Self-Consolidating Concrete

Technical Bulletin #22 - October 2023

What is Self Consolidating Concrete?

Self Consolidating Concrete, or SCC, is a highly flowable concrete mix that resists segregation and consolidates under it's own weight, eliminating the need for vibrators and allowing encapsulation of tight rebar congestion. At the high end of flowability, SCC mixes will find their own level nearly as efficiently as water.

How is SCC made?

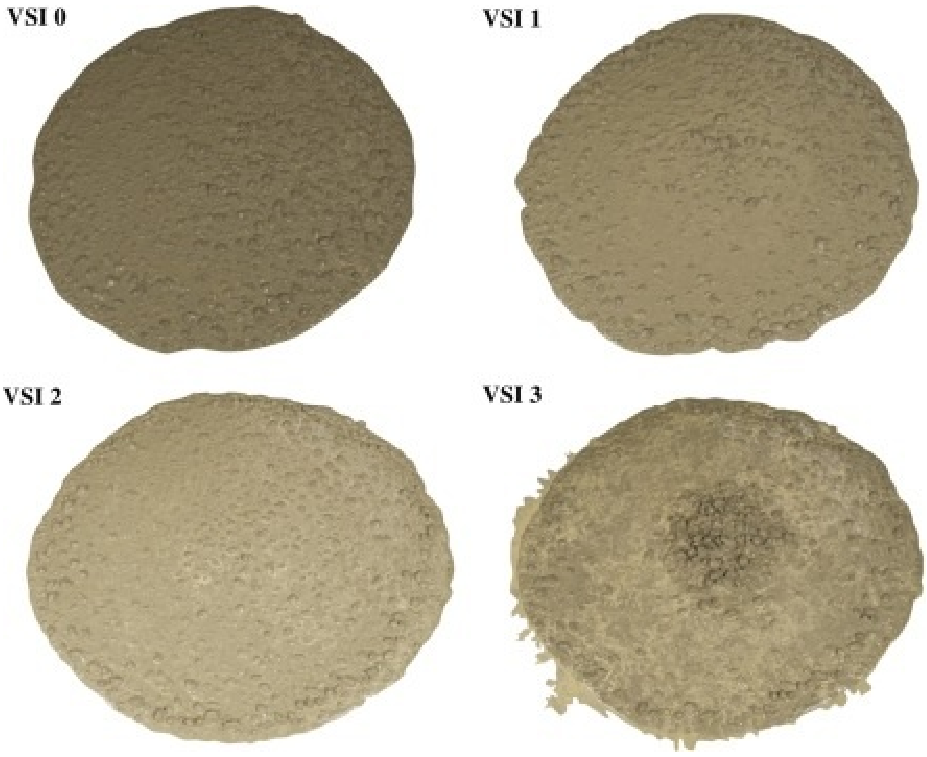
SCC is made by carefully balancing cementitious materials, aggregate proportions, admixtures and water into a mix design that flows well, and does not segregate. This is mostly achieved by using a higher quantity of cementitious materials, using a high-range water reducer, and a viscosity modifier (Technical Bulletin #21). The aggregates must also be in balance, as a gap-graded combined aggregate gradation will promote segregation. The increased cementitious material and the viscosity modifier work to hold the mix together and “thicken” the water. The high-range water reducer gives the flowability necessary for the mix to move under it's own weight during placement. The resulting mix can do things like this.

SCC mixes can be made with or without air entrainment, but often one of the greatest challenges of an SCC mix design is holding the desired air. The first sign of instability in an SCC mix can often be air entrainment loss.

How is SCC tested and evaluated?

Unlike conventional concrete in which flowability is tested by slump, SCC mixes are tested for spread. The test is similar, but critically different: a slump cone is inverted on a moist flat non-porous board. The cone is filled with concrete and then slowly lifted off the board. The resulting puddle of concrete is measured from end to end at two perpendicular directions, and then averaged to result in a spread value. To be considered a true SCC mix, the spread value is often between 22-30".

