be in number of wash basins, flushing cisterns, dismantled.

Dismantling of Indian or European type W.C. shall include removal along with its connections, attachments, fittings, supports, transporting and stacking at Air India Stores or at places directed, measurement shall be in numbers.

Dismantling of M.S. or Hume pipe overhead tank shall include removal of all its connections, attachments, valves, plugging the plumbing pipes cut off, carefully lowering down, transporting and stacking at places directed or at Air India Stores as directed by the EIC. Measurements shall be in numbers separately for (a) capacity 2500 ltrs. (b) Capacity above 2500 ltrs. Capacity shall mean the net internal volume in litres.

**8.0 REPAIRS :**

Repairs to Plaster :

The work includes cutting the patch to proper shape and preparing wall surface. Patches upto 2.50 sq.mtrs. or less in area shall be measured under the item of repairs to plaster. Plaster in patches above 2.50 sq.m. in area, shall be paid for at the rate applicable to new work under respective item and is not covered under this sub-head.

Scaffolding as required shall be erected. Existing plaster which has cracked, crumbled or sounds hollow, shall be removed and the patch cut out to a square or rectangular shape. Edges shall be cut so as to provide neat joints. The joints in masonry shall be raked to a depth of minimum 10mm for brick masonry and 20mm for stone masonry. The surface shall be watered till the plastering work is commenced. In the case of concrete surfaces, after the removal of is commenced. In the case of concrete surfaces, after the removal of plaster, the surface shall be hacked properly and wire brushed.

Application of Plaster :

This shall be as described under the sub-head 'Plastering & Pointing'. All dismantled mortar etc. shall be carted away and disposed off as directed by the EIC.

Precautions :

All doors, windows, furniture, etc. and parts of the building, shall be properly covered and protected from splashing of mortar, water, etc. at the contractor's cost. After completion of plaster repairs, all such splashing shall be removed and the surface cleaned. Damage to furniture, fittings, fixtures, existing floor/ plaster, etc. shall be made good/shall be recoverable from the Contractor.

Measurements :

Length and breadth shall be measured correct to a cm. The area shall be calculated in square metres correct to two places of decimal. Patches below 0.05 square metres in area shall not be measured for payment. Measurements of the patches to be plastered shall be recorded after the old plaster has been cut and the wall surface prepared.

Rate :

Rate shall include the cost of materials, labour involved in all the operations as described in the item above.

**9.0 FIXING OF WOODEN DOOR, WINDOW FRAMES, IN EXISTING OPENING**

Holes 40mm deep shall be made in floor for fixing door frame posts in floor and 80mm x 115mm x 230 mm in walls at correct positions for fixing of holdfasts. The holes shall be cleaned.

The sides of the frames abutting wall shall be painted with two coats of coal tar/ solignum or any other anti-termite solution as directed by the EIC before erecting in position. After the frames are erected in position, the cement concrete blocks 115mm x 230 mm x 80mm shall be filled around the holdfasts in walls. Holes around the door frame bottom in floor also shall be filled in cement concrete 1:2:4 (nominal mix). The concrete blocks in walls shall be plastered so as to have matching finish with the rest of the wall. All debris shall be removed and area cleaned up. The work shall be in plumb and level.

Due care shall be taken not to disturb the adjoining masonry and the masonry under the bearing of lintels and arches etc. spanning the opening.

Special care shall be taken when holes are made in load bearing pillars or wall positions separated by openings to ensure that the beams, etc. supported by them are properly propped up. In such portions, cutting holes shall be done on one side at a time. The sides of the holes shall be truly parallel and perpendicular to the plane of the wall. The holes shall then be cleaned of all dust, mortar and brick bats or stone pieces and thoroughly wetted.

Measurements :

Measurements shall be in numbers.

Rate :

The rate shall be inclusive of labour and materials involved in all the operations described including concrete blocks, supplying and fixing of holdfasts, screws, finishing etc. but excluding cost of frames of doors, windows, etc.

