

## GENERAL TECHNICAL SPECIFICATIONS

## FOR ROAD/CD WORKS

**Name of Work :- Construction of Vented Causway at Ghoghasamadi Ingorala road(Non plan)  
at chainage 1/000 to 1/200 ta.Gadhda Dist:Botad**

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**Wotk :-** 1/000 to 1/200 ta.Gadhda Dist:Botad

**SPECIFICATIONS**

Item No	Item of work	Item No.	Page No.
	General Technical Specifications	Attached	
1	Rolling and Watering of earth work in layers with vibratory roller including filling in depressions which occur during the process as directed.	Attached	
2	Water Bound Macadam Grading -2 providing laying and spreading and compacting stone aggregate of 63 to 45 mm sizes hand packing rolling with smooth wheel roller 80-100kn in stages to proper grade and camber to the required density	Attached	
3	Providing and casting in situ Ordinary cement concrete M-100 for R.C.C. Raft and cut-off walls including necessary shuttering laying, vibrating, ramming and curing complete.	Attached	
4	Excavation for foundation upto 1.5 m. depth including sorting out and stacking of useful materials and disposing of the excavated stuff upto All lead. Dense or hard soil	Attached	
5	Providing and casting in situ Ordinary cement concrete M-150 for R.C.C. Raft and cut-off walls including necessary shuttering laying, vibrating, ramming and curing complete.	Attached	
6	Providing and fixing in position FE500/500D TMT bar reinforcement including cutting, bending and tying complete as per detailed drawings. (A) R.C.C. Kerb. (B) R.C.C. Footpath.(C) R.C.C. Approach slab.(D) Wearing Coat.	Attached	
7	Providing and laying in position FE 500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings for the following.(A) Piers (B) Abutments (C) R.C.C. Returns	Attached	
8	Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal diameters.(v) 900mm dia. With All Lead.	Attached	
9	Providing and fixing flood gauge post mark C angel size 100mm x 50mm x 6mm fixed haed wall	Attached	
10	Filling available excavated earth (excluding rock) in trenches. plinth, sides of foundations etc. in layers not exceeding 20 cm. in depth consolidating each disposed layer by ramming and watering.	Attached	
11	Providing and casting in situ controlled cement concrete M-200 for average 75 mm thick wearing coat laid as directed including tamping, vibrating, finishing, curing and filling in joints with bitumen complete	Attached	

Item No	Item of work	Item No.	Page No.
12	Cautionary warning sign;-Providing & Fixing sign boards made out of 2mm. aluminium sheet size 90x90x90cms. equilateral triangle as per design of IRC-67-1977 Pretrated with phospheting process & acid atching : coated with one coat of apoxy primer and two coats of best quality epoxy paint, reflectorised with retro reflective sheeting as per latest MOSTspecifications. 3.1mt. lomg stand post & frame fabricated from suitable size iron angle of 35x35x3 mm., 75x75x6mm. required paited with best quality epoxy coatings in black and white bends, the detail of symbols for each board shall be as per the instruction of the engineer in charge. The fixing at site shall be in C.C. 1:2:4 block of size 45x45x60 cms for each leg, incl. excavation,curing etc. comp.under the supervision of Engineer - in charge. (A) Engineer grade.	Attached	

(.....)  
Deputy Executive Engineer  
Panchayat R.& B. Sub Division  
Botad

(.....)  
Executive Engineer  
Panchayat R.& B. Division  
Botad

## GENERAL TECHNICAL SPECIFICATIONS FOR C.D. WORK

### 1.0 General :

All Measurements shall be made in metric system. Different items of work shall be measured in accordance with the procedures set forth in relevant sections read in conjunction with General Conditions of contract. The same shall not however apply in the case of lump-sum items. All measurements and computations ; unless other wise indicated, shall be carried nearest to be following limits :

- (i) Length and breadth.....10mm
- (ii) Height, depth or thickness of earthwork,  
Sub-base, bases surfacing, and structural members.....5mm
- (iii) areas..... 0.01 Sq. Metre.
- (iii) Cubic contents.....0.01 Cubic Meter.

In recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

### 2.0. Measurement of lead for Materials :

Where lead is specified in the contract for construction materials, the same shall be measured as described hereunder.

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regards shall be taken as final. Distance up to and including 100 meters shall be measured in units of 50 meters, exceeding 100 metes but exceeding 1 Km. in units of 100 meters, and exceeding 1 Km. in units of 500 meters. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the materials shall be divided into suitable blocks and for each block the distance from the centre of the block to the centre of placing pertaining to that block shall be taken as the lead distance.

### 3.0 Surface Regularity of sub grade and Pavement courses :

The surface regularity of completed sub-base courses and wearing surface in the longitudinal and transverse direction shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 meter long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set for three camber boards at intervals of 10 meters.

PERMITTED TOLERANCES OF SUB REGULARITY FOR PAVEMENT COURSE.

Sr.	Type of construction	Longitudinal Profile with 3 meter straight edge.					Cross Profile
		Maximum permissible undulation in mm	Maximum number of undulation permitted in any 300 m. length exceeding in				Maximum permissible variation from specified profile camber themplate mm
			18	12	10	6	
1	2	3	4	5	6	7	8
1	Earth sub grade	36	30	-	-	-	15
2	Granular/lime Cement stabilized sub base.	23	-	30	-	-	12
3	Water Bound Macadam with nominal size metal (20-50)mm	18	-	-	30	-	8
4	Semi Dense carpet	15	-	-	-	20	6

## Notes:

1. These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance up to 50 percent above these values in the columns may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 in the table.

2. Surface evenness requirements in respect of both the longitudinal and profiles should be simultaneously satisfied.

3. **Rectification** : Where the surface irregularity of sub grade and the various pavement courses fall out side the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer- in-Charge at this own cost.

(I) **Sub grade**; Where the surface in high, it shall be trimmed and suitably compacted. Where the same in low, the deficiency shall be corrected by adding frees material. The degree of compaction and the type of material to be used shall confirm to the specified requirements.

(ii) **Granular/Sub Base**: Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

(iii) **Lime/Cement stabilized soil sub-Base**: For lime/ cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However where the surface is low, the same shall be corrected as described here in below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material, is less than 2 hours, the surface shall be scarified to a depth of 50mm, supplemented with freshly mixed material as necessary and recomposed to the relevant specification. When this time is more than 2 hour, the full depth of the layer shall be removed from the pavement and replaced with fresh material, to specification. In either case, the area treated shall not be less than 5 meters wide. This also applies to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

(iv) **Water Bound Macadam Base** : Where the surface is high or low, that top 75mm shall be scarified, reshaped with added material as necessary and re compacted. The area treated at a place shall not be less than 5 meters long and 2 meters wide.

(iv) **Bituminous Construction** : For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and re compaction to specifications, Where this surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 meter long and not less than 1 lane wide.

## 4.0 Quality Control Test during Construction. :

The materials supplied and the works carried out by the Contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control test as described hereinafter, by the Engineer-in-charge. The testing frequencies set forth are the desirable minimum and the Engineer-in-charge shall have the full authority to carry out test as frequently as he may deem

necessary to satisfy that the materials at work comply with the appropriated specification. Test procedures for the various quality control tests are indicated in the respective sections of the specification or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per prevalent accepted engineering practice to the directions of the Engineer-in-charge.

## **5.0 Tests of Earthwork for Embankment Construction :**

### **5.1 Borrow Materials:**

- (a) Sand content (IS: 2720 Part IV)  
Two test per 8000 Cubic meters of soil.
- (b) Plasticity Test (IS: 2720 Part-V)  
Each type to be tested. Two tests per 8000 Cubic Meters of soil.
- (c) Density test (IS: 2720 part-VII)  
Each soil type to be tested. Two test per 8000 Cubic Meters of Soil.
- (d) Moisture Content Test (IS: 2720 Part-II)  
One test for every 250 Cubic Meters of soil.