The next important test is a subjective one done with that same sample of concrete used for the spread test. It is called the Visual Stability Index, which is done to evaluate segregation potential. A VSI of 0 means the aggregate in the mix is uniformly spread through the sample and there is no bleeding or halo of water. a VSI of 1 is normally acceptable but represents slight instability where bleeding is present. A VSI of 2 is typically unacceptable and is represented by a water halo around the outside of the concrete sample. A VSI of 3 will show an aggregate pack directly under where the cone was lifted and significant water segregation along the perimieter.



Other tests on SCC include the J-Ring test, where the ability for the mix to move around simulated rebar is tested and the static segregation test, where aggregate weights are measured between the top half and bottom half of a large cylinder filled with SCC to test the segregation potential of a mix design.

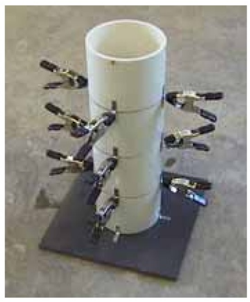
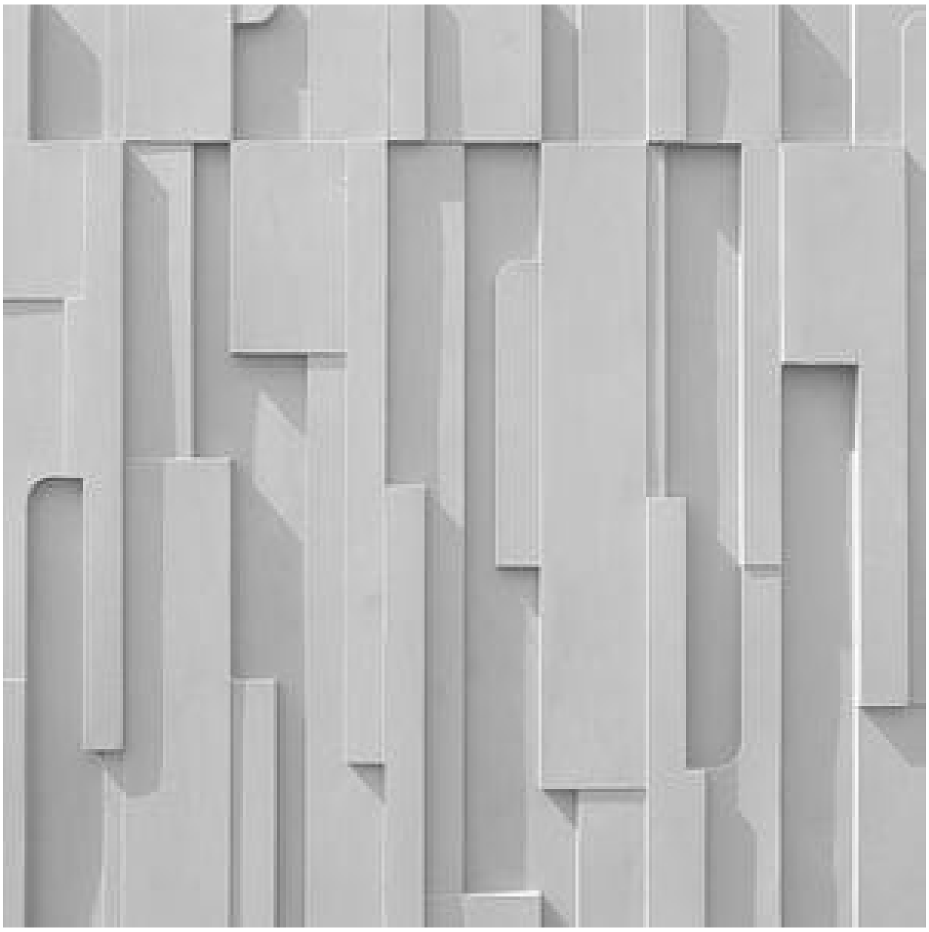
Filling Ability	Passing Ability	Segregation Resistance
Slump Flow Test	J-Ring Test	Column Segregation Test
		
Lab and Field	Lab Only	Lab Only

Figure 2.2: Test Methods for SCC Workability

Strength testing is done with traditional cylinders, however they are filled in one lift and are not to be rodded.

