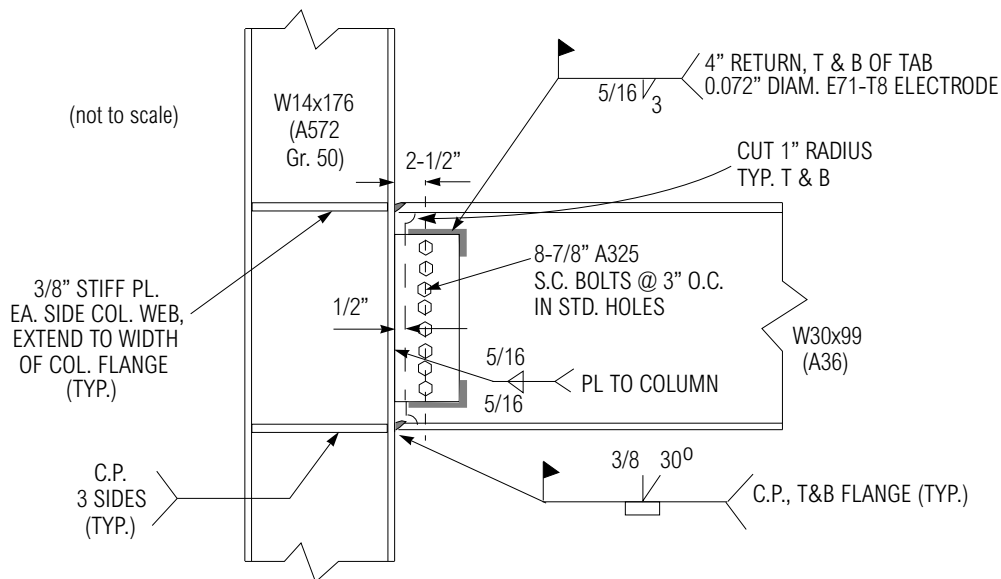


Specimen ID: UCSD-3
 Keywords: Pre-Northridge, simulated field welding, shear tab fracture, backup bar yielding, fracture of top beam flange groove weld
 Test Location: University of California, San Diego
 Test Date: March 2, 1995
 Principal Investigator: Chia-Ming Uang; with Duane Bondad
 Related Summaries: 19
 Reference: "Experimental Investigations of Beam-Column Subassemblages", Report No. SAC 96-01, March 1996.
 Funding Source: FEMA / SAC Joint Venture, Phase 1

CONNECTION DETAIL



MATERIAL PROPERTIES AND SPECIMEN DETAILS

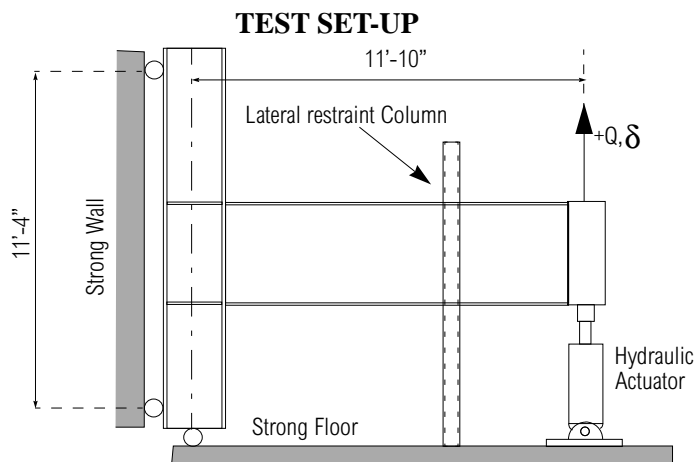
Member	Size	Grade	Yield Stress (ksi)		Ultimate Strength (ksi)	
			mill certs.	coupon tests *	mill certs.	coupon tests *
Beam	W30X99	A36	54.1	46.5 flange 57.1 web	73.4	67.7 flange 72.5 web
Column	W14X176	A572 Gr. 50	56.0	52.5 flange 51.2 web	75.0	68.2 flange 67.2 web
Welding Procedure Specification	All welds FCAW-SS in conformance with AWS D1.1-94, performed with 0.120" diameter AWS E70T-4 electrodes. Preheat and interpass temperature per Table 4.3. Fillet weld of shear tab to beam web performed with 0.072" diameter AWS E71T-8 electrode.					
Shear tab	3/8 x 5" plate with eight 7/8" A325 SC 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 bottom of column equal to beam shear force, specimen tested in upright position					
Other detailing	Connection between column and beam welded in the upright position; backup bars left in place					

