U218-III (ESE) END-SEMESTER EXAM ... S4 B.Tech - 4 Sem

Department of Civil Engg.

Course - Concrete Technology – Course Code → CVUA21175

SOLUTION – SET-I

Q5 (a) – 6 marks.

SOLUTION →

A Mix Design

(1) Target Mean strength -

$f_t = f_{ck} + 1.65S$ [S - standard Deviation from Table No.1 suggested values of standard deviation.]

$f_{ck} = 15$ MPa (Given)

$S = 3.5$

$f_t = 15 + (1.65)(3.5) = 20.775$ MPa – say 21 MPa [1 Marks]

(2) Water - Cement Ratio -

From Compressive strength Consideration [from fig. No.1] = 0.59

From Durability Consideration - [Table No 4] (Table No)

Maximum free water - Cement Ratio - 0.65

Hence Water - Cement Ratio Adopted - 0.59 [1 marks].

(3) Water and Cement Contents -

Water Content [From Table No. 2] → 186 kg/m^3

Proportion of sand of total Aggregate by Absolute Volume, percent → 35%. [1 Mark]

(4) Adjustment for change in condition from the reference value specified in Table No. 3 [1 Mark].

	water	Sand
i) For decrease in water-cement Ratio of 0.01	0.0	- 0.2
ii) For increase in compacting factor by 0.10	+3.0	0.0
iii) For sand conforming to Zone III	0.0	-1.5
	+3.0	-1.7

Sand Proportion = 35 − 1·7 = 33·3 %

Air Content = 2 %. [From Table No. 5

Cement Content = $\frac{191.6}{0.59}$ = 324·75 Kg/m³.

− 2 marks.

Q5 − (b) − 4 marks.

− Solution →

Coarse and fine Aggregates

Total Absolute Volume of Aggregates

$$= 1 - \left[0.02 + \frac{324.75}{3.15 \times 1000} + \frac{191.6}{1000}\right] = 0.6853\ m^3$$

Absolute volume of fine Aggregate = 0·228 m³

Absolute Volume of Coarse Aggregate = 0·457 m³.

Mix Proportions −

i] By Mass

Water	Cement	Fine Aggregate (dry)	Coarse Aggregate (dry)
191·6	: 324·75	: 0·228 × 2600	: 0·457 × 2750 (kg)
0·59	: 1·00	: 1·83	: 3·87

ii] By Volume of Dry Aggregate

Water	Cement	Fine Aggregate	Coarse Aggregate
−	: $\frac{324.75}{1450}$	: $\frac{592.8}{1700}$	: $\frac{1256.75}{1800}$ (m³)
0·59	: 1·00	: 1·56	: 3·12

3 marks.

Quantities of Ingredients (by Mass).

Free water in Coarse Aggregate = 1256.75 x (0.01) = 12.57 kg

Free water in Fine Aggregate = 592.8 x (0.02) = 11.86 kg

Total water present in the Aggregate = 24.43 kg

Mass of wet Coarse Aggregate in mix = 1256.75 + 12.57 = 1269.32 kg

Mass of wet Coarse Aggregate in mix = 592.8 + 11.86 = 604.66 kg

Mixing water Required = 191.6 - 24.43 = 167.17 kg.

Actual Mix Proportions by Mass.

water		cement		Fine Aggregate		Coarse Aggregate
167.17	:	324.75	:	604.66	:	1269.32
0.51	:	1.00	:	1.86	:	3.91

1 mark.

