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Padmashree Dr. Vithalrao Vikhe Patil Foundation's  
PADMASHRI DR. VITHALRAO VIKHE PATIL COLLEGE OF ENGINEERING,  
AHMEDNAGAR.

Ref.No. : CEA/CED/TESTING/16-17/02

Date :- 17/06/2016

**CONCRETE MIX DESIGN FOR M20 CONCRETE**

(Ref. – IS – 10262 – 2009 Method)

Name of Party & Address:- M/S Sr. Section Engineer (Const.),  
Central Railway, Ahmednagar.

Name of the work: Earthwork embankment and cutting from Ch. 160000 to 167500 in Raimoha-  
Beed section of Ahmednagar-Beed-Parli Vajinath new BG line project.

Subject :- Design Mix for M-20 (50% natural sand + 50% crushed sand)  
Ref. Letter No.: Central Railway

Date :-22/03/2016.

Testing Charges Rs. – 10,000/-

Paid Vide Receipt No. : - 3220

Date: - 06/04/2016.

**CONCRETE MIX DESIGN M20**

**A] DESIGN STIPULATIONS:**

**a) Characteristic compressive strength**

Required in the field at 28 days = 20 N/mm<sup>2</sup>

**b) Maximum size of aggregate** = 20 mm

**c) Workability of concrete** = Moderate

**d) Compaction factor** = 0.88

**e) Slump value** = 100 mm

**f) Degree of Quality control** = Good

**g) Type of Exposure** = Mild.

**B] TEST DATA FOR MATERIALS:-**

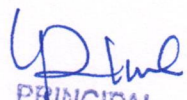
**1] a) Type of cement** = Birla Shakti = OPC – 43 Grade

**b) i) 7 days compressive strength of cement** = 36.53 N/mm<sup>2</sup>

**ii) 28 days compressive strength of cement** = 43.00 N/mm<sup>2</sup>

**c) Specific gravity of cement** = 3.15

**d) Fineness of cement**

  
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- (by dry sieve analysis) as per IS 269-1969 = 1 %  
 e) Initial setting time = 73 min  
 f) Final setting time = 138 min  
 g) Soundness of cement = 1.0 mm

## 2] Aggregate and Sand –

| Test property        | Coarse Aggregate |         | Fine Aggregate |              |
|----------------------|------------------|---------|----------------|--------------|
|                      | 20 mm            | 12.5 mm | Natural Sand   | Crushed Sand |
| Specific gravity     | 2.96             | 2.96    | 2.66           | 2.66         |
| Water absorption (%) | 0.05             | 0.10    | 1.22           | 0.18         |
| Moisture content (%) | 0.81             | 0.73    | 1.73           | 0.53         |

## 3] Sieve analysis:-

a) Coarse Aggregate:- Sample = 5000 gms

| IS Sieve Size | % Passing |         |
|---------------|-----------|---------|
|               | 20 mm     | 12.5 mm |
| 80 mm         | 100       | 100     |
| 40 mm         | 100       | 100     |
| 20 mm         | 54.04     | 100     |
| 10 mm         | 0.24      | 83.22   |
| 4.75 mm       | 0.06      | 24.22   |
| 2.36 mm       | 0.06      | 14.24   |
| Pan weight    | 1 gm      | 14 gms  |

b) Fine Aggregate - Sample= 2000 gms

| IS Sieve size                        | Percentage Passing |              |
|--------------------------------------|--------------------|--------------|
|                                      | Natural Sand       | Crushed Sand |
| 10 mm                                | 100                | 100          |
| 4.75 mm                              | 86.70              | 77.23        |
| 2.36 mm                              | 73.38              | 55.53        |
| 1.18 mm                              | 65.90              | 36.40        |
| 0.600 mm                             | 14.63              | 20.90        |
| 0.300 mm                             | 3.15               | 13.95        |
| 0.150 mm                             | 0.78               | 9.15         |
| Retained weight on following sieves: |                    |              |
| 0.75 mm (weight)                     | 6.0 gms            | 73 gms       |
| Pan Weight                           | 7.5 gms            | 100 gms      |
| Fineness Modulus                     | 3.55               | 3.87         |

