STRUCTURAL STRENGTH ENHANCEMENT OF RIGID PAVEMENT USING SCRAP STEEL FIBRE REINFORCEMENT

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***Abstract*: Concrete is a durable material, enhancing its properties gives it a higher life expectancy, hence on addition of fibres can lead to a high life of concrete. Concrete also possesses an environmental friendly nature, recently is has been found out that various materials that go as a waste and pollute the environment have been used comprehensively with concrete in the form of admixtures or fibres and have been evaluated to possess a strength almost equal to or greater than the normal mix of concrete. Generally, "FRC can be regarded as a composite material with two or more phases in which concrete represents the matrix phase and the fiber constitutes the inclusion phase." Composite material consists of two or more components with different molecular level, mixed purposefully result in new material with new properties in comparison with single component. Moreover, reinforcement of concrete with two or more types of fiber referred to the concept of hybridization. Therefore, the presence of one fiber provides a suitable condition for other fiber to use its potential properties. The objective of this research is to evaluate and compare the mechanical properties of FRC with the use of steel scrap fibers compared to single type fiber composites. In this study, the concrete mixtures were made by replacing cement with 0.8%, 1.2 %, 1.6 %, 2.0 %and 2.4 % of Steel fibre by mass**

***Keywords*: Steel scrap, compressive strength, Concrete, Optimum percentage of steel scrap, Concrete cubes.**

1.0 INTRODUCTION

Concrete pavement is a key structure of highway pavement in India due to its increase in ride superiority, minimum maintenance, and extended design life. These rigid pavements may sometimes experience pavement distress that results in premature failure. This research studies the application of fibers in concrete due to its enhancement resistance to cracking. Now–a-days steel fibers in concrete increase intensively as an engineering demand. From the present scenario it is not only essential to provide safe, efficient and economical design, but it also provide as balanced base for future application. The energy consumption and cost associated with concrete pavements can be reduced through the use of recycled materials with more effective construction techniques. In many developed countries like India, anxiety over resource conservation, reduced material cost and waste production have paying attention on recycling of materials. This recycling of materials from industrial wastes either helps to conserve natural resources or propose environmental profits Conventional plain concrete pavements have low strain capacity, tensile and flexural strength when subjected to repeated loads due to brittleness of concrete; however their structural characteristics and efficiency are improved with fibers addition. The intention of improving the ductility of concrete led to the development of fiber reinforced concrete (FRC) reinforced with the discrete fibers within the concrete mass. These fibers are usually randomly distributed in the concrete and give primary reason to reinforce with concrete is to redistribute the stresses and to delay and control the post cracking of the composite materials. Due to this benefit, the use of FRC has tremendously increases now-a-days. In present different type of fibers are commercially use for Civil engineering applications includes steel or metallic fibers, glass, carbon, aramid, polymeric and cellulose. Among them steel fibers significantly improve the tensile strength, toughness and impact resistance of concrete under subjected to repeat or impact loads. Recent applications of SFRC are found in airport and highway pavements, tunnel linings, shotcreting, earthquake-resistant structures, overlays, bridges deck, industrial floors and marine and hydraulic structures which endure cyclic loading during their design life. An industrial steel fiber available in market makes steel fiber reinforced concrete uneconomical. Investigations to overcome uneconomical, scraps used as recycled steel fiber which exhibits the property of steel fiber in fiber reinforced concrete.

1.1 ROLE OF STEEL FIBRES IN PAVMENTS

Plain concrete pavements have low tensile strength and strain capacity, however these structural features are improved by fibre summation, allowing simplification of the pavement layer thickness. This performance can be more and depends on fibre feature and dosage. The most substantial act of fibre reinforcement is to retard and control the tensile cracking of concrete. Therefore it is found to have more affect on the pavement cost due to decreased thickness essentials, low maintenance costs and longer useful life. Comparing with the life cycle of an asphalt road, SFRC pavements have been described to last twice as long.

- **Social Development**
  The modern conception of the project is the use of reused steel wire as concrete fibre reinforcement, which provides extra environmental profits for tyre reprocessing over land filling. In order to measure the economic and environmental picture of the manifestation pavement, life cycle cost analysis (LCCA) and life cycle assessment (LCA) studies.
- **Economic development**

Utilization of steel filaments influences critical changes in flexure, to effect and weariness quality of cement. It has been utilized as a part of different sorts of structures. Development of recycled steel tyre cord (RTC) fibre reinforcement as an economical alternative to industrially produced steel fibres, used normally in SFRC construction.

- **Strategic Need**
  Steel fibers have been needed for a large time in construction of roads and also in floorings, especially where more wear and tear is come into picture. Specifications and nomenclature are crucial for a material to be utilized as the tenders are invited based on specifications and nomenclature of the items. In a place where steel fiber reinforced concrete was applied for overlays like flooring, adopting nomenclature can be taking up for concreting of small thickness. Concrete was applied for overlays like flooring, adopting nomenclature can be taking up for concreting of small thickness.

1.2 OBJECTIVES OF THE STUDY

The main objectives of this paper are-

1. To investigate the use of steel scraps as steel fiber in rigid pavement.
2. To scrutinize the various physical and mechanical characteristics of the steel fibers in concrete.
3. To compare the effectiveness volume fraction of steel fibers
4. To optimize the fiber proportions

1.3 STEEL SCRAP WASTE

Lathe scrap used as steel scrap and its dimensions are average 1.5 mm thickness, average 25-30 mm length and 2 mm wide. The dimension of fiber varies from industry to industry. It is like a steel fiber but its properties are not same as steel fiber. The shape of steel scrap may be rectangular or twisted. Its shape depends upon industry and type of work done by industry.

Fig 1.1: Steel Scrap Waste

1.4 PREPARATION OF MIX SAMPLES

Concrete is a mixture of cement, sand and aggregate. Cement, Sand and aggregates taken by weight as decided proportions 1:1.76:3.22. This proportion defines M-30 grade concrete with W/C ratio 0.5. The aim of mixing of concrete to produce a homogeneous and dense concrete. Concrete mix has been designed based on Indian Standard Recommended Guidelines. One control mixture was designed per Indian Standard Specifications IS: 10262-1982[34] to have 28 days compressive strength. The other concrete mixtures were made by replacing cement with 0.8%, 1.2 %, 1.6 %, 2.0 %and 2.4 % of Steel fibre by mass. In doing so, water to cementitious materials ratio was kept almost same to investigate the effects of replacing cement with steel fibre when other parameters were almost kept same. The mix designation and quantities of various materials for each designed concrete mix have been tabulated in Table 1.1.

Table 1.1: Mix Designation

Mix Designation	Mix	Cement	SSFR	Fine Agg. (Sand) (kg/m^3	Coarse Agg (kg/m^3)	Water	Plasticizer
C-0	-	375	---	663	1208	187.5	37.5
C-1	0.8 %	372	3	663	1208	187.5	37.5
C-2	1.2 %	371.5	4.5	663	1208	187.5	37.5
C-3	1.6 %	369	6	663	1208	187.5	37.5
C-4	2.0 %	367.5	7.5	663	1208	187.5	37.5
C-5	2.4 %	366	9	663	1208	187.5	37.5

1.5 COMPRESSIVE STRENGTH TEST

For compressive quality test, solid shape examples of measurements 150 x 150 x 150 mm were thrown for M-20 evaluation of cement. Super plasticizer (1.0% by weight of cement) was added to this. Fibres were added to concrete amid blending period in extent of 0.8%, 1.2 %, 1.6 %, 2.0 %and 2.4 % by weight of cement. For the first layer, the RCC mix was placed in the mould up to the half the depth and then compacted for 60 seconds with a vibrating hammer. The graph demonstrates the variety of compressive quality to % of fibres and it is watched that the compressive quality of concrete is expanding with the increment in fiber substance contrasted with customary solid at 28 days.