### **5.2 Compaction Control :**

Control shall be exercised by taking at least one measurement of density for each 1000 square meters of compacted area, or closer as required to yield the maximum number of test results for evaluating day's work on statistical basis. The determination of density shall be accordance with IS: 2720 (Part XXVIII). Test locations shall be chosen only through random sampling techniques. Control shall be not being based on the result of any one test but on the mean value of set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increase to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of result is below 0.08 gm/cc. However for earthwork in shoulders and in top 500 mm portion of the embankment below the sub grade, at least one density measurement shall be taken for every 500 square meters of the compacted area provided further that the number of the test in each set of measurement shall be at least 10. In other respects, the control shall be similar to that described earlier.

## **6. Following materials shall conform to the Indian Standards shown against them;**

- (1) Cement IS: 269
- (2) Sand for masonry IS: 2116
- (3) Sand for concrete IS: 383
- (4) Course aggregate. IS: 383
- (5) Mild Steel. IS: 432
- (6) High yield strength deformed bars
  - (a) Hot Rolled. IS: 1139
  - (b) Cold Twisted. IS: 1786

## **7. Barrel thickness of pipes of different class shall be under:**

Sir No	Internal Diameter of pipes in MM	Barrel thickness (in mm)		
		NP1	NP2	NP3

1	80	25	25	-
2	100	25	25	-
3	150	25	25	-
4	250	25	25	-
5	300	30	30	-
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	-	35	75
10	600	-	40	80
11	700	-	40	80
12	800	-	45	90
13	900	-	50	100
14	1000	-	55	100
15	1100	-	60	115
16	1200	-	65	115

## **GENERAL TECHNICAL SPECIFICATION FOR C.D. & BRIDGEWORK**

### **1. General**

All measurements shall be made in the metric system. Different item of work shall be measured in accordance with the procedures set forth in the relevant specifications read in conjunction with General condition of Contract. The same shall not, however, apply in the case of lump-sum item. All measurements and computations, unless otherwise, indicated, shall be carried nearest to the following limits:

- |       |  |                 |
|-------|--|-----------------|
| (i)   | Length and breadth   | 10mm            |
| (ii)  | Height, depth or thickness of earthwork, sub-base, bases, surfacing and structural member. | 05mm            |
| (iii) | area   | 0.01 Sq.Mtrs.   |
| (iv)  | cubic content's  | 0.01 Cubic Mtr. |

In recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed

### **2. Measurements of Lead for Materials**

Where lead is specified in the contract, the same shall be deemed to mean as described hereunder.

Lead shall be determined on the basis of the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regard shall be taken as final. Distances up to and including 100 metres shall be measured in units of 50 metres, exceeding 100 metres but not exceeding 1 km. in units of 100 metres, and exceeding 1 km. in units of 500 metres. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the materials shall be divided into suitable blocks and for each block the distance from the center of the block to the center of placing pertaining to that block shall be taken as the lead distance. Where no lead is specified, it shall mean all lead.

### **3. Surface Regularity**

The surface regularity of completed wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the center of the road. The transverse profile shall be checked with a set of three camber boards at intervals of ten metres.

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES				
Sr. No.	Type of Construction	Longitudinal	Profile with 3 metre straight edge	Cross Profile
		Maximum Permissible undulations mm.	Maximum number of Undulations permitted in any 300 metres length exceeding 6mm.	Maximum permissible variation from specified profile under camber template mm
1	Bituminous wearing coat 15		20@	6

**Notes:-** 1. @ These are for machine laid surfaces. If laid manually, tolerance up to 50 percent above these values in this column may be permitted. However this relaxation does not apply to the value of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 4 of the table.

4. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

#### **Rectifications.**

Where the surface irregularity falls outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

#### **Bituminous Constructions.**



For bituminous constructions, for wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh materials and compacted to specifications, In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metres long and less than 1 lane wide.

#### **5. Quality Control tests during Construction:**

The materials supplied and the works carried out by the contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control test, as described herein after, by the Engineer-in-charge. Test procedures for the various quality control test are indicated in the respective sections of the Specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per the prevalent accepted Engineering practice to the directions of the Engineer-in-charge.

#### **6. Following materials shall conform to the Indian Standard shown “ Against Them”.**

(1)	Cement	IS : 269
(2)	Sand of Masonary	IS : 2116
(3)	Sand for Concrete	IS : 383
(4)	Coarse Aggregate	IS : 383
(5)	Mild Steel	IS : 432
(6)	High yiled strength deformed bars-	
	(a) Hot Rolied	IS : 1139
	(b) Cold Twisted	IS : 1786
(7)	Cast Steel	IS : 1030
(8)	Cast Iron	IS : 210
(9)	Structural Steel	
	(a) Mild Steel	IS : 226
	(b) H.T. Steel	IS : 961
	(c) Fusion welding quality steel	IS : 2062
	(d) River Steel	IS : 1148 or
(10)	H.T. Steel	IS : 1785
(11)	Greese	IS : 1002
(12)	Electrodes for metal or welding of N.J. IS : 814	

### **SPECIFICATION FOR MATERIALS**

#### **M-1 Water:**

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

concrete during curing of those which produce objectionable stains of their unsightly deposits on concrete or mortar surfaces

**1.4** Hard and bitter water shall not be used for curing

**1.5** Potable water will generally found suitable curing mortar or concrete.

**M-3 Cement.**

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

**M-6 Sand.**

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

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

I.S. Designation	Sieve passing sieve	Percentage by weight Designation	I.S. Sieve percentage by weight passing sieve.
4.75 mm.	100	600 Micron	30-100
2.36 mm.	90 to 100	300 Micron	5-70
1.18 mm.	70 to 100	150 Micron	0-50

**6.3 Fine Sand :**

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

I.S. Designation	Sieve passing sieve	Percentage by weight Designation	I.S. Sieve percentage by weight passing sieve.
4.75 mm.	100	600 Micron	40-85
2.36 mm.	100	300 Micron	5-50
1.18 mm.	75 - 100	150 Micron	0-10

**M-7 Stone Dust**

**7.1** This shall be obtained from crushing hard black trap of equivalent. It shall not contain more than 8 % of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under.

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

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

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

**M-8 Stone Grit.**

**8.1** Grit shall consist of crushed or broken stone and be hard, strong, dense, durable, clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar. Grit shall generally be cubical in shape and as far as possible flakey elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383-1970. unless special stone of particular quarries is mentioned grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer in charge. The grit shall have not deleterious with cement.

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

I.S. Designation	Percentage by weight passing sieve.	I.S. Sieve Designation	Percentage by weight passing sieve.
12.50 mm.	100	600 Micron	0-20 %
10.00 mm.	85 - 100	300 Micron	0-25 %

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

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

## **M-11 Cement Mortar**

**11.1** Water shall conform to specification M-1 Cement. Cement shall conform to specifications M-3 sand. Sand shall conform M-6.

### **11.3 Proportion of Mortar :**

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

**11.3.2** The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 min.

## **M-12 Stone Coarse Aggregate For Nominal mix Concrete.**

**12.1** Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong dense, durable clean and free from skin and coating likely to prevent proper adhesion of mortar.

**12.2** The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall generally be as per the table given below. However, in case of reinforced cement concrete the maximum limit may be restricted to 6mm. less than the minimum lateral clear distance between bars or 6mm. less than cover whichever is smaller.

## **TABLE**

I.S. Sieve	Percentage passing for single			I.S. Sieve	Percentage passing for single		
Designations	<u>Sized aggregates of Nominal size</u>			Designation	<u>Sized aggregates of Nominal size</u>		
	-	-	-		-	-	-
80 mm.	100	-	-	12.5 mm.	0.5	0.2	0.3
63 mm.	85-100	100	-	10 mm.	-	0.5	0.5
40 mm.	0-20	85-100	100	4.75 mm.	-	-	-
20 mm.		85-100		2.35 mm.	40 mm.	20 mm.	16 mm.
16 mm.	40 mm.	20 mm.	16 mm.				

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

**12.3** The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests. Indicating I.S.:383-1970 and 456-1978 shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. if the aggregates are covered with dust, they shall be washed with water to make them clean.

### **M-13 Black Trap or Equivalent Hard Stone Coarse**

**13.1** Aggregates For Design Mix Concrete : Coarse aggregate shall be of machine crushed stone of black trap of equivalent hard stone and be hard, strong, dense, durable, clean and free from kin and coating likely to prevent proper adhesion of mortar.

**13.2** The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, black trap or equivalent hard stones as approved. Aggregate shall have no deleterious with cement.

**13.3** The necessary tests indicated in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability of the material.

**13.4** If aggregate is covered with dust it shall be washed with water to make clean.

### **M-14 Brick Bats Aggregates :**

**14.1** Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40mm. 50 mm. size unless otherwise specified in the item. The under burnt or over burnt brick bats shall not be allowed.

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

### **M-15 Bricks**

**15.1** The bricks shall be hand or machine moulded and made from suitable soils and kiln burnt. They shall be free from cracks and flaws and modules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform color.

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

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

**15.3** The size of conventional bricks shall be as under :

(9" x 4 3/8" x 2 3/4") 225 x 110 x 75 mm.

**15.4** Only bricks of one standard size shall be used on one week. The following tolerance shall be permitted in the conventional size adopted in a particular work. Length + 1/8" (3.0 mm) Width + 1/16" (1.50 mm.) Height + 1/16" (1.50 mm.)

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

#### **M-16 Stone.**

**16.1** The stone shall be of the specified variety such as Granite/Trap Stone/Quartzite or any other type of good hard stones. The stones shall be only from defects like cavities, cracks, sand holes, flaws injurious veins, patches of loose or soft materials and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5% of dry weight. When tested in accordance with I.S. 1124-1974. The minimum crushing strength of stone shall be 200 Kg./Sq. Cm. unless otherwise, specified.

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

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

#### **M-18 Mild Steel Bars**

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

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

**18.3** For the purpose of payment, the bar shall be measured correct up to 10 mm. length and weight payable worked out at the rate specified below.

1.	6 mm.	0.22 Kg./Rmt.	8.	20 mm.	2.47 Kg./Rmt.
2.	8 mm.	0.39 Kg./Rmt.	9.	22 mm.	2.98 Kg./Rmt.
3.	10 mm.	0.62 Kg./Rmt.	10.	25 mm.	3.85 Kg./Rmt.
4.	12 mm.	0.89 Kg./Rmt.	11.	28 mm.	4.83 Kg./Rmt.
5.	14 mm.	1.21 Kg./Rmt.	12.	32 mm.	6.31 Kg./Rmt.

6.	16 mm.	1.58 Kg./Rmt.	13.	36 mm.	7.99 Kg./Rmt.
7.	18 mm.	2.00 Kg./Rmt.	14.	40 mm.	9.86 Kg./Rmt.

#### **M-19 High Yield Strength Deformed Bars**

**19.1** High yield strength steel deformed bars shall be either cold twisted other rolled and shall conform to I.S. 1786-1966 and I.S. 1139-1966 respectively.

**19.2** Other provisions and requirements shall conform to specification No. M-18 for Mild Steel Bars.

#### **M-20 High Tensile Steel Wires.**

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

**20.2** The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength the minimum strength shall be taken as per para 6-1 of the I.S. 1785-1962. Testing shall be done as per I.S. requirements.

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

**20.4** The high tensile wire shall be obtained from manufactures in coils having diameter not less then 350 times the diameter of wire itself so that wire springs back straight on being uncoiled.

#### **M-21 Mild Steel Binding Wire**

**21.1** The mild steel wire shall e of 1.63 mm. or 1.22 mm. (16 to 18 gauge ) diameter and shall conform t I.S. 280-1972,

**21.2** The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

#### **M-22 Structural Steel**

**22.1** All structural steel shall conform to I.S. 226-1985. The steel shall be free from the defects mentioned in I.S. 226-1975 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defect affecting the strength and durability. River bars shall conform to I.S. :1148-1973.

**22.2** When the steel is supplied by the Contractor test certificate of the manufacturer shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

## ITEM WISE DETAILED SPECIFICATIONS

### **Item No. 01 Rolling and Watering of earth work in layers with vibratory roller including filling in depressions which occur during the process as directed.**

1. Immediately following the spreading of the coarse aggregates rolling shall be with three wheeled power rollers of 8 to 10 tonne capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the type of the aggregate and be indicated by Engineer in charge.
2. Except on super elevated portion where the rolling shall proceed from inner edge to outer. rolling shall be from the edges gradually progressing towards the centre. First the edge / edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to center line of the road, in successive passes uniformly lapping preceding tracks by at least one half the width.
3. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wave like motion in the sub grade or sub base courses.
4. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and rerolling until the entire surface conforms to desired camber and grade. In no case shall the use of screening be permitted to make up depression.
5. The binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to till the works properly and rolled, during which water shall be applied to the wheels of the roller if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the moving roller.
6. After the final compaction of water bound macadam course the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings of binding materials as directed. lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The engineer in charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface,
7. Payment will be made on Cum. basis of the finished work and shall include cost of watering, rent of machinery cost fuel, wages of drivers and cleaners and stone dust bound etc.

**Item No. 02 Water Bound Macadam Grading -2 providing laying and spreading and compacting stone aggregate of 63 to 45 mm sizes hand packing rolling with smooth wheel roller 80-100kN in stages to proper grade and camber to the required density**

## **WATER BOUND MACADAM SUB-BASE/BASE**

### **401.1 Scope**

404.1.1. This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared subgrade/sub-base / base or existing pavement, as the case may be and finished in accordance with the requirements of these specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

404.1.2. It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

### **401.2. Materials**

**401.2.1 Coarse aggregates:** Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400 – 6. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part 5).

**403.2.2. Crushed or broken stone:** The crushed or broken stone shall be hard, durable and free from excess flat elongated, soft and disintegrated particles, dirt and other deleterious material.

TABLE 400-6. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE / BASE COURSES

Test	Test Method	Requirements
<b>1</b>	<b>* Los Angeles Abrasion value</b>	<b>40 percent (Maxi.)</b>
	<b>Or</b>	
	<b>*Aggregate impact value</b>	<b>30 percent (Maxi.)</b>
<b>2</b>	<b>Combined Flakiness and Elongation indices (Total)***</b>	<b>30 percent (Maxi.)</b>
	<b>IS:2386 (Part - 1)</b>	

\* Aggregate may satisfy requirements of either of the two sets.

\*\* Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet condition in accordance with IS : 5640.

