TESTS ON STEEL BEAM-COLUMN JOINTS

BY

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Two types of structural steel beam-column joints have been subjected to racking tests in order to investigate their ability to sustain loads and deformations which were chosen to simulate those likely to be suffered under severe earthquake loading conditons. A specially fabricated test rig was installed on a strong floor and both axial column loads and reversed stub beam shears were applied to the test units.

The first joint tested was typical of those used in the thirty storey Bank of New Zealand building in central Wellington (1). This building has a structural steel frame comprising shop welded beam-column units, site welded together at mid span and selected mid height positions. Computer based predictions of the response to the design earthquake indicate that when a typical lower column is supporting 5 x 10^6N axial compression the stub beams are likely to have to resist vertical shears of the order of 1 x 10^6N whilst the beams simultaneously suffer vertical displacements of five or six times those corresponding to their elastic limits. Consequently loads and deformations of these magnitudes were applied to three test joints. Each consisted of a rolled wide-flange column section to the flanges of which rolled section stub beams were welded. Designed to Lehigh University criteria, doubler plates and column flange stiffeners were incorporated in the joint. The first two beam-column units which were tested failed prematurely; the first in a beam flange-column junction and the second within the column section under one corner of the centre doubler plates. The third prototype beam-column joint was found to possess adequate ductile capacity to survive the prescribed loading pattern, failure being finally induced by the application of distortions equivalent to a displacement ductility of 6.5 on the nineteenth half cycle of loading.

The second type of joint tested was of a star plate beam to column joint configuration typical of those used in the new Auckland international airport building (2). The joint comprised two star plates connected by a stub box column cut as a short length from the normal box column members. Rolled section stub beams were welded on to projecting wings of the star plate and column axial loads and beam shear loads were again applied to the test specimen well beyond the elastic range. The loading sequence involved the maintenance of a column axial load of about 7 x 10^5N and reversal of the stub beam shear loads corresponding to end displacement ductilities of the order of 5. Satisfactory behaviour was verified, with correlation between predicted and measured properties being examined.

In the papers referenced (1 and 2) the form of the tests is described, the results are analysed and the observed behaviour is discussed in detail.

(1) Shepherd R. & Spring, K.C.F. "Racking Load Tests on a Steel Beam-Column Joint. New Zealand Engineering 30 (11), 326-327, Nov. 1975

(2) Croad, R.N., Mead, F.H. & Shepherd, R. "The Cyclic Yield Response of a Steel Star Plate Cruciform Joint". Bull. N.Z. Nat. Soc. for Earthquake Engineering 8 (3), 204-221, Sept. 1975

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