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Evolution of Hollow Concrete Block by using Granite Fine

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ABSTRACT

Solid waste management including the granite fines has become one of the major environmental concerns in the world. With the increasing awareness about the environment, scarcity of land-fill space, and due to its ever-increasing cost, waste materials and by-product utilization like granite fines have become an alternative to disposal. In this work, we have highlighted some aspects concerning the use of granite fines in various proportions in the manufacture of hollow concrete blocks. In this high performance, Hollow blocks are manufactured of size 400mm x 200mm x 200mm utilizing granite fines as an additive. This granite fines waste can be utilized for the preparation of concrete as a partial replacement of coarse aggregate to improve the workability of concrete due to the exorbitant hike in the price of coarse aggregate and its limited availability. The percentages of granite fines added by weight to replace coarse aggregate weight were 0, 12.5, 25, 37.5, and 50. The compressive strength of blocks was tested for 7, 14, and 28 days. The test results indicate the replacement of coarse aggregate with granite fines has a beneficial effect on mechanical properties such as compressive strength. The hollow concrete blocks made with 1:2:4 mix proportion using 25% granite fines replacement with coarse aggregate gave optimum compressive strength of 7.85 N/mm2. Based on the results of this research work it can be concluded that High Strength and High-performance Hollow Concrete Blocks can be manufactured by using the Granite fines as an additive.

1. INTRODUCTION

A. Hollow Concrete Block's

A concrete block is primarily used as a building material in the construction of walls. It is sometimes called a concrete masonry unit (CMU). A concrete block is one of several precast concrete products used in construction. The term precast refers to the fact that the blocks are formed and hardened before they are brought to the job site. Most concrete blocks have one or more hollow cavities, and their sides may be cast smooth or with a design. In use, concrete blocks are stacked one at a time and held together with fresh concrete mortar to form the desired length and height of the wall.

Concrete mortar was used by the Romans as early as 200 B.C. to bind shaped stones together in the construction of buildings. During the reign of the Roman emperor Caligula, in 37-41 A.D, small blocks of precast concrete were used as a construction material in the region around present-day Naples, Italy. Much of the concrete technology developed by the Romans was lost after the fall of the Roman Empire in the fifth

century. It was not until 1824 that the English stonemason Joseph Aspdin developed Portland cement, which became one of the key components of modern concrete.

The first hollow concrete block was designed in 1890 by Harmon S. Palmer in the United States. After 10 years of experimenting, Palmer patented the design in 1900. Palmer's blocks were 8 in (20.3 cm) by 10 in (25.4 cm) by 30 in (76.2 cm), and they were so heavy they had to be lifted into place with a small crane. By 1905, an estimated 1,500 companies were manufacturing concrete blocks in the United States. These early blocks were usually cast by hand, and the average output was about 10 blocks per person per hour.

1.2 Granite Fine's

The granite is procured from Bidadi. The granite fine contained 12% of sand-size particles, 71% of silt size particles, and 16.6% of clay size particles Granite is an igneous rock that is widely used as construction material in different forms. Granite industries produce a lot of dust and waste materials. The wastes from the granite polishing units are being disposed of in the environment which causes a health hazard. The density of granite is between 2.65 to 2.75 g/cm3 and compressive strength will be greater than 200 MPa.

Granite fines were obtained from the polishing units and the properties were found. Since the granite powder was fine, hydrometer analysis was carried out on the granite powder to determine the particle size distribution. From hydrometer analysis, it was found that the coefficient of curvature was 1.95 and the coefficient of uniformity was 7.82. The specific gravity of the granite fines was found to be 2.61. The grain size distribution for granite fines is shown in figure 1 below.

