Abstract

Since it works well, concrete is a critical building element. Researchers seek to develop their properties more to make them more economical. Different waste materials and fibers in concrete are checked for this reason. The research aims at analyzing and evaluating the mechanical performance of the compressive, splitting tensile and bending strength of concrete with the addition of lathe as steel fiber refurbishment into the matrix of cement. Different mixes of 0 percent, 0.5 percent, 1 percent, 1.5 percent, 2.5 and 3 percent waste fiber are produced. Results demonstrated that the slump value of mixes decreases, as fiber reinforcement, the higher the waste, the lower the workability. Adding the lathe waste to concrete increases the structural properties of concrete, such as compressive, tensile and bend strength. The application of 1.5% of lathe waste raises compressive intensity up to 26.52%, of 13.70% and 16.12%, respectively, for 7, 14 and 28 cure days. With the introduction of 1.5% of the waste lathe, tensile intensity rises to 20.84% for 28 days. Also bending strength was improved by increasing lathe waste steel fibers.

Keywords: lathe waste steel fiber, Fiber reinforcement, workability test, Mechanical strength and Scanning Electron microscopy.

I. Introduction

The flexibility, resilience, efficiency, and productivity of Concrete have rendered this construction material the most commonly produced in the world. Every person per year, about four tons of concrete is produced. The term concrete refers to a mixture of aggregates, often sand, and gravel, or crushed stones, holding a cementitious paste binder together. The paste is usually formed of cement and water in Portland and may also contain additional concrete materials (SCM) including fly
Concrete is the basis for much of the architecture and growth of humanity. The worldwide usage of concrete is twice as much as any other commodity. This is important for constructing public roads, transport facilities, buildings for offices, and homes. And, although cement is resource and energy-intensive, it is a building medium with very low effect from an environmental and ecological viewpoint, because of the characteristics of the concrete. Indeed, most concrete applications contribute directly to building an infrastructure that is sustainable [XIII]. Concrete is known to be the foundation of new buildings. Without it, a framework that is solid, stable, and able to withstand earthquakes and other loads such as dead loads, loads placed on it, snow load, etc. cannot be built. A concrete framework is superior to other frameworks constructed from other materials, mixing water, fine aggregates, and cement until collectively mixed into a strong stone and is defined as concrete to endure various forms of vibration. If such components are mixed, they are new and exciting and can be arranged to an ideal type. The resulting materials from which concrete is shaped are used to control properties including power, density, chemical, and thermal resistance in unsullied and firm conditions. As these ingredients differ in number, they do not have the same properties [XIV]. To ensure freshly manufactured concrete is workable and able to survive the environment and the loads, the materials will be balanced correctly upon hardening. Concrete structures of greater tensile strength [VIII] would be improved by being prone to strain and less stress. To overcome the weaknesses, several studies were undertaken worldwide by using various concrete materials; one of these was Fiber-reinforced concrete (FRC), a material that was very common during the last two decades of the study. Researchers are also attempting to develop high-performance concrete using concrete fibers and admixtures of different dimensions [XXI]. In addition to some more strength properties, the introduction of fiber into concrete has strengthened numerous characteristics, including splitting, damage, tear resistance, ductile, and fatigue resistance. In comparison to constructing walls, concrete paved floors are an integral aspect of the highway surface owing to improved dominance in the driving climate, reduced upkeep, and enhanced structural reliability utilizing recycled materials [X]. Once the RCC beam is fortified with textiles, besides that, its shear, bending, and operability increase even the crack width Bit reinforced with cellulose, which has shown that crack width is high in contrast with flat concrete with a smaller crack diameter, and cellulose reinforced concrete was found to be 40 percent more extreme than unreinforced concrete. The power of the cement was equivalent to that of concrete, such as thread, aramid [XVI]. The world faces the construction of extremely difficult and challenging civil engineering structures today. Concrete, the most important and widely used material, are required to have very high strength and to have sufficient working properties and efforts to develop the properties of cement through fibers and other concrete compounds in certain proportions. With a view to globally sustainable technologies, enhancements to tensility, durability, ductility, post-crunch tolerance, fatigue characteristics, strength, shrinking functionality, effects, cavitation, erosion resistance and concrete usability [IV] are indispensable.
II. Literature Review

