

Early-Age Cracking of Low Carbon Concrete Incorporating Ferronickel Slag as Supplementary Cementitious Material

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Abstract : Concrete viscoelastic properties such as shrinkage, creep, and associated relaxation are important in assessing the risk of cracking during the first few days after placement. This paper investigates the early-age mechanical and viscoelastic properties, restrained shrinkage-induced cracking and time to cracking of concrete incorporating ferronickel slag (FNS) as supplementary cementitious material. Compressive strength, indirect tensile strength and elastic modulus were measured. Tensile creep and drying shrinkage was measured on dog-bone shaped specimens. Restrained shrinkage induced stresses and concrete cracking age were assessed by using the ring test. Results revealed that early-age strength development of FNS blended concrete is lower than that of the corresponding ordinary Portland cement (OPC) concrete. FNS blended concrete showed significantly higher tensile creep. The risk of early-age cracking for the restrained specimens depends on the development of concrete tensile stress considering both restrained shrinkage and tensile creep and the development of the tensile strength. FNS blended concrete showed only 20% reduction in time to cracking compared to reference OPC concrete, and this reduction is significantly lower compared to fly ash and ground granulated blast furnace slag blended concretes at similar replacement level.

Keywords : ferronickel slag, restraint shrinkage, tensile creep, time to cracking

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