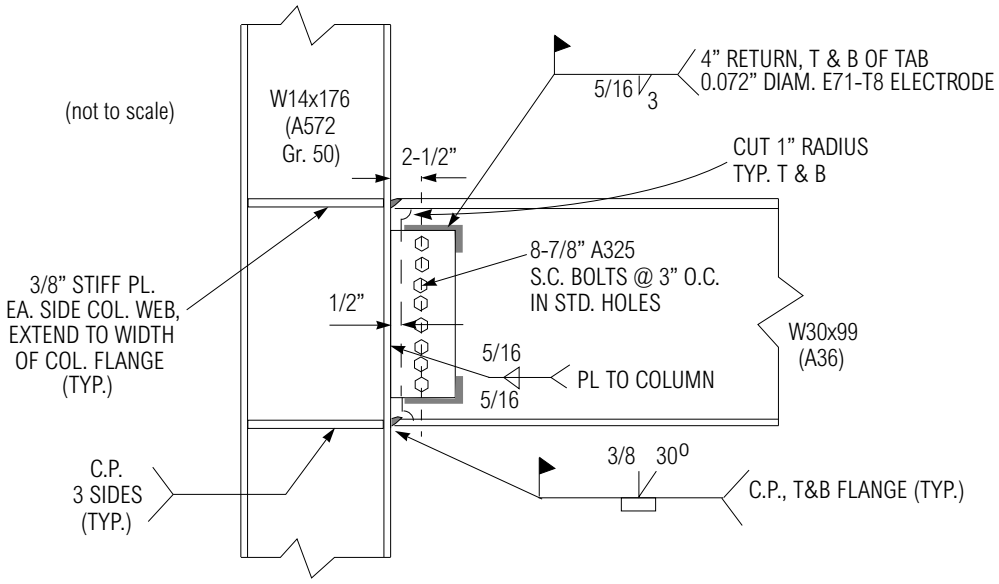
Specimen ID:	UCSD-1
Keywords:	Pre-Northridge, simulated field welding, beam bottom flange fracture, shear tab fracture, small rotation capacity
Test Location:	University of California, San Diego
Test Date:	February 16, 1995
Principal Investigator:	Chia-Ming Uang; with Duane Bondad
Related Summaries:	17
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 AWSD1.1-94, 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

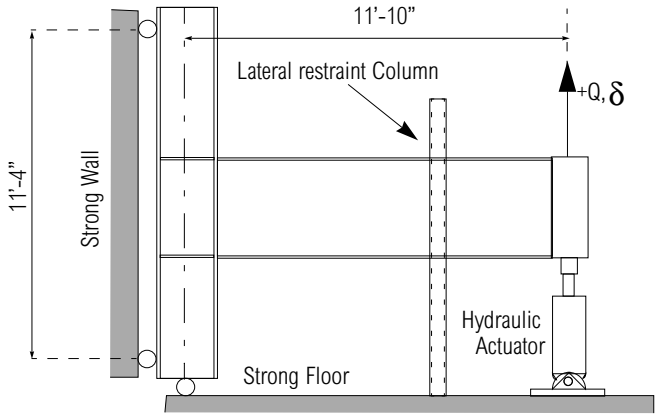
* Coupon locations per ASTM

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. 5 and 6. It us 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.

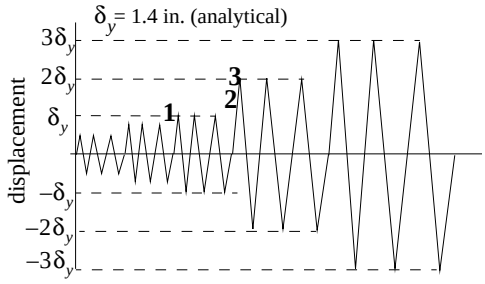
The standard SAC/ATC-24 loading history was used in the quasi-static testing of the specimen. The yield displacement (δ_y) of the specimen was determined to be 1.40 in. based on a nonlinear analysis.

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
2	Complete fracture of beam bottom flange in the fusion zone between the column flange and beam bottom flange groove weld
3	Fracture of supplemental weld on the bottom of the shear tab

DETAILED TEST RESULTS

Quantity (see Introduction for definitions used in UCSD tests)		Maxima
Force/Displacement Properties	Peak actuator force (kips):	93
	Beam tip displacement (in.):	2.4
	Experimental yield displacement (in.)	1.52
Rotation Capacity	Maximum plastic rotation (% radian):	0.79
	Cumulative plastic rotation (% radian):	2.0
Energy Dissipation Properties	Cumulative energy dissipated (k-in.):	197

Mode of failure: Fracture of the welded beam bottom flange to column flange connection during the first half-cycle to $2\delta_y$ cycle.

DISCUSSION

Specimen UCSD-1 failed during the first half-cycle displacement excursion to $2\delta_y$. 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. The stable hysteretic behavior during these cycles was primarily a result of shear yielding in the panel zone. The specimen failed suddenly in the first excursion to $2\delta_y$. At 2.4 in., a complete fracture developed across the beam bottom flange width in the heat affected zone between the column flange and groove weld. As a result, the neighboring supplemental web weld also fractured. Data from the strain gages on the bottom flange of the beam indicated axial strains due to flexure exceeding 17,000 micro-strain. However, little sign of beam yielding was observed after the test. Flaking of the whitewash clearly indicated that yielding occurred in the panel zone. In the post-elastic range, the measured shear strain in the center of the panel zone was approximately 50% higher than the average shear strain. The maximum plastic rotation of the joint prior to failure was approximately 0.79% radian, consisting of 0.60% radian from the panel zone, and 0.39% radian from the beam (note that these values are not directly additive due to the way the individual quantities are defined). Examination of plots of beam plastic rotation and panel zone plastic rotation versus moment at the face of column indicated that the panel zone dissipated substantially more energy than the beam.

This specimen was subsequently repaired and retested with the designation UCSD-RN1. The results of that test are given in Test Summary No. 17.