Overview of carbonation behaviour of slag-based concrete as a sustainable construction material for rigid road pavement use according to TfNSW QA specification 3211 and R83 requirements

The carbonation of concrete in structures causes deterioration and a reduction in service life. Carbonation can increase the porosity and reduce the compressive strength in the carbonated zone of concrete. Various studies have been carried out to source alternative binder materials to mitigate greenhouse gas emissions arising from cement production. Sustainable concrete mixes incorporating supplementary cementitious material additions such as ground granulated blast furnace slag (GGBFS) as an environmentally friendly solution to address the fly ash (FA) shortage and decarbonise the cement sector in Australia are becoming increasingly common. In recent times, fly ash supply has been less reliable.

Transport for NSW (TfNSW) RMS QA specification 3211 specifies the use of varying quantities of GGBFS as a direct replacement for cement in concrete. The specification prescribes a minimum shrinkage limited ordinary Portland cement content to be used for the carbonation resistance formula to apply with slag-based concretes. However, there are currently some uncertainties regarding the applicability of this formula for high-volume slag use. Finding both the optimal and maximum contents of GGBFS is vital in establishing and validating the usefulness of this carbonation resistance formula.

This study assesses the influence of GGBFS content impacting some of the key fresh (slump and air content) and hardened properties (compressive and flexural strengths), and time-dependent (drying shrinkage) and carbonation (carbonation depth and rate) behaviours, of slag-based concretes. The outcome of this research will provide practical solutions for TfNSW in terms of adopting high-volume slag concrete use in rigid road pavements in comparison to conventional OPC and FA-based concretes for adhering to the requirements of RMS QA specifications 3211 and R83.

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