INVESTIGATION OF STRENGTH CHARACTERISTICS AND COST SENSITIVE ANALYSIS OF CONCRETE REINFORCED WITH LATHE MACHINE SCRAPS

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ABSTRACT

In order to enhance the properties of concrete, it may be reinforced with scrap. Scraps from lathe machine manufacturing industries similar to that of steel fibre. In every lathe machine industry lathe dumping of lathe scraps causes contamination of natural resources so, the use of lathe machine scrap in concrete can prove environmental friendly and economical as well. The purpose of the paper was to determine the suitability of using concrete reinforced with lathe machine scraps by checking various strength, characteristics viz compressive strength, splitting tensile strength, flexural strength and compare the cost of using lath machine scrap reinforced concrete to normal steel fibre reinforced concrete. The experimental investigation was carried out by using M2o grade of concrete. The lathe machine steel scraps were used in varying percentages by weight of M2o concrete viz,0%,1%,1.5% and 2%. Hence finding out optimum percentage of lathe machine scraps in concrete up to which its mechanical properties like compressive strength, splitting tensile strength, flexural strength can be increased. Moreover, the cost analysis was done at different proportions of lathe scraps concrete and steel fibre concrete such that the economical among the two gets distinguished.

Keywords: compressive strength, flexural strength, lathe machine, steel fibre, steel scrap, split tensile strength.

1. INTRODUCTION

Concrete is considered as one of the most important construction materials among all other construction materials, which is manufactured at site. Since all the ingredients of concrete are of geological origin which are required for extensive construction activities can always be made available. Various researches and efforts are being made to obtain a durable, strong and economical concrete mix. The present time is witnessing the construction that is very challenging and difficult. In today`s world building materials reinforced concrete is most widely used. Concrete being an artificial stone which is a mixture of cement, water and aggregates. We can give concrete any desired shape which gives concrete an inherent benefit over others constructions material which are available. In modern world the use of RC construction stems from the wide availability of its ingredients-concrete as well as reinforcing steel. So far as production of concrete is concerned it does not require any expensive manufacturing mills expect for the production of cement and steel bars. In view of this need for sophistication, a large number of single-family houses and low-rise residential buildings in whole world have been and are built by using reinforced concrete without any assistance of engineering. In earthquake prone areas, such buildings are death traps. In concrete it has found that incorporation of fibre also improves several properties such as cracking resistance, tensile strength, ductility and fatigue resistance. Different types of fibres like steel, nylon, asbestos etc. were used in the past. From all of these asbestos fibres concrete is successful, its exposure is detrimental to the human being's health, steel fibres improve flexural strength and toughness. Increased density and corrosion damage are the limitations of steel fibres.

Present world is witnessing that the construction is very challenging and difficult in civil engineering structures. In the field of concrete technology efforts are being made to develop such materials which have special characteristics. All over the world researchers are trying to develop high performance concretes by using fibres and admixtures in concrete with proportions. Fibre reinforced concrete (FRC) is a construction material which became prominent through various research work during last two decades.

Scrap from lathe machine is produced from different manufacturing processes which are carried out by lathe machine. Scrap, a waste can be used as a reinforcement in concrete to improve its various properties. Scrap from machine can act in a same way as steel fibre. In addition to get sustainable development and environmental benefits, lathe scrap can be used as recycled fibre with concrete. With increase in population and industrial activities, the quantity of waste fibres generated will increase in coming years.

2.Material to be used in experimental work

The material to be used for casting of specimen is discussed below:

2.1 Cement

Locally available Ambuja cement (PPC) was used in present experimental investigation work. Portland pozzolana cement is preferred over ordinary Portland cement because it makes concrete more impermeable and denser. Abuja cement satisfies nearly all the requirements of the Indian standard code.

