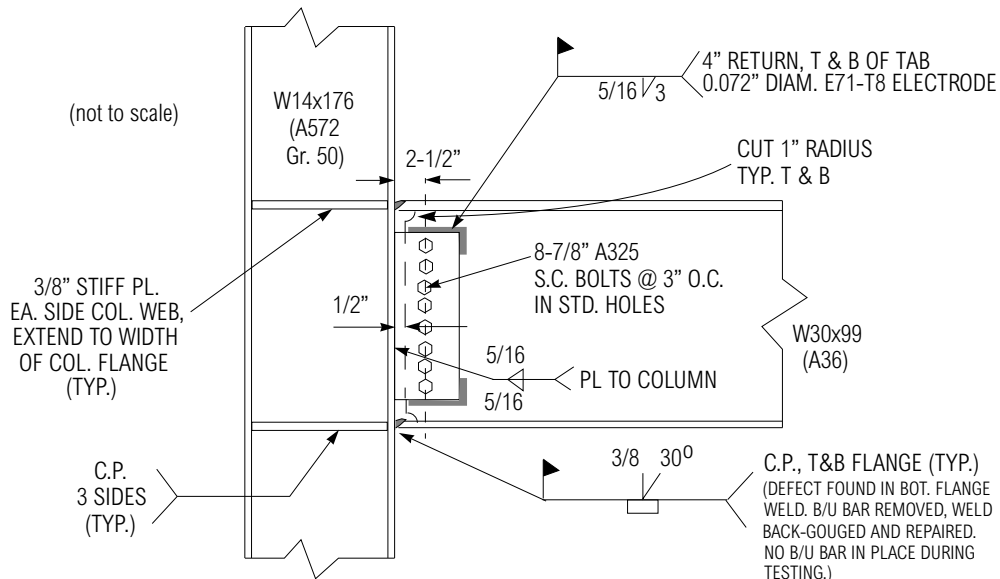


Specimen ID: UCSD-2
 Keywords: Pre-Northridge, repair defective beam bottom flange groove weld, beam top flange and shear tab fracture, local buckling, small rotation capacity
 Test Location: University of California, San Diego
 Test Date: February 23, 1995
 Principal Investigator: Chia-Ming Uang; with Duane Bondad
 Related Summaries: 18
 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	Repair defective bottom flange groove weld, remove backup bar at the beam bottom flange					

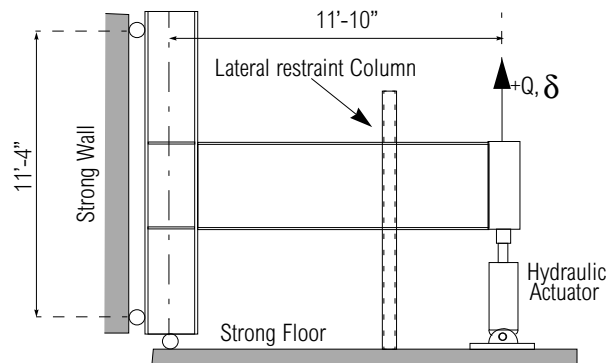
* Coupon locations per ASTM

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 6. 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. Ultrasonic testing revealed defects in the groove weld at the beam bottom flange. The backup bar was removed and the defective weld was back-gouged and rewelded. Consequently, the specimen was tested without the backup bar at the beam bottom flange. 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., utilizing nonlinear analysis.

TEST SET-UP



DISPLACEMENT HISTORY AND KEY EXPERIMENTAL OBSERVATIONS

Applied Displacement History	Key Observations of the Test	
	Point	Description
	1	Shear yielding in the panel zone, minor yielding of beam top flange
	2	Vertical fracture of bottom end of shear tab
	3	Fracture of top end of shear tab, transverse crack in the center portion of beam top flange-groove weld interface
	4	Local buckling of beam top flange
5	Fracture of beam top flange in the heat effected zone	

DETAILED TEST RESULTS

Quantity (see Introduction for definitions used in UCSD tests)		Maxima
Force/Displacement Properties	Peak actuator force (kips):	120
	Beam tip displacement (in.):	4.2
	Experimental yield displacement (in.):	1.53
Rotation Capacity	Maximum plastic rotation (% radian):	2.0
	Cumulative plastic rotation (% radian):	16.7
Energy Dissipation Properties	Cumulative energy dissipated (k-in.):	2027

Mode of failure: Fracture of the welded beam top flange to column flange connection during the first $3\delta_y$ cycle.

DISCUSSION

Specimen UCSD-2 failed during the second half-cycle displacement excursion to $3\delta_y$. The specimen behaved elastically during the first six cycles of the test. The specimen yielded in the next three cycles of $1\delta_y$ displacement amplitude, primarily in the panel zone. The specimen remained stable during the first cycles at $2\delta_y$ displacement amplitude. During the third positive excursion of the third $2\delta_y$ cycle, the bottom end of the shear tab fractured vertically by about 1/2 in. A similar fracture developed at the top end of the shear tab during the following negative excursion. A transverse crack also developed in the middle of the beam top flange, at the flange-groove weld interface. Some local buckling of the top flange occurred at the first positive $3\delta_y$ excursion. Failure occurred suddenly in the following negative excursion to 4.2 in. A fracture developed across the beam top flange width in the heat affected zone between the beam flange and groove weld. Data from the strain gages on the bottom flange of the beam indicated axial strains due to flexure exceeding 20,000 micro-strain, the limit range of the gages. 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 the connection prior to failure was approximately 2.0% radian, consisting of 0.97% radian from the panel zone, and 1.4% radian from the beam (these values are not directly additive due to the way the individual quantities are defined).

This specimen was subsequently repaired and retested with the designation UCSD-RN2. The results of that test are given in Summary No. 18.

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.