

Green Concrete for partial replacement of cement with marble and Granite Slurry : A Case review

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Abstract: As per analysis of various review articles and research we have studied that the study the behaviour of concrete, having partial replacement of cement with waste marble powder M25 grade for which the marble powder is replaced by an experimental study was carried out and the effect on compressive strength and split tensile strength characteristics (0%, 4%, 8%, 12%, 16%, 20%) was studied. The result of this present investigation indicates that the replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength. The optimum percentage for replacement of marble powder with cement and it is almost 12% cement for both cubes and cylinders and it also minimize the costs for construction with usage of marble powder which is freely or cheaply available more importantly.

The Optimization of Granite Powder and its effect on fresh and hardened properties of Ready Mix Concrete with partial replacement to Cement were investigated. Mix design of M20 Grade was done according to Indian Standard Code IS 10262:2009 using Granite Powder and Manufactured Sand. Specimens were tested for evaluation of optimum percentage of Granite Powder in Ready Mix Concrete for Compressive Strength. Workability was measured in terms of Slump and Compacting factor. The Ready Mix Concrete exhibits excellent strength with 20 percent replacement of Cement by Granite Powder along with Manufactured Sand. Granite Powder and Manufactured Sand can be used in concrete as viable alternative materials in making the Concrete. This paper proposes the Applications of Granite Powder and Manufactured Sand as an attempt towards sustainable development in India. This paper describes the feasibility of using Granite powder in Ready Mix Concrete production as partial replacement to cement. Further, this paper encourages the Engineers, Contractors and Government to accept the alternative materials for the better future.

Key Words: Ready Mix Concrete (RMC), Granite Powder, Manufactured Sand (M. Sand), Super plasticizer, Compressive Strength, Optimization. Marble powder, slump, compressive strength and split tensile strength.

Introduction:

The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. Presently large amounts of marble dust are generated in natural stone processing plants with an important impact on environment and humans. This project describes the feasibility of using the marble sludge dust in concrete production as partial replacement of cement. In INDIA, the marble and granite stone processing is one of the most thriving industry the effects if varying marble dust contents on the physical and mechanical properties of fresh

and hardened concrete have been investigated. Slump and air content of fresh concrete and absorption and compressive strength of hardened concrete were also investigated. Test results show that this industrial by product is capable of improving hardened concrete performance up to 10%, Enhancing fresh concrete behaviour and can be used in architectural concrete mixtures containing white cement. The compressive strength of concrete was measured for 7 and 28 days. In order to evaluate the effects of marble dust on mechanical behaviour, many different mortar mixes were tested.

Influence of granite waste as partial replacement of cement in concrete:

Indian Granite Stone Industry currently produces around 17.8 million tonnes of solid granite waste and out of which 12.2 million tonnes will be the rejects at the industrial sites, 5.2 million tonnes in the form of cuttings or trimmings and 0.4 million tonnes granite slurry at processing and polishing units. Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. Marble stone industry generates both solid waste and stone slurry. Solid waste results from the rejects at the mine sites or at the processing units. Stone slurry is a semi-liquid substance consisting of particles originating from the sawing and the polishing processes and water used to cool and lubricate the sawing as well as polishing.

Objectives:

In this project our main objective is to study the influence of partial replacement of cement with marble powder, and to compare it with the compressive and tensile strength of ordinary M20 concrete. We are also trying to find the percentage of marble powder replaced in concrete that makes the strength of the concrete maximum.

Nowadays marble powder has become a pollutant. So, by partially replacing cement with marble powder, we are proposing a method that can be of great use in reducing pollution to a great extent.

Results and Discussion:

Compression Test:

Mechanical behaviour of concrete cubes prepared without chemical admixtures was studied by compressive tests (Grade M20 and curing time of 7 days and 28 days. It can be noticed that 5% replacement of cement with marble dust in mild condition and 10% replacement of cement with marble dust in mild condition, are showing increase in compressive strength.

Tensile Strength test:

Mechanical behaviour of cylindrical specimens prepared without chemical admixtures was studied by tensile strength test. (Grade M20), curing times of 7 days and 28 days and the results obtained are reported. It is noticed that 5% replacement of cement with marble dust in mild condition and 10% replacement of cement with marble dust in severe conditions, are showing increase in tensile strength.

Discussion:

- 1) With the inclusion of Marble powder the strength of concrete gradually increases up to a certain limit but the gradually decreases.
- 2) With the inclusion of Marble powder up to 12% the initial strength gain in concrete is high.
- 3) Up to 12% replacement of cement with waste marble there is increase in all mechanical properties.

- 4) The replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength.
- 5) The optimum percentage for replacement of marble powder with cement and it is almost 12% cement for both cubes and cylinders.
- 6) To minimize the costs for construction with usage of marble powder which is freely or cheaply available more importantly.
- 7) To realm of saving the environmental pollution by cement production; being our main objective as Civil Engineers.
- 8) Compressive strengths of 30.14 Mpa and 24.46 Mpa were obtained for 20% and 25% replacements from which the optimum percentage of replacement can be established for the Target Mean Strength of 26.6 Mpa which was calculated in the Mix Design. This works out to be 23.11 % by interpolation. 20% will be the ideal replacement.
- 9) The cost of construction can be minimized by using Granite Powder which is available at free of cost.
- 10) Environmental Pollution can be minimized by reducing the production of cement and also the health hazards can be controlled by using the Granite powder as the partial replacement to Cement.
- 11) Manufactured sand gives better surface finishes and can be conveniently used in making the Ready Mix Concrete. Considering, the acute shortage of river sand, huge short-comings on quality of river sand, high cost, greater impact on road damages and environmental effects, the M. Sand proves to be one of the best alternatives to the Natural River Sand.
- 12) The Construction Industry shall start using Manufactured Sand to the full extent as alternative to the Natural River Sand.

Conclusions:

Due to marble dust, it proved to be very effective in assuring very good cohesiveness of mortar and concrete. From the above study, it is concluded that the marble dust can be used as a replacement material for cement; and 10% replacement of marble dust gives an excellent result in strength aspect and quality aspect and it is better than the control concrete. The results showed that the substitution of 10% of the cement content by marble stone dust induced higher compressive strength, higher splitting tensile strength, and improvement of properties related to durability.

Test results show that this industrial waste is capable of improving hardened concrete performance up to 15%, enhancing fresh concrete behaviour and can be used in plain concrete.

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