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EXPERIMENTAL ANALYSIS ON GRANITE WASTE POWDER

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ABSTRACT

Granite powder is one of the most active research element that influence a number of construction activities including civil engineering and construction materials. In India granite stone dust settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and Public health. Therefore, utilization of stone dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the Environment. It is most essential to develop eco-friendly concrete from stone waste. In this research study the cement has been replaced by granite stone waste accordingly in the range of 0%, 5%, 15%,& 20% by weight for M20 grade concrete. Concrete mixture was tested and compared in terms of workability and strength to the conventional Concrete. These tests were carried out to evaluate the mechanical properties for 7 and 28 days. Along with this concrete mixes constant 1% and 2% of admixture galvanized steel is used as fibre and again compared with conventional concrete.

Index Terms: Granite, Galvanized fiber, workability.

1. INTRODUCTION

1.1General:

Concrete is compound and homogeneous material that is compound mainly of water, aggregate and cement. In general additives and reinforcements are included in the mixture to get the desired physical properties of the finished material. When the ingredients mixed together, they form a fluid mass that can be simply mould into the required shape. Over time goes on, the cement form a hard matrix which binds the rest of the ingredients into a durable stone like material so with many uses.Concrete has been a leading construction material for over a century. Its annual global production is about 3.8 billion m^3 - roughly 1.6 tonnes per capita which is from Portland Cement Association. For the last few years, great emphasis was chosen on green concrete as the results of sustainable development. Green concrete is implies by an application of industrial wastes to reduce consumption of natural resources, to save energy and minimize pollution in environment. In the various varieties of industrial wastes produced the marble or granite wastes, having potentiality in utilisation as the one of the element in the concrete.These wastes can be used as a filler material to reduce the total voids content in concrete and pozzolonic material like as cement in the concrete as mix while containing its of the physical and mechanical properties. Granite or marble waste is an industrial

waste which obtain from the granite industry in a powder form. As from the data total waste from these industries in this region may be approximately 2100 Tonnes per week. This waste is easily carried away by the air and hence causes problems to human beings as in case of health and environment.With the greater increase in the quantity of waste disposal, coupled with shortage of dumping sites, increase in the transportation and dumping costs the quality of environment, has got seriously deteriorated preventing sustainable development. As granite powder waste (GPW) is a very finer material, it will easily carried away in the air and it causes nuisance causing health problems and also environmental pollution. Granite powder waste (GPW) is a fine material; it gets easily carried away by air and causes nuisance and health problems as well as environmental pollution.The major effects of air pollution are lung diseases and inhaling problems with the majority of people living in and around being affected the worst. In this present work, GPW to cement. To find in this investigation have used granite waste as partial replacement to different percentage the compressive strength, split tensile strength and flexural strengths of concrete have been determined. By doing so, the objective of reduction of cost construction can be met and it will help to overcome the environmental problem associated with its disposal including the environmental problems of the region.

1.2 SIGNIFICANCE:

In structural construction, the usage of cement is most prominent material of concrete. Resources having granite have no problem in construction industry, but places with the other type of aggregate is also available as equal to the granite. We need to preserve the natural granite material for upcoming generations, it is very important to use other available resources as construction material up to some percent. Because of this reason this study should be carried out to overcome the problem as well as to the benefits of coming generations.

1.3 OBJECTIVES:

1. To provide some details about the use of granite powder.
2. To examine the suitability of locally granite powder as replacement of cement.
3. To be examine the shear strength of concrete with replaced granite powder.
4. Beneficial and economic value to the local people.
5. To make explore the usage of locally available materials in structural constructions.

2. LITERATURE REVIEW

Literature review Many studies have been carried out in different countries (including Egypt) to use natural stone waste in mortar and concrete. Most of these researches used marble, granite and lime stone waste as a replacement of cement or sand in concrete mix in order to investigate their effects on the physical and mechanical properties of concrete. Most of these researchers used marble waste as a replacement of sand in mortar or concrete mix. All the experimental data showed that the addition of these wastes improves the physical and mechanical properties due to its high fineness of the waste particles. It was investigated by Yılmaz, et al., 2010 that 90% of the particles are below m The results of study done by Almeida,N., Brancoμ200 F., and Santos, J., 2007 showed that the substitution of 5% of the sand content by stone slurry induced

higher compressive strength, higher splitting tensile strength and higher modulus of elasticity. Hameed, M., and Sekar, A., 2009 found that the compressive, split tensile strength and durability studies of concrete made of quarry rock dust are nearly 14 % more than the conventional concrete.

Valeria C. et al., 2010 study revealed that 10% substitution of sand by the marble powder in the presence of a super-plasticizing admixture provided maximum compressive strength at the same workability level, comparable to that of the reference mixture. Other studies such as undertaken by Rai, B., et al., 2011 and Ali A. et al, 2014 concluded that there was an increase in compressive strength (higher than the reference concretes) up to 15% replacement of fine aggregate with marble granules.

