# SHEAR BEHAVIOUR ON BETHAMCHERLA MARBLE STONE AGGREGATE

**V.RAMESH BABU[1], Dr.D.JAGAN MOHAN[2], B.SRAVANI[3]**

[1]Assistant professor, Dept of Civil Engineering, K.S.R.M College of Engineering, KADAPA, AP
[2]*Lecturer, Dept. of Civil Engineering, JNTUA university, Ananthapuram, AP*
[3]*Assistant professor, Dept of Civil Engineering, K.S.R.M College of Engineering, KADAPA, AP*

**ABSTRACT**

Concrete plays the most prominent role in the structural construction works, it is the most widely used as a construction material throughout the world. Based on the global usage, concrete is placed at second position over water. It plays a very significant role in the shaping our environment and sustainability of the construction industry. Ever since its discovery has become indispensable in construction practices, owing to its durable, reliable and workable properties. The name concrete is derived from the Latin term "concretes" meaning 'grows together' hinting at the chemical hydration process that causes the material inside to grow together from a visco-elastic state into a hard, dense and durable product. There are numerous plans of solid, which give differing properties, and cement is the most-utilized man-made item on the planet. Meanwhile we are not allowed to complete the natural resource usage in concrete. We have some waste materials which were not useful in that pattern of works.

One of those materials is Bethamcherla marble stone aggregates as replacement of coarse aggregate in concrete.This paper represents the study of shear strength of concrete for different combinations. The comparison is made between conventional aggregate cubes and cubes made with Bethamcherla marble stone aggregates (BMSA). The cubes of varying proportions are casted replacing partially and totally natural granite coarse aggregate (NGCA) with using BMSA. The cubes are tested by adding GI steel fibre of volume 0%, 1% and 2% of volume of conventional cube. It is observed that there is consistent decrease of shear strength of concrete of 0, 25, 50, 75 and 100 % of replacement of natural granite coarse aggregate (NGCA) with Bethamcherla marble stone aggregates. It was also observed that strength increased (volume) when 1% and 2% of GI steel fibers were used compared with conventional cube.

**Key-Words:** **Natural Granite coarse Aggregate(NGCA), Bethamcherla marble stone aggregate(BMSA),GI steel fibers, shear strength, concrete.**

## I. INTRODUCTION

The global use of concrete is next to water in this era. As the demand for concrete as construction material increases, the demand and scarcity has been raised to a peak.

There has been rapid increase in the waste materials and by products production due to exponential growth rate of population from last few decades the basic strategies to decrease solid waste disposal problems have been focused at the reduction of waste production and recovery of usable materials from the waste as raw materials as well as utilization of waste as raw materials whenever possible. Natural aggregate is becoming expensive due to scarcity. The world-wide consumption of natural aggregate as coarse aggregate in concrete production is very high and several developing countries have encouraged some demand in the supply of natural aggregate in order to meet the increasing needs of infrastructural development in recent years. In particular, the demand of natural aggregate is quite high in developing countries owing to rapid infrastructural growth.

In the recent years, the growth in industrial production and the consequent increase in consumption have lead to fast decline in available natural resources on the other hand, a high volume of production has generated a considerable amount of course material which have adverse impact on the environment. The Civil Engineering construction industry is to be one of the most potential consumers of mineral recourses, thus generating a great amount of solid waste as a bye product stones. Stones have perhaps the noblest material from nature used by men for his artistic expression. In the concrete industry, generally used coarse aggregate is obtained from granite rocks, but in locations where there is no availability of granite rocks and also in the places where, there is a disposal problem of Bethamcherla marble waste, in such situations, the usage of BMSA is an advantageous consideration.

Bethamcherla marble is abundantly available, occupying about 10% of the earth's surface in different forms. The main constituent of Bethamcherla is calcium carbonate along with silica and iron as impurities .Many grades of limestone are available and their classification is done on the basis of calcium carbonate content. The marble rock is metamorphic from the lime stone. In this research work the performance of discarded flooring Bethamcherla limestone from the town of Bethamcherla, located in the Kurnool district of

Andhra Pradesh is considered. This occurs in the naturally cleft slab like elements which on polishing and processing into regular shapes that would make an excellent strength of flooring stone that has the luster and finish on par with its granite counterpart. Bethamcherla waste stone is one of the natural mineral having specific gravity ranging from 2.6 to 2.85. Bethamcherla marble stones are fundamental flaggy lime stone with natural split. It is very excellent flooring stone, which have been unique geo mechanical properties required for flooring stones.

## SIGNIFICANCE OF RESEARCH WORK

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## AIM AND SCOPE OF THE STUDY

Main aim of the study is to know the involvement of Bethamcherla waste stone in construction works. In this study importantly, it is concentrated on some basic properties Bethamcherla waste stone, to know the suitability of the Bethamcherla waste stone in construction works by conducting some workability tests and some mechanical properties tests, in this paper we worked with shear strength. To make explore the usage of local accessible materials to the surrounding people.