* Coupon locations per ASTM

BACKGROUND

The objectives of testing the Pre-Northridge specimens were to replicate in the laboratory the failure modes observed in the field after the Northridge earthquake to develop a better understanding of the failure mechanisms, and to acquire data on the likely deformation characteristics of beam-column connections constructed to industry standards before 1994. The specimen described in this summary was fabricated under controlled conditions by a local commercial steel fabricator to details specified by SAC and the principal investigator. This specimen was intended to be identical to the other Pre-Northridge specimens tested at UCSD and described in Test Summaries No. 4 and 5. It is also similar in size to the specimens described in Test Summaries No. 1, 2, and 3. The construction of these specimens followed typical commercial practice in which the continuity plates and the shear tab are first shop welded to the column, and then the beam-to-column connection is welded with the specimen in the upright position to simulate field conditions. Because each of these were fabricated under controlled conditions, however, it is possible that their quality is superior to typical moment connections fabricated in the field prior to the Northridge earthquake. As such, some field-fabricated moment connections may exhibit less rotation capacity than these test specimens.

The standard SAC/ATC-24 loading history was used in the quasi-static testing of the specimen. The yield displacement (δ_y) of the specimen was determined to be 1.40 in. based on a nonlinear analysis.



DISPLACEMENT HISTORY AND KEY EXPERIMENTAL OBSERVATIONS

Applied Displacement History	Key Observations of the Test	
	Point	Description
	1	Minor shear yielding in the panel zone
	2	Fracture of the toe of the lower beam web access hole
	3	Vertical fracture of top end of shear tab, hairline crack in the middle of top flange near weld
	4	Fracture of bottom end of shear tab
	5	Fracture of upper beam web access hole
	6	2 in. fracture of beam bottom flange near weld, minor local buckling of top flange, yielding of backup bar
	7	Complete fracture of top flange across the groove weld

DETAILED TEST RESULTS

Quantity (see Introduction for definitions used in UCSD tests)		Maxima
Force/Displacement Properties	Peak actuator force (kips):	1.23
	Beam tip displacement (in.):	4.2
	Experimental yield displacement (in.):	1.53
Rotation Capacity	Maximum plastic rotation (% radian):	2.0
	Cumulative plastic rotation (% radian):	16.0
Energy Dissipation Properties	Cumulative energy dissipated (k-in.):	1987

Mode of failure: Fracture of the beam top flange groove weld during the first negative $3\delta_y$ cycle.

DISCUSSION

Specimen 6 failed during the second half-cycle displacement excursion to $3\delta_y$. The specimen behaved elastically during the first six elastic cycles of the test. The specimen yielded in the next three cycles of $1\delta_y$ displacement amplitude, primarily in the panel zone. During the first cycle of $2\delta_y$ positive displacement excursion, the toe of the lower beam access hole fractured horizontally. During the negative excursion, a 2-in. long hairline crack formed in the middle of beam top flange-groove weld interface. Additionally, the top end of the shear tab fractured vertically approximately 1/4 in. During the next positive excursion, similar fracture was noted at the bottom end of the shear tab. Another fracture of top beam web access hole occurred during the third negative excursion. During the first positive $3\delta_y$ cycle, the beam bottom flange outside of the groove weld fractured in the middle by about 2 in., and some local buckling of the top flange, and yielding of backup bar occurred. None of these fractures or other forms of damage resulted in substantial loss of load-carrying capacity. During the second half-cycle to $3\delta_y$, a complete fracture across the groove weld of the top beam flange developed. Data from the strain gages on the bottom flange of the beam indicated axial strains due to flexure exceeding 60,000 micro-strain. In the post-elastic range, the measured shear strain in the center of the panel zone was approximately 2.5 times than of the average shear strain. The maximum plastic rotation of joint prior to failure was approximately 2.0% radian, consisting of 1.2% radian from the panel zone, and 1.2% radian from the beam (these values are not directly additive due to the way the individual quantities are defined).

This specimen was repaired and subsequently retested with the designation UCSD-RN3. The results of that test are given in Summary No. 19.

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 contained herein, 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.