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PARTIAL REPLACEMENT OF BROKEN ROOF TILES AND BONE WASTE IN CEMENT CONCRETE

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Abstract: This study has been undertaken to investigate the determine the performance of concrete with partial replacement of coarse aggregate with broken roof tiles and fine aggregate with bone waste. The broken roof tiles waste was varied from 0% to 50% for coarse aggregate and bone waste was constant at 4% for fine aggregate in M20 mix. Flexural tensile strength test was conducted to determine the strength of beam. As per the result analysis the maximum strength was obtained at 30% of partial replacement. This project ensures an eco-friendly and cost-efficient nature of the proposed replacement, aiming to sustainable construction practices.

Index Terms **– Bone waste, Broken roof tiles, flexural tensile strength, eco-friendly, sustainable**

I. INTRODUCTION

Nowadays, in the construction area, concrete is a big deal, second only to water in usage. But, there's an environmental downside. We're in need of additional materials similar to fine and coarse aggregates to enhance our concrete mix. So, here is the plan that let's consider using Broken Roof Tiles and Bone wastes instead of the usual construction materials. It is not just about being unique but it's about being eco-friendly and changing how we look at construction materials.

Bones are tough and strong in animals, and provide structural integrity. The bone utilised from animals either after they're slaughtered and cleaned or from animals that died naturally. Bones last a really long time and history proves it. So, for our project, we're turning them into bone wastes. That means subjecting animal bones to high temperatures and pulverizing them to achieve the required gradation. Using bone waste in construction is special because it adds strength, due to its calcium, phosphate and minerals like magnesium and potassium content.

The utilization of Broken Roof Tiles waste and Bone wastes serves as an innovative approach to not only meet the demands of the construction industry but also contribute to sustainable practices. By incorporating these materials as partial replacements for natural sand and coarse aggregate in concrete, we aim to make a positive impact on the environment and encourage a shift towards more eco-friendly construction practices. This paper is all about connecting the gaps between the old construction material with some new eco-friendly options. We want to make the construction world greener and more responsible.

II. LITERAURE REVIEW

In this project, the referred journals are mentioned below. These journals are mainly regarding the partial replacement of concrete mix.

Supraja B, Ruchitha P T, Salma S K, Manohari R.V.K, & Sahithi K (2023), they studied by taking M20 grade concrete using ceramic tiles as partial replacement at different mix proportions like 10%,20%,30%,40% to the total weight of coarse aggregate. They got the maximum strength at 40% replacement. The aim of their project is to study the strength parameters of concrete.

Harikaran M, Kulanthaivel P, Krishnaraja A.R & Murugan P.C(2022), they studied by taking M20 grade concrete using ceramic tiles as partial replacement at different mix proportion like 0%,20%,40%,60%,80% and 100% to the weight of coarse aggregate. They got the maximum strength at 40% replacement.

Jayanth R.N, Bytaraju M, Kumar L.H, Mahesh, Nithin, Poornima K. A, Shivappa (2021), they studied by taking M25 grade concrete using mangalore tile waste as replacement at 7,14 and 28 days. They got the maximum strength at 50% replacement.

Geetha S D, Kavyashree M P, Krupaksha H K, Sthuthi K A, Viksheetha A R (2018), they studied by taking M20 grade concrete using 10% of Mangalore tiles waste was kept constant for coarse aggregate and bone aggregate was varied from 4% to 14% for fine aggregate. They got maximum strength at 8% replacement of fine aggregate.

Aruna D, Rajendra Prabhu, Subhash C Yaragal, Katta Venkataramana (2015), they studied by taking M30 grade concrete using broken tiles as replacement of coarse aggregate. They got maximum strength at 20% replacement.

III. RESEARCH METHODOLOGY

An experimental investigation was conducted to get the flexural strength of specimen made with the use of broken roof tiles and bone waste in partial replacement of coarse aggregate and fine aggregate respectively. The strength of conventional concrete and other mix proportions were determined at the end of 7, 14 and 28 days of moist curing. To study the design mix M20 grade concrete were cast. The beam was tested for flexural tensile strength. The M20 mix proportion was (1:1.5:3) taken at w/c ratio of 0.50.

Cement

In the study, ordinary Portland Cement of Ultra tech was used throughout the investigation. The physical and chemical properties of OPC as determined are given in table 1.

Table 1. properties of cement (method of test refers to IS: 1489:1985)

PROPERTIES	EXPERIMENTAL VALUE
Grade	53
Fineness (%)	7%
Specific gravity	3.1
Consistency (%)	37
Initial setting time	35 min
Final setting time	211 hours

Fine Aggregate

The fine aggregate used was M sand, which passed through 4.75 mm. The physical and chemical properties of fine aggregate is given in table 2.

