# EXPERIMENTAL STUDY ON HIGH PERFORMANCE CONCRETE

[1]V.S.POORNIMA, [2]B.SHARMILA, [3]R.VINITHA, [4]H.YOGESWARI, [5]G.KUMARESAN

[1,2,3,4]STUDENT, [5]ASSISTANT PROFESSOR
DEPARTMENT OF CIVIL ENGINEERING
PRATHYUSHA ENGINEERING COLLEGE, TAMIL NADU

***Abstract*: High performance concrete should have at least one property like high strength, high durability, Self compaction, low permeability to water. Conventional concrete is designed on the basis of compressive strength does not meet any functional requirements since it is deficit in aggressive environmental conditions, time of construction, energy absorption capacity. So, there is a need to design high performance concrete which is far superior to conventional concrete. High performance concrete has received increased attention in the development of infrastructures, hydraulic structures, bridges, highways, etc. This study is based on influence of two mineral admixtures and chemical admixtures like silica fume and fly ash, on the properties of super plasticized high performance concrete. The mineral admixtures generally improve strength and durability characteristics. Silica fume is slightly more effective than the fly ash in improving durability properties. In high performance concrete that have a water/binder ratio between 0.20 and 0.35 are usually more durable than the ordinary concrete. This project deals with the study on strength of high performance concrete.**

***Keywords*: silica fume, fly ash, super plasticizers, water-cement ratio.**

## I. INTRODUCTION

High performance concrete in which has high grades, various tests and applications. In high performance concrete that has been designed to be more durable and stronger than the conventional concrete. Based on the compressive strength; concrete has classified as normal strength concrete, high strength concrete and Ultra strength concrete. To achieve high strength concrete it is necessary to use high cement concrete with low water cement ratio. In high cement content may liberate large heat of hydration. To overcome this problem we use additive materials to improve the quality of concrete the cement based concrete meets the special performance with respect to strength and durability known as a "high performance concrete". Here, a cube of size 150x 150 x 150 mm is used. As an outcome of the experiments and researches cement based concrete which meets special performance with respect to workability, strength.

OBJECTIVES OF HPC:

1. The objective of this work is to develop the concrete with good strength, less porous, so that durability will be reached.
2. For this purpose the use different materials like fly ash, silica fume.
3. To determine the water binder ratio so that Design mix having a proper workability and strength.
4. To compare the basic properties of concrete such as compressive strength, flexural strength.

APPLICATIONS OF HPC:

- High performance concrete was mostly applied to high rise buildings, bridges and off shore platforms.
- It is applied to other applications such as harbour and costal structures, hydraulic structures, pavements and industrial floors, water treatment plants.

## II. METHODOLOGY

To find mix proportion, mix design was done as per is code. A cube size of 150 x 150 x 150 mm is used to make cube of various mix at different water ratio. Mix ratio for different mixes is taken and calculated. Materials are collected based on various properties are observed by various tests. Material are batched for mixing as per mix design and mixed uniformly. It is then casted in cube of 150 x 150 x 150 mm mould and compacted with tamping rod. Hence the cube must be fully compacted. The mineral admixture and chemical admixtures are added to the cement. The fly ash and silica fume are added 10% with the cement. The super plasticizers are added 20 ml for 10% fly ash and silica fume. The specimen is allowed to Hardened for 24hrs and cured.
The Specimen were cured by water till 28 days to attain strength. The compressive strength for various mixes is determined at 28 days.

## III. MATERIALS

Fly ash also improves the permeability of concrete by making it more cohesive and less prone to segregation. Silica fume is used for filling voids. CONPLAST SP430 disperses the fine particles in the concrete mix, enabling the water content of the concrete to perform more effectively. The very high levels of water reduction possible allow major increases in strength to be obtained.
It significantly improves the workability .To provide excellent acceleration of strength gain at early ages and major increases in strength.

**IV. CONCRTE MIX DESIGN**

CONCRETE Mix design for M-40

Grade M40 Designation = M-40
Type of cement = OPC-43 grade
Brand of cement = Ultra Tech
Sp. Gravity Cement = 3.15
Fine Aggregate = 2.61
Coarse Aggregate (12mm) = 2.65
Minimum Cement = 370kg / $m^3$
Maximum water cement ratio = 0.35