So what are the benefits of SCC? Where would I use this kind of mix?

The main benefits of SCC are all associated with the concrete's ability to move. SCC mixes are commonly useful where rebar congestion is very tight and it is difficult to vibrate the concrete. A good SCC mix will easily navigate the congestion and ensure proper consolidation around the rebar. Other times a smooth a face of concrete is desired with virtually no bug holes or honeycombing. SCC mixes can provide that finish with no vibration necessary. Sometimes, concrete is needed to get strange architectural shapes and the concrete is either difficult to get placed throughout the strange shape or has to fill unusual surfaces on the forms. SCC is ideal for these situations.

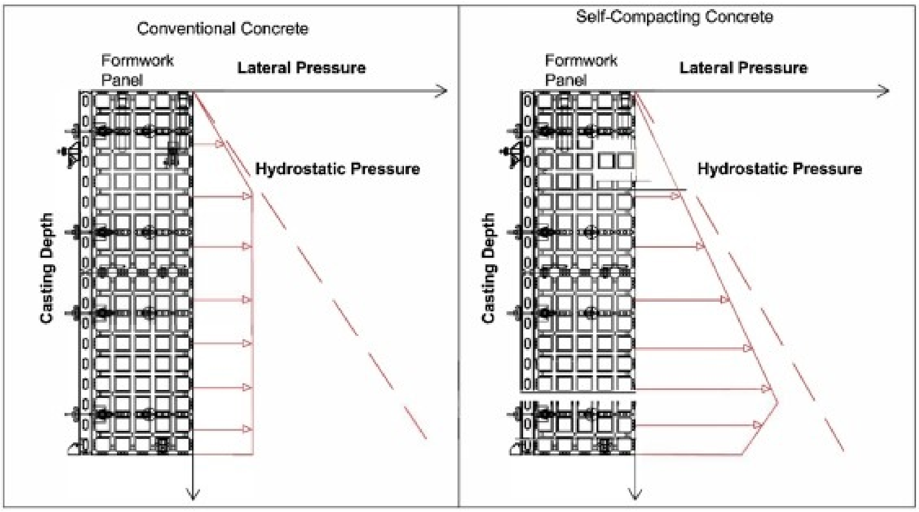


SCC mixes also tend to perform phenomenally in regards to strength, as the efficient cement dispersion, high cementitious contents and low w/c ratios all create a perfect storm to maximize the strength potential of the cementitious materials in the mix.

Often with SCC mixes, there is a savings on labor for the contractor as less personnel are needed and concrete discharge and placement can sometimes be accomplished more quickly.

What are the disadvantages to SCC?

SCC certainly has it's downsides. To start, the forming used on an SCC placement with any verticality needs to be completely watertight and able to withstand full liquid pressure. Form blowouts are common with SCC mixes when SCC specific forms are not utilized.



SCC mixes tend to be very sensitive. A gallon too much water or a change in aggregate gradations can throw the whole mix into instability and require re-batching or even re-designing the mix. SCC performance can change drastically with environmental changes in temperatures, meaning a long-duration SCC project might need multiple SCC mixes for use at different times of the year. Often development of these mixes boils down to guess and check routines that are costly and not time efficient.

SCC mixes themselves are often a great deal more expensive than conventional concrete due to higher material costs, greater quality control and mix development time, transportation quantity limitations (it's not a great idea to fill a truck up completely with SCC if you want it all to arrive at the jobsite), and the greater risk for rejection on site.

Finally, due to the high amount of paste in an SCC mix design, the potential for shrinkage (and cracking) is elevated.

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