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Study on Beam-Column Joints with Self Compacting Concrete

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ABSTRACT- Innovative concrete known as Self-Consolidating Concrete (SCC) does not require vibration for placement or compaction. Even in the midst of crowded reinforcement, it can flow under its own weight, completely filling forms and attaining full compaction. Self- Consolidating Concrete has unique characteristics from regular concrete. The workability characteristics of self-consolidating concrete containing fly ash and silica fume with super plasticizer as the silica fume are examined in this research. Workability tests including the slump flow, V-funnel, and L-Box tests are used to assess the workability properties of SCC such as filling ability, passing ability, and segregation resistance. The cubes' compressive strength at 7 and 28 days was also measured, and it was discovered that the mixture had an excellent compressive strength.

KEYWORDS- Concrete, compressive strength, flexural strength, tensile strength, fine aggregate, quarry dust, silica fume.

I. INTRODUCTION

The last ten years have seen significant advancements in concrete technology. Today's concrete is an engineering material made up of numerous new materials that operates well in all situations rather than a material made just of cement, fine aggregate, coarse aggregate, and water. Fly ash, micro silica, GGBS, and other filler elements are used in modern concrete. One of the most significant advancements in the construction business recently has been the invention of Self-Consolidating Concrete (SCC). This tangible idea aims to increase human effort, improve economic efficiency, Self-Consolidating Concrete was developed at designers and builders more freedom, and reduce risk associated with the human aspect.

Self-Consolidating Concrete is a type of concrete that moves and settles under the weight of itself. SCC has various advantages in crowded reinforced regions, such as beam columns, because it is amorphous, non-porous, and flawless. the time to improve the durability of concrete structures. Since then, various investigations have been carried out and SCC has been used in practical structures in Japan, mainly by large construction companies. Self-Consolidating Concrete consists of the same components as conventionally vibrated concrete, which are cement, aggregates and water, with the addition of chemical and mineral admixtures in different proportions. In order to enhance the desired qualities of cement without impairing the desirable features of the mix, additives— materials other than cement and aggregates—are added to the concrete mix. High-Range Water Reducers (super plasticizers) and Viscosity Modifying Agents are the most often employed chemical admixtures because they alter the rheological properties of concrete. The impact of using mineral admixtures such fly ash and silica fume on the fresh properties of self-consolidating concrete was assessed. The qualities of regular conventional concrete are greatly enhanced by fibre reinforced concrete. Nan Su et al (2001) have proposed the simple mix design, First the amount of aggregates required is determined, and the paste of binders is then filled into the voids of aggregate ensure that the concrete thus obtained has flow ability, self-compacting ability and other desired SCC properties. The amount of aggregates, binders and mixing water, as well as type and dosage of super plasticizer (SP) to be used are the 492 Performance of Self-Compacting Self Curing Concrete with Fly Ash and M Sand International Journal of Earth Sciences and Engineering ISSN 0974-5904, Vol. 08, No. 01, February, 2015, pp. 491-497major factors influencing the properties of SCC. Slump flow, V-funnel, L-flow, U-box and compressive strength tests were carried out to examine the performance of SCC, and the results indicate that the proposed method could produce successfully SCC of high quality. The method involved determines aggregate Packing Factor (PF) and influence on the strength, flow ability and Self-compatibility ability. Brower's and Radix (2005) have addressed experiments and theories on Self-Compacting Concrete. Mixes, consisting of slag blended cement, gravel (4–16 mm), three types of sand (0– 1, 0–2 and 0–4 mm) and a polycarboxylic ether type super plasticizer, were developed. These mixes are extensively tested, both in fresh and hardened states, and meet all practical and technical requirements such as medium strength and low cost. It follows that the particle size distribution of all solids in the mix should follow the grading line as presented by Andreasen and Andersen.

II. MATERIALS AND METHODS

A. Silica Fume

A particularly reactive, amorphous, and fine mineral additive is silica fume. When Portland cement is hydrated, calcium hydroxide is created, and it reacts with it quickly. Concrete with silica added has finer pore structure and greater mechanical strength.

The chemical name for silica is SiO2, and it is a solid with a density between 2 and 3 g/cm3 and a high melting point (about 1700 °C).

