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Self-Compacting Concrete Aggregate on Effective Size of M70 Grade

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Abstract: The original contribution in the field of SCC is attributed to the pioneering work of Nan Su et al; who have developed a simple mix design methodology for Self Compacting Concrete. In this method, the amount of aggregate required is determined first, based on Packing Factor (PF). This will ensure that the concrete obtained has good flowability, self compacting ability and other desired SCC properties. The European Federation of Producers and Applicators of Specialist Products for Structures (EFNARC) [2005] have also laid down certain guidelines for fresh properties of SCC.

The present investigation is aimed at developing high strength Self Compacting Concrete of M70 Grade. The parameters of study include grade of concrete and effect of size of aggregate. The existing Nan Su method of mix design was based on packing factor for a particular grade of concrete, obtained on the basis of experimental investigation. SCC characteristics such as flowability, passing ability and segregation resistance have been verified using slump flow, L box and V funnel tests.

I. INTRODUCTION

The versatility and the application of concrete in the construction industry need not be emphasized. Research on normal and high strength concrete has been on the agenda for more than two decades. As per IS: 456–2000[Code of Practice for Plain and Reinforced Concrete], concretes ranging 25 – 55 MPa are called standard concretes while those above 55 MPa can be termed as high strength concrete. Concretes above 120/150 MPa are called ultra high strength concrete. High strength concrete has numerous applications worldwide in tall buildings, bridges with long span and buildings in aggressive environments. Building elements made of high strength concrete are usually densely reinforced. This congestion of reinforcement leads to serious problems while concreting. Densely reinforced concrete problems can be solved by using concrete that can be easily placed and spread in between the congested reinforced concrete elements. A highly homogeneous, well spread and dense concrete can be ensured using such a type of concrete.

Self-compacting concrete (SCC) is a concrete, which flows and compacts only under gravity. It fills the mould completely without any defects. Usually self-compacting concretes have compressive strengths in the range of 60-100 N/mm2. However, lower grades can also be obtained and used depending on the requirement. SCC was originally developed at the University of Tokyo in Japan with the help of leading concrete contractors during 1980's to be mainly used for highly congested reinforced structures in seismic regions. As durability of concrete structures was an important issue in Japan, an adequate compaction by skilled labors was required to obtain durable concrete structures. This requirement led to the development of SCC. The development of SCC was first reported in 1989.

SCC is a new kind of High Performance Concrete (HPC) which has an excellent deformability and segregation resistance. By name it can be defined as a concrete, which can flow through and fill the gaps of reinforcement and corners of the moulds without any need for external vibration. SCC compacts itself due to its self weight and de-aerates almost completely while flowing in the formwork. SCC can also be used in situations where it is difficult or impossible to use mechanical compaction for fresh concrete, such as underwater concreting, cast in-situ pile foundations,

machine bases and columns or walls with congested reinforcement. The high flowability of SCC makes it possible to fill the formwork without vibration. Since its inception, it has been widely used in large construction works or projects in Japan. Recently, this concrete has gained wide use for different applications and structural configurations across the world.

High strength concrete can be produced with normal concrete. But these concretes cannot flow freely by themselves, to pack every corner of moulds and all gaps of reinforcement. High strength concrete based elements require thorough compaction and vibration in the construction process. SCC has more favourable characteristics such as high fluidity, good segregation resistance and distinctive self-compacting ability with out any need for external or internal vibration during the placing process. It can be compacted into every corner of formwork purely by means of its own weight without any segregation. Hence, it reduces the risk of honey combing of concrete.

Development of SCC is a very desirable achievement in the construction industry for overcoming the problems associated with cast-in place concrete. It is not affected by the skill of workers, shape and amount of reinforcing bar arrangement of a structure. Due to its high fluidity and resisting power to segregation, it can be pumped over longer distances. It extends the possibility of use of various by products in its manufacturing. The use of SCC not only shortens the construction period but also ensures quality and durability of concrete. It replaces manual compaction of fresh concrete with a modern semi-automatic placing technology. Some of the advantages of Self Compacting Concrete are as follows:

II. EXPERIMENTAL RESULTS

The mix proportion of M70 grade of concrete designed on the basis of Nan Su method for different maximum sizes of aggregates 10, 12.5 and 20 mm. For the mix proportions obtained, **Tables 1**, highlights the details of various parameters including total aggregate – cement ratio (A/C), water – cement ratio (w/c), coarse aggregate - fine aggregate ratio (CA/FA) and fine aggregate – total aggregate ratio (S/a) for various aggregate sizes.

Table 1 Parameters of M70 grade SCC mix proportions

Size of aggregate (mm)	A/C	w/c	w/p	CA/FA	S/a
10	2.42	0.38	0.269	0.935	0.520
12.5	2.43	0.366	0.257	0.914	0.514
20	2.45	0.365	0.236	0.820	0.550

Fresh properties of SCC

The details of the fresh properties are shown in **Table 2,** M70 grade of concrete.

Table: 2 Fresh properties of M 70 grade SCC

S. No	Size of Aggregate	Slump Flow value	T_{50}	V-Funnel	V-Funnel at $T_{5\ Minutes}$	L-Box H_2/H_1 (blocking ratio)
1.	20 mm	720 mm	5 Sec	9 Sec	12 Sec	1.00
2.	12.5 mm	725 mm	5 Sec	6 Sec	8 Sec	1.00
3.	10 mm	735 mm	5 Sec	7 Sec	9 Sec	1.00

A. Compressive strength

The results of the mechanical properties obtained based on the specimens tested as per Indian standard test procedures (as per IS: 516) are discussed. M 70 grade of concrete, three maximum sizes of aggregate and three different ages of curing are the variables of investigation. The details of the compressive strengths of M70 grade are shown in **Table 3**.

Table: 3 Compressive strength of M 70 grade SCC

Size of Aggregate	3 Days	7 Days	28 Days
20 mm	31.80	46.30	74.00
12.5 mm	36.20	49.00	77.10
10 mm	38.33	49.66	79.30

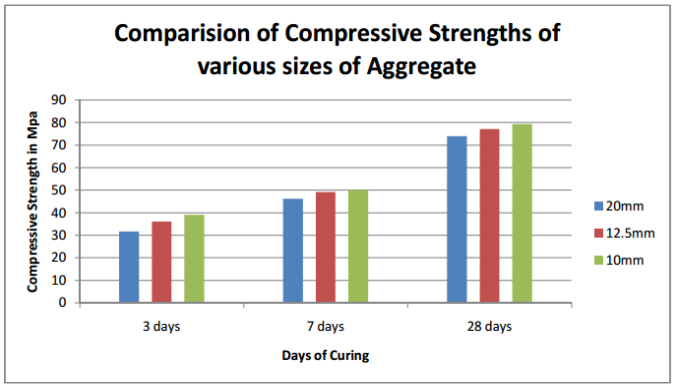

Fig 1: Bar Diagram of Compressive Strength with various sizes of Aggregates

B. Split tensile strength

Table 4 shows the details of the split tensile strength of three grades of concrete for different sizes of aggregate.

Table: 4 Split tensile strength of M 70 grade SCC

Size of Aggregate	3 Days	7 Days	28 Days
20 mm	2.40	6.04	9.15
12.5 mm	2.80	5.90	9.62
10 mm	2.85	6.36	9.95

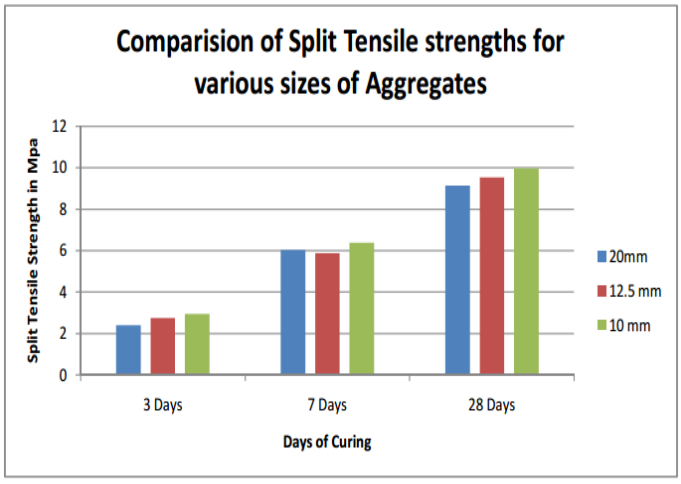

Fig 2: Bar Diagram of Split Tensile Strength with various sizes of Aggregates

C. Flexural strength

Table 5 shows the details of the flexural strength of the different sizes of aggregate and M 70 grade of concrete.

Table: 5 Flexural strength of M 70 grade SCC

Size of Aggregate	3 Days	7 Days	28 Days
20 mm	4.03	6.75	8.50
12.5 mm	4.60	7.47	9.13
10 mm	5.35	7.65	9.35

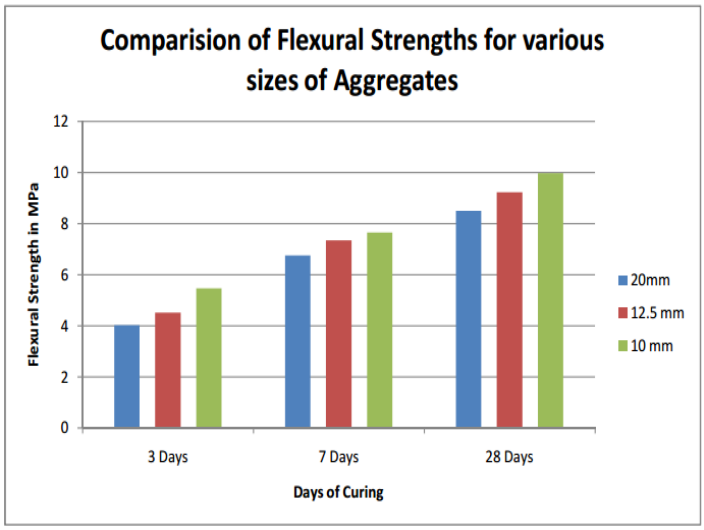

Fig 3: Bar Diagram of Flexural Strength with various sizes of Aggregates

From the results of the studies on mechanical properties for M70 grade of SCC mix, it is clear that the effective size of aggregate was 10 mm.

III. CONCLUSION

Based on the systematic and detailed experimental study conducted on SCC mixes with an aim to develop performance mixes, the following are the conclusions arrived.

[1] The mixes designed using the lower size of aggregate yielded better fresh properties than higher size of aggregates.

[2] As the strength of concrete increases, the effective size of aggregate has decreased.

Significant contribution of the Project:
The present investigation has brought out explicitly the effect of size of aggregate on the compressive strength and other mechanical properties of self compacting concrete.

Scope of the future work:

1. The simplified mix design methodology was presented may be extended to the more number of concrete strength ranges.
2. The investigations may be conducted with different mineral admixtures like Rice Husk Ash and GGBS apart from fly ash.

REFERENCES

1) Bouzoubaa N, Lachemi M. "Self-compacting concrete incorporating high volumes of class F fly ash: Preliminary results", Cement and Concrete Research, 2001, Vol. 31, No.3, pp 413-420.

2) EFNARC. "Specification and guidelines for self-compacting concrete", European Federation of Producers and Applicators of Specialist Products for Structures, 2002.

3) EFNARC. "Specification and guidelines for self-compacting concrete", European Federation of Producers and Applicators of Specialist Products for Structures, May 2005.

4) Jaya Shankar R, Hemalatha T, Palanichamy.K and Santhakumar. S, "Influence of fly ash and VMA on properties of self compacting concrete", National Conference on Advances in materials and mechanics of concrete structures Department of Civil Engineering, IIT Madras, Chennai 12-13 August 2005, pp 25 – 32.

5) Nan Su, Kung-Chung Hsub and His-Wen Chai. "A simple mix design method for self-compacting concrete". Cement and Concrete Research, 2001, Vol. 31, pp1799 – 1807.

6) Okamura H, Ozawa K. "Mix design for self-compacting concrete". Concrete Library of Japanese Society of Civil Engineers, 1995, Vol. 25, No. 6, pp107-120.

7) Okamura Hajime and Ouchi Masahiro. "Self – Compacting Concrete". Journal of advanced concrete technology, 2003, Vol.1, No.1, pp 5 – 15.

8) Ouchi M, "Current conditions of self-comapcting concrete in Japan". The 2nd International RILEM Symposium on Self-Compacting Concrete, 2001.Ozawa K, Ouchi M, editors, pp 63-68.

9) Subramanian, S. and Chattopadhyay D. "Experiments for mix proportioning of self-compacting concrete", The Indian Concrete Journal, 2002, pp.13-20.