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AN EXPERIMENTAL INVESTIGATION ON HIGH STRENGTH CONCRETE PARTIALLY REPLACED BY ECO SAND FOR FINE AGGRGATE

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Abstract - *High strength concrete is widely used in construction of high rise reinforced and prestressed concrete buildings. The increase in construction requirements leads to increase in cost and decrease in natural resource(sand).Therefore, it is replaced by industrial waste material like glass fibre partially as 1% and fine aggregate is partially replaced by eco sand as 10%,20%,30%,40% respectively. Project also aims to determining the best mix that fetches maximum strength factors. Strength parameter includes compressive strength, Tensile strength and Flexural strength of specimens casted and tested for curing.*

Key Words: **Ecosand, glass fiber, compressive strength, flexural strength.**

1. INTRODUCTION

Concrete is a complex material which is composed primarily of cement, fine aggregate and coarse aggregate mixed with portable water that hardens with time. The aggregate are mostly crushed rocks or coarse gravels like lime stones, together with fine aggregate i.e., sand. Portland cement is usually used for production of concrete and other materials which have cementitious properties such as fly ash and slag cement all are function as a binder for the aggregates. The cement in concrete reacts with water and forms a hardened mass. During the increased demand for river sand causes a dramatic issue in producing conventional concrete. This made many researches to be developed and focus on the alternative for fine aggregate. On based on the research a trial mix was prepared by replacing fine aggregate with an industrial by-product called Eco sand. The utilization of these by-products reduces the problem faced for demand of material aggregate required for concrete.

1.1 OBJECTIVE

- To determine the optimum percentage of addition of eco sand and glass fiber.
- To study the fresh and hardened property of concrete incorporated with eco sand.
- To reduce the demand for fine aggregate and to reuse the waste materials like eco sand and glass fiber.
- To compare the strength of different portion of glass fiber, eco sand with partial replacement of fine aggregate.

1.2 MATERIALS & PROPRTIES

1.2.1 CEMENT

Ordinary Portland Cement (53 grade) conforming to IS: 12269 -1987 and with the specific gravity 3.15 was used for casting all the specimens. Tests conducted on cement are fineness of cement by sieve analysis (using 90 µ sieve), specific gravity using Le-chatlier's apparatus, initial setting time and final setting time using vicat apparatus.

Table-1 properties of cement

SI.No	TESTS	RESULTS
1	Specific Gravity	3.15
2	Initial Setting Time	32min
3	Final Setting Time	540min
4	Consistency test	36%
5	Fineness test	4.93

1.2.3 FINE AGGREGATE

Clean and dry M- sand available locally was used. Sand passing through IS 4.75 mm sieve and as per IS: 383-1970 was used for all the specimens. Test conducted on fine aggregate are specific gravity using pycnometer, fineness modulus by sieve analysis.

Table-2 properties of fine aggregate

SI.No	TESTS	RESULTS
1	Specific Gravity	2.74
2	Fineness modulus	2.53
3	Water absorption	0.8%

1.2.4 COARSE AGGREGATE

Crushed granite aggregate with specific gravity of 2.56 and passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383 - 1970 is used for all the specimens

Table-3 properties of coarse aggregate		
S.No	**TESTS**	**RESULTS**
1	Specific Gravity	2.56
2	Bulk density	1652.89kg/m^3
3	Water absorption	0.5%

1.2.4 ECO SAND

Eco sand are very fine particles, a bi-product from cement manufacture which can be used to increases efficiency in concrete. It acts as inert materials and being very small particle 530 nm range, it can fill pores and add physical durability to concrete. For this experimental study, eco sand is obtained from ACC cement factory, Madukkarai, Coimbatore.

Table-4 properties of Eco sand		
SI.No	**TESTS**	**RESULTS**
1	Specific Gravity	2.54
2	Fineness modulus	3.42
3	Water absorption	2%
4	Bulk density	1587.6%

1.2.5 GLASS FIBER

It is the material extremely made from fineness of glass. It is a light weight, extremely strong and robust material. There are distinctive sorts of fiber however in these we have taken e-glass fiber to show better resistance and a very good insulation to electricity.

