Partial Replacement of Cement with Marble Powder and Fine Aggregates with Glass Powder

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Abstract— Marble stone industry generates both solid and stone slurry and as per survey solid waste generation is more in marble stone industry, in and about 40% of waste is formed, that is around 68 million tonnes. So, by dumping these wastes to the land may cause environmental problem and also effect the fertility of the soil. In this present study, concrete mix was prepared according to IS 10262:2009 and experimental studies were carried out to investigate the strength properties of M25 concrete made with various mixes. Properties studied include compressive strength and split tensile tests of hardened concrete. Marble dust used was 6%, 9%, 12%, 15% and 18% and also strength will be compared with conventional concrete. this study was undertaken to evaluate the effect of partial replacement of Fine aggregates with glass powder in concrete. Experimental programme was conducted using 5% partial replacement of fine aggregates with glass powder has taken for concrete of M25 grade with 0.45 water cement ratio. In this study, set of cubes and beams were cast for compressive and split tensile strength respectively. Concrete specimens were tested after 7-, 14- and 28-days curing. It has been observed that 25% replacement of fine aggregates with glass powder is adaptable.

Keywords: Ansys, Beam, Failure, Cracks, Frequency, Mode Shape, Structural Analysis

I. INTRODUCTION

Concrete is by far the most widely used construction material today. The versatility and flexibility in concrete, its high compressive strength and the discovery of the reinforcing and prestressing techniques which help to make up for its load tensile strength have contributed largely to its widespread use. We can rightly say we are in age of concrete. But now a Days due to rapid growth in construction cement is very costly. Also due to large growth in industrialization there is a large amount of wastes generated, which is hazardous to environment and living beings. To overcome above problems wastes generated can be used as alternative materials. Marble powder can be used as replacement for cement.

Marble dust is produced from the marble processing plants during the cutting, shaping and polishing. During this process, about 20-25% of the process marble is turn into the powder form.India being the topmost exporter of marble, every year million tons of marble waste form processing plants are released. The disposal of this marble on soils causes reduction in permeability and contaminates the over ground water when deposited along catchment area. Thus, utilizing these materials in construction industry itself would help to protect the environment from dumpsites of marble and also limit the excessive mining of natural resources of sand.

Construction activities are taking place on huge scale all over the world and demand of construction materials are increasing day by day. Production of concrete and utilization of concrete has rapidly increased, which results in increased consumption of natural aggregates and sand. Aggregate is one of the main ingredients in producing concrete which covers 75% of the total for any concrete mix. Strength of concrete produced is dependent on the properties of aggregates used .conventionally concrete is mixture of cement, sand and aggregates since all the ingredients of the concrete are of geological origin, the construction industries are in stress to identify alternative materials to replace the demand of natural sand and aggregate. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients. Every year 250-400 tons of stone wastes are generated on site. The stone cutting plants are dumping the powder in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. Thisleads to serious environmental and dust pollution and occupation of a vast areas of land, especially afterthe powder dries up so it is necessary to dispose the stone waste quickly and use in the construction industry.

II. LITERATURE REVIEW

1) Manju Pawar et.al (2014) A Study has been conducted on Periodic Research, TheSignificance of Partial replacement of Cement with Waste Marble Powder. They found that the effect of using marble powder as constituents of fines in mortar or concrete by partially reducing quantities of cement has been studied in terms of the relative compressive, tensile as well as flexural strengths. Partial replacement of cement by varying percentage of marble powder reveals that increased waste marble powder (WMP) ratio result in increased strengths of the mortar and concrete .Leaving the waste materials to the environment directly can cause environmental problem. Hence the result, The Compressive strength of Concrete are increased with addition of waste Marble Powder up to25 % replace by weight of cement and further any addition of WMP the compressive strength decreases. The Tensile strength of Concrete are increased with addition of waste marble powder up to 25 % replace by weight of cement and further any addition of WMP the Tensile strength decreases. Thus they found out the optimum percentage for replacement of MDP with cement and it is almost 25 % cement for both compressive & tensile strength.
2) V.M. Sounthararajan et.al (2013) A Study has been conducted on Effect of theLime Content in MDP for Producing High Strength Concrete. They found that the MDP up to 10% by weight of cement was investigated for hardened concrete properties. Furthermore, the effect

of different percentage replacement of MDP on the compressive strength, splitting tensile strength and flexural strength was evaluated. It can be noted that the influence of fine to coarse aggregate ratio and cement-tototal aggregate ratio had a higher influence on the improvement in strength properties. A phenomenal increase in the compressive strength of 46.80 MPa at 7 days for 10% replacement of MDP in cement content was noted and also showed an improved mechanical property compared to controlled concrete.

