DEVELOPMENT OF SELF COMPACTING CONCRETE

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Abstract- The growing use of concrete is special architectural configurations and closely spaced reinforcing bars have made it very important to produce concrete that ensures proper filling ability, good structural performance and adequate durability. Self-compacting concrete (SCC) is an innovative concrete that does not requires vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. Popularity of using self-compacting concrete (SCC) in concrete construction is increased in many countries, since SCC is effectively applied for improving durability of structures while reducing the need of skilled workers at the construction site. Nowadays, the use of different chemicals as an admixture to improve concrete or getting some new properties of concrete. But, there is increased use of alternative chemicals, which shows significant advantages. One of such admixture Viscosity Modifying Admixture (VMA) increases the viscosity of concrete in order to preventing segregation under the water.

I. INTRODUCTION

1. Self Compacting Concrete:

Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. In North-America, self-compacting concrete is referred to as self-consolidating concrete. Self-compacting ability can be, but is not necessary, equivalent to self-levelling ability. Sometimes, the term self-levelling is applied to describe a self-compacting concrete with a perfect levelling after casting.

Self-compacting concrete is a type of concrete that gets compacted under its self-weight. It is commonly abbreviated as SCC and defined as the concrete which can be placed and compacted in to every corner of a formwork, purely by means of its self-weight and eliminating the need of either external energy input from vibrators or any type of compacting efforts. It is also referred as self-leveling concrete, super workable concrete, highly-flowable concrete, non-vibrating concrete etc.

With this revolutionary development, the construction engineer is now relieved of two annoying problems: one, the difficulty in ensuring thorough compaction employing unskilled labor, and two, the necessity to deal with repairs and making good finishes. The reduced manpower required for casting and finishing leads to an increase in the speed of construction. Two other important advantages of SCC are; the improvement in performance of concrete (including its durability) and new design options that are available with the use of SCC (Subramanian, 2004). The concept of self-compacting concrete was proposed in 1986 by Professor Hajime Okamura, but the prototype was first developed in 1988 in Japan, by Professor Ozawa (1989) at the University of Tokyo.

Worldwide, there is a wide range of mix proportions that can produce successful SCC. However, in most of these compositions, a number of key factors fall within limiting values. Expressed in volumetric terms, these are:

1. A coarse aggregate volume of 30% to 34% of the concrete volume. This is significantly less than typical values for normal workability concrete of 40% to 45%.

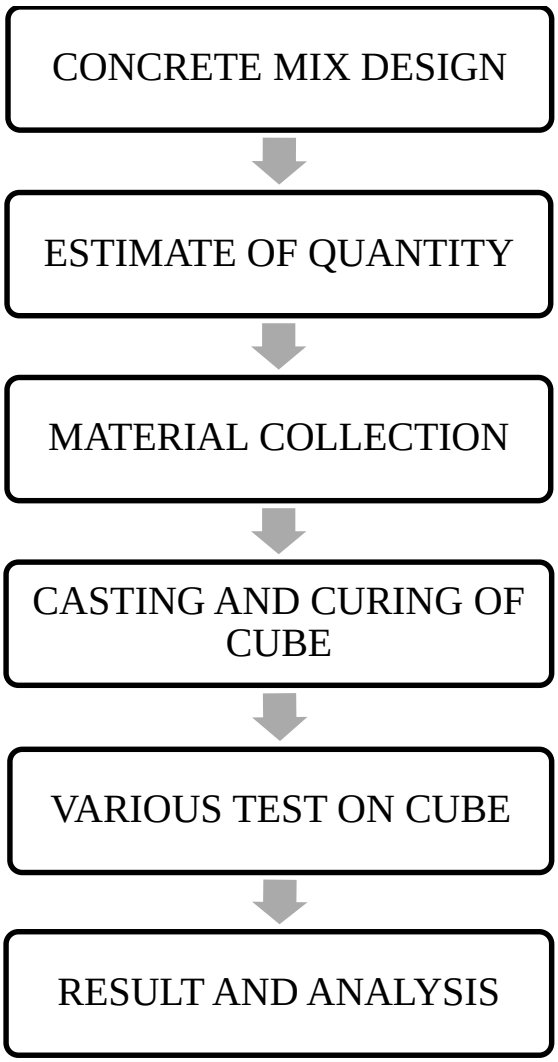
2. A water/powder ratio of 0.8 to 1.2, with mixes with values at the upper end of this range usually containing a viscosity agent for enhanced viscosity.
3. A water content of 155 to 175 l/m3 if no viscosity agent is used, or up to about 200 l/m3 with a viscosity agent.
4. A paste volume of 34% to 40% of the concrete volume.
5. A fine aggregate volume of 40% to 50% of the mortar volume.

1. Viscosity Modifying Agent:

VMA stabilizes rheology. VMA increase viscosity of concrete by the generation of a polymer chain at low shear rate. It creates a very thin layer of polymers around the concrete so that the water & the other Materials are binding together, water will not enter the mix from the outside. There are two types of VMA are available i) Polymer Based ii) Cellular Based.

VMA has extensive property to grab and hold the water. It does nor affects any properties of concrete except viscosity. The admixture is water soluble & chloride free so that it is compatible with all types of cement.

II. METHODOLOGY



III. MATERIAL SPECIMEN

1. Cement (OPC 53 Grade)

Ordinary Portland cement of 53 grade satisfying all the requirements of IS 269-1976 was used in making the concrete cubes in the experimental work, and the specific gravity of cement was found to be 3.15.