1.2.6 WATER

Water acts as lubricants for the fine and coarse aggregate and acts chemically with cement to form the binding paste for the aggregate. Water is used for curing the concrete after it has cast into the forms. Water used for both making and curing should be free from injurious amount of deleterious materials. Portable water is generally considered satisfactory for mixing and curing of concrete.

Table-5 water test		
S.No	**WATER**	**PH VALUE**
1.	Sample 1	7
2.	Sample 2	7
3.	Sample 3	7

1.3 MIX PROPORTIONS

The concrete mix design is a process of selecting suitable ingredients and determines their relative proportions with an object of producing the concrete of certain minimum strength and durability as economical as possible. The mix design was proposed by using IS 10262:2009. Concrete cubes of size 150mm x 150mm x 150mm were cast in cube mould using the design mix of (1 : 2.1 : 2.9)with w/c ratio of 0.45. The cylindrical specimen of 300mm height and 150mm radius and prism of 700mm X 150mm x 150mm were casted for testing. Five mixes were used i.e. **M0 -** Conventional mix, **M1 –** eco sand-10%,F.A-90%, G.Fiber-1%, **M2-** ecosand-20%,F.A-80%, G.Fiber-1%, **M3-** eco sand-30%,F.A-70%, G.Fiber-1%, **M4-** eco sand-40%,F.A-60%, G.Fiber-1%.

1.4 TESTS ON SPECIMENS

Testing of specimens plays an important role in controlling the quality and quantity of concrete. All the specimens cast were subjected to testing to study the effect of partial replacement of fine aggregate by eco sand on strength properties are studied with

- Compressive strength test,
- Split tensile strength test,
- Flexural strength test.

1.4.1 COMPRESSIVE STRENGTH TEST

Table-6 Compressive strength			
Mix proportions	**Compressive Strength @ 3 days(N/mm^2)**	**Compressive strength @ 7days (N/mm^2)**	**Compressive strength @ 28 days (N/mm^2)**
M0	18	20	37.9
M1	19.6	21.3	41.2
M2	21	26.5	44
M3	24	29.8	49.7
M4	22.3	27	47

The compressive strength test was carried out on 150mm x 150mm x 150mm cubes as specified by IS 516-1959(1989). The results of the compressive strength of conventional and partial replacement of fine aggregate by eco sand and glass fiber concrete at 3 days, 7 days and 28 days for M40 grade concrete are tabulated.

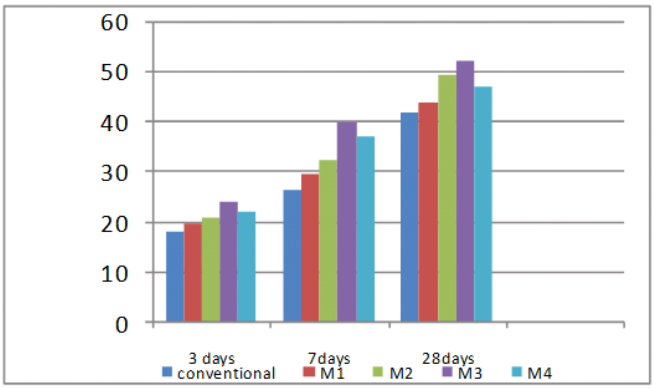

Chart -1: compressive strength test

1.4.2 SPLIT TENSILE TEST

The split tensile strength test was carried out on cylindrical specimens of 150mm diameter and 300 mm length. The results of the split tensile strength of conventional and partial replacement of fine aggregate by eco sand & glass fiber concrete at 7 days and 28 days for M40 grade concrete are tabulated.

