An Experimental Investigation On Mechanical Properties Of Scc Using Steel Scrap

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Abstract- *This project presents the experimental study on self-compacting concrete (SCC) with replacement of cement by various percentage of fly ash. The main objective is to be determine the flexural strength, compressive & split tensile on Self compacting concrete by partial replacement of cement by fly ash (20%,25%,30%)&steel scraps. The work involves making several types of SCC mixes. For each mix preparation, twenty one cubic specimens, twenty one cylinder specimens and twenty one beam specimens are cast and cured. The specimens are cured in water for 7 days & 28 days. The slump cone, L-BOX,J-RING and V-FUNNEL test are carried out on fresh SCC. The hardened concrete properties such as compressive strength, Split tensile strength and Flexural strength are determined. The result show that SCC with various percentage of fly ash (20%,25%,30%),steel scraps & super plasticizer is mixed with optimum SCC. After each mix preparation, specimens are casted and cured for 28 days in water and compressive strength values are determined.*

Keywords: steel scrap, fly ash, compressive strength, flexural strength, split tensile strength

I. INTRODUCTION

Now a day's Concrete is the most widely used construction material which has several desirable properties like high compressive strength and durability under usual environmental factors. At the same time concrete is weak in tension. Plain concrete has two deficiencies, low tensile strength and a low strain at fracture. Hence reinforcements are necessary. Normally reinforcement consists of continuous deformed steel bars or pre-stressing tendons. Many of the current applications of self-compacting concrete using steel scraps by volume of concrete. By experimental investigations on steel scraps in concrete improve several properties like tensile strength, cracking resistance, impact and wear resistance, ductility and fatigue resistance. The built concrete structures in highly polluted urban and industrial areas, harmful sub-soil water in coastal area and many other hostile conditions are found to be non-durable. One of the main reasons for deterioration of concrete is that too much emphasis is placed on concrete compressive strength and less consideration in durability aspects. It is now recognized that strength of concrete alone is not sufficient, also the environmental condition to which concrete is exposed over its entire life is equally important. Hence strength and durability aspects of concrete are the important factors to be considered for enhanced performance in life time of structure

II. LITERATURE SURVEY

"Analysis of Effect of Addition of Lathe Scrap on the Mechanical Properties of Concrete"[1],Poorva Haldkar and Ashwini Salunke .The effect of addition of lathe scrap on the mechanical properties of concrete. In this paper, M30 concrete is used and lathe scrap fiber is added up to 2% by weight, at a gap of 0.4% (i.e. 0%, 0.4%, 0.8%, 1.2%, 1.6%, 2%). In this investigation, a comparison have been made between plain cement concrete and the fiber reinforced concrete containing lathe scrap (steel scrap)in various proportions by weight. The fiber used is irregular in shape and with varying aspect ratio. The workability of fresh lathe fiber reinforced concrete (LFRC) is restricted to less lathe contents. Analytical comparison is being done between the compressive strength, tensile strength and flexural strength of plain cement concrete and LFRC. The 28 days strength of LFRC for compressive strength, tensile strength and flexural strength, is found to be increased when compared with the 28 days strength of plain cement concrete.

"Study on the properties of high strength concrete using glass powder and lathe scrap" [2], T. Sezhiyan, R.Rajkumar They have aimed to use glass powder as a replacement of cement to assess the pozzolonic activity of fine glass powder in concrete and study the properties of concrete. Lathe scraps are the waste materials which are collected from workshops and other steel industries at very minimum cost. Scraps considered in this work are 0.5mm thick. 30% concentration of glass powder replacement in concrete is found to be the optimum dosage for their project work.

"Study of utilization of waste lathe scrap on increasing compressive strength and tensile strength of concrete" [3], Irwan lie keng Wong In this research method, they have mixed the lathe waste in three proportions, i.e. 0.5, 1 and 2%. The results show that the compressive strength increased by 16.4% and tensile strength increased by 25.3% due to addition of waste lathe by 2% as compared to plain cement concrete.

"Reuse of steel scrap from lathe machine as reinforce material to enhance properties of concrete" [4], Shirule Pravin, Swami Suman, Nilesh Chincholkar In this study, a comparison has been made between plain cement concrete and steel scrap (i.e. 0.5%, 1%, 1.5%, 2%) by weight of cement has been taken into account. Compressive strength, tensile strength and flexural strength of SSFRC is found to be maximum for volume fraction of 1.5% steel scrap fiber.

"Impact and energy absorption characteristics of lathe scrap reinforced concrete" [5], G. Vijayakumar, P. Senthilnathan, K Panduangan, G Ramakrishna In this research paper, the addition of lathe scrap in concrete has increased the performance of beams in flexural by 40% as compared to PCC. There is only considerable increase in split tensile strength of concrete with lathe scarp as compared with PCC. The result shows that addition of lathe scraps into PCC mixture enhance its compressive strength while it decreases the workability of fresh concrete containing the lathe scrap. The impact strength of concrete mixed with lathe scrap shows increased impact strength as compared with PCC.

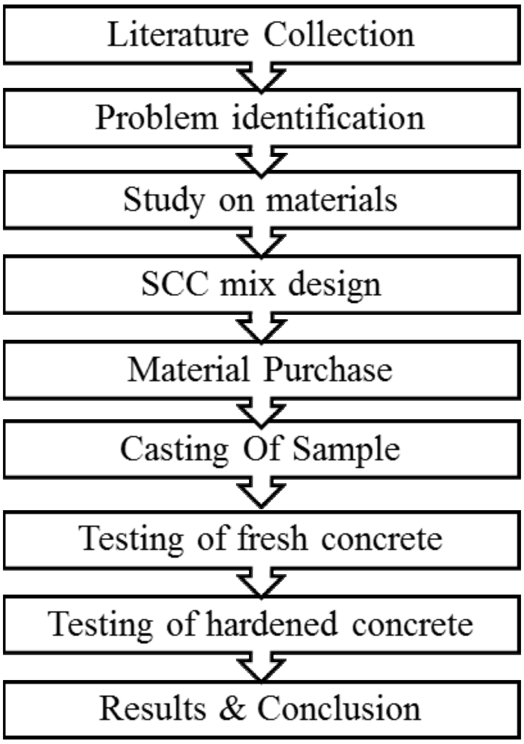
"Experimental study on steel fiber reinforced concrete for M40 Grade" [6], A.M Shende, A.M Pande, M. Gulfam Pathan In this paper, authors observed that compressive strength, split tensile strength and flexural strength are on higher side for 3% fibers as compared to that produced from 0%, 1% and 2% fibers. All the strength properties are observed to be on higher side for aspect ratio of 50 as compared to those for aspect ratio 60 and 67.It is observed that compressive strength increases from 11 to 24% with addition of steel fibers. It is observed that flexural strength increases from 12 to 49% with addition of steel fibers .It is observed that split tensile strength increases from 3 to 41% with addition of steel fibers.

"Properties of green concrete containing quarry rock dust and marble sludge powder as fine aggregate[7] (M. Shahul Hameed and A. S. S. Sekar., 2009)", Green concrete capable for sustainable development is characterized by application of industrial wastes to reduce consumption of natural resources and energy and pollution of the environment. Marble sludge powder can be used as filler and helps to reduce the total voids content in concrete. Natural sand in many parts of the country is not graded properly and has excessive silt on other hand quarry rock dust does not contain silt or organic impurities and can be produced to meet desired gradation and fineness as per requirement. Consequently, this contributes to improve the strength of concrete. Through reaction with the concrete admixture, Marble sludge powder and quarry rock dust improved pozzolanic reaction, micro-aggregate filling, and concrete durability. This paper presents the feasibility of the usage of quarry rock dust and marble sludge powder as hundred percent substitutes for natural sand in concrete. An attempt has been made to durability studies on green concrete compared with the natural sand concrete. It is found that the compressive, split tensile strength and durability studies of concrete made of quarry rock dust are nearly 14 % more than the conventional concrete. The concrete resistance to sulphate attack was enhanced greatly. Application of green concrete is an effective way to reduce environment pollution and improve durability of concrete under severe conditions.