\*\*\* The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

**403.2.3. Crushed slag:** Crushed slag shall be made from air cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m<sup>3</sup> and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:



(i)	Chemical stability	To comply with requirements of appendix of BS : 1047
(ii)	Sulphur content	Maximum 2 per cent
(iii)	Water absorption	Maximum 10 per cent

**404.2.4. Overburnt (Jhama) brick aggregates:** Jhamah brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

**403.2.5. Grading requirement of coarse aggregates:** The coarse aggregates shall conform to one of the Gradings given in Table 400 – 7 as specified, provided, however, the use of Grading No. – 1 shall be restricted to sub-base courses only.

**404.2.5.**

TABLE 400 – 7. GRADING REQUIREMENTS OF COARSE AGGREGATES

Gradation	Size range	I.S. Sieve designation	Percent by weight passing
1	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2	63 to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3	53 to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

Note: The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other gradings i.e., 2 & 3, it shall be 75 mm.

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

Screenings shall conform to the grading set forth in Table 400 – 8. The consolidation details of quantity of screenings, required for various grades of stone aggregates are given in Table 400 – 9. The table also gives the quantities of materials (loose) required for 10 m<sup>2</sup> for sub-base/base compacted thickness of 100/75 mm. The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites etc. as they are likely to get crushed to a certain extent under rollers.

**404.2.7. Binding Material :** Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS:2720 (Part 5).

The quality of binding material where it is to be used, will depend on the type of screening. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06 – 0.09 m<sup>3</sup>/10m<sup>2</sup> and 0.08 – 0.10 m<sup>3</sup>/10m<sup>2</sup> for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel

TABLE 400 – 8. GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 mcn	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 mcn	15-35

TABLE 400 –9. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100 / 75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE / BASE COURSE FOR 10 M<sup>2</sup> AREA

Classification	Size Range	Compact thickness	Loose Qty.	Screenings			
				Stone screening		Crushable type such as mooram or gravel	
				Grading classification and size	For WBM sub-base/ base course (loose Qty)	Grading classification and size	Loose Qty.
Grading1	90 mm to 45 mm	100 mm	1.21 to 1.43 m <sup>3</sup>	Type A 13.2 mm	0.27 to 0.30 m <sup>3</sup>	Not Uniform	0.30 to 0.32 m <sup>3</sup>
Grading2	63mm to 45 mm	75 mm	0.91 to 1.07m <sup>3</sup>	Type A 13.2 mm	0.12 to 0.15 m <sup>3</sup>	- do -	0.22 to 0.24 m <sup>3</sup>
- do -	- do -	- do -	- do -	Type B 11.2 mm	0.20 to 0.22 m <sup>3</sup>	- do -	- do -
Grading3	53mm to 22.4 mm	75 mm	- do -	- do -	0.18 to 0.21 m <sup>3</sup>	- do -	- do -

### 402.3. Construction Operations

**402.3.1. Preparation of base:** The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling course) to Clause 501 of these Specifications.

As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage to the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one metre intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

**404.3.2. Inverted choke :** If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

**402.3.3. Spreading coarse aggregates:** The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base to proper profile by using templates placed across the road about 6m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in Clause 404.2.5. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results. The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

**404.3.4. Rolling:** Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled Vibratory rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least on half widths.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses as per Clause 407.4.1.

**404.3.5 Application of screenings:** After the coarse aggregate has been rolled to Clause 404.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grid spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

**404.3.6 Sprinkling of water and grouting:** After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bounded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction. In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down on the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

**404.3.7 Application of binding material:** After the application of screenings in accordance with Clause 404.3.5 and 404.3.6, the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the roller if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

**404.3.8 Setting and drying:** After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

#### **404.4. Surface Finish and Quality Control of Work**

**404.4.1** The surface finish of construction shall conform to the requirements of Clause 902.

**404.4.2** Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

**404.4.3** The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0°C in the shade.

**404.4.4 Reconstruction of defective macadam:** The finished surface of water bound macadam shall conform to the tolerance of surface regularities as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

**402.5. Arrangement for Traffic**

During the period of construction, the arrangement of traffic shall be done as per Clause 112.

**402.6. Measurement for payment**

Water bound macadam shall be measured as finished work in position in **cubic metre**.

**402.7. Rates**

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (iv) including arrangement of water used in the work as approved by the Engineer.

**Item No.03 Providing and casting in situ Ordinary cement concrete M-100 for R.C.C. Raft and cut-off walls including necessary shuttering laying, vibrating, ramming and curing complete.**

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportion of cement, fine aggregate and coarse aggregates are specified by volume as given in table below for different grades of concrete designed as ordinary M. 100. , M. 150, M.200 and M.250.

2. In the designation of a concrete mix. letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150mm cubes expressed in kg./ cm<sup>2</sup>.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50kg. of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for "bulking" shall be made as per IS: 2386 (Part-III).

4. Ingredients required for ordinary concrete containing one 50 kg bag of cement of different proportions of mix shall be as given in Table below.

**TABLE**

Grade of Concrete	Mix By Volume	Total quantity of dry aggregates by volume per 50 Kg. of cement, to be taken as sum of the individual volumes of fine and coarse aggregates max.,	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
1	2	3	4	5
Ordinary M.100	1:3:6	300	General 1:2 for fine aggregate to coarse aggregate by volume but	Litres 34

M.150	1:2:4	220	subject to a upper limit of 1:1.1/2 & 2 lower limit of 1:3	32
M.200	1:1 ½:3	160		30
.250	1:1:2	100		27

**NOTE:-** The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & the maximum size of coarse aggregate becomes larger.

**Example:-** For an average grading of fine aggregate (that is Zone II of IS: 383-1963) the proportions shall be 1: 1 1/2, 1:2 and 1:3 for maximum size of aggregates 10mm, 20mm, and 40mm respectively (after carrying out sieve analysis).

**Note-2** A mix leaner than M.100 (1:3:6) may be used for non-structural parts, if provided in the contract. In such case grading of aggregates shall be by volume. Other requirements for mixing, placing & curing shall be the same.

5.0 Following shall be the maximum nominal size of coarse aggregate, for the different items of work:

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregate
(i)	R.C.C. well curb, R.C.C. well steining and R.C.C. Piles	40mm
(ii)	R.C.C. well steining	63mm
(iii)	Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps	40mm
(iv)	R.C.C. Works in cross girders deck slab, wearing coars, kewrb, light posts, blast walls, approach slab etc. and hollow type piers, abutments, wing-walls and their pier caps.	20mm
(v)	R.C.C. bearings	20mm
(vi)	For any other item of construction not covered by item (i) to (v)	As specified on the drawing or as desired by the Engineer- in- charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams nominal maximum size of aggregate shall usually be restricted to 5 mm. Less than the minimum lateral clear distance between the main bars or 5mm less than the minimum cover to the reinforcement, whichever is the smaller.

6. Fine aggregate shall be clean, hard, coarse sand, It shall be free from dust and such other substances. The sand be got approved by the Engineer-in-charge.

7. All materials shall be stored as to prevent their deterioration or instruction of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

8. Cement shall be stored above the ground level in perfectly and water tight shed. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.

9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained through the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement, In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign materials shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 per cent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent materials takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started within 24 hours of the approval given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be with 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trunking or chutes are used they shall be kept clean and used in such a way as to

avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness, and shall be well rammed against oldwork particular attention being given to corners and close spots.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used, Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

17.. immediately after compaction, concrete, shall be protected against harmul, effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frosts and driving out process. It shall be covered with wet sacking, hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Form work shall however be divided into following two district categories:-

(1) Shuttering i.e. form work required for forming the concrete.

(2) Scaffolding i.e. form work required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitable lined. Forms for scaffolding shall be constructed for metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter-sunk and well ground to provide a smooth, level surface.

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed line occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed loads as to provide such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chamfers or fillets of sizes 25mm x 25mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works.



