

DETERMINATION OF WATER CONTENT:

It is given by the formula:

$$\text{Water content} = \frac{2}{3} W_f + \frac{1}{3} W_c$$

Maximum size of aggregate is 20 mm

$$\text{Water content} = \frac{2}{3} * 180 + \frac{1}{3} * 210 = 190 \text{ kg/m}^3$$

(table 38, SP 23)

Slump (mm)		0-10	10-30	30-60	60-180
Vee-bee (s)		>12	6-12	3-6	0-3
Maximum size of aggregate (mm)	Type of aggregate				
(1)	(2)	(3)	(4)	(5)	(6)
10	Uncrushed	150	180	205	225
	Crushed	180	205	230	250
20	Uncrushed	135	160	180	195
	Crushed	170	190	210	225
40	Uncrushed	115	140	160	175
	Crushed	155	175	190	205

Determination of water cement ratio and cement content:

1. Water cement ratio according to the target strength:

From the chart the water cement ratio is 0.52

2. Water cement ratio according to durability i.e. environmental condition (Moderate)

From the table water cement ratio is 0.5.

So, the final water cement ratio is to be considered minimum out of both the criteria i.e. 0.5

For cement content:

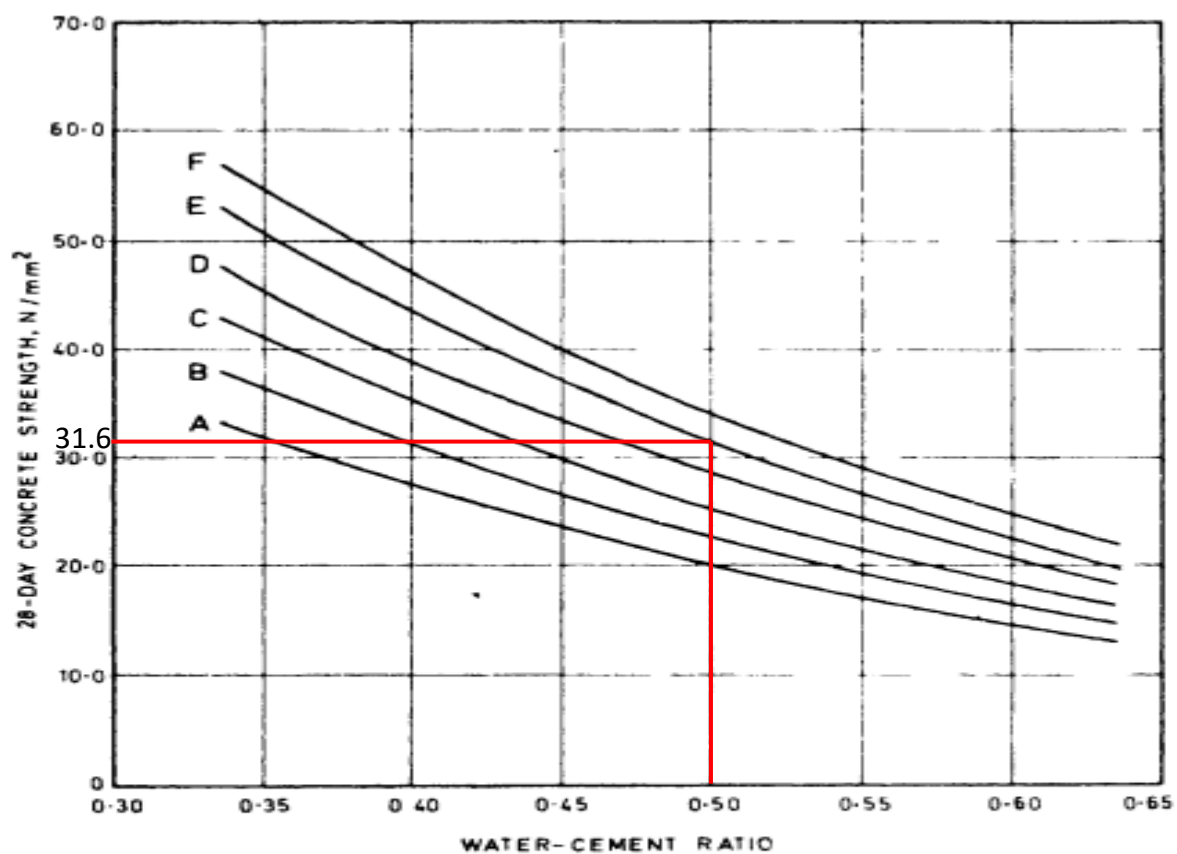
Water cement ratio is 0.5

$$\text{Therefore } \frac{\text{Water}}{\text{Cement}} = 0.5$$

Water content is 190 kg/m³

Therefore, cement content comes out to be 380 kg/m³

Collective content of water and cement = 190 + 380 = 570 kg/m³



