Flexural Behaviour of Beam using Crumb Rubber and Steel Scrap

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Abstract:- *The flexural strength and behaviour of reinforced concrete filled fibre-reinforced polymer were investigated experimentally. The most widely used construction materials in concrete production are cement and aggregates , which has led to a continuous and increasing demand of natural materials used for their production. Hence to avoid demand of aggregate to make sustainable concrete crumb rubber and steel powder can be utilized in manufacturing of concrete. Crumb Rubber was replaced (by 5%, 10% & 15%) and 0.75% of steel scrap was added to volume of fine aggregate to enhance the properties of hardened concrete. Mechanical strength of concrete was observed in all research papers and compared with normal concrete.M35 mix was adopted as a grade of concrete and water cement ratio 0.40 was followed. The test on mechanical properties of concrete compressive, flexural strength being carried out for 7,14 and 28 days of cured specimen for both the fibre reinforced and the conventional concrete. The study gives clear picture regarding the effect caused by the addition of steel scrap and crumb rubber compared with that of the conventional concrete. In phase 1 of project work compressive strength and flexural strength were to be determined.*

Key words: *cement, sand, coarse aggregate, crumb rubber and steel scrap.*

1. INTRODUCTION

Cement and aggregates are the most important constituent materials used in concrete production. Parallel to the need for utilization of natural resources emerges a growing concern for protecting the environment and a need to preserve natural resources. Dumping of waste tyre on land represent a major environmental problem of increasing significance. The strength, durability and other characteristics of concrete depend upon the properties of its ingredients, size and proportions of mix, method of compaction and curing. Disposal of these organic and inorganic wastes is a serious problem due to severe environmental problems. With the development of technology, construction industry has opened a gateway for handling these industrial wastes. Recycling of non-degradable wastes, particularly discarded rubbers tire has become a major issue since these materials have been banned from landfills and also incineration of these wastes is not environmental friendly. Crumb Rubber is obtained by recycling rubber from automotive and truck scrap tires. Steel scrap is generated as from lathes in significant amount recently over the years. It also creates a serious problem when damped on the land.

2. MATERIALS USED

Materials used in this study are (i)Portland pozzolona cement (ii)fine aggregate (iii)crumb rubber(iv)steel scrap (v)coarse aggregate). The materials are tested according to the codal provisions and are given in the table 1,2 and 3 respectively.

Table-1 properties of cement

S.no	Properties	Results	Nominal values as per IS 1489-1991
1	Standard consistency	30%	26%-33%
2	Initial setting time(min)	75	Min 30
3	Final setting time(min)	190	Max 600
4	Fineness retained on 90mm	400	300

Table -2 properties of fine aggregate

S.no	Properties	Results
1	Specific gravity	2.878
2	Water absorption	0.83

Table- 3 properties of coarse aggregate

S.No	Properties	Results
1	Specific Gravity	2.884
2	Water Absorption	0.97

Table -4 properties of crumb rubber

S.no	Test particulars	Results
1	Specific gravity	1.72
2	Bulk density	22lb/cu.ft^3

Table -5 properties of steel scrap

S.no	Test particulars	Results
1	Specific gravity	2.5
2	Bulk density	2.53
3	Moisture content	Nil

3. PREPARATION OF CONCRETE SPECIMENS

(1)M_{35} grade of concrete is adopted in this study according to IS 456-2000.(2)the specimens were prepared in the following size moulds :(i)cube-150mm X 150mm X 150mm (ii)cylinder – 150mm diameter and 300 mm height (iii)prism-100mmX 100mmX500 mm.(3)specimens are cast with conventional concrete and also with fibres. After 24 hours the moulds are removed and curing is done.

4. CONCRETE TESTING

4.1 slump cone test

This test method is used for determining the slump with the internal dimensions 200mm at the base 100mm diameter at the top and a height of 300mm.500mm dia concrete is poured in three layers and each layer is tampered about 25 times. Immediately concrete is lifted in upward direction.