In the past, there have been many forms of steel fibers. In addition to other mixed constituents, four significant characteristics of steel fiber have an impact on the composites' properties, namely: form (i.e. shape), volume fraction, aspect ratio (length to steel fibre diameter ratio), and fiber orientation in a matrix. The refinement of these parameters was recently examined to enhance the attachment properties of fiber matrix and increase the dispensability of fiber [XVIX] SFRC with hooked end stainless steel wires are found to have better physical properties in contrast to straight fibres. It is because the ankle given has been strengthened and the aspect ratio has been higher than the corresponding fiber length [I]. Laboratory size work conducted by several organizations as well as academics indicates that by applying steel fibers to concrete the overall energy consumed is substantially improved until a full specimen breakdown [VI]. Fatigue effects, flexure strength, shear strength, and impact resistance were also improved by the inclusion of steel fibers [XIII]. The mechanical features of SFRC are improved by the crack regulation system. The ability of steel fibers to survive the spread of cracking relies mainly on the relation between cement and fiber and the propagation of fiber (spreading and orientation). The relation between concrete and fibers is the process by which the tension is passed from the matrix of concrete to the steel fibers. Reinforced steel fiber (SFRC) is stiffer relative to standard cement without fibers, but the workability (concerned with some friction test) is the same. This is the product of a lower downturn. Steel fibers appear to intertwine. This promotes vibration to maximize capacity, raising air vacuum quality, and boost communications with compliance bars. A well-adjusted fibre-mix may be pumped [XV] despite its rigid nature. The fiber lengths relative to the components dictate the distribution of these components. Choose fibers to be successful in the hardened condition not shorter than the average aggregate scale. The fibers are typically 2-4 times thicker than the fiber of the average thickness [II]. The Buildability of the cement is determined by its scale, form, and contents of the earth aggregate as well as by morphology and volume fractures. Compact efficiency is linear with the aspect ratio (If / df) of fibers at a particular diameter and volume fraction. The comparatively small fibers amount to the raw aggregates and the 'fixation' of steel fibers control the lowest potential quality [XVII]. The tensile strength of steel fibers is usually 2-3 times greater than standard reinforced fabrics, and the surface area to establish ties to a concrete matrix is important. Such parameters influence the efficiency of the concrete-steel fibers and the relationship between the fibers and the concrete collection. For eg, a highly tensile steel fiber with bad bonding in concrete would not function as steel tensile strength will make. At a certain dosage, a combination of these three parameters gives a strength value. The hardness of a given steel fiber can therefore vary with various dosages (volume fraction of fiber in concrete). Steel fiber concrete is used primarily for uses of commercial floors and flooring. "In the last 10 years, more than two million m3 of reinforced steel fiber sheets in the UK have been built." Based on the load added to the part, the tension on a concrete surface becomes challenging. There are various pressures, as a consequence of a variety of factors including declines and thermal impacts, the strong turning of bucket-lift trucks, and impact loads [VII], that are difficult to quantify. Lathe wastes are a lathe material that may be used as steel fibres.
Nevertheless, it was not a continuous aspect number. The waste aspect ratio of 50 to 110 is used here and is managed by the side. The range ranges between 0.45 and 1 mm and 15 mm to 50 mm [III]. Machine scrap is produced from various manufacturing processes carried out by the machine. Waste scrap can be used to enhance the various characteristics of the concrete as a reinforcing material. Machine scrap can act in the same way as fiber of steel. That batting industry generates waste steel, which is a batting waste, and dumping such waste in unclean soil causes soil and groundwater contamination and creates a hazardous environment. As well as pursuing economic growth and environmental gains, the scrap may also be used as recycled concrete material. The quantity of waste fiber generated would increase in the coming years with the growth in population and industry [V]. The waste dust scrap may be used to improve the different properties of the concrete as a building element. Lathe scrap is the same as steel yarn. Scrap is the same. Wastes are available in the lathe industry in the form of steel scraps created in various processes in which the lath product is manufactured and dumping these waste on untreated soil and soil water causes pollution and creates an unhealthy environment. Concrete M30 (1:0.75:1.5) is used to monitor the disparity in intensity of the concrete by inserting scrap fibers in varying amounts (0.5%, 1.0%, 1.5% & 1.75%). Three separate forms of waste metal tests were equivalent to an industrial reinforcing bar of 40, 60, and 72 graded steel. The fibers used are of an irregular form and have different aspect ratios [IX].

### III. Investigation Approach

The goal of this research was to investigate the probability of the usage of lathe waste by testing the compressive, tensile, and bending ability. All such criteria were noticed by 0 percent, 1.5 percent, 2.5 percent, and 3 percent by weight concrete in various amounts of lathe waste. All tests were performed by ASTM guidelines. Cylindrical concrete sample cast with 0 %, 0.5%, 1%, 1.5%, 2%, 2.5%, and 3% inclusion of the washed was cast and the cylindrical test with control concrete with no substitution is contrasted. To find the mixing ratio for desired strength, a mix design was done.

### Slump Test (ASTM C-143-M03)

The concrete slump test shall determine whether the concrete mix prepared in the laboratory or on the building site is working or uniform during work. Batch to batch slump monitoring is conducted to track consistent concrete consistency during the building. The slump method is the shortest concrete workability test for low-cost tests. That is why it has been used widely since 1922 for workability research. The slump takes place in the United States by procedures described in ASTM C143. Clean the mold's inner surface and spray the wax. Place the mold on a non-porous flat horizontal foundation layer. In 4 nearly equivalent layers line the mold with the prepared concrete blend. Tamp the mold cross-section in a single way over each layer with 25 strokes of the rounded end of the padding rod. The tamping will reach the underlying substrate for the corresponding layers. Join the surplus cement, and plane the air with a container. Wash the water between the mold and the foundation layer, or powder the mortar. Immediately and gradually rising the

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mold in a vertical direction from the concrete. Measure the slump as the difference between the mold height and the height point of the tested specimen. The procedure above should be carried out at a noise or shock-free position and within 2 minutes of sampling.

Compression Test and Splitting Tensile Strength

Detail number of concrete cylindrical samples is shown in Table 1.

Table 1: Number of concrete specimen for Compressive and Split Tensile Test

| Concrete Mix | Lathe waste added (%) | Compressive Test | Split Tensile Test |
|--------------|------------------------|------------------|-------------------|
|              |                        | 7 Days | 14 Days | 28 Days | 28 Days |
| M0           | 0                      | 2      | 2       | 2       | 2       |
| M1           | 0.5                    | 2      | 2       | 2       | 2       |
| M2           | 1                      | 2      | 2       | 2       | 2       |
| M3           | 1.5                    | 2      | 2       | 2       | 2       |
| M4           | 2                      | 2      | 2       | 2       | 2       |
| M5           | 2.5                    | 2      | 2       | 2       | 2       |
| M6           | 3                      | 2      | 2       | 2       | 2       |

Total = 56 Cylindrical concrete Samples were casted

Fig. 1: Compression strength test

Flexural Strength Test (ASTM C-293/C293M-10)

1.5% addition of lathe waste was cast and tested for flexure.
Scanning Electron Microscopy (SEM)

A microscope with a standard scan electron runs at a high vacuum. The basic theory is that an electron beam is generated by a suitable source, usually a tungsten filament or a rifle. A high voltage (e.g. 20 kV) speeds the electron beam and enters a series of apertures and electromagnetic lenses to create a thin electron beam, so the beam tests the surface of the specimen with scan coils (like a “simple” TV site in a cathode ray tube)
IV. Results/Discussion

Slump Test (ASTM C143 M03)

Fig. 3: Slump test (Water Demand)

Results indicate the control / ordinary concrete slump down to around 80 mm, whereas slumps up to 71 mm, 63 mm, 57 mm, 49 mm, 43 mm and 35 mm on 0.5%, 1.5 %, 2%, 2.5% and 3% use lath waste as fiber reinforcement. Also, the slump in the form of the workability of a concrete blend was found to decrease as lath was applied to the product. The workability of the blends has been seen to decline with the amount of lath waste being raised as fiber reinforcement, i.e. greater lath waste, less workability.

The concrete mixture with the lath waste is well freshly associated. If waste fiber is used in construction, the slump benefit of the blend can be reduced by growing the percentage of the waste fibers.

Compressive Strength (ASTM C-39/39M)

Compressive strength test results are shown in the figures below:

Fig. 4: Complied Data of compressive strength (7 Days)
Fig. 5: Complied Data of compressive strength (14 Days)

Fig. 6: Complied Data of compressive strength (28 Days)

This concluded that optimum compressive strength (peak value) for 7, 14, and 28 days of curing period is on 1.5% replacement.

**Splitting Tensile Strength (28 days age)**

Splitting tensile test result of samples are shown in the figure below:

Fig. 7: Complied Data for Splitting Tensile strength (28 Days)

On 1.5% addition, it gives an optimum tensile strength of 540.87 psi.
Flexure Strength (28 days age)

The flexure strength result for 28 days of curing period is shown in Table 3.

Table 3: Flexure Strength (MOR) 28 Days

| Addition of Lathe waste (%) | Flexure Strength psi (MOR)-28 days | Percent increase/Decrease |
|-----------------------------|-----------------------------------|---------------------------|
| Control Sample | 675.22  | 666.68  | 670.95  | 0.00  |
| 1.50%  | 815.87  | 820.23  | 818.05  | 21.92 |

Results show that there is an increase in the strength of 21.92% on 1.5% addition of Lathe waste

Scanning Electron Microscopy (SEM)

In SEM-images below are displayed micrograms collected using scan-electron microscopy of the fracture surfaces with 40 enlargements. The pieces of waste put on the concrete surface are considerably shorter. The length of the waste fiber to which the forces are distributed would separate the waste from the cement matrix. As a consequence of an increased bond in concrete since the waste was broken rather than washed out. Due to the lower w / b in the matrix, this increase in bond strength caused more waste to break into the cement. A rise in the bond intensity at the waste matrix interface was correlated with an improvement in matrix power.

Fig. 8: Scanning Electron Microscope Micrographs of fracture surface showing lathe waste breakage and pull out in concrete.

Often instructive is the malfunction process of late waste in the concrete given the fracturing zone. Although much of the waste late was accumulated in concrete during the application, damaged lathe wastes were found in the presence of the waste late. This can be observed in SEM representation, in which the visible waste from the fracturing surface becomes slightly shorter and smaller than in synthetic
reinforcement mixtures. This is because more of the waste on or about the crack surface broke down. This demonstrates that the waste later will improve the matrix and enhance its holding of the waste, raise tension on the waste, and destroy it. The choice to choose waste will, however, hold extra crack bridging loads without cracking, e.g. by raising their lath thickness, the concrete's strength and durability will substantially be improved.

V. Conclusion

The workability of the mixes was observed to decrease with an increase in the percentage of lathe waste as fiber reinforcement i.e., the higher the lathe waste, the lesser was the workability. Compressive, flexure, and split tensile strength increase extend, and then decrease with further increase in fiber content. 1.5% lathe waste fiber content is optimum content for strength. The provided SEM images verified the experimental results.

VI. Recommendations

For strength enhancement, the lathe waste can be used as steel fiber reinforcement up to 1.5% (by weight of cement).

VII. Acknowledgment

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Conflict of Interest:

There is no conflict of interest regarding this article.

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