"Self-Compacting Concrete Using Marble Sludge Powder and Crushed Rock Dust [8], M. Shahul Hameed and A. S. S. Sekar., Self Compacting Concrete (SCC) has had a remarkable impact on the concrete construction industry, especially the precast concrete industry. Crushed Rock Dust (CRD) and Marble Sludge Powder (MSP) are discarded in the nearby land and thenatural fertility of the soil is spoiled. MSP and CRD can be used as filler and helps to reduce the total voids content in concrete.Consequently, this contributes to improve the strength of concrete. An experimental investigation has been carried out to study the combined effect of addition of MSP and CRD on the strength and durability of SCC. The study on physical, chemical and mechanical properties such as compressive strength and split tensile strength and the durability tests include water absorption test, water permeability, rapid chloride permeability; electrical resistivity and half cell potential are carried out in this study.From the results it is confirmed that compressive strength increases with increase in percentage replacement of MSP up to 15% of CRD in place of FA. It is found that split tensile strength is directly proportional to the compressive strength. The highest electrical resistivity values were obtained for

Normal Concrete with 100% CRD and significant increase in resistivity values for SCC.

III.METHODOLOGY



IV. EXPERIMENTAL PROGRAMME

4.1. Concrete Mix Design

In the present study M30 grade concrete mix design as per IS: 10262-2009 is carried out. The concrete mix proportion was1:1.91:1.72:0.38 and water content was 178 l/m3

Table 1: Concrete Mix

S.NO	Items	Per m3 of concrete
1	Cement	378.12 kg
2	Fly ash	92.32 kg
3	Fine Aggregate	898.3 kg
4	Coarse Aggregate	809.5 kg
5	Water	178 L

4.2. Casting and Testing

Total 24 cubes, 24 prism and 24 cylinders were casted. Fly ash was added in concrete in 3 different percentages starting from 20% at a gap of 5% up to 30%. For each percent of Fly ash addition, 3 cubes, 3 prism and 3 cylinders were casted. Final compressive strength of cubes was tested after 7, 28 days curing. Flexural strength of beams were tested after 28 days curing and split tensile strength was tested for cylinders after 28 days curing. Compression testing machine is used for determining the compressive strength and split tensile strength of concrete and Flexural Testing machine was used to determine the flexural strength of concrete. The crushing loads were noted and average strengths for three specimens tested were determined for each percentage of Fly ash added (i.e.20%, 25%, 30%).

A.Compressive Strength Test

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M30 grade of concrete. Super-plasticizer (1.5% by weight of cement) was added to this. The moulds were filled with 20%,25%, 30% fly ash. Vibration was given to the moulds using table vibrator. The top surface of the specimen was levelled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank where in they were allowed to cure for 7 days, 28 days . After 7, 28 days curing, these cubes were tested on compression testing machine as per I.S. 516-1959. The failure load was noted. In each category three cubes were tested and their average value is reported. The compressive strength was calculated as follows. Compressive strength (MPa) = Failure load / cross sectional area.

Fig 1.Compression Test

B. Flexural Strength Test

For flexural strength test prism specimens of dimension 100x100x500 mm were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These flexural strength specimens were tested under two point loading as per I.S. 516-1959, over an effective span of 400 mm on Flexural testing machine. Load and corresponding deflections were noted up to failure. In each category three prisms were tested and their average value is reported. The flexural strength was calculated as follows. Flexural strength (MPa) = (P x L) / (b x d2), Where, P = Failure load, L = Centre to centre distance between the support = 400 mm, b = width of specimen=100 mm, d = depth of specimen= 100 mm

Fig 2.Flexural Test

C. Split Tensile Strength:

For Split tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category three cylinders were tested and their average value is reported. Split Tensile strength was calculated as follows as split tensile strength: Split Tensile strength (MPa) = 2P / π DL, Where, P = failure load, D = diameter of cylinder, L = length of cylinder.

Fig 3.Split Tensile Test

V. RESULT AND DISCUSSION

5.1 Compressive Strength:

The compressive strength of concrete with different proportions of concrete are determined for 7 days, 28 days. The strengths appear to increase gradually and then decrease gradually after a certain proportion of flyash added.

