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AGGREGATE OF BETHAMCHERLA MARBLE AND STONE, SPLIT TENSILE STRENGTH BEHAVIOR

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ABSTRACT

Concrete is the most extensively used building material in the world and has a significant impact on structural construction projects. In terms of worldwide consumption, concrete is second only to water. It's very important for the future of the environment and the building industry as a whole. Due to its long lifespan, dependability, and adaptability, it has quickly become a staple in the building industry. The Latin word "concretes" means "grows together," which alludes to the chemical hydration process that transforms the viscoelastic constituents of concrete into the hard, thick, and long-lasting substance we know as concrete. Cement is the most widely used manufactured product on Earth, and its many forms provide a wide range of useful features. Meanwhile, we are not permitted to fully exhaust our allocation of natural resources. We now have some scrap materials that were useless in that construction scheme.
Bethamcherla marble stone aggregates is one such material used to replace concrete's coarse aggregate.This report shows the results of research on the split tensile strength of concrete. Standard aggregate cylinders and BMSA cylinders (manufactured from Bethamcherla marble stone) are contrasted. These cylinders are cast utilizing BMSA in place of either some or all of the natural granite coarse aggregate (NGCA). The cylinders are put through their paces by being filled with GI steel fiber at percentages of 0%, 1%, and 2% of the volume of a standard cylinder. Compressive strength of concrete consistently drops when using Bethamcherla marble stone aggregates to replace natural granite coarse aggregate (NGCA) at percentages of 0, 25, 50, 75, and 100%. The usage of 1% and 2% GI steel fibers resulted in greater strength (volume) compared to using a standard cylinder.

<u>Key-Words:</u> Natural Granite coarseAggregate(NGCA), Bethamcherla marble stone aggregate(BMSA),GI steel fibers, Split tensile strength, concrete.

I. INTRODUCTION

Today, only water is used more widely than concrete across the world. Concrete's importance as a building material has led to record levels of both demand and shortage.Throughout the last few decades, the human population has increased exponentially, leading to a corresponding increase in the production of waste materials and byproducts. As a result, the primary strategies for lowering the burden of solid waste disposal have centered on cutting down on waste generation, recycling as much as possible, and repurposing materials. As supplies decrease, the price of natural aggregate rises. Natural aggregate is widely used as coarse aggregate in concrete production across the globe. In recent years, some emerging nations have pushed for an increase in the supply of natural aggregate to keep up with the rising demands of infrastructure expansion.Recent years have seen a rapid depletion of natural resources due to rising industrial production and consumption, while at the same time a large amount of production has resulted in a great deal of waste with negative effects on the environment. As one of the largest potential users of mineral resources, the civil engineering construction sector also produces a substantial quantity of solid waste as a by-product. Stones are the most magnificent substance man has ever utilized to express himself creatively from nature. Although granite rocks are typically used as coarse aggregate in the concrete industry, using BMSA is a viable alternative in areas where neither granite rocks nor a solution to the disposal problem of Bethamcherla marble waste are readily available.About ten percent of Earth's surface is comprised of various types of Bethamcherla marble, therefore it's easy to come by. Bethamcherla consists mostly of calcium carbonate with trace amounts of silica and iron.Limestone is categorized according to the amount of calcium carbonate it contains. Metamorphism transforms limestone into marble. Bethamcherla limestone, sourced from the nearby town of Bethamcherla in the Kurnool region of Andhra Pradesh, is evaluated for its performance in this study. This comes in naturally split slab-like parts that, if polished and processed into regular forms, would produce a great strength of flooring stone with a sheen and finish on par with that of granite. The specific gravity of Bethamcherla waste stone, a naturally occurring mineral, ranges between 2.6 and 2.85. The primary Bethamcherla marble stones are a basic flaky lime stone that naturally splits. It's a high-quality flooring stone with the specific geo mechanical qualities sought for in such materials.

AIM AND SCOPE OF THE STUDY

The primary objective of the research is to examine the use of Bethamcherla waste stone in building projects. The focus of this research is on the mechanical properties of Bethamcherla waste stone, specifically its workability and split tensile strength, so that its suitability for use in construction projects can be determined. In order to investigate how the local community makes use of readily available resources.

II. LITERATURE REVIEW

PARTIAL REPLACEMENT OF COARSE AGGREGATE BY CRUSHED TILES AND FINE AGGREGATE BY GRANITE POWDERTO IMPROVE THE CONCRETE PROPERTIES

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Some differences in workability and strength were observed between concrete mixes with different percentages of replacing materials (Crushed tiles in place of coarse aggregate and granite powder in place of fine aggregate) after the completion of the entire experimental methodology, as evidenced by the above investigations and the test results.

