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Improvement of Cement Concrete Properties by Utilization of Flex Banner & Steel Scrap to Reduce the Pollution Load on Earth

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Abstract

Overall economy of construction plays very significant role in the development of the country. Waste materials are available in abundance, both in industries and in nature that can be utilized in concrete and can boost its strength for economical construction. Out of these materials, Flex Banner is a commercial waste material are harmful for environment and steel scrap is also a waste material originated from steel industries. Prior researches indicate that steel scrap provide enhanced strength as compared to Flex banner. Steel scrap slightly reduced the workability to the concrete and raises its compressive strength higher w.r.t. workability. This research deals utilization of the commercial and industrial waste material into concrete, which may enhance the characteristics of concrete and makes environment eco-friendly and also shows the comparative study between Flex Banner and Steel scrap concrete with M30 concrete grade.

Keywords: Steel Scrap, Concrete, Flex banner, Compressive Strength, Split tensile Strength, Flexural Strength.

I. INTRODUCTION

Use of recycled or waste materials for the construction of civil structures is a matter of great significance in this century. Use of waste materials in construction industry reduces the utilization of Portland cement per unit volume of concrete. OPC has large energy source related with its production, which may be declined by substituting cement partly with waste mixing of mineral admixtures in concrete and mortar enhances compressive strength, pore structure and permeability. Some waste materials to be used with concrete to reduced pollution load on the Environment.

Portland cement is widely known as the key material used in concrete construction. Cement is utilized mutually in mortar and concrete, so it is the most vital element of the infrastructure and has been identified as a resilient construction material. Though, the environmental characteristics of cement are now growing anxiety of researchers, as cement Of waste materials is a twofold function (a) to lessen the amount of waste to be deposited and (b) to preserve environment from pollution. Concrete compound of waste materials Concrete composed by adding commercial waste termed as flex banner and industrial wastes are termed as steel scrap. This improved the cement concrete properties by many researchers. Motive behind the increased use of waste materials in cement concrete are-

1. To reduce the pollution load on Environment by using waste materials viz. Flex Banner, Steel scrap
2. To decrease the utilization of cement/sand/ aggregate though partially replacing the cement/sand/ aggregate with waste material.
3. To get better the properties of fresh and hardened concrete. Many researches depicted high performance concrete by increasing the compressive strength and flexural strength concrete with using the flex banner and steel scrap.
4. In recent times, several researchers produced high performance concrete by application of super-plasticizers and fine mineral admixtures.

In developing countries cost-effective construction material plays very vital role in making its structures economical. Waste materials in construction can be utilized to make structures economical and also durable because of their definite properties. Steel scrap is a waste material available in the industries which can be substituted by cement well as it can develop the properties of concrete.

From previous researches, it has been observed that steel scrap boosts the compressive & flexural strength and workability of concrete. Apart from steel scrap, natural fiber is also a waste material, has some significant properties that can be modify the properties of concrete. It has been noted that Flex Banner decreases compressive strength of concrete for a certain ratio. If both materials are utilized together into concrete, significant modifications may be noticed in the properties of concrete. In the present work, Steel scrap and Flex Banner are used into concrete for observing their effect and compare with normal concrete in terms of workability, compressive strength and flexural strength.

1. Objective of the study

The objective of the dissertation is to conduct comparative study between the properties of concrete, Case (i) by adding up Flex banner by weight of sand in different ratios; and Case (ii) by adding up Flex banner by weight of sand in different ratios (i.e. percentage of flex banner same as case I) and Steel scrap by weight of sand with constant percentage with the cement concrete. The following properties are examined:

- Workability of Concrete
- Compressive Strength of Concrete
- Flexural Strength of Concrete

II. LITERATURE SURVEY

Pooja Shrivastava et al (2014), This research work assess on the study of the workability and mechanical strength properties of the concrete reinforced with industrialized waste fibers or the recycled fibers. Different experimental studies are done to identify about fresh and hardened concrete properties of steel scrap fiber reinforced concrete (SSFRC) and their mechanical properties are found to be increase due to the addition of steel scrap in concrete i.e. compressive strength, flexural strength, impact strength, fatigue strength and split tensile strength were increased but up to 0.5-2% scrap content . When compared with usual concrete to SSFRC, flexural strength increases by 40% and considerable increases in tensile and compressive strength. The workability of fresh SSFRC are carried out by using slump test but it restricted to less scrap contents.

Saravanan et al (2015), In this research work, we have proposed to investigate the effect of replacement of coarse aggregates with flex banner, being a man made solid waste which can pose very serious environmental problems on solid waste management perspective. As flex banners have all severe effects as plastics, it becomes essential to find out the solution for the disposal option for them. It is considered as one approach here as using them for replacing the coarse aggregate. With usual compressive strength testing of cubes for replacement of two different percentages (10 % and 20 %) the results reveals that, there is no big difference in strength of concrete when replacing 10% and we cannot go beyond in replacement than 10%, since 20% replacement leads to deficient strength achievement for concrete.

Abdul Rahman et al (2017), This project work emphasis on the study of using steel scrap and manufacture sand in the innovative construction industry. "Steel scrap" concrete is a concrete containing fibrous material that is uniformly distributed and casually oriented. The steel scrap waste material which is obtainable from the lathe can be used as steel fiber for the innovative construction industry and in pavement construction. It is generated by each lathe industries Dumping of these wastes contaminates the soil and groundwater, which creates a harmful environment.

In addition, to get sustainable development and environmental benefits, lathe scrap with concrete is likely to be used. In this project steel scrap concrete using lathe waste is prepared and its properties are studied. "Manufactured sand" is such alternative for good quality Natural River sand due to depletion of resources and restriction due to environmental consideration has made concrete manufacturers look for suitable alternative fine aggregate.

Though it has been in use in concrete manufacturing in India, the percentage of its contribution is still very negligible in many parts of the country. The tests conducted were slump test, compressive strength test, split tensile strength test and. For this concrete

cubes, beams and cylinders were cast and cured and tests were done at 3th day, 7th day and 28th day.

Shivam P. Darji et al (2017), This research work assesses the effective use of steel scrap in concrete. In this study, total 39 nos. concrete cubes of size 150 mm x 150 mm x 150 mm casted using steel scrap concrete grades M-20. Steel scrap used up to 2.4% by weight, at a gap of 0.2% (i.e. 0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2%, 1.4%, 1.6%, 1.8%, 2.0%, 2.2%, and 2.4%).

As per Indian standard, after 28 days compressive strength test done on casted concrete cubes and test results are compared with plain cement concrete. After completing study, we know that the 28 days compressive strength of steel scrap concrete is more than plain cement concrete. The main objective of this study to find out optimum percentage of steel scrap in concrete up to which its compressive strength initially increased and then gradually decreased. At the end of the study, we found that up to 1.4% of steel scrap, compressive strength increased then after more percentage of steel scrap causes slight reduction in compressive strength.

Alex Tharun et al (2018), Researchers are being conducted all over for the development of new, sustainable, high performance construction materials. Concrete pavements are widely used and preferred over bituminous pavements due to its longer life and less maintenance requirements. Advertising sheets, called flex can be used in concrete to produce a new pavement material with better performance. Flex, also called PVC banners is a jute woven fabric material used for advertisements, awareness posters, etc, which, after use becomes a non-biodegradable, reusable waste material.

Incorporation of this material in concrete, to produce concrete pavement material is a step towards waste management and sustainability. Our study involves the experimental analysis of strength of concrete pavements and its future scopes using flex and a comparative strength analysis of the same with conventional concrete. The strength analysis of the concrete is done by the tests on hardened concrete, like, compressive strength test, split tensile strength test, flexural strength test, impact test, etc using the moulds casted suitably for the analysis.

Ramchandran et al (2019), The project explains about an experimental study on strength properties of concrete with steel scrap. Steel scrap can be used as fiber which is collected from the lathe industries. Concrete with steel waste used in construction industry reduces the disposal problem. The percentage of steel with consider in the study were 0, 0.6%, 1.2%, 1.8% respectively. Test like compressive strength test and split tensile test were conducted to determine the impact of steel waste in concrete 7 days and 14 days tests were conducted to find out the strength of concrete with steel waste.

III. PROPOSED MODEL

In the present work, experimental researches were carried out to know how effectively we can add the different waste i.e. Flex banner & steel scrap in the concrete. A complete explanation of the methodology followed in the present researches shows in the following:

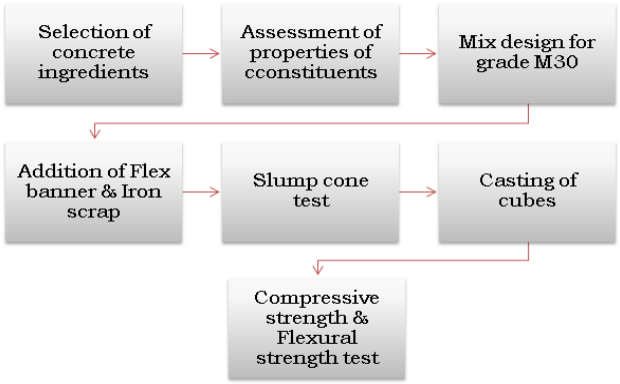

Figure 1: Schematic flow chart of methodology.

In durability analysis of flex banner & steel scrap waste, we conduct the slump cone test, compressive strength tests and flexural strength tests of duration 7 days, 14 days and 28 days and the results which we concluded in the next chapter.

1. Ingredients of concrete

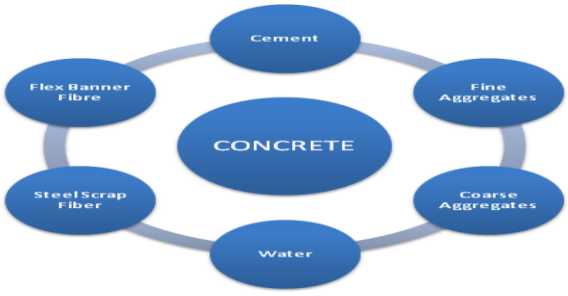

Figure 2: Concrete constituents.

1. Cement:
Grade 43 cement has been selected as per IS 8112:2009. Properties of cement used in the experiment are as follows:

Table - 1: Properties of cement used in the experiment.

Properties of Cement		
S. No.	**Property**	**Value**
1	Fineness	8.17%
2	Initial Setting Time	35 min
3	Final Setting Time	180 min
4	Specific Gravity	3.15
5	Soundness	4 mm

2. Fine Aggregate:
Zone II sand has been taken as the fine aggregate. Properties of fine aggregate used in the experiment are as follows:

Table - 2: Properties of Fine aggregate used in the experiment.

Properties of Fine Aggregate		
S. No.	**Property**	**Value**
1	Sieve Analysis	ZONE II
2	Specific Gravity	2.61

3. Coarse Aggregate:
Maximum 20 mm size aggregate has been taken. Properties of coarse aggregates used in the experiment are as follows:

Table - 3: Properties of Coarse Aggregate used in the experiment.

Properties of Aggregate		
S. No.	**Property**	**Values**
1	Crushing Value	14.86%
2	Impact Value	2.75%
3	Abrasion Value	11.40%
4	Specific Gravity	2.655
5	Water Absorption	1.20%

2. Flex Banner Fiber:
Dry and clean polyester fabric flex banner having 40 mm long and 10-15 mm wide has been taken. Properties of flex banner used in the experiment are as follows:

Figure 3: Flex Banner Fibers.

Table - 4: Properties of Flex Banner used in the Experiment.

S. No.	**Property**	**Value**
1	Fiber length	40 mm
2	Fiber width	10-15 mm
3	Fiber thickness	0.1 to 0.2 mm

4. Steel Scrap:
Steel Scrap from steel based industry from Mandideep, Bhopal has been collected. 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.