**Mix Calculation**:

Step1: target mean strength
fck =40N/$mm^2$, S=5N/$mm^2$
fck'=fck+1.65x5
=48.25N/$mm^2$
Step 2: water cement ratio
As per IS code 456:2000
W/C ratio=0.40
Step 3:
From 6.6 table,
Size of aggregate 20mm =186litres for 50mm slump
For 100mm slump water content by 6%.
=186+ (6/100x186) =197 litres
Super plasticizer is used in water content can reduced up to 20%
=197x0.75
=148 litres.
Step 4: calculation of cement content
W/C =0.40
Water used =148 litre 400x0.4=160kg
C =148/0.40
Cement content =370 kg/$m^3$
=400kg/$m^3$
Step 5: calculate the CA and FA
Volume of CA= [W+(C/SC) + (1/p) (FA/SFA) x (1/1000)]
V = [(W+C/SC) + (1/ (1-p))-(CA/SCA)] x (1/1000)
0.98 = [160+ (400/3.15) + (1/0.635) (CA/2.655)](1/1000)
CA =1168.37
CA =1168kg
For FA,
0.98 = [160+ (400/3.15)+(1/0.365)(FA/2.61)](1/1000)
FA = 660.2kg
FA = 660kg
Cement = 400kg
Water = 160kg
FA = 660kg
CA = 1168kg
Water: cement: FA: CA=0.4:1:1.65:2.92
Volume =0.15x0.15x0.15
=0.0034m3
Unit WT of concrete =24kN/$m^2$
=24 x 103 x 0.0034
=8.16kg
WT of cement =1/5.57x8.16 =1.46kg
Add 20% of wastage =1.66kg
WT of FA =1.65/5.57 X8.16=2.41kg
Add 20% of wastage =2.61kg
WT of CA =2.92/5.57x8.16 =4.27kg
Add 20% of wastage =4.47kg
W/C ratio of cement =0.25x1.66=0.415kg
=415ml
W/c ratio of cement = 0.3x1.66=0.500kg
= 500ml
W/C ratio of cement = 0.35x1.66=0.600kg

= 600ml

Super plasticizers for 10% 0f silica fume and fly ash

Cement+ fly ash+ silica fume =1.66+0.166+0.166

= 1.992 kg=20ml

Silica fume & fly ash

5% =0.083

10% =0.166

15% =0.243

**V. TEST AND RESULTS:**

As per IS 456- 2000 concrete cubes are tested in compression to find their strength at 28 days. The test strength of sample shall be the average of the strength of the three specimens. By using PYCNOMETER we found out the fineness modulus of the fine aggregate lies between 2.2 to 2.6 and also found that the coarse aggregate is to be 2.69. Three test cubes shall be made from each Sample for testing at 28 days.

Procedure:

1. Measure the dimensions of the concrete cube.

2. Place the concrete cube in the compression testing machine in position.

3. Apply the load to the specimen uniformly.

4. Apply further load until the specimen fails.

5. Note down the load at failure.

6. This load is the ultimate compressive load.

Calculation:

$$\text{Ultimate compressive strength} = \frac{\text{Ultimate load}}{\text{Area of cross section}} \text{ N/ mm2}$$

TABLE 1.1 COMPRESSIVE STRENGTH OF CONCRETE AT 28DAYS

| W/C RATIO | SAMPLE 1 | SAMPLE 2 | AVERAGE | COMPRESSIVE STRENGTH |
|---|---|---|---|---|
| 0.25 | 55.38 | 54.85 | 55.4 | 55.4 N/mm$^2$ |
| 0.3 | 52.35 | 51.46 | 51.09 | 51.09 N/mm$^2$ |
| 0.35 | 49.65 | 48.96 | 49.30 | 49.30 N/mm$^2$ |

COMPRESSIVE STRENGTH OF CUBE:

FIGURE1.1 TESTING OF CUBE

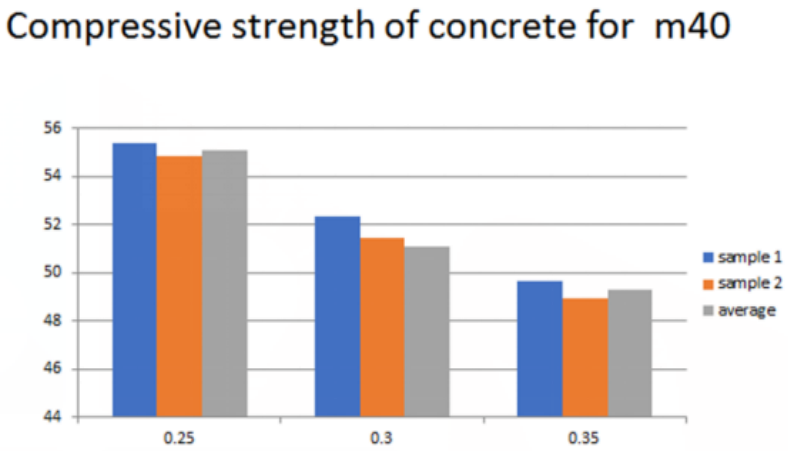


FIGURE1.2 BAR CHART

**CONCLUSION**:

In our study we have made samples of M40 grade concrete cubes of dimension 150 mm x 150 mm x 150 mm and the ratio of mix design were 1:1.65:2.92 were designed according to the IS code method. Addition of 5%, 10%, 15% of silica fume and fly ash to the normal grade of concrete mix and above cubes are casted. These cubes were tested for compression strength on 28 days from the casting. It has been observed that, 10% addition of mineral admixtures, the strength of the specimen is increased. It is also observed that, by decreasing the water- cement ratio, compressive strength of concrete increases.

**REFERENCES:**

[1] Experimental study on high performance concrete. International journal of electronics communication &computer science engineering ISSN2277:9477 Mr, SABALEVISHAL, et.al.
[2] Concrete technology by M.S. SHETTY.
[3] Fibres, percolation & Spalling of high performance concrete. ACI material journal may- June 2000 Dale P.BENTZ
[4] Strength & durability properties of high performance concrete incorporating high reactivity Metakaoline. International journal of modern engineering research May – June 2012 B.B. PATIL.