3) Corinaldesi V et.al., (2010) Marble as a building material especially in palacesand monuments has been in use for ages. However the use is limited as stone bricks in wall or arches or as lining slabs in walls, roofs or floors, leaving its wastage at quarry or at the sizing industry generally unattended for use in the building industry itself as filler or plasticizer in mortar or concrete. The result is that the mass which is 40% of total marble quarried has reached as high as millions of tons. This huge unattended mass of marble waste consisting of very fine particles is today one of the environmental problems around the world.

III. Experimental Investigations

A. Waste Marble Dust

Marble powder is produced from the marble processing plants during the cutting, shaping and polishing. During this process, about 20-25% of the process marble is turn into the powder form. It was initially in wet form (i.e. slurry); after that it is dried by exposing in the sun and finally sieved by IS-90 micron sieve before mixing in concrete India being the topmost exporter of marble, every year million tons marble waste from processing plants are released. The disposal of this waste marble on soils causes reduction in permeability and contaminates the over ground water when deposited along catchment area.

B. Cement

A cement is a binder, a substance that sets and hardens and can bind other materials together. The word "cement" traces to the Romans, who used the term opus caementicium to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick supplements that were added to the burnt lime, to obtain a hydraulic binder, were later referred to as cementum, cimentum, cäment, andcement. Cements used in construction can be characterized asbeing either hydraulic or non-hydraulic, depending upon the ability of the cement to beused in the presence of water.

C. Glass Powder

Glass powder is an extremely fine powder made from ground glass. It can be used in a number of industrial and craft applications and is often available through suppliers of glass and industrial supplies. High precision machining equipment is necessary to prepare it, as it needs to be very uniform, with an even consistency. Costs vary, depending on the level of grind and the applications. Some companies use recycled glass to make their glass powders, while others may use specially made glass. The process can involve dry or wet grinding to achieve particles of the desired size. Pigments can be added to make colored glass powders, and companies can also work with colored glass if they want to make powders of a particular color, like blue. The finished product can be hazardous and must be handled with care.

D. Coarse Aggregates

Construction aggregate (coarse aggregate), or simply "aggregate", is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geo synthetic aggregates. Aggregates are the most mined materials in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material. Due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundation and French drains, septic drain fields, retaining wall drains, and road side edge drains.

IV. Experimental

A. Glass Powder Concrete Mix:

The present experimental study was undertaken to replace the fine aggregates in concrete with glass powder and to check the compressive strength and split tensile strength of concrete for M25 grade concrete. In the present work cubes and cylinders were tested for different percentage of glass powder replacing fine aggregates in concrete for M25 grade concrete. In the experimental study stone dust, the cubes were tested for 7,14 and 28 days compressive strength 5% replacement of fine aggregate by glass powder in M25 grade concrete.

B. Casting of Specifications with Marble Dust:

Marble powder were added in concrete in step of 6%, 9%, 12%, 15% and 18%. For each percent ofmarble dust replacing cement, 3 cubes and 2 cylinders for 7 days,14 days and 28 days. However, there is a slight decrease in compressive strength value concrete mix when 18% marble granule is used as compared with that of 15% marble granule mix.

