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An Experimental Study On Strength Characteristics Of Concrete With The Partial Replacement Of Cement By Marble Dust And Sand By Stone Dust

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ABSTRACT:

The current study aided in the development of a better knowledge of the strength properties of concrete utilising marble dust as a partial substitute for cement and stone dust as a partial replacement for sand. The need to use marble dust and stone dust as a partial substitute for cement and sand has arisen since the cost of materials has risen steadily, and sand has become scarce. The acquired waste material is utilised as a partial replacement material for the waste material produced during marble processing, stone crushing, or rock blasting.

The strength properties of concrete using marble dust and stone dust as partial replacements for cement and sand. The dissertation work is done using M30 grade concrete, in which marble dust is substituted by 0%, 5%, 10%, 15%, and 20% by weight of cement, and sand is replaced by stone dust in the range of 0%, 10%, 20%, 30%, and 40% by weight. For the M30 grade of concrete, examples were cast for 7 days, 14 days, and 28 days with different percentages of partial replacement of cement by marble dust and sand by stone dust. Compressive strength, flexural strength, and split tensile strength of all the mixtures are measured on various curing days. According to the findings of this research, partial substitution of cement with marble dust and sand with stone dust improved the compressive strength, flexural strength, and split tensile strength of concrete by 10% and 20%, respectively.

I.INTRODUCTION

1.1 INTRODUCTION

The current state of the construction sector necessitates the improvement of construction activities as well as the replacement of building materials. Concrete is important in the building business because it meets human requirements. Cement, fine aggregate, coarse aggregate, and water are mixed together to make concrete of high quality. Nowadays, material availability is a significant issue in the building business, and material costs are excessively high and uneconomical for human requirements. To address these issues in the construction sector, it is necessary to replace or partially replace materials that are both uneconomical and unavailable in the building business.

Marble dust and stone dust were used as partial replacement materials in this research. These materials are produced as a by-product of cutting, polishing, and are also collected from crusher facilities. The waste marble dust is produced by the cutting and polishing of marble stone, and the marble powder is removed in the range of 250 to 400 tonnes per year. Because marble dust is readily accessible and is a by-product of marble stone, it is used as a partial substitute for cement. By decreasing the use of cement, we may reduce pollution in the environment, and cement is also extremely expensive, since it is rising in price day by day in our everyday lives. Sand is also extremely expensive, and the major issue is that there is a shortage of sand these days. Sand is a naturally occurring resource with a high demand in the building sector. As a consequence of the heavy use of sand, there is currently a shortage of sand, making it uneconomical. As a result, stone dust is utilised as a partial sand substitute. Stone dust is a naturally occurring substance that is recovered from stone cutting, blasting, and crushing facilities. The majority of the stone dust comes from stone quarrying. Stone dust is a naturally occurring waste substance that has the same strength as sand.

The goal of this research was to determine the strength properties of concrete by substituting marble dust for cement and stone dust for sand in certain ratios, as well as to decrease the cost and scarcity of materials by substituting partial replacement materials.

1.2 NEED FOR STUDY:

Marble dust and stone dust are inexpensive waste materials that are readily accessible. There is also no shortage of material these days. Because marble dust has certain characteristics that are similar to cement, there will be no low strength. Stone dust, on the other hand, is gathered from stone quarries and has properties that are similar to sand in terms of strength. Concrete's strength characteristics will improve as a result of partial material substitution.

1.3 OBJECTIVES:

• To determine the difference between ordinary concrete and concrete in which the cement and sand have been partially replaced with marble dust and stone dust, respectively.

• To determine the compressive strength of concrete using marble dust as a partial substitute for cement and stone dust as a partial replacement for sand.

• To determine the flexural strength of concrete using marble dust as a partial substitute for cement and stone dust as a partial replacement for sand.

• Determine the split tensile strength of concrete using marble dust as a partial substitute for cement and stone dust as a partial replacement for sand.

• To decrease pollution in the environment by utilising goods such as marble dust and stone dust.

• To save money on supplies.

1.4 SCOPE:

• This project is for residential development in rural areas.

• It's also utilised in road paving projects.

II.METHODOLOGY

2.1 GENERAL:

The strength characteristics of concrete with partial replacement of cement by marble dust and sand by stone dust are made with regard to ordinary concrete, and the percentages of replacements are also examined, based on the findings of earlier studies. Marble dust and stone dust are used as partial replacement materials in the percentages of cement by marble dust in the range of 0%, 5%, 10%, 15%, and 20%, and sand by stone dust in the range of 0%, 10%, 20%, 30%, and 40%. This study includes compressive strength testing, flexural strength testing, and split tensile strength testing.

2.2 COLLECTION OF RAW MATERIALS:

The materials used in this study are,

Ordinary Portland cement (OPC) : Deccan cement of 53 grade
Fine aggregate : Sand passing through IS 4.75mm sieve
Coarse aggregate : Aggregate passing through 20mm IS sieve
Marble dust : Collected from construction sites
Stone dust : Passing through IS 4.75mm sieve
Water : Collected from fresh collage tap water
Admixture : ROOFPLAST SP 45

2.3 STUDY ON MATERIAL USED:

2.3.1 CEMENT:

Cement is the most significant agent and source of building materials in the construction sector. Cement is a binding substance that has the ability to bond. Deccan ordinary Portland cement of grade 53 was utilised in the research. The Indian standard code 1S 12269: 2013 specifies the ordinary Portland cement 53 grade. It's a substance made up of calcareous and argillaceous materials that burn at high temperatures in clinkers. After burning, no ingredients other than gypsum and less than 0.1 percent air-entraining agents may be applied. The cement should be kept in a location where it is simple to put and use. It's kept in a weather-tight facility to keep the cement safe from the elements like rain and snow. Cement's properties include the following:

It should be an excellent binding material.