21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and or results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purposes shall be cut inside the cement concrete member to a depth of at least 25mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honey comb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use, considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids, surface which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/ honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

24. In the case of reinforced concrete work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slump tests. Following slump shall be adopted for different types of works.

Type of work		Where vibrators are used	SlumpsWhere vibrators are not used
(i)	Mass concrete in R.C. C. foundations, footings and retaining walls	10mm to 25mm	80mm
(ii)	Beams, slabs and columns simply reinforced	25mm to 40mm	100mm to 120mm
(iii)	Thin R.C.C. section or section with congested steel	40mm to 50mm	125mm to 150mm

25. Works strength tests shall be made in accordance with IS:516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day in less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge, similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapchi, or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of department person not below the rank of Asst. Engineer/ Addl-Asst. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

29. All necessary labour, materials equipment, etc. for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by Engineer-in-charge in an approved laboratory at the cost of the contractor.

### **30. The payment will be made on cmt. basis of the finished work.**

31. The unit rate for concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as show on the drawings and according to these specifications. The rate shall also include the cost of making/ fixing and remixing of all centers and forms required for the work.

## **Item No.04**

### **Excavation for foundation upto 1.5 m. depth including sorting out and stacking of useful materials and disposing of the excavated stuff upto All lead. Dense or hard soil**

#### **1.0. General**

1.1. Any soil which generally yields to the application of pick axes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel silt, sand turf, clay peat etc. fall under this category.

#### **2.0. Clearing the site**

2.1. The site on which the structure is to be built shall be cleared and all obstructions loose stone materials and rubbish of all kind, bush wood and trees shall be removal as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50 m. lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt.

2.2. The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

#### **3.0. Setting out**

After clearing the site the centers lines will be given by the Engineer in charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Contractor shall supply labours materials etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

#### **4.0. Excavation**

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown I the drawings or as directed. The contractor shall do the necessary shoring and shuttering or providing necessary slopes to a safe angle, at his own cost. The payment for precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transferely as directed by removing and watering as required no earth filling will be allowed for bringing it to level. If by mistake or any excavation is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m. depth shall be measured under this item.

#### **5.0. Disposal of the excavated stuff**

5.1. The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers including ramming and watering etc.

5.2. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 50 M. and all lift.

#### **6.0. Mode of measurements & payment**

6.1. The measurement of excavation in trenches for foundation shall be made according to the section of trench shown on the drawing or as per sections given by the Engineer in charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stopping and sloping back as found necessary on account of conditions of soil and requirements safety.

6.2. The rate shall be for a unit of one cubic meter.

#### **1.0. Dense or Hard Soil**

Any soil which generally require close application of picks or jumpers or sacrifier to loosen it stiff clay gravel and stone etc. fall under this category.

#### **2.0. Workmanship**

The relevant specifications of item No. 4.0.0. (A) shall be followed except that the excavation work shall be carried out in dense or hard soil.

**3.0. Mode of measurements & payment**

3.1. The relevant specifications of item No. 4.0.0.(A) shall be followed.

3.2. The rate shall be for unit of one cubic meter.

**Item No.05 Providing and casting in situ Ordinary cement concrete M-150 for R.C.C. Raft and cut-off walls including necessary shuttering laying, vibrating, ramming and curing complete.**

**Specification shall apply as per item No.03 Above**

**Item No. 06 Providing and fixing in position FE500/500D TMT bar reinforcement including cutting, bending and tying complete as per detailed drawings. (A) R.C.C. Kerb. (B) R.C.C. Footpath.(C) R.C.C. Approach slab.(D) Wearing Coat.**

**DESCRIPTION**

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars (un tensioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

**MATERIALS**

Steel for reinforcement shall meet with the requirements of Section 1000.

TABLE 1000 – 3

Grade Designation	Bar type conforming to governing IS Specification	Characteristic Strength Mpa	Elastic Modulus GPa
<b>S 240</b>	<b>IS : 432 Part IMild Steel Bar</b>	<b>240</b>	<b>200</b>
<b>S 415</b>	<b>IS : 1786 High Yield Strength Deformed Bars (HYSD)/TMT</b>	<b>415</b>	<b>200</b>

Reinforcements may be either mild steel/medium tensile steel or high strength deformed bars/ TMT. They may be uncoated or coated with epoxy or with approved protective coatings.

**PROTECTION OF REINFORCEMENT**

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc., as directed by the Engineer. Reinforcements shall be stored on blocks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

Portions of uncoated reinforcing steel and dowels projecting from concrete, shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

## **BENDING OF REINFORCEMENT**

Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand or power to obtain the correct radii of bends and shape. Bars shall not be bent or straightened in a manner that will damage the parent material or the coating. Bars bent during transport or handling shall be straightened before being used on work and shall not be heated to facilitate straightening.

## **PLACING OF REINFORCEMENT**

a) The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

b) Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS:280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.

c) Bars shall be kept in position usually by the following methods:

(i) In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

(ii) In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed upto a level just below their location.

(iii) Layers of reinforcements shall be separated by spacer bar at approximately one metre intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

(iv) Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc, or other subsidiary reinforcement shall be provided to fix the reinforcements firmly in its correct position.

(v) Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted.

d) Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Reference shall be made to Section 1000 for other requirements.

e) Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

## BAR SPLICES

### 1. Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1 1/2 times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

### 2. Welding

.2.1. Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

.2.2. While welding may be permitted for mild steel reinforcing bars conforming to IS: 432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S, 240 grade including special welding grade of S 415 grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mg+V}{5} + \frac{Ni+Cu}{15}$$

is 0.4 or less.

.2.3. The method of welding shall conform to IS:2751 and 15:9417 and to any supplemental specifications to the satisfaction of the Engineer. Welding may be carried out by metal arc welding process. Oxy- acetylene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on over heating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double- V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators, welding procedure are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall have to be qualified by tests prescribed in IS: 2751. Inspection of welds shall conform to IS: 822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in 2 or 3 stages, previous surface shall be cleaned properly.

Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

**2.4** M.S. electrodes used for welding shall conform to IS: 814. 1606.2.4. Welded joints shall preferably be located at points where steel will not be subject to more than 75 per cent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 per cent of the bars are welded.

**2.5.** Welded pieces of reinforcement shall be tested. Specimens shall be taken from the site and the number and frequency of tests shall be as directed by the Engineer.

### **3. Mechanical Coupling of Bars**

Bars may be joined with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swagged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 per cent of the characteristic strength of the reinforcement bar.

### **TESTING AND ACCEPTANCE**

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by the Contractor at his own cost.

The fabrication, furnishing and placing of reinforcement shall be in accordance with these specifications and shall be checked and accepted by the Engineer.

### **MEASUREMENTS FOR PAYMENT**

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in **tonnes** on the basis of IS: 1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

### **RATE**

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. . The rate shall also cover sampling, testing and supervision required for the work.

**Item No.07 Providing and laying in position FE 500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings for the following.(A) Piers (B) Abutments (C) R.C.C. Returns**

**Specification shall apply as per item No.06 Above**

**Item No.08    Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal diameters.(v) 900mm dia. With All Lead.**

1. The work shall consist to furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer in charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item each consignment of cement concrete pipes shall be inspected. If necessary and approved by the engineer in charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3 , NP3 , NP1 pipes are used for RCC pipes where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from this responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work in account of defects found subsequently during the execution It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS : 458 at his factory.

**FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES**

We..... manufacture of RCC pipes produce RCC pipes as per the requirement of IS : 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carry out test at our factory sites.

We have experience of manufacturing of pipes of ..... years The pipes supplied by us to M/s ..... Satisfy the requirement of IS " 458.

