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TORSION BEHAVIOUR ON BETHAMCHERLA MARBLE STONE AGGREGATE

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ABSTRACT

In the recent year demand for concrete has increased worldwide. This has lead to development of various studies on materials. Meanwhile we ae 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 material is Bethamcherla marble stone aggregates as replacement of coarse aggregate in concrete. This paper represents the study of 'torsion' strength of concrete for different combinations. The comparison is made between conventional aggregate beams and beams made with Bethamcherla marble stone aggregates (BMSA). The beams of varying proportions are casted replacing partially and fully natural granite coarse aggregate (NGCA) with using BMSA. The beams are tested by adding GI steel fibre of volume 0%, 1% and 2% of volume of conventional beam. It is observed that there is consistent decrease of torsion 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 with respect to each other percentages when 1% and 2% of GI steel fibers were used compared with conventional beam

Key Words: ***Natural Granite coarse Aggregate, Bethamcherla marble stone aggregate, GI steel fibers, Torsion 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. There are many natural stone wonders the earth offers us which we must pamper as unique treasures. India offers a variety of a natural stone viz; Granite, Sandstone, Slates, Marbles, Quartzite, Bethamcherla marble stones in multi colors, shapes and size. Bethamcherla stones are basically flaggy lime stone it is natural split table and when spitted in compact slabs and tiles, Kurnool district of Andhra Pradesh has been gifted by nature with huge deposit of Bethamcherla stone. It is excellent flooring stone have been unique geo mechanical properties required for flooring stones. When polished it gives glossy finish even as good as galaxy granite. Natural stone sector has grown from an almost manual activity to a highly industrialized business in last decades.

Waste has always been big news to business. Watching what you throw away at the end of the production is almost as important as finished product itself. More and more companies are examining ways of saving waste in their everyday activity as a route to both project and cleaner production. Quarries producing natural stone, Bethamcherla marble stone, marble slate stone etc, generate large quantity of solid waste. This waste is in the form of over lying Burdon, inter bedded burden, production waste generation during cutting, sizing, splitting at quarry floor. Besides many environmental problems especially from large generation of waste and its disposal continue to be the biggest factor that will determine the future development of Bethamcherla stone like other natural stones. In this situation, some developing countries are facing a shortage in the supply of natural aggregate. Therefore, it is necessary to replace natural aggregate in concrete by alternate materials either partially or completely without compromising the quality of concrete. Also, is it desirable to obtain cheap, environmentally friendly substitutes for coarse aggregates that are preferably by-product in recent years, there is a growing interest in the use of marble waste obtained from quarries in some countries where natural aggregate is not widely available and also marble is a prosaic but nearly indispensable construction material. This work examines the influence of marble as aggregate in partial replacement of natural aggregate on concrete properties, which include workability of fresh concrete, compressive and split tensile strengths. The concrete contains different ratios of quarry dust while maintaining a constant water/cement ratio. The results of this work confirm that the natural aggregate may be replaced totally or partially with marble.

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 torsion. To make explore the usage of local accessible materials to the surrounding people.

II. LITERATURE REVIEW

- **Nishanth1, A. Joshua Daniel2**, Experimental study on Torsional behavior of Silica Fume based Geopolymer concrete beam. This research investigates and evaluates the results of geopolymer concrete beams subjected to torsion and compared with conventional concrete beams. Eight beams, four with geopolymer concrete and four with conventional concrete were fabricated and tested. Study includes the general cracking characteristics, pre-cracking behaviour, post cracking behaviour, crack width stiffness and ductility. From the compression, torsion and split tensile tests, the optimum replacement of silica fume is found to be 40%. The ultimate torque resistances of geopolymer concrete is less in comparison to that of conventional concrete. Further, with increase in reinforcement percentage, the ductility of geopolymer concrete increase.

KesaniSarath Chandra gowd, D. Arul Prakash Torsion Behaviour of Beam with Bamboo asReinforcement and Coconut Shell as Aggregate Bamboo, which is fast growing grass and eco-friendly andnaturally renewable material, is proved to be appropriate forstructural applications. The tensile strength of bamboo is quitehigh and is almost similar to that of steel. This makes bamboo a perfect alternative to steel in tensile loadingapplications. Theintention of the research is to evolve a design using bamboo asone of the chief structural materials, for a safe and durable house.This research investigates and evaluates the results of bambooreinforced coconut shell concrete beams subjected to torsion andcompared with conventional concrete beams and coconut shellconcrete beams with steel reinforcement. Twelve beams, three with treated bamboo reinforced coconut shellconcrete, three withun-treated bamboo reinforced coconut shell concrete, three withsteel reinforced coconut shell concrete and three withconventional concrete were fabricated and tested. Study includes the general cracking characteristics, pre-cracking behaviour andanalysis, post cracking behaviour and analysis, crack width andstiffness. It was observed that the torsional behaviour of bambooreinforced coconut shell concrete is comparable to that of conventional concrete.

