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Water Penetration Test on Basaltcrete with Partial Replacement of M-Sand

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Abstract

An Increased growth in construction industry needs continuous supply of materials, especially concrete. Natural aggregate is essential in making concrete. The current resource which is widely used in river sand but due to increase of mining, there exists threats to environment. To overcome this, there exists a constant search for an alternative. The main alternative that has been identified is m-sand. the reasons to look for these are mainly they are easily available, transportation cost is cheaper, they blend well in any grade of concrete generally concrete is not strong on tension but when basalt fibre is added it overcomes this limitations.The present research work is to find out water penetration capacity of concrete with a combination M-sand and Basalt fibre.M-sand is replaced with river sand by 50%and 60% and basalt fibre is added at 0.1 % ,0.3% by volume fraction of concrete . Conplast SP430 is used to enhance the workability of the concrete . The experimental results below reveal that the impact of fibre in concrete .

Keywords: Basalt fibre, M-sand, Natural sand, Superplastiaspicizer, Water penetration test.

INTRODUCTION

Concrete is the most important material in construction industry . Due to growth in population we need more concrete. It is made up of cement; fine aggregate, coarse aggregate, water. In world widely there are some problems for getting river sand one of the best alternative material for river sand is m–sand. This paper deals with water penetration property of m- sand. When we consider durability of concrete there are some tensile cracks are developed .These tensile cracks are arrested by adding fibres into the concrete. It is also helpful to enhance load carrying capacity of the concrete. [1] Several fibres have been used so far to improve the properties of conventional concrete via asbestos, steel, glass, carbon, poly propylene, nylon, etc. A new advancement in the fibre reinforced concrete is the use of basalt fibre. Which has Shown better result in improving the compressive and flexural strength of concrete composite .Basalt fibre is a relatively new material for strengthening of concrete .It has a similar chemical composition like glass fibre but has better strength characteristics ,and it highly resistant to alkaline, acidic, and salt attack making it good for concrete, bridge and shoreline structures .

It is easy to disperse when mixed with cement concrete .and mortar .by using this concrete more flexural strength. Therefore basalt fibre reinforced concrete serves the functions of reinforcement, crack resistance and can extend the life of construction in the fields of housing ,Highways ,Railways ,Urban elevated roads, runways ,ports ,subway tunnels etc. The flexural strength of concrete is improved [6].basalt fibre worked as crack arrester and also improves the ductility properties of the concrete, Using basalt fibres in concrete give good compressive strength, tensile strength and flexibility strength.[3] the use of basalt fibre in the sand concrete increases the tensile strength bending and splitting. This is due to not only to reinforcement of the matrix with floor ,but also to high cohesion of cement stone and basalt fibre, which is a positive change from other types of fibres[5].Basalt Rock fibres have no toxic reaction with air or water are non combustible and explosion proof. When in contact with other chemicals they produce no chemical reactions that may damage health or the environment .Basalt base composites can replace steel and known reinforced plastics(1 kg of basalt reinforces equals 9.6kg of steel).Basalt can replace almost all applications of asbestos and has three times its heat India(especially in Maharashtra).the cost of basalt is 10 time slower than that of materials for fibre glass .Basalt is more available than any other raw material. Also the melting temperature is lower ,thus energy consumption is lower.Thus the cost of basalt fibre is lower than that of similar materials .more workers are not required to operate. [4]through the SEM analysis, it is confirmed that the rod like structure of basalt fibre observed at the interface of cementitious and aggregate matrix could probably be the reason for the increased split tensile and flexural strength of concrete, as it bridges connects the weak and strong matrix upon loading. [7] M-sand is best alternative material for river sand now days. Partial replacement of 50% of m-sand give good result in mechanical and durability properties. [2]

