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Proportioning of self–compacting concrete mixes based on target plastic viscosity and compressive strength: Part I - mix design procedure

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Methods for proportioning self-compacting concrete (SCC) mixes have not kept pace with their production techniques. This paper develops a mix design method for SCC based on the desired target plastic viscosity and compressive strength of the mix. The simplicity and usefulness of this method are enhanced by the provision of design charts as a guide for mix proportioning. The target plastic viscosity of these mixes varied between 3 and 15 Pa s, and the characteristic cube strength between 30 and 80 MPa at 28 days age. Several examples on the use of the design charts are given. In a companion paper experimental validation of the mix design procedure is provided on a series of SCC mixes in both the fresh and hardened states.

Keywords: Self-compacting concrete; mix design; plastic viscosity; cube compressive strength

1. Introduction

The proportioning of self-compacting concrete (SCC) mixes requires a balance between their flow and passing ability on the one hand, and the resistance to segregation on the other.[1–3] The early mix proportioning approaches proposed by Okamura et al. [4–6] and later developed by others [7] were all heuristic in nature requiring many trial mixes. However, the extensive research work carried out on the rheological properties of SCC [8–16] has greatly improved the proportioning of SCC mixes. A summary of different mix proportioning approaches can be found in [17]. The European Federation of National Trade Associations (EFNARC) guidelines [18] give typical ranges of primary ingredients (Table 1); the actual amounts depend on the desired strength and other performance requirements. Thus, the mix proportioning still involves considerable trial and error.

A rigorous method for proportioning normal and high strength SCC mixes based on their plastic viscosity has been proposed by Karihaloo and Ghanbari [19] and Deeb and Karihaloo [20]. It exploits the expression for the plastic viscosity of an SCC mix developed by Ghanbari and Karihaloo [21] using micro-mechanical principles. This expression shows how the known plastic viscosity of the paste is increased by the addition of solid phase

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