## **10.0 FIXING M.S./ WOODEN DOORS, WINDOWS, VENTILATORS IN EXISTING OPENINGS :**

The work will be the same as the item for fixing of doors and window frames. However, in this case, the shutters shall be removed while the frames are fixed in position. Brass hinges and brass screws shall be supplied and fixed to the shutters.

## **11.0 REPAIRS TO JAMBS OF OPENINGS :**

Where opening in masonry is of a size larger than the door or window frame to be fixed, the masonry work shall be done to bring the openings to the required size. Proper cutting for toothing in masonry shall be done and masonry built in cement mortar 1:4 (1 cement : 4 sand) to ensure bonding this to the existing masonry. The masonry shall then be plastered on side and jambs to match the existing finish.

The measurement shall be in cubic metres. The width shall be measured to the full depth of toothing correct to a cm. thickness of plaster will not be measured.

## **12.0 RENEWING GLASS PANES WITH PUTTY & NAILS :**

### Removing broken glass panes :

Old putty shall be raked out with a knife. The brad (small nails without head) and pieces of broken glass shall be removed from the rebates of the sash bars. The pieces of glass panes as found useful shall be handed over to the EIC of the work. No glass shall be inserted in frames until they have been primed and prepared for painting so that the wood may not draw oil out of the putty.

### Fixing :

The glass panes shall be so cut that it fits slightly loose in the frame. A thin layer of putty (prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding the boiled linseed oil to the mixture to form into a stiff paste) shall be drawn along the inner edge of the rebate, for bedding the back of the glass pane. The glass pane shall then be put in position, pressed home against the thin layer of putty and secured in rebate by new brads. The brads shall not be spaced more than 7.5 cm from each corner and not more than 15 cm apart. The putty shall then be applied in the rebate uniformly, sloping from the inner edge of the rebate. In doing this, care shall be taken to keep the putty a little within the inner edge of the rebate and surplus putty removed so that none of it may show through the glass from the inside. The putty so filled in the rebate shall be levelled smooth and finished in a straight line. When dried the putty shall be covered with a coat of paint of approved quality and shade to match the existing finish of joinery work.

The glass panes shall be cleaned with methylated spirit. All splashing or droppings of washing and paint shall be removed. All rubbish and unserviceable materials shall be disposed off as directed by the EIC.

### **13.0 FIXING FAN CLAMPS IN EXISTING R.C.C. SLAB :**

The fan clamps shall be of out of 12 mm diameter M.S. bar. The clamps shall project minimum 100 mm below slab soffit and bent to shape as directed.

#### Fixing :

A chase 150 mm x 75 mm shall be carefully made in the location, where fan is to be fixed, to expose the reinforcement, without damaging the adjoining portion. The two arms at the ends of the clamp shall be passed through the space over the reinforcement exposed and bent down 15mm and the chase filled up in cement concrete 1:2:4 (nominal mix). The ceiling shall be finished to match the existing surface and properly cured. The exposed clamp shall be given 2 coats of Synthetic enamel paint over one paint coat of steel primer.

#### Measurement & Rate :

Clamps shall be measured in numbers. The rate shall include cost of material and labour involved in all the operations described. The rate shall apply irrespective of the thickness of the slab.

### **14.0 FIXING AVAILABLE FLOOR TILES :**

The existing broken or hollow tiles where directed shall be removed carefully in patches of full number of tiles without damaging the adjacent tiles, alongwith the slurry backing. The fixing of tiles shall be as per relevant specification for fixing of floor tiles.

### **15.0 CUTTING OF HOLES, CHASES & MAKING GOOD IN BRICK, STONE MASONRY AND CONCRETE :**

The chase for concealing of conduits in walls shall be done carefully to the size required, without damaging the adjacent portions. The surface shall be cleaned of the loose materials. The chase shall be done neatly in lines and lengths as required. After the conduit or pipeline is fixed in the chase, it shall be filled in properly with cement mortar 1:4 (1 cement : 4 sand) cured and plastered to match the surrounding wall surface. Any damage caused to the wall while making chase etc. shall be made good by the Contractor.

