International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

An Experimental Study on Compression and Flexural behaviour of Concrete using Stainless-Steel Scrap

M A Balaji[1], R Dhoushika[2]

[1,2]PG Student, Department of Civil and Structural Engineering, Annamalai University, Chidambaram, India

---

ABSTRACT – *This work emphasis on the study of adding stainless steel scraps and M-Sand in the construction industry. The steel scrap, which is obtained from the lathe industry can be used as a steel fiber in Building construction and Pavement construction. This study is mainly conducted is because, the wastes are dumping into the soil which contaminates it and the ground water gets affected. So, the stainless-steel scrap is likely to be used in addition with concrete. The test to be conducted are Compressive strength, Split Tensile strength test and Carbonation test. The stainless-steel scrap is added in percentage are 0%, 0.5%, 1%, 1.5%. In this study OPC 43 grade has been used, and stainless-steel type 302 is used.*

Key Word: Stainless -Steel, M-Sand, OPC 43 grade cement, Steel fiber, Stainless- steel type 302

1. INTRODUCTION

Concrete is most used material in Civil Engineering construction, so that considerable attention is taken for serviceability of the structure depend upon the properties of concrete with respect to strength and durability. India's total capacity of cement stood at 320 million tons per annum (MTPA). Industrial waste like Stainless steel scrap which is dumping to creating environmental problems, is mainly used as a building material due to its low cost and easy availability and its adoption will enable the concrete construction industry to become more sustainable.

In recent years, many researches are going on for improving the SFRC properties of concrete with respect to strength, durability and performance as a structural material. The aim of the study is to investigate the strength and durability properties of the SFRC concrete.

1.1 Stainless-Steel Scrap

Stainless steel scrap is an industry by product obtained from lathes. It is produced in large quantities during the steel pipe cutting operations and steel slag can be used in the construction.

Fig-1: Stainless-steel Scrap

1.2 Stainless steel grades

Type 301 - Highly ductile, for formed products. Also hardens rapidly during mechanical working. Good weldability.

Type 302 – Corrosion resistance with slightly higher strength due to additional carbon.

Type 303 - Corrosion resistance with slightly higher strength due to additional carbon and also good weldability.

Type 304 – The most common grade, the classic 18/8 stainless steel and highly corrosion resistance.

Type 309 – Austenitic Chromium-nickel stainless steel and its corrosion resistance, high strength.

Type 316 – This grade is molybdenum-bearing austenitic stainless-steel.

And the higher nickel and molybdenum content in this grade.

Type 321 – In this grade, susceptible to stress corrosion cracking in halides similar to type 304 stainless steel.

2. METHODOLOGY

Step 1: Literature Review

Step 2: Collection of materials

Step 3: Initial testing of materials

Step 4: Trial Mix

Step 5: Results of workability tests, if passed in test casting is done, if not next trial mix is designed.

Step 6: Casting and curing is done

Step 7: Test on Casted concrete

Step 8: Strength and durability studies were done

Step 9: Conclusion

3. MATERIALS USED

Cement: Ordinary Portland cement 53 grade confirming to IS 12269 – 1989.

Fine Aggregate: Locally available M-sand confirming to grading zone I of IS 383 -1970.

Coarse Aggregate: Locally available Coarse Aggregate confirming to graded aggregate of nominal size 20 mm as per IS 383 -1970.

Stainless steel scrap: Stainless Steel scrap is an industrial by-product obtained from the lathes.

Superplasticizer: The **MasterGlenium SKY 8233** superplasticizer is used in concrete. This type of admixture is developed the high-performance concrete where the highest durability and performance is required.

Water: Potable water.

3.2 Stainless-steel scrap (302 Grade)

Stainless Steel scrap is an industrial by-product obtained from the lathes. It is produced in large quantities during the steel pipe cutting operations and steel slag can be used in the construction. And its properties are,

Elements	Composition
Iron	64.99-74%
Chromium	18%
Nickel	8%
Manganese	2%
Nitrogen	0.10%
Silicon	0.75%
Phosphorus	0.045%

Table 1: Stainless steel composition

3.3 Superplasticizer (Admixture)

In research, the MasterGlenium SKY 8233 is used in concrete. This type of admixture develops the high-performance concrete where the highest durability and performance is required. It is compatible with all type of cement

The admixture has a **pH of greater than 6, relative density of 1.08, Aspect Brown liquid.**

4. TESTING OF MATERIALS

4.1 Test on cement

The basic test on cement such as initial and final setting time, fineness modulus and specific gravity test are conducted.

Fig-2: Initial and Final Setting time

Results for **Initial Setting time = 36 min**

Final Setting time = 470 min

4.1.1 Specific gravity test for cement

Specific gravity of cement is the ratio of weight of given volume of substance to a weight of an equal volume of water. It is done using Pycnometer.

The obtained result were, 3.15 which is within the limits.

4.2 Test of Fine Aggregate

4.2.1 Specific gravity test

Specific gravity of Sand is the ratio of the weight of given volume of a substance to a weight of a equal volume of water. It is done using the apparatus called pycnometer with water. Specific gravity of Sand should be within 2.5-2.7

The obtained results were 2.54

4.2.2 Fineness modulus test

This test is to find the fineness of the fine aggregate. It gives whether the aggregate is the coarser or finer based on this it is decided to use in concrete or mortar.

The aggregate has a fineness modulus of 1.994, it is obtained using particle size distribution.

4.2.3 Water absorption test

The percentage of water absorption was **1.8%**

Fig – 3: Water absorption test

4.3 Test of Coarse Aggregate

4.3.1 Specific gravity test

Specific gravity of Sand is the ratio of the weight of given volume of a substance to a weight of a equal volume of water. It is done using the apparatus called pycnometer with water. Specific gravity of Sand should be within 2.6-2.8

The obtained results were 2.66

4.3.2 Fineness modulus test

This test is to find the fineness of the fine aggregate. It gives whether the aggregate is the coarser or finer based on this it is decided to use in concrete or mortar.

The aggregate has a fineness modulus of 5.22, it is obtained using particle size distribution.

4.3.3 Water absorption test

The percentage of water absorption was **2.0%**

4.4 Corrosion test on stainless steel scrap

In this test has been carried out to determine the corrosion of 304 grade Stainless steel scraps and mild steel scraps in acids like hydrochloric acid. The corrosion rates have been calculated using weight loss method. In weight loss method without inhibitor, the sample lathe scraps have been weighed and immersed into acids in 28 days. The results are also confirmed using the polarization and FTIR studies.

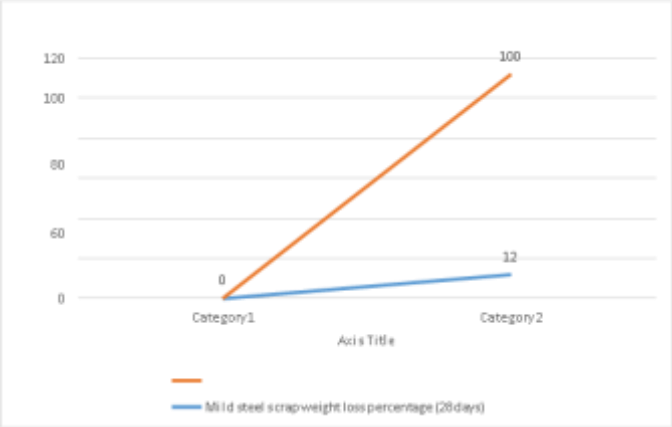

Chart 1- Weight loss in percentage

This study reveals that maximum weight loss percentage (100%) occurred in MS scrap and minimum weight loss percentage (12%) occurred in stainless steel scrap at the time period of 28 days.

5. MIX DESIGN

Mix design is a process of selecting suitable ingredients for concrete and determining their proportion which would produce as economically as possible, a concrete that satisfies the job requirements. The mix design is done as per **IS:10262-2016.**

After the procedure the mix design obtained was **1:2.8:3.2 (Cement: Fine aggregate: Coarse aggregate).**

6. TEST RESULT AND DISCUSSION

6.1 Compressive strength (As per IS516-1959)

Compression strength is the capacity of a material or structure to withstand axially directed pushing force.

Fig-4: Compression strength

S.no	% of stainless steel added in concrete	7 Days	14 Days	28 Days
1	0%	26.33	32.33	37.21
2	0.5%	28.42	33.79	38.11
3	1%	30.59	35.72	39.92
4	1.5%	27	32.17	37.56

Table 2: Compressive strength for concrete

Compressive strength = (P/A) (N/mm^2)

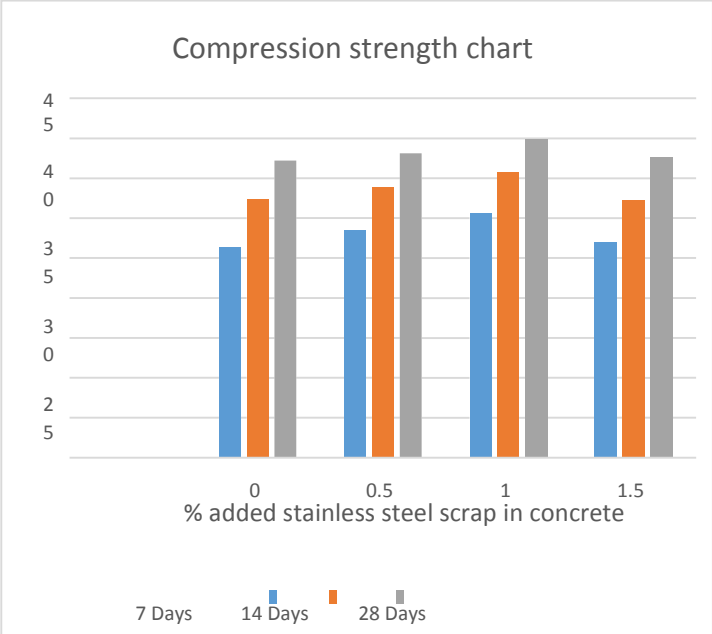

Chart 2: Compression strength chart

6.2 Split tensile strength (As per IS 516&5819)

S.No	% of SS scrap	7 days	14 days	28 days
1	0%	2.97	3.68	4.85
2	0.5%	3.17	3.97	4.95
3	1%	3.5	4.32	5.43
4	1.5%	3.2	3.97	5.01

Table 3: Split tensile strength

Fig-5: Split tensile strength

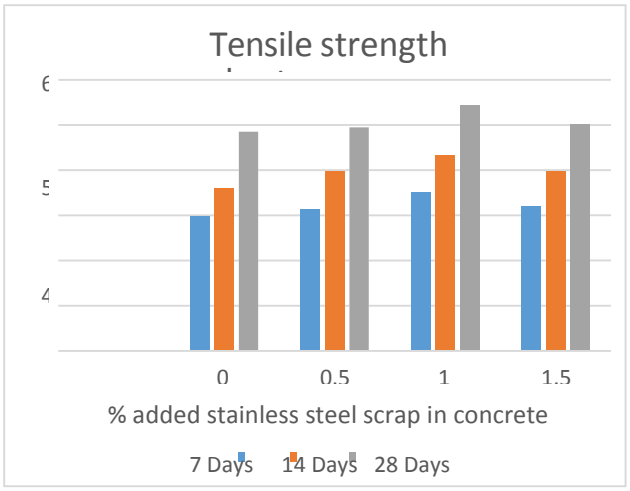

Chart 3: Split tensile strength chart.

7. CONCLUSION

The experimental investigation was done for M25 grade concrete. The work shows that the workability of SFRC gets reduced as we increased the fiber amount. It shows that the compressive strength of SFRC gets increased up to 12% with 1% of steel fiber used as compared to plain concrete. It has been concluded that the use of fiber content of 1% by weight of concrete is the optimum value. The split tensile strength of steel fiber reinforced concrete gets increased up to 24% with 1% as compared to plain concrete.

8. REFERENCES

[1].Ahsana Fathima K MI & Shibi Varghese "Behavioral study of steel fiber and polypropylene fiber reinforced concrete"(impact IJretvol.2,issue10, oct2014)

[2].Vasudev r, Dr .B .g vishnuram "studies on steel fiber reinforced concrete, a sustainable approach. "International journal of scientific & engineering research, volume 4, issue 5, may-2013 1941issn 2229-5518 ijser ©2013http://www.ijser.org

[3]. Shende.A.M. I, Pande .A.M. "Comparative Study on steel fibre Reinforced cum control concrete under flexural and deflection "international journal of applied Engineering Research ,Dindigul volume 1.No .4,2011

[4]. Pooja Shrivastava "reuse of lathe waste steel scrap in concrete pavements ". international journal of Engineering Research & application ISSN:2248-9622 vol 4.issue 12(part 4)Dec.2014,pp45-54

[5] Indian Standard recommended guidelines for concrete Mix Design IS 10262: 2009.ist Revision, Bureau of Indian standard, New Delhi

[6] Indian road congress for guidelines for concrete mix design for pavements IRC 44:20082nd revision, Indian Road congress, New Delhi