STUDY OF SELF COMPACTING CONCRETE

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Abstract- Today concrete is most widely used construction due to its good compressive strength and durability. Depending upon the nature of work, cement, fine aggregate and water are mixed in specific proportion to produce plain concrete. self compacting concrete is a type of concrete which flows easily due to its weight. Flowability can be achieved by using admixture and VMA. We dedigned SCC by admixture as POLY CARBOXYLIC ETHER and VMA as MICROSILICA.

Index Terms- Self Compacting Concrete, Compressive strength, Fly ash, Rice husk ash.

Introduction- The development of new technology in the material science is progressing rapidly. In last three decades, a lot of research was carried out throughout globe to improve the performance of concrete in terms of strength and durability. The growing use of concrete in special architectural configuration and closely spaced reinforcing bars have made it very important to produce concrete that ensures proper filling ability, good structural performance and adequate durability. In recent years a lot of research was carried out throught the world to improve the performance of concrete in terms of its most important properties, i.e. strength and durability. Concrete technology has undergone from macro to micro level study in the enhancement of strength and durability properties from 1980's onwards. Till 1980 the research study was focused only to flow ability of concrete, so as to enhance the strength however durability did not draw lot of attention of the concrete technologists. SCC eliminates the needs of vibration either external or internal for the compaction of the concrete without compromising its engineering properties.

Ingredients of SCC:

Aggregates- The maximum sixe of aggregate is generally limited to 20mm. Aggregate of size 10mm is desirable for structure having congested reinforcement. Well grades cubical and rounded aggregate are desirable.

Fine aggregate can be natural or manufactured. The grading must be uniform throughout the work. Particles smaller than 0.125mm i.e. 125 micron sixe are considered as FINES which contribute to the powder content.

Cement- Generally Portland cement is used for SCC. Portland cement contain 20-25% fly ash which increase the flowability of concrete that is basic requirement of Self Compacting Concrete. Ordinary Portland cement can also be used but it leads to additional cost of fly ash.

Polycarboxylic Ether- The new generation of this kind of admixtures is represented by carboxylate ether based superplasticizers(PCEs). With a relatively low dosage (0.15–0.3% by cement weight) they allow a water reduction up to 40%, due to their chemical structure which enables good particle dispersion.

PCEs are composed by a methoxy-polyethylene glycol copolymer (side chain) grafted with methacrylic acid copolymer (main chain). The carboxylate group -COO−Na+dissociates in water, providing a negative charge along the PCE backbone. The polyethylene oxide (PEO or MPEG) group affords a not uniform distribution of electron cloud, which gives a chemical polarity to the side chains. The number and the length of side chains are flexible parameters that are easy to change. When the side chains have a huge amount of EO units, they lower with their high molar mass the charge density of the polymer, which enables poor performances on cement suspensions.To have both parameters on the same time, long side chain and high charge density, one can keep the number of main-chain-units much higher than the number of side-chain-units.

Superplasticizer- Superplasticizers, also known as high range water reducers, are chemical admixtures used where well-dispersed particle suspension is required. These polymers are used asdispersants to avoid particle segregation(gravel,coarse and fine sands), and to improve the flow characteristics (rheology) of suspensions such as in concrete applications. Their addition to concrete or mortar allows the reduction of the water to cement ratio, not affecting the workability of the mixture, and enables the production of self-consolidating concrete and high performance concrete.This effect drastically improves the performance of the hardening fresh paste. The strength of concrete increases when the water to cement ratio decreases. However, their working mechanisms lack a full understanding, revealing in certain cases cement-superplasticizer incompatibilities.[1] The addition of superplasticizer in the truck during transit is a fairly new development within the industry.

Viscosity Modifying Agent- This organic liquid viscosity modifying agent is used to produce concrete with enhanced viscosity and controlled rheological properties.
Fly ash- Fly ash is one of the residues generated in burning, and comprises the fine particles that rises with the flue gases. In an industrial field, fly ash usually refers to ash produced during burning of coal.
Rice husk ash- Rice plant is one of the plants that absorbs silica from the soil. Rice husk is the outer covering of the grain of rice plant with a high concentration of silica, generally more than 80-85%.

Testing on concrete:
SLUMP FLOW TEST- The slump flow is used to assess the horizontal free flow of SCC in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concrete. The test method is based on the test method for determining the slump. The diameter of the concrete circle is a measure for the filling ability of the concrete.The Permissible range of values for slump flow are 650 to 800 mm and T50cm test time are 2 to 5 seconds.

L-BOX TEST- This test, based on a Japanese design for underwater concrete, has been described by Peterson. The test assesses the flow of the concrete, and also the extent to which it is subjected to blocking by reinforcement.The whole test has to be performed within 5 minutes.

U-BOX TEST- This standards covers the method of passability through spaces of self-compacting concrete with a maximum coarse aggregate size of 25mm or less using a U- shaped or Box-shaped container.

V-FUNNEL TEST- This standard covers the method of funnel testing for average flow-through speed, relative flow-through speed and flow-through indicesof self-compacting concrete with a maximum coarse aggregate size of 25mm or less.

COMPRESSIVE STRENGTH TEST- The cubes were tested on compression testing machine of capacity 2000KN. The bearing surface of machine was wiped off clean and sand or other material removed from the surface of the specimen. The specimen was placed in machine in such a manner that the load was applied to opposite sides of the cubes as casted i.e. not top and bottom. The axis of the specimen was carefully aligned at the center of loading frame. The load applied was increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained. The maximum load applied on specimen was recorded.
Compressive Strength = P/A

TABLE No. 1

S.No.	*Concrete type*	*3 days strength*	*7 days strength*	*28 days strength*
1	*Normal concrete M30*	*17.45N/mm²*	*24.9N/mm²*	*41.60N/mm²*
2	*SCC M30*	*18.9N/mm²*	*31.5N/mm²*	*42.85N/mm²*

TABLE No. 2 Tests results as compared to standard results

Test	*Standard result*	*Achieved result*	*Unit*
Slump flow	*650-800*	*680*	*Mm*
V-Funnel T0	*8-12*	*11*	*Sec*
V-Funnel T5	*0-3*	*3*	*Sec*
L-Box (H2/H1)	*0.8-1.0*	*0.9*	*ratio*

Advantages of SCC:

1.) Improved Concrete Quality
SCC yields homogeneous concrete in situations where the castings are difficult due to congested reinforcement, difficult access etc.
SCC shows a good filling ability especially around reinforcement
SCC is very well suited for special and technically demanding structures such as tunnel linings, as the possibility to compact the concrete is limited in the closed space between formwork and rock. Shows narrow variation in properties on site.

Most suitable for concrete filled tubes (CFT) technology construction for high rise buildings.
It ensures better quality of in-situ pile foundation.

2.) Environmental & Human Health Protection
Reduces noise at sites, the pre cast factory, and neighborhood, hence, it is a silent concrete.
Eliminates problems with blood circulation leading to "white fingers" caused by compacting equipment, hence called a healthy concrete.
SCC gives noise protection in precast industry, by introducing no restrictive measures like ear protection, marked areas, safety instructions are necessary.
Shortens the construction time by accelerating construction process, especially in pre cast industry.

3.) Economy & Time Reducing
Its ease of placement improves the productivity and the cost saving through reduced equipment and labor equipment.
Reduction in wear and tear of forms, therefore, it extends the service life of forms.
Reduction in the number of worker. Normally one cum requires 1.5 man-hours; with SCC this is reduced to 0.35 man-hours.
It reduces the consumption of resources and cost, even considering a higher price per cubic meter for the concrete. Okamura has reported that it is possible to reduce the overall bridge cost by 5-15%.
Because of its high fluidity, this concrete does not need any vibrations so that it allows to save energy and ensure suitable cost in place.
Reduction of expenses and manpower needed for patching finished precast elements.

4.) Construction with SCC is not affected by the skill of the workers, and shape and arrangement of reinforcing bars of the structures.

5.) SCC use at construction sites reduces the chance of accident by reducing number of cables needed for the operation of compacting equipment, hence, reduces the workers compensation premiums.

Disadvantages of SCC:

1.) The production of SCC places more stringent requirements on the selection of materials in comparison with conventional concrete.

2.) An uncontrolled variation of even 1% moisture content in the fine aggregate will

3.) have a much bigger impact on the rheology of SCC at very low W/C (~0.3) ratio. Proper stock pilling of aggregate, uniformity of moisture in the batching process, and good sampling practice are essential for SCC mixture .

4.) A change in the characteristics of a SCC mixture could be a warning sign for quality control and while a subjective judgment, may some times be more important than the quantitative parameters. The development of a SCC requires a large number of a trial batches. In addition to the laboratory trial batches, field size trial batches should be used to simulate the typical production conditions. Once a promising mixture has been established, further laboratory trial batches are required to quantify the characteristics of the mixture.

Conclusion- In present scenario there is a greater need for self compacting concrete due to sickness of member and architectural requirement, also to improve durability of the structure.
Now the world is going to facing greater need of high performance concrete, durability point of view and SCC where the conventional way of compacting may not be always useful under different site condition. So instead of going for the conventional concrete let us mix the concrete compacting on its own which is called as self compacting concrete. Based on above results and discussions the following conclusions are drawn-
We can reduce the in-place cost and maker a safer working environment for the workers.
SCC can be effectively placed in most congested areas and also where normal methods of vibration are not possible.
Further research are required to interpret influence on the hardened properties of SCC more precisely.
The cost of SCC is 10-15 % higher than the conventional concrete.
Self Compacting Concrete (SCC) technology can save time, cost, enhance quality, durability and Moreover it is a green concept.
Since the concrete is capable of self-consolidating and reaching the difficult areas in moulds, manual variables in terms of placing and compacting concrete is nil. This factor ultimately yields defect less, better-quality concrete structures.
Cast-in-place concrete construction in tight space and congested reinforcement, such as, drilled shafts, columns and earth retaining systems, can be accelerated by using SCC.

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