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Internal Assessment Test 2 – Mar. 2018

Solution

Sub:	Advance Concrete Technology	Sub Code:	10CV81	Branch:	Civil

1 (a) You are required to proportion concrete for a given set of materials. List the various tests you conduct in your laboratory and explain why.

Fine aggregate	Specific gravity	To calculate weigh batch to volume batch and vice versa.
	Moisture content	Calculation of water content
	Water absorption	Calculation of water content
	Fineness modulus	Calculation of water content. Decide all in aggregate ratio.
Course aggregate	Specific gravity	To calculate weigh batch to volume batch and vice versa.
	Moisture content	Calculation of water content
	Water absorption	Calculation of water content
	Fineness modulus	Calculation of water content. Decide all in aggregate ratio
Course aggregate	Specific gravity	To calculate weigh batch to volume batch and vice versa.
	Fineness modulus	Calculation of water content

(b) Mention the relation used for calculating the volume of fine and course aggregate as per Indian standards, by absolute volume method.

$$V = \left[W + \frac{C}{S_c} + \frac{1}{p} \cdot \frac{f_a}{S_{fa}} \right] \times \frac{1}{1\,000}, \text{ and}$$

$$V = \left[W + \frac{C}{S_c} + \frac{1}{1-p} \cdot \frac{c_a}{S_{ca}} \right] \times \frac{1}{1\,000}$$

where

V = absolute volume of fresh concrete, which is equal to gross volume (m^3) minus the volume of entrapped air,

W = mass of water (kg) per m^3 of concrete,

C = mass of cement (kg) per m^3 of concrete,

S_c = specific gravity of cement,

p = ratio of fine aggregate to total aggregate by absolute volume,

f_a, c_a = total masses of fine aggregate and coarse aggregate (kg) per m^3 of concrete respectively, and

S_{fa}, S_{ca} = specific gravities of saturated surface dry fine aggregate and coarse aggregate respectively.

2 Explain the water cement ratio and age on permeability of concrete.

Permeability is defined as the property that governs the rate of flow of a fluid into a porous solid. Permeability is also can be defined ability to resist weathering action, chemical attack, abrasion, or any process of deterioration.

The permeability occurs in hardened concrete in two scenarios; firstly from the trapped air pockets from incomplete compaction and secondly from the empty space due to loss of mixing water by evaporation.

Factored Affecting Permeability of Concrete

W/C ratio: The mixing water is indirectly responsible for permeability of the hydrated cement paste because its content determines first the total space and subsequently the unfilled space after the water is consumed by either cement hydration reactions or evaporation to the environment. Concrete will not be vulnerable to water-related destructive phenomena if there is a little or no evaporable water left after drying and provided that the subsequent exposure of the concrete to the environment did not cause to resaturation of the pores. The latter, to a large extent, depends on the hydraulic conductivity, which is also known as the coefficient of permeability (K).

Curing: Moist- curing for the 7-day (minimum recommended in ACI 308, Standard Practice for Curing Concrete), resulted in a much more impermeable concrete. The following graph shows the relationship between permeability, w/c ratio, and initial moist-curing for 4x8-inch cylindrical concrete specimens the relationship between w/c ratio, curing period, and permeability would be similar.

Age: Increasing concrete age causes the permeability to reduce, this is because concrete is material that will continue to hydrate over a long period of time as long as there is a presence of un-hydrated lime. So with the presence of water, the hydration products will fill the empty spaces in the matrix.

The use of Admixtures: Such as silica fume, latex emulsions, and highrange water reducers allows placement of highly impermeable concrete. More information on the effects of these admixtures, concrete mix design, and curing is needed so that low permeability concretes can be uniformly specified and manufacture.

3 Mention various tests performed to check the properties of fresh SCC. Explain any one of them briefly with neat sketch.

