Moment-Rotation Behavior of Welded Connections in Steel Structures

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Abstract
Structural elements are linked through connections to form a structure. If all aspects of true behavior of connection were not considered in design, it acts as weak part of structure and decrease accuracy of analysis and consequently, cause problems in serviceability and safety of building. Generally, connections are considered as pinned or rigid in modeling, but actually all them behave as semi-rigid connections.
Many researches have been conducted in connection behavior during past decades. Behavior curves consist of moment-rotation curve were derived through some of these investigations, to evaluate rotation of connections caused by moment in the joint. Moment-rotation curves are used to study effect of considering connections in analysis of structure. Welded connections are widely used in Iran. But, unfortunately there is few study on these connections, specially on their behavior curves.
Failure in welded connections in buildings during earthquakes leads to incorrect beliefs about their behavior. Experts in this field believe that connections designed based on codes regulations should not have serious problems. Investigations on behavior of these connections after Northridge 1994, Cobe 1995 earthquakes, confirm their proper behavior when are correctly reinforced.
Current study has been conducted to derive moment-rotation curves of some welded connections based on FEM modeling of these connections. To achieve this goal, firstly, five experimental specimens are verified by FEM modeling of these specimens to confirm modeling ability. Then, 210 specimens for 5 type of welded connection are modeled in ABAQUS FEM software. The Connections types are Double Web Angle, Top and Seat Angle, Top Angle with Stiffened Seat, Moment Connection with Cover Plate and Moment Khorjini Connection.
A three parameter tangent inverse model has proposed for moment-rotation behavior of these connections. The parameters are initial stiffness, plastic stiffness and reference moment. With these three parameters and using tangent inverse model, Moment-rotation curve for connections can be derived. Large part of this study is about determination of proposed model's parameters. These parameters were determined with using semi-analytical relations and have been compared with FEM results. Also a macro model (Torsion spring Model) from each 5 type of mentioned connections has been comprised with FEM response. Result of this comparison show that proposed model is efficient for modeling of connections.

Keywords
Moment-Rotation curve, weld stress-strain curve, Beam-to-column connections, Semi-rigid connections, Finite element model.