- It should give good strength.
- It should be resistant to moisture.
- It should opposes heavy loads on hardening.
- It should also be resistant to impacts, vibrations and weather.
- It should attains homogeneity quickly on mixing.

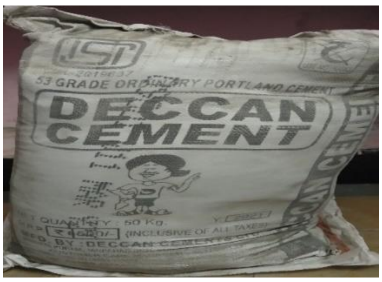


Fig 2.1 Cement

2.3.2 FINE AGGREGATE:

Fine aggregate plays a significant role in concrete since it takes up 70 to 90 percent of the volume. Fine aggregate has a fine angular form and serves as an excellent space filler in concrete. Fine aggregate is nothing more than sand, an inorganic substance composed of angular sharp grains produced by the breakdown of sandstone under the influence of weathering agents. The aggregate must be hard, robust, and long-lasting, as well as devoid of alkali and vegetable matter. Sand is split into zones; zone I, zone II, zone III, and zone IV are the four zones of sand. Zone I sand is extremely coarse, whereas zone IV sand is very fine, and neither is utilised in reinforced concrete or structural construction unless extensive testing is performed. In structural work, zones I through III are utilised. The IS 383-1970 code requirements for fine aggregate are followed, and aggregate that passes the 4.75mm IS sieve is preferable. The fine aggregate utilised in this research was sand that passed the IS 4.75mm filter. For this research, fine aggregate was gathered from a college campus where building activity was underway.

• Sand should have sharp, gritty, angular, and firm grains as some of the characteristics of excellent sand.

• Sand should be devoid of clay, organic, and vegetative debris; it should be strong and durable; and it should minimise shrinkage.

• The colour of the sand should be consistent.

• Sand should be used to prevent cracks from forming.

Fig 2.2 Fine aggregate

2.3.3 COARSE AGGREGATE:

Coarse aggregate is also an important component of concrete since it provides it strength. Coarse aggregate is made by blasting stone quarries or crushing them by hand using blasting equipment. Coarse aggregates are granular solids that are uneven in shape. Coarse aggregate comes in a variety of sizes, ranging from the material retained on a 4.75mm filter to the aggregate with a maximum size of 63mm. Before usage, coarse aggregate should be washed. The IS 383-1970 code requirements are followed for coarse aggregate. The coarse aggregate utilised in this research was gathered on the college campus, where building is now taking place. The following are some of the characteristics of coarse aggregate:

• Coarse aggregate determines the concrete's volume.

• Coarse aggregate is used as a filler.

• The coarse aggregate must have an angular form.

• Coarse aggregate provides excellent strength.

• The coarse aggregate should not be porous or soft.

• Coarse aggregate should not absorb more than 5% of its weight in water.

Fig 2.3 Coarse aggregate

2.3.4 MARBLE DUST:

Marble dust is a fine powder or dust produced by cutting and polishing marble stone. Marble dust is a by-product of the marble stone manufacturing process. Marble dust is a fine, cement-like powder. Marble is a metamorphic rock formed by the transformation of pure limestone. Marble dust serves as a binding material, similar to how lime acts as a binding substance. Because marble dust is a byproduct of the polishing of marble stone on sites, the waste generated each year is in the region of 25%, or 250-400 tonnes. Marble dust was gathered from several locations in the Tolichowki for this research. After polishing the marble stones at the sites, the dust was collected and sieved in the IS 90 micron sieve in the form of slurry and stored in the corners of rooms in a moist state. It was initially moist, but after drying and collecting it, it was utilised as a partial substitute for cement in the range of 0 percent, 5 percent, 10 percent, 15 percent, and 20 percent. The dust was light and fluffy, and there were no dust particles in it. The following are some of the characteristics of marble dust:

• Marble dust must be free of lights and dust particles, and its durability and workability must be improved.

• Marble dust must be strong and firm in order to bind the particles together.

• Before usage, marble dust should be sieved in an IS 90 micron sieve. • Marble dust should serve as an excellent binding material.

Fig 2.4 Marble dust

2.3.5 STONE DUST:

Stone dust is a by-product of stones which is obtained from stone quarries by blasting of stones. Stone dust is white sand like product obtained in large quantity it also known as M-sand and dust. Stone dust is collected in stone quarries and sale was done in the construction markets. As this is naturally available material and easily available material now a days this stone dust was used in large quantity for the construction purposes. As this material is also available in a low cost this preferred in the present situation. Stone dust is material which is equal to sand because stone dust is obtained from stones so that stone is hard in strength characteristics is can be used in construction activities. In this study the stone dust collected in college campus were construction work is going on. The collected stone dust was sieved in IS 4.75mm sieve and used in this study. Some of properties of stone dust are,

- Stone dust can be laid very flat and smooth to create even surface.
- It is advantage over other options.
- Stone dust is a non-porous material.
- It will not allow rain water to seeping below material.
- It avoids the risk of shifting and damage to the paving stone.
- Marble dust may be used as a binding material

Fig 2.5 Stone dust

2.3.6 WATER:

Water also plays an essential part in building; without it, no construction activity would be possible. Water is utilised in every aspect of building, including concrete mixing, mortar mixing, and curing.

Every building operation necessitates the use of water. Water used for mixing and curing must be pure and devoid of oils, acids, alkalis, salts, sugar, organic compounds, or other contaminants that may harm concrete or steel, according to IS 456:2000. In most cases, potable water is sufficient for mixing concrete. The PH of the water should not be less than 6. The water used to mix the concrete in this research was simply fresh tap water. Collage fresh tap water is also used to cure the specimens.

2.3.7 ADMIXTURE:

ROOFPLAST SP 45 was the admixture utilised in this research. It is specifically designed to create high-strength, high-grade concrete M30, and it is free-flowing and uniformly mixed. It also lowers the high rate of water from 20% to 30% without sacrificing slump. It has a high early strength and prevents segregation and bleeding, which reduces the danger of honeycombing. Because this admixture does not include chloride, it will not corrode the reinforcement. In PCC and OPC cement mixes, it is safe. Because of the reduced heat of hydration, it also lowers the danger of shrinking. It's a light brown liquid with a specific gravity of 1.220 to 1.228 at 30 degrees Celsius. ROOFPLAST SP 45 was applied at a rate of 250 to 500ml per bag of 50kg cement.

Fig 2.6 Admixture roofplast sp 45

2.4 TESTS ON MATERIALS:

2.4.1 TESTS ON CEMENT:

- Fineness of cement
- Specific gravity of cement

2.4.1.1 FINENESS OF CEMENT:

The fineness of cement, according to IS 4031-part-1-1996, was IS 4031-part-1-1996. The purpose of the cement fineness test is to ensure that the cement has been properly ground. Because finer cement has a larger surface area for hydration, it develops strength more quickly. Take 100gms of cement and put it in a 90 micron IS sieve, break up the air lumps with your fingers while holding the sieve with both hands, and sift it constantly for 5-10 minutes until all the fine materials have passed through, making sure the cement does not run out. Collect and weigh the residue on the sieve.

W1 (weight of cement) = 100 gms

W2 = 5.08gms (weight of residue after sieving).

Weight of residue retained /weight of cement x 100 = 5.08/100 x 100= 5.08gms 10 gms.

Cement fineness is 5.08gms.

2.4.1.2 SPECIFIC GRAVITY OF CEMENT:

IS 4031 part-11-1988 was the IS code for cement specific gravity. The weight of a particular volume of solids divided by the weight of an equivalent amount of water at a given temperature is defined as specific gravity. The weight of an empty specific gravity bottle with the stopper is measured as W1 after it has been cleaned and dried. W2 refers to a third of the container that is filled with cement and weighted with a cork. Then fill the bottle to the neck with kerosene and shake to fill the gaps; the weight is W3. Empty the specific gravity bottle and carefully clean it. Then fill it with kerosene and multiply by W4 to get the weight. Specific gravity of cement = (W2-W1)/ (W2-W1)-(W3-W4) X (W4-W1)/ (W5-W1)

W1 = 34.23 W2 = 50.50 W3 = 85.50 W4 = 75.06 W5 = 79.9 (50.50-34.23)-(85.50-75.06) X (75.06-34.23)/ (79.9-34.23) = 2.49

Cement has a specific gravity of 2.49.

2.4.2 TEST ON FINE AGGREGATE:

- Bulking of fine aggregate
- Specific gravity of fine aggregate

2.4.2.1 BULKING OF FINE AGGREGATE:

Fine aggregate is bulked according to IS 2386 – 3. The presence of free moisture in fine aggregate causes volume bulking. Because the film that forms around each particle produces a surface tension force that keeps the particles apart, no point of contact between them is conceivable. Fine aggregate has a totally implausible volume due to bulking. As a result, the impact of bulking in the proportioning of concrete by volume must be taken into account at all times. Pour 500g of oven dry sand into a container, level the top of the sand, then measure the height of the sand, H0, by pushing a steel rule vertically down through the sand from the centre to the bottom. Pour the sand onto a clean metal tray to empty the container. 1 percent water by weight of sand is added, and the sand and water are well mixed. Pour the wet sand freely into the container without tamping it down, level the top, and use a steel rule to measure the retained sand height in the centre, H1. Repeat the experiment, each time increasing the water content by one percent. Stop the process when the moist sand in the container reaches the top of the container.

W = weight of the sand = 500gms.

H0 = height of oven dry sand = 8.5cm

H1 = height of wet sand after water adding = 9.8

Percentage of bulking = (H1-H0/H0) x 100

Sl. No.	Percentage of water added	Height of the sand after the addition of water (H1)	Percentage of bulking (H1-H0/H0) x 100
1.	5ml	8.9	(8.9-8.5/8.5) x 100 = 4.70
2.	10ml	9.5	(9.5-8.5/8.5) x 100 = 11.76
3.	15ml	10.4	(10.4-8.5/8.5) x 100 = 22.35
4.	20ml	9.8	(9.8-8.5/8.5) x 100 = 15.29

Table 2.1 Calculation of bulking of fine aggregate.

Bulking percentage of fine aggregate = 15.29.

2.4.2.2SPECIFIC GRAVITY OF FINE AGGREGATE:

The quality and strength of fine aggregate are measured by their specific gravity. It is carried out in accordance with IS 2386 part 3 – 1963. Fine aggregate has a specific gravity of 2.65-2.67. It's defined as the weight of fine aggregate divided by the weight of an equal volume of distilled water at that temperature, both weights measured in air. A pycnometer is used for this. W1 is the weight of the empty pycnometer, W3 is the weight of the fine aggregate and pycnometer in water, and W4 is the weight of the water and pycnometer in air.

Specific gravity of fine aggregate = (W2-W1) / [(W4-W1)-(W3-W2)]

W1 = 635gms

W2= 1125gms

W3 = 1706gms

W4 = 1400gms

Specific gravity of fine aggregate = (1125-635) / [(1400-635)-(1706-1125)]

= 2.66

III.EXPERIMENTAL STUDY

3.1 MIX DESIGN:

Mix design is a technique of combining concrete with appropriate materials and calculating their relative proportions in order to provide the necessary strength and durability for a concrete construction. Because the concrete mix is a mixture of five different proportions such as cement, fine aggregate, coarse aggregate, water, and air, the concrete mix proportions are defined by the concrete mix design. The concrete mix design utilised in this research was M30 grade concrete. This research followed IS 10262: 2009, IS 10262: 2019, and IS 456: 2000 for mix design.

3.1.1. CALCULATION OF CONCRETE FOR OVERALL EXPERMENTAL STUDY:

Materials	0% Mix	5% & 10% Mix	10% & 20 Mix	15% & 30% Mix	20% & 40% Mix
Cement	35.963 kg	34.165kg	32.367kg	30.568kg	28.77kg
Fine aggregate	62.017kg	55.815kg	46.1kg	43.412kg	37.210kg
Coarse aggregate	90.54kg	90.54kg	90.54kg	90.54kg	90.54kg
Marble dust	-	1.798kg	3.253kg	5.394kg	7.192kg
Stone dust	-	6.201kg	12.403kg	18.605kg	24.807kg
water	18.099litres	18.099litres	18.099litres	18.099litres	18.099litres

Table 3.1 Calculation of concrete for overall experimental study.

- Recommended dosage of admixture ROOFPLAST SP 45 is 250 to 500ml per bag of 50kgs cement.

3.2 MIXING AND CASTING PROCEDURE OF CONCRETE:

In this experimental study the process of mixing and casting is done in the concrete technology lab in the collage with the provided collage lab instruments. The mixing and casting processes are carried out in the concrete technology lab at the collage using the supplied collage lab equipment in this experimental research.

3.2.1 MIXING OF CONCRETE:

Concrete is typically mixed using one of two methods: manual mixing (also known as hand mixing) or machine mixing. The mixing of concrete was done manually in this research. Concrete mixing is likewise a major undertaking that requires certain safeguards. The concrete must be mixed on a level surface that is devoid of vegetation, dirt, and dust particles such as discarded papers, dried leaves, and mud stones. The surface or platform should be clean in order for the concrete to mix properly. Concrete was mixed on a clean platform on the college grounds in front of the concrete technology lab for this research.

The concrete is mixed at this location according to my preferences. The concrete ingredients for this research were gathered and transported to the mixing site; the mixing equipment included a tray, 20mm, 4.75mm, and 90 micron sieves, a weighing machine, a measuring jar, and a shovel. The gathered materials are cleaned and sieved according to their classification. The coarse aggregate is sieved on a 20mm sieve, the coarse material is collected, weighed, and distributed over the surface, and the fine aggregate is sieved on a 4.75mm sieve and kept on a 2.36mm sieve. The fine aggregate is placed over the coarse aggregate after it has been weighed. Following that, the partial replacement material stone dust is sieved and weighed, then distributed across coarse and fine aggregates. The cement is sieved through a 90 micron sieve, weighted according to the calculations, and uniformly distributed across the coarse and fine aggregate layers. The partial replacement material marble dust is then collected in a solid form, ground into a powder, and sieved through a 90 micron sieve before being weighed. Over the layers of coarse aggregate, fine aggregate, stone dust, and cement, marble dust is placed. As a heap, all of the ingredients are poured layer by layer. Three tests, for cubes, beams, and cylinders, are used to arrange the three piles on a surface. The three piles are placed so that the concrete for the research may be mixed easily according to the calculations.

Fig 3.1 Three heaps for cubes, beams and cylinders

One by one, the three piles are blended. All of the ingredients must be combined once before pouring water, i.e., in the dry condition, using a shovel, in such a manner that the materials are blended in a homogenous form, ensuring that each and every material is correctly mixed. The next stage was to make a pound-like depression in the centre of the mix so that water could not escape. This whole procedure was completed in a dry condition. The calculated water is poured into the pound-like depression based on the water-to-cement ratio, and the whole material must be mixed gently with the shovel without losing the water. The material must be combined two to three times until it is properly and evenly mixed, resulting in a consistent colour and consistency. The admixture is introduced in the estimated amount in the midst of the mixing phase in this procedure. The concrete has been mixed and is now in the plastic stage, ready for casting. The mix must be put within 30 minutes of the first setting time

Fig 3.2 Mixing of concrete

3.2.2 CASTING PROCEDURE OF CONCRETE:

Concrete casting is simply the process of putting concrete at the desired location. Casting is another procedure that must be carried out correctly in order for the specimens to be suitable for testing. Casting is done for cubes, beams, and cylinders in this research. The casting procedure is carried out in the same manner for three testing.

3.2.3. CASTING OF CONCRETE FOR CUBES:

The process of casting cubes involves pouring mixed concrete into the cubes. The cube size utilised in this research was 150 x 150 x 150mm. The first step was to cover the cubes thoroughly inside and out with oil. Oiling the cube helps the specimen have clean edges without harming the corners and makes it easier to unmould. The next stage was to pour the concrete into the cubes layer by layer, i.e., three layers of concrete were poured by blowing with the tamping rod. After laying the first layer, evenly distribute 25 blows with the tamping rod around the cube; this will assist the concrete avoid air gaps, honey combs, and give the specimen a soffit structure; repeat this procedure for the next two layers as well. Apply a nice finish to the tops of the cubes after completing this procedure with the trowel

Fig 3.3 Casting of cubes

3.2.4. CASTING OF CONCRETE FOR BEAMS:

The process of casting beams include pouring the mixed concrete into the beams. The beam size utilised in this research was 150 x 150 x 700mm. The first step was to cover the beams thoroughly inside and out with oil. Oiling the beams makes it easier to unmould the specimen with clean edges and without harming the corners. The following stage was to pour the concrete into the beams layer by layer, i.e., three layers of concrete were poured by blowing with the tamping rod. After laying the first layer, evenly distribute 25 blows with the tamping rod around the beams; this helps the concrete avoid air gaps, honey combs, and a soffit structure to the specimen; repeat this procedure for the next two layers as well. After completing this procedure, use the trowel to give the tops of the beams a nice polish.

Fig 3.4 Casting of beams

3.2.5 CASTING OF CONCRETE FOR CYLINDERS:

Placing the mixed concrete into the cylinders is known as beam casting. The cylinders utilised in this research were 150 x 300mm in size. The first step was to cover the beams thoroughly within the cylinders with oil. Oiling the beams makes it easier to unmould the specimen with clean edges and without harming the corners. The next stage was to pour the concrete into the cylinders layer by layer, i.e., three layers of concrete were poured by blowing with the tamping rod. After putting the first layer, evenly distribute 25 blows with the tamping rod around the cylinders; this will assist the concrete avoid air gaps, honey combs, and a soffit structure to the specimen; repeat this procedure for the next two layers as well. After completing this procedure, use the trowel to give the tops of the cylinders a nice polish.

Fig 3.5 Casting of cylinders

3.3 CURING:

Curing is the process of immersing specimens in water. Curing is a method of lowering the cement's hydration heat. For a period of time, it regulates the moisture and temperature in concrete to ensure appropriate hardening. It develops strength by curing the specimens.

3.3.1. CURING OF CUBES, BEAMS AND CYLINDERS:

Curing is done in a collage curing tank using fresh tap water in this research. After finishing the whole casting process, the specimen is left for 24 hours to solidify. After 24 hours, the specimens are unmoulded and exposed to the environment for an hour before being put in the curing tank. The specimens are carefully put in the curing tank to avoid any harm. The water used for curing should be fresh and not have a high salt level. Curing may be done in a proper manner without causing any disruptions to the specimen if the following conditions are followed.

Fig 3.6 Specimens which are kept outside to expose to atmosphere

Fig 3.7 Curing of cubes, beams and cylinders

IV.TESTS PERFORMED IN EXPERMENTAL STUDY

4.1 TEST ON FRESH CONCRETE:

Fresh concrete is defined as concrete that is still in a plastic condition. Fresh concrete is just newly mixed concrete that may be moulded into any form. Initial and final setting times apply to new concrete.

4.1.1 SLUMP TEST:

One of the workability tests is the slump test. This test is carried out in accordance with IS: 1199-1959. It's used to assess the new concrete's consistency. Workability refers to how simple it is to work with concrete, i.e. how easy it is to put it. When we add more water to the concrete, it becomes more workable, therefore it is excellent for workability. Strength diminishes as workability improves. The slump cone is used in the slump test. The slump test is carried out at the collage concrete technology lab in this research. The slump cone is open on both sides and measures 20cm in diameter at the bottom, 10cm in diameter at the top, and 30cm in height. The cone is set on a non-absorbent surface and has two clamps to keep it locked in place while the concrete is poured into it. The slump cone and its surface are thoroughly cleaned and oiled in the first stage. The concrete is then mixed according to the calculations and troweled into the slump cone. The concrete is poured in three layers, with 25 blows delivered evenly over the surface of the cone with the aid of a tamping rod for each layer to prevent air gaps in the concrete. The top surface of the cone must be levelled once it has been filled with concrete. The slump cone mould must then be gently raised upright without causing any damage, the concrete slump must be measured using the scale, and the distance from top to surface must be measured. Slump valve refers to the measured valve..

Fig 4.1 Slump cone test

Fig 4.2 Measuring the slump valve

4.2 TESTS ON HARDENED CONCRETE:

Hardened concrete is just concrete that has transitioned from a plastic to a solid condition. Tests on hardened concrete are performed once the concrete has reached its solid condition. After 24 hours of concrete casting, the concrete becomes hard, i.e., solid, and testing must be performed on solid specimens.

4.2.1 COMPRESSIVE STRENGTH TEST:

The compressive strength of a hard solid concrete or cement specimen is determined using a compressive strength test. This test is carried out in accordance with IS: 516-1959. It is the structure's capacity to bear stresses on the surface without cracking or deflection. Any substance that is compressed shrinks in size, whereas any material that is stretched lengthens. The formula is the load applied to the cross-sectional area at the moment of failure.

Failure load / cross-sectional area = compressive strength

The compressive strength is measured in this research for cube specimens of 150 x 150 x 150mm, since this is the most common mould size. The specimens are taken from the curing tank once the casting and curing procedure is completed. The extracted specimens are wiped dry and left out for one hour to allow the moisture content in the specimens to evaporate. After that, clean the bearing surface of the compressive testing equipment and position the specimen such that the load is delivered on the opposite side of the cube. Place it in the centre of the base plate and spin the moveable portion of the handle by contacting the top surface of the specimen with your hand. Then progressively increase the weight without contacting the top surface of the specimen until it fails, taking note of the reading and recording the maximum load. Repeat the process with two more specimens, using the average of the results to determine the concrete crushing strength.

Fig 4.3 Compressive strength test

4.2.2FLEXURAL STRENGTH TEST:

The flexural strength of hard concrete in its solid form is also tested. This test is carried out in accordance with IS: 516-1959. The flexural test is used to determine the concrete's tensile strength indirectly. This test is used to determine if an unreinforced concrete beam or slab canresist bending failure. This test is divided into two parts: a three-point load test and a center- point load test.

The flexural strength of a beam of 150 x 150 x 700mm is tested in this research. Following thecasting and curing processes, the specimens should be removed from the curing tank and testedas soon as possible to avoid surface drying, which reduces flexural strength. Take a marker anddraw lines on the specimen where the loading will act. The loading points should be in touch with the surface. Then apply a load to the specimen that is 2 to 6% of the calculated load. Continuously load the specimen without shock until it fails at a consistent pace. Repeat the process for the remaining two specimens, then record the average valve of specimen failure. The flexural strength test formula was as follows:

Flexural strength of beam = pl/bd^2

Fig 4.4 Flexural strength test.

4.2.3 SPLIT TENSILE STRENGTH TEST:

The split tensile strength test is performed on solid, cemented concrete. This test is carried outin accordance with IS 5816. (1999). this test is used to evaluate a concrete's tensile strength over a vertical diameter. The test is carried out on cylinders and is an indirect technique of determining concrete tensile strength. Because concrete is strong in compression but weak in tension, this test is used to determine the tensile strength of concrete.

The spilt tensile strength test for cylinders of 150 x 300mm is performed in this research. Afterthe casting and curing processes are completed, remove the specimens from the curing tank and clean them to remove any moisture from the cylinder's surface. Mark a line along both sides of the cylinder at the same axial location using the marker. Place the specimen in the compressive testing machine by contacting the specimen's surface to the machine's top plate. Continuously apply the weight without causing shock. Repeat the process with the remaining two specimens. Take the average of three specimens and record the sample's reading. Split tensile strength test formula

Split tensile strength of cylinder = 2 x failure load/πDL

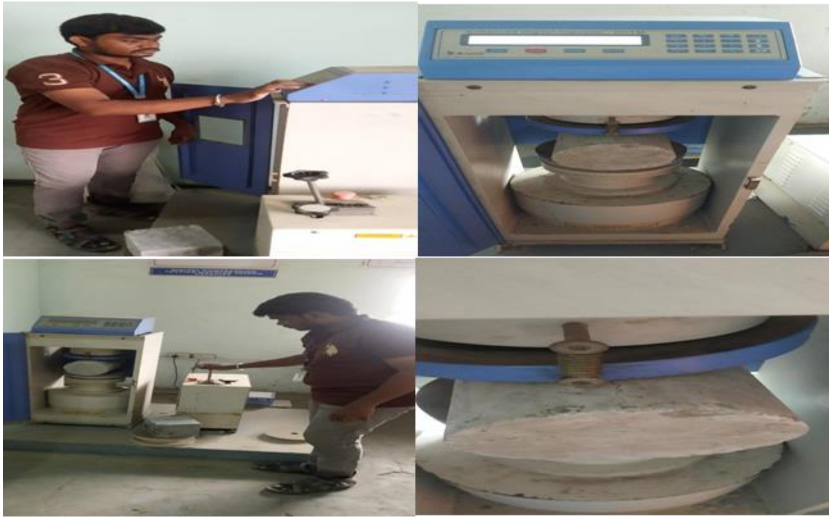


Fig 4.5 split tensile strength test

V.TEST RESULTS

5.1 TEST RESULTS:

The experiments that are carried out at the concrete technology lab at the college are included in this research. The slump test on new concrete and the compressive strength test, flexural strength test, and split tensile strength test are performed on both fresh and hardened concrete. In this chapter, the test findings for both fresh and hardened concrete are described.

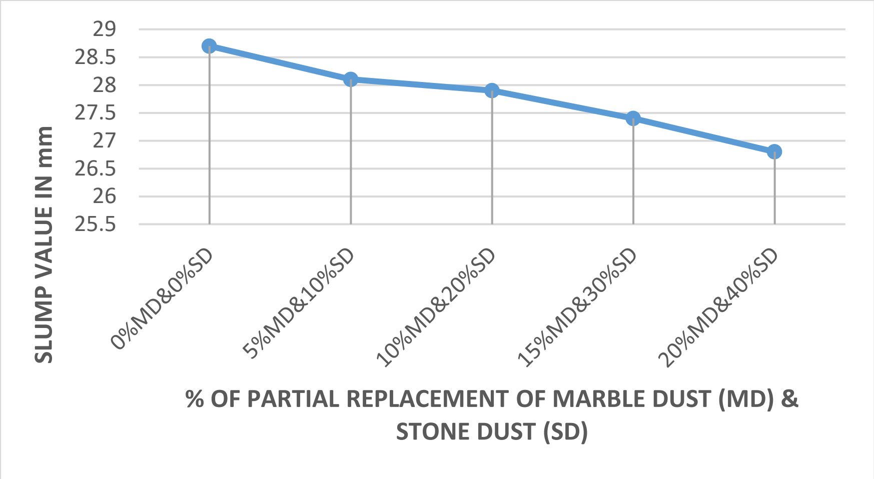
5.2 TEST RESULTS OF SLUMP TEST:

Slump test is performed on fresh concrete, the test results are tabulated and graphs are drawn below.

Percentages of concrete for partial replacement of marble dust (MD) and stone dust (SD).	Slump valve (mm)
0%MD & 0%SD	28.7
5%MD & 10%SD	28.1
10%MD & 20%SD	27.9
15%MD & 30% SD	27.4
20% MD & 40% SD	26.8

Table 5.1 Test results of slump test.

Here by observing the test results of slump test there is decreasing the valve of slump by adding the partial replacement materials i.e., cement by marble dust and sand by stone dust in the concrete.



Graph 5.1 Test results of slump test

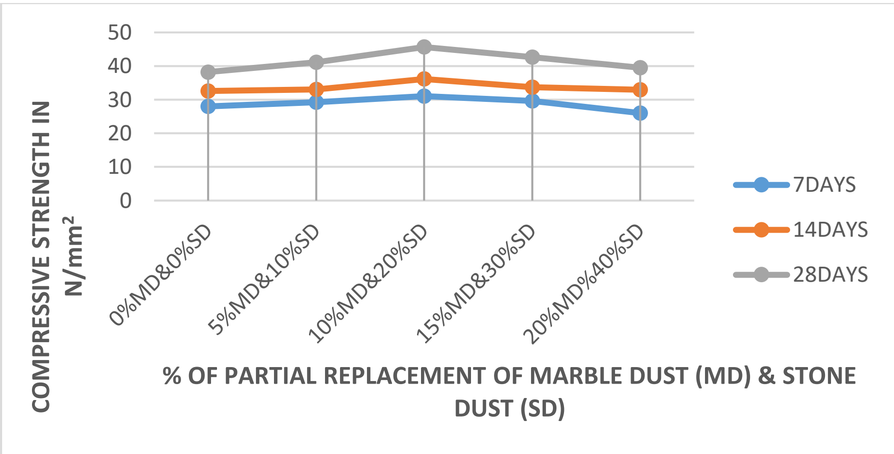
5.3 TEST RESULTS OF COMPRESSIVE STRENGTH TEST:

Compressive strength test is performed on hardened concrete, the test results are tabulated and graphs are drawn below.

Mix % of MD &SD	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
0%MD & 0%SD	28.043	32.591	38.227
5%MD & 10%SD	29.249	33.049	41.162
10%MD & 20%SD	31.057	36.142	45.651
15%MD & 30% SD	29.594	33.747	42.674
20% MD & 40% SD	26.017	32.941	39.491

Table 5.2 Test results of compressive strength test

Here by observing the test results of compressive strength test there is increasing the strength characteristics for partial replacement of 10% of marble dust by cement and 20% of stone dust by sand in the concrete.



Graph 5.2 Test results of compressive strength test

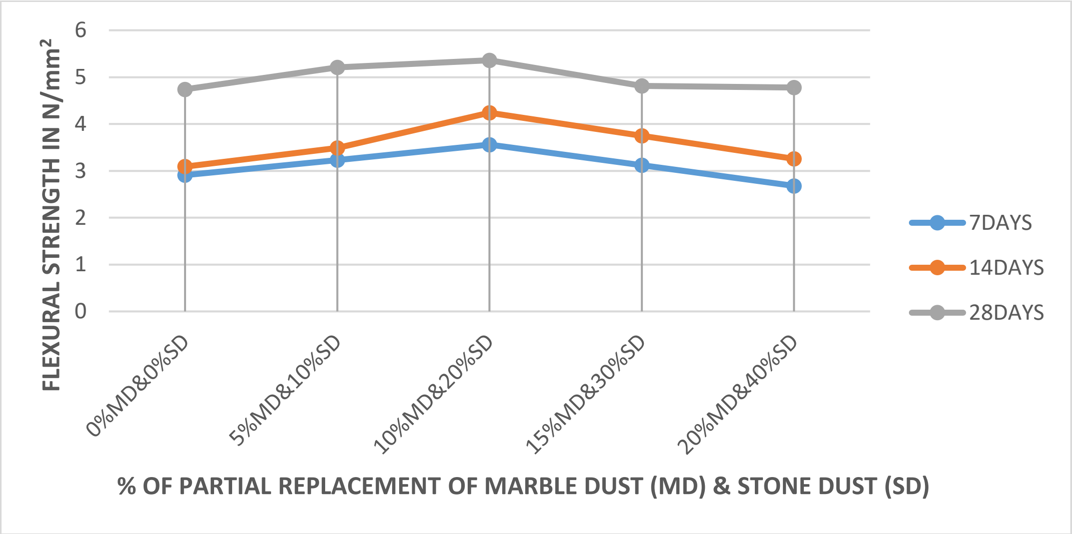
5.4 TEST RESULTS OF FLEXURAL STRENGTH TEST:

Flexural strength test is performed on hardened concrete, the test results are tabulated and graphs are drawn below.

Mix % of MD &SD	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
0%MD & 0%SD	2.91	3.09	4.74
5%MD & 10%SD	3.23	3.49	5.21
10%MD & 20%SD	3.56	4.24	5.36
15%MD & 30% SD	3.12	3.75	4.81
20% MD & 40% SD	2.68	3.26	4.78

Table 5.3 Test results flexural strength test

Here by observing the test results of compressive strength test there is increasing the strength characteristics for partial replacement of 10% of marble dust by cement and 20% of stone dustby sand in the concrete.



Graph 5.3 Test results of flexural strength test

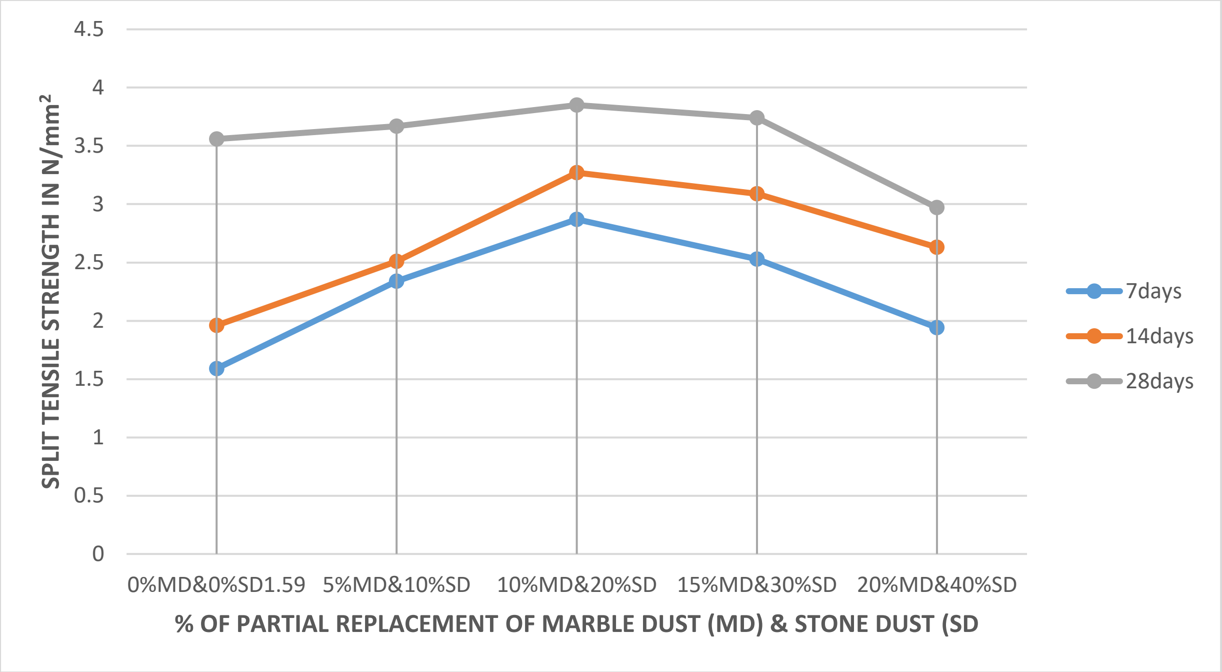
5.5 TEST RESULTS OF SPLIT TENSILE STRENGTH TEST:

Split tensile strength test is performed on hardened concrete, the test results are tabulated and graphs are drawn below.

Mix % of MD &SD	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
0%MD & 0%SD	1.59	1.96	3.56
5%MD & 10%SD	2.34	2.51	3.67
10%MD & 20%SD	2.87	3.27	3.85
15%MD & 30% SD	2.53	3.09	3.74
20% MD & 40% SD	1.94	2.63	2.97

Table 5.4 Test results of split tensile strength test

By analyzing the compressive strength test results, it is possible to improve the strength properties of the concrete by replacing 10% of the marble dust with cement and 20% of the stone dust with sand.



Graph 5.4 Test results of split tensile strength test

VI.CONCLUSION

- When 10% of the cement is replaced with marble dust and 20% of the sand is replaced with stone dust, the compressive strength of the concrete increases, and when any proportion of partial replacement is added, the compressive strength drops.
- When 10% of the cement is replaced with marble dust and 20% of the sand is replaced with stone dust, the flexural strength of the concrete increases, and when any proportion of partial replacement is added, the flexural strength drops.
- When 10% of the cement is replaced with marble dust and 20% of the sand is replaced with stone dust, the split tensile strength of the concrete increases, and when any percentage of partial replacement is raised, the split tensile strength drops.
- As a result, it has been shown that 10% of marble dust may be replaced by cement and 20% of stone dust by sand in concrete.
- These are one of the most cost-effective materials for partial replacement of marble and stone dust, both of which are readily accessible and waste products in the building sector.
- It also lowers the building costs in terms of materials.
- This technique of using waste products as partial replacement materials may also help to decrease the amount of land used for dumping trash, and it is one of the ways to reduce environmental pollution by reducing the use of cement.
- Because the cost of sand and its availability has become a major issue in the building sector, utilising stone dust as a partial substitute material reduces sand use.

VII. FUTURE SCOPE:

In this experimental research, M30 grade concrete was utilised and evaluated, and the grade of concrete may be raised and tested in the future, for example, for M35, M40, and so on. Replacement of 11 percent, 12 percent, and 13 percent marble dust and 21 percent, 22 percent, and 23 percent stone dust may also be done using the percentages of marble dust and stone dust.

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