## II. LITERATURE REVIEW

### ESTIMATING THE SHEAR STRENGTH OF CONCRETE WITH COARSE AGGREGATE REPLACEMENT

**Folagbade Olusoga Peter ORIOLA, George MOSES, Jacob Oyeniyi AFOLAYAN and John Engbonye SANI***

- From experimental work, it can be observed that the values of shear strength for corresponding shear strength for different kinds of concrete are not significantly different as the Coefficients of Variation (COV) for all the concrete types are below the practical limit of 15%.
- Therefore, any of work have been used to represent the experimental results. However, the test which appears to follow the trend of the results better and with the lowest COV of 7.33%is the preferable choice.
- It was expected to predict the shear strength of both normal concrete and those with coarse aggregate replacement at the prescribed level. For safer design however, the design strength could be obtained from the characteristic value of C3 = 1.109. With this value, all the results will be above the regression line and there may be no need to further apply the partial factor of safety for shear recommended by BS 8110

## III. MATERIALS AND PROPERTIES

**Cement:** Cement is the most important material in the 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 BMSA into 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

Shear strength is related to change in bending moment between adjacent sections. The shear strength is calculated as ratio of failure shear load and shear area. For every mix, the shear strength is recorded as average of six test results. In this test the double L-shaped beams are divided into three categories each representing 30 units of beams having 0%, 1%, 2% fibre inclusion, by volume. Further these specimens are cast varying the aggregate replacement ratios as 0%, 25%, 50%, 75% and 100%. Details of the individual specimen are tabulated in below Table

**Test results and discussion for average shear strength**

The results of average shear strength made with NGCA and BMSA for twenty eight days with 0,1,2% of G.I Steel fibres are presented in the table 6.14. From these it is observed that as a replacement of BMSA increases, the average shear strength decreases continuously.

For NGCA-0-0 the average shear strength reported as 8.73MPa and for BMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0, The shear strength are 7.65, 6.00, 5.12 and 3.40 MPa respectively. Percentage decrease of average shear strength with respect to NGCA-0-0 are 12.37, 31.27,41.35and 61.05 for BMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0 respectively.

For NGCA-0-1 the average shear strength reported as 9.40MPa and for BMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1, The average shear strength are8.43, 7.36, 5.62 and 3.90 respectively. Percentage decrease of average shear strength with respect to NGCA-0-1 are 10.32, 21.70, 40.21 and 58.51 for BMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1 respectively.

For NGCA-0-2 the average shear strength reported as 10.76MPa and for BMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2, The average shear strength are 9.52,8.63,6.78 and 4.61MPa respectively. Percentage decrease of average shear strength with respect to NGCA-0-2 are 11.52, 19.79, 36.99 and 57.16 for BMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2 respectively.

**Effect of G.I steel fibres for average shear strength**

The percentage increase in average shear strength for NGCA-0-1 and NGCA-0-2 is 7.67 and 23.25 over NGCA-0-0 mix. Similarly percentage increase for BMSA-25-1 and BMSA-25-2 mix is10.20 and 24.44. The same trend continued for all other mixes. There is a percentage increase in average shear strength for BMSA-50-1 and BMSA-50-2 mix is22.67 and 43.83. Percentage increase in average shear strength for BMSA-75-1 and BMSA-75-2 mix is9.76 and 32.42. Percentage increase in ultimate torsional shear strength for BMSA-100-1 and BMSA-100-2 mix is14.70 and 35.59.

**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 has been 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: Shear strength values recorded for each mix batch with 0%, 1% and 2% GI steel Fibres**

| S.NO | Nomenclature of the specimen | Average load in (KN) | Average Shear area ($mm^2$) | Average shear strength in MPa | % difference in shear strength |
|---|---|---|---|---|---|
| 1. | NGCA-0-0 | 40.40 | 52×89 | 8.73 | - |
| 2. | BMSA-25-0 | 35.40 | 52×89 | 7.65 | -12.37 |
| 3. | BMSA-50-0 | 27.77 | 52×89 | 6.00 | -31.27 |
| 4. | BMSA-75-0 | 23.69 | 52×89 | 5.12 | -41.35 |
| 5. | BMSA-100-0 | 15.73 | 52×89 | 3.40 | -61.05 |
| 6. | NGCA-0-1 | 43.50 | 52×89 | 9.40 | +7.67 |
| 7. | BMSA-25-1 | 39.01 | 52×89 | 8.43 | -3.44 |
| 8. | BMSA-50-1 | 34.06 | 52×89 | 7.36 | -15.69 |
| 9. | BMSA-75-1 | 26.01 | 52×89 | 5.62 | -35.62 |
| 10. | BMSA-100-1 | 18.05 | 52×89 | 3.90 | -55.53 |
| 11. | NGCA-0-2 | 49.80 | 52×89 | 10.76 | +23.25 |
| 12. | BMSA-25-2 | 44.06 | 52×89 | 9.52 | +9.05 |
| 13. | BMSA-50-2 | 39.94 | 52×89 | 8.63 | -1.14 |
| 14. | BMSA-75-2 | 31.38 | 52×89 | 6.78 | -22.34 |
| 15. | BMSA-100-2 | 21.33 | 52×89 | 4.61 | -47.19 |

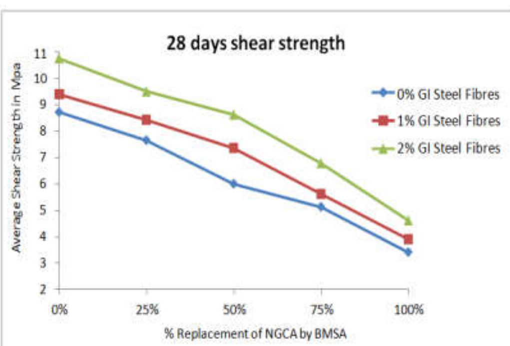


**Figure: 28 days average shear strength Vs % replacement of NGCA by BMSA at 0%, 1% and 2% GI steel Fibres**

## VI. CONCLUSIONS

The average shear strength decreases with increase in replacement with BMSA and increase with increase in G.I steel fibre content in concrete.

- For NGCA-0-0 the average shear strength reported as 8.73MPa for 28 days respectively
- For NGCA-0-1 the average shear strength reported as 9.40MPa for 28 days respectively
- For NGCA-0-2 the average shear strength reported as 10.76MPa for 28 days respectively

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