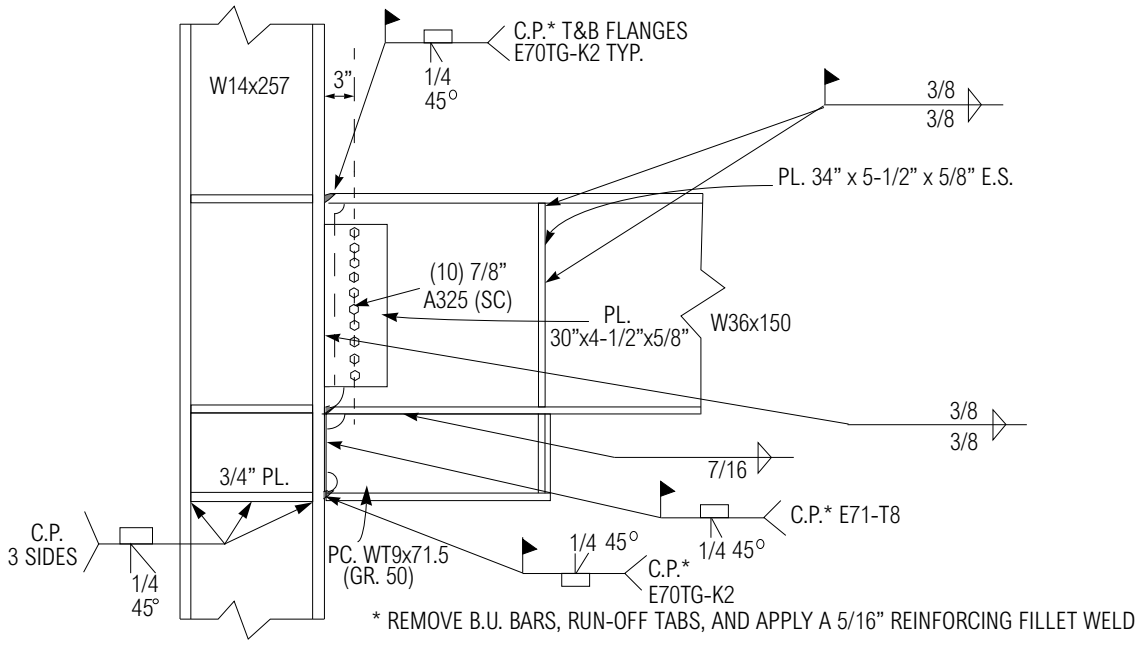
SAC Steel Project

Test Summary No. 30

the FEMA Program to Reduce the Earthquake Hazards of Steel Moment Frame Structures

Specimen ID:	UCB-AN1
Keywords:	New construction, straight haunch, vertical stiffeners beam yielding, top flange fracture, access hole crack, medium rotation capacity
Test Location:	University of California, Berkeley
Test Date:	January 23, 1996
Principal Investigator:	Egor P. Popov; with Marcial Blondet, Lev Stepanov, and B. Stojadinovic
Related Summaries:	None
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

Material Properties	No mill certificates were supplied, and no coupon tests were performed
Welding Procedure Specification	Reference states only that "improved welding procedures" were used
Shear tab	5/8"x 5" plate with ten 7/8" A325 (SC) bolts
Panel zone	No doubler plates
Continuity plates	3/4" plates with c.p. weld, 3/4" plate at the haunch level with c.p. weld
Boundary conditions	Single-sided test, no floor slab, axial load in bottom half of column equal to beam shear, specimen tested in flat position
Other detailing	Add vertical stiffeners on each side, remove B.U. bars, add 5/16" reinforcing fillet weld

