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Assessment of Shrinkage-induced Cracks in Restrained and Unrestrained Cement-based Slabs

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Abstract: Concrete slabs and bridge decks experience early ages cracks mainly due to volumetric changes associated with moisture and temperature variations. These cracks have no immediate effect on their safety, but they have detrimental effects on their durability and long-term performance. This paper presents an experimental investigation on quantification of shrinkage-induced cracks in slabs made from different cement-based materials. An experimental test setup was used to simulate the shrinkage-induced damage of restrained slabs. Vacuum pressure impregnation with ultra-low viscosity epoxy was used for the preparation of concrete samples for image analysis. Crack measurements in terms of crack length, width, density were performed on the concrete samples. Crack orientation was recorded and shown in a radar diagram. The results showed that drying of unrestrained specimens develop few and randomly distributed cracks, neither connected to each other nor to the specimen surface, with short extensions into the slab depth. Therefore, they had no significance effect on the transport properties. On the other hand, restrained slabs developed localized cracks, oriented perpendicular to the drying surface and extending through the whole depth of the slab. Further drying, increases the crack width and new branches grew up on the vertical basic cracks. Understanding crack patterns and their effect on the concrete transport properties, allows for more accurate prediction of the long-term performance of concrete slabs and bridge decks.

Keywords:
Cement-based slabs, drying shrinkage, degradation, crack quantification, image analysis.

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