Cutting of holes through the masonry, concrete shall be done with proper equipment and tools without damaging the masonry or concrete work. The openings shall be made square along their sides so as to get a final opening of required size. The making good shall be in cement mortar 1:4 of thickness not exceeding 20 mm and in cement concrete 1:2:4 for thickness exceeding 20 mm. The surface shall be finished to match the rest of the work surface.

All the debris shall be removed as directed by the EIC and the place should be left clean.

Measurement :

Shall be in length in metres for chases and in number for openings of sizes as described in the items.

Rate :

Rate shall include all the materials and labour involved in the operations, including cutting in walls, making good, finishing to match the rest of the surface, removing the debris, etc.

**16.0 REPAIRS TO BRICK FLOORING IN CEMENT MORTAR :**

The bricks used for repair shall be of the specified class and as per specifications.

Bricks required for flooring shall be adequately soaked in water by profusely sprinkling with clean water at regular intervals for a period not less than six hours so as to keep them wet, except for dry brick flooring.

The portion under repairs, base concrete i.e. sub-grade shall be properly cleaned and coated with thick cement slurry so as to get a good bond between sub-grade and flooring.

The brick shall be laid in the existing pattern. These shall be laid with 'frog' downwards.

Bricks shall be laid on 12 mm thick mortar bed of specified proportion of the ingredients, and each brick shall be properly bedded and set home by gentle tapping, with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar, before the next brick is laid and pressed against it.

After the bricks have been laid, mortar should be scrapped out from the joints to a depth of 20 mm, cement grouted and then cement pointed. After pointing the whole surface should be kept moistened by covering with wet absorbent material.

Measurements :

Length and breadth shall be measured correct to a cm. before laying skirting, dado or wall plaster. The area of the repaired brick flooring shall be measured as laid in square metre correct to two places of decimal. No deductions shall be made nor extra paid for any openings in the floor area upto 0.1 square metre. Nothing extra shall be paid for laying the floor at different levels in the same room or court yard. Brick flooring when laid in diagonal herring bond or other pattern as specified or directed shall be measured separately.

Rate :

The rate shall include the cost of all the materials and labour involved in all the operations described above. Sub-grade shall be paid separately unless otherwise specified.

#### **17.0 REPAIRS TO CEMENT CONCRETE FLOORING :**

The panels of the flooring to be repaired shall be adjusted according to the existing pattern and proper slope as per the existing floor slope. No damage shall be done to the existing floor panels. Edges of the adjoining panels shall be repaired and strengthened and surface shall be made smooth to get straight vertical joint.

#### **18.0 REPAIRS TO CEMENT CONCRETE FLOORING (OF RED OXIDE OF IRON)**

The panels of the flooring to be repaired shall be adjusted according to the existing pattern and proper slope as per existing floor. Edges of the adjoining panels shall be repaired and strengthened and surface shall be made smooth to get straight vertical joints.

Samples of cement concrete flooring with red oxide topping shall be prepared and got approved from the Engineer-in-Charge before laying the cement concrete flooring to match the colour of the existing flooring.

#### **19.0 REPAIRS TO TERRAZZO (MARBLE CHIPS) FLOORING LAID IN SITU :**

The panels of the flooring to be repaired shall be adjusted according to the existing pattern and proper slope as per existing floor. Edges of the adjoining panels shall be repaired and strengthened and surface shall be made smooth to get straight vertical joints.

Samples of terrazzo (marble chips) flooring conforming to shade, texture and pattern of the existing flooring shall be prepared and got approved from the Engineer-in-Charge before commencing the work.

Cement slurry shall be applied to the edges of the existing flooring before fixing of glass strips.

Terrazzo tile flooring shall be laid higher than the level of existing flooring to make allowance for rubbing and polishing.

#### **20.0 REPAIRS TO TERRAZZO TILE FLOORING :**

The patches of terrazzo tile flooring to be repaired shall be adjusted according to the existing pattern and proper slope as per existing floor.

