October - 2018

Concrete Technology

PART-A.

1. To regulate the Setting time of Cement.
2. The increase in the volume of a given mass of fine aggregate caused by the presence of water is known as bulking of Sand.
3. Curing is the process of keeping wet environment on and around the surface of hardened Concrete to prevent the loss of water from the Concrete intended for hydration Curing thus helps water present in the Concrete mass, to chemically react as long as all the cement is hydrated.
4. The art of obtaining a Concrete of the required properties, at the lowest cost, by a suitable choice and proportions of available materials.
5. The Continued deformation with time under applied load is Creep. ie increase of strain in concrete with time under Sustained Stress.

7. State the affects of [illegible]

(5×6 = 30)

[P.T.O.

PART-B.

1. 1. Lime CaO - 60-67%
   2. Silica SiO_2 - 18-25%
   3. Alumina Al_2O_3 - 5 to 9%
   4. Iron oxide Fe_2O_3 - 0.5 to 6
   5. Gypsum - 1 to 3
   6. Magnesium oxide - 0.1 to 4.
   7. Sulphur trioxide SO_3 - 1 to 3.
   8. Soda - 0.5 to 1.3.

2. -> To accelerate the initial set of Concrete.
   -> To retard the initial set.
   -> To enhance the workability
   -> To improve the Penetration and pump ability of Concrete.
   -> To reduce the segregation in grout and Concrete mixtures
   -> To reduce heat of hydration.

3. Water Content in a given volume of Concrete, will have significant influences on the workability. The higher the water content per cubic meter of Concrete, the higher will be the Fluidity of Concrete, which is one of the important factors affecting workability

Greater workability reduces the strength of Concrete Because with increasing w/c ratio the strength decrease as more water will result in higher Concrete porosity. So the lower w/c the lower is the Void volume / Solid volume, and Stronger the hardened Cement paste.

4. 1) Strength
   - Compressive Strength
   - Tensile strength.
   - Shear strength.
   2) Creep.
   3) Durability
   4) Shrinkage.
   5) Permeability :- To.
   6) Stress - Strain characteristics.

5. Nominal ~~Normal~~ Mix.

The wide use of Concrete as Construction material has lead to the use of mixes of fixed Proportions which ensure adequate strength. These mixes are called nominal Mix.

-> They offer simplicity and under normal circumstances, have a margin of strength above that Specified.

-> & Expressed in terms of aggregate / cement ration by volume.

-> used for grades M5, M7.5, M10, M15 and M20

-> Nominal mixes called standard mixes

Design Mix.

The proportion of ingredients of Concrete to obtain a desired mix can be found out by laboratory method of mix design.

-> They should produce the grades of Concrete having the required workability and a characteristic strength not less than the appropriate values.

-> The design mix or controlled mix is being used more and more in variety of important structures,

-> It have better strength, reduced variability, leanier mixes with consequent economy.

7. Contraction of Concrete in the absence of load is known as shrinkage. It may be plastic shrinkage :- shrinkage of Concrete is due to absorption of water by aggregates, evaporation of water and bleeding or drying shrinkage :- The shrinkage taking place after the Concrete has set and hardened.

Concrete shrinkage can become problematic when doing any type of construction, but especially when dealing with floors. water evaporation will cause the Concrete to weaken. This can lead to cracks, interna warping & external deflection.

PART-C.

III a) Mineral admixtures are

→ clay and shales
→ opaline cherts
→ Diatomaceous Earth.
→ Volcanic Tuffs and pamicites.
→ Fly ash.
→ Blast furnace slag
→ Silica fume
→ Surkhi.....

The Calcium hydroxide otherwise, a water Soluble material is converted into insoluble cementitious material by the reaction of mineral admixtures.

Fly ash:- The use of fly ash as Concrete admixture not only extends technical advantages to the properties of Concrete but also Contributes to the environmental pollution Control.

b) Lime – • Controls Strength & Soundness.
• Its deficiency reduces the Strength & Setting time.
• Excess quantity makes the Cement unsound

Silica – • Gives Strength.
• Excess Causing slow Setting time.

