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Review on Self Compacting Concrete

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*Abstract:***When large quantity of heavy reinforcement is to be placed in a reinforced concrete (RC) member, it is difficult to ensure that the formwork gets completely filled with concrete that is, fully compacted without voids or honeycombs. Compaction by manual or by mechanical vibrators is very difficult in this situation. The typical method of compaction, vibration, generates delays and additional cost in the projects. Underwater concreting always required fresh concrete, which could be placed without the need to compaction; in such circumstances vibration had been simply impossible. This problem can now be solved with self-compacting concrete. Self-compacting concrete (SCC) is characterized by a low yield stress, high deformability, and moderate viscosity necessary to ensure uniform suspension of solid particles during transportation, placement (without external compaction), and thereafter until the concrete sets.**

Keywords:Compaction, Viscosity, Stress, Deformability, Slump, Permeability.

I. INTRODUCTION

Self – compacting concrete (SCC) is a fluid mixture, which is suitable for placing difficult conditions and also in congested reinforcement, without vibration. In principle, a self – compacting or self – consolidating concrete must:

a) Have a fluidity that allows self – compaction without external energy
b) Remain homogeneous in a form during and after the placing process and
c) Flow easily through reinforcement

Self – consolidating concrete has recently been used in the pre – cast industry and in some commercial applications, however the relatively high material cost still hinders the wide spread use of such specialty concrete in various segments of the construction industry, including commercial and residential construction.

Compared with conventional concrete of similar mechanical properties, the material

cost of SCC is more due to the relatively high demand of Cementation materials and chemical admixtures including high – range water reducing admixtures (HRWRA) and viscosity enhancing admixtures (VEA). Typically, the content in Cementation materials can vary between 450 and 525 Kg/m^3 for SCC targeted for the filling of highly restricted areas and for repair applications. Such applications require low aggregate volume to facilitate flow among restricted spacing without blockage and ensure the filling of the formwork without consolidation. The incorporation of high volumes of finely ground powder materials is necessary to enhance cohesiveness and increase the paste volume required for successful casting of SCC.

Proper selection of finely ground materials can enhance the packing density of solid particles and enable the reduction of water or HRWRA demand required to achieve high deformability. It can also reduce viscosity for a given consistency; especially in the case of SCC made with relatively low Water – Binder ratio. Reducing the free water can decrease the VEA dosage necessary for stability. High binder content typically includes substitutions of cement with 20 to 40% fly ash or GGBS and, in some cases low contents of micro silica employed. The cost of SCC can be reduced through the selection of adequate concrete - making materials and admixture constituents, including partial substitutions of cement and supplementary Cementations materials by readily available fillers.

The SCC essentially eliminates the need for vibration to consolidate the concrete. This results in an increase in productivity, a reduction in noise exposure and a finished product with few if any external blemishes such as "bug holes". However, after completion of proper proportioning, mixing, placing, curing and consolidation, hardened concrete becomes a strong, durable, and practically impermeable building material that requires no maintenance.

A. Developments of self – compacting concrete

For several years beginning in 1983, the problem of the durability of concrete structures was a major topic of interest in Japan. The creation of durable concrete structures requires adequate compaction by skilled workers. The designs of modern reinforced concrete structures become more advanced, the designed shapes of structures are becoming increasingly complicated and heavy reinforcing is no longer unusual. One solution for the achievement of durable concrete structure independent of the quality of construction work is the employment of self – compacting concrete, which can be compacted into every corner of a form work, purely by means of its own weight and without the need for vibrating compaction. Okamura proposed the necessity of this type of concrete in 1986.

The prototype of SCC was first completed in 1988 using materials already on the market. The proto type performed satisfactorily with regard to drying and hardening shrinkage, heat of hydration, denseness after hardening, and other properties. This concrete was named "High Performance Concrete" and was defined as follows at the three stages of concrete:

a) Fresh : Self – Compactable.
b) Early age : Avoidance of initial defects
c) After hardening: Protection against external factors.

B. Necessity for new structural design and construction systems

Self – compacting concrete saves the cost of vibrating compaction and ensures the compaction of the concrete in the structure. However, total construction cost cannot always be reduced, except in large – scale constructions. This is because conventional construction systems are essentially designed based on the assumption that vibrating compaction of concrete is necessary.

Self – compacting concrete can greatly improve construction systems previously based on conventional concrete that required vibrating compaction. This sort of compaction, which can easily cause segregation, has been an obstacle to the rationalization of construction work. Once this obstacle is eliminated, concrete construction can be rationalized and a new construction system including form work, reinforcement, support and structural design, can be developed.

One example of this is the so called sandwich structure, where concrete is filled into a steel shell. Such a structure has already been completed in Kobe, and could not have been achieved without the development of self – compacting concrete (Shishido etal, 1999).

II. ADVANTAGES OF SELF COMPACTING CONCRETE

At present self – compacting concrete (SCC) can be classified as an advanced construction material. The SCC as the name suggests, does not require to be vibrated to achieve full compaction. This offers benefits and advantages over conventional concrete.

1. Improved quality of concrete and reduction of onsite repairs.
2. Faster construction times.
3. Lower overall costs.
4. Facilitation of introduction of automation into concrete construction.
5. Improvement of health and safety is also achieved through elimination of handling of vibrators.
6. Substantial reduction of environmental noise loading on and around a site. Possibilities for utilization of “dusts”, which are currently waste products and which are costly to dispose of.
7. Thinner concrete sections.
8. Greater Freedom in Design.
9. Improved durability, and reliability of concrete structures.
10. Ease of placement results in cost savings through reduced equipment and labor requirement.
11. SCC makes the level of durability and reliability of the structure independent from the existing on – site conditions relate to the quality of labor, casting and compacting systems available.

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