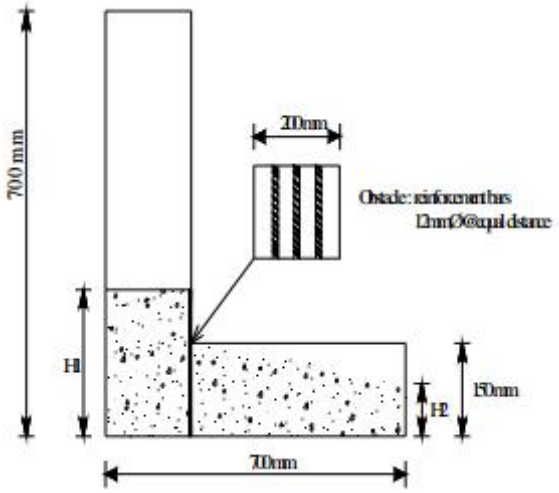
SCC (Self-Compacting Concrete): Defined by researchers as: “concrete that is able to flow and consolidate under its own weight, completely fill the formwork of any shape, even in the presence of dense reinforcement, while maintaining homogeneity and without the need for any additional compaction”

TEST METHODS FOR DETERMINIG FRESH SCC PROPERTIES

- ➢ FILLING ABILITY
  - **Slump flow & T_{50CM} slump flow**
  - **V- Funnel**
- ➢ PASSING ABILITY
  - L-Box
  - U-box
  - **J-ring**
  - Fill Box
- ➢ SEGREGATION RESISTANCE
  - V-Funnel at $T_{5\ Minutes}$
  - GTM Screen stability test

L-Box Test

- Passing ability of fresh concrete.
- T 20 cm and T 40 cm marks of horizontal section of L – box are the indications of ease of flow of concrete.
- Recommended values of flow time are :
  - T 20 cm = 1 ± 0.5 sec
  - T 40 cm = 2 ± 0.5 sec



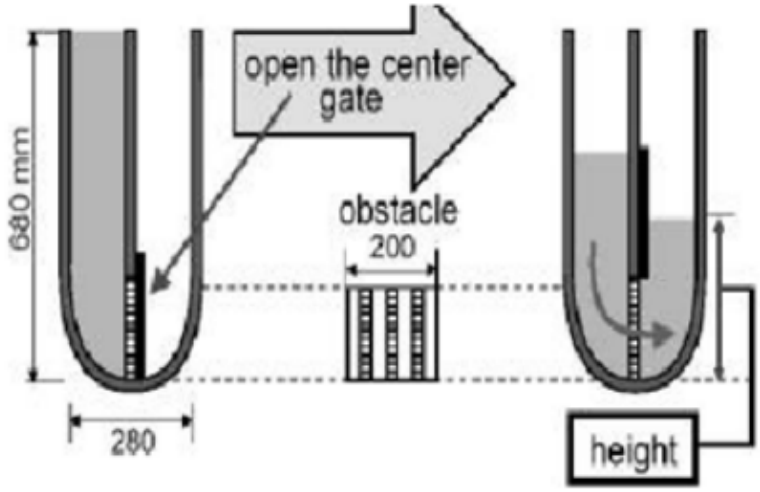
L-Box Test

 Height of the concrete at the end of the horizontal section is expressed as a proportion of that of remaining in the vertical section (H2/H1).

 Recommended value for blocking ratio:
- Blocking ratio H2/H1 ≥ 0.80.

U-Box Test

- Also called as ‘Box-shaped’
- Measures the filling ability of concrete.
- The difference in height of two sections is measured
- Recommended value:
  - difference in the height of the limbs < 30 mm



4 Explain the method of mixing and transporting in RMC.

All concrete Should be mixed thoroughly until it is uniform in appearance with all ingredients evenly distributed.

Mixing can done by

1.Hands(using hand shovels)
2.Stationary Mixers
3.Ready mix concrete
4.Mobile batcher (Continuous mixer)

1.Hands(using hand shovels)

- Mixing ingredients of concrete by hands using ordinary tools like, hand shovels etc.This type of mixing is done for Less output of concrete. Mixing by hands
- Laborious
- Disturb the Properties of Concrete
- Wastage of time hence not economical

2.Stationary Mixers

- Concrete is sometime mixed at jobsite in a stationary mixer having a size of 9 cubic meter or 12 cubic yard.
- These mixers may be of Tilting as well as of non tilting drums.
- Many specifications require a minimum mixing time of one minute plus 15 seconds for every cubic meter (yard)

