A Study on Partial Replacement of Cement with Marble Waste in Concrete

P. PRAVALLIKA[1], A. KUSUMA[2], G. V. SUBBARAO[3], M. RAKESH[4], S. ANIL KUMAR REDDY[5], L. RAMA PRASAD REDDY[6]

[1, 2, 3 4, 5] *Student, PACE Institute of Technology & Sciences*

[6]*AssociateProfessor PACE Institute of Technology & Sciences*

***Abstract*— By partially lowering the amount of cement and other standard fines, the relative workability, compressive and flexural strengths of using marble powder and stone granules as fines in mortar or concrete have been investigated in this study. Research on fine aggregates by varying ratios of marble powder and stone granules often results in greater workability and compressive strength of the mortar and concrete, with partial cement replacement. Increased building activities for different regions and utilities are forcing natural resources to become overexploited and scarred. Stone dust works well as a natural sand alternative in construction. combining all of the ingredients, including water, aggregates, cement, and sand. Stone dust is used to make concrete instead of fine aggregates. For this use, stone dust is collected from quarries. A 1mm screen should be used to filter stone dust. We are using M30 grade concrete for this job. Mix design is taken into account here. The environment may suffer if waste is let into the ecosystem directly. As a result, the significance of recycling trash has been emphasized. The results show that adding marble dust in different percentages to partially substitute cement improves the workability and compressive strengths of the concrete. Marble dust powder pollutes the environment, creates dust in the summer, and puts agricultural and public health at jeopardy when it is settled by sedimentation and subsequently dumped. In this investigation, OPC and PPC cement have been replaced with marble dust powder in the following proportions: 0%, 5%, 10%, 15%, 20%, and 25% by weight of M-30 grade concrete, respectively. In order to compare concrete mixtures to standard concrete in terms of compressive strength, they were developed, assessed, and investigated. One byproduct of crushing operations is stone dust. It could be used in concrete in place of some of the natural river sand. With stones In addition to being of higher quality, concrete that contains dust helps protect the natural river sand for upcoming generations. Studies have shown that stone dust can partially replace natural sand for creating concrete. Consequently, we reviewed a large number of pertinent research papers in this field and attempted to enhance employing waste that was easily accessible in the neighborhood. To make all the necessary breakthroughs with the least amount of environmental damage, research in this field must yield positive outcomes.*

***Index Terms*— Marble Powder, Stone dust Granules, Compressive Strength, Split tensile Strength**

I. INTRODUCTION

Nowadays, concrete is the building material that is utilized the most frequently. Concrete is widely used because of its adaptability and flexibility, high compressive strength, and the development of pre-stressing and reinforcing techniques that help to compensate for its low load tensile strength. It is accurate to state that we live in the concrete age. But because construction cement is growing so quickly these days, it is incredibly expensive. Additionally, a great deal of garbage is produced as a result of the rapid rise of industry, endangering the environment and all living things. Wastes produced can be utilized as alternative materials to solve the aforementioned issues. Cement can be substituted with marble dust.

During the cutting, shaping, and polishing processes, marble processing factories produce marble dust. About 20–25% of the marble is turned into powder during this procedure. As the world's largest marble exporter, India releases millions of tons of waste marble from its processing facilities each year. When this marble is dumped along a catchment region, it reduces the permeability of the soil and contaminates the surface water. Therefore, using these materials in the construction sector itself would help prevent marble dump sites from polluting the environment and also restrict overuse of sand resources due to excessive mining.

There are massive construction projects going on all over the world, and there is a constant need for building

supplies. Natural aggregate and sand consumption has increased as a result of the sharp rise in concrete production and usage. One of the primary elements in concrete is aggregate, which makes up 75% of the total weight of any given concrete mix. The qualities of the particles utilized determine the strength of the concrete that is produced. Since all of the components of concrete are derived from geology, typical concrete is a blend of cement, sand, and aggregates.

As a result, the construction industry is under pressure to find substitute materials to meet the need for natural sand and aggregate. Proper component proportioning, mixing, and compacting are essential for producing strong, long-lasting concrete. On site, 250–400 tons of stone waste are produced annually. Even though places have been designated for dumping, the stone-cutting plants are disposing of the powder in any open pit or area close to their unit.

To begin this investigation was motivated by the current shortage and rising expense of natural aggregate (coarse and fine) that satisfies Indian Standards. These factors include the law of the land, sand mafia-permitted illegal dredging, and easy access to river sources during the rainy season. With this in mind, the purpose of this study was to assess the impact of partially substituting stone dust for natural sand in concrete. A trial program was carried out wherein concrete of M25 grade with a 0.45 water-to-cement ratio had partial replacements of fine aggregate with stone dust at percentages of 5%, 10%, 15%, 20%, 25%, and 30%. This project used a set of beams and cubes that were cast.

II. MATERIALS AND METHODOLOGY

Initially, the sand and cement were added and properly mixed in a dry state until homogeneity was reached. After fully combining all the materials, the mixture was added to the dry coarse aggregates and stirred for an additional three minutes. Concrete specimens were then cast using steel molds and compared in three layers using a table vibrator. Six 150 x 150 x 150 mm cubes and 150 mm diameter x 300 mm long cylinders were made for each combination in order to evaluate the split tensile strength and compressive strength, respectively.

