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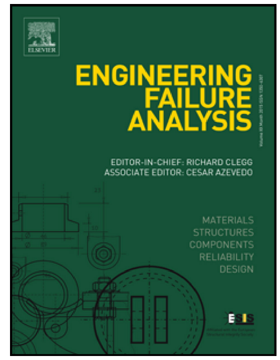

Development of a damage model for assessing fracture failure of steel beam-to-column connections subjected to extremely low-cycle fatigue

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Development of a damage model for assessing fracture failure of steel beam-to-column connections subjected to extremely low-cycle fatigue

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Abstract: This paper presents numerical analysis on fracture failure of steel beam-to-column connections subjected to low-cyclic fatigue loading. A numerical approach is developed and implemented in the finite element program using the concept of lumped damage mechanics to estimate the extent of fracture damages until complete rupture failure occurred in beam and column hinges. In this framework, a damage variable is introduced for each end of beam elements, and can be linked to the extension of the fatigue fracture in the real structural components. The damage evolution law is based on the Manson–Coffin law and a new crack-driving variable to emulate the state of ultimate failure. The model also describes crack closure effects due to weld access hole at the edge of beam connected to column surface. The analytical model is validated using a component tests of steel beam-column connections with weld access hole subjected to cyclic loadings with constant and variable amplitudes. Limitations of the model are also discussed for wider applications on the failure simulation of steel frame systems subjected to seismic loading.

Keywords: Lumped damage mechanics; Finite element method; Steel structures; Fatigue failure; Beam-column connections

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