When comparing the split tensile strength of conventional concrete (A0) at 7 days with that of CTM and UTM (A1, A2, A3, A4, A5, A6, A7, A8, A9, and A10, respectively), it is seen that the former have a 13.08%, 40.18%, 69.15%, 29.90%, 48.59%, 60.74%, 43.92%, 51.40%, 58.87%, and 49.53% increase, respectively. When comparing conventional concrete A0 after 28 days with the A1, A2, A3, A4, A5, A6, A7, A8, A9, and A10 mixes of course and fine aggregates, it is seen that the concrete's split tensile strength increases by 17.85%, 80.01%, 98.57%, 68.36%, 83.16%, 97.44%, 81.12%, 86.73%, 92.87%, and 61.22%, respectively.

COCONUT SHELL AS A REPLACEMENTOF COARSE AGGREGATE IN LIGHTWEIGHT CONCRETE

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At 28 days, samples with 0%, 10%, 25%, and 50% CS substitution of stone chips were tested for splitting tensile strength.

Based on the results, it can be concluded that a higher percentage of stone chips replaced by coconut shells reduces the concrete's splitting tensile strength. It is also noted that the tensile strength at the point of fracture is only around 9% of the compressive strength.

III. MATERIALS AND PROPERTIES

Cement: Cement is the most important material inthe concrete and it act as the binding material. Ordinary Portland cement of 53 grade was used.

Aggregate: The basic objective in proportioning any concrete is to incorporate the maximum amount of aggregate and minimum amount of water into the mix, and thereby reducing the cementitous material quantity, and to reduce the consequent volume change of the concrete.

Coarse aggregate:

The fractions from 20 mm are used as coarse aggregate. The Coarse Aggregates from Crushed Basalt rock, conforming to IS: 383 is being used.

Bethamcherla Marble Aggregate:

The stone itself, specifically in the forms of overburden, screening residual, stone fragments. Stone wastes are generated as a waste during the process of cutting and polishing. It is estimated that 175 million tons of quarrying waste are produced each year, and although a portion of this waste may be utilized on-site, such as for excavation pit refill or berm construction, the disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. In this project we crushed BMSAinto required sizes i.e., 20mm .

Fine aggregate:

The amount of fine aggregate usage is very important in concrete. This will help in filling the voids present between coarse aggregate and they mix with cementitous materials and form a paste to coat aggregate particles and that affect the compact ability of the mix. The aggregates used in this research are without impurities like clay, shale and organic matters. It is passing through 4.75mm sieve.

IV EXPERIMENTAL INVESTIGATION

Split tensile strength of concrete is one of the essential and crucial properties. Splitting tensile strength test on concrete cylinder is a technique to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle

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nature and is not expected

to resist the direct tension. The concrete develops cracks when subjected to tensile forces. In such a way, it isimportant to decide the tensile strength of concrete to determine the load at which the concrete members may crack. Here the test results of split tensile strength of concrete with and without Fibre for 7and 28 days curing for cylinder are discussed below.

Test on Split tensile strength

The split tensile strength with replacement of BMSA aggregate concrete by 25, 50, 75, 100% and natural aggregate concrete. Cylinders arecast with these replacement proportions andgalvanized Fibres are added as 0%, 1% and 2% of the volume of the concrete at the time of mixing at7 days and 28 days.

Test Results and discussion for 7 days

The results of split tensile strength made with NGCA and BMSA for seven days with 0,1,2% of G.I Steel fibres are presented in the table 5.6. From these it is observed that as a replacement of BMSA increases, the split tensile strength decreases continuously.

For NGCA-0-0 the average split tensile strength reported as 2.66MPa and for BMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0, The average split tensile strength are 2.52, 2.14, 1.90 and 1.60MPa respectively. Percentage decrease of average split tensile strength with respect toNGCA-0-0 are 5.26, 19.55, 28.57 and 39.85 forBMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0 respectively.

For NGCA-0-1 the average split tensile strength reported as 2.91MPa and for BMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1, The average split tensile strength are 2.73, 2.38, 2.12 and 1.88MPa respectively. Percentage decrease of average split tensile strength with respect toNGCA-0-1 are 6.18, 18.21, 27.15 and 35.39 forBMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1 respectively.

