# MS Thesis Title: Prediction of Fracture and Loss in Ductility Due to Presence of Defects in CJP Weld


## Abstract

Complete Joint Penetration (CJP) welds are commonly used in many industries such as structural steel-fabrication, pressure vessels, pipelines, nuclear industries, etc. However, CJP weld could be susceptible to defects such as lack of fusion, slag, porosity, etc. The 1994 Northridge earthquake and the 1995 Kobe earthquake revealed that there was a significant loss in the ductility of CJP welded connections due to the presence of defects. There are very limited experimental and numerical studies available to understand the overall behavior and strength of CJP welded connection in the presence of defect. This study aims to bridge this gap.

The objective of this study is to understand the influence of defects on ultimate strength and ductility of the CJP welded connection. To achieve this objective, a total of twelve specimens were tested, out of which four specimens were without any defect, while eight specimens had defects in the weld. A process was developed to introduce defects in the CJP weld specimens. A simplified lower bound approach using ductile damage criteria was proposed based on benchmarked finite element models to simulate the weld fracture. Moreover, a parametric study was performed to understand the effects of various parameters such as length and depth of defect, failure criteria, etc on behavior and ductility of the welded connections.

It was found that the welded specimens having no defect were able to reach the ultimate strength and ductility of the base metal. Whereas loss in ductility and strength was observed in the specimens with defect. The loss in ductility as compared to base metal ranges from 30% to 88% for different specimens. The maximum loss in strength was observed to be 12% only for specimen with worst defect. The study concluded that the depth of defect had significant influence over ductility as compared to length of defect. If the depth of defect (d) is greater than half of plate thickness ($d > t/2$), it exhibits similar behavior regardless of actual depth. However, no significant influence of defect was observed if the depth of defect was less than $t/8$.