

Coal bottom ash concrete: Mechanical properties and cracking mechanism of concrete subjected to cyclic load test

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ABSTRACT

Coal waste has gained interest as an alternative aggregate for concrete production. Still, a topic that has been less researched is the serviceability of concrete containing coal waste, and the main concern is whether the namely coal bottom ash (CBA) aggregate affects the cracking of concrete beams. This research aims to elucidate the mechanical properties of concrete with the inclusion of CBA and its cracking mechanism on beams. Thus, concrete specimens were designed into four distinct combination replacements between half (50 %) and full (100 %) of coarse and fine CBA aggregate with the addition of 20 % fly ash to the cement amount. The beams were subjected to a cyclic load test to evaluate the cracking mechanism. The experimental results revealed that the compressive strength of all replacements achieved the targeted strength of 30 MPa at 28 days. However, the splitting tensile and flexural strengths decreased with the increment in volume of CBA in the design mixture. The cyclic load criteria with respect to deviation from linearity (DFL) was found promising to correlate to beam failure according to the deflection in each specific load cycle. Nonetheless, the cracking mechanism of the concrete beams was mainly influenced by the porous structure and high crushing index of coarse CBA, where all tested beams failed by flexural and shear cracks. Therefore, excessively increasing the coarse CBA replacement amount in a concrete mix produces a lower structural performance in beams under cyclic load.

KEYWORDS: Coal bottom ash, Fly ash, Mechanical properties, Cyclic load test, Crack mechanism, Failure mode

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