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EXPERIMENTAL INVESTIGATION ON MODULUS OF ELASTICITY OF SELF - COMPACTING CONCRETE

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Abstract:

Concrete is a mostly used construction material in the world. As the use of concrete becomes more widespread, the specifications of concrete like durability, quality, compactness and optimization of concrete becomes more important. Self-compacting concrete (SCC) is a very fluid concrete and a homogeneous mixture that solves most of the problems related to ordinary concrete. Self-Compacting Concrete gets dense and compacted due to its own self-weight. An experimental investigation has been carried out to determine different characters like workability and strength of Self-Compacting Concrete (SCC). Test involving various fly ash proportions for a particular mix of SCC. Test methods used to study the properties of fresh concrete were slump test, U – tube, V – funnel and L – Box. The property like modulus of elasticity of SCC was also investigated. The stress-strain relationship was studied for the M20 concrete mix using cylinders of size 150mmX300mm. The specimens were cured and tested for 7 and 28 days. Test Results shows that the workability characteristics of SCC are within the limiting constraints of SCC. The variation of different parameters of hardened concrete with respect to various fly ash contents was analysed.

Key Words: Self -Compacting Concrete, Workability, Segregation, Aggregate, Super Plasticizer & Fly Ash

1. Introduction:

Self-compacting concrete (SCC) represents one of the most outstanding advances in concrete technology during the last decade. At first developed in Japan in the late 1980s, SCC meanwhile is spread all over the world with a steadily increasing number of applications. Due to its specific properties, SCC may contribute to a significant improvement of the quality of concrete structures and open up new fields for the application of concrete. SCC describes a concrete with the ability to compact itself only by means of its own weight without the requirement of vibration. It fills all recesses, reinforcement spaces and voids, even in highly reinforced concrete members and flows free of segregation nearly to level balance. While flowing in the formwork, SCC is able to delegate almost completely. The use of SCC offers many benefits to the construction practice: the elimination of the compaction work results in reduced costs of placement, a shortening of the construction time and therefore in an improved productivity. The application of SCC also leads to a reduction of noise during casting, better working conditions and the possibility of expanding the placing times in inner city areas. Other advantages of SCC are an improved homogeneity of the concrete production and the excellent surface quality without blowholes or other surface defects. Often the materials costs of SCC will be higher than the equivalent material costs of a normal vibrated concrete. However, when SCC is sensibly utilized, the reduction of costs caused by better productivity, shorter construction time and improved working conditions will compensate the higher material costs and, in many cases, may result in more favourable prizes of the final product.

2. Scope:

The project started with objective of achieving the following,

- ✓ To improve filling capacity through highly congested reinforcement by using the Self-Compacting concrete.
- ✓ To reduce the construction time in the project.

3. Materials Used:

In this experimental study following materials are to be used.

Cement: The Portland Pozzolana cement of 43 grade conforming to IS: 8112 1989 was used for the present experimental study. The important properties of this cement have been tested and tabulated.

Table 1: Properties of Cement

Property	Values
Fineness of Cement	12.86%
Grade of Cement	53
Specific Gravity	3.24
Initial Setting time	32 min

River Sand: Clean and dry river sand available locally was used. Sand passing through IS 4.75 mm sieve and as per IS: 383:1970 was used for all the specimens. Its specific gravity is about 2.25.

Coarse Aggregates: Locally available, aggregate passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383 – 1970 is used for all the specimens. Its specific gravity is about 2.46.

Water: Potable water was used for the experimentation.

Fly Ash: Fly ash consists of fine, powdery particles that are predominantly spherical in shape, either solid or hollow, and mostly glassy (amorphous) in nature. The specific gravity of fly ash usually ranges from 2.1 to 3.0, while its specific surface area may range from 170 to 1000 m^2/kg.

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Table 2: Properties of Fly Ash

Specification	Values
Fineness Modulus (%)	78.60
Specific Gravity	2.10

Super Plasticizers: VISCO Crete 20 HE was used as a Super Plasticizer.

2. Mix Proportion:

Mix design has been adopted from IS 10262:2009 to design for M20 grade of concrete.

Table 3: Quantities of Materials Used for SCC

Materials	By weight	By Proportion
Cement	360kg/m^3	1
Fine aggregate	584 kg/m^3	2.67
Coarse aggregate	1223.8 kg/m^3	2.19
Water	180.42 kg/m^3	0.54

3. Tests on Hardened Concrete:

A. Modulus of Elasticity Test: Modulus of Elasticity or Young's Modulus of concrete can be found out from stress–strain characteristics. Cylindrical specimen of 150mm diameter and 300mm height is assembled on the top and bottom frame of the Compressometer by keeping the spacers in position. The compressometer is placed centrally on the specimen so that the tightening screws of the bottom and top frames are at equal distance from ends. The specimen with the compressometer is placed on the Universal Testing Machine and the deformation is noted in the dial gauge for every load increment. The stress and strain values are calculated and plotted.

B. Stress-Strain Relationship: One of the important properties of concrete is its stress-strain relationship. The aim of this experimental test is to determine the maximum Young's Modulus of test specimens. Cylinders of size 150mm x 300mm were cast. Four numbers of specimens were rested for 7, 28 days. A total of 20 cylinders for M-20 grade concrete of SCC, SCC with 5%, 10%, 15% and 20% of fly ash were tested.