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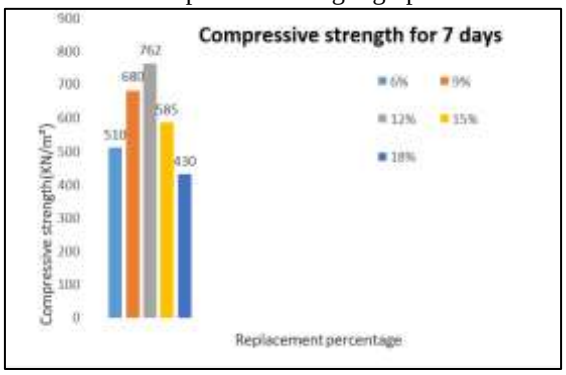
D. Curing of Concrete:

Cubes must be cured before they are tested. Unless required for test at 24 hours, the cube should be placed immediately after demoulding in the curing tank or mist room. The curing temperature of the water in the curing tank should be maintained at 27- 30°C. If curing is in a mist room, the relative humidity should be maintained at no less than 95%. Curing should be continued as long as possible up to the time of testing. Marking cubes for identifying.

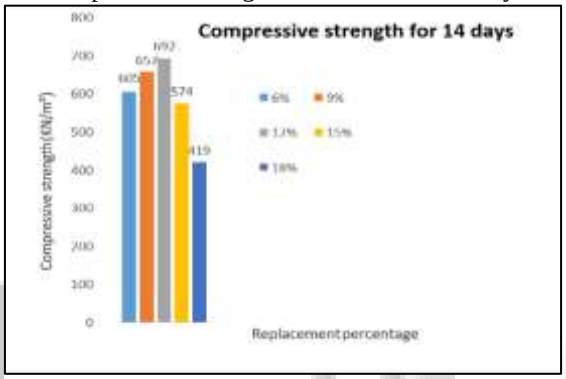
V. RESULTS AND DISCUSSIONS

A. Compressive strength of Concrete:

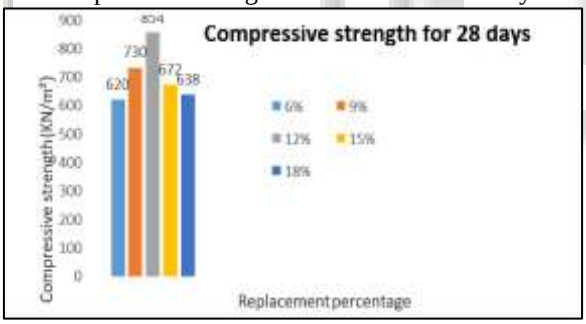
Compressive strength graph



Compressive Strength of Concrete for 7 Days



Compressive Strength of Concrete for 14 Days



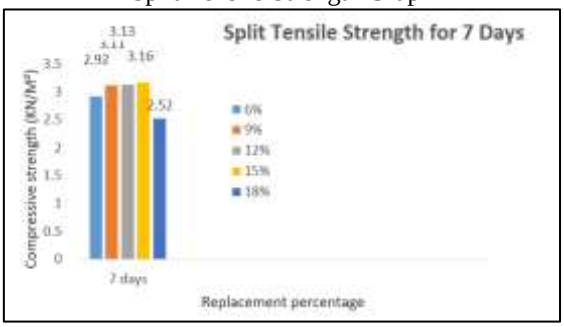
Compressive Strength of Concrete for 28 Days

The concrete mix is prepared for M25 grade and cement is replaced by marble dust and fine aggregate with a glass powder as certain percentage. These are the graphs which shows the 7 days, 14 days and 28days strength of the concrete mix, graph also says, there is increase in strength as compared to conventional concrete. However there is a decrease in compressive strength value concrete mix when 5% glass powder is used and cement is replaced partially with a marble powder up to 15%.

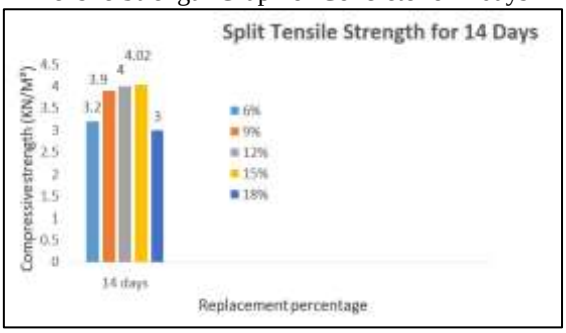
B. Split Tensile Test:

The cylinder is placed horizontally between the loading surfaces of compression testing machine and the load is applied till failure of the cylinder. Packing material such as plywood is used to avoid any sudden loading. During the test the platens of the testing machine should not be allowed to rotate in a plane perpendicular to the axis of cylinder.