Table - 5: Properties of Steel scrap used in the Experiment.

S. No.	Property	Value
1	Fiber length	25-30 mm
2	Fiber width	2 mm
3	Fiber thickness	1.5 mm

Figure 4: Steel Scrap fibers.

5. Admixture

Admixtures are the materials that are used to enhance the properties of concrete. The main qualities of admixtures are as follows:

1. Admixture increased strength of the concrete
2. It improves workability of concrete
3. It can increase or decrease setting time of cement
4. It can decrease the requirement of water in concrete

In present research work we have used the modified sulphonated naphthalene formaldehyde type admixture for enhance the property of concrete.

Figure 5: Modified sulphonated naphthalene formaldehyde admixture.

6. Mix Design

In this experimental work, M30 grade concrete with maximum water-cement ratio of 0.60 was used. In this experimental study, totally 54 numbers of specimen of 150 mm x 150 mm x 150 mm size concrete & 18 numbers of specimen of size 700 mm x 150 mm x 150 mm size flexural beams were casted and tested. The results are discussed in the next chapter.

Figure 6: Preparation of concrete mix.

Figure 7: Workability test.

Figure 8: Prepared concrete cubes.

Figure 9: Prepared flexural beams.

Figure 10: Cubes & Beams for testing.

Figure 11: Concrete cube for testing.

Figure12: Flexural Beam for testing.

III. EXPERIMENT AND RESULTS

In the experimental study, addition of Flex banner with 0.1 to 1.0 percentage of weight of sand in the concrete mixture and get the results after performing the test of slump cone, compressive strength and flexural strength of concrete. We found that Flex

Banner enhanced the workability of concrete with increasing the percentage, but compressive strength of concrete gradually decreasing with increasing the percentage of flex banner at 7 days, 14 days and 28 days. Also, flexural strength gradually decreasing with increasing the percentage of flex banner. Flex banner is very harmful for the environment. So, uses of Flex banner in the concrete are good for our environment, if we add in the concrete it reduces the environment pollution. Results of adding flex banner in to the concrete is that it increases the workability of concrete and reduces the compressive strength as well as flexural strength of concrete; as construction point of view it is not good. The results of the experimental investigation are given in the Table 3.1.

Table 6: Compressive & Flexural Strength of Concrete with different percentage of Flex Banner.

S. No.	Flex banner (%)	Compressive Strength (N/mm^2)			Flexural Strength (N/mm^2)		
		7 days	14 days	28 days	7 days	14 days	28 days
1	0.1%	23.94	39.52	43.85	3.38	4.12	4.3
2	0.2%	23.16	37.15	43.04	3.19	4.1	4.27
3	0.3%	22.46	35.89	42.56	3.08	4.06	4.24
4	0.4%	21.28	34.38	41.49	2.98	3.85	4.21
5	0.5%	19.03	33.22	40.68	2.71	3.61	4.13
6	1.0%	18.38	31.74	36.74	2.59	3.51	3.86

It has been noted that Flex Banner decreases compressive strength of concrete for a certain ratio. In further experimental work, if both materials are utilized together into the concrete, significant modifications may be noticed in the properties of concrete. Steel scrap and Flex Banner are used into concrete for observing their effect and compare in terms of workability, compressive strength and flexural strength. So, we have adopted another waste materials i.e. steel scrap. Reason for selection of this waste only is that it has higher strength and lower workability. Selection of this waste material is referred from the previous researches studies. We use the constant percentage of steel scrap (8%) with percentage of flex banner varies from 0.1 to 1.0. The results of the experimental investigation are given in the Table 3.2.

Table 7 : Compressive & Flexural Strength of Concrete with Flex Banner and Steel scra.

S. No.	Flex Banner (%)	Steel Scrap (%)	Compressive Strength (N/mm^2)			Flexural Strength (N/mm^2)		
			7 days	14 days	28 days	7 days	14 days	28 days
1	0.1 %	8%	26.23	42.98	46.26	3.46	4.18	5.28
2	0.2 %	8%	25.98	39.89	45.14	3.31	4.16	5.03
3	0.3 %	8%	25.65	38.02	44.41	3.27	4.11	4.78
4	0.4 %	8%	24.78	36.57	43.09	3.22	4.05	4.57
5	0.5 %	8%	23.54	35.78	42.18	3.15	3.96	4.5
6	1.0 %	8%	21.69	33.36	38.24	2.84	3.82	4.23

Figure 3.1 to 3.12 shows the variation of compressive strength & flexural strength of concrete at 7th, 14th & 28th days.

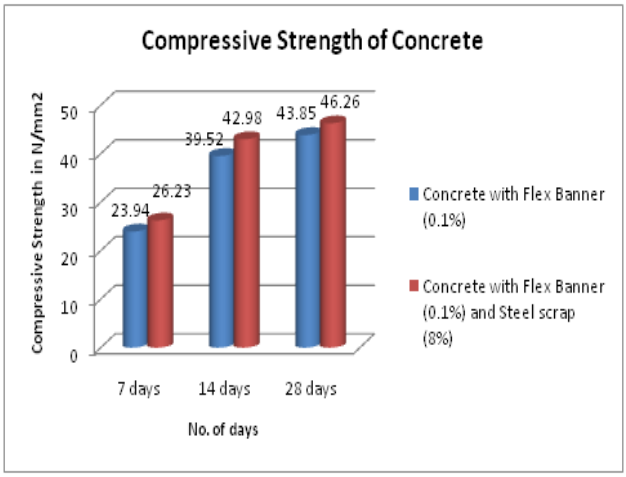

Figure.13. Compressive strength of concrete with flex banner (0.1%) & Steel scrap (8%).

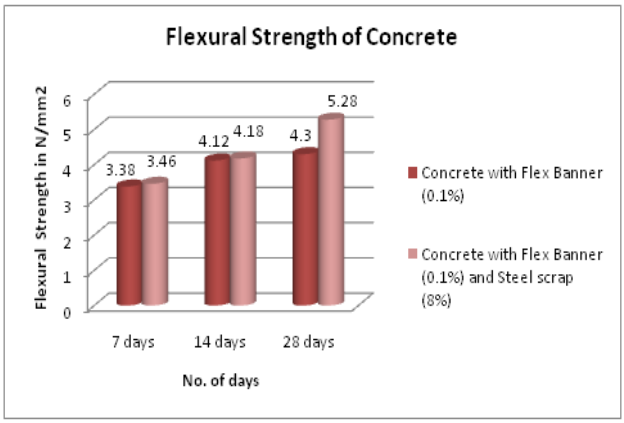

Figure.14 Flexural strength of concrete with flex banner (0.1%) & Steel scrap (8%).

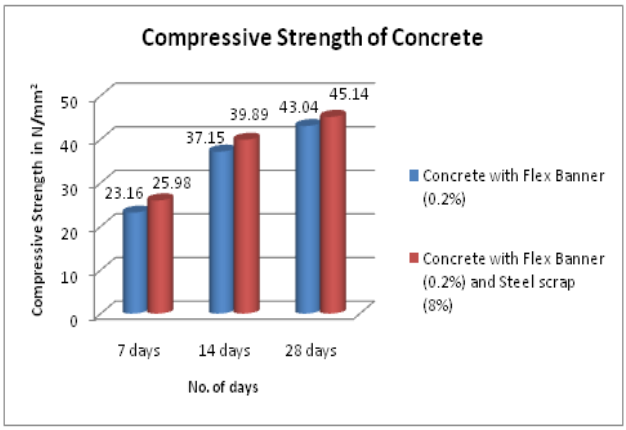

Figure 15 Compressive strength of concrete with flex banner (0.2%) & Steel scrap (8%).