Similar tests have been conducted in a laboratory on cube specimens and beam samples of M30 grade concrete, examining various percentages of marble powder, including 0%, 5%, 10%, 15%, and 20%. Workability, compressive strength, and flexural strength are the three characteristics of concrete that have been chosen for investigation and assessed in accordance with IS: 1199-1959 and IS: 516-1959, respectively. Prior to starting the test, the materials' qualities were ascertained using the corresponding IS codes.

Concrete was mixed with marble powder in increments of 5% (0%, 5%, 10%, 15%, and 20%). For 7 and 28 days, use 3 cubes and 3 cylinders for every percentage of marble dust substituted for cement. However, compared to a 15% marble granule mix, the compressive strength value of the concrete mix decreases slightly when 20% marble granules are added.

In order to replace the fine particles in concrete with stone dust and to assess the concrete's compressive and split tensile strengths for M30 grade concrete, the current experimental investigation was conducted. In the current study, various percentages of stone dust replacing fine particles in concrete for M30 grade concrete were investigated using cubes and cylinders. In the stone dust experimental investigation, cubes were evaluated for compressive strength for seven days and for twenty-eight days when fine aggregate was replaced with stone dust in M30 grade concrete at percentages of 0%, 10%, and 20%.

III. RESULTS AND DISCUSSION

Table 1 Results of concrete mix of stone dust and marble powder

Mix proportions	Concrete Mix		7 Days	28 Days
CM	Concrete mix		28.88	34.6
	Stone Dust	Marble Powder		
M1	0%	5%	30.66	35.55
M2	0%	10%	32.22	36.45
M3	0%	15%	30.53	36.05
M4	0%	20%	28.88	34.22

S1	5%	0%	20.22	36.3
S2	10%	0%	23.33	38
S3	15%	0%	27.55	39.11
S4	20%	0%	31.55	40.23
S5	25%	0%	28.44	34.89
C1	10%	10%	32.89	49.33
C2	10%	20%	36.67	55
C3	10%	30%	35.55	53.32

CONCLUSION

- It was discovered that the concrete for M30 manufactured using river bed sand and stone dust as fine aggregates and cement substituted with marble dust had similar compressive and split tensile strengths to that of the other concrete.
- It was discovered that concrete's compressive strength increased when 10% of the cement was replaced with marble powder and 20% of the fine particles were replaced with stone dust.
- In plain cement concrete, stone dust can be effectively substituted for fine aggregates.
- When there isn't enough sand available for a fair price to use as fine aggregate in cement concrete for a variety of reasons, stone crusher (quarry) dust can be found for very little money and is a good alternative.
- Concrete's strength and durability are enhanced by crushed stone dust, which is free of chemical contaminants such sulphates and chlorides.
- When quarry dust is used effectively, it can reduce waste from quarry operations and create "greener" concrete.
- In the investigation, adding marble dust to standard concrete increases the specimen's compressive strength by up to 10%. However, adding 20% causes the strength to abruptly decline.
- According to the study, adding marble dust to standard concrete can boost the specimen's split tensile strength by up to 10%. However, adding 20% causes the strength to abruptly decline.

REFERENCES

[1] Pooja. J. Chavhan et al Int. Journal of Engineering Research and Applications ISSN:2248-9622 vol.4, April 2014.

[2] Concrete Technology – M.S.Shetty. Design Of Concrete Mixes - N.Krishna Raju.

[3] Bahar Demire (2010), "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete".

[4] "International Journal of Civil and Structural Engineering Volume 1, No 4, (2011)." By Baboo Rai, Khan Naushad H , Abhishek Kr , Tabin Rushad S, Duggal S.K, (Influence Of Marble Granules In Concrete Mix).

[5] Valeria Corinaldesi, Giacomo Moriconi, and Tarun R. Naik (2005) "Characterization Of Marble Powder for Its Use In Mortar And Concrete .

[6] Manju Pawar et.al (2014) Feasibility and need of use of waste marble powder in concrete production. ISSN No. 2349-943435.PP 1-6.

[7] V. M. Sounthararajan and A. Sivakumar (2013) Effect of the lime content in marble powder for producing high strength concrete .ISSN 1819-6608.PP 260-264.

[8] Corinaldesi V, Moriconi G, Naik TR, (2010), ―Characterization of marble powder for its use in mortar and concrete‖, Const. Build. Mat., 24, pp 113-117.

[9] Vaidevi C (2013) Study on marble dust as partial replacement of cement in concrete .ISSN 2319 – 7757.PP14-16.

[10] Candra Aditya, Abdul Halim Chauliah, Fatma Putri, Waste Marble Utilization from Residue Marble Industry as a Substitution of Cement and Sand within Concrete Roof tile Production International Journal of Engineering Research Volume No.3, Issue No.8, pp.: 501-506 ISSN: 2319-6890) (online), 2347-5013(print) 01 Aug2014.

[11] IS:383-1970, Specification for Coarse and fine aggregate from natural sources for concrete, Bureau of Indian standard, New Delhi.

[12] IS:2386(Part I to V)-1963, Methods of Test for Aggregates for Concrete, Bureau of Indian standard, New Delhi.

[13] IS:1489(Part I)-1991, Specification for Portland pozzolana cement (Fly ash based), Bureau of Indian standard, New Delhi.