Experimental study of beam with replacement cement with polyster fiber and using ceramic waste replacement with aggregate

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Abstract - Recent structures are using more and more ceramic materials, such as tiles, sanitary fittings, and electrical insulators. Therefore, reusing these wastes during the creation of concrete may be an excellent strategy to protect the environment while simultaneously enhancing the concrete's qualities. The ceramic tiles are added to concrete cubes in crushed form at a weight of 20% and a dimension of 10 to 20 mm. About 75% of all trash produced worldwide come from construction and demolition (C&D) wastes. Additionally, ceramic materials contribute a maximum of 54% of the wastes in the C & D wastes. Brick wall (debris), ceramic tiles, and utensil garbage are all examples of ceramic waste. The sole method currently used to dispose of these ceramic wastes is landfill. In the current investigation, ceramic tile waste was substituted for natural coarse aggregate in concrete to varying degrees (0, 10, 20, and 30%), and M20 grade concrete was used. Although concrete structures often have poor tensile strength, they typically have significant compressive strength. The qualities of concrete, such as compressive strength, tensile strength, impact strength, and abrasion resistance, are improved by the introduction of polyester fibre. For this study, 25 MPa of compressive strength concrete was used. For the purpose of determining the samples' compressive strength, split tensile strength, and flexural strength, samples with varying fibre concentrations ranging from 0 to 6% were manufactured with an increment of 0.5%.

***Key Words*: Ceramic, Waste, And Concrete, Polyester Fibers, Workability, Compressive Strength, Flexural Strength.**

1. INTRODUCTION

Waste from floor tiles used in concrete applications can significantly lessen the harm done to the environment and the depletion of natural resources. It is feasible to use ceramic waste generated during the production of ceramic as aggregates in the creation of concrete in order to recycle it and so reduce the amount of trash generated. This study looked into the compressive strength of concrete made from waste floor tile aggregates.

India is classified as a developing nation; numerous new innovations may be observed in the construction industry. As the population has grown, so have the advancements, resulting in more buildings being built to meet our personal needs. Cement, sand, and aggregates (coarse and fine) are among the many construction materials that are in high demand in the construction sector. Around the world, rapid industrial expansion contributes to major issues including the depletion of natural aggregates and the production of vast quantities of debris from construction and demolition activities. Utilising the garbage is one strategy to lessen this issue. Because of its extremely low tensile strength, plane concrete can crack both under stress and when it is not. Low strain, brittle, and less ductile are some characteristics of it. concrete reinforced with polyester fibres can be used to solve these issues. These fibres are dispersed at random and are necessary for Portland cement concrete reinforcing. The compressive and flexural strength of a concrete is increased when polyester is added to regular concrete. Because concrete has so many uses, it has become the most important component in the development of infrastructure worldwide. Cement, fine and coarse aggregate, and water make up the constituents of concrete. Many studies have been conducted over the past few decades to find ways to strengthen concrete without using its traditional constituents.

2. LITRATURE REWIEW

1. Anurag Wahane, Munazza Amir Khan, Veena Dewangan, Omprakash Rajak

"Experimental Study on Concrete by incorporating Waste Broken Tiles" @2021 International Journal for Research Trends and Innovation All rights reserved.

Recent structures are using more and more ceramic materials, such as tiles, sanitary fittings, and electrical insulators. However, because ceramic is so fragile, a substantial amount of it is lost during production, shipping, and installation. Therefore, reusing these wastes during the production of concrete may be a good strategy to protect the environment and enhance the concrete's properties. The study focuses on an experimental investigation of broken ceramic tile mixed with concrete. 20% by weight of the weight of the concrete cube's crushed ceramic tiles, measuring 10 to 20 mm, are added.The findings indicate that waste ceramic tiles were utilised in concrete in place of coarse natural aggregates. The best amount of leftover ceramic tile to use in After examining the findings, a concrete mixture with a water/cement ratio of 0.3 was chosen.

Concrete using waste tile has a 5.5% higher compressive strength than regular concrete of the same grade. roughly 75%. Additionally, 54% of the C&D wastes come from ceramic materials, which constitute the highest amount of wastes overall. Around 11,166 million square metres of ceramic tiles were produced worldwide in 2011–12 alone. China produces the most ceramic tiles worldwide (5,200 million square metres). This is 38.9% of global consumption and 4,250 million square metres, or 46.6% of global output. India comes in third place after China in terms of production of tiles, accounting for just 691 million square metres, or 6.2% of global production, and consumption, with 681 million square metres, or 6.2% of global consumption.

➢ Experimental results

The result of design-mix is been represented

S.NO.	NO. OF CURING DAYS	SPECIMEN	LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	7	1	400	18.2
2	28	2	400	29.8

Fig. 1: Nominal Mix Concrete Compressive Strength

S.No	NO. OF CURING DAYS	SPECIMEN	LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	7	2	450	21.4
2	28	1	450	32.6

Fig. 2: Ceramic Mix Concrete Compressive Strength

2. ACHSAH ELIZABETH JACOB, Er. AKASH AGGARWAL, YOGENGRA KUMAR KUSHWAHA.

"UTILIZATION OF CERAMIC WASTE AS A REPLACEMENT OF AGGREGATES AND ITS EFFECT ON VARIATION OF EXPENDITURE"@2017 International Journal of Engineering Research-Online All rights reserved.

India is classified as a developing nation; numerous new innovations may be observed in the construction industry. As the population has grown, so have the advancements, resulting in more buildings being built to meet our personal needs. Cement, sand, and aggregates (coarse and fine) are among the many construction materials that are in high demand in the construction sector. Environment and climatic conditions for cement and aggregates (coarse and fine). The most important components for conserving these natural resources, such as aggregates, are employed in the manufacturing of concrete, which is needed for society's welfare and can be used in construction.

reported using ceramic waste powder as a partial replacement for cement in M-25 grade concrete in the range of 0%, 10%, 20%, 30%, 40%, & 50% by weight. The wastes used were from the ceramic industry and had been declared unfit for sale for a number of reasons, such as dimensional or mechanical flaws, flaws in the firing process, or other causes. The findings showed that adding ceramic masonry debris actively endows cement with beneficial properties, including significant mechanical strength and financial benefits.

Experimental results

The compressive strength of conventional concrete as well as ceramic waste concrete at 7, 14, 28 days are given in table 1.

Table 1: Compressive strength of ceramic waste concrete (W/C=0.55)

S.N.	Cube designation	Compressive strength(kN/mm^2)				% age of ceramic waste	% increase in strength
		7 days	14 days	28 days	Avg. at 28 days		
1	V1	12.93	15.7	15.83	17.31	0%	-
		11.8	14.42	18.2			

		13.5	15.8	17.9			
2	V2	11.56	16	18.67	20.19	10%	16.64%
		8.89	13.78	20.13			
		11.28	13.15	21.78			
3	V3	7.56	18.22	25.33	27.42	15%	58.41%
		9.91	19.37	27.78			
		9.33	17.33	29.16			
4	V4	4.18	9.42	24.58	20.5	20%	18.42%
		16.09	11.2	21.11			
		11.2	13.78	15.82			
5	V5	11.24	15.56	23.24	21.43	25%	23.80%
		16.09	15.2	19.2			
		12.44	16.09	21.87			
6	V6	9.96	18.76	23.56	25.78	30%	48.93%

Workability: The replacement concrete is equally as workable as the concrete used as a reference. Workability is unaffected by replacing coarse aggregate with ceramic waste. The values are given in table 2.

Table2: workability of the replaced concrete

COST ANALYSIS:

In the present study the cost of 10 m^3 referral concrete (M15 with PPC). The cost of material is calculated below according to market rate (march April 2017). CEMENT CONCRETE OF 1: 2: 4 (for 10 cum) Dry volume of 10 cum = 1.52 * 10 = 15.2 cum Therefore the percentage reduction in cost for the percentage replacement of the ceramic waste concrete is shown in the table 5.

Table3: Cost analysed for the percentage replacements

Percentage Replacement	Percentage in cost reduction (approx)
10%	3.7%
15%	5.65%
20%	7.53%
25%	9.42%
30%	11.31%

3. Prof. Shruthi. H. G1, Prof. Gowtham Prasad. M.E Samreen Taj, Syed Ruman Pasha

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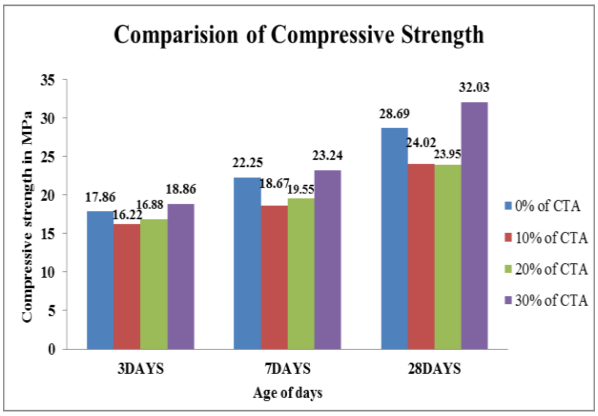
In the current investigation, ceramic tile waste was substituted for natural coarse aggregate in concrete to varying degrees (0, 10, 20, and 30%), and M20 grade concrete was used. After 3, 7, and 28 days of cure, the concrete moulds were cast and tested for Compressive Strength and Split Tensile Strength. The findings show that a 30% substitution of natural coarse aggregate with ceramic tile aggregate yields the highest compressive strength. In this investigation, ceramic tile aggregate with a maximum coarseness of 20 mm will be used. Sand and regular Portland cement (OPC) 53 grade were used. Compressive testing were run, and the findings show that, with the exception of M30 mix, there isn't much of an impact on M20 and M25 Mixes. But after that, strength progressively began to decline as the percentage of tile aggregate in concrete increased. [7] Crushed tile was used as the coarse aggregate in concrete, and its substitution with 0%, 50%, and 100% natural aggregate was studied. Physical and mechanical tests were conducted.

- **Experimental results**

shows the process flowchart, which includes choosing materials like cement, fine aggregate, coarse aggregate, and ceramic tile aggregate. For M20 mix intended for plain concrete, concrete is prepared. Coarse aggregate is used in place of ceramic tile aggregate in some cases. Materials are combined by taking the proportions into account according to the mix design. The mould has three layers with dimensions of 150x150x150 mm and a height of about 50 mm for each layer. Each layer's compaction is carried out using a shake table and tamping rod. Moulds are created for various ratios in accordance with the **Graph -** M20 concrete grade with 0%, 10%, 20% and 30% replacement of CTA and their compressive strength at 3,7 and 28 days



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in concrete by replacing it. It also reduces carbondioxide emission in environment by all possible ways. Although concrete structures often have poor tensile strength, they typically have significant compressive strength. The qualities of concrete, such as compressive strength, tensile strength, impact strength, and abrasion resistance, are improved by the introduction of polyester fibre. Fibres support concrete by being evenly dispersed throughout the matrix and acting as a support in all directions. In addition, rusting is avoided. The most popular and widely used pozzolan is fly ash. It is a coal byproduct trash. It is based on the thermal power produced by electricity. Because of their spherical shape, fly ash may freely flow and mingle with other ingredients. The durability of concrete is significantly increased by these components. One can see that fly ash is used both affordably and safely. As part of sustainable development, efforts were made to

➢ Experimental results

Flexural test on concrete:

Concrete's tensile strength is determined by flexural strength. It resists bending failures. Tests are conducted in beams with span lengths that are at least three times deeper. When a certain point is loaded, a crack forms and a point is marked.