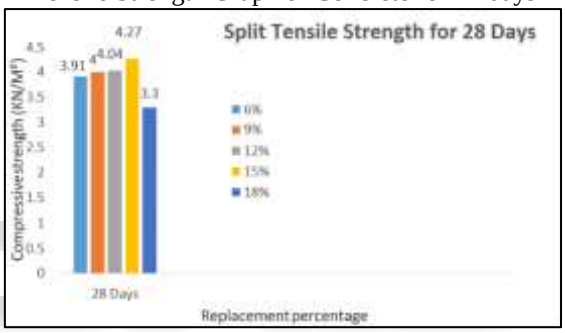
Split Tensile Strength Graph



Tensile Strength Graph of Concrete for 7 days



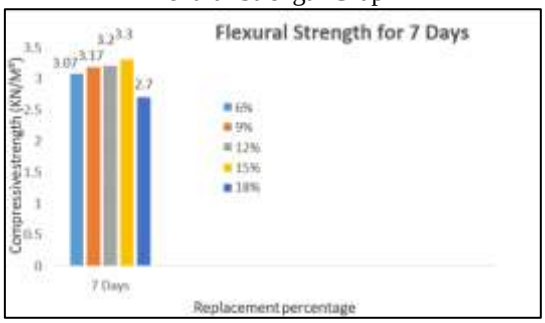
Tensile Strength Graph of Concrete for 14 days



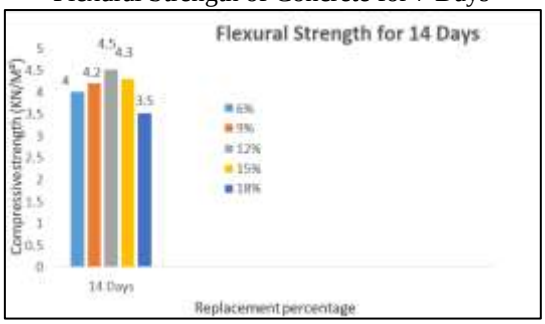
Tensile Strength Graph of Concrete for 28 days

C. Flexural Strength:

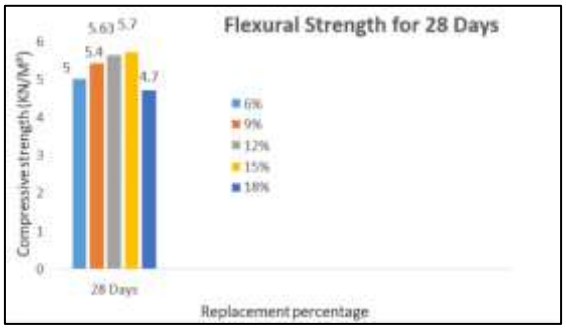
Flexural Strength Graph



Flexural Strength of Concrete for 7 Days



Flexural Strength of Concrete for 14 Days



Flexural Strength of Concrete for 28 Days

VI. Conclusion

The following conclusions can be made from the results of compressive strengths and from the analysis of the graph

1) The compressive strength and split tensile strength of concrete for M25 with glass powder as fine aggregates and cement replaced with a marble dust were found to be comparable with the concrete made with the river bed sand.
2) The increase in compressive strength of concrete with 12% replacement of cement with a marble powder and 5% replacement of fine aggregates with brick dust were found to be given better strength.
3) Glass powder can affectively be used in plain cement concrete in place of fine aggregates.
4) Non availability of sand at reasonable costs as fine aggregate in cement concrete for various reasons, search for alternative material brick dust qualifies itself as a suitable substitute for sand at very low cost.
5) Crushed glass powder is a free chemical impurities such as chlorides and sulphates which improves the property of concrete like strength and durability.
6) Effective utilization of glass powder in concrete can save the waste of quarry works, and also produces a "greener" concrete.
7) In the study compressive strength of specimen is increased with addition of marble dust compared to conventional concrete up to 12% and there is a sudden decrease in strength for 15% concrete.
8) Split Tensile and Flexural strength of concrete is observed to be higher and varying from 12% to 15%.

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