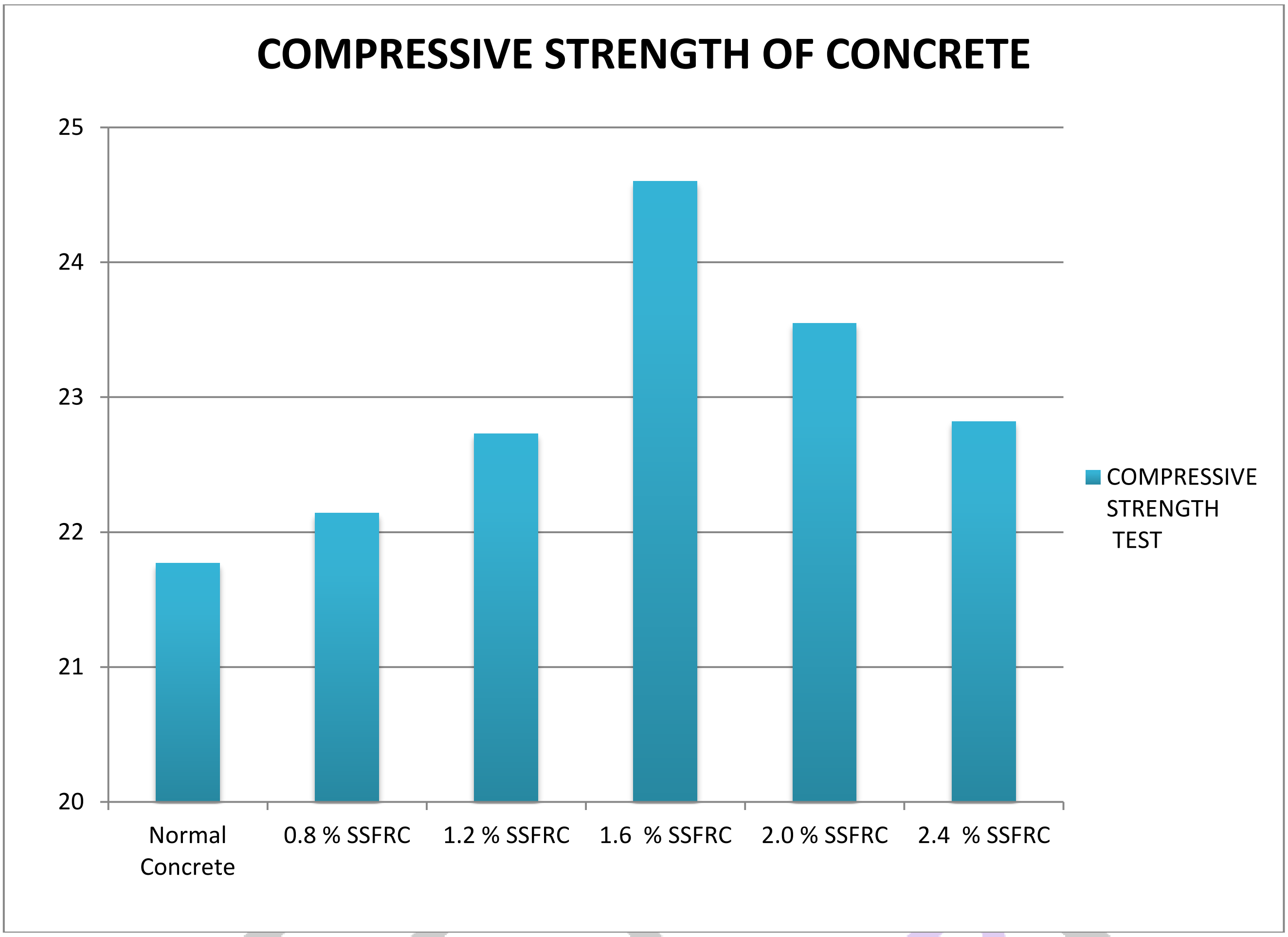

Figure 1.2: Compressive Strength Test

CONCLUSION

The purpose of this research program was to perform an experimental and analytical study on the performance enhancements from the use of steel-fibre reinforced concrete in rigid pavement. The conclusions based on the experimental and analytical programs are summarized below:

1. The optimum percentage of scrap steel fibre is 1.6 % as compared to other mixes.
2. It also shows that the compressive strength of SFRC gets increased up to 12% with 1.6% of steel fibers used as compared to plain concrete
3. SFRC is a sustainable improvement inside the present technology.
4. The studies additionally establish that the residences of hardened SFRC, consisting of flexural electricity, are remarkably higher than those of conventional RCC. Thus, the use of metal fibre for powerful pavement construction can be cautioned undoubtedly.
5. Addition of metallic fibres reduces the workability of concrete; hence it becomes important to utilize top notch plasticizers. And those SFRC is used for foremost, high budget tasks only because Steel fibres are value effective.
6. SFRC controls cracking and deformation under impact load much better than plain concrete and increased the impact strength 25 times.
7. During testing it has been noted that addition of fibres could improve the dimensional stability and integrity of the joints.
8. It is possible to reduce the congestion of steel reinforcement in the beam-column joints by replacing part of ties in the columns by steel fibres.
9. Load carrying capacity of the joints also increased with the increasing fibre content.

REFERNCES

[1] Nataraja, M.C., Dhang, N,& Gupta,A.P (1998) “Steel fibre reinforced concrete under compression” The Indian concrete journal, pp 353-356.
[2] Nagarkar,P.K., Tambe,S.L.,(1987)“Study of fibre reinforced concrete proceedings of the international symposium on fibre reinforced concrete, Chennai , pp 2.56 –2.72.
[3] Panda, B.C and Ghosh A.K (1999) “Structural modeling and design of interlocking concrete block pavement” The Indian concrete journal ,pp 122-127.
[4] R.M.Damgir, Y.M.Ghugal (2011) “Compressive Strength for FRC Member using Silica Fume” International Journal of Engineering Science and Technology (IJEST).
[5] Dinesh W. Gawatre et al (2016), “Study on Addition of Lathe Scrap to Improve the Mechanical Properties of Concrete”, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 5.

[6] T. Sezhiyan, R.Rajkumar, (2014)"Study on the properties of high strength concrete using glass powder and lathe scrap", Vol 3, April 2014
[7] Irwan lie keng wong, (2013) "Study of utilization of waste lathe scrap on increasing compressive strength and tensile strength of concrete", September,2013
[8] Shirule Pravin, Swami Suman, Nilesh Chincholkar, (2012), "Reuse of steel scrap from lathe machine as reinforce material to enhance properties of concrete", PP 164-167, 2012