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Concrete Using Basalt Fibre and Basalt Reinforcement

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Abstract- Concrete is a composite mixture of cement, coarse aggregate, fine aggregate and water. Steel reinforcement has become expensive due to it's limited availability and increase in demand. It has encouraged the market to find an alternative material to steel which is having similar properties like flexural strength, tensile strength etc. Basalt fibre has gained very much interest in last few years because of it's relevance in properties with steel, it's availability and eco-friendly nature. The objective of this work is to compare the strength of conventional concrete with concrete using basalt fibre. The percentage of basalt fibre used are 0.1 ,0.2, 0.3, 0.4 and 0.5 by volume of the concrete. Cubes were casted and tests like compressive strength test and percolation test were conducted to obtain the necessary result. Also slab using basalt reinforcement bar were casted to increase flexural strength. A large number of trial mixes were carried out to find optimum percentage of basalt fibre to achieve the required strength.

Index Terms – Concrete, Basalt Fibre, Compressive Strength, Tensile Strength.

1. INTRODUCTION

Concrete is the most widely used material after petroleum in the world. Concrete is extensively used in the field of construction. In India almost 7.25 million cubic meter of concrete is used every year. Concrete is a composite material with high compressive strength but low tensile and strain capacity. It has its application in highways, tunnels, bridges, high rise building, dams, etc. An addition of fibre into the concrete mix can significantly improve the engineering properties of concrete such as flexural, tensile, impact and abrasion strength. Many natural and synthetic fibre are utilized in concrete obtained from glass, carbon, aramid, polypropylene and basalt rock. Basalt fibre is one of the high performance non-metallic fibre obtained from basalt rock melted at high temperature. Basalt rock fibre have non toxic reaction with water or air , are non- combustible and explosion proof. In the past decade basalt fibre has been widely used as a alternative reinforcement material in concrete.

The fibre is developed by Moscow Research Institute of Glass and Plastic in 1953-1954 and its first industrial production was completed in 1985 at Ukraine Fibre laboratory. The manufacturing process of basalt fibre is similar to glass fibre but consume less energy which makes them cheaper than the carbon or glass fibre. Basalt fibre is produced by heating basalt rock in the furnace at 1450^0C to 1500^0C. The molten material is then passed through a platinum and rhodium crucible bushing to create fibre. The technology used is known as continuous spinning. It is present in the form of chopped, continuous and reinforced bars. Basalt fibre can provide resistance against thermal, corrosion and alkali reaction on the concrete, making it suitable and preferable to be utilized with the construction material. It is eco- friendly and non- hazardous to human health.

2. LITERATURE REVIEW

Navnath Raut (2017)[1],concluded that basalt fibre increase the compressive,flexural and tensile strength. Workability of concrete increases with decrease in basalt fibre. Less crack formation in concrete when basalt fibre is used.

Suchita Hirde and Sagar Shelar (2017)[2], concluded that the maximum increase percentage in compression strength is 7.31% for 3 % basalt fibre content. There is no significant increase in compressive strength of concrete due to inclusion of basalt fibres.The addition of basalt fibre resulted increase in flexural strength.

Nayan Rathod, Mukund Gonbare and Mallikarjun Pujari (2015)[3], concluded that about 40 to 50 % increase in strength is absorbed after 14 days when 2% fibre is used. One should take care while mixing basalt fibre in concrete. The basalt fibre are added in concrete before addition of water, otherwise it will stick at surface.it is concluded that basalt fibres of great interest for the building industry.

Stephen A. Arhin et. al.(2014)[4], conducted test on the five design mixes using three different type of compaction method. Compaction method affect the compressive strength of concrete. It is reported that, the 28 day compressive strength by using water

cement ratio 0.3 to 0.4 ranges from 800 psi to 2000 psi based on compressive strength testing per ASTM C39.