2.2. Fine Aggregates (Coarse sand)

Coarse sand was used which is locally available. As per IS 383-1870 sieve analysis of the fine aggregates was carried out in the laboratory. The material whose particles are of size as are retained on IS sieve no

480(4.75mm) is termed as coarse sand. Fineness modulus of sand was found to be as 2.91 and specific gravity of fine aggregates is 2.6.

2.3. Coarse Aggregates

Crushed coarse aggregates which are locally available was used. Analysis of the coarse aggregates was carried out. The coarse aggregates used in this experiment investigation are of 20 mm crushed angular in shape. The aggregates are free from dust before used in concrete. The fineness modulus was found to be 6.3 and specific gravity of coarse aggregates is 2.64.

2.4. Lathe Machine Scrap

Lathe machine scrap which is obtained from the manufacturing industry is used in concrete to improve various properties. With the help of universal testing machine, the tests were carried out. Various important properties were obtained including breaking strength, breaking load, elongation and modulus of elasticity. The type of lathe machine scraps used were turned and deformed. Length was found out to be 40-60mm with a diameter of 0.4-0. 8mm.The aspect ratio, was found out to be 70-100mm.Tensile strength and young's modulus was found out to be 0.02-0.08N/mm^2 and 0.04-0.06N/mm^2 respectively.

Fig: 1. Coarse sand

Fig: 2.Coarse aggregates

Fig: 3. Lathe machine scrap

3.EXPERIMENTAL PROGRAM

3.1. Workability

Workability plays a very vital role. The lathe scrap is mixed with concrete proportions in which the concrete is of adequate workability for the placing conditions of the concrete and can be properly compacted with the available means. During casting specimens, it was found out that up to 1.5% scrap the concrete was easy to work with but with 2 % scrap content the workability decreases up to some extent.

3.2. Compressive strength test.

It is one of the frequently conducted test on hardened concrete, firstly because it is very easy to perform and secondly because most of the desired characteristic concrete properties are related to compressive strength. Specimens which are cubical in shape are used in compression test. The size of specimens is 150x150x150mm. Concrete is filled in layers approximately of 5cm deep. IS:516-1979 was followed for testing of cubes. Electro-hydraulically operate machine is used for compression testing and compressive load is applied on opposite faces axially. For ultimate failure compressive load is noted. A total of 12cubes were casted and tested to determine the compressive strength with varying percentages of lathe scrap (0%, 1%, 1.5%, 2%). 3 specimens are to be casted for every percentage of lathe scrap. The specimens were casted and cured for 28 days to determine the compressive strength.

3.3. Split tensile strength test.

Similar to compression test split tensile strength test is also carried on the compressive testing machine. Specimens of size 150x300 mm were used for this test according to IS 516:1959.

Three specimens were casted for conventional concrete and similarly 9 specimens 3 for each percentage of lathe scrap (1%, 1.5%, 2%) were casted and tested to determine the split tensile strength for 28 days of curing. A total of 12 cylinders specimens were casted and tested.

3.4. Flexural strength test.

The flexural strength test is carried out on manually operated 10 ton capacity flexural testing machine. The specimen’s size for this test is 100x150x100mm. A total of 12 beams are to be casted, three beams for conventional concrete and nine beams for different percentages of lathe scrap (1%,1.5%,2%) average of three beams is to be taken into consideration and tested to determine the flexural strength after a curing of 28 days.

3.5. Cost sensitivity analysis at different percentages of scrap and steel fibre.

Cost analysis was done at different proportions of lathe scrap and steel fibre. The comparison is made between the cost of lathe scrap and steel fibre and strength (Compressive, split and flexure) of lathe scrap and steel fibre.

3.6. Concrete Mix Design

M-20 concrete mix was used with coarse aggregates of size 10mm.Mix design was carried out as per ACI-544 guideline

Mix design for M20 grade concrete. The main purpose of designing is to achieve the stipulated strength, durability and to get concrete which is highly economical.

