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SELF COMPACTING CONCRETE

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ABSTRACT

The application of concrete without vibration in high way bridge construction is not new. e. g. placement of seal concrete underwater is done by the use of tremie without vibration, mass concrete has been placed without vibration and shaft concrete can be successfully placed without vibration. SCC offers many advantages for the precast, prestreessed concrete industry and for cast in place. Several European countries were interested in exploring the significance and potentials of SCC developed in Japan. The SCC mixes are designed and tested to meet the demands of the projects. e.g. the mix for mass concrete is designed for pumping and depositing fairly high rate. Laboratory and field test have demonstrated that the SCC hardened properties are indeed similar to those of HPC. Self compacting concrete is a highly workable concrete due to this cause it is used in speedy construction. It is also a light weight and hence it is used where weight plays important role in structure than any other concrete.

Keywords: Concrete, Self compacting Concrete, Compressive strength

I. INTRODUCTION

The application of concrete without vibration in high way bridge construction is not new. e. g. placement of seal concrete underwater is done by the use of tremie without vibration, mass concrete has been placed without vibration and shaft concrete can be successfully placed without vibration. These seal, mass and shaft concrete are generally of lower strength, less than 34.5 MPa and difficult to attain consistent quality. Modern application of self compacting concrete is focussed on high performance - better and more reliable quality, dense and uniform surface texture, improved durability, high strength and faster construction.

Recognizing the lack of uniformity and complete compaction of concrete by vibration, researchers at the University of Tokyo, Japan, started out in late1980's to develop SCC. By the early 1990's Japan has developed and used SCC that does not require vibration to achieve full compaction. More and more applications of SCC in construction have been reported in Japan. As of the year 2000, the amount of SCC used for prefabricated products (precast members) and ready mix concrete (cast in place) in Japan was about 40000 m^3.

II. CONSTRUCTION

1. Low noise level in the plant and construction sites
2. Eliminated problems associated with vibration.
3. Less labour involved.

4. Faster construction.
5. Improved quality and durability.

Several European countries were interested in exploring the significance and potentials of SCC developed in Japan. These European countries formed a large consortium in 1996 to embark on a project aimed at developing SCC for practical application in Europe. The title of the project is " Rational Production and Improved Working Environment through using Self - compacting concrete."In the last six years, a number of SCC bridges, walls and tunnel linings have been constructed in Europe.

In United states, is beginning to gain interest, especially by the precast concrete industry and admixture manufactures. The precast industry is beginning to apply the technology to commercial projects when specifications permit. The applications range from architectural concrete to complex private bridges.

III. DEVELOPING SSC MIXES

SCC mixes must meet three key properties:

1) Ability to flow in to and completely fill intricate and complex forms under it's own weight.
2) Ability to pass through and bond to congested reinforcement under its own weight.
3) High resistance to aggregate segregation.

The SCC mixes are designed and tested to meet the demands of the projects. e.g. the mix for mass concrete is designed for pumping and depositing fairly high rate. SCC was used in the construction of the anchorages of the Akashi-Kaokyo Suspension Bridge. The SCC was mixed at the batch plant at the job site and pumped through a piping system to the location of anchorages 200 m away. The SCC was dropped from a height of as much as 5.0 m without aggregate segregation. For mass concrete, the maximum size of coarse aggregates may be as large as 50 mm. The SCC construction reduced the construction time for the anchorages 2.5 to 2 years. Similarly, SCC mix can be designed and placed successfully for concrete members with normal and congested reinforcement. The coarsed aggregate size for reinforced concrete generally varies from 10 mm to 20 mm.

IV. EXAMPLES OF SCC MIXES

When designing an SCC mix , a suitable mix is selected among " Powder - type" by increasing a powder content, "VMA- type" using viscosity modifying admixture and "Combined type" by incresing powder content and using viscosity agent in consideration of structural conditions, constructional conditions, available material, restrictions in concrete production plant, etc. SCC mixes are differ from concrete mixes and from each other based on the specific needs of the project.

V. PROPERTIES OF FRESH SCC

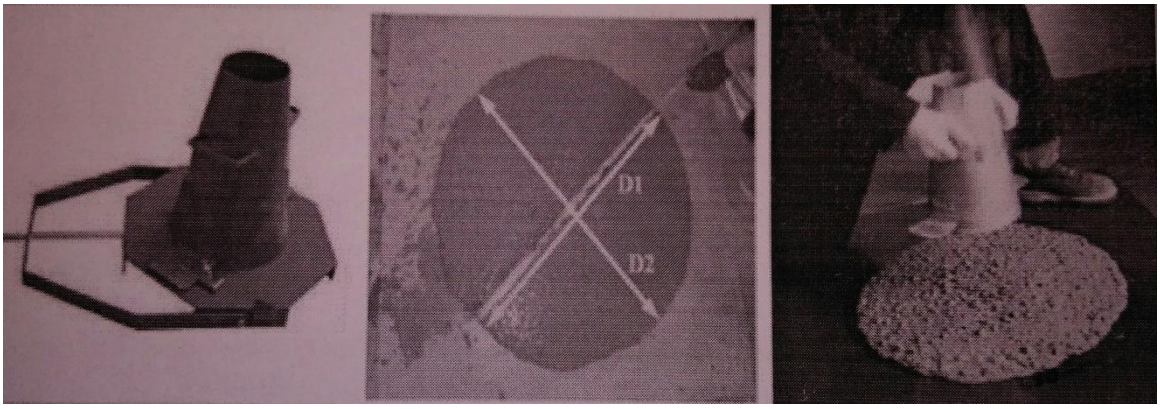
The main characteristics of SCC are the properties in the fresh state. SCC mix is focussed on the ability to flow under its own weight without vibration , the ability to flow through heavily congested reinforcement under its

own weight, and the ability to obtain homogeneity without segregation of aggregates. Several test methods are available to evaluate main characteristics of SCC. The tests have not been standardised by national or international organizations. The more common tests used for evaluating the compacting characteristics of fresh concrete in accordance with the draft standards of the Japan society of civil engineers.

VI. TEST METHODS FOR FRESH SCC:

6.1 The Sump Flow Test

This is the test method for evaluating the flow ability of SSC, where the slump flow of SSC with coarse aggregates having the maximum size of less than 40 mm is measured see figure. The basic equipment is the same as for conventional slump test . However, the concrete placed in to the mould is not rodded. When the slump cone has been lifted and the sample has collapsed, the diameter of the spread is measured rather than the vertical distance of the collapse.



VII. PROPERTIES OF HARDENED SCC

7.1 Structural Properties

The basic ingredients used in SSC mixes are practically the same as those used in the conventional HP vibrated concrete, except they are mixed in different proportions and the addition of special admixtures to meet the project specifications for SCC. The hardened properties are similar to those obtainable with HPC. Laboratory and field test have demonstrated that the SCC hardened properties are indeed similar to those of HPC.

SSC compressive strengths are comparable to those of conventional vibrated concrete made with similar mix proportions and water cement ratio. there is no difficulty in producing SCC with compressive strengths up to 60 MPa.

7.2 Tensile Strength

Tensile strengths are based on the indirect splitting test on cylinders. For SCC the tensile strengths and the ratios of tensile and tensile strengths are in the same order of magnitude as the conventional vibrated concrete.

7.3 Bond Strength

Pull out test have been performed to determine the strength of the bond between concrete and reinforcement of different diameters. In general, the SSC bond strength expressed in terms of the compressive strengths are higher than those of conventional concrete.

7.4 Modulus Of Elasticity

SCC and congenital concrete bear a similar relationship between modulus of elasticity and compressive strength expressed in the form of E/fc(0.5), where E= modulus of elasticity, fc= compressive strength. This is similar to the one recommended by ACI for conventional normal weight concrete.

7.5 Feasible Performance Specification

Based on the current state of knowledge, the performance specifications for SCC are achievable through proper mix design and testing.

7.6 Workability

i) Slump Flow > 600 mm.

ii) Remain Flowable > 90 minutes.

iii) Withstand a slope of 3%.

iv) Pumpable more than 90 minutes through pipes > 100 m long.

7.7 Mechanical Properties

i) 28 day compressive strength= similar to HPC.

ii) Creep and shrinkage also similar to HPC.

Durability Parameter:- Freeze thaw resistance > HPC.

IX. CONCLUSION

Self compacting concrete is a highly workable concrete due to this cause it is used in speedy construction. It is also a light weight and hence it is used where weight plays important role in structure than any other concrete.

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