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A STUDY ON MIX DESIGN OF HIGH-PERFORMANCE CONCRETE

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ABSTRACT

The main aim of mix design method is to obtain suitable proportions of concrete ingredients which is used for a first trial batch make a concrete for desirable strength and also increase in quality and performance. A high performance concrete are not required high strength, but also aim is that to obtain a mix proportioning that should be low permeability as possible. High performance concrete is different from other types of concrete because of water-ratio is very low. In HPC the admixture added to improve the quality and properties of concrete. In fresh and hardened concrete compaction factor and slump test is adjusted as with using high range water reducing admixture.

In high performance concrete having void free mass dense with full contact of reinforcing bars. The mix should be that which having easy to vibrate and enough fluid to pass through reinforced. In high performance concrete having three main characteristics – high strength, high workability and high durability

The minimum slump should be 100 mm. durability is high if concrete having low permeability. High strength and low permeability are connected to each other if we require high strength kept pores should be minimum durability and workability are two main characteristics which need careful control and monitoring at the stage of production.

There are many method of mix design for high performance concrete. Indian standards mix design method and trial mixes, in HPC the mainly trial mixes are used.

I.MATERIALS

In HPC concrete the cement used should be ordinary Portland cement and experiment is also done on O.P.C the 28 days compressive strength and specific gravity of concrete have 50.1 N/mm2 and 3.11 respectively. Sand which used should be having specific gravity (2.7) of the alluvial sand which is locally available. The stone which is used in experiment should be having nominal maximum size is 16mm which use in concrete as a coarse aggregate and specific gravity having 2.6. Ordinary tap water is used for all the mixes to prepare fresh

concrete. Poly- carboxylic polymer with set retarding effect was used as a high range water reducing admixtures.

II.MIXING

The concrete should be mixed in a tilting mixer. Process of mixing concrete is-

1) Mix all the aggregate, fine and coarse for two minutes.
2) After that mix water in aggregates for 2 minutes.
3) After mixing all ingredients in mixer stop mixing for 3 minutes.
4) Add water reducing admixture.
5) Pour the concrete mix.

Experimental program

A Rheological test was conducted for investigation of the effect of percentage sand, sand zone such as (coarse, medium, fine), volume of paste, and nominal size of all aggregates. Three readings were taken for determines the rheological parameters.

This test is performed with a rheometer fabricated. A flat circular vane plate drive with a motor through gearbox having diameter 150 mm. vane plates is mounted axially with cylindrical container of diameter 270mm. the cylindrical container is attached with projection pitch of 60mm. The effective gap between bottom and shearing surface have 75mm effective concrete height above vane plate is kept 75mm. Providing 20mm high mesh for avoiding slip condition. 10 ampere AC variance voltage are used the no. of revolution of plate is measured with non-contact infrared digital tachometer. The arrangement of all system give the braking torque at different stage and reading is notes.

The formula for total torque in present Rheometer is

$$\frac{T}{\pi d^2 / 2\left(2h+t+\frac{d}{3}\right)} = \tau_0 + \left[\frac{\frac{d}{2h}+\frac{2(h+t)}{g}\pi Na}{2h+t+\frac{d}{3}120}\right]$$

d= diameter of vane plate - 0.270m

h= effective gap between bottom of vane plate to bottom of cylinder - 0.075m

g= effective gap of annulus – 0.060m

t= height of ribs of vane plate – 0.025m

All these values are put in above equation

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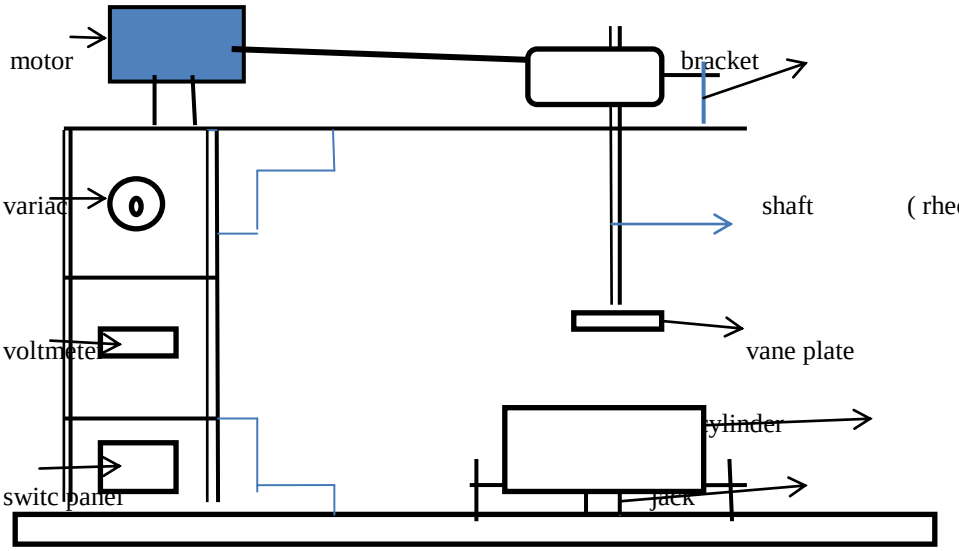
Sieve analysis of sand -

Sieve size (mm)	% of passing
4.75	**98.3**
2.36	**96.4**
1.70	**94.7**
1.18	**91.1**
0.60	**66.5**
0.3	**20.2**
0.15	**1.7**

Sieve analysis for coarse aggregates –

Sieve size (mm)	% of passing
16	99.9
12.5	42.21
10	31.81
6.3	24.99
4.75	0.91



(rheometer diagram)

$124.95\text{T} = \tau_0 = 0.079N\mu$

$\tau = 124.95$

$\gamma = 0.079$

This is overall shear strain rate per second in term of rotational frequency in (rpm) is –

$$\gamma = 0.079$$

The total shear and overall shear both quantities (γ) and (τ) are obtain during experiment . flow curve are plotting from the value of (τ)and (γ) .

After conducting rheological tests on the concrete ,the fresh concrete are transfer to the concrete and mortar are balanced and left in the cylinder container should be cleaned by manually and transferred to the mixer. after this process the concrete was mixes in the mixer for two minutes after that the concrete transferred to the bucket. Finally the concrete are placed in cube mould in three layers, each layer of concrete are compacted with 16mm rod and 25 times. The final compaction of the concrete were achieved with vibration table in standard manner. Casting is done between 1-2 hours. After all process the concrete mould is kept for drying and curing is done for 28 days. The curing should be wax based done with spray after 24 hours of casting. After 28 days the compressible strength is measured. Average of three readings is measured and strength are known.

III.CONCLUSION

A mix design process of high performance concrete is based of rheological parameters .which used to determine water cement ratio, compressive strength and as well as aggregate volume to paste volume ratio alternatively. Using water-cement ratio or compressive strength, physical properties of aggregates and rheological parameter was used in mix design. The chart is obtained on the bases of cube test result of trial mixes.

- Yield stress is : 40-80 pa
- Plastic viscosity: 15-120 pa
- Compressive strength for 28 days : 40-90 Mpa

It is also notice that it is also difficult to develop a mix design method that are used universally because properties of fresh and hard concrete is same difficult to obtain by different ways of same types of concrete.

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