4.2 compressive strength test

The compressive test is used to determine the hardness of the cube and beam specimen of concrete. The strength of a concrete specimen depends upon cement, aggregate, water cement ratio, curing temperature, age, and size of the specimen. Mix design in the major factor controlling the strength of the concrete.

After curing the concrete cube specimen was surface dried for 24 hrs. Then the compressive test were taken using the compression testing machine(CTM) using the formula compressive strength were calculated.

Compressive strength = load at failure/area

Area = 150mm x 150mm

Table-6 compressive strength test

Compressive Strength test	CS at 7 days (N/mm^2)	CS at 14 days (N/mm^2)	CS at 28 days (N/mm^2)
Conventional concrete	21.75	34.08	39.84
5% of CR & 0.75% of SS	26.73	39.12	44.72
10% of CR & 0.75% of SS	28.21	42.45	43.25
15% of CR & 0.75 %of SS	34.37	43.25	45.58

4.3 Flexural Strength Test

Flexural strength test is done as per IS: 516-1959. Beams are tested for flexure in Universal testing machine of capacity 500 KN as shown in Fig. 4.4 & and the results obtained are reported in Table 4.5 & also shown in graph 4.4. During loading, the bearing surfaces of the supporting and loading rollers are wiped clean. The beams are placed in the machine in such a manner that the load is applied to the upper most surface along the two lines spaced 13.30 cm apart. The loading device is

aligned with the axis of the specimen .The load is applied at a rate of 180 kg/min without shock on the specimen till it fails and the specimen is tested during the application of maximum load (P).

Where, P = maximum load at failure in N, and

L = length of the beam specimen (400mm)
b = Width of the beam specimen in mm,
d = Depth of beam specimen in mm.

Table-7 flexural strength test

Flexural strength test	F.S at 7 days (N/mm²)	F.S at 14 days (N/mm²)	F.S at 28 days (N/mm²)
conventional concrete	3.26	4.08	4.37
5% of CR& 0.75% of SS	3.71	4.60	4.72
10% of CR	3.91	4.91	5.13
15% of CR	5.31	5.72	6.43

5. DISCUSSION

The FRC of all types have shown improvement in terms of first crack, ultimate load and deflection characteristics.

1. By the addition of steel scrap and crumb rubber the compressive strength and flexural strength of concrete increased considerably .
2. In normal concrete when the crumb rubber percentage varied from 5-15%, the compressive strength of concrete is reduced by 3-3.2%.when 0.75% of steel scrap is added to crumb rubber varied from 5-15% the compressive strength is increased.
3. The negative effects of the rubber on the flexural strength have a more significant effects than those on the compressive strength. The addition of steel fiber can partially counterbalance these negative effects resulting from the incorporation of rubber.

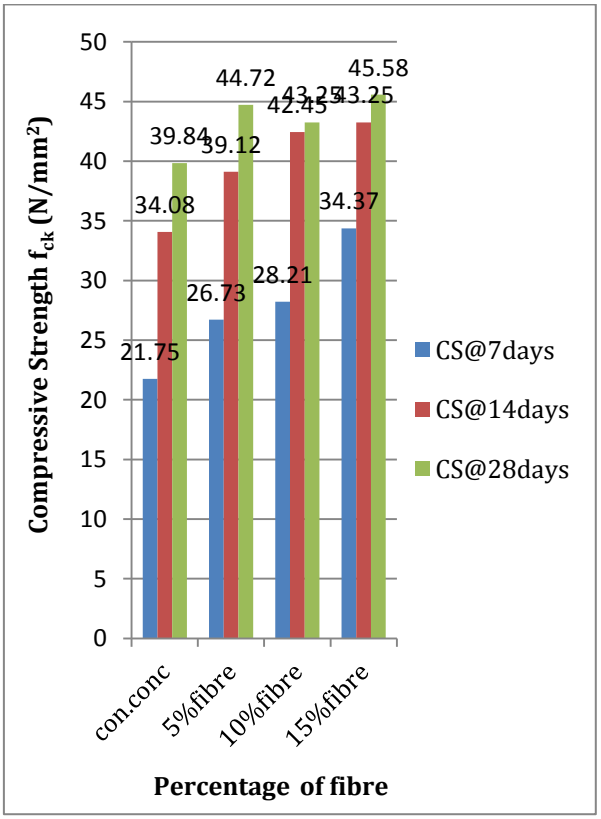

Chart- 1 Compressive Strength Test (N/mm²)