Demirel, B., 2010 explained that as the curing age increased, its contribution to the compressive strength of the marble waste dust is reduced. As curing time increases, the waste contribution to the compressive strength decreases. Similar results have been reported earlier by Binici et al, 2007 and Patel, N., Raval, A., and Pitroda, J., 2013. To the contrary of all previous research, Hebhoub, H., et al., 2011 observed that the substitution of natural aggregates by waste marble aggregates up to 75% of any formulation is beneficial for the concrete resistance. On the other hand, the concrete resistance to sulphate attack was enhanced greatly (Hameed, M., and Sekar, A., 2009). Omar M. et al, 2012 concluded that the workability of green concrete was not affected by the addition of lime stone waste (LSW) to the concrete mix while the compressive strength increased by 12% after 28days when using LSW up to 50% of sand replacement with a super plasticizer.

Presence of marble powder (MP) with LSW (up to 50%) increased the compressive strength in the mixes about7%. Indirect tensile strength increased about 17% when using 50 % LSW and 15 % M.P as sand replacement. Other researchers used marble waste as a replacement of cement in mortar or concrete mix. Results showed that - comparing with the reference sample- there was insignificant variation in compression strength values (Alzboon, K., and Mahasneh, K., 2009). Ali A. et al, 2014 revealed that the compressive strength of concrete made with 15% marble dust as cement replacement has been found to be either comparable or less than control mix. However, Valeria C. et al., 2010 indicated a decrease in compression strength of 20% than control mix using a substitute of 10% of cement by marble powder in the presence of a super-plasticizing admixture. Rare researchers investigated the contribution of granite wastes in concrete mix as a replacement of sand or cement.

Abukersh, S. and Fairfield, C., 2011 assessed red granite dust (RGD) for suitability as a replacement for up to 30% by mass of the cement content of concrete made with recycled coarse aggregates. The results showed that natural aggregate concretes produced with RGD at 30% cement replacement had strengths either comparable to, or better than, equivalent control mixes. Concrete mixes containing 30% RGD showed good workability, better than expected mechanical properties and excellent surface finish. Based on the extensive review of research conducted in some stone producing countries in the field of re-using marble and granite wastes in

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the production of mortar and concrete, it is clear that few Egyptian attempts has been presented to incorporate natural stone waste in other industrial activities. These efforts had been undertaken to re-use marble wastes in concrete on a preliminary basis but rarely investigated granite wastes. This research is part of an on-going project aiming to reuse granite waste in producing green concrete to reduce its negative environmental damage.

3. EXPERIMENTAL INVESTIGATION

Experimental work

Materials

All the materials used in this research were local materials. The properties of these materials were determined according to the Egyptian Standard Specifications and the recommended code of practice.

Portland cement

Commercial Torah Portland-limestone blended cement (OPC) according to the Egyptian standards was used. The fineness of cement was 9 % passing from sieve 170 and its relative density (specific gravity) was 3.15. It's initial and final setting were 2 hrs and 3hrs 12 minutes resp.

Aggregate

Natural sand from pyramids quarries Giza with a maximum size of 4.75 mm was used as fine aggregate. Course aggregate with a maximum nominal size of 19 mm was used.

Granite waste

A granite sludge powder was used, which was obtained as a by-product of granite sawing and shaping from Egyptian marble factory (gang saw granite type from Shaqu Elteban zone). It can be observed that the granite powder had a high specific surface area; this could mean that its addition should confer more cohesiveness to concrete. The granite waste is produced as ''slurry", a mud made of powder and water. The wet granite sludge was dried up prior to the preparation of the concrete samples in order to have a constant W/C ratio in the designed mix. Slurry granite waste was weighed before putting in an oven at a temperature of 200 C for 6 hours. The granite powder was then weighed back and the difference of weight (before and after drying) should be less than 10% to insure minimum water content. The granite waste used as cement replacement has particles passed through sieve no. 300. While, the granite waste used as sand replacement has particle passed through sieve no 4.76.mm.

Water

Clean tap water was used in the production of the concrete samples. Water used in mixing and curing concrete is in accordance to ASTM C 94 (1993) specifications. The temperature of mixing water was maintained between 20-30C Concrete design mix Based on the Egyptian Standard, design mix for 350 grade of concrete was prepared by partially replacing cement or fine aggregate with four different percentages by weight of granite waste (0%, 5%, 10%, and 15% for cement replacement) and (0%, 10%, 17.5% and 25% for sand replacement).

3.1 GENERAL:

Few experimental works has been done on following materials to attain the specified objectives, which were mentioned in the previous chapters.

