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POWDER TYPE SELF COMPACTING CONCRETE FOR INFRASTRUCTURE PROJECTS

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Abstract: ***In this paper we study on Self Compacting Concrete (SCC) to be made using various Mineral Admixtures. In current scenario of construction industries due to demand in the construction of large and complex structures, which often leads to difficult concreting conditions. When large quantity of heavy reinforcement is to be placed in a reinforced concrete (RC) member, it is difficult to ensure fully compacted without voids or honeycombs. Compaction by manual or by mechanical vibraators is very difficult in this situation. That leads to the invention of new type of concrete named as self-compacting concrete (SCC).***

This type of concrete flows easily around the reinforcement and into all corners of the formwork. Self-compacting concrete describes a concerete with the ability to compact itself only by means of its own weight without the requirement of vibration. Self-copacting concrete also known as Self-consolidating Concrete or Self Compacting High Performance Concrete. It is very fluid and can pass around abstructions and fill all the nooks and corners without the risk of either mortar or other ingredients of concrete separating out, at the same time there are no entrapped air or rock pockets. This type of concrete mixture does not require any compaction and is saves time, labour and energy.

In this project we explains the utilization of powder type SCC and various mineral admixtures for big Infrastructural project.

Keywords: concrete, compaction, admixture, infrastructure, SSC, stability etc.

1.1.1. INTRODUCTION

Self-compacting concrete is defined as a concrete which is capable of self- consolidating without any external passing, ability of filling and ability of being stable.

SCC developed by Prof. Okamura and his team in Japan in the early nineties, has evolved as an innovative technology, capable of achieving the status of being an outstanding advancement in the sphere of concrete technology. Though the concept of self-compacting concrete was evolved initially in Japan around 1988, since then several research efforts have been made in developed countries such as Western Europe, Canada, Sweden and Netherlands. Self-Compacting Concrete has been described as “The most revolutionary development in concrete construction for several decades”.

1.1.1 ESSENTIAL PROPERTIES OF SELF COMPACTING CONCRETE

1.1.2 Filling Ability

It is the property of Self Compacting Concrete to flow into and fill all spaces within the formwork completely under its own weight without any honeycombing. If Self Compacting Concrete is satisfying this test, that means one can be sure about its property to fill the form completely and can believe on ‘Pour and forget.’

1.1.3 Passing Ability

It is the property of the Self Compacting Concrete to pass through congested reinforcement without blocking. As one of the distinct advantages of Self Compacting Concrete is that it can use in the situation of congested reinforcement, it has to satisfy the test of passing ability.

1.1.4 Segregation Resistance

It is the ability of Self Compacting Concrete to remain stable in composition. SCC being flowing in nature, it must satisfy this property.

1.1.5 Need of SCC

Need of Self Compacting Concrete through reinforcement and fill all the space in the form for meeting strength and durability requirement. If compaction is not complete, it will lead to loss of strength and affect performance of the structure. The compaction becomes difficult when percentage of reinforcement is high which does not allow insertion of vibrator at some places.

Fig. 1 A Self Compacting Concrete

1.1.6 Benefits and Advantages of Self Compacting Concrete

- Improved filling capacity of highly congested structural member withouthoney combing.
- Increases speed of construction.
- Reduced formwork and equipment cost.
- Reduction in site manpower.
- The surface finish produced by SCC is exceptionally good and no patching isrequired.
- Placing of concrete becomes easier.
- It improves durability of concrete.

1.1.7 Disadvantages of self-compacting concrete

- SCC requires higher powder and admixture contents than NVC and so the material cost is higher. It was reported that in most cases, the cost increase ranged from 20% to 60% compared to similar grade NVC. However in very large structures, increased material cost by using SCC was outweighed by savings in labor costs and construction time.
- The benefits of SCC were fully displayed in a composite sandwich system, which involves casting SCC and NVC in layers within the same structural elements.
- The increased content of powder and admixture also leads to higher sensitivity of SCC to material variation than that of NVC; thus greater care with quality control is required.

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Fig. 2 workability Test on Self Compacting Concrete

1.1.6 Applications of Self Compacting Concrete

SCC is a very dense, homogenous and durable concrete. It is readily used in precastand on site construction.

1.1.7 Applications of SCC in Precast/Prestress Industry

SCC is also advantageously and effectively used in precast industry.

- The renovation work being proposed for Soldier Field in Chicago will feature precast concrete tubes using SCC. The material will provide a flawless concrete that eliminates the need for patching, speeding the work considerably.
- Precast panels using SCC are poured at the Fin fork industries plant in Orlando, Fla. The material flows quickly to fill every nook & cranny, leaving no voids and flowing around densely packed reinforcements.

1.1.8 Applications of SCC in India

Nuclear Power Corporation of India (NPCIL) intended to use SCC at two NuclearPower Plants of India

1) Nuclear Power Plant at Kaiga in Karnataka.
2) Nuclear Power Plant at Tarapur Atomic Power Research Plant for its 3rd and4th stages.
3) SCC was used in the construction of a pre-cast slab element used in a Gujaratschool project.
4) It was used as a backpack concrete in tunnel for Khopoli New WaterConductor system. A total 10,000 m^3 of SCC was placed in a tunnel length of 1.48 km.

1.2.3 Variable in proportion with the given material four variable factor

Variable in proportion with the given material four variable factor to beconsidered in connection with specifying are:

A. Water -cement ratio.
B. Cement content or cement- aggregate ratio
C. Gradation of the aggregates
D. Consistency

In general all four of these inter related variable cannot chosen or manipulated arbitrarily two or three factors are specified and other are adjusted to give minimum workability and economy. We use arbitrary proportion method with variable cementations material content.

1.1.9 Self compacting concrete as Eco-friendly material

The major environmental impact of concrete is caused by CO_2-emissions during cement production. Great potential for reducing the impact is seen especially for concretes with normal strength. The use of Superplasticizer and highly reactive cements as well as optimization of particle-size distribution and reduction in water content allows a significant reduction in Portland cement clinker in the concrete. Essential is the addition of mineral fillers (e.g. limestone powder) to provide an optimal paste volume. In addition, the already practicable substitution of secondary raw materials like fly-ash or furnace-slag for cement clinker is an appropriate option which is however limited by the availability of these resources.

In several test series the fresh and hardened concrete properties of concretes with reduced water and cement contents were investigated, especially their workability, strength development, design-relevant mechanical properties as well as durability aspects such as carbonation. It was shown that concretes with cement clinker and slag contents as low as 150 kg/m^3 were able to meet the usual requirements of workability, compressive strength (approx. 40 N/mm^2) and mechanical properties. The carbonation depth of concretes with 150-175 kg/m^3 clinker and slag was equal or lower than the depth of conventional reference concretes for exterior structures. The ecological advantages were identified, using environmental performance evaluation. A reduction of up to 35% in environmental impact was calculated compared with conventional concrete and of more than 60% with granulated blast-furnace slag. Practical application was verified by means of full-scale tests in a precast and ready-mix concrete plant.

1.2 Objective of the study

The uses of SCC in the construction of rigid pavements are now seen in major areas. However, problems arise from the consideration that the infrastructures susceptible to cracking and structural defects. This can be overcome by use of powder type SCC in Infrastructure.

The fly ash added in appropriate quantity as replacement. The addition of fly ash imparts properties. Hence property impartation can be used for concreting in infrastructure works. Current problems associated with onsite concrete manufacturing, specific properties, compaction equipments and vibration machineries and their costings is a big concern. For comparison properties like compressivestrength, Flexural Strength and tensile strength are being considered.

CONCLUSION

From the current investigation, we can say that as compared to traditional concrete SCC have improved properties. Compressive strength of SCC with GGBS, fly ash or other filling materials can be increased. These properties of concrete at hardened state are important considering infrastructure projects. Hence, rather than traditional concrete SCC can be used to achieve economy in structures where no special load conditions are susceptible with large variation and huge demand. Now a day, efforts are made to succeed in creating durable and reliable structures with less maintenance so that SCC will change from Special to standard concrete.

- From the literature review, it is seen that fly ash in appropriate quantity improves the fresh as well as hardened properties of SCC. From results, it is seen that addition of fly ash increases strength of concrete.
- As compared to normal (vibrated) concrete, strength results shown by powder type SCC are slightly on higher side. Also, compressive strength results of 650 kg/m^3 were more than 600 kg/m^3 powder content. Hence, Powder content plays important role in increasing Characteristics Compressive strength of SCC mix.
- Flexural strength concrete examined for beams with 28 days curing, powder type SCC beams shown higher flexural strength than Normal concrete.
- Indirect Tensile strength of concrete calculated by Split tensile strength test. The tensile strength of 600 PC was slightly more than 650 PC i.e., for 650 PC the split tensile strength decreased. Hence we can conclude powder content should be less than 650 kg/m^3.
- Shrinkage analysis is done to understand shrinkage behavior of Powder type SCC. Shrinkage for SCC is more than the normal (vibrated) concrete. Again, shrinkage of PC 650 seems slightly more than PC 600. Hence, increase in powder content results in increase in shrinkage. Considering Infrastructure works, Powder Content can be limited up to 600 kg/m^3.

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