

Test of Circular Steel Tubes in Bending

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Serial Information: *Journal of the Structural Division*, 1976, Vol. 102, Issue 11, Pg. 2181-2195

Document Type: Journal Paper

Abstract:

A series of tests on 10-3/4in. (270-mm) tubes was conducted to determine the plastic rotation capacity of tubular beams. Six different D/t values ranging from 18-102 were used in the tests. Cantilever and fixed-ended beams, with moment gradients (shears) and restraints against ovalizing at the end, are compared with the behavior of the constant moment region of simple beams. Tubes with D/t greater than about 50 do not have sufficient plastic hinge rotation capacity to develop the classical ultimate strength. In the absence of a small moment gradient or stiffening, the plastic moment is not quite reached in tubes with D/t of 35. For inelastic buckling in the range of D/t of 18-80, critical strains appear to be proportional to $(t/D)^2$, as opposed to the conventional linear relationship. Information concerning the complex post-buckling behavior is also presented.

Subject Headings: [Material tests](#) | [Steel columns](#) | [Bending \(structural\)](#) | [Plastics](#) | [Rotation](#) | [Moment \(mechanics\)](#) | [Plastic hinges](#) | [Tubes \(structure\)](#)

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"Test of circular steel tubes in bending" ASCE J. Struct. Div., 102(11), 2181-2195. Published in: International Journal of Mechanical Sciences, 74, 143-153. "Buckling of circular steel cylindrical shells under different loading conditions" PhD Thesis, The University of Edinburgh. [33] Ades C.S. (1957). "Bending strength of tubing in the plastic range" J. Aeronautical Sci., 24, 605-610. Circular steel tubes Hysteretic behavior Biaxial bending Ductility Energy dissipation Finite element analysis. List of symbols. A. Su MZ, Gu Q (2000) Study on hysteretic behavior of box-section steel beam-columns under cyclic bending and on limiting ratio of width-to-thickness of its plates. J Build Struct 21(5):41-47Google Scholar. 14. Jiang L, Goto Y, Obata M (2002) