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# TO ENHANCE MECHANICAL PROPERTIES OF CONCRETE BY USING LATHE STEEL SCRAP AS REINFORCED MATERIAL

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**Abstract— Every day about 8 to 10 kg of lathe waste are generated by each lathe industry in the Rajasthan region and through away in the barren soil, thereby contaminating the soil and ground water, which produces an environmental issue. Hence, by adopting actual management by recycling the lathe scrap with concrete is observed to be one of the best compounds. The test was conducted as per the Indian standard procedure for its mechanical properties such as flexural strength, split tensile strength, compressive strength, and compared normal PCC. The 7 days strength of the Lathe scrap reinforced concrete communicates an increase in its compressive strength when compared with PCC, and has practically become equal to the strength when tested on 28 days under normal curing. The addition of steel scrap in concrete has enhanced the performance of beam in flexural by 40% when compared with plain cement concrete. There is only a sizable increase in the split tensile strength of concrete with steel scrap when compared with plain cement concrete. The workability of fresh concrete that accommodate different ratios of lathe scrap was carried out by using slump test. The result showed that addition of lathe scrap into plain cement concrete mixture increased its compressive strength while it decreased the workability of the fresh concrete containing the steel scrap.**

**Comparatively the population of the world is increasing there is an emerging necessity of mass constructions or multi storied constructions which can accommodate a larger number of people. In this situation high strength concrete is required, which is eco-friendly, i.e. it must be moreover sustainable and effort worthy. To speed up the properties of concrete we can add some fibrous material to the concrete, which are uniformly distributed and randomly oriented and helps to enhance the compressive strength, shear resistance, crack résistance, modulus of elasticity, toughness and reduction of shrinkage of concrete. And also, by keeping sustainability in mind, we have used Lathe steel scrap as a fibrous material in the concrete, which is non-bio-degradable solid waste generate by Lathe machinery in fabricate industries, land stuffing by these waste materials causes land pollution and also influence the quality of ground water at such places. In consideration of environmental pollution and the huge availability of these scrap material we have used Lathe steel scrap as partial adding to concrete at 0%, 0.5%, 1%, 1.5%, and 2% by volume proportions for M30 grade concrete and the properties like compressive strength, split tensile strength, flexural beam strength, modules of elasticity are tested for 7 and 28 days and compared with normal M30 concrete.**

**Keywords— Lathe Steel Scrap, Compressive Strength, Split Tensile Strength, Flexural Strength, Workability, Waste Material, Sustainable Material.**

## 1.0 INTRODUCTION

In the current scenario, the world is facing the construction of very challenging and difficult engineering structures. Concrete is the most important and widely used material for construction of engineering structure, pavements etc. it is called upon to possess very high compressive strength and sufficient workability properties and efforts are made in the field of concrete technology to develop the properties of concrete by using fibers and other admixtures in concrete up to certain proportions. In the view of the global sustainable development, it is imperative that Fiber Reinforced Concrete (FRC) provide improvements in tensile strength, toughness, ductility, post cracking resistance, fatigue characteristics, durability, shrinkage characteristics, impact, cavitations, erosion resistance and serviceability of concrete. Due to these benefits, the use of FRC has increased during last two decades.

In the present experimental work, an attempt will be made to analyze the compressive strength of the waste lathe steel scrap material which is available from the lathe machine, is used as a steel fiber in concrete for various construction works and to optimize fiber content. Lathe Scarp is easily available in mechanical workshops, car pantry shops etc. with minimum cost. By adding lathe scrap as a reinforced fibre, we can reduce the construction cost as well as material. As we know concrete has more compressive strength, but less in tensile, so by using some waste as a additional material so we can increase the tensile strength as well as compressive strength.

