SIMULATING FRACTURE AND POST-FRACTURE RESPONSE OF WELDED COLUMN SPLICES

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Abstract

Pre-Northridge moment frames with PJP Welded Column Splices (WCS) are highly vulnerable to brittle fracture much before the connection develops the strength of the upper connected column due to the inherent crack-like flaw (unfused region of the weld) and the low toughness of the weld material. Given that the consequences of fracture are catastrophic and that retrofitting these splices can be highly disruptive to building operations, accurately estimating their fracture risk is of great importance. To achieve this, a probabilistic quantification of splice fracture is necessary, along with tools that simulate splice fracture and post-fracture response in a global frame assessment framework.

A framework to probabilistically assess the fracture strength of these splices is presented which addresses shortcomings of previous research and performance assessment guidance that do not consider key mechanistic or statistical effects. A new element model (in OpenSees), which is informed by the fracture mechanics-based estimates of splice strength and existing material models in OpenSees, is developed to simulate the splice response. The element simulates – a) fracture initiation at extreme fibre of section and subsequent loss of section, b) post-fracture loss of sectional capacity in tension, c) post-fracture re-seating in compression, and d) post-fracture shear loss of section. Application of the new splice element in assessment of a 20-story building to scaled ground motions is demonstrated.