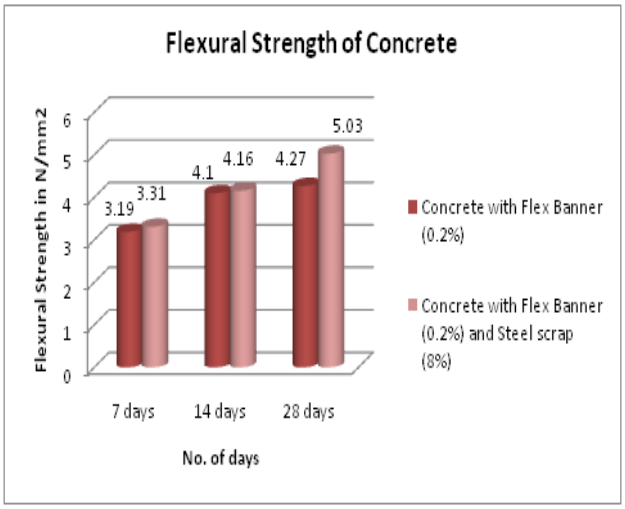

Figure 16 Flexural strength of concrete with flex banner (0.2%) & Steel scrap (8%).

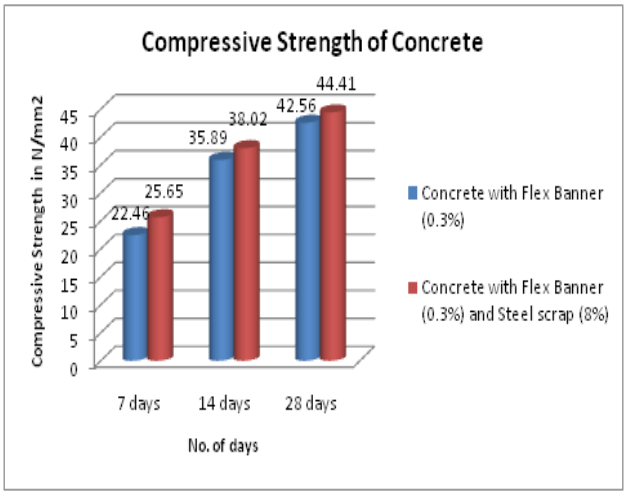

Figure 17 Compressive strength of concrete with flex banner (0.3%) & Steel scrap (8%).

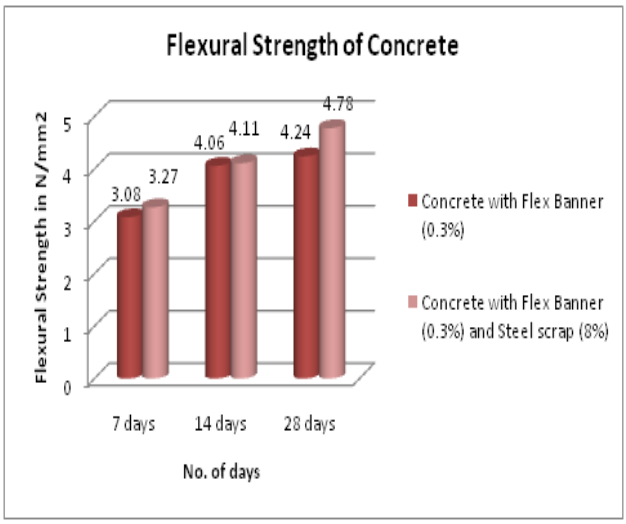

Figure18 Flexural strength of concrete with Flex banner (0.3%) & Steel Scrap (8%).

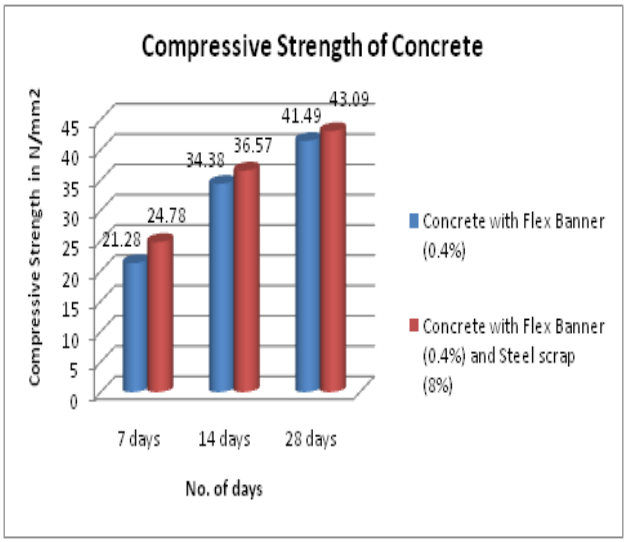

Figure 19 Compressive strength of concrete with flex banner (0.4%) & Steel scrap (8%).

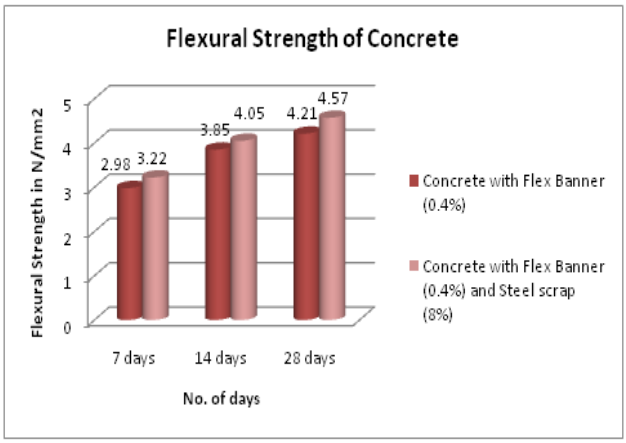

Figure 20 Flexural strength of concrete with Flex banner (0.4%) & Steel scrap (8%).

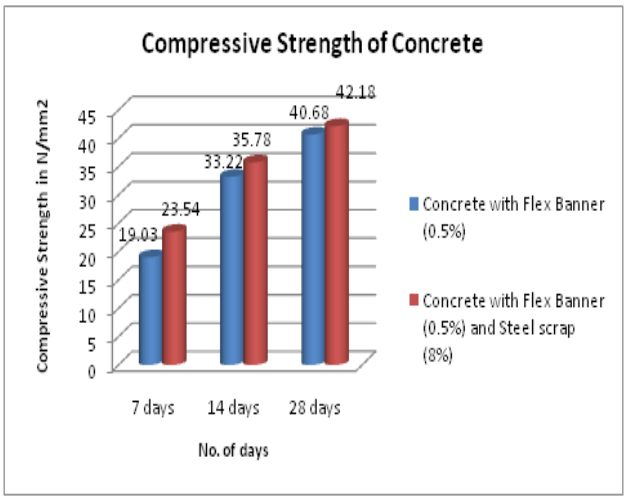

Figure 21 Compressive strength of concrete with flex banner (0.5%) & Steel scrap (8%).

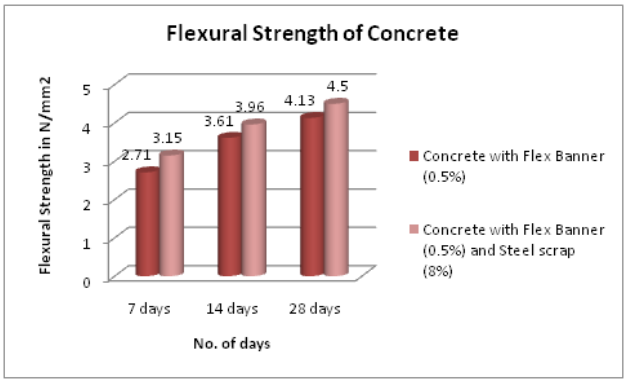

Figure 22 Flexural strength of concrete with flex banner (0.5%) & Steel scrap (8%).

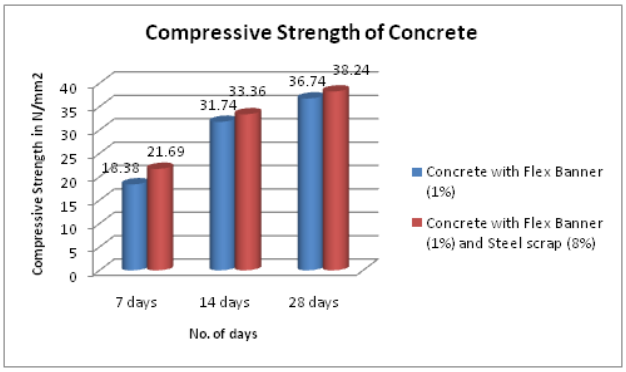

Figure 23. Compressive strength of concrete with flex banner (1%) & Steel scrap (8%).

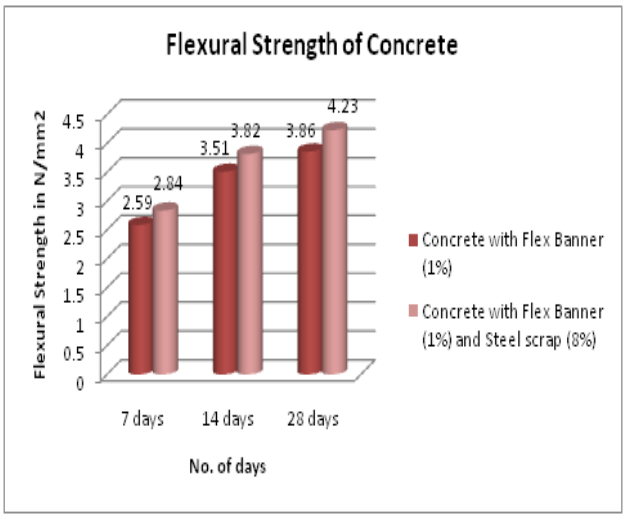

Figure 24 Flexural strength of concrete with flex banner (1%) & Steel scrap (8%).

As results shown in the above, Flex Banner enhanced the workability of concrete with increasing the percentage, but compressive and flexural strength of concrete at 7 days, 14 days and 28 days gradually decreasing with increasing the percentage of flex banner. We found in further experimental investigation the concrete with steel scrap and flex banner enhanced the compressive and flexural strength of concrete with M30 grade; and the steel scrap also provide additional reinforcement to the concrete.

Hence, it is balanced the reduction of strength of concrete due to addition of flex banner in the concrete. In the case of workability of concrete, it reduced when steel scrap added with the concrete. But, flex banner balanced the reduction of workability of concrete. After this dissertation work we have concluded, both the waste materials i.e. flex banner and steel scrap are mutually dependent on each other to enhance the concrete properties. Utilization of the commercial and industrial waste material into concrete has enhanced the characteristics of concrete and makes environment eco-friendly and it also prevent the damages on environment, risk to health, prevent to soil and water pollution.

IV. CONCLUSIONS

Waste materials are available in abundance, both in industries and in nature that can be utilized in concrete and can boost its strength for economical construction. Out of these materials, Flex Banner is a commercial waste material are harmful for

environment and steel scrap is also an industrial waste material originated from steel industries are also contaminate the land. This research dealt with utilization of the commercial and industrial waste material into concrete, which has been enhanced the characteristics of concrete and makes environment eco-friendly and also performed the comparative study between Flex Banner and Steel scrap concrete with M30 concrete grade.

As discussed in the previous chapter, Flex Banner enhanced the workability of concrete with increasing the percentage, but compressive and flexural strength of concrete at 7 days, 14 days and 28 days gradually decreasing with increasing the percentage of flex banner. We found in further experimental investigation the concrete with steel scrap and flex banner enhanced the compressive and flexural strength of concrete with M30 grade; and the steel scrap also provide additional reinforcement to the concrete. Hence, it is balanced the reduction of strength of concrete due to addition of flex banner in the concrete. In the case of workability of concrete, it reduced when steel scrap added with the concrete. But, flex banner balanced the reduction of workability of concrete.

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