PROBLEM Q.6- a

Exercise

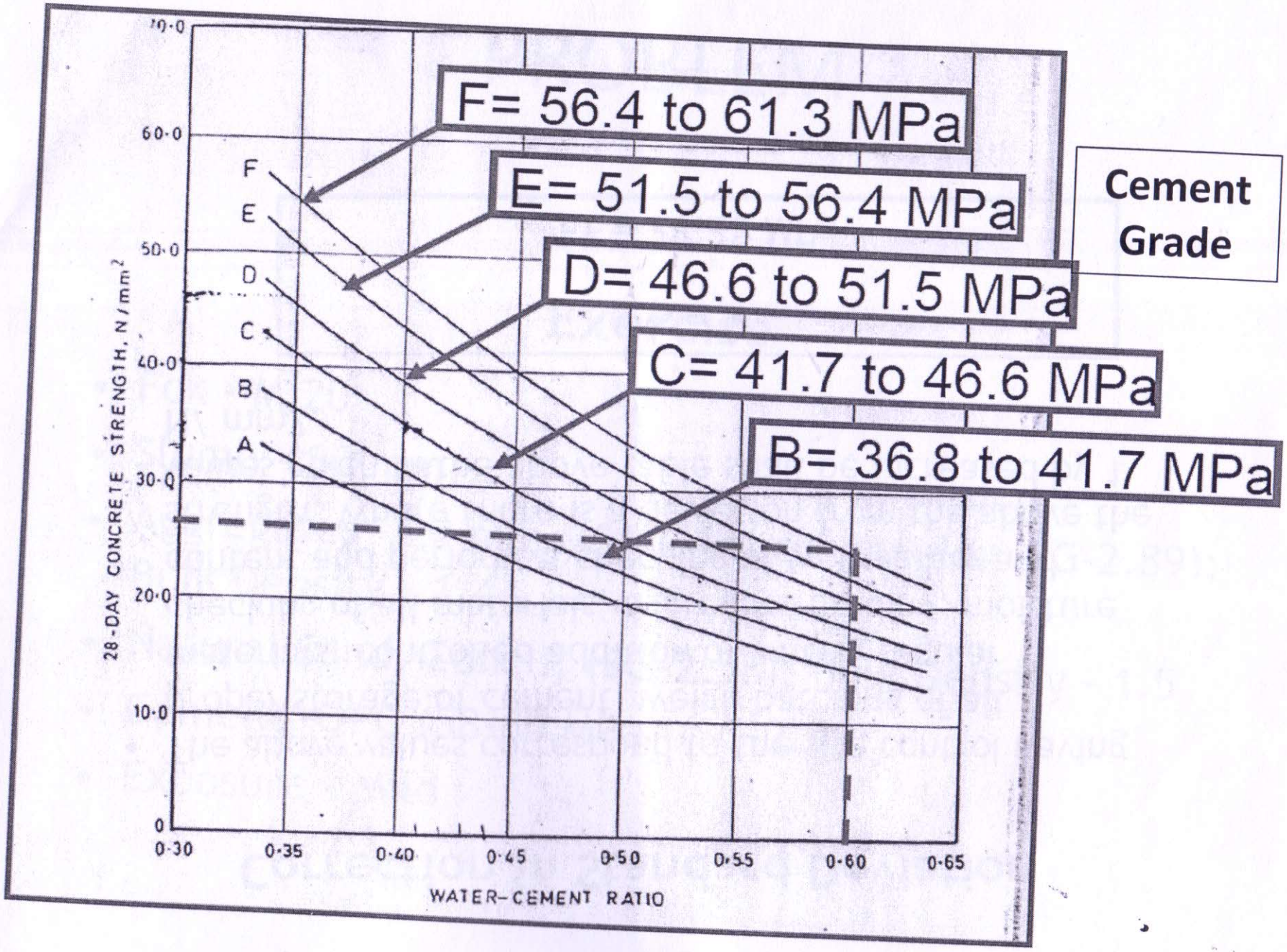
- Fck - M:20
- Slump - 80 mm
- Aggregates - 20 mm MSA Crushed Angular (SG-2.89); Bulk Density - 1.44
- Natural Sand, Zone I; (SG-2.58); Bulk Density - 1.5
- Cement -OPC (58-60 MPa) (SG-2.95)
- Exposure - Mild

Correction in Standard Deviation

- The above values correspond to the site control having proper storage of cement, weigh batching of all materials, controlled addition of water, regular checking of all materials, aggregate grading, moisture content and periodical checking of workability and strength. Where there is a deviation from the above the values given in the above table shall be increased by 1 N/ mm2.