3.1.1 CEMENT:

Ordinary Portland cement of 53 GRADE was used. The physical and chemical Properties of cement are represented in following table 4.1 & 4.2

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4. TEST RESULTS

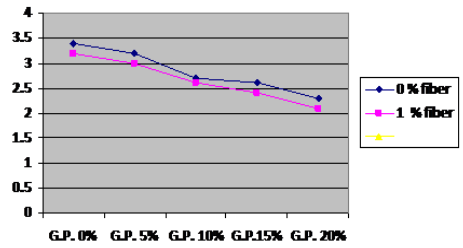

Figure 4.1 % replacement vs slump

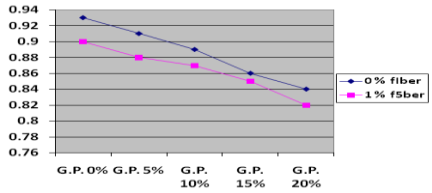

Fig 4.2. Percentage of replacement Vs Compaction factor

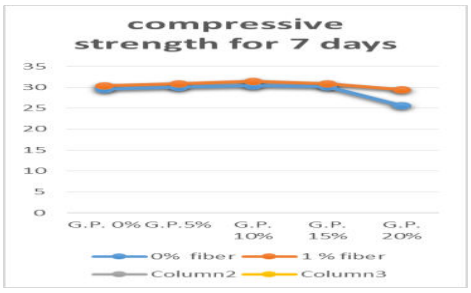

Figure 4.3 Percentage replacement vs Compressive strength for 7 days

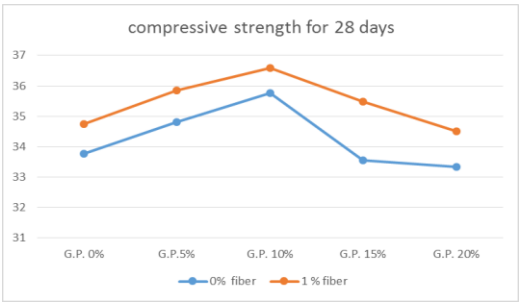

Figure 4.4 Percentage replacement vs Compressive strength for 28 days

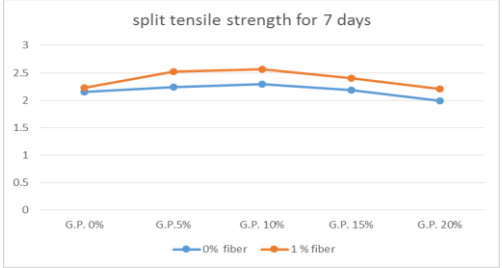

Figure 4.5 Percentage replacement vs tensile strength for 7 days

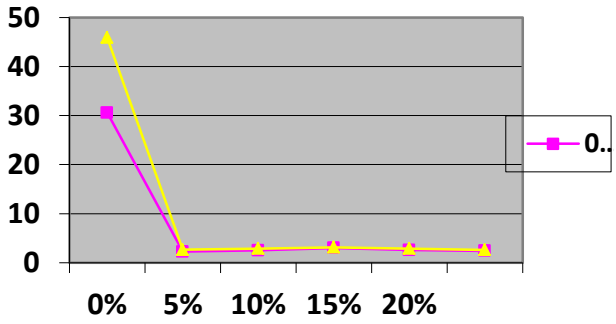

Figure 4.6 Percentage replacement vs Split tensile strength for 28 days

CONCLUSIONS

i. The Compressive strength of Cubes are increased with addition of granite powder up to 10% with +5.92% and further any addition of granite powder the compressive strength decreases till 20% with -1.3%. Addition of 1% fibres improves the compressive strength value of concrete +6.32%.

ii. The Split Tensile strength of Cylinders are increased with addition of granite powder up to 10% with 33.18% and further any addition of granite powder till 20% the Split Tensile strength decreases with +7.07%.Addition of 1% fibres improves the split tensile strength value +36.38%.

iii. Workability of concrete mix decreased with replacement of cement with granite powder. But up to some extent even replaced concrete mixes got optimum results. Addition of fibres decreases the workability properties of mix even it replaced with Granite Powder.

iv. Thus we found out the optimum percentage for replacement of granite powder and fibre with cement and it is almost 10% cement for both cubes and cylinders

v. By considering all the above parameters like slump cone value, compaction factor value, compressive

strength and split tensile strength, it is concluded that it is better to limit the replacement level of "Granite Powder up to 10%" only.

vi. Failure pattern of cube specimens and cylindrical specimens is almost similar to all mix batches.

vii. We have put further a simple step to minimize the costs for construction with
usage of Granite Powder which is freely or cheaply available.

· We have also stepped into a realm of saving the environmental pollution by cement production being our main objective as Civil Engineers.

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