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Computer Modelling of Fresh Concrete Flow

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Self-compacting concrete are widely used in deep foundations construction, for bore piles and diaphragm walls. The depth of bore piles ranges from 60 meters to 100+ meters, while the diameter varies between 1.5 meters and 4 meters. This large amount concrete is typically placed via a tremie pipe, over a period of 8-12 hours, during which the concrete flow needs to pass through the reinforcement cage and form a cover zone outside the rebar cage. It is essential for the concrete to have good workability during the entire concrete placement period. As such the rheology of self-compacting concrete is very different from standard concrete, which typically settles within 2-3 hours.

The focus of this research is to understand via computer modelling the flow features of fresh concrete flow, including the flow pattern in the bore pile, bleeding, segregation and other the mechanisms of other defects. Using Bingham flow models and discrete element models, a large number of simulations are performed for lab experiments, including slump flow, V-funnel, L-box etc., and case studies on tremie piles. We have also performed experiments and field tests. Through parametric studies, simulation-experiment comparison and field trials, a series of useful conclusions have been established. Shown below are some preliminary examples: