Experiment Investigation on Steel Fiber Reinforced Concrete with partial replacement of Cement by Rice Husk Ash

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***Abstract*— In today's time considerable work has been performed on steel fiber reinforced concrete. Steel fiber is used to increase the load carrying capacity of concrete member. Fibers are significantly reduce the brittleness of concrete and improve the engineering properties such as tensile, compression, flexural, impact resistance, fatigue etc. Behavior of Steel fiber reinforced concrete in flexure , torsion , compassion and shear is already studied separately and different geometry of beam however not much work has be replaced on the behavior of Steel fiber reinforced concrete in with partial replacement by rice husk Ash . So it's my purpose to work on this topic is to do a comprehensive study on the properties of concrete containing rice husk Ash and steel fiber. The property is studied include the workability of fresh concrete compressive strength and tensile strength, the rice husk Ash content was used in the range of 10 to 25% by weight of cement. It was found that adding more than 15% rice husk Ash to concrete reduce compressive strength of concrete, but adding 15% rice husk Ash improve the tensile properties of concrete then we added 15% RHA and Steel fiber dosages(0% , 0.5% , 1.0% , 2.0%)because concrete is strong in compression, but weak in tension so to increase tensile strength we added Steel fiber to it.**

***Index Terms*— Rice husk ash, Steel fiber, compressive strength, Split Tensile strength, M25 grade of concrete**

I. INTRODUCTION

Given its long history, it is surprising that the introduction of fibers to improve physical properties didn't advance much in the period until the early 1930s However, post 1930 progress has been more impressive with the most significant gains after 1960 . This can be attributed to both the appearance of synthetic fibers and the evolution of a more particular scientific views to the computation of cement based composite behavior. Mechanical properties of steel fiber reinforced concrete are influenced by many types. These include type of fiber and percentage of fiber addition, aspect ratio of the fiber, size of aggregate, strength of matrix etc.

compressive strength:- significant improvement in compressive strength is unlikely to be achieved by steel fiber. Increase up to 25% can be obtained .However , reinforcing concrete with steel fiber gives the concrete post cracking ductility.

Tensile strength:- Fiber orientation has significant effect on the tensile strength of SFRC . The fibers aligned in the direction of loading increase the direct tensile strength to a great extent . This effect is reduced in cases with a more random fiber distribution and the fiber inclusions don't contribute to te tensile strength of the concrete . Splitting up the tensile strength tests on the SFRC gives similar results. Like compression, steel fiber is involved in concrete and post cracking strength.

Flexural strength :- Steel fibre are more efficient in increasing the flexural strength of concrete .The increase in flexural strength is sensitive to the fibre volume and fibre aspect ratio . Fibre with aspect ratio lead to higher flexural strength.

Creep Behaviour:- Steel fibre inclusions don't significantly affect creep behaviour because the fibre content volume is very small as a percentage compared to the total material . In addition since creep generally does not involve micro cracking steel fibre inclusion are not expected to have much effect.

Toughness and ductility :- The primary purpose of incorporating fibres into concrete to increase strength but to provide rigidity and ductility ,There are different ways to define the hardness of the steel fibre reinforced concrete . Basically flexural toughness can be defined as the area under the full load deflection curve. Fibre with better bond characteristics like fibres with a high aspect ratio or deformed fibres give higher toughness values when compared with other types of fibres.

II. LITERATURE SURVEY

Satish H and Vikrant s. (2013) have examined on this paper reports the effects on the behavior of concrete produced from cement with combination of FA and RHA at different proportions on the mechanical properties of concrete such as compressive strength, tensile strength and flexural strength. Compressive strength increase with the increase in the percentage of FA and RHA to replacement (22.5% FA – 7.5 % RHA) of cement in concrete for different mix proportions and the maximum 28 days split tensile strength was obtained with combination of FA and RHA mix in all combination which was less than control concrete. The workability of concrete had been found to be decrease with increase RHA in concrete. cement is costly material so the partial replacement of these materials by RHA reduces the coast of concrete.

Zemei Wu , Caijun Shi, Wen He , Linmei Wu (2015) This investigated the effects of three shaped steel fibers (straight , hooked –end , corrugated) with different fiber contents by volume (0% ,1% , 2% and 3%) on mechanical properties of ultra high performance concrete. The involved properties included flowbility, compressive strength and flexural behavior. Experimental results showed that adding 3% straight steel fiber to concrete increased the compressive strength of concrete by 35 MPA.and adding 3% hooked end or corrugated steel fiber increased the compressive strength of concrete by 48 to 55% .

Kaushik S.K., et al. (2015) in this paper, Experimentally investigation was done on the mechanical properties of reinforced concrete by adding 1.0 % volume fraction of 25 mm and 50 mm long crimped flat steel fibers. the result found, it was observed that short fibers acts as crack arrestors and 45 enhances the strength, whereas long fibers contributed to overall ductility. They concluded that best performance was observed with mixed aspect ratio of fibers.

Kolhapure B.K.(2016) Investigated experimentally the mechanical properties of concrete using recorn 3s fibers along with super plasticizer. The result found the compressive strength, Tensile strength and flexural strength is increased by 30 %, 23% and 24% when compared to plain concrete.

Sara Farooq, Hiroshi yokota (2016) This research aim at empirically investigation the residual mechanical properties of plain and steel fiber reinforced concrete damaged by alkali silica reaction (ASR) and subsequent chloride ion ingress. It consists of three types of concrete mixes ex. plain concrete, steel fiber reinforced concrete and high strength fiber reinforced concrete. Rapid degradation tests were performed on all three types of concrete. First the samples were precipitated by Alkali silica Reaction, later immersed in a chloride solution in the minus 40 °C temperature range, later found to reduce the surface crack width at 5 to 25 °C to the steel fiber. The accelerated motor was found to be able to reduce expansion by 65% using double hooked steel fibers. Testing of compressibility and flexural showed that exposure to a chloride environment assisted the hydration reaction and helped to balance the damage caused by ASR.

Josephin Alex , B.Ambedkar (2016) In this paper cement manufacturing and improper disposal of rice husk ash increased CO2 emission (RHA) leads to the problem of air pollution and land filling. To mitigate these issues, the use of RHA as a cement additive has been discussed in making concrete. from the result, mechanical properties with decreasing RHA size and 20% wt RHA replacement is optimal for 15 and 60 min of grounded sample. Although 15 min ground sample exhibits better results, grinding of RHA for 60 min was found to impart higher strength in concrete. In case of compressive strength development, the partial replacement of RHA ground samples at 20 wt% could be regarded suitable and for unground RHA 15 wt% might be considered satisfactory. For tensile strength development, 20 wt% replacement was considered to be optimal

Patil premchand j and kanase javant s (2016) study on this paper beams of fiber content 0.5 %, 1.0% and 1.5 % by weight and one without fiber beams. Result was found that cracking torsional strength and ultimate torsional strength goes on increase as the percentage of steel fiber goes on increasing.

Maheshbhai prajapati and Dr. jayesh kumar pitroda (2016) have examined on the present study includes the experimental investigation of concrete by adding rice husk ash with using steel fiber different proportion in M30 grade of concrete. The result found compressive strength of concrete increase after replacement of cement by RHA and addition of steel fiber in it. Use of RHA and addition of steel fiber increase strength. Thickness of rigid rural road pavement decrease with increase in compressive strength of concrete by replacement of cement by Rice husk and addition of steel fiber.

III. METHODOLOGY FOR EXPERIMENTS

An extensive experimental program has been executed to find out the behavior of steel fiber reinforced concrete with partial replacement of cement by rice husk ash. The experimental were conducted on the standard cubes and standard cylinder of concrete mix M25 with different percentage of RHA and steel fiber. The experiment done in different phase:-

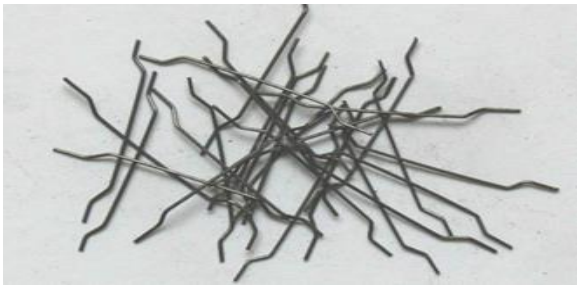
1. Evaluation of compressive strength, Split Tensile strength and workability of conventional concrete and concrete along with 10 %, 15%, 20%, 25% cement replace by rice husk ash.
2. Evaluation of compressive strength, Split Tensile strength and workability of SFRC in which steel fiber dosages are 0 %, 0.5%, 1.0%, 1.5% and 2.0% along with 15% replacement of cement with Rice husk ash.

Under the research two types of specimens have prepared I.e. standard cube specimens (150mm*150mm*150mm) and standard cylinder (diameter 150mm length 300mm)

Rice husk is one of the ingredients available in abundance in rice producing countries. More than 78countries in the world cultivate rice, the chief among them is china. About 770 million metric tones of rice is produced every year of which more than 15% husk. Rice husk ash is used as a base material which enhances the strength of concrete. When rice husk is burnt, we get rice husk ash. on burning, cellulose and lignin are removed leaving behind silica ash. controlled temperature and proper burning environment provide superior quality of rice husk ash. This ash is potential sources of amorphous reactive silica. most of the rice husk ash is used in the production of Portland cement. when burnt completely , the rice husk ash can have a Blaine number of as much as 3600 compared to the Blaine number of cement (between2800 and 3000) meaning it's finer cement.

STEEL FIBER

In the present study steel fiber has been used as a reinforcing material of concrete. It is used by weight of concrete as an addition. In the present study different types of percentage of steel fiber used 0 , 0.5 , 1.0 , 1.5 , 2.0 % .



MIXING, CASTING AND CURING :-

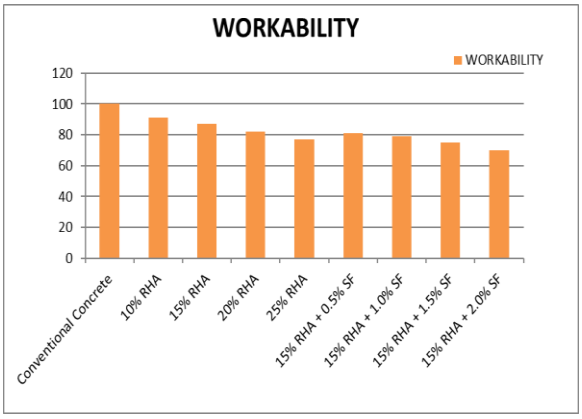
Different row materials such as aggregate , cement , fibers , Rice husk ash etc. were taken from their stocks and weighted accurately according to the mix design .The laboratory equipment was utilized in the accomplished of this experimental program. Firstly, the coarse aggregate were washed a day before casting in order to make it silt free and was laid to dry. On the following day, the coarse aggregate were found to be satisfactorily moist. This was necessary to prevent absorption of moisture by the aggregate from the water being added to the mix i.e. the designed water cement ratio had to be carefully regulated. Next, the coarse aggregate were mixed with the fine aggregate. The fibers and RHA was added gradually during mixing in fibrous concrete mixes. The process of mixing was performed by machine. The concrete was filled in three layers in all the moulds. About an hour after casting, the surface was smoothened by the trowel. The specimens were demoulded 24 hours later and labeling were put under water for a period 7 and 28 days. After 7 and 28 days, the concrete specimens was taken out and dried sufficiently and were tested at room temperatures.

IV. RESULTS AND DISCUSSIONS

WORKABILITY:- Workability is a property of freshly mixed concrete. Concrete is a mixture of cement, fine aggregate , coarse aggregate and water . An understanding and knowledge of the workability

are the most importance to create a well designed concrete mix that can be easily laid and compacted with minimal effort. Workability of concrete simply means the ability of work with concrete. There are five types of test by which measure the workability of concrete such as slump cone test, Vee Bee consistometer test, compaction factor test, Kelly Ball Apparatus test and Flow table test. But we have measured the workability of concrete only with the help of slump cone test as per IS 1199.