B. Coarse Aggregate

In the current investigation, two fractions of locally accessible coarse aggregate, 20 mm and 10 mm sizes, were independently sieved. Two fractions were separated using sieves of different sizes: 20 mm and 10 mm. Both fractions' coarse aggregate specific gravities were 2.66. The aggregate's fineness modulus was 6.9 for 10 mm and 7.7 for 20 mm. 40% 10 mm aggregate and 60% 20 mm aggregate were used as the coarse aggregate ratio in the concrete mix.

C. Quarry Dust

Stone dust of a grey colour was gathered from nearby stone crushing operations in Chimakurthi, Ongole (Andhra Pradesh). Before making the mix, it was initially dry and completely kept on an IS 150 sieve. Zone II of IS 383-1997 was also validated by the stone dust [5]. Stone dust had a fineness modulus of 2.85 and a specific gravity of 2.4.

D. Fine Aggregate

[6] In terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm (or 1⁄16 mm) to 2 mm. An individual particle in this range size is termed a sand grain. [7] Sand grains are between gravel (with particles ranging from 2 mm up to 64 mm) andslite (particles smaller than 0.0625 mm down to
0.004 mm).

E. Cement

The volcanic ash and pulverized brick supplements that were added to the burnt lime, to obtain a hydraulic binder, were later referred to as, cimentum, cement, and cement. Cements used in construction can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to be used in the presence of water. [8] Non-hydraulic cement will not set in wet conditions or underwater, rather it sets as it dries and reacts with carbon dioxide in the air. [9] It can be attacked by some aggressive chemicals after setting.

F. Mix Design Data

Table 2: Mix design Data

Grade	Proportions		W/C ratio	
	NC	SCC	NC	SCC
M25	1:1.70:3.30	1: 2.05:2.22	0.48	0.44
M40	1:1.40:2.70	1: 2.1: 2.30	0.40	0.38

G. Tests Load Frame

All the vertical loads of up to capacity of 200 Tones are to be calculated in the load frame machine. [10] Also finds out compression and tensile and torsion forces by using this.

The compressive force and flexural and tensile forces are to be calculated. And compared to normal concrete beam and column joints and results are compared and conclusions will be declared.

III. RESULTS AND DISCUSSION

The investigation on beam-column joints with self-compacting concrete (SCC) reveals promising outcomes. The SCC significantly enhances the durability of joints by minimizing voids and improving compaction. It exhibits greater load-carrying capacity due to improved contact between concrete and reinforcement.

Table 1: Compressive strength results for M25 grade concrete

Mix	Compressive strength (N/mm2)			
	M 25 grade		M 40 grade	
	7 days	28days	7days	28days
Control Mix	21.5	33.5	38.30	49.2
SCC	20.0	34.0	40.25	44.6

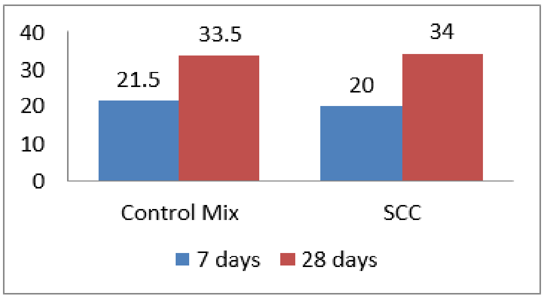

Figure 1: Compressive Strength Results for M25 Grade concrete

Additionally, SCC mitigates segregation and honeycombing, enhancing the structural integrity of beam-column connections. The study underscores the efficacy of SCC in addressing construction challenges associated with conventional concrete, presenting it as a feasible solution to enhance the performance and longevity of beam-column joints in various structural applications.

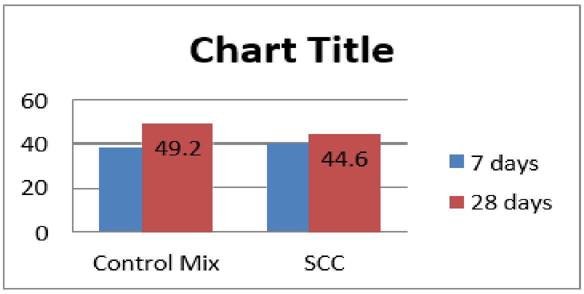

Figure 2: Compressive strength results for M40 grade concrete.