S = 5

Ft = 28.25 MPa


F= 56.4 to 61.3 MPa
E= 51.5 to 56.4 MPa
D= 46.6 to 51.5 MPa
C= 41.7 to 46.6 MPa
B= 36.8 to 41.7 MPa
Cement Grade
28-DAY CONCRETE STRENGTH, N/mm²
70·0
60·0
50·0
40·0
30·0
20·0
10·0
0
F
E
D
C
B
A
0·30
0·35
0·40
0·45
0·50
0·55
0·60
0·65
WATER-CEMENT RATIO

Durability Criteria as per IS 456- 2000

Exposure	Plain Concrete			Reinforced Concrete		
	Min. Cement	Max w/ c	Min grade	Min. Cement	Max w/c	Min grade
Mild	220 kg/m³	0.60	--	300 kg/m³	0.55	M 20
Moderate	240 kg/m³	0.60	M 15	300 kg/m³	0.50	M 25
Severe	250 kg/m³	0.50	M 20	320 kg/m³	0.45	M 30
V. Severe	260 kg/m³	0.45	M 20	340 kg/m³	0.45	M 35
Extreme	280 kg/m³	0.40	M 25	360 kg/m³	0.40	M 40

Step 2

W/C (chart) - 0.60
W/C (Table) - 0.55

W/C - 0.55

Step 3

Estimate the air content for maximum size of aggregate used

Approximate Entrapped Air Content

Max. size of Aggregate (mm)	Entrapped air as % of concrete
10	3.0
20	2.0
40	1.0

Step 4

Applicable for concrete up to **M 35 grade, W/C=0.60, Workability = 0.80 C.F.** (approx. 30 mm slump), **Crushed angular aggregates** and **Zone II graded sand.**

For 25 to 50 mm Slump Range

Max aggregate size	Water content per cum of concrete (kg)	Sand as % of total aggregate by absolute volume
10	208	40
20	186	35
40	165	30

Step 4

W - 186 lit

Sand - 35 %

- For other conditions of workability, W/C ratio, grading of FA, adjustments in water content and percentage of sand in total aggregate is done.

Step 5

Change in condition	Correction in Water content (%)	Correction in sand %
For Sand of Zone I, III & IV	0	+ 1.50 for Zone I -1.50 for Zone III - 3.0 for Zone IV
Inc or Dec in CF by 0.1 (25 mm slump)	±3	0
Inc or dec in W/C by 0.05	0	±1

Step 5

Change in condition	Correction in Water content (%)	Correction in sand %
Zone I	0	+ 1.5
CF - 0.9	+3	0
W/C - 0.55	0	-1
	+3 %	**+0.5 %**

Step 5

- W = 186 + 186 x 3%
  = 191.6 lit

- S = 35 + 0.5
  = 35.5 %

Step 6

W / C = 0.55

Cement = 348 Kg/m^3

Step 7

Calculate the CA and FA contents per unit volume of concrete as per the following formula.

$$V = (W+(C/Sc)+ (1/p) \times (FA/SFA)) \times 0.001$$

$$V = (W+(C/Sc)+ (1/1-p) \times (CA/SCA)) \times 0.001$$

where,

V= absolute volume of fresh concrete [gross volume (1cum) minus the volume of entrapped air],

Sc, SFA, SCA= specific gravity of cement, FA and CA resp.

W= mass of water per cum of concrete

C= mass of cement per cum of concrete

p= ratio of FA to total aggregate by absolute volume.

FA, CA= total mass of FA & CA per cum of concrete.

Final Mix Design

Cement	348
Water	191.6
Fine Aggregate	614
Coarse Aggregate	1249
YIELD	2402.6

Corrections

- Assuming Fine Aggregate containing 2% of water
  - Moisture content by mass = 614 x 0.02 = 12.28 Kg.
- Assuming absorption of Coarse Aggregate 0.5%
  - Moisture absorption = 1249 x .005 = 6.245 Kg.

- **Final Proportions:-**
  - Cement = 348 Kg / m^3
  - Water = 191.60 - 12.28 + 6.245 = 185.565 Kg / m^3
  - Fine Aggregate = 614 + 12.28 = 626.28 Kg / m^3
  - Coarse Aggregate = 1249 - 6.245 = 1242.76 Kg / m^3

Final Mix Design after correction

Cement	348	50
Water	185.6	26.67
Fine Aggregate	626	90
Coarse Aggregate	1243	179
YIELD	2402.6	Per bag