Date .....

Place .....

Manufacturer's sign.

3. No pipe shall be placed in position until the foundations have been approved by the engineer in charge, Where two or more pipes are to be laid adjacent to each other they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed toward the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at the cost of contractor.

4. The pipes shall be jointed either by collar joint or by flush joint in the former case the collars shall be of RCC 150 to 200 mm wide and having the same strength as the pipes to be jointed . Caulking space shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joint space 13 cm wide, The joining space shall be filled with cement mortar, 1 cement 2. sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer, Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. RCC pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading unloading handling storing laying in position and joining complete.



**Item No. 09 Providing and fixing flood gauge post mark C angel size 100mm x 50mm x 6mm fixed haed wall**

-: Scope :-

The item covers supplying and installing flood gauge post conforming to IRC:67:2001 in all respect in accordance with these specifications and as approved by the Engineer-in-charge.

**General:-**

The colour, configuration, size and location of flood gauge shall be as shown on the drawings and in absence of any details if any missing details, the same shall be provided as directed by the Engineer-incharge.

**Material for Sign:-**

The various materials and fabrication of traffic signs shall conform to the following requirement Concrete:- Concrete shall be of M-150 grade (mix 1:2:4).

**Reinforcing Steel:-**

Reinforcing steel shall conform to the requirements of IS:1786 unless otherwise specified.

**Alluminium:-**

Alluminium sheets used for sign boards shall be of smooth, hard and corroresistant alluminium alloy conforming to IS 736- Material designation 24345 or 1900.

**Plate Thickness:-**

Plate thickness shall be at least 2 mm thick. The thickness of the sheet be related to the size of the sign and its support and shall be such that it dose not bend or deform prevailing wind and other loads.

**Retro-reflective Sheeting:-** The retro-reflective sheeting used on the signs shall consists of the white or coloured sheeting having a smooth outer surface which has the property of reflection over its entire surface. It shall be weather resistant and exhibit colourfastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. The reflective sheeting can be either of Engineering Grade material with enclosed lens.

**Engineering grade sheeting:-** The sheeting shall be of enclosed lens type con of microscopic lens elements embedded beneath the surface of a smooth, flexible, transperant, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient retro-reflection(determined in accordance with ASTM Standard:E-810) as indicated in Table below.

**Table Showing the Acceptable Minimum Co-efficient of Retro-Reflection for Engineering Grade Sheeting(Candelas per Lux per Square Metre)**

Observation angle in degrees	Entrance angle in degree	White	Yellow	Orange	Green	Red	Blue
0.2	- 4	70	20	25	9.0	14.5	4.0
0.2	+30	30	22	7.0	3.5	6.0	1.7
0.5	- 4	30	25	13.5	4.5	7.5	2.0
0.5	+30	15	13	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall not show less than 90 percent of the values of retro-reflection indicated in above table. At the end of 5 years, the sheeting shall retain at least 50 percent of its original retro-reflectance.

**Adhesive:-** The sheeting shall either have a pressure-sensitive adhesive of the aggressive- tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's specification. Sheeting with adhesive requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

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

Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm or butted with a gap not exceeding 0.75mm. Where screen printing with transparent colour is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

**Colour for signs:-** Signs shall be provided with retro-reflective sheeting in colours as shown on the detailed drawings. The reverse side of all sign shall be painted grey.

Colours shall comply with the following I.S.I. shades given in Bureau of Indian Standard(B.I.S.):5-1978 "Colours for Ready Mixed Paints":

**Blue** - Indian Standard Colour No. 166 : French Blue

- Red** - Indian Standard Colour No. 537 : Signal Red
- Grey** - Indian Standard Colour No. 630 : French Grey
- Green** - Indian Standard Colour No. 284 : Indian Green

**Testing:-** Retro reflective sheeting of various colours shall be got tested in the recognized/Govt. laboratory as decided by the Engineer-in-charge before being used.

**Measurement:-** The measurement for payment shall be per number of sign board post fixed in position

**Item No. 10 Filling available excavated earth (excluding rock) in trenches. plinth, sides of foundations etc. in layers not exceeding 20 cm. in depth consolidating each disposed layer by ramming and watering.**

1.0. Workmanship

1.1. The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

1.2. As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, bricks bats, mortar dropping etc. and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars where rammer cannot be used.

1.3. The plinth shall be similarly filled with earth in layers not exceeding 20 Cms. Adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.4. The finished level of filling shall be kept to shape intended to be given to floor.

1.5. In case off large heavy duty flooring like factory flooring, the consolidation may be done by power rollers where so specified. The extent of consolidation required shall also be as specified.

1.6. The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

2.0. Mode of Measurements & Payment

2.1. The payment shall be made for filling I plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

2.2. The rate shall be for a unit of **one cubic** meter.

**Item No.11 Providing and casting in situ controlled cement concrete M-200 for average 75 mm thick wearing coat laid as directed including tamping, vibrating, finishing, curing and filling joints with bitumen complete**

1. For controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designed as M.100, M. 150, M.200, M.250, M.300, M.350, M.400, M.450 with the suffix 'controlled' added to it.

2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubs compressive strength of that mix on 150 m. cubes, expressed in kg/cm. where ordinary.

Portland cement conforming to IS:269 or Portland blast furnace cement conforming to IS:455 is used. the compressive strength requirements for various grades of concrete shall be as given below on the next page:

Grade of Concrete	Compressive works test strength in Kg. / cm <sup>2</sup> on 150mm, cubes, conducted in accordance with IS: 516	
	Min. at 7 days	Min.at 28 days
M 100 ...	70	100
M 150 ...	100	150
M 200 ...	135	200
M 250 ...	170	250
M 300 ...	200	300
M 350 ...	235	350
M 400 ...	270	400
M 450 ...	300	450

**NOTE:** In cases the 28 days compressive strength specified in the above. Table shall alone be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above. Table such concrete shall be classified for all purposes as a concrete belonging to the lower or the two grades between which its strength lies.

3. Concrete mix shall be designed on the basis of preliminary tests so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and bleeding them in the right proportions as required. Aggregates of different size shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible,

frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

4. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the major weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked.

5. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregate shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates IS: 2386 (Part-III) shall be referred to. Suitable adjustment shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 Kg. per cubic metre in plain concrete and not less than 300 kg./per cubic metre in reinforced concrete structural members. The minimum quantity of cement for professed concrete work shall not be less than 360 kg/m<sup>3</sup> per cubic metre of concrete nor shall it be more than 540 kg/m<sup>3</sup> per cubic metre of concrete.

6. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

Sr. No.	Item of construction	Maximum nominal size of Coarse aggregate
(i)	R.C.C. well curb, R.C.C. well steining and R.C.C. Piles	40mm
(ii)	P.C.C. well steining.	63mm
(iii)	Well cap or pile cap, solid type piers, abutments and wing-walls, their pier caps.	40mm
(iv)	R.C.C. works in cross girders, deck slab, wearing coarse, kerb, light posts, blast, walls approach slab etc. and hollow type piers, abutments wing-walls and their pier caps.	20mm
(v)	R.C.C. bearings	20mm
(vi)	For any other item of construction covered by items (i) to (v) above	As specified on the drawing or as desired by the Engineer-in-charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregate shall usually be restricted to 5mm less than the minimum lateral clear distance between the main bars of 5mm. less than the minimum cover to the reinforcement whichever is the smaller.

7. Fine aggregate shall be clean, hard, coarse sand. It shall be free dust and such other substances. The sand be approved by the Engineer-in-charge.

