Studies on acoustic emission characteristics of fatigue failure in concrete

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1. INTRODUCTION & OBJECTIVES

Concrete is a versatile material widely used for constructing various structural applications like buildings, bridges, roads, dams, etc. These structures experience various loads such as tension, compression, shear, and a combination. The studies done by researchers mainly focus on the strength of the structures. The structures have been designed for factored load due to concern about the limit state of strength and serviceability. Even though the structure has been designed for factored load, during the service period, it may collapse due to fatigue even before it reaches its actual load. An understanding of the tensile behaviour of concrete gives valuable insight information of concrete to emphasize its fracture.

Fatigue is a delayed gradual degradation of structures due to the application of repeated loading. The understanding of the fatigue behaviour of plain and reinforced concrete has lagged behind that of metals because reinforced concrete is typically assumed to crack in conventional constructions. The fracture mechanism of structures due to fatigue is necessary to understand. We need to pay attention to fatigue failure because many bridges and offshore platforms face fatigue loading. Reinhardt et al. compared the experimental tension softening behaviour of beams under flexure with the analytical fitting of beam specimens. Keerthana and Kishen evaluated the post-peak behaviour of concrete subjects under flexure similarly to compact tension evaluated by Parvinder et al. Experiments are required to project the variability due to hybrid composite forms heterogeneity and anisotropy in concrete since a fracture process zone is ahead of the crack. A fracture process zone is present in concrete subjected to monotonic loading to evaluate the static strength of the specimen rather than the presence of a fracture process zone not existing. Another difficulty for the researchers is figuring out how to assess the fracture quantitatively.

The pre-existence of many voids, microcracks, and an interfacial region in the hybrid material. It is challenging to understand the various microstructural fracture due to fatigue. The micromechanical damage includes the nucleation of micro cracks, micro-crack initiation termed as short crack formation, crack growth, and complete failure of the structure. These are the primary stages in metal; regardless, it's essential to understand how concrete fractures develop. In the experiment, acoustic emission (AE) and image processing are used as a non-destructive methodology to monitor the fracture phenomenon. AE is transient elastic waves formed due to the dislocation, microcrack, etc., since the application of applied stress or forces. The generated elastic waves are transmitted through the specimen, and the mechanical waves

are captured by the piezoelectric AE sensor, which is converted into electrical signals. Each signal has low strength and is amplified by the preamplifier. Then the signal is sent to the data acquisition system. Image processing is used to see and study surface deformations and strains.

Research Significance

This study primarily focuses on the experimental mechanics of the wedge-splitting test program on fatigue-tested concrete specimens. The acoustic emission characteristics (i.e., acoustic emission energy, event, etc.), and damages of variables, and the relationships between the mechanical variables are discussed in depth. To understand the fracture features at surfaces are characterized using image processing and the mechanism of fracture at various phases.

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