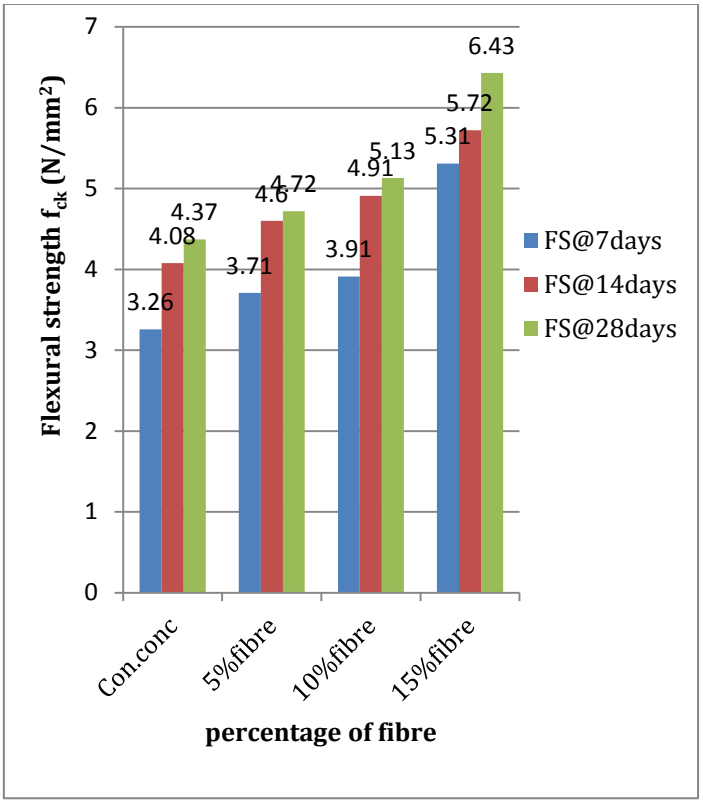

Chart-2 Flexural Strength Test (N/mm²)

6. CONCLUSIONS

Better results were obtained from adding crumb rubber and waste scrap in concrete where the compressive strength and flexural strength concrete obtained 45.58 N/mm² respectively for 28 days curing.

When compared with conventional concrete the fibre content in concrete increase the compressive strength for 7 days, 14days and 28 days curing.

On comparing the flexural strength results adding 15% of fibre content concrete with the conventional concrete it showed, higher flexural strength than conventional concrete.

REFERENCES

1) Shirule pravin Ashok,"reuse of steel scrap fom lathe machine as reinforced material to enhance the properties of concrete", Rising Research Journal publication, pp.164-167.

2) Athira pavithran," An experimental study on strength of concrete containing crumb rubber with alccofine ", international journal of emerging technology and advanced engineering p-ISSN:2395-0056.

3) Tushar R More, "strength appraisal of concrete containing waste tyre crumb rubber" , International journal of science and civil engineering research, Vol.4 , No.1.

4) Abhishek mandloi, " utilization of waste steel scap for increase in strength of concrete-waste management",International journal for scientific research and development vol.3 , issue 09, 2015.

5) Sreeshma P K, "effect of combination of steel fiber and crumb rubber on the propeties of concrete" , international journal for innovative research in advanced engineering, ISSN, 2349-2763 Issue 08, volume 3.

6) Mohamed K.Ismail,"An experimental study on flexural behaviour of large-scale concrete beams incorporating crumb rubber and steel fibers, ISSN:2278-0181,VOL.6 Issue 03.

7) Shivam P Darji,"analysis of compressive stregth of concrete using steel scrap" , International Journal of Advance Engineering and Research Development E-ISSN: 2321-9367.