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Non-Destructive Test on Granite Powder Concrete

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ABSTRACT

This paper presents a definite exploratory investigation on penetrability qualities of granite powder (GP) concrete. The primary parameter researched in this investigation was M30 and M60 grades concrete with substitution of sand by GP of 0, 25,50 and 100 and concrete as fractional supplanting with super plasticiser, fly ash, slag and silica fume. The antacid arrangement utilized for present examination is the mix of sodium hydroxide and sodium silicate arrangement. The test example was 50 mm (thick) x 100 mm (diameter) cylinder shapes heat-relieved at 60°C in an oven. The variety was concentrated on the examples exposed to ambient air just as oven heat relieving. non-destructive tests on cylinders with the help of rebound hammer for a time of 28, 56, 90, 180 and 365 days. The test outcomes show that the substitution of rock and incomplete substitution of admixtures display better execution.

Keywords: Schmidt hammer, Rebound hammer Test, Non-Destructive test, and Qualitative strength of Concrete.

1. INTRODUCTION

Concrete is a versatile material of construction used globally. Unlike metals like steel, aluminium etc., which are produced in mills by employing skilled workers, concrete is prepared locally using granites, river sand, cement and water with the help of semi-skilled and unskilled workers. Sometimes in small quantities, it is obtained by mixing the ingredients described above at the site by hand. For the requirements of medium quantities and continuous supply the ingredients are mixed at the site using a machine called mixture machine. The concrete is then transported by trucks to the site. In whatever mode, the concrete is prepared it is laid in a formwork and allowed to set and harden. After a day of casting it is cured with water or by any other means to a required number of days as demanded by site condition. After 28 days the concrete hardens completely like a rock. It is then use. Compressive strength is a backbone of concrete. It is evaluated by testing representative samples cast in the form of control specimens like a cube, cylinder, and prism at required number of days. Cement is an essential material in concrete. It binds all other ingredients. However, there is a drawback in it. Its production releases CO2[5] to the environment at the rate of 1 ton of it per ton of cement produced. Therefore, to prevent degradation of the environment and to achieve sustainable construction the consumption of cement has to be curtailed. This can be obtained by harnessing the wastes in the production of concrete. These cement substitutes are called supplementary cementitious materials as well as pozzolans. Normally during the hydration of cement calcium hydroxide is released as a by-product. It is an unstable compound and tries to leave the body mass of concrete leaving pores in it through which atmospheric agent like oxygen and moisture ingress into it and attack steel reinforcement thus causing its corrosion by an electrochemical process. As a result of this concrete degrades and suffers a loss in its durability. This deterioration of concrete can be prevented by adding industrial wastes like fly ash, silica fume, marble powder, and ground granulated blast furnace slag (GGBFS), etc[4]. These wastes react with calcium hydroxide and convert it into C-S-H gel which is beneficial to concrete adding strength to it. Another issue affecting the environment is river sand. Continuous use of this material as a fine aggregate in concrete causes strain in the environment due to its depletion, thus affecting the sustainability in construction. This problem could be solved by replacing the river sand partially with industrial waste such as granite powder.

2. EXPERIMENTAL DETAILS

2.1 Materials

The following materials are used as part of this experimental study.

2.1.1 Cement

In the current work, the cement was used is OPC of 53-grade. In Compliance with the fineness modulus of cement was measured as per IS code.

2.1.2 Fine aggregate

The normal river sand was used in preparing the concrete mixes and specific gravity of the sand was found to be 2.33. The sand used was confined to zone 3.

2.1.3 Coarse aggregate

Granite stone with the size of 10 -20 mm was the coarse aggregate used in the current study. As per sieve analysis, size of 19 mm sieve found successful with 99 percent.

2.1.4 Water

Drinking water was used for mixing concrete since normal water may have impurities which may impact the strength and other properties of concrete.

2.1.5 Granite powder

Granite belongs to igneous rock family. Granite powder obtained from the polishing units and the properties were found. Since the granite powder was fine, hydrometer analysis was carried out on the powder to determine the particle size distribution.

2.1.6 Admixture

The partial replacement of cement using mineral and chemical admixtures like Silica fume, fly ash, slag (GGBFS) and Superplastciser.

2.2 Mixing, Demoulding and Curing

Thorough mixing and adequate curing are most essential for achieving a good concrete. In the laboratory, the concrete was hand mixed. The mixing time was kept to about 3–4 min for normal concrete. Generally, the demoulding was done 24 hours of casting. Potable water was used for curing all the concretes and was kept in moist environment immediately after the initial set and before the demoulding

3. EXPERIMENTAL PROCEDURE

Sample specimens of cylinder is shown in Figure.1. The cylinders were subjected to Schmidt hammer test [1][2] to ascertain their strength. Readings were collected at 28 days, 56 days, 90 days, 180 days and 365 days for M30 concrete and M60 concretes. It was only a qualitative test to determine the integrity of concrete, i.e., whether there are voids or cracks in concrete.

