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EXPERIMENTAL INVESTIGATION ON HIGH PERFORMANCE CONCRETE USING DIFFERENT TYPES OF AGGREGATE

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Abstract — A new generation of concrete, High performance of concrete has been developed of its outstanding strength performance shows a very promising future in construction application in this paper several possibilities are examined for reducing the price of producing high performance concrete and to minimize the ability of normal concrete. The following types of coarse aggregate were used to produce the concrete; secondary aggregate; marble; light weight aggregate (pumice) and natural mineral (gravel). The concrete contain a highly effective Super plasticizer,metakaoline and silica fume. Mechanical properties sharply increased during early stage approaching asymptotic valves, depending on design strength codes. Results of 28 days of curing light weight aggregate gives the high mechanical properties. When estimated with the conventional concrete. These experimental results demonstrate that the light weight aggregate strongly influences the mechanical and durability properties without basic properties of concrete.

Keywords — High performance concrete, aggregate type, workability, compressive strength.

I. INTRODUCTION

India being a place for multiple biodiversity holds a highly dynamic range of topography, hence having various kinds of rock materials depending upon the area of residing. Various new construction methods have come up in the past decade to make use of the resources cost efficiently without causing any distress and to make people live in safe zone. This safe zone majorly consists of keeping the building as high performance building.

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Theoretical studies are available to determine strength of different building components. But a very few studies are available which deal with experimental investigation. The various rock materials end up in giving variety of coarse aggregates; Aggregate characteristics as well as properties of cement paste and Interfacial Transition Zone (ITZ) govern the strength of concrete with the improvement in properties of cement matrix and ITZ by the use of mineral and chemical admixtures in HPC.

HPC is a concrete mixture, which possess high strength when compared to conventional concrete. The term 'High performance' is somewhat pretentious because the essential feature of this concrete is that it's ingredients and proportions are specifically chosen so as to have particularly appropriate properties for the expected use of the structure such as high strength and low permeability. Hence HPC is not a special type of concrete. It comprises of the same materials as that of the conventional cement concrete. The use of some mineral and chemical admixtures like silica fume and super plasticizer enhance the strength and workability qualities to a very high extent.

II. LITERATURE REVIEW

T.Subulakshmi et al investigation made on the mechanical properties of High performance concrete made with quarry dust material. This paper presents the results of a study to use quarry dust in concrete as a partial replacement of sand. The strength characteristics such as compressive strength and flexural strength were investigated to find the optimum replacement of quarry dust. The mechanical properties of HPC with quarry dust at the replacement levels of 0,50,100% were studied at

3,7,14,28 and 60 days curing. Quarry dust plays a vital role in improving the strength of the concrete.

K.S. Kulkarni et al studied the use of HPC has been used extensively throughout the world, predominately in the high rise buildings, bridges, tunnels etc. The first fire that occurred in a HPC structure was in the channel tunnel fire. From different studies in progress in several countries, it is clear that the fire resistance of HPC does not seem to be as good as that of ordinary concrete. This experimental work regarding the physical characteristics, mechanical properties of partial micro cement based HPC subjected to elevated temperatures.

Saied Ahmed Al. Sheikh studied the experimental investigation in to the effects of high temperature on the residual compressive and tensile strengths for HPC made with ordinary portland cement are presented. The results showed that the compressive and tensile strengths, pulse velocity and rebound number were decreased with the increase in exposed temperature. The weight loss from concrete increased non- linearly with the maximum exposed temperature. Sudden cooling caused reduction in concrete strength.