No	Properties	IS; 269-1976
1	Normal Consistency	31.25 %
2	Initial setting time	Minimum of 72 min
3	Final setting time	Maximum of 180 min
4	Specific gravity	3.15

Table 3: Physical property of cement

2. Mix Proportion:-

Cement = 469.65 kg/m^3

Water = 187.86 kg/m^3

Fine aggregate = 510.93 kg/m^3

Coarse aggregate = 1192.17 kg/m^3

Water / cement ratio = 0.4

The proportions for normal mix of M30 Normal Mix are as follows:

Cement: Sand: Coarse Aggregate: Water

1 : 1.08 : 2.53

3. Compression Test

The compression test was perform using CTM. Compressive strength test is the most common test conducted on concrete, because it is easy to perform and most of the desirable characteristic properties of concrete are quantitatively identified to its compressive strength. Compressive strength was determined by using Compression Testing Machine (CTM) of 2000 KN capacity.

The compressive strength of concrete was tested using 150 x150x150 mm cube specimens. The test was carried out by placing a specimen between the loading surfaces of a CTM and the load was applied until the specimen fails. Three specimens should cast and to measure the compressive strength for each test conditions and average value was considered.

IV. RESULTS

1. COMPRESSIVE STRENGTH TEST

The compressive strength of concrete is one of most important properties of concrete in most structural applications. For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M30 grade of concrete. After curing, these cubes were tested on Compression Testing machine as per I.S. 516-1959. The failure load was noted.

Sr No.	Compressive Strength		
	7 Day	14 Day	28 Day
1	20.5	25.6	32.8

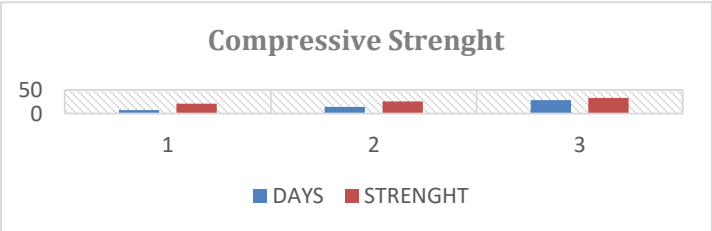


Table 4: Test Result of Compressive Strength Test

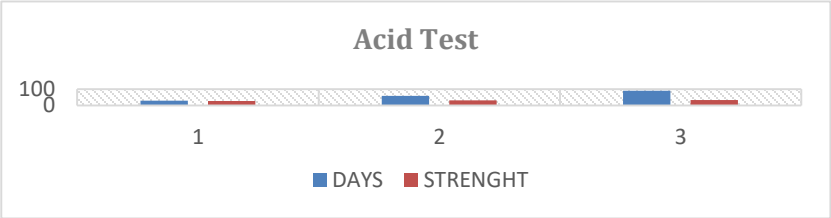
2. DURABILITY TEST

Durability is the ability of concrete to resist weathering action, chemical attack and abrasion while maintaining its desired engineering properties. The nature, intensity and mechanism implied in each of these different attacks could vary considerably. No standardized method exists for measuring the durability of concrete in general. Similarly, there are no units in which to evaluate the durability of the concrete.

a) Acid Test:

Acid resistance was tested on 150 mm size cube specimens at the age of 28 days of curing. The cube specimens were weighed and immersed in water diluted with one percent by weight of sulphuric acid for 30, 60 and 90 days. Then, the specimens were taken out from the acid water and the surfaces of the cubes were cleaned. Then, the weight and the compressive strength of the specimens were found out and the average percentage of loss of weight and compressive strength were calculated.

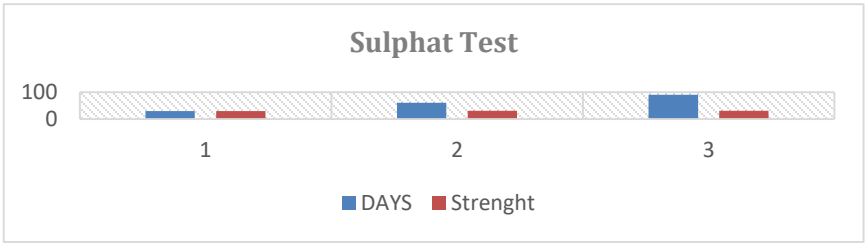
ACID TEST		
30 Day	60 Day	90Day
28.04	31.04	33.29



b) Sulphate Test:

The sulphate attack testing procedure was conducted by immersing concrete specimens of the size 100x100x100 mm over the specified initial curing in a water tank. Then, they were cured in 5% Sodium sulphate solution for 30, 60 and 90 days, respectively. This type of testing represents an accelerated testing procedure, which indicates the performance of particular concrete mixes to sulphate attack on concrete. The degree of sulphate attack was evaluated by measuring the weight losses of the specimens at 30, 60 and 90 days, respectively. The following general conclusions can be made:

30 Days	29.77 N/mm2
60 Days	31.30 N/mm2
90 Days	30.93 N/mm2



VI. CONCLUSION

Based on limited study carries out on strength behavior of VMA, the following conclusion is shown.

1. Workability of concrete is increased with the help of VMA admixture.
2. The compressive strength of concrete is increased as compared to the target strength.
3. The Acid Test results and Sulphate test results proved to be more better than the normal concrete without VMA admixture.

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