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# Ultra-low Cycle Fatigue Fracture of Tensile Weld Detail of Typical Steel Beam-to-column Connections

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**Abstract:** Two micromechanical approaches, cyclic void growth model (CVGM) and improved cyclic void growth model (ICVGM), were employed for the prediction of ultra-low cycle fatigue (ULCF) fracture of the tensile weld detail of typical steel beam-to-column connections. Both symmetric and asymmetric fatigue loads were considered. The predicted fracture location and ULCF lifetime were compared with corresponding test results to verify the applicability of these two micromechanical criteria for ULCF analysis of steel connections. ULCF fracture under symmetric load predicted by both CVGM and ICVGM agreed very well with test results. For asymmetric load, ICVGM gave more accurate ULCF fracture prediction than CVGM. ULCF fracture caused by the artificial crack at the interface between the backing bar and the column flange was also studied with ICVGM. It was illustrated that the tip of the artificial crack is also a potential source of ULCF fracture and the ULCF fracture can be prevented by closing the artificial crack with a continuous fillet welds.

**Keywords:** Ultra-low cycle fatigue; fracture; micromechanical approaches; steel beam-to-column connections

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