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Research Paper

IMPACT AND ENERGY ABSORPTION CHARACTERISTICS OF LATHE SCRAP REINFORCED CONCRETE

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This project work emphasis on the study of using lathe scrap as fibre reinforced concrete in the innovative construction industry. Every day about 8 to 10 kg of lathe waste are generated by each lathe industries in the Pondicherry region and dumped in the barren soil there by contaminating the soil and ground water, which creates an environmental issue. Hence by adopting proper management by recycling the lathe scrap with concrete is considered to be one of the best solutions. The test were conducted as per the Indian standard procedure for its mechanical properties such as flexural, split tensile, compressive, and impact strength and compared conventional PCC. The 7 days strength of the Lathe scrap reinforced concrete shows an increase in its compressive strength when compared with PCC, and almost become equal to the strength when tested on 28 days under normal curing. The addition of lathe scrap in concrete has increase the performance of beam in flexural by 40% when compared with PCC. There is only a considerable increase in the split tensile strength of concrete with lathe scrap when compared with PCC. The workability of fresh concrete that containing different ratios of lathe scrap was carried out by using slump test. The result showed that addition of lathe scrap in to PCC mixture enhanced its compressive strength while it decreased the workability of the fresh concrete containing the lathe scrap. The impact strength of concrete mixed with lathe scrap shows increased impact strength when compared with PCC.

Keywords: Lathe scrap, Flexural strength, Impact strength, Workability, Crack resistance

INTRODUCTION

Concrete is a material weak in tension and fails in a brittle manner when subjected to flexure, tension and impact forces. When, Steel fibers added to concrete, the behavioral efficiency of this composite material is superior to that of plain concrete and many other construction materials of equal cost (Ganesan *et al*., 2004; and Niranjana *et al*., 2007). Due to this benefit, the use of FRC has increased largely in the recent years and finds its application in airport and highway pavements,

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earthquake-resistant and explosive-resistant structures, mine and tunnel linings, bridge deck overlays and hydraulic structures (Anette Jansson, 2008; Barros, 2008; and Sekar, 2004). However, steel fibers available in market are costly and this makes steel fiber reinforced concrete uneconomical. As a part of waste management, effective utilization of waste material is indeed a great need in the recent years (Abbas, 2011). Lathe scrap, which exhibits the property of steel fiber largely, can be used as an alternate for steel fiber in the FRC production. Various experimental studies were conducted on lathe scrap reinforced concrete, found that there is a considerable increase in the compressive strength when compared to plain cement concrete and also when tested for flexural strength, the lathe scrap reinforced concrete shows an increase in flexural strength to great extent (Hamid, 2010; and IS: 10262, 1982). Apart from the mechanical property of concrete the major issues are development of cracks and failure of concrete pavement due to impact load. Several works are been conducted in exploring the relation between permeability and crack width and reported that using steel fibre have decreased the permeability of the specimens with reduced crack width upto 100 microns (Gupta *et al.*, 2009). Steel-fibre-reinforced concrete containing above 1.5% fibre by volume when tested for impact strength has substantially improved resistance to impact and greater energy absorption (Balasubramaniam *et al.*, 1996). Based on the above studies and as a part of waste management, the above experiments have been conducted on concrete mixed with lathe scrap.

A good management of such a solid waste is to find the way to make use of it in addition to dispose it. Hence, this material can be effectively used in concrete to enhance the property of concrete.

SIGNIFICANCE OF THE WORK

From the review of literature, it is understood that, lathe scrap which is a waste product obtained from lathe industries, creates an adverse environment to the surrounding. Addition of lathe scrap instead of steel fibres in plain cement concrete improves it flexural, compressive and impact strength. As the SFRC, the Lathe Scrap Reinforced Concrete (LSRC) also reduces the crack width when subjected to flexural load. In general, the mechanical properties of the concrete are increased by increasing the proportion of the lathe scrap up to 1.5%.The thickness of concrete pavementcan be reduced to nearly 40%, when mixed with lathe scrap upto 1.5% by volume, which is economical when compared to plain cement concrete slab.The energy absorption capacity was increased almost linearly with the fibre content. Concretes containing lathe scrap have been shown to have substantially improved resistance to impact and greater ductility of failure in compression, flexure and torsion and can be effectively used in pavement. When fly ash used as a good substitute for cement in reasonable proportions by volume and whatever deficiencies that may result can be easily overcome by use of steel fibres.In this study, an attempt has been made to analyze the mechanical characteristics of the waste lathe scrap material which is available from the locally available lathe industries is used as a steel fibre for determining the characteristics compressive, flexural and impact strength of M35 cement concrete for various proportions of steel scraps are experimentally found out.

EXPERIMENTAL WORK

Experiment where conducted by varying the percentage of lathe scrap such as 0%, 0.5%, 1%, 1.5%, 2%. The strength and work-ability characteristic of the composite are studied (Ganesan *et al*., 2004) Table 6.