Table 2. properties of fine aggregate

PROPERTIES	EXPERIMENTAL VALUE
Fineness Modulus	2.75
Specific gravity	2.4
Water absorption	2%

Coarse Aggregate

Locally available coarse aggregate having two fractions of 20mm sizes were sieved and used in this study. The fraction completely passed through 20 mm sieve. The physical and chemical properties of coarse aggregate are shown in table 3.

Table 3. properties of coarse aggregate

PROPERTIES	EXPERIMENTAL VALUE
Fineness Modulus	4.66
Specific gravity	2.7
Water absorption	0.24%

Broken Roof Tiles

The roof tile we used, is manufactured from Malabar supreme roof tile company shown in figure 1. The physical and chemical properties of broken roof tiles is given in table 4.

Table 4. properties of broken roof tiles

PROPERTIES	EXPERIMENTAL VALUE
Specific gravity	2.28
Water absorption	0.5%

Fig1.Broken roof tile

Bone Waste

Bone waste was collected from agro-farm units of Thiruvalla. It was powder form when collected, and mixing in concrete shown in figure 2.

Fig 2. Bone waste

Table 5. properties of bone waste

PROPERTIES	EXPERIMENTAL VALUE
Specific gravity	2.17

Water

Potable water was used for mixing and curing.

Mix design

The design mix proportion of 1:1.5:3 at W/C ratio of 0.50 were used for M20 grade of concrete and the cement content was 394.32 kg/m3, satisfying the requirements of IS-10262-2009.

Curing of concrete

Casting of concrete after the completion of 24 hours mould will be removed then cured by using potable water. The specimen is fully immersed in portable water for specific age of 7,14 and 28 days. After the completion of curing, it will be tested.

IV. RESULTS AND DISCUSSION

Casting

The concrete is prepared in laboratory. The concrete is poured into the mould in 3 layers by 25 strokes with tamping rod. The cast specimens are removed after 24 hours and these are immersed in a water. After curing 7,14 and 28 days the specimens were removed and these are tested for flexural tensile strength is found out for concrete which was replaced with broken roof tiles in the proportion of 0%,10%,20%,30%,40%,50% and bone waste was kept the proportion constant at 4% This was to be partial replacement of coarse and fine aggregate with broken roof tiles and bone waste respectively. The results compared with conventional concrete.

Workability

Slump test and compacting factor tests are the most widely used workability tests for concrete. The degree of workability of concrete depends on the values of test results obtained from slump test and compacting factor tests as in table 6

Slump Value:

Slump Value =h1−h2, where h1 is Initial height of the cone which is 300 mm and h2 is height of the concrete after removal of the mould.

Table.6 Slump value and compaction factor

CONCRETE MIX	SLUMP VALUE	W/C RATIO	COMPACTION FACTOR
CONVENTIONAL CONCRETE	52mm	0.5	0.947
10% REPLACEMENT	56mm	0.5	.0.942
20% REPLACEMENT	52mm	0.5	0.938
30% REPLACEMENT	60mm	0.5	0.912
40% REPLACEMENT	82mm	0.5	0.86
50% REPLACEMENT	88mm	0.5	0.873