Figure 1: Sample of Specimens (cylinder) for Rebound Hammer Test

4. RESULTS AND DISCUSSION

The strength of various grades of concrete was assessed qualitatively by conducting non-destructive tests on cylinders with the help of rebound hammer. Results obtained are given in Table.1 and Figure.2 for M30 concrete and in Table 2 and Figure 3 for M60 concrete. Accordingly, in the case of M30 concrete the normal concrete (CC) with sand as fine aggregate and without any admixture was estimated to attain a strength of 33 MPa at 28 days. The strength of the same grade of concrete with only granite powder as fine aggregate and without any admixture (NA100) was estimated to achieve 35 MPa, an increase of 6.06% over conventional concrete with sand. Similar enhancement in estimated strength was observed for other ages like 56 days, 90 days, 180 days and 365 days. Concrete with sand only and with cementitious materials (GP0) could get a qualitative strength of 39 MPa. There is an increase of 18.2% over the conventional concrete with 100% sand as a fine aggregate. The strength of concrete with 25% granite powder and 75% sand with cementitious materials (GP25) was estimated at 40 MPa with an increase of 21.2% over conventional concrete[3] with 100% sand (CC). With other percentages of the addition of granite powder with the quantity of cementitious materials remaining the same the strength of concrete decreased.

Table 1: Strength of Rebound Hammer Values for M30 Concrete (MPa)

Replacement Level	Total No. of Specimens	28 Days	56 Days	90 Days	180 Days	365 Days
GP0	15	39	42	44.65	46.25	49
GP25	15	40	44.2	48	51	53
GP50	15	38.25	41.9	44	46.65	48
GP75	15	37	40	42	44	46
GP100	15	35.75	39	42.5	45	47
NA100	15	35	38.65	42.25	43	45
CC	15	33	35	39	40.95	43

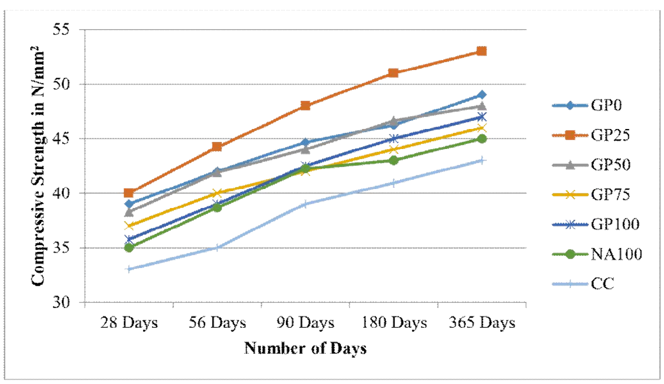

Figure 2: Strength of Rebound Hammer Test for M30 Concrete

In the case of M60 grade concrete the strength of conventional concrete (CC) was assessed as 66.80 MPa at 28 days. Corresponding estimated strength of NA100 concrete was 62 MPa, a decrease in strength of 7.2% over the CC concrete. This shows that mere addition of granite powder without admixtures is not able to increase the strength of concrete for all ages of 56 days, 90 days, 180 days and 365 days, especially in the case of high-performance Concrete. The estimated strength of GP0 concrete was 68 MPa. There is an increase of 1.8% over CC concrete.

In the case of GP25 concrete the estimated strength was 70 MPa which is 4.8% greater than the CC concrete. The assessed strength in respect of concrete with the addition of other percentages of granite powder and admixtures decreased with the increase in percentages of these materials.

Table 2: Strength of Rebound Hammer Values for M60 Concrete (MPa)

Replacement Level	Total No. of Specimens	28 Days	56 Days	90 Days	180 Days	365 Days
GP0	15	68	70.8	73	75	77
GP25	15	70	72	74.25	75.7	79
GP50	15	67	69	71.25	73	75.7
GP75	15	66	68.2	70	72	74
GP100	15	65.8	68	70	71	73.5
NA100	15	62	64	66	67	70
CC	15	66.8	70.2	73	74.8	76.5

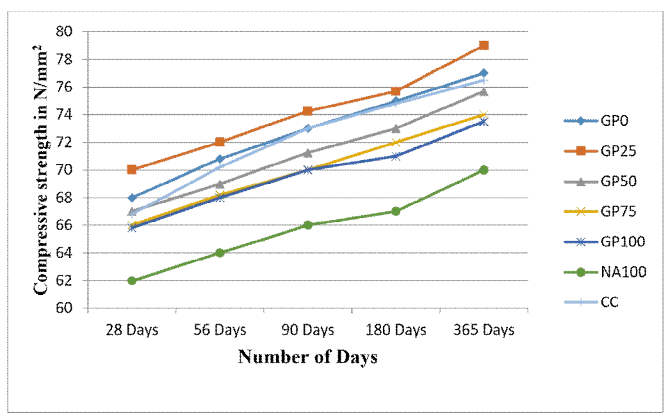

Figure 3: Strength of Rebound Hammer Test for M30 Concrete

The normal concrete (CC) in the case of M30 grade with 100% sand as fine aggregate and without granite powder as well as cementitious admixtures has attained a value of 35 MPa as against 33 MPa obtained by Schmidt Hammer test indicating close agreement between both values whereas that contained 100% granite powder (NA100) without sand, and cementitious materials has registered a compressive strength of 36 MPa as against 35 MPa obtained from non-destructive test. This shows that addition of granite powder to concrete has a distinct advantage of enhancing the strength of conventional concrete by 2.86%. A similar increase in strength in both concretes was also observed at different ages, viz, 56 days, 90 days, 180 days 365 days in the case of M30 grade.

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