Samples of terrazzo tiles shall be got approved from the Engineer-in-Charge before the start of the work to match the shade, texture and pattern of the existing terrazzo tile flooring.

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## **GUNITING**

### **1.0 INDIAN STANDARDS :**

1. I.S. : 6433 – 1972 : Guniting Equipment
2. I.S. : 9012 – 1978 : Recommended practice for shotcreting.
3. I.S. : 1566 – 1982 : Hard drawn steel wire fabric for concrete reinforcement.

The above mentioned I.S. Specifications and Codes of Practice have been indicated for general guidance.

However, these I.S. Specifications and Codes will be adopted only for those particular items in the contract, where either the mode of measurement or detailed technical specifications are not laid down in the Tender Documents.

### **2.0 MATERIALS :**

Cement, Sand and Steel reinforcement shall conform to the specifications given under Concrete sub-head.

Weld mesh/Fabric shall be 12 gauge and of opening size 100 mm x 100 mm.

Araldite :

Araldite epoxy resins (manufactured by M/s. Ciba Geigy Ltd., or other approved manufacturer) shall be used for bonding fresh concrete or gunite to old concrete surfaces.

### **3.0 GENERAL :**

R.C.C. Columns, beams, slabs, chajjas, walls, etc. which have cracked or wherever reinforcement has corroded shall be repaired by guniting.

Where necessary centering/ formwork for columns, beams, slabs, etc. shall be provided before guniting.

### **4.0 SCAFFOLDING :**

In order to provide working space for workers, nozzleman, etc., double scaffolding shall be provided.

### **5.0 SEQUENCE OF GUNITING WORK :**

The guniting work will progress from Ground floor upwards. The members which are to be gunitied / strengthened shall be relieved of the dead load. If the columns are deteriorated, and have developed major cracks, the loose concrete shall be removed. If, after removing the loose concrete, the column section

reduces by 50% or more, then the R.C.C. columns are required to be strengthened by providing and fixing new additional steel reinforcement, cleaning thoroughly the old reinforcement and encasing the reinforcement with concrete not less than 75 mm thick.

#### **6.0 PREPARATION OF SURFACE :**

Any plaster on R.C.C. work shall be removed and the R.C.C. surface roughened by hacking about 6mm deep and at close intervals not less than 10mm c/c. Plaster on masonry work shall be removed totally and joints raked to a depth of 10mm for brick masonry and 20mm for stone masonry. All cracks shall be opened out to a maximum depth possible in 'V' form and then cleaned of all loose mortar and material. All loose deteriorated concrete shall be removed. All corroded reinforcement shall be cleaned properly to remove all the scales and rust by wire brushing and by rubbing with emery paper. A coat of neat cement slurry shall be applied on existing reinforcement after cleaning it as mentioned above just before guniting is done.

#### **7.0 PLACING OF ADDITIONAL REINFORCEMENT :**

The additional reinforcement based on actual design shall be placed in position by fixing it to the existing concrete by fastening with wire, tightened to nails driven into the concrete and secured rigidly, and supported so that reinforcement does not get displaced when guniting is done. In any case, clear spacing between the reinforcement bars shall not be less than 50 mm.

#### **8.0 PREPARATION OF SURFACE TO RECEIVE EPOXY COATING :**

For good adhesion, the surface shall be clean and sound. This shall be done by various techniques including chemical treatment, mechanical methods such as grinding, milling, abrading sand blasting, etc.

#### **9.0 APPLICATION OF EPOXY COATING :**

Epoxy coating shall be prepared and applied to concrete surfaces and reinforcement as per instructions of the manufacturer.

Where directed, Araldite epoxy resins (manufactured by M/s. Ciba-Giegy Ltd., or other approved manufacturer) shall be used for bonding fresh concrete to old concrete. This gives a monolithic bond capable of transmitting high stresses when traditional bonding agents such as cement slurry cannot be relied upon to provide good adhesion where large areas are involved. Epoxy resins possess excellent water and alkali resistance also.

