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Fatigue performance of continuously reinforced concrete pavement under cyclic wheel loading: Effect of binder composition

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ABSTRACT

Continuously reinforced concrete pavement (CRCP) is known for its excellent long-term durability; however, the absence of joints can lead to critical cracking depending on the mixture design, potentially degrading its performance. Therefore, this study aims to investigate the fatigue performance of CRCP incorporating various binder compositions, such as Ordinary Portland cement, fly ash, and expansive additives (EA), under actual environment conditions. A multi-scale chemo-hygral computational system (DuCOM-COM3) was employed to simulate the damage caused by shrinkage under actual temperature and humidity variations, as well as long-term fatigue performance under cyclic wheel loading. The computational system integrates models for cement hydration, pore structure development, moisture transport, expansive pressure owing to EA, and time-dependent constitutive laws for structural analysis, enabling comprehensive analysis for drying shrinkage and the stress-strain behavior of concrete under cyclic fatigue loading. Through this approach, the effects of environmental deterioration on long-term fatigue performance were evaluated quantitatively, and the suitability of mixture designs for enhancing the durability of CRCP was discussed in detail.

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