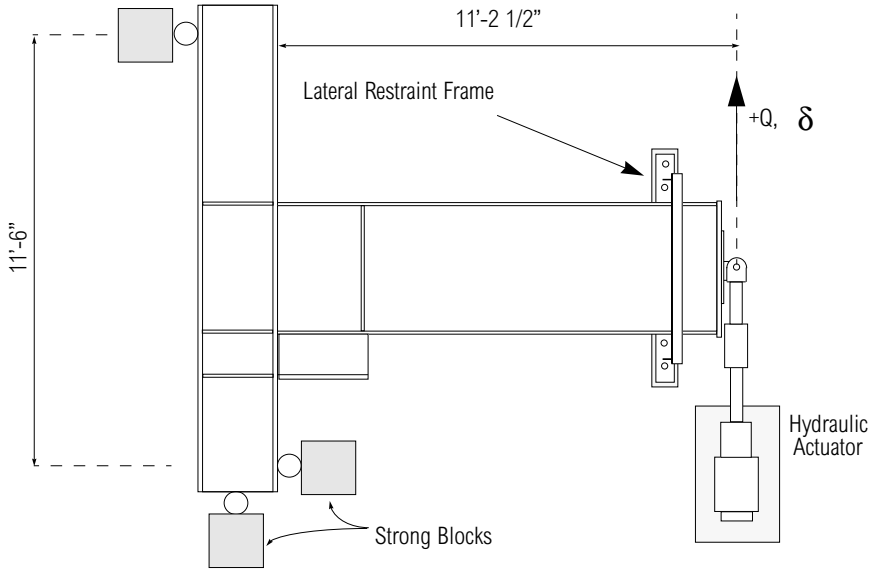
BACKGROUND

The objective of testing specimen UCB-AN1 was to evaluate the cyclic response of new construction approaches. The sizes of the beam and column were identical to the other specimens tested at UCB. With the improved performance achieved through the use of a triangular haunch (see Test Summary No. 25), it was decided to design a specimen with a straight haunch, potentially reducing the labor required for attaching the haunch to the connection.

The construction procedure was not thoroughly documented at the time this test summary was prepared.

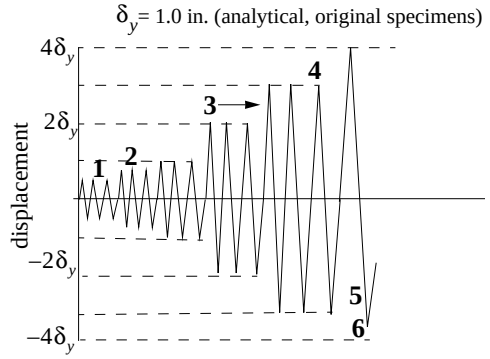
The reference loading displacement (δ_y) was specified as 1.00 in., to maintain consistency with the other specimens tested at UCB.

TEST SET-UP



DISPLACEMENT HISTORY AND KEY EXPERIMENTAL OBSERVATIONS

Applied Displacement History



Key Observations of the Test

Point	Description
1	Spalling of whitewash at beam top flange
2	Spalling of whitewash in the panel zone
3	Yielding of beam flanges, panel zone, beam web, back column flange opposite the top beam flange, and haunch web
4	Slippage between the beam web and the shear tab
5	Fracture of the beam top flange across the entire width
6	Shearing of the shear tab bolts, and cracking at the bottom access hole; widespread yielding throughout the specimen

DETAILED TEST RESULTS

Quantity (see Introduction for definitions used in UCB tests)		Maxima
Force/Displacement Properties	Peak actuator force (kips):	299
	Beam deformation (in.) total/beam only:	3.48/2.21
	Experimental yield displacement (in.)	0.94
Rotation Capacity	Maximum plastic rotation (% radian) total/beam only:	1.53/1.13
	Cumulative plastic rotation (% radian):	N.A.
Energy Dissipation Properties	Cumulative energy dissipated (k-in.):	5760

Mode of failure: Fracture of the beam top flange across the entire width during the first negative $4\delta_y$ cycle.

DISCUSSION

Specimen UCB-RN1 sustained displacement cycles up to and including the initial positive excursion to $4\delta_y$. Yielding was first noted visually in the beam top flange above the vertical stiffener and near the column during the $0.5\delta_y$ cycles. After the excursions to $0.75\delta_y$, visual evidence of panel zone yielding was also noted. However, the overall response of the specimen up-to and including the $1\delta_y$ cycles could be defined as elastic. Starting with the $2\delta_y$ cycles, considerable yielding in the connection became evident. The nonlinearity was present in both beam flanges, in the panel zones, beam web, beam web stiffener, back column flange (opposite the beam top flange), and on the haunch web. During the last $3\delta_y$ cycle, slippage between the beam web and the shear tab, accompanied by loud bangs, was observed. The specimen failed suddenly during the first negative excursion to $4\delta_y$. The beam top flange fractured across the entire width near the flange weld. The crack started at the weld edge near the beam flange axis and then extended symmetrically to the flange edges. As the loading was continued, five shear tab bolts were sheared off and another fracture was initiated at the bottom access hole. The maximum plastic rotation of the connection was approximately 1.53% radian.