The Araldite based formulation is applied to suitably prepared concrete surface and fresh concrete is poured as soon as possible within the 'Open Time' of the adhesive.

### 9.1 Open Time :

'Open Time' is the maximum period of time allowable between application of the Araldite adhesive and pouring of fresh concrete. Beyond this period, adhesion will be considerably reduced. The adhesive should be applied to the re-treated substrata as soon as the components have been mixed and fresh concrete shall be poured immediately. For sub-strata temperature of 30°C to 35°C, the 'Open Time' is about 40 minutes. Any delay in adhesive mixing and application will reduce the 'Open Time'.

### 9.2 Formulation :

For bonding new concrete to old concrete.

The ideal formulation is as under :

	<u>(Parts by weight)</u>
Araldite GY 250	100
Hardener HY 825	20
Hardener HY 830	20
Hardener HY 850	20

### 9.3 Mixing :

Araldite resin and Hardeners should be thoroughly mixed before mixing dry filler. Hand mixing shall be permitted for a total weight of one kg. or less.

### 9.4 Pot life :

Pot life is the period during which ready-to-use Araldite based formulation must be applied. After this period, the mix will have begun to set in its container. For batches less than one kg., potlife is :

<u>Mix Temperature</u>	<u>Pot life in minutes</u>
25°	90
30°	60
35°	45

### 9.5 Methods of Application :

Depending on the shape and size of the concrete structure, the adhesive may be applied by hand using brushes, brooms, squeezes or any other suitable applicator.

The best results are obtained when the water cement ratio of the new concrete is as low as is practicable.

#### 9.6 Coverage :

One kg. of mixed Araldite adhesive, including hardeners and filler, covers an area of 2 to 3 sq.m. depending on the finish of the concrete sub-strata.

#### 10.0 GUNITING :

Guniting consists of cement and sand in 1:3 proportion ejected under a pressure of 2 to 3 kg/cm<sup>2</sup> from a cement gun and deposited as a cement plaster 12mm to 50mm for walls and 25mm to 30 mm for soffits of slabs. The sand is screened through a sieve of specified designation. Cement and sand are mixed almost dry and blown through a hose. Water just sufficient for the purpose of hydration is added by a separate hose at the nozzle, under a pressure of 1 to 1.5 kg/cm<sup>2</sup>.

The surface must be cleaned before guniting.

The required depth of gunite is achieved by a number of layers of gunite.

The nozzle is to be held at right angles and at 0.40 m to 1.20 m away from the surface to be gunitied.

No rebound mortar shall be used in any batch.

All rebound sand pockets shall be cut and made good during the course of the work.

No batch shall be used if it has tooled for more than one hour after mixing and at the end of the day's work should be tapered off to a fine edge and on the next day, wetted and cleaned with air/water blast before resuming the work.

Adequate curing by spray for eight days required.

Where work is to continue, the gunite at the joint shall not be dropped at right angles, but shall be sloped down.

#### 11.0 Mode of Measurement :

##### a) Surface preparation :

A flat area on the surface prepared for guniting shall be measured in sq.m., as a product of length and width of surface prepared upto the nearest cm.

##### Rate :

Shall be inclusive of all the labour, tools and equipment, scaffolding and carting away the debris, as directed by the EIC.

b) Application of Araldite :

Mode of measurement shall be in sq.m. of the area of the concrete surface applied with epoxy coating.

Rate

Shall be inclusive of all the labour, materials, tools, scaffolding, etc.

c) Chiselling around the main reinforcement :

Measurement shall be taken in a Running Metre length of the reinforcement exposed all around.

Rate

Shall be inclusive of all the labour, scaffolding, tools and carting away the debris as directed by the EIC.

d) Guniting

Area of gunited surface shall be measured in sq.m. as a product of length and width of gunited surfaces, measured upto the nearest cm.

Rate :

Shall be inclusive of all material, labour as specified, tools, equipment, scaffolding, weld mesh fabrics as described in the item and curing for 8 days.

e) Additional Reinforcement

This shall be measured under a separate item of the reinforcement.

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