M. Harshavarthana Balaji et. al. (2015)[5], designed pervious concrete using SILICA FUME to increase its strength. They have designed the pervious concrete using ACI-522R-06. The aim of this project is to lay the pervious concrete in pavement and parking thus allowing the water to pass to the underground surface very easily for maintaining the groundwater table even in all the places. Ordinary Portland cement 53Grade, aggregate size 12.5 mm, silica fume obtained from ELKEM India Private Limited, Navi Mumbai was used for Casting all the specimen.

Dharmendra Sondarva &Ankur C. Bhogayata (2017)[6] This paper represents the outcomes of some latest trends of research in the field of concrete composites prepared with chopped basalt fibres (CBF) as fillers. The paper summarizes noticeable findings of the experimental studies carried out to demonstrate the advantages and limitations of the addition of CBF in a conventional concrete specifically.

3. METHODOLOGY

3.1. Material

3.1.1. *Cement*
Ordinary Portland cement, 53 grade confirming IS:269-1976. It will be used for casting all the specimens. The compressive strength measured in standard mortar at 28 days was 54 Mpa.

3.1.2. *Course Aggregate*
Locally available crushed blue granite stones conforming to graded aggregate of nominal size 19mm-9.5mm as per IS: 383-1970.

3.1.3. *Water*
To mix the ingredients of concrete ordinary tap water is used.

3.1.4. *Basalt Fibre*
Basalt rock is a volcanic rock and can be divided into small particles then formed into continues or chopped fibres. Basalt fibre has a higher working temperature and has a highly resistance to chemical attack, impact load, and fire with less poisonous fumes.


Fig.1.Basalt Fibre

3.2. Equipment's

3.2.1. *Universal Testing Machine*
UTM is used to test the compressive strength and tensile strength of materials. The "universal" part of the name reflects that it can perform many standard compression and tensile strength on material, component and Structure.

3.2.2. *Mould*
Cubical mould of size 150mm X 150mm X 150mm.

3.2.3. *Transit Mixer*
A concrete mixer is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to from concrete. A typical concrete mixer uses a revolving drum to mix the ingredients of concrete.

3.2.3. *Steel Tamping Rod*
16mm diameter Rod.

3.2.4. Curing

Using jute bags. To prevent the top surface of the pervious concrete from drying we used jute bags.

3.3. Testing Program

3.3.1. *Compressive Strength Test*
The compressive strength of previous concrete is strongly affected by the mix proportion and compaction effort during placement. The high strength is achieved with the reduction of aur void content. Although w/cm ratio of previous concrete mixture is important for the development of compressive strength and void structure, the relation between the w/cm ratio and compressive strength of conventional concrete does not apply to the previous concrete properties. Experience has shown that a w/cm ratio of 0.26 to 0.45 provides a good aggregate coating and paste stability.
Test were conducted on 150×150×150 mm cubes by using UTM. The mean of three cubes was adopted for each test. The test will be conducted aged of 7, 14, and 28 days.

3.3.2. *Permeability Test*
One of the most important features of previous concrete is its ability to percolate water through the matrix. The drainage rate of previous concrete pavement varies with the aggregate size and the density of the mixture, but will generally fall into range of 0.14 - 1.22 cm/s. Test have shown that a minimum porosity of approx 15% is required to achieve significant percolation.
Permeability of previous concrete can be measured by a constant head method. In this approach, the sample is enclosed in a rubber membrane to avoid water

flowing along the sides of the specimen. Test is performed with slab of 1 m2 size. The specimen is preconditioned by allowing water to drain through it.

Fig.2.UTM Machine

4. CONCLUSION

- The properties of concrete are influenced by the volume of fibre and aspect ratio. The slump value decreases and workability increases with the increase in basalt fibre proportion
- The compressive strength and tensile resistance is noticeably improved due to addition of basalt fibre
- The preferred length of basalt fibre is in the range of 12mm to 22mm.
- However all the author noted that basalt fibre reinforced concrete has higher strength property compared to normal concrete. But , very research work has been done on effect of basalt fibre on pervious concrete therefore there is a scope of future research work.

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