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Comparitive Study of NCC and SCC for R.C.C Columns with Different Eccentricities

Dr. B. Krishna Rao

Associate Professor, Department Of Civil Engineering, University College Of Engineering Kakinada, J. N. T. University Kakinada, Kakinada-5330003, Andhra Pradesh, India,

ABSTRACT: *Now a day's applications of Self Compacting Concrete (SCC) have been used in high rise buildings, long span bridges and in some special applications in structures, which would result in both technical and economical advantages. SCC gets compacted under its own weight and no need for any external vibrator for body to the mould. This helps in construction of structural members with congestion in reinforcement. In the scope of this dissertation compression members are taken for investigation of their behavior in the field of compressive strength and buckling failure due to eccentricity developed because of unskilled labour mistakes. Ground Granulated Blast Furnace Slag (GGBS) in the family of pozzolans that are introduced to chemically react with calcium hydroxide Ca(OH$_2$) in the process of hydration of cement to enhance the properties of concrete and subsequently improves the concrete in the strength and durability. An investigation is made here to study the effect of GGBS influencing the strength of concrete as partial replacement of cement in concrete.*

An experimental investigation was made for M30 grade concrete with a water-cement ratio 0.32 with 20mm MSA at 50% replacement of cement by GGBS. The strength characteristics such as compressive strength and the magnitude of deflection, is observed after 7and 28 days curing. The results are compared with the results of conventional concrete made of ordinary Portland cement without any admixture, at different eccentricities like 0mm, 25mm, 50mm and 75mm.

Keywords: *workability, strength, GGBS, columns, aggregate and concrete*

I. INTRODUCTION

The self compacting (or) super workable concrete, also referred to self consolidating concrete is a highly flowable (or) self levelling cohesive concrete that can spread through and around dense reinforcement under its own weight. SCC mix has a low yield stress and an increased plastic viscosity. The yield stresses is reduced by using an advanced synthetic High Range Water Reducing Admixtures (HRWR), while the Viscosity Modifying Admixtures (VMA) (or) by increasing the percentage of fines incorporated in to the SCC mix design, SCC is also referred as self levelling concrete, super workable concrete, non-vibrating concrete etc. The intention behind developing this concrete was the concerns regarding the homogeneity and compaction of cast in site concrete with in highly reinforced structure and improvement of overall durability, quality of concrete due to lack of skilled labours.

II. LITERATURE REVIEW

Zhou Li (2002): Studied the influence of crack on elastic deflection of eccentric rectangular column. In this paper, a trigonometric series solution of the deflection curve and an analytical solution of maximum deflection derived by means of Rayleigh-Ritz energy method were introduced. According to above solution, the effects of crack size on maximum deflection of eccentric rectangular column under different load and eccentricity states were discussed. The range of crack influence and crack closing were illustrated according to the load-crack length curve under the equal Dd/d condition, where the parameter Dd/d is a ratio of the deflection change caused by crack to the deflection of un-cracked column. The numerical results show that the deflection change caused by crack is increasing with the decrease of slenderness ratio or the increase of eccentricity.

III. PROPERTIES OF THE MATERIALS

Cement: Ordinary Portland Cement (OPC) of 53 Grade from a single lot was used throughout the course of the investigation. It was fresh and without any lumps. The specific gravity of cement obtained is 3.04.

Fine Aggregate: The fine aggregate used is natural sand obtained from the river Godavari conforming to grading zone-II of IS: 10262-2009. The specific gravity and fineness modulus are 2.57 and 3.49 respectively.

Coarse Aggregate: Crushed granite angular aggregate of size 20mm are used and the aggregates are free from dust before used in the concrete. The specific gravity and fineness modulus are 2.78 and 6.75 respectively.

Water: This is the least expensive but most important ingredient of concrete. A good thumb rule to follow is that if water is pure enough for drinking it is suitable for mixing concrete. Locally available portable water was used for mixing and curing.

Ground Granulated Blast Furnace Slag: It is collected from Vizag Steel plant Visakhapatnam, Andhra Pradesh, the specific gravity and fineness modulus are 2.50 and 2.69 respectively.

Superplasticiser: Glenium B233 is an admixture of new generation based on modified polycarboxylic ether. The product has been primarily developed for applications in high performance concrete where the highest durability and performance.