28-Day Strength of Cement, Tested According to IS : 4031-1968

A	— 31.9-36.8	N/mm ²	(325-375 kg/cm ²)
B	— 36.8-41.7	N/mm ²	(375-425 kg/cm ²)
C	— 41.7-46.6	N/mm ²	(425-475 kg/cm ²)
D	— 46.6-51.5	N/mm ²	(475-525 kg/cm ²)
E	— 51.5-56.4	N/mm ²	(525-575 kg/cm ²)
F	— 56.4-61.3	N/mm ²	(575-625 kg/cm ²)

(table 5, IS 456:2000)

Exposure	Reinforced concrete		
	Minimum cement content kg/m ³	Maximum free water cement ratio	Maximum grade of concrete
Mild	300	0.55	M 20
Moderate	300	0.50	M 25
Severe	320	0.45	M 30
Very severe	340	0.45	M 35
Extreme	360	0.40	M 40

Determination of sand content:

Zone of the sand is 3

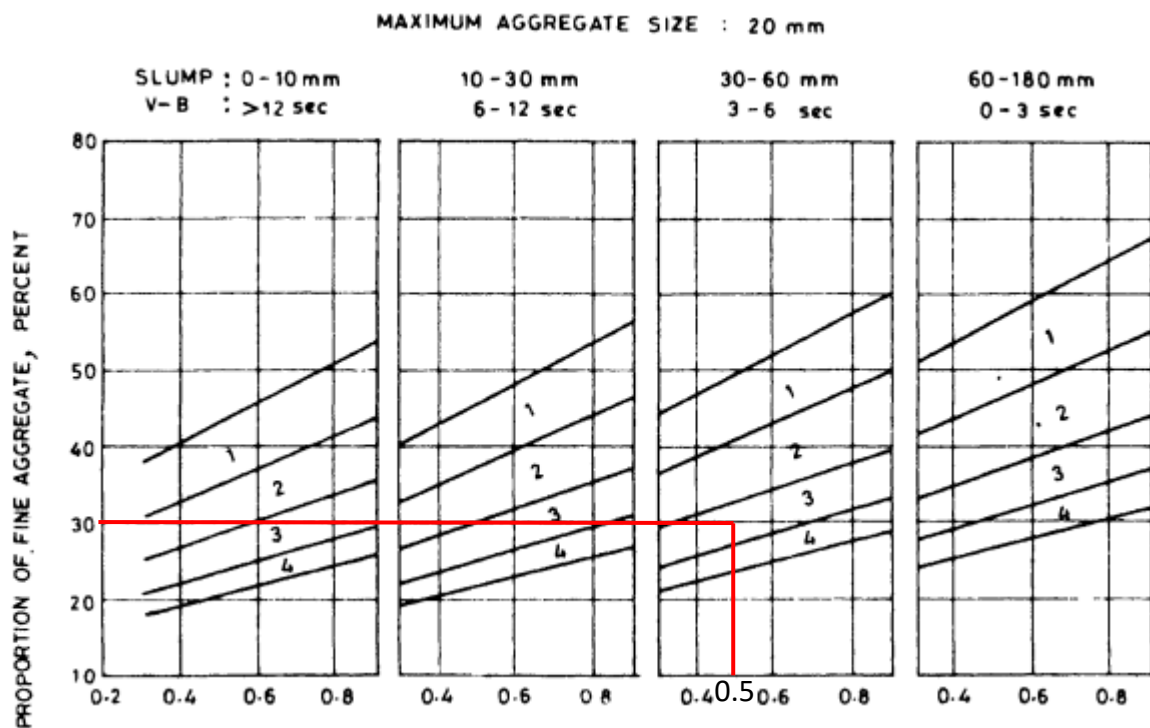
According to chart percentage of sand content is 30 %

Therefore, the content of coarse aggregate will be 70 %

Assuming $\frac{2}{3}$ of kapchi (20 mm) and $\frac{1}{3}$ of 10 grit (10 mm) of total coarse aggregates.

Content of grit = $\frac{1}{3} * 70 = 23.33 \%$

Content of kapchi = $\frac{2}{3} * 70 = 46.67 \%$



Determination of mean specific gravity:

Mean specific gravity = $(30 * 2.68) + (23.33 * 2.85) + (48.62 * 2.88) = 2.87$

Determination of wet density of concrete:

Using figure 44 of SP 23 wet density of concrete comes out to be 2540 kg/m^3 for 190 kg/m^3 water content.