- Torsional response of Fibre-reinforced polymeric (FRP) composites are more complex than conventional materials. ln 2006, Kota V.S. Gangarao, and vimalashekar investigated on performance evaluation of FRP bridge deck component under torsion. Experimental data of multicellular FRP bridge deck components had been compared with simplified theoretical model studies focused on torsional rigidity, equivalent in-plane shear modulus, in-plane shear strain, and joint efficiency are studied by using simplified classical lamination theory (SCLT) to predict torsional rigidity. This investigation gives the result as in an FRP deck system with 100% joint efficiency, the two-dimensional effect on torsional rigidity results in a 20% higher rigidity when compared to a beam model. However, if a refined model has just 80% joint productivity, at that point plate action results in a 6% distinction from the beam model. Moreover, service load design criteria for FRP decks under shear must not excess 16% of the ultimate strain by accounting for environmental and aging effects.

- A.A. Jadhav1, V.P. Kulkarni2,Effect on Torsional and Flexural Behavior RC Concrete Beam made with Plastic Waste Bags (PWB) Granules. Concrete is one of the most common materials used in the construction industry. In the past few years, many and modification has been done to produce concrete which has the desired characteristics. There is always a search for concrete with higher strength and durability. Plain concrete has good compressive strength but has low tensile strength, low ductility and low fire resistance. To circumvent these shortcomings, extensive research by concrete technologist has led them to find a very promising concrete material called as fiber reinforced concrete. This study aim to characteristics and comparison of the mechanical properties of PWB,Plastic waste Bags granular concrete with conventional concrete. In order to achieve and verify that 00%,10% , 20% 30% fiber percentage by the volume of sand are used in this study with three different concrete mixes test such as Compression test ,Split tensile, Bending test and Torsional Test on different specimens for 28days compressive strength, spilt tensile strength, flexural strength, tests have been performed in the hardened state. The total tested specimens are 48. Performance of conventional concrete is enhance by the addition of PWB in concrete. The brittleness in concrete is reduced and adequate ductility of concrete in ensure by addition of PWB in concrete. In this project the behavior of cube, cylinder & beam structures strengthen by using PWB is experimentally tested. The PWB used are fibers in various volume fraction the main reason for adding this to concrete matrix is to improve the post cracking response of the concrete i.e. to improve its energy absorption capacity and apparent ductility and to provide a crack resistance and crack control and addition of strength for bridging the micro-cracks are suggested as the reason for the enhancement in flexural fiber. The torsional test is an attempt made in this study to implement it for further seismic study. In Concrete Natural sand can be replaced with plastic waste by 10 to 30% to achieve green concrete. Sand can also be replaced up to 30% in the members of building which do not carry high load. Using plastic waste such as polyvinylchloride (PVC), Polypropylene (PP), Polyethylene in concrete reduces the environmental issues and minimizes the difficulties of dumping the major plastic waste. This will help to tackle the increasing pollution all over the world, especially in countries that face the complications regarding waste. In addition to the environmental benefits, it was noted that using plastic scrap can be used to fight against the obstacle of scarcity of natural sand in India.

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., 20 mm

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

The experimental program comprises casting and testing of Bethamcherla marble stone aggregate (BMSA) and Natural granite coarse aggregate (NGCA). The mix proportion details for the beams without Fibres (0%) are presented in Table. The beams with fibre material 1% and 2% are casted. Total 90 beams were casted in which 30 beams are without fibre (0%) and 60 beams with 1% and 2% G.I steel fibre and with replacement of natural aggregate by BMSA of 0% 25, 20, 75 and 100 %. All he beams were tested at after 28 days of curing period.

TEST PROGRAM FOR TORSION

Torsiontest:

When torsion is applied to a structural member, its cross section may warp in addition to twisting. Torsion in beams arises generally from the action of shear loads whose points of application do not coincide with the shear centre of the beam section. The test results of torsion and angle of twist with and without Fibre are discussed as in the upcomingsection.