Alumina – • Responsible for quick Setting
• Excess quantity lowers the Strength.

Iron oxide – Gives Colour
helps in fusion of different ingredients

Gypsum – regulate the Setting time.

IV a) Water Cement ration.

• The Strength of Cement paste depends upon the dilution of paste or in other words, the strength of Paste increase with cement content and decreases with air and water content.

• Gel / Space ratio – which govens the porosity of Concrete ~~affecting~~ affecting its strength, is affected by water / cement ratio. Higher water / cement ratio decreases the gel / Space ratio

• Size of aggregate.

• Shape of aggregate.

b) (i) Reactive type of aggregate.

(ii) Alkali content. – High alkali content in cement Promot alkali- aggregate reaction.

(iii) Availability of moisture.

(iv) optimum temprature Conditions – It also promot alkali aggregate reaction. The ideal temperature for the Promotion is in the range of 10 to 38°C.

(v) Void Space in Concrete.

(vi) Admixtures &.

a) Aggregate / Cement ration.

-> For a Constant w/c ratio a leaner mix leads to a higher Strength.

-> A higher aggregate Content would lead to lower shrinkage and lower bleeding and therefore to less damage to the bond blw thee aggregate and the cement paste.

-> Cement Content

-> Higher the Cement Content higher the Strength of Concrete.

b) Durability.

Defined as the time for which the Structure can fulfill the function for which it was designed and Constructed.

- Compaction. – well Compacted Concrete have high durability
- workmanship.
- The Type of Cement :- use of alumino Sulphate resisting Cement, Portland blast furnace Slag increase durability
- Sufficient Cover over reinforcement.
- w/c ration – lower w/c ration higher durability.

VI a) (i) Water Content :- Higher the water content will be the workability

(ii) Mixproportion.

(iii) Size of aggregate :- Bigger size of aggregate will give higher workability

(iv) Shape of aggregate :- Rounded aggregate will have higher workability.

(v) Surface texture.

(vi) Grading of aggregate.

(vii) use of admixtures.

b) Cement Concrete :-

-> Concrete is economical in long run as compared to other Engg. materials.

-> Concrete posses high compressive strength.

-> Newly mixed concrete can be easily handled and moulded into virtually any shape or size according to specifications.

-> Concrete can be pumped and hence it can laid in difficult positions also.

VII (i) characteristics Compressive strength of Concrete at 28 days

(ii) Degree of workability desired

(iii) Limitations on w/c ratio and the minimum cement to ensure adequate durability

(iv) Type and maximum size of aggregate to be used.

(v) Standard deviation of Compressive Strength of Concrete.

(6) Purpose & Requirment of Concrete Mix design.

→ Complies with the Specifications of Structural Strength laid down, which is usually Stated in terms of the Compressive Strength of Standard test Specimens.

→ Be capable of being mixed, trasported, Compacted as efficiently as possible.

→ It should be as most economical

→ It should ~~be~~ Comply with the durability requirment to resist environment in which the structure will Serve its functions.

VIII Step: 1

$$\bar{f}_{ck} = f_{ck} + tS \qquad t = 1.65 \quad S = 4.$$

$$= 25 + 1.65 \times 4$$

$$= 31.6 \text{ N/mm}^2.$$

Step: 2. w/c for targent mean Strength of 31.6 N is 0.44

for moderate exposure - 0.50.

Minimum is 0.44 = w/c.

Step: 3

Air Content = 2%

Step: 4

Water Content per Cubic meter of Concrete = 186kg.

