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REPLACEMENT OF COARSE AGGREGATE USING WASTE CERAMIC-MARBLE PIECES,FINDING DURABILITY

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ABSTRACT

As a result of the expanding growth and innovation in the construction industry around us, natural aggregate prices have increased tremendously. Solid waste production from building demolitions has also increased significantly. Studies show that a portion of the waste marble-ceramic tile production facilities create is changed and thrown.This waste material ought to have been put to better use in order to reduce building waste and deal with the limited supply of natural aggregate. Electric insulators, sanitary fittings, ceramic tiles, uneven bricks and other materials that are commonly wasted throughout the building and development process are all easily recycled in the construction industry. Similar to how ceramic-marble wastes can also be used as a partial substitution for coarse aggregate, ceramic tile powder can be utilised as a fine aggregate. Both coarse and fine aggregates can be substituted with crushed waste ceramic -marble and crushed waste ceramic tile powder. Here, marble-ceramic waste broken tiles were used to replace 0 percent, 20 percent, 40 percent, 60 percent, 80 percent, and 100 percent of the coarse aggregates. This experimental study looks into the viability of employing waste ceramic tile in concrete in addition to the coarse ceramic tileM30 was created and tested for this. Broken tiles were substituted for coarse aggregates and cement at varying percentages to construct the mix design for various types of mixes. Workability, compressive strength, split tensile strength, and flexural strength tests for various concrete mixes including varied amounts of crushed garbage have been completed after 7, 14, and 28 days of curing. Conditions for durability are also being tested. It has been found that workability increases as the percentage of broken tiles replaced increases. When ceramic-marble coarse aggregate is utilised, the strength of concrete can be increased by up to 80%.

Keywords -Aggregate, Ceramic Tile, Concrete, Recycling, Solid Waste,durability

1. INTRODUCTION

One of the most important building materials used worldwide is concrete. In the construction business, concrete is utilised in large quantities. Cement, fines, and coarse aggregate are also used when concrete is used. In order for concrete to have both strength and volume, aggregate is a crucial component. A non-renewable natural resource is aggregate. Our nation's resources are being overused, and the natural stock is dwindling at a startling rate. Waste marble-ceramic fragments can be used in place of coarse aggregate to assist control waste and reduce over-exploitation.The earth's supply of waste marble and ceramic is sufficient to be used as an aggregate in concrete. Utilising diverse industrial or agricultural wastes in the manufacturing of concrete is a component of green concrete building. Because of this, numerous research have looked at using recycled resources in place of aggregates or cement to create green, sustainable, and environmentally friendly concrete. Ceramic-marble trash is chosen in this instance because it resists chemicals and other physical deterioration elements quite well.These ceramic wastes are disposed of in a landfill because there is no way to recycle them. As a result, we will need to discover a different way to get rid of ceramic waste because using natural aggregates in concrete could give it better performance in terms of strength and durability while also being more environmentally friendly. The primary goal of this to Furthermore,

The main objectives are

- To reuse waste that has been dumped into the environment and to solve the disposal issue.
- Depletion of natural resources is something that can be somewhat managed.

To determine the ideal aggregate replacement rate.

2. LITERATURE REVIEW

To lessen the environmental impact of the growing amount of ceramic tile trash, researchers undertook numerous studies.In the review, it is illustrated by determining the strength of prepared concrete utilising waste ceramic wastes. The supporting tests are then conducted using a variety of different replacement percentages, and the best replacement percentage is determined.

3. MATERIALS AND METHODS

3.1 Materials

3.1.1 cement

The Bureau of Indian Standards are met by the Portland Pozzolana cement of grade 43 employed in this study.The cement's consistency, compressive strength, and beginning and final setting times have all been tested.

3.1.2 Fine aggregate

M Sand was taken from a factory nearby. Sand's specific gravity and rate of water absorption are calculated.

3.1.3 Coarse aggregate

This study's crushed stone aggregate came from a local factory. The coarse aggregate's specific gravity and water absorption are shown.The coarse aggregate utilised had a nominal maximum size of 20 mm.

3.1.4 Marble aggregate and ceramic waste

The marble waste used in this investigation was hammer-crushed from the adjacent marble industry sector. The marble aggregate's specific gravity and water absorption are shown. The chemical makeup of marble waste is described.The marble aggregate utilised has a nominal maximum size of 20 mm. The particle size distribution of traditional coarse aggregate and marble aggregate is provided.As can be seen, marble aggregate absorbs around 10% less water than natural conventional aggregate. Additionally identified were flakiness-elongation.When opposed to natural aggregate, marble aggregate lacks finer fractions of aggregates, according to the particle size distribution.ceramic particles collected from the neighbourhood has olso been carried out.