III. MATERIALS

OPC confirming to IS 12269: 1987 (Specification for 53 grade OPC), fine aggregates, coarse aggregates and potable water were used for the control OPC concrete specimens. The HPC was obtained by mixing calculated quantities of cement, fine aggregate, coarse aggregate and super plasticizer. River sand available in Chennai was used as fine aggregates and tested as per IS 2386: Part I: 1963 (Methods of test for aggregates for concrete). In this investigation locally available crushing natural stone rock as (Gray Gravel), wastage material from the demolished buildings as Secondary aggregates (Brick debris), crushed Marbles, Light weight aggregate all these aggregate as maximum size of 20mm was used and characterization tests were carried out as per IS 2386: Part I: 1963 (Methods of test for aggregates for concrete)

1) Ordinary Portland cement (OPC)

The basic properties of 53 grade OPC such as consistency, initial setting time, final setting time and specific gravity were given in Table 1. as per IS 4031- methods of physical test for hydraulic cement.

TABLE 1 PROPERTIES OF 53 GRADE ORDINARY PORTLAND CEMENT

TEST DETAILS	OBTAINED VALUE	CODAL REQUIREMENT AS PER IS 4031-1998
Fineness of cement	7%	
Consistency	27%	
Initial setting time	30 min	Not less than 30 min
Final setting time	540 min	Not more than 600 min
Specific gravity	2.91	

2) River sand

River sand obtained from local source was used as a fine aggregate. The properties of fine aggregate are tabulated in Table 2 the test was carried out as per IS 383- specification for fine aggregate from natural source for concrete.

TABLE 2 PROPERTIES OF FINE AGGREGATE

Specific Gravity of Fine aggregate – 2.60			
Sieve size	**Weight retained (gms)**	**Cumulative (%) passed**	**Zone**
4.75 mm	21	98.95	1, 2, 3, 4
2.36 mm	109	93.5	1, 2, 3, 4
1.18 mm	353	75.85	1, 2, 3
600 micron	861.5	32.77	1, 2, 3
300micron	510.5	7.25	1
150 micron	122.5	1.125	1, 2, 3, 4
Pan	22.59	0	Nil

From table 1 the soil sample comes under Zone 1 with ref to table 2.

3) Aggregates

In the present investigation, locally available different types of aggregate such as Gravel, debris aggregate, pumice, Marble are obtained from the local source was used. The properties of coarse aggregate are given in Table 3.as per IS 383-Specification for coarse and fine aggregate from natural source for concrete

TABLE 3 PROPERTIES OF COARSE AGGREGATE

SI NO	AGGREGATES TYPE	SPECIFIC GRAVITY
1	Gravel	2.80
2	Secondary	2.62
3	Pumice	2.33
4	Marble	2.72

4) Super Plasticizer

In order to improve the workability of fresh concrete, Varaplast SP 123 type of super plasticizer was used. The properties of super plasticizer are given below,

Properties of Super plasticizer:

Brand name : Varaplast Sp 123
Calcium chloride content : Nil
Specific gravity : 1.22 at 25□ C.
Air Entrainment : Less than 1% additional air is entrained.
Setting time : no retardation at normal dosage.
Chloride content : Nil to BS 5075.
Cement compatibility : Compatibility with sulphate resisting and other Portland cements, high alumina cements and cement replacement.

5) WORKABILITY

The workability of HPC is normally good even at close slumps,and high performance concrete typically pumps very well , due to the ample volume cementitious materials and the presence if chemical admixture. Super workable concrete have the ability to fill the heavily reinforced section flows without internal or external vibration, without segregation and without developing large size voids. This mixtures are intended to be self leveling and the rate of flow is an important factor in determining the rate of production and placement schedule. It is also a use tool assessing a quality of the mixture flowing concrete is, of course, not required in all HPC and adequate workability is normally not difficult to attain.

TABLE 4 WORKABILITY FOR TYPES OF AGGREGATE

TYPES OF AGGREGATE	HEIGHT OF SLUMP (CM)
Control	30
Gravel	28
Marble	18
Secondary aggregate	14
Pumice	29

6) PREPARATION OF TEST SPECIMENS

Cement, sand and aggregate are weighted separately and mixed together in a dry manner. The amount of water and Super plasticier are calculated also as per Indian standard are measured, mixed together thoroughly and this emulsified water should be used for the preparation of concrete. The mixing was done by the hand and precautions were taken to ensure the uniform mixing of ingredients.