IV. MIX PROPORTION

After conducting the preliminary tests on various ingredients of concrete, the concrete mix of M30 grade for NCC and SCC were designed and the following quantities were arrived as shown in table:1.

Table:1 Details of mix proportion for NCC and SCC

S. No	Mix Id	Cement (kg/m^3)	GGBS (kg/m^3)	Total powder (kg/m^3)	F.A (kg/m^3)	C.A (kg/m^3)	Water (Liters)	w/c-ratio
1.	NCC	400	--	400	623.35	1252.25	180	0.45
2.	SCC	300	300	600	712	761	192	0.32

V. TEST RESULTS AND DISCUSSIONS

Specimen Details: Cube specimens of 150 mmx150mmx150mm size for compressive strength, Cylinder specimens of size 150 mm diameter x 300 mm height and prisms of size 100mm x 100mm x 500mm were casted to study the mechanical strength properties such as compressive strength, split tensile strength and flexural strength at 7 and 28days, according to Indian standards. The details of compressive, split tensile and flexural strength of NCC and SCC are shown in table:2.

Table:2 Hardened properties of NCC and SCC

S. No.	Mix. Id.	Compressive strength (MPa)		Split tensile strength (MPa)		Flexural strength (MPa)	
		7d	28d	7d	28d	7d	28d
1.	NCC	31.65	38.25	3.01	3.56	4.01	4.67
2.	SCC	33.25	40.1	3.14	3.67	4.18	4.82

The following graphs below shows the compressive, split tensile and flexural strength of NCC and SCC.

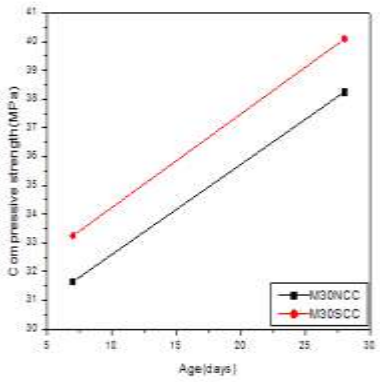

Fig.1 Compressive strength Vs. **Age**

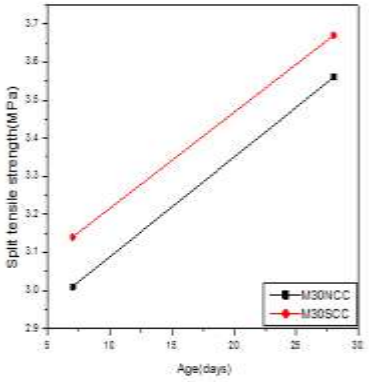

Fig.2 Split tensile strength Vs. Age

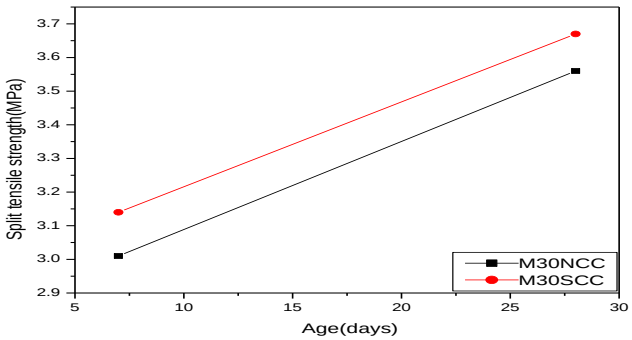

Fig.3 Flexural strength Vs. Age

Fig.1 shows the compressive strength of NCC and SCC at the age of 7, 28days are 31.65MPa, 38.25MPa and 33.25MPa, 40.1MPa.The compressive strength of SCC increased by 5.05% and 4.84%, when compared to NCC at the age of 7 and 28 days.

Fig.2 shows the split tensile strength of NCC and SCC at the age of 7, 28 days are 3.01MPa 3.56MPa and 3.14MPa, 3.67MPa. The split tensile strength of SCC increased by 4.32% and 3.09%, when compared to NCC at the age of 7 and 28days.

Fig.3 shows the flexural strength of NCC and SCC at the age of 7, 28days is 4.01MPa, 4.67MPa and 4.18MPa, 4.82MPa. The flexural strength of SCC increased by 4.24% and 3.21%, when compared to NCC at the age of 7 and 28days.

Table: 3 Deflections of specimens of NCC & SCC

S. No	Load (kN)	NCC Different Eccentricities (mm)				SCC Different Eccentricities (mm)			
		0	25	50	75	0	25	50	75
1.	10	0.20	0.5	0.15	0.15	0.25	0.35	0.75	0.5
2.	20	0.50	1.00	0.25	0.25	0.50	0.75	1.50	0.75
3.	30	1.00	1.80	0.50	0.50	0.75	1.00	2.25	1.20
4.	40	0.75	1.75	2.30	1.00	0.90	1.25	2.75	1.00
5.	50	1.00	3.00	3.50	1.00	1.00	1.50	3.50	1.00

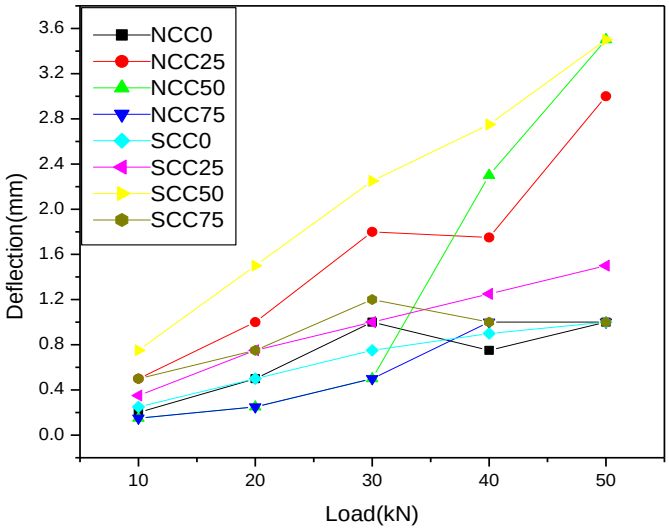

Fig.4 Deflection Vs. Load

Fig.5 Casting of specimens

Fig.6 Testing of specimens

The deflection values for 0mm, 25mm, 50mm and 75mm eccentricities of specimens in NCC and SCC are shown in table:3. The deflection curves were drawn in between deflection Vs. Load for 0mm, 25mm, 50mm and 75mm eccentricities of specimens in NCC and SCC. The deflections observed from the experiment were compared for both NCC and SCC which were shown in fig.4, for different eccentricities. Casting and testing of specimens are shown in Fig.5 and Fig.6.

VI. CONCLUSIONS

- From the Graphs the deflections are comparatively higher for the specimens made with self compacting concrete than that of the normal cement concrete at all the eccentricities.
- The deflections are higher for an eccentricity of 50 mm in both normal cement concrete and self compacting concrete mixes.
- The experimental study reported in this report that ground granulated blast furnace slag can be used in self compacting concrete without losing the characteristics of SCC.
- Self compacting concrete fills the formwork and encapsulates the reinforcements without needing vibration to achieve compaction only through the action of gravity and gives an excellent surface finish.
- Self compaction test can be obtained for widely differing fly Ash contents are cement contents as long as paste volume constituted by the powder and water is kept unaltered.
- The compressive strength of SCC increases by 5.05%and 4.84% when compared to NCC at the age of 7 days and 28days.
- The split tensile strength of SCC increases by 4.32%and 3.09% when compared to NCC at the age of 7 days and 28days.
- The flexural strength of SCC increases by 4.24%and 3.21% when compared to NCC at the age of 7 days and 28days.
- As compared with the conventional concrete self compaction concrete has not shown any advantage in resisting displacements in compression members.
- Compressive strength on compression member is not executed any extra load carrying capacity even when it is subjected to zero eccentricity.
- Cross section of the member used for the experimental work are being small self compaction concrete has not shown any significant results.
- Crack width is measured, the width of the crack 2mm to 5mm in case of 50mm and 75mm eccentricity cases.
- As the loading increases on the specimen the deflection is increased.
- For the different eccentricities of 0mm, 25mm, 50mm, 75mm the deflections are more in Self Compacted Concrete specimens than for the Normal Cement Concrete specimens.

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