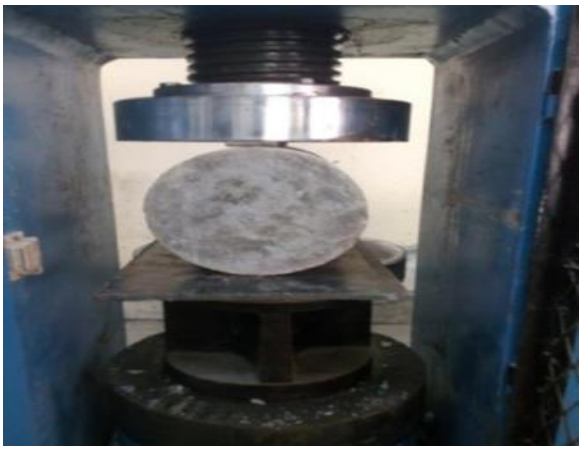
RESULT:- From the above workability measures it is seen that workability of fresh concrete without any fiber inclusion obtained higher than the steel fiber reinforced concrete. On the other hand workability of steel fiber reinforced concrete decreases with increases steel fiber contents. workability of 0.5 % steel fiber mixed concrete obtained is 81 mm and its gradually decreases up to 70mm when fiber dosages increases from 0.5 % to 2.0 % by weight of concrete. Also when we replaced cement by RHA, workability of concrete decrease with increase RHA contents. Graphical view of workability is shown in fig.



COMPRESSIVE STRENGTH:- Compressive strength of hardened concrete determined by compression testing machine . In the present study 7- & 28-days compressive strength of cube specimens of 150 mm * 150 mm * 150mm have checked.

Compressive Strength Results:- We obtained that when we Replace cement with 10% Rice husk ash in conventional concrete , the compressive strength of our concrete is increased by a few percent on 7 days but at 28 days it increases rapidly. Then we add more than 10 % Rice husk ash to the concrete, the compressive strength of concrete starts decreasing. And also then we added Steel fiber dosages (0.5 and 1.0%) to our conventional concrete, we get more compressive strength than conventional concrete, but adding more than 1.5% Steel fiber it reduces the compressive strength of concrete.

TENSILE STRENGTH:- Split Tensile strength is the important property of concrete .we know that concrete is strong in compression but weak in tension. That's why we have used steel fibers to increase the tensile strength of our concrete. In the present study 7 & 28 days split tensile strength of cylinder specimens of (150mm dia & 300mm length) have checked.



RESULT:-We obtained that when we replace cement with Rice husk ash , we get maximum tensile strength at 15% .To further increase the tensile strength of concrete , we added steel fiber to it because concrete is strong in compression but weak in tension , so we replace cement with 15% Rice husk ash and added some percentage of steel fiber(0.5% , 1.0% ,1,5% and 2.0%) to it. Hence, we get more Tensile strength than Rice husk ash mix concrete.

V. CONCLUSIONS

1. The inclusion of steel fiber reduces the workability with increasing the steel fiber dosages.
2. The workability of concrete have been found to be decrease with increase Rice husk ash in concrete.
3. In the case of cube of grade M25 (Case I) - We found that when we replaced cement with RHA, Adding 10 % Rice husk ash we got a slightly higher compressive strength than conventional concrete at 7 days but we got about 8 % more compressive strength at 28 days. And if we gradually increase the percentage of RHA (15, 20, 25 %), our concrete compressive strength starts decreasing.
4. Our main objective of adding RHA or Steel fiber in this project was to increase the strength of the concrete. Basically Rice husk ash consists of Reactive silica and alumina in excess amount. By using Rice husk ash, pozzolonic Reaction takes place in which reactive silica and alumina react with calcium hydroxide to form C – S – H gel and calcium hydroxide which is dangerous for concrete is converted into C – S- H gel by this Reaction we get two benefits . one is that calcium hydroxide (CH) will be eliminated from the concrete and secondly , in the process of calcium hydroxide elimination , C -S – H gel will be generated which provides strength to our concrete.
5. Case II - when we add 15% RHA to concrete and 0.5 % and 1.0 % steel fiber dosages to it , the compressive strength of our concrete increases by a few percent on the 7 Days but it increases rapidly on the 28 Days . But with the addition of more then 1.5 % fiber, the compressive strength of the concrete begins to decreases.

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