Table No 1. Final Mix Proportions

Cement	FA	CA	W/C
1	1.88	2.86	0.52

4.RESULTS AND DISCUSSIONS

4.1Workability

Slump test was conducted to check the workability of lathe scrap. Given below are the values obtained from slump test.

Table No 2. Workability of concrete for lathe steel scrap

Scrap content%	0	1	1.5	2
Slump value	30	22	16	10

4.2. Compressive strength test.

The compressive strength shows significant increase when compared with plain concrete. A total of 12 specimens cubes were casted having size of 150x150x150mm for different proportions (0% to 2%) of scrap and 3 cubes were used for taking average value.

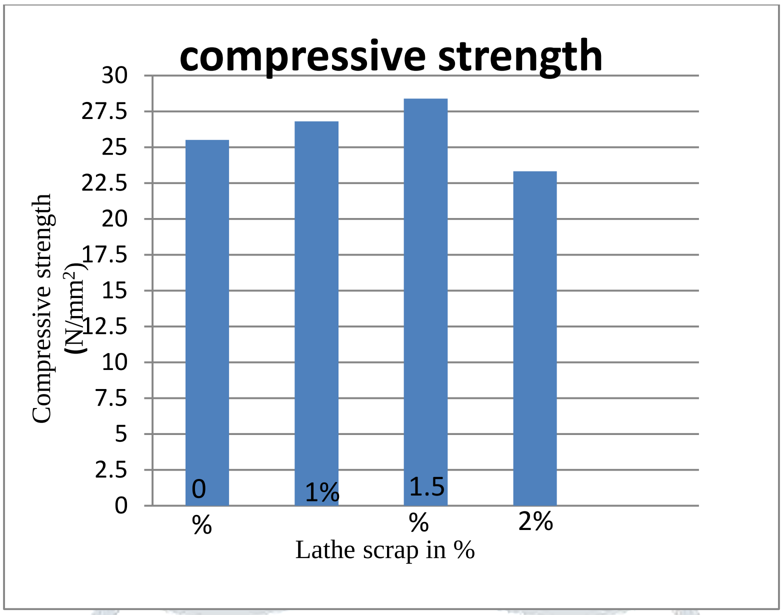


Fig:4. Compressive strength

From fig:4, it is observed that addition of lathe scrap in concrete increases the compressive strength of concrete. For 0%, 1%, 1.5% scrap content concrete the compressive strength obtained is 25.5N/mm^2, 26.8N/mm^2,28.4N/mm^2 respectively but at 2% scrap content the strength obtained is 23.33N/mm^2 which shows decrease in compressive strength. Compression strength increases up to 11.37% for 1.5% scrap as compared to conventional concrete

4.3. Split tensile strength of lathe machine scrap concrete

A total of12 cylindrical specimens were casted for various percentages of lathe steel scrap of size 150mm diameter and 300mm in height. Diametrically and along the length of cylinder compressive load until failure occurs along vertical diameter.

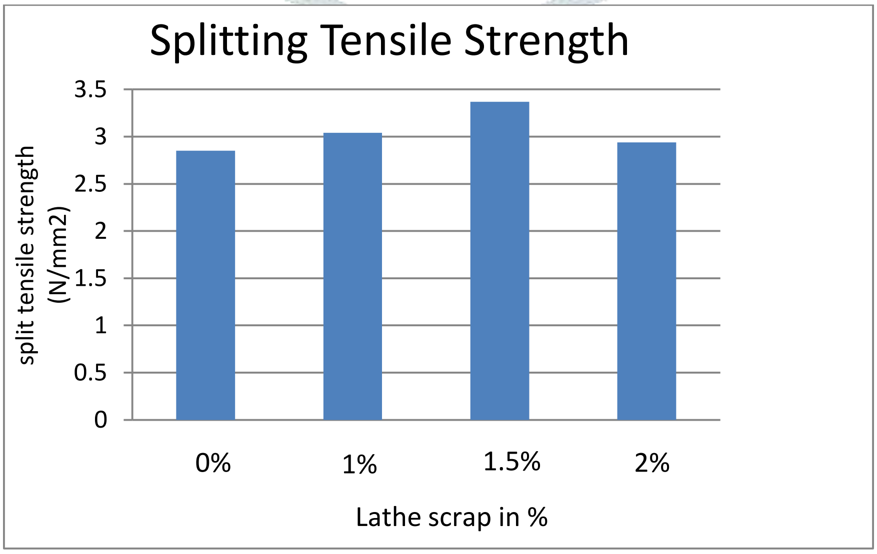


Fig:5. split tensile strength.