Materials Used

Ordinary Portland Cement (OPC – 53 grade) conforming to the requirements of IS:12269 – 1987 (IS: 12269, 1987), graded river sand and crushed aggregate of size varying from 10 to 20 mm conforming to (IS: 383, 1970) were used. Ordinary potable water was used which are free from organic impurities and turbidity for preparing concrete and curing. To impart additional desired property superplastizer (Conplast – 420) was used (Ganesan *et al*., 2006). The basic properties of the above

Table 1: Physical Properties of Cement

S. No.	Properties	Value Obtained	Permissible Value as per 1S: 8221, 1989
1.	Std. consistency	32%	–
2.	Initialsetting time (min)	80 min	30 (min.)
3.	Final setting time (min)	190 min	600 (max.)
4.	Specific gravity	3.1	–

Table 2: Physical Properties of Coarse Aggregate

S. No.	Property	Test Result
1.	Specific gravity	2.7
2.	Bulk density (kg/m^3)	1,420 kg/m^3
3.	Fineness modulus	7.4
4.	Water absorption (%)	0.05

Table 3: Physical Properties of Fine Aggregate

S. No.	Property	Test Result
1.	Specific gravity	2.65
2.	Fineness modulus	2.80
3.	Bulk density (kg/m^3)	1,560 kg/m^3
4.	Water absorption (%)	1%

Table 4: Sieve Analysis of Fine Aggregate

Sieve No.	Wt. Retained (kg)	Wt. Retained in %	Cumulative retained C (%)
4.75 mm	0.019	3.8	3.8
2.36 mm	0.010	2	5.8
1.18 mm	0.101	20.2	26
600 μm	0.191	38.2	64.2
300 μm	0.071	14.2	78.2
150 μm	0.094	18.8	97.2
Cumulative sum C	275.4		

Note: Fineness modulus = C/100 = 275.4/100 = 2.74.

Table 5: Mix Proportion per m^3 of Concrete for Lathe Scrap

Mixes	Percentage of Lathe Scrap	Water (L)	Cement (kg)	Sand (kg)	Coarse Aggregate (kg)	Lathe Scrap (kg)	Super Plasticizer (L)
M1	0	171	380	649.88	1252.68	0	0
M2	0.5	171	380	649.88	1252.68	13.6	0.38
M3	1	171	380	649.88	1252.68	27.3	0.76
M4	1.5	171	380	649.88	1252.68	40.97	1.14
M5	2	171	380	649.88	1252.68	54.63	1.14

Table 6: Various Test Results of LSRC

% Addition Addition of Lathe Scrap	Compressive Strength (MPa) 7 Days	Compressive Strength (MPa) 28 Days	Tensile Strength (MPa) 28 Days	Flexural Strength (MPa) 28 Days	Slump Test (mm)
0	30	40	2.68	4.09	85
0.5	35.66	41.51	2.912	4.3	80
1	36.00	41.81	2.970	4.5	75
1.5	43.2	48.1	3.57	5.1	70
2	32.3	43.4	3.3	4.74	70

materials evaluated by standard tests (IS: 383, 1970) are given in Tables 1 to 4. Lathe scarps are the waste materials which are collected from workshops and other steel industries at very minimum cost. They are similar to the steel fiber but they don't have any regular shape and size. The dimension varies with nature of source which depends upon the type of industries (Ozcan *et al*., 2009). Scraps considered in this work are 0.5 mm thick, 3 mm in width and 5 mm in length as shown in Figure 1.

Figure 1: Lathe Scraps Chopped

The mix proportions are obtained for M30 grade of concrete for various percentage of lathe scrap. The various percentage of lathe scrap considered for this study are 0%, 0.5%, 1%,1.5% and 2% . The IS 10262:2009 method of mix design is adopted for attaining various concrete mixes (IS, 1982). The water cement ratio adopted is 0.45 which is kept constant for all five mixes but the percentage of super plasticizer is varied with respect to percentage of lathe scrap/steel fibre. The Table 5 shows various mix proportions for concrete. In this study, a total of 24 numbers of concrete specimens were casted with and without fibers. The specimens considered in this study consisted of 150mm size cubes. The nominal mix proportion used for casting the specimens was 1:2:4: 0.5 (cement: sand: coarse aggregate: water-cement ratio). The slump attained from workability test for various mixes are shown in the Table 6.

CONCLUSION

The following conclusion could be drawn from the present work :

The mechanical properties of the concrete are increased by increasing the proportion of the lathe 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 LSRC .The compressive strength of LSRC increased by 10% for 7 days strength when compared to Plain Cement Concrete (PCC) for all the tested proportions of lathe scrap and steel fiber. For the 28 days strength the LSRC poses almost the same compre-ssive strength as PCC for all the tested proportion. The addition of lathe scrap has significantly enhanced the performance of beam in flexural nearly 40% when compared with PCC .There is a considerable increase in split tensile strength of about 10% when compared to PCC. The result showed that addition of lathe scrap in to PCC 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 steel fiber reinforced concrete regarding its mechanical properties.

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