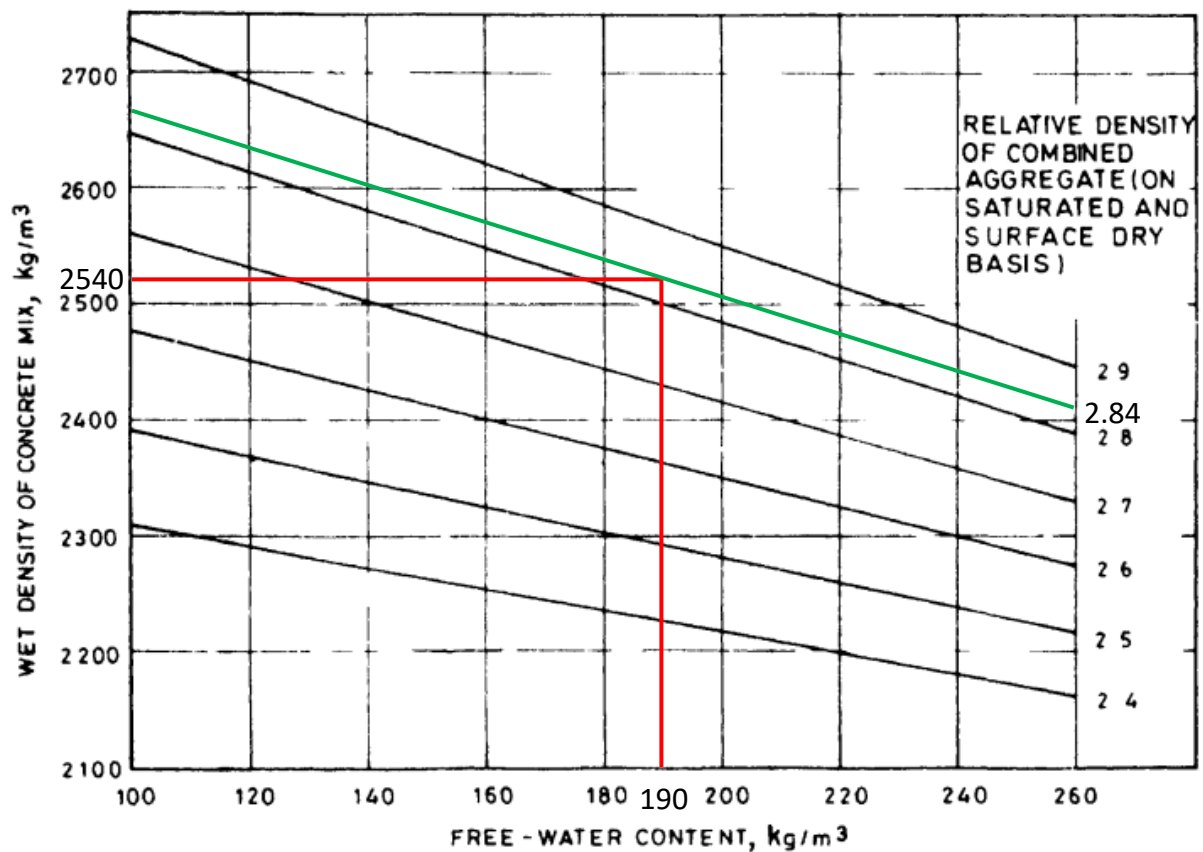


Fig. 44 Estimated Wet Density of Fully Compacted Concrete

Therefore, remaining content of aggregates = 2540 – 570 = 1970 kg/m³

Content of kapchi = $\frac{46.67}{100} * 1970 = 919.40 \text{ kg/m}^3$

Content of grit = $\frac{23.37}{100} * 1970 = 459.60 \text{ kg/m}^3$

Content of sand = $\frac{30}{100} * 1970 = 591 \text{ kg/m}^3$

Water absorption:

Material	% absorption	Wet density (kg/m ³)	Water absorption (kg/m ³)
sand	1.5	591	8.87
kapchi	1.0	919.40	9.19
grit	0.80	459.60	3.68

Water absorption = $\frac{\text{wet density} * \% \text{ absorption}}{100}$

Total water absorption = 21.74 %

Material quantity:

Material	Quantity (kg)	Density (kg/m ³)	Volume (m ³)
Cement	380	3150	0.121
Sand	591	2680	0.221

water	190	1000	0.190
grit	459.60	2750	0.156
Kapchi	919.40	2890	0.318

Total volume= (0.12+0.15+0.19+0.16+0.32) +entrapped air volume = (0.02 l)
= 1.006 + 0.02 = 1.008

Mix design ratio:

Water: cement: fine aggregates: coarse aggregates

0.5: 1: 1.55: 3.63