Table-7 split tensile		
Mix proportions	**Split tensile strength@ 7days (N/mm²)**	**Split tensile strength @ 28 days (N/mm²)**
M0	2.58	4.3
M1	3.36	5.6
M2	4.62	6.6
M3	5.18	6.8
M4	4.2	6.4

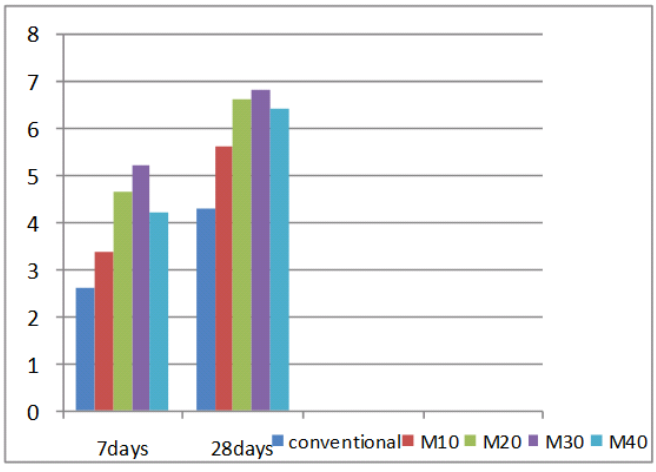

Chart -2: split tensile test

1.4.3 FLEXURAL STRENGTH TEST

The flexural strength test was carried out on prism specimens of 700mm length, 150 mm breadth and 150 mm height. The results of the flexural strength of conventional and partial replacement of fine aggregate by eco sand and glass fiber concrete at 28 days for M40 grade concrete are tabulated.

Table-8 flexural strength	
Mix proportions	**Flexural strength of @ 28days(N/mm²)**
M0	7.8
M1	8.6
M2	9.2
M3	9.7
M4	8

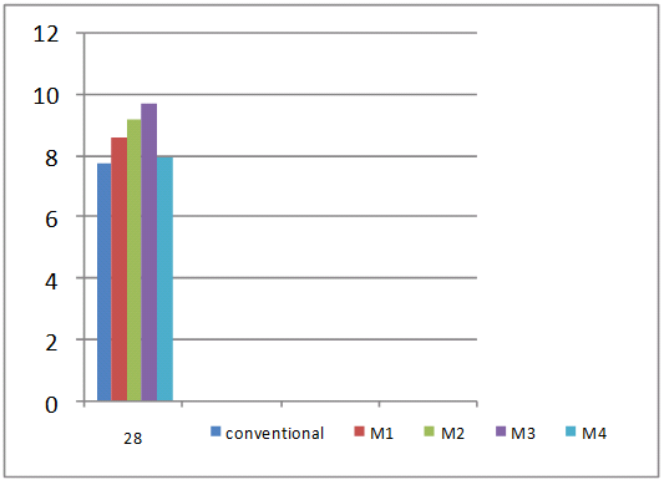

Chart -3: Flexural strength test

1.5 CONCLUSIONS

The present work investigated the physical and chemical properties of eco sand &glass fiber. Concrete properties (compressive strength, water absorption and porosity) were analyzed and eco sand as partial replacement of sand (10%, 20%, 30%&40%). On the basis of the results from the present study, following conclusions are drawn.

Based on the test carried out on the five mixtures the following conclusion has been made:

1. The fineness and high water absorption properties of eco sand reduce the workability of the concrete, and the workability of the concrete also decreases with an increase in the substitution rate.

2. The concrete specimen prepared by replacing certain percentage of fine aggregate by eco sand certainly increases the strength of the structure.

3. The maximum compressive strength ,split tensile strength, flexural strength were obtained at 30% replacement at 28 days of age and decrease at 40%.It aids in environmental and economic benefits and also the utilization of waste by products.

4. From the results obtained it is suggested that eco sand and with a substitution rate up to 30% can be used effectively as a fine aggregate in good concrete production without affecting the concrete standards.

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