4. Experimental Results:

- ✓ Basic tests for cement, coarse aggregate and fine aggregate were conducted and results were tabulated.
- ✓ The mix design for the self-compacting concrete is founded out with using L box, V funnel, U tube and Fillability box.
- ✓ The acquired mix design is used for casting cylinder with replacement of cement with use of fly ash about 5%, 10%, 15% and 20% respectively.
- ✓ Test results for 7 days and 28 days stress-strain relations of M20 grade of self-compacting concrete were shown in graph.
- ✓ From the above stress-strain values find out the modulus of elasticity of self-compacting concrete for various proportions.
- ✓ The mix with 20% fly ash of 28 days giving good hardened properties among the mixes.

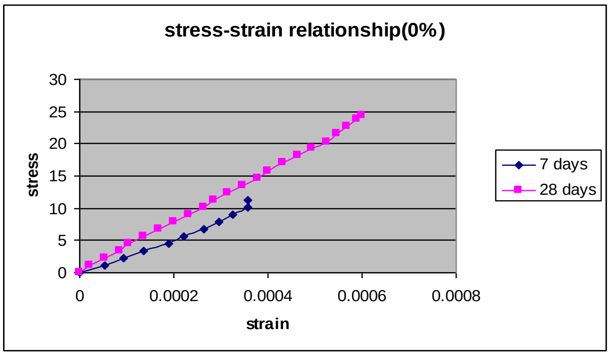

Figure 1: Comparison of stress-strain curve for 0% of fly ash added SCC mix

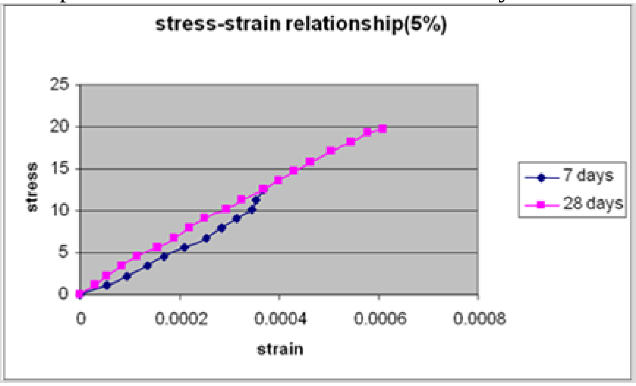

Figure 2: Comparison of stress-strain curve for 5% of fly ash added SCC mix

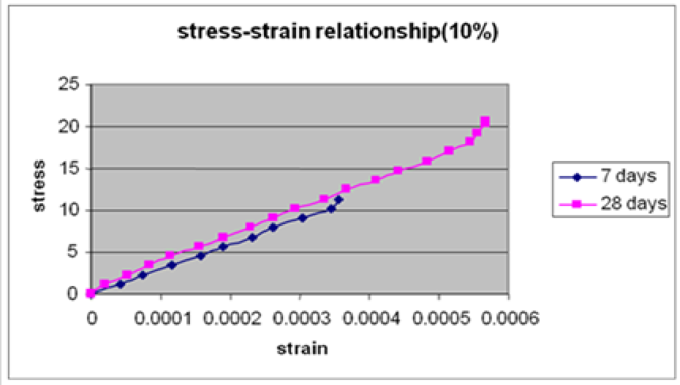

Figure 3: Comparison of stress-strain curve for 10% of fly ash added SCC mix

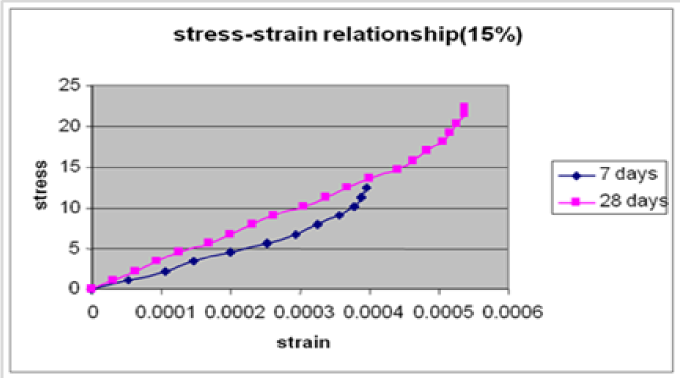

Figure 4: Comparison of stress-strain curve for 15% of fly ash added SCC mix

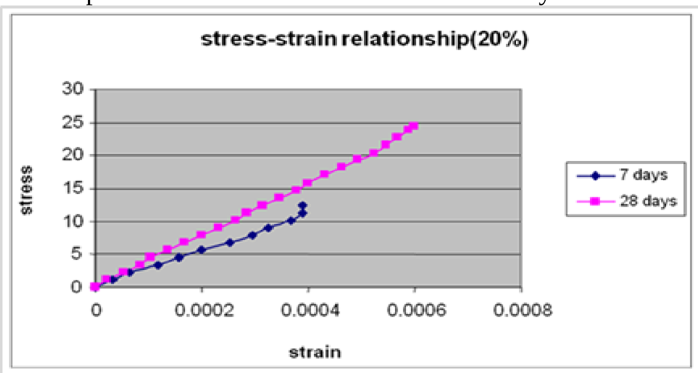

Figure 5: Comparison of stress-strain curve for 20% of fly ash added SCC mix

Table 4: Results of modulus of elasticity for various mixes

% of fly ash added	Young's modulus of cylinders at 7th day (N/mm^2)	Young's modulus of cylinders at 28th day (N/mm^2)
0%	26621.79	31390.93
5%	28619.72	34294.3
10%	29723.49	34452.5
15%	29594.3	35954.6
20%	28754.88	39617.08

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