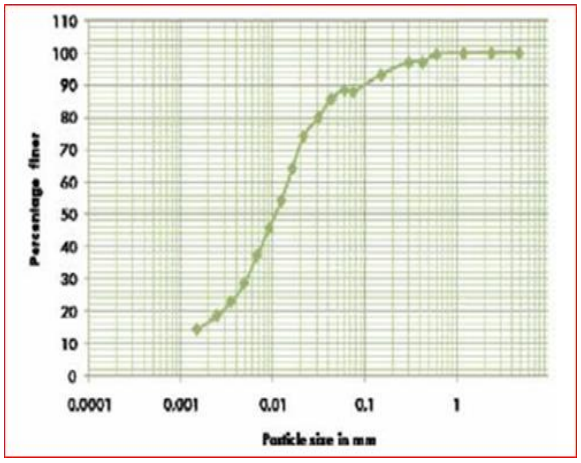

Figure 1: Particle Size of Granite Fines

2. EXPERIMENTAL SETUP

A. *Raw Material Required*

The concrete commonly used to make concrete blocks is a mixture of powdered Portland cement, water, sand, and gravel. This produces light blocks with a fine surface texture and high compressive strength. A typical concrete block weighs 38-43 lb (17.2-19.5 kg). In general, the concrete mixture used for manufacturing the blocks used for general construction purposes has a higher percentage of sand and a lower percentage of gravel and water than the concrete mixture used for the manufacturing of the Hollow concrete blocks. This produces a very dry stiff mixture that holds its shape when removed from the mold. The Hollow Concrete Blocks are made up of sand, cement, and varying proportions of granite fines and water.

Sand: The sand used was clean, sharp river sand that was free of clay, loam, dirt, and any organic or chemical matter. It was sand passing through a 4.75mm zone of British Standard test sieves. The sand had a specific gravity of 2.66 and an average moisture content of 0.90%. The coefficient of uniformity of the sand was 2.95.

Cement: The cement used was Ordinary Portland Cement.

Water: The water used was fresh, colorless, odorless, and tasteless potable water that was free from organic matter of any type.

Granite fines: The granite fines were obtained from the limestone quarry in City. The specific gravity of the granite fines was 2.7 and the average moisture content was 0.32%. The coefficient of uniformity of the granite fines was 10.7.

Grading of aggregates: The grading of an aggregate defines the properties of different sizes in the aggregate. This grading has a considerable effect on the workability and stability of the mix. Mechanical sieving analysis was used for the particle size distribution of the sand and aggregates used in this study.

3. RESULTS

The results are presented in the graphical and tabular form showing the readings of compressive strength against the percentage of replaced granite fines. For the blocks made with a 1:2:4 mix proportion, the observed readings show that a percentage of 25 % replaced granite fines gave the highest compressive strength for all ages of the hollow concrete block.

Table 1: Percentage of Granite

Percentage	Cement	Fine Agg.	Coarse Agg.	Water	Granite fines
0.00%	14.44Kg	39.34 Kg	56.06 Kg	6.21 lit	0.000 Kg
12.5%	14.44 Kg	39.34 Kg	49.06 Kg	6.21 lit	7.000 Kg
25.0%	14.44 Kg	39.34 Kg	42.05 Kg	6.21 lit	14.01 Kg
37.5%	14.44 Kg	39.34 Kg	35.03 Kg	6.21 lit	21.02 Kg
50.0%	14.44 Kg	39.34 Kg	28.03Kg	6.21 lit	28.03 Kg

Replacement of Coarse Aggregate by Granite Fines

Table 2: Replacement of Coarse Aggregate by Granite Fines

S/N	Specimen Notation	% Replacement Of Coarse Agg.	Cement	Fine Agg.	Granite Fines	Coarse Agg.
1	4HHCB1	0.00%	1	2	0.0	4
2	4HHCB2	12.5%	1	2	0.5	3.5
3	4HHCB3	25.0%	1	2	1.0	3.0
4	4HHCB4	37.5%	1	2	1.5	2.5
5	4HHCB5	50.0%	1	2	2.0	2.0

4. CONCLUSION AND FUTURE SCOPE

Based on the results obtained, the following conclusions

a) Granite fines do improve the compressive strength of the Hollow concrete blocks.

b) The compressive strength increases with the age of Hollow concrete blocks.

c) The compressive strength increases from 0% to 25% granite fines replacement beyond which the strength falls.

d) At 25% granite fines content shows the most effective replacement for the structural performance.

e) The Blocks manufactured in this experimental program with granite fine particles as an additive ensure effective packing and large dispersion of

f) cement particles which resulted in a good degree of surface finish and edges.

g) It is evident from the results obtained that the compressive strength and the performance of the Hollow concrete blocks can be increased with proper compaction techniques. When compared to compaction with machine vibration the blocks manufactured with uniform hand compaction give higher compressive strength

h) The 28 days compressive strength of the 4 Holed Hollow concrete block with mix proportion 1:2:4 with is taken as a base without;

The hollow concrete block will continue to evolve as architects and block manufacturers develop new shapes and sizes. These new blocks promise to make building construction faster and less expensive, as well as result in structures that are more durable and energy-efficient.

Some of the possible block designs for the future include the biaxial block, which has cavities running horizontally as well as vertically to allow access for plumbing and electrical conduits; the stacked siding block, which consists of three sections that form both interior and exterior walls; and the heat soak block, which stores heat to cool the interior rooms in summer and heat them in winter.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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