

SSDA Pre-Northridge CONNECTION RETROFIT and/or UPGRADE Rationale
(U.S. Patent 10,697,192)

The SSDA recommended seismic connection retrofit methodology for the pre-Northridge moment frame connection uses pre-qualified SlottedWeb moment connection technology given in ANSI/AISC 358 Chapter 14 as follows:

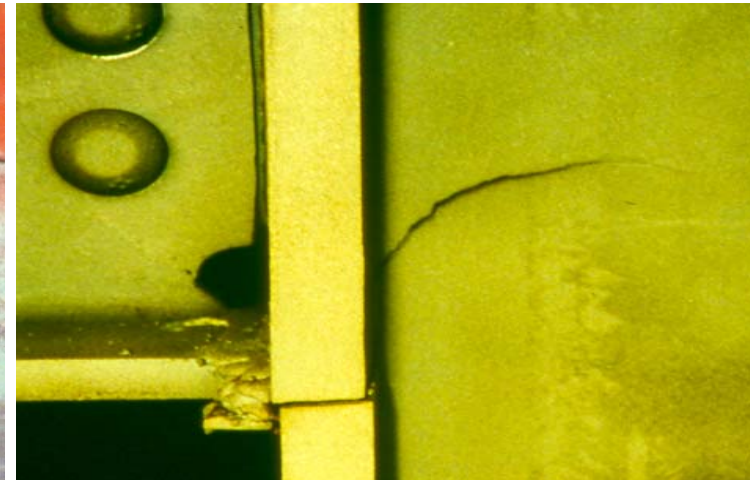
Repair as required the fractured pre-Northridge beam/column connection to its pre-fractured design using weld material having an equivalent to a Charpy value of 20 ft/lb and Grade 50 plate material. The following three slides show typical modes of the fracture of the pre-Northridge connections. These fracture modes accounted for approximately 80% of the pre-Northridge connection fractures.



Pre-Northridge Connection Bottom Beam Flange Fracture – Column Flange Divot Pullout. This Fracture Mode is a Result of the Prying Action Due to the Shear in the Beam Flanges.



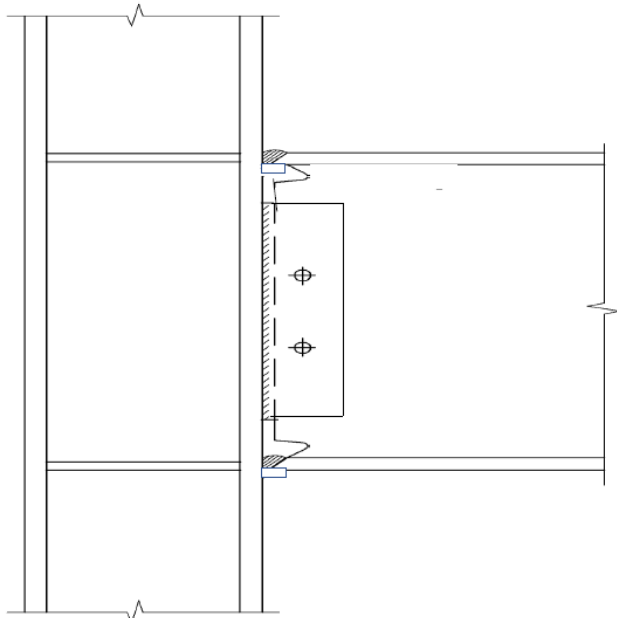
Pre-Northridge Connection - Bottom Beam Flange Weld Fracture. This Fracture Mode is a Result of Large Stress and Strain Gradients Across and Through the Beam Flanges and Welds.



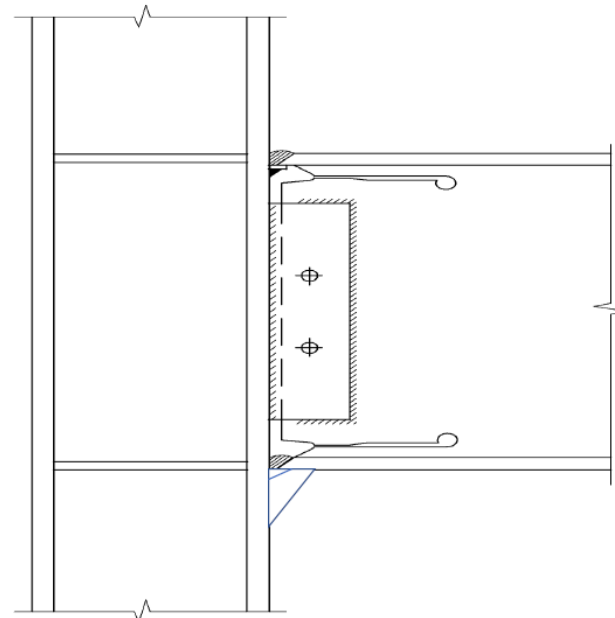
Pre-Northridge Connection Column Flange and Web Fracture Caused by Beam Flange Prying Action. Note the Absence of a Column Continuity Plate.

Modify the pre-Northridge connection:

- Weld the beam web to the column flange with a groove weld
- Fillet weld the shear plate to the beam web (TBD)
- Drill the stress relief holes in the beam web
- Thermal cut the beam web slots
- Fillet weld the top flange backup bar to the column flange
- Remove the bottom flange backup bar, back gauge and use a fillet weld to replace the gauged out backup plate weld
- Weld reinforcing fins to the bottom beam flange and to the column flange if required



Pre-Northridge Connection (1970 -1994 – ref: FEMA 350)



Retrofit Connection with Fins

SSDA full scale retrofit test protocol demonstrating the use of fins to strengthen the beam flange welds and reduce the ductility demands on the existing welds.



ATC-24 Test for Using a W36x170 Beam and a W14x283 Column

Commentary

Full scale ATC-24 tests and low cycle fatigue tests and research by FEMA/SAC and SSDA have shown that the major cause of the pre-Northridge connection fractures was that a large fraction of the beam shear (50% to 80%) was resisted by the beam flanges. This resulted in very large stress and strain gradients across and through the beam flanges at the column flange. Over 80% of these fractures comprised bottom beam flange, column flange divot pullout, and column web fractures (FEMA 350). By separating the beam flanges from the beam web with slots and welding the beam web to the column flange, the force distributions are changed in the *fundamentally flawed* (SEAOC evaluation) pre-Northridge connection as follows: (1) the beam shear in the flanges is eliminated, (2) the large stress and strain gradients across and through the beam flanges are eliminated, and (3) the beam web connection to the column and shear plate resist all of the beam shear. Moreover, the ductility demand on the beam flange welds is reduced by an order of magnitude. The SW technology applied to the pre-Northridge connection results in a kinematic connection so that the force distributions in the connection are independent of the force amplitudes.

SSDA has retrofitted seven buildings (two to ten stories) that were designed with the pre-Northridge flange welded - web bolted connection using SW technology.