Table 1:Mix Design

Mix Type	Reference Mix	50% M.Sand & 0% Fiber	50% M.Sand & 0.1% Fiber	50% M.Sand & 0.3% Fiber	60% M.Sand & 0% Fiber	60% M.Sand & 0.1% Fiber	60% M.Sand & 0.3% Fiber
Material	**Design**	**Design**	**Design**	**Design**	**Design**	**Design**	**Design**
Zuari OPC	465	465	465	465	465	465	465
Coarse Aggregate	1148	1148	1148	1148	1148	1148	1148
River Sand	618	309	309	309	247	247	247
Manufactured Sand – VSI sand	Nil	309	309	309	371	371	371
Water	180	180	180	180	180	180	180
TOTAL	2411	2411	2411	2411	2411	2411	2411
Conplast SP-ES2	2.8 kg/cum	2.3 kg/cum	2.8 kg/cum	2.8 kg/cum	2.2 kg/cum	2.8 kg/cum	2.8 kg/cum
Basalt Fiber	Nil	Nil	0.4 kg/cum	1.2 kg/cum	Nil	0.4 kg/cum	1.2 kg/cum

EXPERIMENTAL PROGRAM

MATERIALS USED

CEMENT

Ordinary Portland cement of 53 grade conforming to IS 12269- 1987 was used for the present experimental investigation.

Fine Aggregate

Natural river sand confirming to Zone II as per IS 383 – 1987 was used.

Fine Aggregate – Manufactured Sand

The Concrete mixes were prepared using river sand and M - sand. The percentage of M- sand by weight used as a replacement of sand in concrete is 50 % and 60% is obtained from nearby crusher units in Chennai. Fineness modulus and specific gravity of the m – sand are 3.12 and 2.72 respectively. Locally available river sand was also adopted to prepare reference mix for comparison purpose. Its range in size from less than 0.25 mm to 6.30 mm. Fineness

Modulus and specific gravity of the sand are 2.84 and 2.76 respectively. The amount of fine particles present in m –Sand is considerably higher when compared to the river sand.

Coarse Aggregate

20mm coarse aggregate was used.

Properties of Basalt Fiber

12mm size basalt chopped fibres were used experimental work

Basalt Fiber Chopped Strand

Chopped strand for composite applications is entirely made of 100% BCF (Basalt Continuous Filament) roving. The silane sizing is selected, which has components to ensure elasticity of the yarn during textile processes. The sizing allow good compatibility with epoxy, vinyl ester and polyester resin systems

Product Stability

Products have not been designed for full external exposure conditions and cannot be guaranteed for use in such situations. However their products have considerable tolerance to damp conditions and occasional water immersion.

PREPARATION OF TEST SPECIMENS

Making of test cubes from fresh concrete

IS-456 has laid down the acceptance criteria of quality concrete. In all the cases, the 21-days for Water Penetration Test (WPT)

Procedure of test cube preparation

Equipment

The following equipments are needed for the preparation of concrete cubes.

1. Sample tray;
2. Mould for making test cube;
3. Spanner;
4. Scoop;
5. Steel float or trowel;
6. Compacting bar;
7. Cleaning rags;
8. A bucket or barrow for transporting the samples;
9. Curing tank
10. Permanent Marker.

No of cubes

21 no of Cubes of 150 x 150 x 150 mm size shall be cast for 21-days testing

Sample of concrete

Sample of concrete for test specimen shall be taken at the mixer. Such samples shall be obtained by repeatedly passing a scoop or pail through the discharge stream of the concrete. The samples thus obtained shall be mixed on a non-absorbent base with shovel until it is uniform in appearance.

Casting of cubes

The cube mould plates should be removed properly cleaned assembled and all the bolts should be fully tight. A thin layer of oil then shall be applied on all the faces of the mould. It is important that cube side faces must be parallel.

After taking concrete samples and mixing them, the cubes shall be cast as soon as possible as described below

Casting & compaction by hand

The concrete sample shall be filled into the cube moulds in 3 layers, each layer approximately 5 cm deep. In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete slides from it, in order to ensure a symmetrical distribution of the concrete within the mould. Each layer shall be compacted either by hand or by the vibration. Each layer of the concrete filled in the mould shall be compacted by not less than 35 strokes by tamping bar. The strokes shall be penetrating into the underlying layer and the bottom layer shall be rodded throughout its depth. Where voids are left by the tamping bar the sides of the mould shall be tapped to close the voids.