Test onTorsion

The torsion test is conducted with the replacement of NGCA aggregate by BMSA in concrete by 0, 25, 50, 75, 100% along with addition of G.I steel fibres in 0%, 1% and 2% of the volume of the concrete. Beams are cast with these replacement proportions and galvanized iron steel fibres are added as at the time of mixing. The beams tested for torsion at the age of 28 days. The details of test results of torsion tests are illustrated as the following table.

SPECIMEN DETAILS

Standard specimens beams are used to conduct the strength tests are taken according *to IS10086-1982*.

- For Torsion test was carried out on beam moulds of 0.15×0.15x1.5mare used.

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.

Fig: Specimens

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).

Fig: Typical failure of the specimen under torsion

V. TEST RESULTS

Table: Ultimate torque and maximum angle of twist

S.NO	Nomenclature of the specimen	Ultimate torque (kN-mm)	Maximum deflection ($mm\times10^{-2}$)	Maximum angle of twist $\times10^{-4}$ rad/cm	% increase / decrease in angle of twist
1.	NGCA-0-0	5789	402	0.28	-
2.	BMSA-25-0	5528	393	0.27	-3.57
3.	BMSA-50-0	5345	365	0.25	-10.71
4.	BMSA-75-0	5012	341	0.23	-17.86
5.	BMSA-100-0	4788	327	0.22	-21.43
6.	NGCA-0-1	5842	419	0.29	+3.57
7.	BMSA-25-1	5500	389	0.27	-3.57
8.	BMSA-50-1	5298	377	0.26	-7.14
9.	BMSA-75-1	5115	359	0.25	-10.71
10.	BMSA-100-1	4893	347	0.24	-14.28
11.	NGCA-0-2	5915	436	0.30	+6.67
12.	BMSA-25-2	5645	410	0.28	0.00
13.	BMSA-50-2	5408	396	0.27	-3.57
14.	BMSA-75-2	5218	383	0.26	-7.14
15.	BMSA-100-2	4987	364	0.25	-10.71

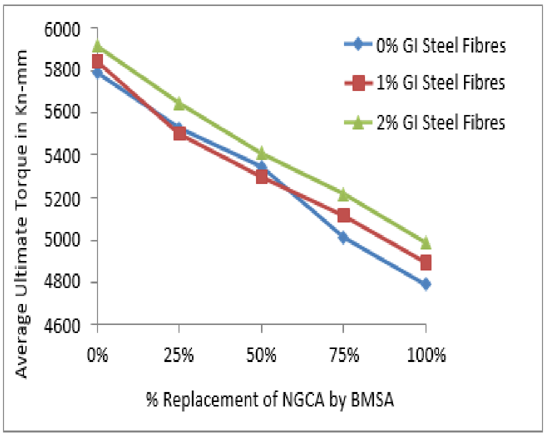

Figure: 28 days average Ultimate torque Vs % replacement of NGCA by BMSA at 0%, 1% and 2% GI Steel Fibres

The concrete with fibres showed greater rotational capacity over conventional concrete. At higher dosage of fibre content the rotational capacity increases. The stiffness at a particular rotation is enhanced for concrete produced with fibres. The crack bridge and load transfer mechanism is more effective in fibre concrete and it leads to enhance the rotationcapacity

VI. CONCLUSIONS

1. It is observed that Torsion strength of beams decreases gradually. For 0% replacement of BMSA we are getting torsion strength of 5.15Mpa , after adding 1% and 2% of GI steel fibers for same mix proportion strength is around 5.19 Mpa and 5.26Mpa respectively.
2. For 25% replacement of BMSA,torsion strength of 4.91Mpa after adding 1% and 2% of GI steel fibers for same mix proportion strength is around 4.89Mpa and 5.02Mpa respectively.
3. For 50% replacement of BMSA, flexural strength of 4.75 Mpa after adding 1% and 2% of GI steel fibers for same mix proportion strength is around 4.71 Mpa and 4.81 Mpa respectively.
4. For 75% replacement of BMSA, flexural strength of 4.46Mpa after adding 1% and 2% of GI steel fibers for same mix proportion strength is around 4.55Mpa and 4.64 Mpa respectively.
5. For 100% replacement of BMSA, flexural strength of 4.26Mpa after adding 1% and 2% of GI steel fibers for same mix proportion strength is around 4.35Mpa and 4.43 Mpa respectively.
6. The torsional strength decreases with increase in replacement with BMSA and increase with increase in G.I steel fibre content in concrete.

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