**1.1 Lathe Steel Scrap**

Waste usages are an attractive substitute to disposal in that disposal cost and likely pollution problems are decreased or even eliminated along with the achievement of measurable conservation. However, the utilization strategy must be coupled with environmental and energy reflection to use available materials most efficiently. Steel slag, the by-product of steel and iron manufacture processes, started to be used in civil engineering projects during the past 12 years. The secondary waste from steel is the iron filing, which is produced locally in large amounts from steel workshops and factories. This product has a refuse impact on the environment when disposed from this reason the research project started. Most of the previous researches were discussed with steel slag where a rare of it was concerned with iron filing.

Scrap from lathe machine is built from different manufacturing processes which are carried out by lathe machine. Scrap which is a waste can be used as a reinforcing material in concrete to strengthen the various properties of concrete. Scrap from the machine can react in a same way as steel fiber. Steel scrap which is a lathe waste generated by each lathe industry and dumping of such wastes in barren soil causes contamination of soil and ground water, which generate harmful environment. In adding to get sustainable development and environmental profit, lathe scrap can be used as a reuse fiber with concrete. With expanded in population and industrial activities, the amount of waste fibers generated will increase in coming years.

**Figure 1.1: Steel Scrap from Lathe Machine**

These industrial waste fibers can be effectively used for manufacturing high-strength, low cost Fibre Reinforced Concrete after exploring their suitability. Plain reinforced concrete is brittle material due to adding of steel fibers in concrete, considerably expand the tensile strength, static flexural strength, durability, impact strength and shock resistance.

Concrete is a substance which is weak in tension and fails in a brittle manner when subjected to tension and flexure. When steel scrap is put into concrete, the performance of composite material is superior to plane concrete. A good waste, solid management is to occur a way to make use of it. In this experimental study was carried out to study the practicability of using steel scrap obtained from lathe machine in concrete by inspecting the compressive strength, splitting tensile strength and flexural strength of M30 concrete and thus boost the fiber proportions. Lathe steel scrap reinforced concrete (LSSRC) is a costly essential replacement for fiber reinforced concrete (FRC).

Steel scraps gets from lathe machines has similar physical properties as that of steel fibers. The essential utilization of localized available lathe waste material is certainly a great have to in the recent years. The lathe waste was ready manually to get an aspect ratio from 50-110. It is known that too long fibers cause balling effect.

**1.2 BENEFITS OF USING LATHE STEEL SCRAP IN CONCRETE**

- To reach high strength concrete economically.
- To explore the proper replacement percentage for lathe steel scraps and lathe scraps based on the strength and workability parameters.
- To study the degree of workability of concrete on all present replacement percentages.
- To study and compare the showing of usual concrete and high strength concrete using Lathe scraps and Steel fibers

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- To understand the effectiveness of Lathe and Steel fibers in betterment of concrete strength
- To study the carry out of varying percentage of replacement of fine aggregate by lathe steel scraps and steel fibre on concrete.
- To study the advantage of Lathe steel scraps and Steel fibers as an supplement in concrete

## 2.0 MATERIAL AND METHODOLOGY

### 2.1 MATERIALS USED

Concrete Material mainly consists of cement, fine aggregate, coarse aggregate, lathe scrap waste, anti corrosive agent and water.

### 2.2 Cement

The Aditya Birla brand of Ordinary Portland cement (OPC) of grade-43 used in this study was purchased from the local market of Chittorgarh. Cement is an artificial material, generally available in powder form, which can be made into paste form by the mixing of water and it will set into solid mass when it is moulded or poured. Various organic compounds used for fastening and adhering materials, are called cements, but cement classified as adhesives, and cement alone means a construction material.

### 2.3 Fine Aggregate

Fine aggregate is a naturally occurring granular material. Sand is collected of finely divided rock and mineral particles. The main ingredient of sand is, in non-tropical coastal settings and inland continental settings, is silica ($SiO_2$), usually it is in the form of quartz. It is the most usual mineral resistant to weathering. It is used as fine aggregate in concrete and mortar.

Sand is a collection of grains of mineral matter derived from the disintegration of rocks. Sand is specifying from gravel only by the size of the particles or grains, but is differ from clays which contain organic materials. Sands that has been and separated from the organic material by winds or by the action of currents of water across arid lands are generally quite uniform in size of the grains. Commonly, commercial sand is obtained from sand dunes formed by the action of winds and from riverbeds.

### 2.4 Coarse Aggregate

Crushed stone aggregate with particle size less than 20mm size was used for the present investigation. The specific gravity of the coarse aggregate was tested as per IS 2386:1963 (PART 3) and it was found to be 2.89.

Aggregates are immobile granular materials such as sand, gravel, or crushed stone that, along with water and Portland cement, are a basic ingredient in concrete.

For an actual concrete mix, aggregate needs to be cleaned, hard, strong particles unconfined of absorbed chemicals and other fine materials that could end the deterioration of concrete. Aggregates, which account for 60 to 75 percent of the total volume of concrete, are split into two distinct categories--fine and coarse. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the residue.

| S.NO. | Properties | Values |
|---|---|---|
| 1 | Cross –section | Straight and deformed |
| 2 | Diameter(mm) | 0.3-0.75 |
| 3 | Length (mm) | 25-40 |
| 4 | Density kg/m3 | 7850 |
| 5 | Young modulus(N/mm²) | 2 x 105 |
| 6 | Tensile strength (N/mm²) | 500-3000 |
| 7 | Specific gravity | 7.85 |
| 8 | Aspect ratio | 45-100 |
| 9 | Elongation (%) | 5-35 |

### 2.5 lathe Steel Scrap

To make concrete more economical and clean with a remarkable quality, application of Computer Numeric Controlled (CNC) Lathe machine waste can have massive importance. By using this large amount of (according to ICI 1200 million tons annually) CNC waste can help to generate large quantities of eco-friendly concrete and decrease large amount of land pollution.

At this present time when the unbelievable demand of steel is at its maximum, this nature of blindly following the broadening strategy not only leads toward development, but it heads to a throwaway ground of Industrial Waste as well. To utilize this large quantity of steel the CNC Lathe Machines are used and due to their usage a large amount of waste is generated.

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From the previous many researchers during their research work have come across many profits and obstacles. Lathe waste is a material through lathe machines and that can be used as a steel fiber. Now manually processed lathe waste with an aspect ratio range from 45 to 100 was used. The thickness varies from 0.3 to 0.75 mm and length from 25 mm to 40 mm was included in Lathe Steel Scrap Fiber Reinforced Concrete (LSSFRC).

**Figure 2.5: Lathe Steel Scrap of various length**

**Table 2.5.1: Properties of Scrap Steel Fibre**

**2.6 Water**

Potable water available from the laboratory which satisfies the drinking standard was used for mixing and curing.

**2.7 Anti Corrosive Agent**

These when added to concrete reduces the corrosion of steel fibers in it. These are water soluble and easy to mix with water. Here, "CORROMIN W" containing alkyl phosphonate salt mixture has been used.

**3.0 Methodology**

**3.1 Working Procedure**

The working procedure applied in this research is shown in the flow diagram below:

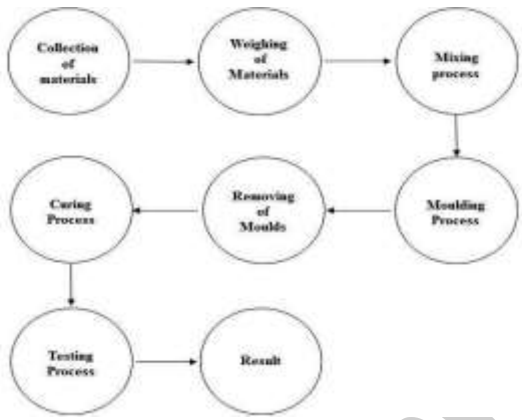


**Figure 3.1: Schematic flow diagram of methodological approach**

**3.2 Concrete Mix Proportion**

In this study M30 grade concrete mix design as per IS: 10262-2009 is carried out. The concrete mix proportion was 1:1.73:3.3 and water content was 197 l/m3

In this present study, all the properties are tested for M30 concrete as per IS 456-2000. The design mix is prepared as per the specifications of the materials mentioned above. And the quantities of the materials are shown in the table 3.2.1

**Table 3.2.1: Mix Proportion per m3 of Concrete for Lathe steel Scrap**

| Material | Mix 1 | Mix 2 | Mix 3 | Mix 4 | Mix 5 |
|---|---|---|---|---|---|
| % Addition of steel scrap | 0 | 0.5 | 1 | 1.5 | 2 |
| Cement (kg) | 370 | 370 | 370 | 370 | 370 |
| Coarse aggregate (kg) | 1242.58 | 1242.58 | 1242.58 | 1242.58 | 1242.58 |
| Fine aggregate (kg) | 639.88 | 639.88 | 639.88 | 639.88 | 639.88 |
| Steel scrap weight (kg) | 0 | 11.26 | 22.52 | 33.78 | 45.04 |
| Chemical admixture (litre) | 0 | 0.34 | 0.68 | 1.04 | 1.14 |
| Water (litre) | 169 | 169 | 169 | 169 | 169 |

**4.0 RESULT AND DISCUSSION**

**4.1 Workability:** The workability of fresh Lathe Steel Scrap Fibre Reinforced Concrete (LSSFRC) is a measured of its ability to be mixed, handled,

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transported and importantly place and consolidated. Slump test is a common, convenient and inexpensive test, but refer only for small fiber contents, for high volume contents inverted cone or Vee Bee test is referred (IS 1199-1959).

**Figure 4.1.1: Workability Measured by Slump Test Apparatus**

**Table 4.1.1: Slump Value of lathe Steel Scrap Reinforced Concrete (LSSRC)**

| S. No | Addition of Lathe Steel Scrap (%) | Slump Value(mm) |
|---|---|---|
| 1 | 0 | 85 |
| 2 | 0.5 | 80 |
| 3 | 1.0 | 75 |
| 4 | 1.5 | 70 |
| 5 | 2.0 | 70 |

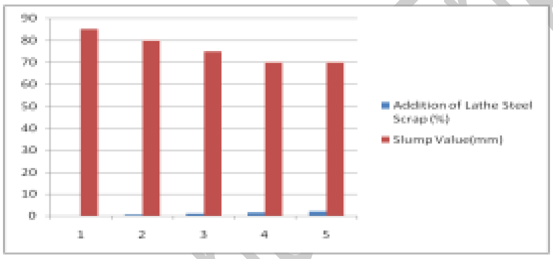


**Figure 4.1.2: Graphical arrangement of Slump Value**

**4.2 Compressive Strength:** (IS 516-1959): Fibers usually minor effects on compressive strength, slightly increasing or decreasing the result. Cubes moulds are used to prepare 30 cubes testing under the Compressive testing machine.

**Figure 4.2.1: Concrete Cube under CTM**

**Table 4.2.1: Compressive Strength of LSSRC at 7 days (MPa)**

| S. No | Addition of Lathe Steel Scrap (%) | Compressive strength at 7 days (MPa) |
|---|---|---|
| 1 | 0 | 31.2 |
| 2 | 0.5 | 36.43 |
| 3 | 1.0 | 37.2 |
| 4 | 1.5 | 44.2 |
| 5 | 2.0 | 33.3 |

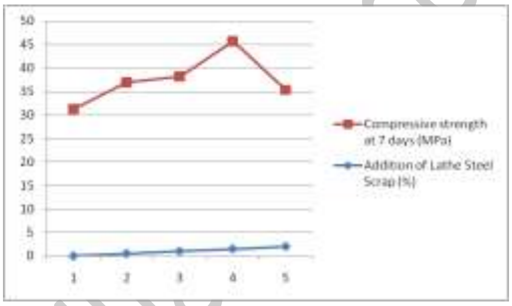


**Figure 4.2.2: Graphical Arrangement of Compressive Strength of LSSRC at 7 days**

**Table 4.2.2: Compressive strength of LSSRC at 28 days (MPa)**

| S. No | Addition of Lathe Steel Scrap (%) | Compressive strength at 28 days (MPa) |
|---|---|---|
| 1 | 0 | 41.2 |
| 2 | 0.5 | 42.52 |
| 3 | 1.0 | 42.83 |
| 4 | 1.5 | 49.32 |
| 5 | 2.0 | 44.42 |

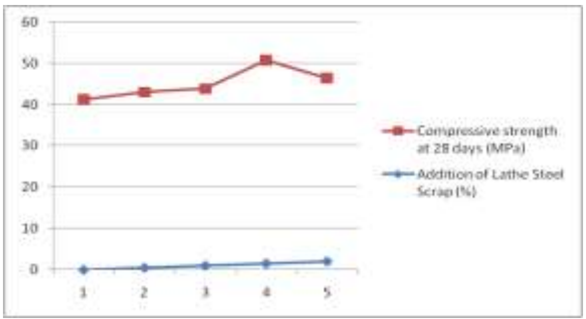


**Figure 4.2.3: Graphical Arrangement of Compressive Strength of LSSRC at 28 days**

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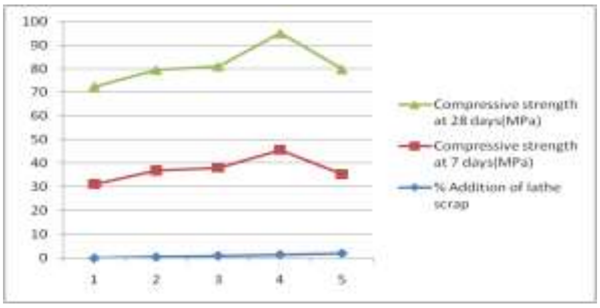


**Figure 4.2.4: Graphical Comparison of Compressive Strength of LSSRC at 7 & 28 day**

**4.3 Flexural strength (I.S. 516 - 1959):** The flexural strength of the beams tested for different proportion shows a gradual increase in flexural strength up to 1.2% of fiber added concrete and then a gradual decrease in the strength up to 2%.

**Table 4.3.1: Flexural Strength of LSSRC at 28 days (MPa)**

| S. No | Addition of Lathe Steel Scrap (%) | Flexural Strength at 28 days(MPa) |
|---|---|---|
| 1 | 0 | 4.13 |
| 2 | 0.5 | 4.56 |
| 3 | 1.0 | 5.86 |
| 4 | 1.5 | 6.34 |
| 5 | 2.0 | 4.83 |

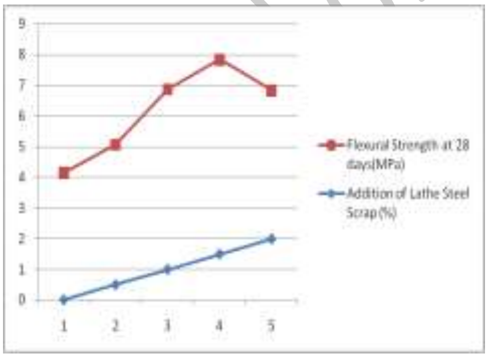


**Figure 4.3.1: Graphical Arrangement of Flexural Strength of LSSRC at 28 days**

**4.4 Split Tensile strength (I.S. 5816 - 1999):** The split tensile strength of the concrete varies with the proportion of fiber added in concrete. The maximum strength is observed in 1.2% of fiber added to concrete.

**Table 4.4.1: Split Tensile Strength of LSSRC at 28 days (MPa)**

| S. No | Addition of Lathe Steel Scrap (%) | Tensile Strength at 28 days (MPa) |
|---|---|---|
| 1 | 0 | 2.83 |
| 2 | 0.5 | 2.98 |
| 3 | 1.0 | 3.33 |
| 4 | 1.5 | 4.23 |
| 5 | 2.0 | 3.45 |

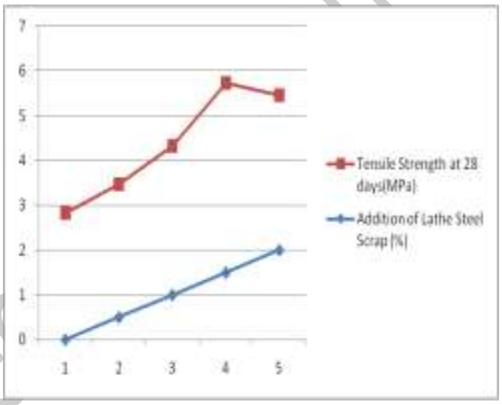


**Figure 4.4.1: Graphical Arrangement of Tensile Strength of LSSRC at 28 days**

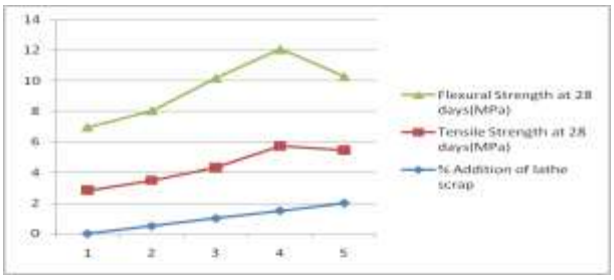


**Figure 4.4.2: Graphical Comparison of Flexural and Tensile Strength**

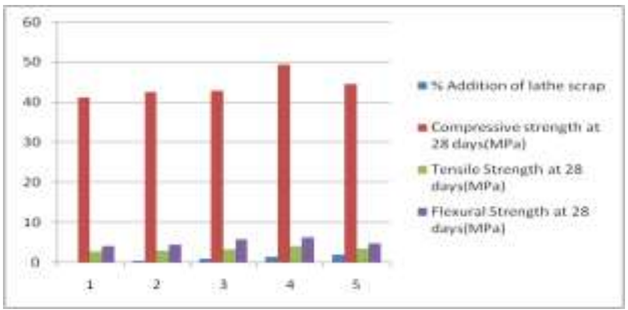

**Figure 4.4.3: Graphical Comparison of Compressive Strength, Flexural Strength and Tensile Strength at 28 days**

### 5.0 Conclusion

This study shows that restore of lathe waste enhance mechanical properties of concrete. Different tests were done at 7 and 28 days after casting the specimens. The following conclusions were made from the test results and discussions of this investigation:

The mechanical properties of the concrete are increased by increasing the proportion of the lathe steel scrap from 0.5% up to 1.5%. From 1.5% to 2.0% it shows slight decrease in the mechanical strength. At 2.0% of lathe scrap proportion there is a considerable reduction in the mechanical strength of LSSRC .The compressive strength of LSSRC increased by 10% for 7 days strength when compared to Plain Cement Concrete for all the tested proportions of lathe scrap and steel fiber. For the 28 days strength the Lathe Steel Scrap Reinforced Concrete (LSSRC) poses almost the same compressive strength as plain cement concrete for all the tested proportion. The addition of lathe steel scrap has significantly increased the performance of beam in flexural nearly 40% when compared with plain cement concrete .There is a considerable increase in split tensile strength of about 10% when compared to plain cement concrete. The result published that addition of lathe scrap in to plain cement concrete mixture enhanced its compressive strength while it decreased the workability of the fresh concrete containing the lathe scrap. In general from the above study it was incurred that, the performance of lathe scrap reinforced concrete proves to be better than the normal concrete and very much comparable with SFRC regarding its mechanical properties.

Natural maneuver are not immense and also, there is a global need to preserve to our environment and preserve our scarce natural resources for next generation. Use of lathe waste in concrete is beneficial as compared to conventional concrete decrease the environmental pollution as well as providing economical value for the waste material.

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