Table 3: Compressive strength results

Specimen type	First crack load (P_{cr}) (KN)	Ultimate load (P_u) KN	Maximum Deflection (mm)	Maximum crack width (mm)
Conventional	26.49	35.32	85	5.64
SCC	28.70	37.53	65	5.25

Deflection Behavior of M25 Grade Conventional and Self Compacting Concrete Test Specimen:

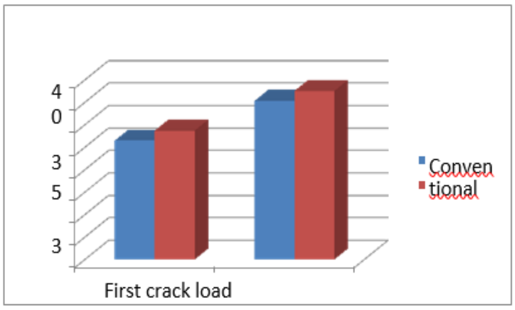

Figure 3: Load pattern for m25 grade specimen

Table 4: Test Specimen

Load(KN)	Deflection(mm)
4.41	25
8.83	30
13.2	35
26.49	65
28.70	80
35.32	85
44.15	45
48.57	28
50.77	18
57.40	19

Table 5: Test Specimen

Load(KN)	Deflection(mm)
4.41	22
8.83	30
13.2	35
26.49	55
28.70	60
35.32	65
37.53	60
50.77	28
52.98	15
54.0	10

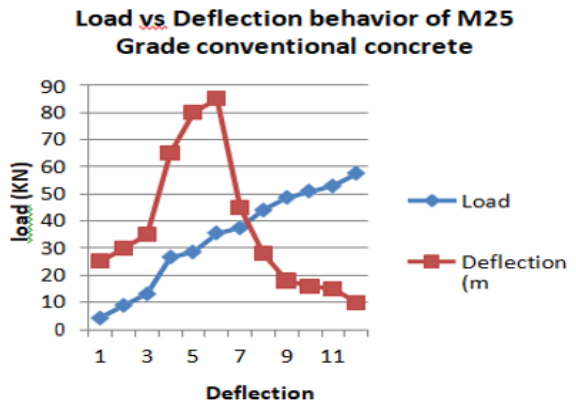

Figure 4: Load vs. deflection behavior of M25 grade C.C

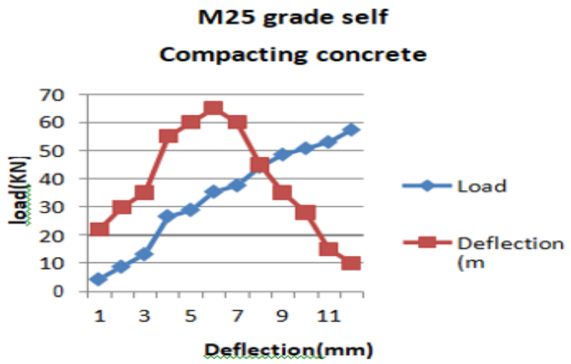

Figure 5: M25 grade self-compacting concrete

IV. CONCLUSION

- SCC findings for grades M25 and M40 have improved in terms of flow ability, passing ability, and filling ability.
- The maximum compressive strength of typical concrete for 28 days is 33.5 N/mm2 for M25 grade and 49.2 N/mm2 for M40 grade.
- SCC joints have a higher maximum load carrying capacity than joints made of conventional concrete. However, due to the greater interlocking behaviour of the aggregate, conventional concrete joints have demonstrated higher results in terms of maximum load carrying capability.
- Because to its flowable qualities, the SCC is more workable than NC.
- Compressive, tensile, and flexural strength parameters are all lower in the case of SCC at 7 days than in the case of NC; however, these are higher in the case of SCC after this age.
- At 7 days, SCC has compressive, tensile, and flexural strengths that are roughly 9.0, 9.0, and 6.0% lower than those of NC. However, in the case of SCC, the corresponding strengths are higher after 28 days by 6.0, 9.8, and 5.4%, respectively. At 56 days, the corresponding changes are 12.7, 4.8, and 4.7% C

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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