3.Ready mix concrete

Ready mixed concrete is proportioned and mixed off at the project site and is delivered to the construction area in a freshly mixed and unhardened state. It can be manufactured by any of the following methods:

1.Central-mixed concrete
2.Shrink-mixed concrete
3.Truck-mixed concrete

Central-mixed concrete

- mixed completely in a stationary mixer

- delivered in
  - A truck agitator: **A vehicle carrying a drum or agitator body, in which freshly mixed concrete can be conveyed from the point of mixing to that of placing, the drum being rotated continuously to agitate the contents.**

    Advantages: Operate usually from central mixing plants

    Watch for: Timing of deliveries should suit job organization. Concrete crew and equipment must be ready onsite to handle concrete.
    Used for: Transporting concrete for all uses. Haul distances must allow discharge of concrete within 1½ hours.

  - A non-agitating truck:
    Used for: Transport concrete on short hauls(small distance) over smooth roadways.
    Advantages: Cost of nonagitating equipment is lower than that of truck agitators or mixers.
    Watch for: Slump should be limited. Possibility of segregation. Height upon discharge is needed

Shrink-mixed concrete means
- mixed partially in a stationary mixer and completed in a truck mixer

Truck-mixed concrete
- mixed completely in a truck mixer

4.Mobile batcher
Mobile volumetric mixers are special trucks that batch by volume

Used for: Intermittent (periodic) production of concrete at jobsite, or small quantities.
Advantages: Combined materials transporter and batching and mixing system. One-man operation.
Watch for: Good preventive maintenance program.

<u>Transporting can done by</u>

- Wheelbarrows and Buggies
  - **Used for:** Short flat hauls on all types of onsite concrete construction.
  - **Advantages:** Versatile—ideal inside and on jobsites with changing placing conditions.
  - **Watch for:** Slow and labor intensive.

- **Belt conveyor**
  - **Used for:** Conveying concrete horizontally or higher/lower level.
  - **Advantages:** Adjustable reach, traveling diverter, variable speed.
  - **Watch for:** End-discharge arrangements needed to prevent segregation and mortar on return belt. Belt cover needed in hot and windy weather.
- **Truck mounted conveyors**
  - **Used for:** Conveying concrete horizontally or higher/lower level.

- **Advantages:** Conveyer arrives with concrete. Adjustable reach and variable speed.
- **Watch for:** End-discharge arrangements needed to prevent segregation and mortar on return belt. Belt cover needed in hot and windy weather.

- **Buckets**
  - **Used with:** Cranes, cableways, and helicopters.
  - **Advantages:** Enables full versatility of cranes, cableways, and helicopters to be exploited. Clean discharge.
  - **Watch for:** Select bucket capacity to conform to size of the concrete batch and capacity of placing equipment.
- **Cranes and Buckets**
  - **Used for:** Work above ground level.
  - **Advantages:** Can handle concrete, reinforcing steel, formwork, and sundry items.
  - **Watch for:** Has only one hook. Careful scheduling between trades and operations is needed to keep crane busy
- **Pumps**
  - **Used for:** Conveying concrete from central discharge point to formwork.
  - **Advantages:** Pipelines take up little space and can be readily extended. Delivers concrete in continuous stream. Pump can move.
  - **Watch for:** Constant supply of freshly-mixed concrete is needed without any tendency to segregate.

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h) Cement used	: OPC 43 grade confirming to IS 8112
i) Specific gravity of cement	: 3.15
z) Fly ash used	: Fly ash confirming to IS 3812 (Part-1)
j) Specific gravity of fly ash	: 2.2
k) Chemical admixture	: Superplasticiser conforming to IS 9103
l) Specific gravity of	
Coarse aggregate	: 2.74
Fine aggregate	: 2.74
m) Water absorption	
Coarse aggregate	: 0.5 percent
Fine aggregate	: 1.0 percent
n) Free (surface) moisture	
Coarse aggregate	: Nil (absorbed moisture also nil)
Fine aggregate	: Nil
o) Sieve analysis	
Coarse aggregate	: Conforming to Table 2 of IS: 383
Fine aggregate	: Conforming to Zone I of IS: 383