Sand Content = 35%
as % of total agg by absolute volume

Change in Condition.	water Content %	% Sand in aggregate
(i) For decrease in w/c ratio (0.60 - 0.44)	0	-3.2.
(ii) Compaction factor (0.9 - 0.8 = 0.1)	+3	0
(iii) For Sand conforming to Zone I	0	+1.5
	+3	-1.7

water Content = $186 + \left[186 * \frac{3}{100}\right] = 191.6 \, l/m^3$

Sand Content as percentage of total aggregate by absolute Volume.

$$P = 35 - 1.7 = 33.3\%.$$

Step 5:- Cement Content

$$w/c = 0.44$$

$$\frac{191.6}{C} = 0.44 \Rightarrow C = 435.45$$

$C = 436 \, kg/m^3 > 300 \, kg/m^3$ .... ok.

Step. 6

Volume of Concrete : $1 m^3$

air in wet Concrete : 2%.

Volume of fresh Concrete = $1 - 2/100 = 0.93 m^3$

$$V = \left[w + \frac{C}{S_c} + \frac{1}{p} \times \frac{f_a}{S_{fa}}\right] \times \frac{1}{1000}$$

$$0.98 = \left[191.6 + \frac{436}{3.15} + \frac{1}{0.33} \times \frac{f_a}{2.60}\right] \times \frac{1}{1000}$$

$f_a = 563 kg.$

$$V = \left[w + \frac{c}{S_c} + \frac{1}{(1-p)} \times \frac{C_a}{S_{ca}}\right] \times \frac{1}{1000}$$

$$980 = \left[191.6 + \frac{436}{3.15} + \frac{1}{(1-0.33)} \times \frac{C_a}{2.65}\right] \times \frac{1}{1000}$$

$C_a = 1149.0 kg.$

water	Cement	FA	CA
191.6 l	436 kg	563 kg	1149 kg
0.44	1	1.29	2.64

Step. 7 for 1 bag Cement

water	Cement	FA	CA
22 l	50 kg	64.5 kg	132 kg.

Step: 8.

CA absorbes 0.6% water

$$\frac{0.6}{100} \times 132 = 0.792 l.$$

FA ~~contains~~. absorbes 1.2% water.

$$\frac{1.2}{100} \times 64.5 = 0.774 l.$$

water = $22 + 0.792 + 0.774 = 23.56 l$

IX

a) Density = 300 - 1200 kg/m^3

Workability = 50 to 75 mm slump may be sufficient to obtain workability.

Strength = 20 to 35 Mpa.

Thermal insulation :- 3 to 4 times more than that of bricks and about 10 times than that of Concrete.

Economy :- Due to light wt — Quite economical.

Application :- 1) Low density cellular concrete is used for Precast floor & roofing units.

2) Load bearing walls.

b) 1. Selection of Suitable type of cement :- Rapid Hardening cements, Extra rapid hardening cement are such cement that can be used

2. Temperature control of ingredients :- Pre-heating of ingredients.

3. Electrical heating of Concrete mass.

4. Use of insulating formwork.

5. Adding Air-entraing agents.

X a) 1. Cracks :- Causes of Cracks.

→ Excess water

→ ~~Early loss of water~~ Freez & thaw

→ Corrosion of steel

2. Crazing.

Sulphate deterioration. - Caused by soil containg Sulphates.

4) Efflorescence. :- Appearance of fluffy white patches on Surface.

5) Segregation.

6) Bleeding - Autogeneous flow of mixing water within or emergence to the Surface from freshly placed Concrete.

b) Sulphates are generally occuring in Industrial waste disposal, Ground water & Sub soil. Sulphates are harmful to Concrete as they can lead to increase in the Concrete volume & Consequent Cracking. Selection of Cement for minimizing the danger of Sulphate attack, low C_3A content are recommended. Sulphate-resisting Cement with low C_3A Content is most suitable.

PART-B.

6. Geopolymer is an inorganic alumino-Silicate Polymer, Synthesized from predominantly silicon & aluminium material such as fly ash. Alkaline Solution are used, to induce the silicon & aluminium atoms in the Source materials to dissolve to form gel. The polymerisation Process may be assisted by applied heat followed by drying

The geopolymer gel binds the loose coarse and fine aggregate to form geopolymer Concrete.