The test specimen of size 150 x 150 x150 mm were cast in a mould made of 4mm thick sheet for all concrete specimen. The specimens were demoulded after 24 hours of casting and cured in water for7, 28 days. To achieve the initial and finial stage strength curing is carried out which helps us to improve the strength of concrete it will be done as per Indian standard.

7) EXPERIMENTAL INVESTIGATIONS

High performance concrete is not a special type of concrete. It comprises of the same materials as that of the conventional cement concrete. The use of some mineral and chemical admixtures like Silica fume and Super plasticizer enhance the strength, durability and workability qualities to a very high extent in control specimens. To reduce the natural minerals different types of aggregate are used. To investigate that those aggregate types in concrete should increase the strength and durability of concrete structure. The following strength and durability studies were conducted to assess the performance of high performance concrete.

8) Compressive strength tests

The compressive strength tests are carried out as per IS 516-1968 (methods of tests for strength of concrete) to find the influence of high performance concrete on the compressive strength development of cement concrete. The specimens of size 150mm cube were casted with the various types of aggregate. Totally 30 specimens were casted. The test was carried out at the ages of 7 and 28 days tests results are compared with control concrete specimens.

IV. RESULT & DISCUSSION

The results of the experimental program followed for the determination of strength, durability of Concrete cubes and cylinder are discussed with the results.

Results for Compressive Strength

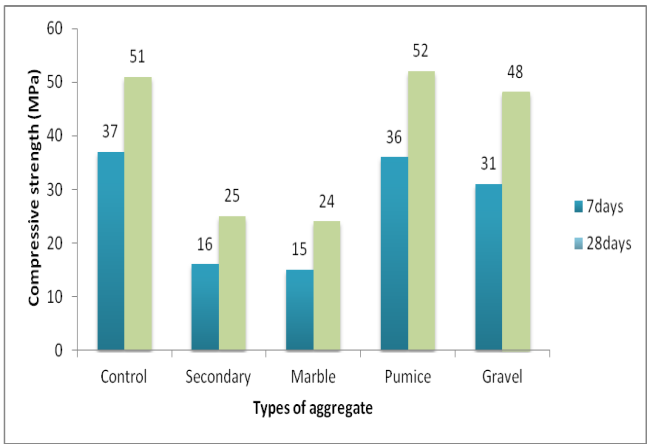

Figure 1 Comparison of Compressive strength for Control Concrete and different types of aggregate

Figure 1 shows Comparison of Compressive strength for Control Concrete and different types of aggregate. In general mix ratio are designed irrespective of types of aggregate used in concrete. In initial stage control concrete offered improved strength of 37 MPa similarly the light weight aggregate (i.e. Pumice) also gives strength of 36 MPa compared to the other types of aggregate such as 016, 15, 31 MPa. Then the gravel gives the moderate strength in the initial stages. It can be concluded that irrespective of type of aggregate 28 days test results revealed similar Compressive strength for Gravel, Pumice, Marble and secondary in concrete. Whereas marginally improved Compressive strength of the order of 30% for Control and Pumice mortar in different mix ratio which may be due to improved hydration.

V. CONCLUSION

This paper presents experimental study on high performance concrete using different types of aggregates. The following conclusions are derived based on the analysis.

- Compressive strength of 36 MPa was achieved at the age of 7day for high performance concrete using Light weight aggregate (i.e. Pumice). The strength improvement is similar to the Control Concrete.
- At the finial stage for curing Pumice and Gravel will gives the expected outcome strength in the High Performance Concrete.
- The observation of Compressive strength is in close agreement with the expected theoretical strength attainment values for M55 Concrete
  Gravel will also offer similar strength.
- The bond strength development of using Pumice in high performance concrete is comparable with the expected values for control concrete.
- It can be concluded that the strength of high performance concrete using different types of aggregate is improved by adequate modification in mixing and curing methods and by appropriate proportion.

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