3.1.5 Concrete mix proportion

According to the BIS, the concrete mix M 30 was created. By weight, marble -ceramic wastes was used in place of the coarse natural aggregate in concrete. lists the mixture ratios for marble aggregate-containing concrete and control concrete.Marble aggregate was used to prepare the concrete, replacing the natural coarse aggregate in various amounts (20%, 40%, 60%, 80%, and 100% by weight). A constant cement content of 310 kg/m3 and a water-to-cement ratio of 0.60 were used for all concrete mixtures. In a capacity mixer, all the concrete mixtures were thoroughly mixed for 5 minutes prior to the addition of water.

Fig.1 Crushed Marble

Fig 2 Waste Ceramic pieces

Table 1 physical Properties of cement

Initial setting time	37 minutes

Final setting time	120 minutes
Compressive strength at 28 days	32.3 N/mm^2
Standard consistency of cement	38%
Specific gravity of cement	3.08

Table 2. physical properties of Aggregates

Aggregates	Specific garvity	Water absorption
Fine aggregates	2.56	0.54
Coarse aggregate	2.73	0.63
Ceramic	2.81	0.6
Marble pieces	2.65	0.3

3.2.. Casting and curing of specimens

To measure the compressive strength, splitting tensile strength, and flexural stiffness test, concrete cubes of 150 mm in size were cast. 150 mm cube specimens were cast to test the material's tolerance to harsh acidic and basic environments. Three layers of concrete were poured into the moulds, and each layer was crushed using a vibrating table in accordance with the technique outlined in Indian Standard BIS: 516-1959. After casting, each specimen underwent a 24-hour de-molding process before being stored in water at room temperature until testing dates.

4. RESULTS AND DISCUSSIONS

4.1 Compressive Strength

Standard 150 mm-size cubes, as depicted in Fig. 2, are used to estimate the compression strength of concrete in accordance with The specimen's failure load (P) must be obtained, after which the strength in compression is calculated using the formula with load divided by the area. below.

Fig.3 cube specimen at compressive testing

4.1.1 Compressive strength after normal curing

Concrete's compressive strength increases by when ceramic-marble waste replacements of 40% used, but decreases from 60% of ceramic-marble replacement. In the end, it is discovered that using upto 40% of ceramic-marble waste produces superior results when using standard curing.

4.1.2 Compressive strength under base environment

Fig 4 curing under acidic environment

The compressive strengths after 28 days of standard curing and 28 days submerged in water mixed with 4% H_2SO_4 solution gives better compressive strength of concrete with 20% replacement of ceramic waste is higher than the strength of regular concrete, according Finally, in an acidic environment, a 20% replacement of ceramic waste produces better results.

4.1.34.1.2Compressive strength under base environment

The compressive strengths after 28 days of standard curing and 28 days submerged in water mixed with 1 Molar NaOH solution gives better compressive strength of concrete with 40% replacement of ceramic waste is higher than the strength of regular concrete, according Finally, in an acidic environment, a 40% replacement of ceramic waste produces better results.

4.2 Splitting Tensile Strength

split tensile strength is tested on the cylinder specimens in with a 150 mm diameter and 300 mm length. During the test, the specimen's failure load was recorded.

Fig 4 Specimen for split tensile test

The split tensile strength is recorded better for 60% of ceramic marble replacement ,which is greater than conventional concrete,and gives more better result for 20% and 40% replacement in acidic and basic environment which is more than conventional concrete.

4.3 Flexural Strength

On beam specimens (Fig. 12) with dimensions of 850mm X 150 mm X 150 mm, a flexure strength test is performed in Universal testing machine and Flexural strength is calculated.The breaking and cracking load is found better for 40% of marble ceramic replacement in normal curing ,40% and 60% for acidic-basic environment.

Fig 5 Specimen for flexural strength

5. CONCLUSION

This study examined the impact of marble-ceramic aggregate use on concrete characteristics, and the following conclusions can be drawn:

i. As more natural coarse aggregate is replaced by marble-ceramic aggregates, the workability of all concrete mixes improves.

ii.Up to 60% of the marble-ceramic coarse aggregate used in concrete demonstrates an increase in compressive strength.

The following findings may be derived from this study's examination of how concrete qualities are affected by the usage of marble-ceramic aggregate:

iii. The workability of all concrete mixes increases when more marble-ceramic particles take the place of natural coarse aggregate.

iv.The compressive strength of upto 60% of the marble-ceramic coarse aggregate used in concrete has increased.

The creation of concrete mixes can utilise this waste as aggregates, which is advantageous from both an economic and environmental standpoint. To use this waste as an aggregate in concrete mixes, more research would be needed from the perspective of durability.

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