FIG.1: FLEXURAL TEST ON BEAM

TABLE 1: FLEXURAL STRENGTH OF DIFFERENT MIXES

Mix	Modulus of elasticity(kN/mm^2) 28th day
P0	37.5
P1	35.8
P2	35
P3	33.33

Compression test on concrete: The entire strength of concrete cubes can be seen in their compressive strength. The specimen is 150mm X 150mm X 150mm. On top of the sample is put the test specimen. 140 kilogramme per cubic centimetre per minute of stress is applied. It mentions the maximum load.

FIG.2:COMPRESSION TEST ON CUBE

TABLE 2: COMPRESSIVE STRENGTH OF DIFFERENT MIXES

Mix	Compressive strength (N/mm²)		
	7th day	*14th day*	*28th day*
N	23.11	29.33	35.11
P0	22	28	34
P1	24.89	30	38.22
P2	26.67	32	41.33
P3	24.89	28.89	39.11
P4	23.11	26	35.11

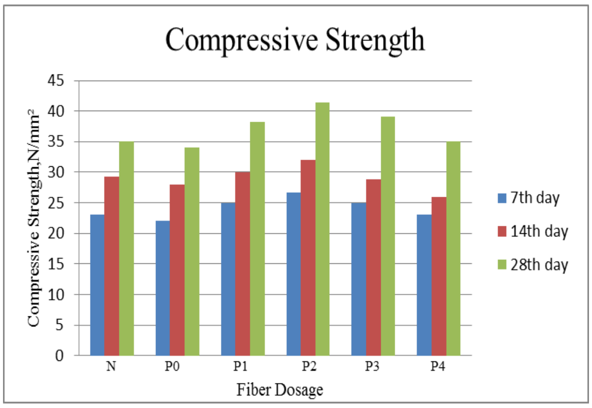


CHART 1: COMPRESSIVE STRENGTH

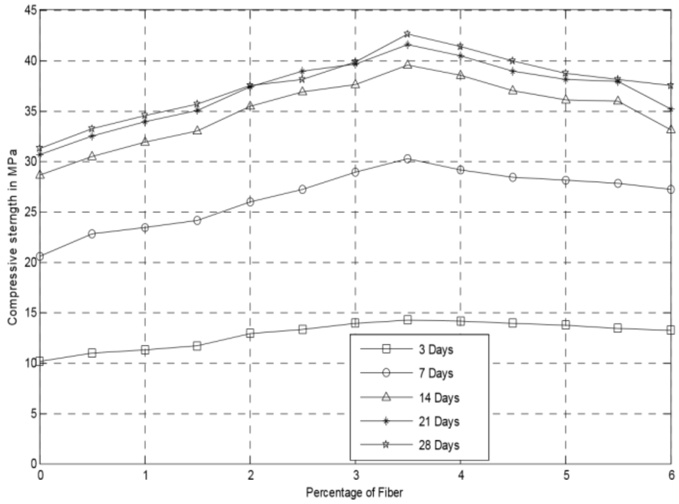
5. Venu Malagavelli , Neelakanteswara Rao Paturu "Polyester Fibers in the Concrete an Experimental Investigation"@2020 researchgate All rights reserved

For this study, 25 MPa of compressive strength concrete was used. For the purpose of determining the samples' compressive strength, split tensile strength, and flexural strength, samples with varying fibre concentrations ranging from 0 to 6% were manufactured with an increment of 0.5%. Compressive strength of concretes is observed to rise as fibre content rises to a certain point.

[1]. Vasudevan et al [2] have looked into the use of waste materials in flexible pavements. The molten waste plastics are applied to the stone aggregate. They discovered a 100% boost in the road's strength. Song and Hwang [3] study the mechanical characteristics of high strength steel fibre reinforced concrete. At volume fractions of 0.5%, 1.0%, 1.5%, and 2.0%, steel fibres were introduced. They discovered that fiber-reinforced concrete's compressive strength peaked at 1.5% volume fraction, representing a 15.3% gain above high strength concrete (HSC). The fiber-reinforced concrete's splitting tensile strength and rupture modulus both increased as the volume fraction increased, reaching values of 98.3% and 126.6% at 2.0% volume percent, respectively.

