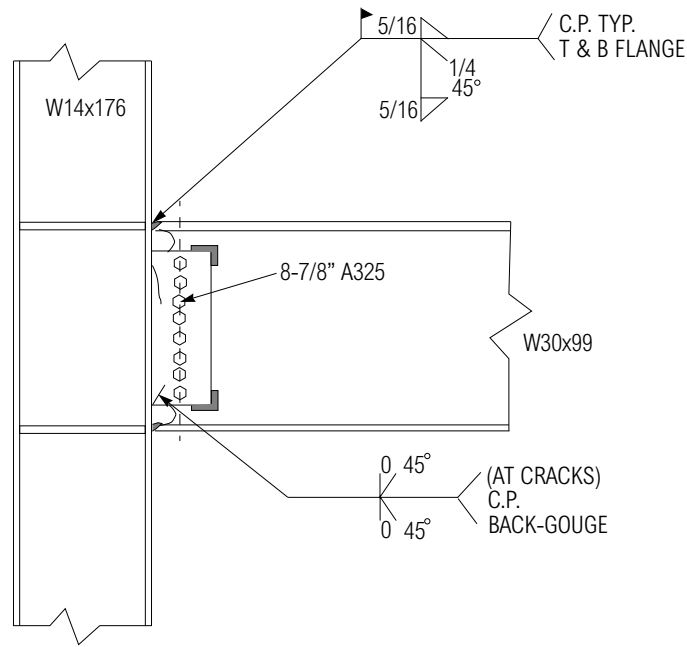


Specimen ID: EERC-RN1
 Keywords: Repaired work, notch-tough electrode material, panel zone yielding, weld fracture, small rotation capacity
 Test Location: Earthquake Engineering Research Center
 Test Date: July 10, 1995
 Principal Investigator: Vitelmo V. Bertero; with Andrew S. Whittaker and Amir S. Gilani
 Related Summaries: 1, 14
 Reference: "Experimental Investigations of Beam-Column Subassemblages", *Report No. SAC 96-01*, March 1996.
 Funding Source: FEMA / SAC Joint Venture, Phase I

CONNECTION DETAIL



MATERIAL PROPERTIES AND SPECIMEN DETAILS

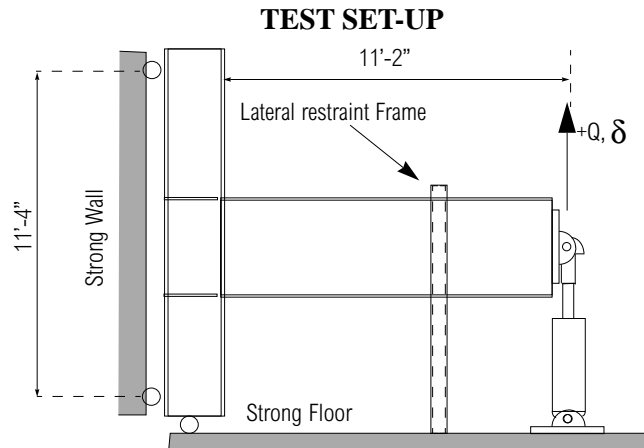
Member	Size	Grade	Yield Stress (ksi)		Ultimate Strength (ksi)	
			mill certs.	coupon tests *	mill certs.	coupon tests *
Beam	W30X99	A36	54.1	50.3 flange 55.7 web	73.4	70.9 flange 71.9 web
Column	W14X176	A572 Gr. 50	56.5	50.0 flange 49.5 web	74.5	69.0 flange 69.5 web
Welding Procedure Specification	All welds FCAW-SS in conformance with AWS D1.1-94. Original bottom flange groove weld performed with 0.120" diameter AWS E70T-4 electrode. Top flange replacement groove weld performed with 0.072" diameter AWS E71T-8 electrode.					
Shear tab	1/2"x4-1/2"x23-5/8" plate with eight 7/8" A325 bolts					
Panel zone	No doubler plates					
Continuity plates	3/8" plates with c.p. weld					
Boundary conditions	Single-sided test, no floor slab, axial force in lower half of column equal to beam shear force, specimen tested in upright position					
Other detailing	Remove and replace fractured top flange groove welds; back-gouge groove welds at top and bottom flanges, remove B.U. bars, place reinforcing fillet welds					

*Coupon locations per ASTM

BACKGROUND

This was a test of repairs on specimen EERC-PN1 (Test Summary No. 1) that was originally tested on March 7, 1995. The original specimen experienced a sudden fracture through the top beam flange to column flange weld before undergoing any significant plastic deformations or rotations. The failure began during the first displacement excursion to $3\delta_y$ (where $\delta_y = 1.40$ in. was obtained from analytical studies of the original specimen). The failure of the specimen was preceded by shear yielding in the panel zone, first observed during the displacement cycles to $0.75\delta_y$. Visual observation of the specimen following testing suggested that there was little plastification in the beam. The cyclic tests were performed quasi-statically.

The specimen repair procedure consisted of realigning the beam-column assembly to 90 degrees, removing the fractured top flange weld material and replacing it with a complete penetration groove weld composed of notch-tough filler metal (AWS E71T-8), removing the back-up bars from the underside of both beam flanges, back-gouging the root pass of the groove welds, and placing fillet welds in the back-gouged zones to reinforce the groove welds, and welding cracks that had formed in the shear tab. The standard SAC/ATC-24 loading history was used in the quasi-static testing of the repaired specimen.



DISPLACEMENT HISTORY AND KEY EXPERIMENTAL OBSERVATIONS

Applied Displacement History	Key Observations of the Test	
	Point	Description
	1	Shear yielding in the panel zone
	2	Local buckling of beam top flange
3	Fracture of welded connection of beam bottom flange to column flange	

DETAILED TEST RESULTS

Quantity (see Introduction for definitions used in EERC tests)		Maxima
Force/Displacement Properties	Peak actuator force (kips):	122
	Beam deformation (in.):	1.5
	Experimental beam yield displacement (in.):	1.0
Rotation Capacity	Maximum plastic rotation (% radian):	1.1
	Cumulative plastic rotation (% radian):	N.A.
Energy Dissipation Properties	Cumulative energy dissipated (k-in.):	145

Mode of failure: Fracture of the beam bottom flange groove weld during the second positive $2\delta_y$ cycle.

DISCUSSION

Specimen EERC-RN1 failed during the second positive displacement excursion to $2\delta_y$. The groove welded connection between the beam bottom flange and the column flange fractured at a beam tip displacement of approximately 2.6 in. Failure of the specimen was preceded by shear yielding in the panel zone, first observed during the first displacement cycle to $1\delta_y$. Minor buckling of the top flange adjacent to the column was observed during the first positive displacement excursion to $2\delta_y$. The specimen failed abruptly during the next positive displacement cycle. Data from the strain gages on the underside of the bottom flange of the beam indicated that the failure was likely initiated at the edges of the flange out-stands and propagated in toward the beam web. There was little evidence of yielding in the beam. The maximum plastic rotation of the connection prior to failure was approximately 0.011 radian, consisting of 0.008 radian from the panel zone, and 0.003 radian from the beam. The beam plastic rotations for this specimen were smaller than those measured for the original specimen. As in the original specimen, the panel zone dissipated substantially more energy than the beam.

DISCLAIMER

This summary has been prepared from the cited reference. The SAC Joint Venture has not verified any of the results presented herein, and no warranty is offered with regard to the results, findings, and recommendations presented, either by the Federal Emergency Management Agency, the SAC Joint Venture, the individual joint venture partners, their directors, members, or employees. These organizations and individuals do not assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any of the information, products, or processes included in this publication. The reader is cautioned to carefully review the material presented herein. More detailed information is available in the cited reference.