

Aesthetics Drive the Use of Self-Consolidating Concrete on the Expansion of Baltimore's National Aquarium

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Over the last few years, Self-Consolidating Concrete (SCC) has become widely accepted in the precast/prestressed industry. The cost savings in the production process as well as the improved appearance of the finished product are the driving forces behind the use of SCC. Current estimates put the use of SCC in this industry at over 60%.

While many can see the benefits of using SCC in ready mix concrete, the hurdles to overcome have proven to be higher than in the precast/prestressed industry. In precast/prestressed concrete, producers are selling a finished product, and customers are ultimately unable to distinguish whether a Double-T or box culvert was produced with SCC or with conventional slump concrete (except maybe for the improved surface appearance). But in ready mix concrete, the producer delivers fresh concrete, and while the difference in appearance is obvious right away, to an untrained eye, the concrete looks more like a watered-down regular mix than High-Performance Concrete. The contractor and engineer had to rely on hardened properties developing over time to make sure this "new" concrete meets their requirements. It wasn't until a few months ago that testing laboratories were provided with the appropriate SCC testing method to evaluate the fresh concrete on the jobsite to qualify or disqualify the mix. Only recently did ASTM approve two standard test methods for measuring SCC: ASTM C-1611 - "Standard Test Method for Slump Flow of Self-Consolidating Concrete" and ASTM C-1621 - "Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring". An Emerging Technology Document on SCC is also about to be published by the newly created ACI Committee 237 on Self-Consolidating Concrete.

Despite these hurdles, a few major, high profile projects have been constructed using ready mix SCC. For the majority of these projects, conventional slump concrete was specified, but due to problems on the jobsite or for aesthetical reasons the engineers and owners decided early on to use SCC. One of these projects is the new National Aquarium in Baltimore, MD. This expansion project, a 10-story glass building that takes visitors on new journeys through the Chesapeake Watershed and across Maryland's Allegheny Cascades, is the largest ever for the aquarium.

The columns, as well as other structural elements, would be fully visible upon completion of the project. The concrete was to be placed in one monolithic pour to ensure a perfect finish. Even though the concrete would be painted, any surface imperfections and pour lines would still have been visible in the finished product. The height of the columns, however, made vibration of the entire height all but impossible and a solution had to be found that would disguise pour lines and eliminate vibration.

The solution was to use SCC and pour the entire height of the columns in one single pour without the need for vibration. The mix design for the SCC was developed using materials available locally. No additional aggregates or fillers were needed in the mix design of the SCC mixtures as are traditionally needed with conventional slump concrete. The design strength for the mix was 5,000 psi. The mix design used on the project can be seen in Table 1 {next page}. The minimum slump flow required was 22 inches. Mock-up pours were also performed before SCC was approved for the project by the engineers.

The final appearance of the columns turned out better than expected and led to significant timesavings. The contractor decided to continue using SCC for the concrete work on walls and slabs for the remainder of the project.

The coordination among architects, engineers, the contractor, and the ready mix supplier on this project allowed for this approach and satisfied the aesthetic requirements of the job, without compromising any engineering properties or time. John Browning, Quality Control Manager of the ready-mixed concrete supplier on the project, believes that, "SCC is a technology that more and more ready mix producers are going to be investigating since the benefits are so clear cut and all parties involved can see the advantages." As more of these projects are built and the awareness among engineers and architects increases, SCC will

slowly make its way into more specifications. Although the SCC technology in the ready mix industry may still have some hurdles to overcome, the early success on some high profile projects is helping to make it the latest innovative technology.