8. All materials shall be stored as to prevent their deterioration of their quality and fitness for the work. Any materials which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

9. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently away from each other to prevent intermixing the materials.

10. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

11. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

12. Mixer which have been out of use more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent materials takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started within 24 hours of the approval being given. It shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position

for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer-unless carried in properly design agitators, operating continuously when this time shall be within hours of the addition of cement to the mix and within minutes of its discharge from the agitator. Except where otherwise agreed to be the. Concrete shall be deposited in horizontal layers to a compacted depth of not more than .5 metre when internal vibrator are used not exceeding . metre in all other cases.

15. Unless otherwise agreed to be the Engineer-in-charge concrete shall not be dropped into place from a height exceeding metres. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13mm layers of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layers of concrete to be placed on this surface shall not exceed 150mm. in thickness and shall be well rammed against old particular attention being to corners and close sports.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used. Sufficient vibrator in serviceable condition shall be kept at site so that spare equipment is always available in the event break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be

covered with wet sacking, hessian or other similar absorbant materials approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delived into following two distict categories:

- (1) Shuttering i.e. from work required for forming the concrete.
- (2) Scaffolding i.e. form work required for supporting shuttering.

Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be substantial rigid construction and shuttering shall be true to shape and dimensions show on the drawings. All bolts and riverts shall be counter-suck and well ground to provide a smooth, plane surface.

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to with stand all pressure ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to conterate the effects of any deflection. The formwork shall be so fixed as to provide for such camber, forms shall be so constructed as to be removable in sections in the desired sequence. Without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chamber or filletlllls or sizes 25mm x 25mm shall be provided at all angles of form work to avoid sharp comers.

20. The inside surface of shuttering shall, except in the case of permanent from work or where otherwise agreed to be the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacture instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation due of false work, scaffolding or propping and the instructure or deferred deformation due to various causes affecting prestressed structures. Where they are re-entrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations, Suitable tolerance should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness, but such unspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intension to stike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of concrete and of concrete and of the materials used in the mix. Where filed operations are controlled by strength tests of concrete the removal of the load supporting of sofit forms may commence when concrete has attained strengthing props including the effect or any further additional of loads. When field re-

operations are not controlled by strength tests of concrete the vertical forms beams, columns and walls may be removed after 2 days, The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete. and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25mm. cover to the finished concrete surface. Where it is intended to be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member to a depth of at least 25mm, below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honey comb spots, broken edges or corners and other defects, shall be thoroughly cleaned saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregated mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filing and pointing to ensure thorough filling in all voids. Surface which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets / honey-combs, in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

24. In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined regular slump tests. Following slump shall be adopted for different types of works.

Type of Work		Slumps	
		Where vibrators are used	where vibrators are not used
(i)	Mass concrete in R.C.C. Foundations footings and retaining walls	10mm to 25mm	80mm
(ii)	Beams, slabs and columns simply reinforced	25mm to 40mm	100mm to 120mm
(iii)	Thin R.C.C. section or section with congested steel	40mm to 50mm	125mm to 150mm

25. For controlled concrete preliminary tests shall consist of three sets of separate tests, and in each set, tests shall be conducted on six specimens. Not more than one set of six specimens shall be made on any particular day. Of the six specimens in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. Work strength tests shall be made in accordance with IS: 516 EACH test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. the samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar work tests shall be carried out whenever the



quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cubs strength 20 per cent of the cubes cast each day amy have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept through out the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. for access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position as not disturbed. for ensuring proper cover, mortar blocks of suitable sie shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be sued for this purpose Concreting of important structural members shall always be done in the presence and under the supervision of department peson not below the rank of Astt. Engineer/Addi. Astt. Engineer/ Overseer or is instructed by the Engineer-in-charge. After removal of from work and sutteing, the executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

29. All necessary labour, materials, equipment, etc., for sampling, preparing test cubes, curing etc. shall be provided by the contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

30. The payment will be made on cmt. basis of the finished work.

31. The unit rate for concrete shall include the cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making fixing and removing of all centers and forms required for the work.

**Item No. 12**    **Cautionary warning sign;-Providing & Fixing sign boards made out of 2mm. aluminium sheet size 90x90x90cms. equilateral triangle as per design of IRC-67-1977 Pretrated with phospheting process & acid atching : coated with one coat of apoxy primer and two coats of best quality epoxy paint, reflectorised with retro reflective sheeting as per latest MOSTspecifications. 3.1mt. lomg stand post & frame fabricated from suitable size iron angle of 35x35x3 mm., 75x75x6mm. required paited with best quality epoxy coatings in black and white bends, the detail of symbols for each board shall be as per the instruction of the engineer in charge. The fixing at site shall be in C.C. 1:2:4 block of size 45x45x60 cms for each leg, incl. excavation,curing etc. comp.under the supervision of Engineer - in charge. (A) Engineer grade.**

## **(A) TRAFFIC SIGNS**

### **801.1. General**

**801.1.1.** The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with the Code of Practice for Road Signs, IRC: 67 or as shown on the drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the contract drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

**801.1.2.** The signs shall be either reflectorised or non-reflectorised as shown on the drawings or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide clause 801.3, fixed over aluminium sheeting as per these Specifications.

**801.1.3.** In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

### **801.2 Materials**

The various materials and fabrication of the traffic signs shall conform to the following requirements :

**801.2.1. Concrete:** Concrete shall be of the grade shown on the Contract drawings or otherwise as directed by the Engineer.

**801.2.2. Reinforcing steel:** Reinforcing steel shall conform to the requirement of IS: 1786 unless otherwise shown on the drawing.

**801.2.3. Bolts, nuts, washers:** High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc., shall conform to IS: 1364.

**801.2.4. Plates and supports:** Plates and support sections for the sign posts shall conform to IS: 226 and IS: 2062 or any other relevant IS Specifications.

**801.2.5. Aluminium:** Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS: 736 – Material designation 24345 or 1900.

**801.2.6.** Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

**801.2.7.** In respect of sign sizes not covered by IRC: 67, the structural details (thickness, etc.) shall be as per the approved drawings.

### 801.3. Traffic Signs Having Retro-Reflective Sheeting

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

**800.1.3.2. High intensity grade sheeting:** This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E: 810) as indicated in Table 800-1.

**TABLE 800- 1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY  
GRADE SHEETING  
(CANDELAS PER FLUX PER SQUARE METRE)**

Observation angle (in degrees)	Entrance angle (in degrees)	White	Yellow	Orange	Green/Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	20
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall now show less than 90 percent of the values of retro-reflectance indicated in Table – 800 – 1. At the end of 7 years, the sheeting shall retain at least 75 percent of its original retro-reflectance.

**801.3.3. Engineering grade sheeting:** This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard: E-810) as indicated in Table 800-2.

**TABLE 800 –2. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR ENGINEERING GRADE  
SHEETING  
(CANDELAS PER LUX PER SQUARE METRE)**

Observation angle in degree	Entrance angle in degree	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	4.0
0.2	+30	30	22	7.0	3.5	6.0	1.7
0.5	-4	30	25	13.5	4.5	7.5	2.0
0.5	+30	15	13	4.0	2.2	3.0	0.8

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

**801.3.4. Messages / borders:** The messages (legends, letters, numerals etc.) and borders shall either be screen printed or of cut-outs. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut-outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in a manner specified by the manufacturer.

**801.3.5.** For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 percent of the values of corresponding colour in Table 800-1 and 2, as applicable.

**801.3.6.** Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 801.3.2. or 801.3.3. as applicable), except those in black which shall be of non-reflective sheeting.