Curing

The casted cubes shall be stored under shed at a place free from the vibration at a temperature 220C to 330C for 24 hours covered with wet straw or gunny sacking.

marking

Immediately after initial curing of the cubes they should be marked clearly. This can be done by writing the details of the cube in ink on a small piece of paper and placing on top of the concrete until it is demoulded.

The cube shall be removed from the moulds at the end of 24 hours and immersed in clean water at a temperature 24^0C to 30^0C till the 21-days age of testing. The cubes shall be tested in the saturated and surface dry condition. For the true representation of actual strength of concrete in the structure, extra cubes shall be cast, stored and curded as per the identical conditions of that structure, and tested at required age 21 days.

EXPERIMENTAL TEST FOR CONCRETE CUBES

Water penetration test

Test apparatus

- Water Regulator
- Water Penetration Cell
- Pressure regulator
- 150x150x150 mm Concrete Cubes

Procedure

Fill the water in the water tube, keep the test specimen in the water penetration cell and tight the bolt nuts and fill the caps with plaster of Paris for the water leakage. Open the water and set the pressure in the pressure regulator (pressure for 5kg / cm^2). After 3 days stop water pressure and remove the test specimen and break the specimen perpendicularly.

Mark the test specimen with marker how much depth water penetrated. The Maximum depth is called water penetration durability. More the depth of water penetration the less durability of concrete. This can be used for comparing the potential durability of various type of concrete. The following pictures show how the penetration depth is taken in to the cube specimen.

RESULT & DISCUSSIONS

Result

The following result was obtained from WPT

Table 2: Water penetration values

Mix Type	Reference Mix	50% M.Sand & 0% Fibre	50% M.Sand & 0.1% Fibre	50% M.Sand & 0.3% Fibre	60% M.Sand & 0% Fibre	60% M.Sand & 0.1% Fibre	60% M.Sand & 0.3% Fibre
Slump Before addition of fibre	185mm	190mm	180mm	160mm	160 mm	200mm	190mm
Slump After addition of fibre	Not Applicable	Not Applicable	90mm	60mm	Not Applicable	120mm	70mm

Water Penetration in mm							
Specimen 1	60, 80,50	10,10,10	15,15,15	15,25,10	0,0,0	10,5,5	5,5,5
Specimen 2	50,75,50	8,0,0	5,5,5	10,15,5	0,0,0	5,5,5	10,15,10
Specimen 3	50,75,50	10,10,0	10,25,10	0,20,10	0,0,0	10,10,15	15,10,0
Average Maximum Depth of Penetration	**77 mm**	**9 mm**	**15 mm**	**20 mm**	0	10mm	12mm