➢ Experimental results

Slump test had been conducted for finding the workability of the concrete. In this test slump is gradually increasing. At 2% fiber maximum slump of 82mm attained for polyester fiber.



3. MATERIAL

Cement: Cement is the primary ingredient for making concrete. cement is ordinary Portland cement of 53 grade confirming to IS:12269.

Fine Aggregate: Locally available silt-free river sand as per IS 383-1970 with a specific gravity of 2.65 is used

Coarse Aggregate: The ceramic tile aggregates as per IS 383-1970 the ceramic tiles with percents of 0 and 20 were substituted for natural coarse aggregates

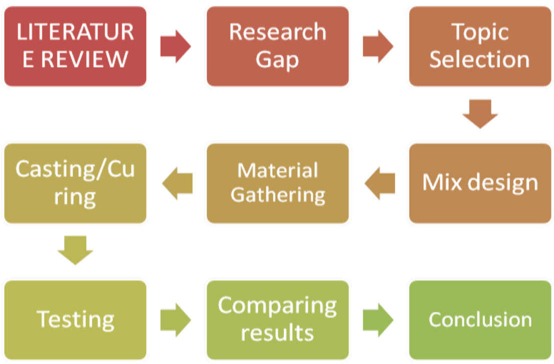
Super plasticizer: The hyper plasticizer must be ADDMIX 389, a highly water-reducing polycarboxylic ether super plasticizer. The product must have a specific weight 1.1 and a solids content of not less than 40% by weight.

Mineral additives: Polyster fiber , ceramic waste, Super plasticizers.

4. METHODOLOGY

- Collection of Material like Pozzolana Portland Cement, Coarse aggregate, Fine aggregate, polyster fiber & ceramic waste , Admixture.

- Laboratory test on basic ingredients of concrete like Cement, Coarse aggregate, Fine aggregate.
- Finalize Mix design for concrete.
- Partial replacement of cement with polyster , aggregate with ceramic waste percentages.
- Check workability of concrete.
- Casting of cube specimen
- Determine Compressive strength of concrete.



5. CONCLUSIONS

1) In this investigation, ceramic tile aggregate with a maximum coarseness of 20 mm will be used. Sand and regular Portland cement (OPC) 53 grade were used. Compressive testing were run, and the findings show that, with the exception of M30 mix, there isn't much of an impact on M20 and M25 Mixes. But after that, strength progressively began to decline as the percentage of tile aggregate in concrete increased. [7] Crushed tile was used as the coarse aggregate in concrete, and its substitution with 0%, 50%, and 100% natural aggregate was studied. Physical and mechanical tests were conducted.

2) It is also clear that the characteristics of concrete are not noticeably harmed by the use of leftover ceramic tiles in the production of concrete.

It is discovered that 10 to 30 percent is the ideal situation for employing used ceramic tiles as coarse aggregates. In these metrics, compressive strength increases while unit weight decreases as well.

3) The compressive strength of ceramic waste-replaced concrete increases in comparison to ordinary concrete up to a replacement level of 40% as the proportion of replacement rises. Strength nearly stays the same (increases by 0.87%) with 50% replacement.

4) Up to a certain extent, or 20% for a w/c ratio of 0.3, adding coarse waste ceramic tile aggregate gradually boosted concrete's compressive strength.The strongest compressive strength was found in concrete.

5) It is also evident that using leftover ceramic tiles during the manufacturing of concrete does not significantly alter its properties. It has been found that using used ceramic tiles as coarse aggregates at a ratio of 10 to 30 percent is optimal. Compressive strength rises in these measurements, and unit weight falls as well.The maximum split tensile strength is obtained when 30% of Ceramic tile aggregate was replaced with coarse aggregate.

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