From Fig:4, it is observed that with addition of lathe scrap increase the splitting tensile strength of concrete. For 0%, 1%, 1.5% scrap content the strength obtained are 2.85N/mm^2, 3.04N/mm^2 and 3.37N/mm^2. But at 2% of lathe scrap addition there is decrease in splitting tensile strength and value obtained is 2.94N/mm^2. Split tensile strength it increases up to 18% for 1.5% scrap when compared with conventional cylinder.

4.4. Flexural strength of LSSRC

In flexural strength test of beam, the specimen of size 100x100x500mm is placed over three-point loading arrangements. Flexural strength is a mechanical parameter and is defined as the material ability to resist deformation under load.

Fig: 6. Three -point loading machine

Fig: 7. Flexural crack

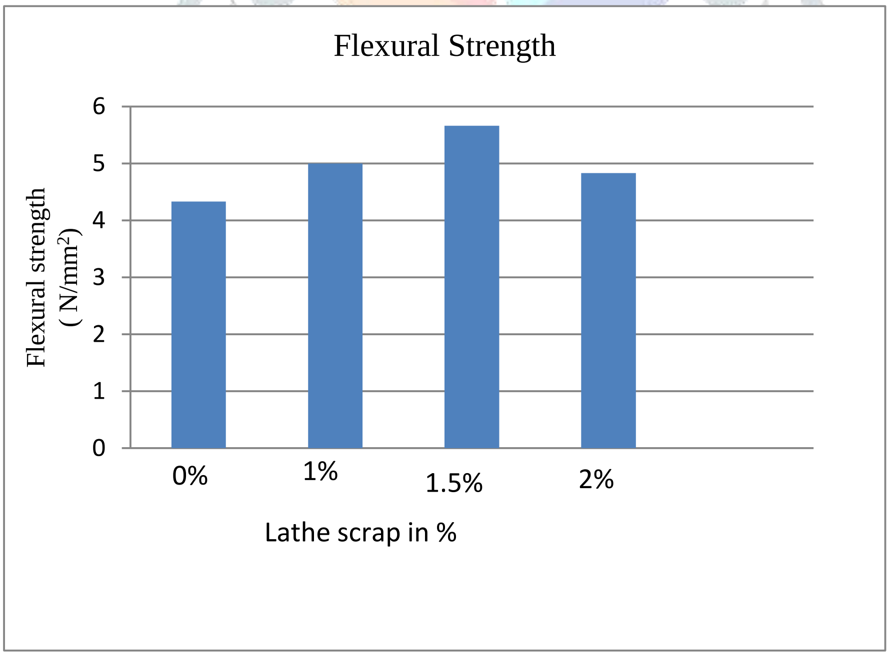
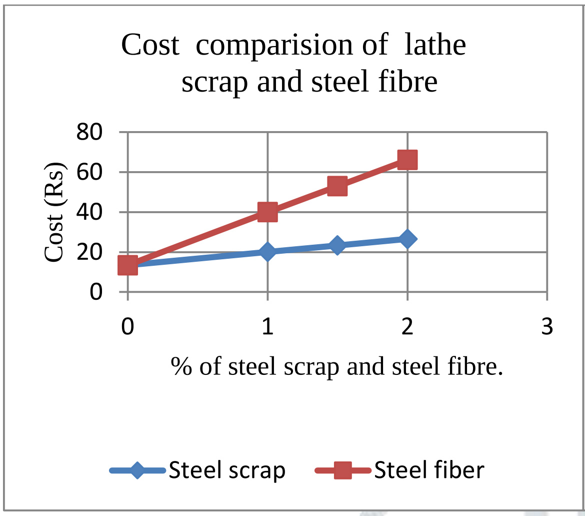


Fig: 8. Flexural strength.