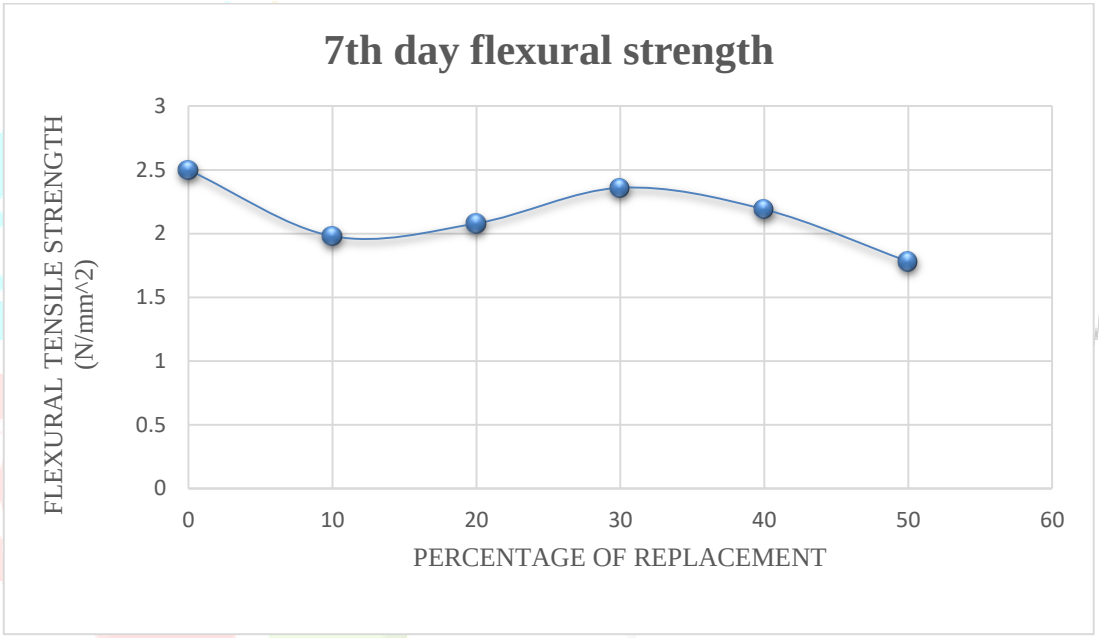
Flexural Tensile Strength Test

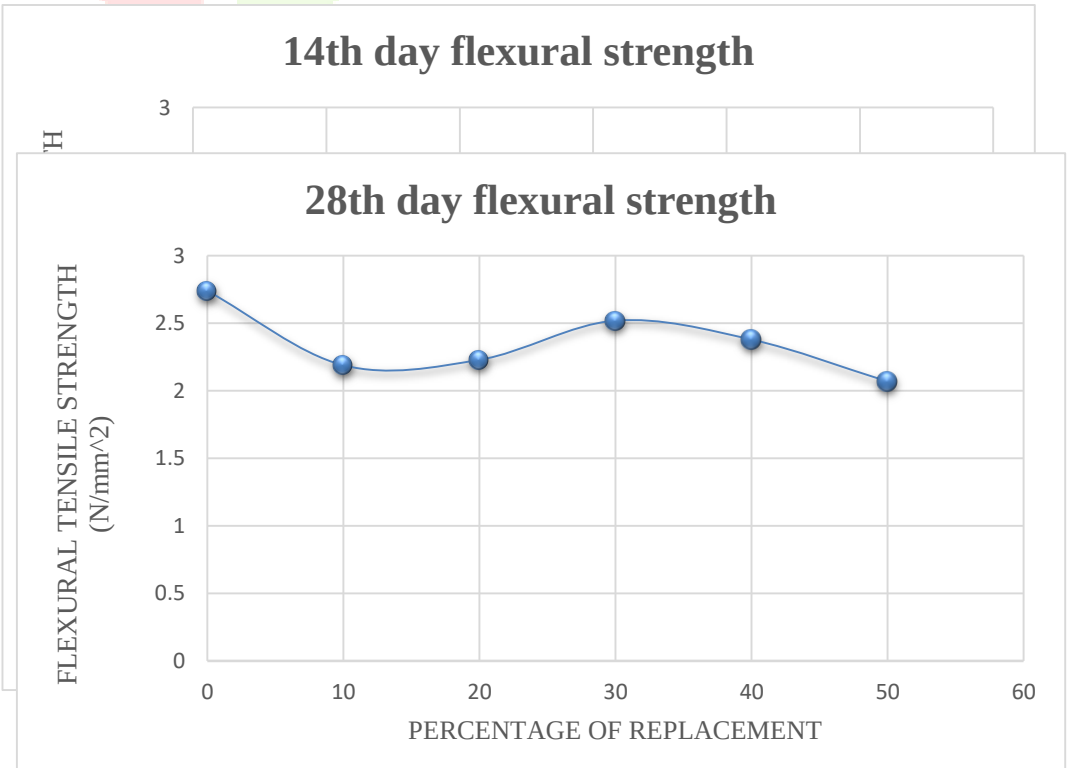
The tensile strength of different mixes for 7,14 and 28 days are shown in Table – 7. Conventional concrete and different mixes of partial replacement of course and fine aggregate with broken roof tiles and bone waste in concrete. Tensile strength results are compared by plotting graphs shown.

Table.7. flexural tensile strength for 7,14 and 28 days

Concrete mix	7 days(N/mm2)	14 days(N/mm2)	28 days(N/mm2)
Conventional concrete	2.5	2.61	2.74
10% replacement	1.98	2.05	2.19
20% replacement	2.08	2.18	2.23
30% replacement	2.36	2.47	2.52
40% replacement	2.19	2.22	2.38
50% replacement	1.78	1.96	2.07

Graphical representation of tensile strength results for 7,14 and 28 days





CONCLUSION

From the above study, the following conclusions were obtained.

1. Flexural tensile strength of concrete make using broken roof tile as partial replacement for coarse aggregate at 30% and 4% of natural sand is replaced by bone aggregate replacement level is comparable to that of ordinary concrete both at 7,14 and 28 days.
2. By using broken roof tiles and bone aggregate for replacement them, we can minimize the problem of disposal.
3. Both coarse and fine aggregate can be effectively replaced by the broken roof tile and bone waste respectively.

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