An Experimental Investigation On Rheological 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 workability, flow ability and passing ability on Self compacting concrete by partial replacement of cement by fly ash (20%, 25% and 30%) & steel scraps. The work involves making several types of SCC mixes. The Slump Cone, L-Box, J-Ring and V-Funnel test are carried out on fresh SCC. The Fresh concrete properties are determined. The result show that SCC with various percentage of fly ash (20%, 25% and 30%), steel scraps & super plasticizer is mixed with optimum SCC. After each mix preparation, all the mentioned tests are done and the values are determined*.

Keywords: *Steel scrap, fly ash, Fresh properties*

I. INTRODUCTION

Self-compacting concrete (SCC), is a concrete which flows by its own self weight. So it does not requires compaction at site or concrete plants. It has been developed in Japan to improve the durability and uniformity of concrete in 1988 by Okamura and Ozawa. The mix composition is chosen to satisfy all performance criteria for the concrete in both the fresh and hardened states. Self-compacting concrete is defined as the concrete which can be placed and compacted into every corner of formwork purely by means of its self-weight by eliminating the need of either external energy. To achieve this, fly ash and silica fume were used as mineral admixtures, and super plasticizers are used in mix as chemical admixtures for design of concrete. The main difference between conventional concrete to self - compacting concrete is the pore value in concrete mass i.e. highly eliminated pores. In this regards, mass of fine aggregate is typically equal or more compare to coarse aggregate. And selection of coarse aggregate size also gives impact on requirement of self-compacting.

There are many advantages of using SCC especially when the material cost is minimized which include

- Reducing the construction time and labour cost.
- Eliminating the need for vibration.
- Reducing noise pollution
- Improving the filling capacity of highly congested structural member.

A. Applications of Self-Compacting Concrete

- SCC can be used in precast industries.
- In complicated reinforcement positions.
- Construction element in high rise buildings.
- Marine structures.
- Reduced form work and equipment cost.
- Less man power.

B. Role of Fly ash as Mineral Admixture

Fly ash is a by-product which is generated from the combustion of coal in the thermal power plants. The increasing scarcity of raw materials and the urgent need to protect the environment against pollution has accentuated the significance of developing new building materials based on industrial waste generated from coal fired. Thermal power stations creating unmanageable disposal problems due to their potential to pollute the environment. The incorporation of one or more mineral admixtures/powdery materials having different morphology and grain size distribution can improve particle-packing density and reduce inter-particle friction and viscosity Fly ash, when used as a mineral admixture in concrete, improves deformability, Self- compatibility and stability of SCC.

II.OBJECTIVE

The objective of the present investigation is to study the effect of the addition of Fly ash in self-compacting concrete. To ensure the strength properties of self-compacting concrete with Scraps will be experimentally compared with nominal self-

compacting concrete. To investigate the workability characteristics, Fresh properties of Self-Compacting Concrete with Fly ash.

III.DEVELOPEMENT OF MIX DSIGN

The mix design of self-compacting concrete is a trial and error method. Many references available for mix proportioning of SCC. Here we use mix proportioning based on previous investigation strength data using Japanese method and also based EFNARC guidelines.

The concrete mix proportion was 1: 1.91: 1.72: 0.38 and water content was 178 lit/m3.

Table 1. Desired Mix Design

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

IV.EXPERIMENTAL PROGRAMME

To study the fresh concrete properties of self-compacting concrete based on the parameters defining the fresh concrete. Many different test methods have been developed in attempt to characterize the property of Self-Compacting concrete.

Table 2. Permissible Limits for SCC

Testing Methods	Units	Typical Ranges	
		Minimum	Maximum
Slump Flow(Diameter)	Mm	660	800
Slump Flow(Time)	Sec	2	6
V-Funnel	Sec	6	12
L-Box	Mm	0.8	1.0
J-Ring	Mm	0	10

A. Filling Ability

1) Slump Flow test

The slump flow is used to assess the horizontal free flow of Self Compacting Concrete in the absence of obstruction. This method is based on the test method for determining the slump. The diameter of the concrete circle is a measure for the filling ability of concrete. This test gives good assessment on the filling ability of the concrete and some indication of resistance to segregation.

Fig.1 Slump Flow Test

2) V-Funnel test

The equipment consists of a V-shaped funnel, shown in Fig. The described V-funnel test is used to determine the filling ability (flow ability) of the concrete with a maximum aggregate size of 20mm. The funnel is filled with about 12 liters of concrete and the time taken for it to flow through the apparatus measured.

Fig.2 V-funnel Test

B. Passing ability

1) L-Box test

The test assesses the flow of the concrete, and also the extent to which it is subject to blocking by reinforcement. The apparatus is shown in Fig. The apparatus consists of a rectangular-section box in the shape of an 'L', with a vertical and horizontal section, separated by a moveable gate, in front of which vertical lengths of reinforcement bar are fitted.

The vertical section is filled with concrete, and then the gate lifted to let the concrete flow into the horizontal section. When the flow has stopped, the height of the concrete at the end of the horizontal section is expressed as a proportion of that remaining in the vertical section (H_2/H_1in the diagram). It indicates the slope of the concrete when at rest. This is an indication passing ability, or the

degree to which the passage of concrete through the bars is restricted.

The horizontal section of the box can be marked at 200mm and 400mm from the gate and the times taken to reach these points measured. These are known as the T_{20} and T_{40} times and are an indication for the filling ability. It assesses filling and passing ability of Self Compacting Concrete, and serious lack of stability (segregation) can be detected visually.

Fig.3 L-Box test

C. Segregation Resistance Test

1) V-Funnel at t-6 minutes test

V-funnel test at 6 minutes is used to measure the segregation resistance of the concrete. The funnel can be filled with concrete and left for 5 minutes to settle. If the concrete shows segregation then the flow time will increase significantly.

V.EXPERIMENTAL INVESTIGATION

Table .3 Test Results of fresh concrete

Testing Methods	Units	Workability Values				
		Permissible limits	SCC Nominal)	SP1 F20%	SP2 F25%	SP3 F30%
Slump Flow(Dia)	Mm	650-800	670	655	665	668
Slump Flow(Time)	Sec	2-5	3	4.30	3.40	3.10
V-Funnel	Sec	6-12	6	7	6	6
J-Ring	Mm	0-10	7	7.20	8.10	8.30
L-Box	Mm	0.8-1.0	0.86	0.91	0.89	0.87

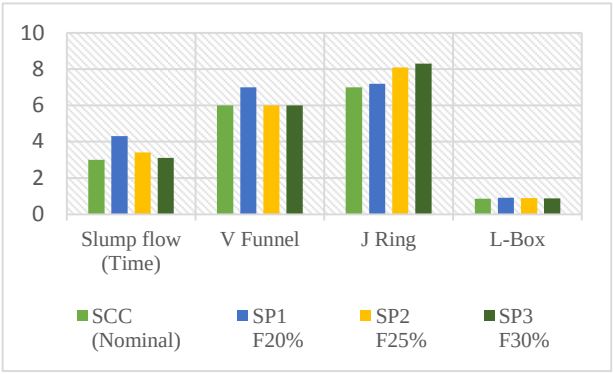

Fig.4 Workability values

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 and 2% of steel scraps gives good results for flowing and passing ability. Hence further addition of fly ash may not satisfy the limits EFNARC Guide lines. The waste Steel scraps used in self-compacting concrete which is now proved to be enhancing the Fresh properties of SCC.

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