Table 2. Compression Strength Test

S.No	Fly ash %	Specimen	Compressive strength(N/mm^2)	
			7days	28days
1.	SCC	Nominal	21.64	32.80
2.	20%	SP1	21.93	33.12
3.	25%	SP2	18.54	29.87
4.	30%	SP3	17.48	28.96

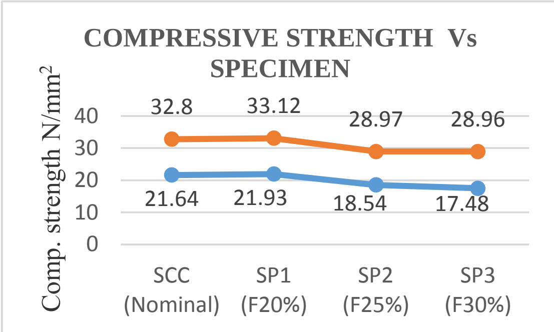


Fig 4. Compressive Strength Variation

5.2 Split Tensile strength

The split tensile strength of the concrete varies with the proportion of flyash added in concrete. The maximum strength is observed for 2% of steel scrap and 20% flyash added concrete

Table 3. Split Tensile Strength Test

Sl. No	Flyash %	Specimen	Split tensile Strength (N/mm^2)	
			7days	28days
1.	SCC	Nominal	2.54	3.76
2.	20%	SP1	2.46	3.79
3.	25%	SP2	2.32	2.98
4.	30%	SP3	2.19	2.76

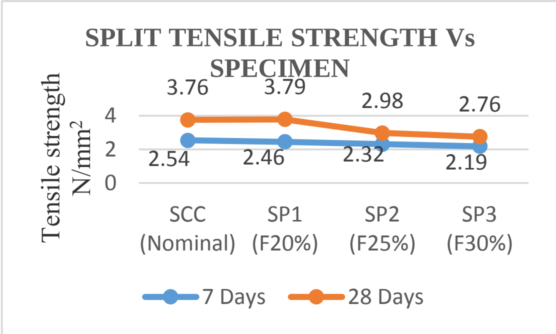


Fig 5. Spilt Tensile Strength Variation

5.3 Flexural Strength

The flexural strength of the prism tested for different proportion shows a gradual increase in flexural strength up to 2% of steel scrap and 20% flyash added concrete and then a gradual decrease in the strength up to 30% flyash.

Table 4. Flexural strength test

Sl. No	Fly ash %	Specimen	Flexural Strength (N/mm^2)	
			7days	28days
1.	SCC	Nominal	3.60	6.78
2.	20%	SP1	3.80	6.82
3.	25%	SP2	3.48	6.43
4.	30%	SP3	3.26	6.04

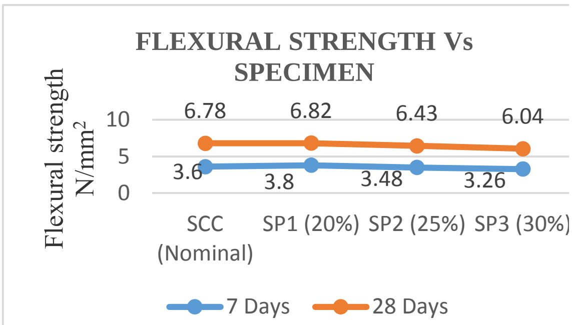


Fig 6. Flexural Strength Variation

VI. CONCLUSION

The SCC mix with the addition of 2% Steel Scraps satisfies the workability limits hardly. The Addition of 20%, 25%, 30% of Fly ash, 2% steel scraps gives good results for flowing and passing ability.As the Same time compressive, split tensile, flexural strength also improved by means of adding steel scraps in 20% and 25%.Hence further addition of fly ash may not satisfy the limits EFNARC Guide lines and mechanical properties may remain constant or decrease.The waste Steel scraps used in self compacting concrete which is now proved to be enhancing the properties of SCC.

VII. FUTURE SCOPE

The effect of rusting of the steel scrap on the strengths of concrete can be determined. Also, the effect of addition of steel scrap on the reinforcement provided in R.C.C structure can be determined.

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