From Fig:8, it is observed that with addition of lathe scrap increase the load carrying capacity of concrete. For 0%, 1%, 1.5% scrap content the load values obtained are 4.33kn, 5kn and 5.66kn. But at 2% of lathe scrap addition there is decrease in load carrying capacity and value obtained is 4.83kn. Flexure strength increase up to 30% for 1.5% scrap content as compared to conventional beam.

4.5. Cost sensitive analysis

The graphical representation of cost variation for steel fibre and steel scrap is given below:



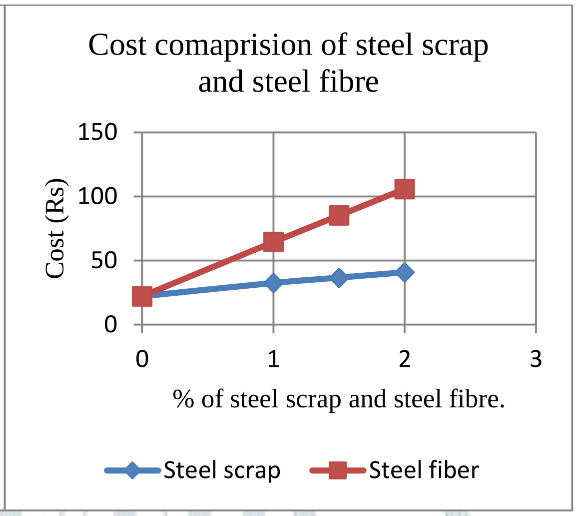


Fig: 9. variation of cost of steel fibre and lathe scrap for cubes.

Fig:10. variation of cost of steel fibre and lathe scrap for cylinders.

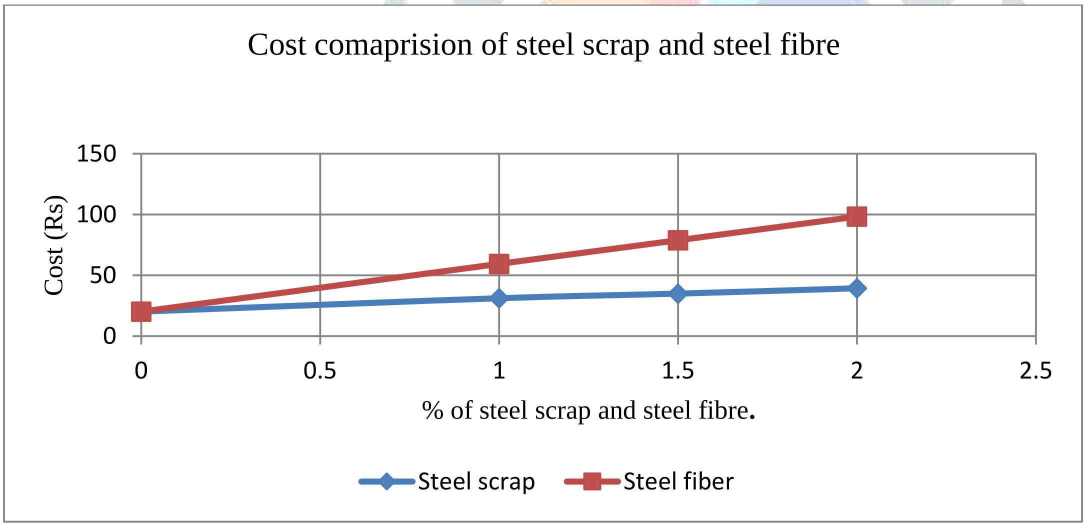


Fig.11. variation of cost of steel fibre and lathe scrap for beams.

The graphs from figures 9 ,10 and 11, show that the lathe machine scrap is cheaper to use than steel fibre for cubes, cylinders and beams Therefore lathe scrap concrete will be economical to use as compared to steel concrete

5.CONCLUSIONS

In this study compressive, split tensile and flexure test were done on concrete with varying percentages of lathe scrap. The study proves that mechanical properties of concrete are increased by adding steel scrap up to certain proportions. Strength increases up to 1.5% of steel scrap from 1.5 to 2% steel scrap there is slight decrease in strength of concrete. At 1.5 % scrap content concrete has shown maximum strength in compression, tension and flexure. During testing it was observed that specimen tested for split tensile and flexural strength the controlled specimen has broken into two pieces but LSSRC specimens retained the geometry. It shows improvement in ductility due to addition of lathe scrap. With further increase in percentage of lathe scrap workability and strength decreases as steel scrap clump together and tend to "ball" formation. It results in higher presence of voids.1.5 % scrap is optimum percentage because with further increase in percentage of scrap there is enhancement in cost but decrease in strength. The lathe scrap shows better results compared to steel fibre when cost is taken into consideration.

REFERENCES

- K.R.Venkatesan (2015) "Studied the behavior of high strength steel fibre reinforced concrete beams for flexure" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 4, Issue 1, January 2015
- 2. E.Mello (2014) "Studied the improvements in concrete properties with addition of carbon and steel fibres" International Journal of Civil, Structural, Construction and Architectural Engineering Vol:8, No:3, 2014
- Ahmed N. (2010) "Made studies on innovative application of scrap-tire steel cords in concrete mixes" Jordan journal of civil engineering, volume 4, No.1, 2010
- S.aravindan (2013) made investigation studies on use of industrial waste in concrete, in this study he used galvanized iron wires to enhance the strength of concrete.
- Kamran Aghaee (2014) made studies on use of waste steel wires in concrete to enhance the strength of concrete.
- Shende.A.M (2011) "made comparative studies on steel fibre reinforced cum control concrete under flexural and deflection" international journal of applied engineering research, dindigul Volume 1, No 4, 2011
- M.Tamil selvi (2013) "Studied the properties of steel and polypropylene fibres reinforced concrete. In this study cubes, cylinders and prisms were casted using M30 grade concrete and reinforced with steel and polypropylene fibres" International Journal of Engineering and Innovative Technology (IJEIT) Volume 3, Issue 1, July 2013
- D.L.Chung (2000) concrete reinforced up to 2% of short carbon fibres.
- Marie.I (2007) Promoting the use of crump rubber in concrete as a step to waste management.

- Haung .Y (2007) A review of use recycled of solid waste materials in asphalt pavements.
- Ahmed .S (2000) mechanical properties of concrete with ground waste tires rubber.
- Gul.R (2005) Effect of steel fibres on the mechanical properties of natural light weight aggregates.
- Altun .F(2013) Investigation of reinforced concrete beams behaviour of steel fibres added lightweight concrete.
- Tarun .N (2002) Properties of concrete containing scrap tire rubber.
- Colin .D. Johnson (2001) fibre reinforced cement and concretes “advances in concrete technology”.
- Youjiang (2000) ,“Concrete Reinforcement with Recycled Fibres”, Journal of Materials In Civil Engineering / November 2000.

- Vasudev R,.(2005) Studies on Steel Fibre Reinforced Concrete – A Sustainable Approach.
- S. Lakusic (2009). studiedInnovative low cost fibre-reinforced concrete Mechanical and durability properties.

- Ashish Kumar Parashar and RinkuParashar.(2008) Utility of Wastage Material as Steel Fibre in Concrete.
- Shafigh P (2011) Effect of steel fibre on the mechanical properties of oil palm shell lightweight concrete. J Mater Design 32:3926-32.