For NGCA-0-2 the average split tensile strength reported as 3.27MPa and for BMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2, The average split tensile strength are 2.97, 2.64, 2.30 and 2.14MPa respectively. Percentage decrease of average split tensile strength with respect toNGCA-0-2 are 9.17, 19.27, 29.66 and 34.56 forBMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2 respectively.

Effect of G.I steel fibres for 7 days

The percentage increase in split tensile strength for NGCA-0-1 and NGCA-0-2 is 9.40 and 22.93 over NGCA-0-0 mix. Similarly percentage increase for BMSA-25-1 and BMSA-25-2 mix is8.33 and 17.86. The same trend continued for all other mixes. There is a percentage increase in split tensile strength for BMSA-50-1 and BMSA-50-2 mix is 11.21 and 23.36. Percentage increase in split tensile strength for BMSA-75-1 and BMSA-75-2 mix is 9.28 and 18.56. Percentage increase in split tensile strength for BMSA-100-1 and BMSA-100-2 mix is 17.50 and 33.75.

Test results and discussion for 28 days

The results of split tensile strength made with NGCA and BMSA for twenty eight days with 0,1,2% of G.I Steel fibres are presented in the table 5.6. From these it is observed that as a replacement of BMSA increases, the split tensile strength decreases continuously.

For NGCA-0-0 the average split tensile strength reported as 3.99 MPa and for BMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0, The average split tensile strength are 3.78, 3.21, 2.85 and 2.40MPa respectively. Percentage decrease of average split tensile strength with respect to NGCA-0-0 are 5.26, 19.55, 28.57 and 39.85 forBMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0 respectively.

For NGCA-0-1 the average split tensile strength reported as 4.36 MPa and for BMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1, The average split tensile strength are4.09, 3.57, 3.18and 2.82MPa respectively. Percentage decrease of average split tensile strength with respect to NGCA-0-1 are 6.19, 18.12, 27.06 and 35.32 forBMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1 respectively.

For NGCA-0-2 the average split tensile strength reported as 4.91 MPa and for BMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2, The average split tensile strength are 4.46, 3.96, 3.45 and 3.21MPa respectively. Percentage decrease of average split tensile strength with respect to NGCA-0-2 are 9.16, 19.35, 29.73 and 34.62 forBMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2 respectively.

Effect of G.I steel fibres for 28 days

The percentage increase in split tensile strength for NGCA-0-1 and NGCA-0-2 is 9.27 and 23.06 over NGCA-0-0 mix. Similarly percentage increase for BMSA-25-1 and BMSA-25-2 mix is 8.20 and 17.99. The same trend continued for all other mixes. There is a percentage increase in split tensile strength for BMSA-50-1 and BMSA-50-2 mix is 11.21 and 23.36. Percentage increase in split tensile strength for BMSA-75-1 and BMSA-75-2 mix is 11.58 and 21.05. Percentage increase in split tensile strength for BMSA-100-1 and BMSA-100-2 mix is 17.50and 33.75 .

CASTING OF SPECIMENS

Before placing the concrete inside faces of the mould are coated with the machine oil for easy removal afterwards after completion of the workability tests, the concrete has been placed in the standard metallic moulds in three layers and hasbeen compacted each time by tamping rod. Before placing the concrete inside faces of the mould are coated with the machine oil for easy removal afterwards. The concrete in the moulds has been finished smoothly.

CURING

After casting the specimen, the moulds were air dried for one day and then the specimens were removed from the moulds after 24 hours of casting of concrete specimens. Markings have been done to identify the different percentages. All the specimens were cured in curing tank (water curing).

V. TEST RESULTS

Table: Split Tensile Strength after 7 and 28 Days of Curing

S. No	Nomenclature of the specimen	Average 7 days split tensile strength In MPa	Average 28 days split tensile strength In MPa	%difference on the 7 day split tensile strength	% difference on the 28 day split tensile strength
1	NGCA-0-0	2.66	3.99	-	-
2	BMSA-25-0	2.52	3.78	-5.26	-5.26
3	BMSA-50-0	2.14	3.21	-19.55	-19.55
4	BMSA-75-0	1.90	2.85	-28.57	-28.57
5	BMSA-100-0	1.60	2.4	-39.85	-39.85
6	NGCA-0-1	2.91	4.36	+9.43	+9.27
7	BMSA-25-1	2.73	4.09	+2.63	+2.51
8	BMSA-50-1	2.38	3.57	-10.53	-10.53
9	BMSA-75-1	2.12	3.18	-20.30	-20.30
10	BMSA-100-1	1.88	2.82	-29.32	-29.32
11	NGCA-0-2	3.27	4.91	+22.93	+23.06
12	BMSA-25-2	2.97	4.46	+11.65	+11.78
13	BMSA-50-2	2.64	3.96	-0.75	-0.75
14	BMSA-75-2	2.30	3.45	-13.53	-13.53
15	BMSA-100-2	2.14	3.21	-19.55	-19.55

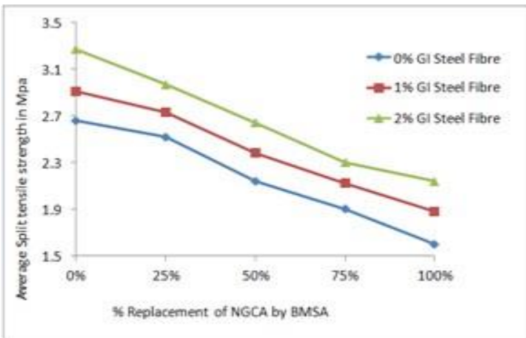

Figure: 7 days average Split tensile strength Vs % of replacement of NGCA by BMSA

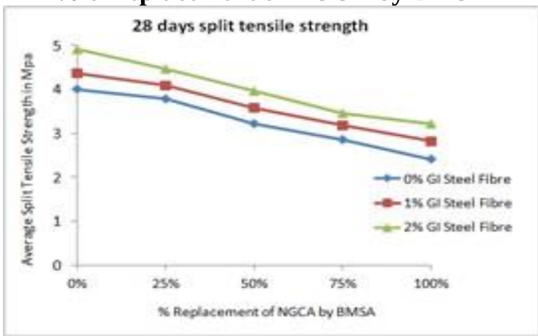

Figure: 28 days average split tensile strength Vs % Replacement of NGCA by BMSA at 0%, 1% and 2% GI steel Fibres

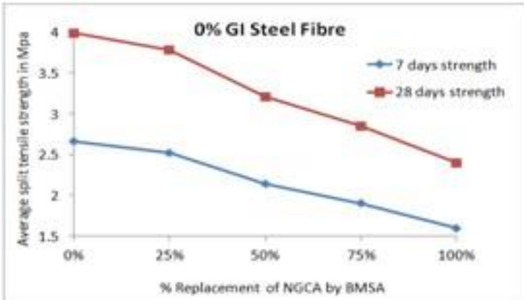

Figure: 7 and 28 days average split tensile strength Vs Percentage replacement of NGCA by BMSA at 0% GI steel Fibres

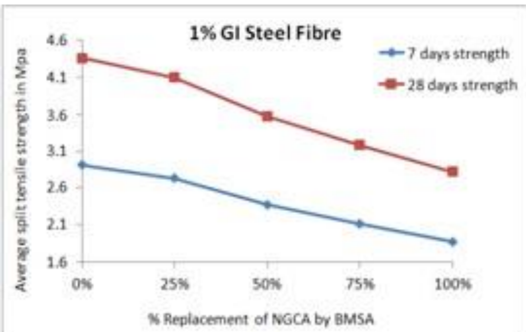

Figure: 7 and 28 days average split tensile strength Vs Percentage replacement of NGCA by BMSA at 1% GI steel Fibres

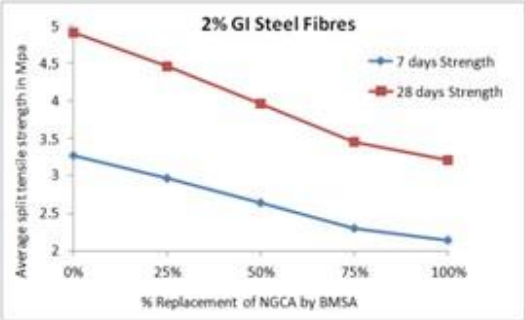

Figure: 7 and 28 days average split tensile strength Vs Percentage replacement of NGCA by BMSA at 2% GI steel Fibres

VI. CONCLUSIONS

1. The split tensile strengths were decreasedfor Bethamcherla marble stone aggregate, and it increases with increase in addition of G.I steel fibres.

- For NGCA-0-0 the average split tensile strength reported as 2.66MPa, 3.99MPa for 7days and 28 days respectively
- For NGCA-0-1 the average split tensile strength reported as 2.91MPa, 4.36MPa for 7days and 28 days respectively
- For NGCA-0-2 the average split tensile strength reported as 3.27MPa, 4.91MPa for 7days and 28 days respectively

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