A-3 TARGET STRENGTH FOR MIX PROPORTIONING

$$f'_{ck} = f_{ck} + 1.65\ s$$

From Table 1 standard deviation, s = 5 N/mm^2
Therefore target strength = 40 + 1.65 x 5 = 48.25 N/mm^2

SELECTION OF WATER CEMENT RATIO

From Table 5 of IS:456-2000, maximum water cement ratio = 0.45
Based on experience adopt water cement ratio as 0.40 0.4 < 0.45, hence ok

SELECTION OF WATER CONTENT

From Table-2, maximum water content = 186 liters
(for 25mm – 50mm slump range and for 20 mm aggregates)
Estimated water content for 100 mm slump = 186 + 6/100 x186 = 197 liters

As superplsticiser is used, the water content can be reduced up to 20 percent and above Based on trials with SP water content reduction of 29 percent has been achieved.
Hence the water content arrived = 19 x 0.71 =140 liters

CALCULATION OF CEMENT CONTENT
Water cement ratio = 0.40 Cement content = 140/0.40 = 350 kg/m^3
From Table 5 of IS: 456, minimum cement content for severe exposure condition = 320 kg/m_3 350 kg/m_3 > 320 kg/m^3,
hence OK

For proportioning fly ash concrete, the suggested steps are;

Decide the percentage of fly ash to be used based on project requirement and quality of materials

In certain situations increase in cementitious material content may be warranted. The decision on increase in cementitious material content and its percentage may be based on experience and trial.

The example is with increase of 10% of cementitious material content
Cementitious material content 1.1 x 350 = 385 kg/m^3
Water content = 140 kg/m^3
Water cement ratio = 140/385 = 0.364 ≈0.40
Let us use fly as at 30 percent of cementitious material content in addition to cement
Fly ash = 385 x 0.3 = 115 kg/m^3

Cement =385-115=270 kg/m^3

(Saving of cement compared to previous design = 350-279 = 80 kg/m^3 and fly ash utilization = 115 kg/m^3)

PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT
From Table 3, volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone I) for water-cement ratio of 0.50 =0.60

In the present case w/c= 0.40. The volume of coarse aggregate is required to be increased to decrease the fine aggregate content. As w/c ratio is lower by 0.10, increase the coarse aggregate volume by 0.02 (at the rate of -/+ 0.01 for every +/- 0.05 change in water cement ratio).

Therefore, corrected volume of coarse aggregate for w/c of 0.40 =0.62.

Note: In case the coarse aggregate is not angular, then also the volume of CA may be required to be increased suitably based on experience

For pumpable concrete these values should be reduced by 10 percent
Therefore volume of coarse aggregate = 0.62 x 0.9 = 0.56
Volume of fine aggregate content = 1- 0.56 = 0.44

MIX CALCULATIONS
The mix calculations per unit volume of concrete shall be as follows

h) Volume of concrete = 1 m^3

i) Volume of cement $= \frac{\text{Mass of cement}}{\text{Specific gravity of cement}} \times \frac{1}{1000}$

j) Volume of fly ash = [115/2.2] x [1/1000] = 0.052 m^3

k) Volume of water = [140/1] x [1/1000] = 0.140 m^3

l) Volume of chemical admixture (SP 2%by mass of cementitious material) = [7.7/1.145] x [1/1000] = 0.007 m^3

m) Volume of all in aggregates (e) =a – (b + c + d)
= 1 – (0.086 + 0.052 + 0.140 + 0.007) = 0.715 m^3

n) Volume of coarse aggregates = e x Volume of CA x specific gravity of CA
= 0.715 x 0.56 x 2.74 x 1000 = 1097 kg

o) Volume of fine aggregates = e x Volume of FA x specific gravity of FA
= 0.715 x 0.44 x 2.74 x 1000 = 862 kg

A-9 MIX PROPORTIONS FOR TRIAL NUMBER 1

Cement	= 270 kg/m^3
Fly ash	= 115 kg/m^3
Water	= 140 kg/m^3
Fine aggregate	= 862 kg/m^3
Coarse aggregates	= 1097 kg/m^3
Chemical admixture	= 7.7 kg/m^3
Water cement ratio	= 0.364