Self-Consolidating Concrete: Today and Tomorrow

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Self-Consolidating Concrete originated and gained initial acceptance in Japan in the late 1980s. It is used successfully today throughout the world in pre-cast and cast-in-place concrete. It is increasingly being specified and used in North America.

Self-Consolidating Concrete (SCC) is a highly flowable non-segregating concrete with a slump/ flow of 20" to 30" that can be easily placed and completely fill forms under its own weight and without mechanical consolidation.

SCC is produced using high range water reducing admixtures (HRWRA), viscosity-modifying admixtures (VMA), and well-graded aggregates. A polycarboxylate based HRWRA is the typical type of high range water reducing admixture used. The HRWRAs and VMAs provide the required fluidity and viscosity required on the project . THE VMAs provide the increase in viscosity (cohesiveness) which ensures the stability of the mixture. They are commonly used in mixes with slump/flows above 24" and in mixes with less than an optimum combined aggregate gradation. Mix designs are initially prepared in accordance with the project specifications, expected slump/flow range, and with a setting time based on climatic conditions at the time of placement. The proposed mixes should be verified by a successful onsite placement. These placements will confirm the optimum slump/flow, pumpability, finish, and setting time. Excessive form pressure can result from retarded set concrete or too rapid placement of concrete or both.
Form work must be designed with slump/flow, rate of placement, and setting time established. SCC has thixotropic properties which tend to minimize form pressures. The following articles provide valuable information on slump/flow, setting time, and resulting form pressure:

- "Form Pressures Generated by Self-Consolidating Concrete," by Peter Billberg, Johan Silfwerbrand, and Thomas Sterberg, Concrete International, October 2005.

- "Pressure of Self-Consolidating Concrete on Formwork," by Andreas Leemann, Cathleen Hoffmann, and Frank Winnefeld, Concrete International, February 2006.

The architectural concrete finish is greatly influenced by the type of form release agent material used. The following pictures indicate the great impact of the thickness of the form release agent.
SCC is currently used in pre-cast concrete, architectural concrete, heavily reinforced concrete and formed repairs. SCC in the plastic state offers the benefits of speed of placement, ease of consolidation, deformability, and resistance to bleeding and segregation in both the dynamic and static states. The hardened concrete benefits include approved appearance and finish, higher early strength than conventional superplasticized concrete when the polycarboxylate admixture is used, higher bond steel strengths because vibration causes some bleeding which results in voids under reinforcement. SCC can also achieve these additional benefits:

- Faster placing, finishing, and stripping of forms
- Reduced equipment costs
- Faster turnaround time of concrete trucks
- Significant cost savings because of the elimination of vibration and increased rate of placement
- Reduction in patching and repair.

The benefits of Self-Consolidating Concrete are recognized by many owners, designers, and concrete producers in the greater metropolitan area. Most structural engineering firms today include self-consolidating concrete in their master specification. The mix designs on the previous page have currently been prepared and/or used successfully. Successful SCC concrete has the following characteristics:

- The specification is clear as to usage, w/cm, air content, the necessity for a pre-concrete conference, and successful test placements onsite.

- The pre-concrete conference agenda requires representatives from the designers, contractors, concrete producers, admixture manufacturers, and testing lab personnel to thoroughly discuss the mix design requirements in both the plastic and hardened state, climatic conditions, form design, form release agent, schedule, rate of placements, test placement location(s), and target setting time.
- The acceptable slump/flow range based on the successful test placement onsite.
- Testing procedures at the concrete plant and in the field with respect to water and air content.
- Acceptable architectural finish requirements regarding uniformity of finish, color and bug hole limits on size and number.

When the planning and preparation are thorough and the QA/QC procedures are followed, very successful architectural and structural concrete are the result.

The entire concrete industry benefits from successful projects. SCC success expands the use of cast-in-place concrete.