**801.3.7. Colour:** Unless otherwise specified, the general colour scheme shall be as stipulated in IS: 5 “Colour for Ready Mixed Paints “. viz.

Blue	IS	Colour	No.166	French Blue
Red	IS	Colour	No.537	Signal Red
Green	IS	Colour	No.284	India Green
Orange	IS	Colour	No.591	Deep Orange

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

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

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

#### **801.3.10 Fabrication:**

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

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

**801.3.11. Warranty and durability:** The contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade and submit the same to the engineer. In addition, a seven year and a five year warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity values (Table 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

#### **801.4. Installation**

**801.4.1.** Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement of vandalism. Normally, signs with an area up to 0.9 sq. m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G. I). Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

**801.4.2.** All components of signs and supports, other than the reflective portion and G. I. posts shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any part of mild steel (M. S.) post below ground shall be painted with three coats of red lead paint.

**801.4.3.** The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G. I. posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

#### **801.5. Measurements for Payment**

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square metres.

#### **801.6. Rate**

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

#### **801.7 The payment shall be made on No. basis**

## **802. OVERHEAD SIGNS**

### **802.1. General**

**802.1.1.** Overhead signs may be used in lieu of, or as an adjunct to, ground signs where the situation so warrants for proper information and guidance of the road user. The following conditions may be considered while deciding about the provision of overhead signs:

- (1) Traffic volume at or near capacity
- (2) Complex interchange design
- (3) Three or more lanes in each direction
- (4) Restricted sight distance
- (5) Closely spaced interchanges
- (6) Multi-lane exits
- (7) Large percentage of commercial vehicles
- (8) High speed traffic
- (9) Consistency of sign message location through a series of interchanges
- (10) Insufficient space for ground mounted signs
- (11) Background of street lighting
- (12) Distances of important places enroute highways at suitable intervals

**802.1.2.** From safety and aesthetic standpoints, overhead signs shall be mounted on overhead bridge structures wherever possible. Where these are required to be provided at some other locations, the support system should be properly designed based on sound engineering principles, to safely sustain the dead load, live load and wind load on the completed sign system. For this purpose, the overhead signs shall be designed to withstand a wind loading of 150 kg/m<sup>2</sup> normal to the face of the sign and 30 kg/m<sup>2</sup> transverse to the face of the sign. In addition to the dead load of the structure, walkway loading of 250 kg concentrated live load shall also be considered for the design of the overhead sign structure.

### **802.2. Height**

Overhead signs shall provide a vertical clearance of not less than 5.5 m over the entire width of the pavement and shoulders except where a lesser vertical clearance to overhead sign structure or supports need not be greater than 300 mm in excess of the minimum design clearance of other structures.

### **802.2. Lateral Clearance**

**802.3.1.** The minimum clearance outside the usable roadway shoulder for expressway signs mounted at the road side or for overhead sign supports either to the right or left of the roadway shall be 1.80 m. This minimum clearance of 1.80 m shall also apply outside of an unmountable kerb. Where practicable, a sign should not be less than 3 m from the edge of the nearest traffic lane. Large guide signs should be farther removed preferably 9 m or more from the nearest traffic lane, unless otherwise specified. Lesser clearances, but not generally less than 1.80m, may be used on connecting roadways or ramps at inter-changes.

**802.3.2.** Where a median is 3.6 m or less in width, consideration should be given to spanning over both roadways without a central support. Where overhead sign supports cannot be placed at a safe distance away from the line of traffic or in an otherwise protected site, they should either be so designed as to minimise the impact forces or protect motorists adequately by a physical barrier or guardrail of suitable design.

#### **802.4. Number of Signs at an Overhead Installation**

In no case should there be more than three signs displayed at any one location, including regulatory or warning signs, either on the overhead structure or on its support.

#### **802.5. Materials for Overhead Sign and Support Structures**

**802.5.1.** Aluminium alloy or galvanized steel to be used as truss design supports shall conform to relevant IS. These shall be of sections and type as per structural design requirements as shown on the plans.

**802.5.2.** After steel trusses have been fabricated and all required holes punched or drilled on both the horizontal truss units and the vertical and support units, they shall be galvanized in accordance with IS specifications.

**802.5.3** Where aluminium sheets are used for road signs, they shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS – 736 – Material Designation 24345 or 1900. The thickness of sheet shall be related to the size of the sign with minimum thickness of sheet as 1.5 mm.

**802.5.4.** High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc. shall conform to IS: 1364

**802.5.5.** Plates and support sections for sign posts shall conform to IS: 226 and IS: 2062

**802.5.6** The overhead signs shall be reflectorised with high intensity retro-reflective sheeting preferably of encapsulated lens type.

#### **802.6. Size, Locations, etc of Signs**

**802.6.1.** The size of the signs, letters and their placement shall be as specified in the Contract drawings and Specifications.

**802.6.2.** In the absence of details or for any missing details in the contract documents, the signs shall be provided as directed by the Engineer.

#### **802.7. Installation**

**802.7.1.** The supporting structure and signs shall be fabricated and erected as per details given in the plans.

**802.7.2.** Sign posts, their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

**802.7.3.** The work of construction of foundation for sign supports including excavation and back fill, forms steel reinforcement, concrete and its placement shall conform to the relevant Specifications given in these Specifications.

**802.7.4.** The structures shall be erected with the specified camber and in such a manner as to prevent excessive stresses, injury and defacement.

**802.7.5.** Brackets shall be provided for mounting signs of the type to be supported by the structure. For better visibility, they shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degree from vertical. This angle shall be obtained by rotating the front lower edge of the sign forward. All brackets shall be of a length equal to the heights of the signs being supported.

**802.7.6.** Before erecting support structures, the bottom of each base plate shall be protected with an approved material which will adequately prevent any harmful reaction between the plate and the concrete.

**802.7.7.** The end supports shall be plumbed by the use of levelling nuts and the space between the foundation and base plate shall be completely filled with an anti-shrunk grout.

**802.7.8** Anchor bolts for sign supports shall be set to proper locations and elevation with templates and carefully checked after construction of the sign foundation and before the concrete has set.

**802.7.9.** All nuts on aluminium trusses, except those used on the flanges, shall be tightened only until they are snug. This includes the nuts on the anchor bolts. A thread lubricant shall be used with each aluminium nut.

**802.7.10.** All nuts on galvanized steel trusses, with the exception of high strength bolt connections, shall be tightened only to a snug condition.

**802.7.11.** Field welding shall not be permitted.

**802.7.12.** After installation of signs is complete, the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the contractor to eliminate or minimize this condition.

**802.8. Measurements for Payment**

**802.8.1.** Aluminium or steel overhead sign structure will be measured for payment by the specific unit (each) complete in place or for each component of the overhead sign structure as indicated in the bill of quantities and the detailed drawing (s).

**802.8.2.** Flat sheet aluminium signs with retro-reflective sheeting thereon shall be measured for payment by the square metre for each thickness, complete in place.

**802.9. Rate**

**802.9.1.** The structural steel part of the overhead sign shall be measured in tonnes while the sign board shall be measured in sq. m. Other items like excavation for foundation and concrete in foundation to be measured and paid in cu. m. separately. The contract unit rate for overhead sign structure shall be payment in full compensation for furnishing all labour, materials, tools, equipment, excavation, fabrication and installation and all other incidental costs necessary to complete the work to the Specifications.

**802.9.2.** The contract unit rate for aluminium sheet signs shall include the cost of making the sign including all materials and fixing the same in position and all other incidental costs necessary to complete the work to the Specifications.

**\*\*\*\*\*THE END\*\*\*\*\***

**Deputy Executive Engineer  
Panchayat R.& B. Sub Division  
Botad**