Confirming to  
Grading Zone – I  
Of Table 4 of I.S :  
383 : 1970

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#### 4] TARGET MEAN STRENGTH:-

$$= 20 + 4.0 \times 1.65 = 26.6 \text{ N/mm}^2.$$

$$\text{Water cement ratio} = 0.55$$

- 1) Water content = 197 Kg / m<sup>3</sup>
- 2) Sand content = 40 %
- 3) Entrapped air in concrete = 2 %

#### 5] Requirement per Cu. M. of concrete :-

- 1) Water content = 197 kg
- 2) Sand content = 40 %
- 3) Cement content = 300 kg/m<sup>3</sup>

By IS 456: 2000 Table No. 05 = 300 Kg/m<sup>3</sup> ]

- 4) Entrapped air = 2 %

#### 6] ACTUAL QUANTITIES REQUIRED FOR CU.M. OF CONCRETE IN KG .

Water : Cement : Fine Aggregate : Coarse Aggregate : W/C

197 : 394.00 : 802.75 : 1204.13 : 0.535

(20mm - 722.48 + 12.5 mm - 481.65)

1 : 2.03 : 3.06

Mix proportion by mass

Note :- After adjustment for absorption & surface moisture .

| Sr.<br>No. | Quantity of material per m3 of concrete |                 |                                  |                        |                        |                  |                 | Concrete Characteristics                      |                               |         | Concrete<br>W/c<br>ratio |
|------------|-----------------------------------------|-----------------|----------------------------------|------------------------|------------------------|------------------|-----------------|-----------------------------------------------|-------------------------------|---------|--------------------------|
|            | Cement<br>in kg                         | Water<br>in lit | Correct<br>ed<br>Water<br>in lit | Fine Aggregate         |                        | Coarse Aggregate |                 | Worka<br>bility<br>(comp<br>acting<br>factor) | Compressive<br>strength N/mm2 |         |                          |
|            |                                         |                 |                                  | Natural<br>sand<br>50% | Crushed<br>sand<br>50% | 20mm<br>(60%)    | 12.5mm<br>(40%) |                                               | 7 days                        | 28 days |                          |
| 1          | 394                                     | 197             | 210.79                           | 401.38                 | 401.37                 | 722.48           | 481.65          | 0.89                                          | 18.90                         | 27.25   | 0.535                    |
| 2          | 350                                     | 157.5           | 185.50                           | 427.78                 | 427.78                 | 727.02           | 484.67          | 0.88                                          | 17.96                         | 26.12   | 0.535                    |
| 3          | 358.18                                  | 197             | 197.00                           | 403.79                 | 403.78                 | 686.24           | 457.49          | 0.90                                          | 14.52                         | 25.92   | 0.535                    |

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7] Actual quantities required per batch of cement in kg after adjustment for water absorption and surface moisture.

Adopt trial mix No 1:

Mix proportion: Cement: F.Agg. Coarse aggregate: W/C ratio = [1 : 2.03 : 3.06 : 0.535]  
Ingredients required per bag (50kg) of cement are

|                          |           |
|--------------------------|-----------|
| Cement                   | = 50 kg   |
| i. Natural Sand          | = 50.97kg |
| ii. Crushed sand         | = 50.97kg |
| Coarse aggregate:        |           |
| i. Fraction I(20mm)      | =91.75 kg |
| ii. Fraction II (12.5mm) | =61.17 kg |

|                               |             |
|-------------------------------|-------------|
| Corrected Water               | =26.77litre |
| Corrected Water /Cement ratio | =0.535      |

Tested By

S. N. Daule  
Assistant Professor

H.O.D.  
Department of Civil Engineering

Principal  
PDVVPCOE Ahmednagar

$$= \frac{30}{(1 + 2.03 + 3.06 + 0.535)}$$
$$\text{cement} = \frac{30}{6.625} = 4.53 \text{ kg.}$$

$$\text{cement} = 4.53 \text{ kg}$$

$$\text{Sand (f.A)} = 4.53 \times 2.03 = 9.20 \text{ kg} \quad \text{Sand (4.6) \& Crushed (4.6)}$$

$$\text{C.A} = 4.53 \times 3.06 = 13.86$$

$$\text{water} = 4.53 \times 0.535 = 2.43 \text{ kg.}$$

$$\text{Ad} = 0.002 \times 4.53 = 10 \text{ ml}$$

  
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