PENETRATION VALUES

Figure 1: Measuring depth of water penetration

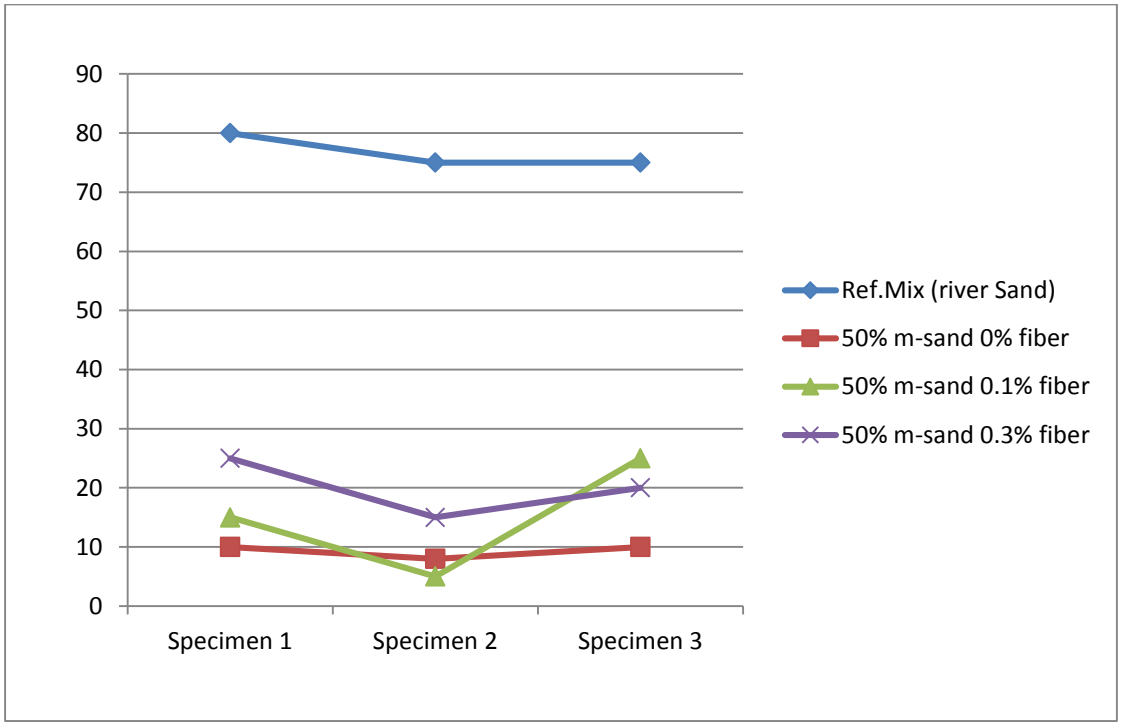

Figure 2: 50% M-sand replacement values

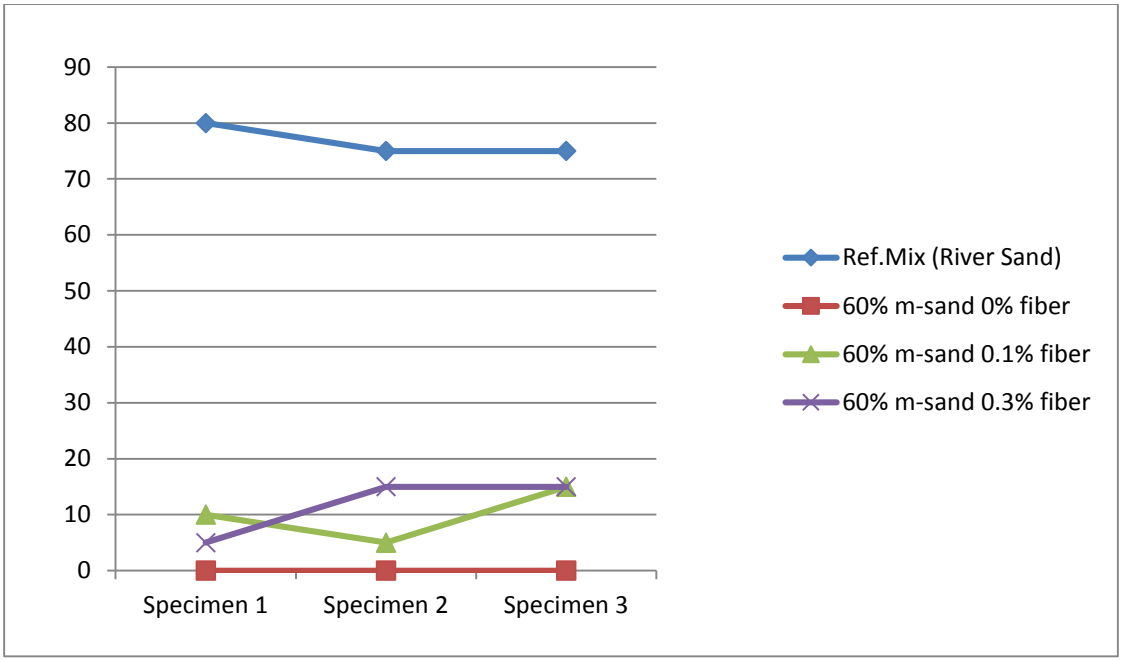

Figure 3: 60% M-sand replacement values

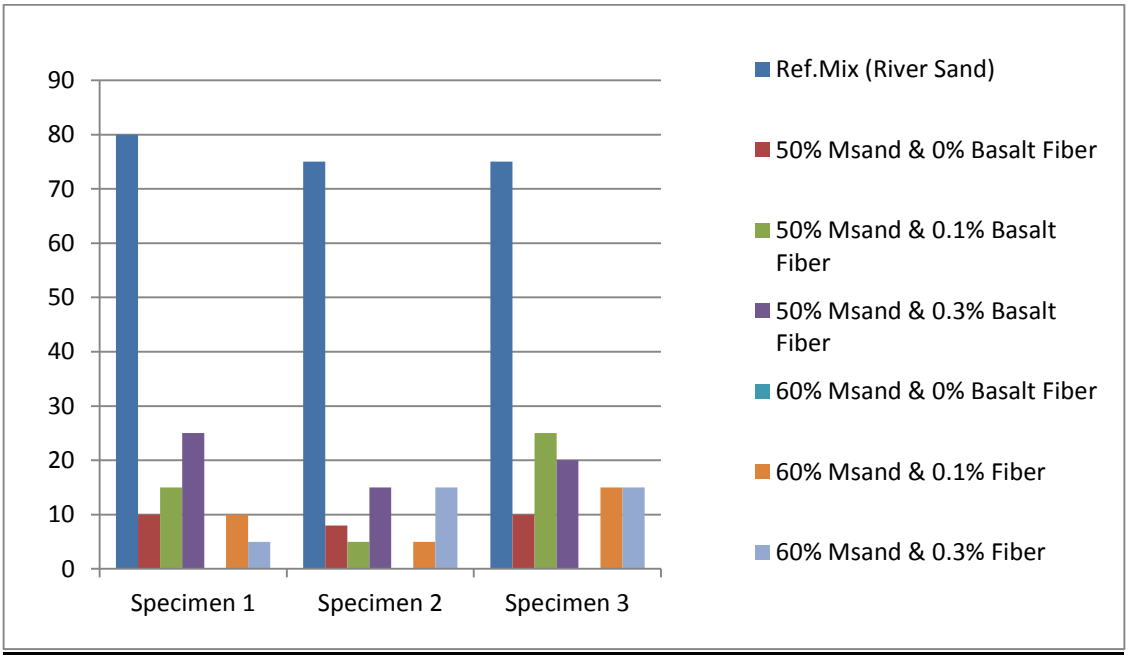

Figure 4: 60% M-sand replacement values

In the durability study, the conventional and M-sand concrete is tested by conducting water penetration test (WPT). The experimental results revealed that the M-Sand 50% replaced concrete have 9 times low penetration and 50 % m-sand with basalt fibre 0.10% has 6 times low penetration and 50% M-Sand with Basalt fibre 0.30% has 4 times low penetration when compared with River sand mix Concrete.

SUMMARY & CONCLUSION

- In the durability study, the conventional and M-sand concrete is tested by conducting water penetration test (WPT).
- The experimental results revealed that the M-Sand 50% replaced concrete have 9 times low penetration
- and 50 % m-sand with basalt fibre 0.10% has 6 times low penetration

- and 50% M-Sand with Basalt fibre 0.30% has 4times low penetration
- when compared with River sand mix Concrete.
- Using m- sand the penetration is much lower than the river sand concrete, the cover of concrete is provide less it cannot affected the steel or not corrosive in the water retaining concrete structures. Hence we can use m-sand in the construction of water retaining structures.

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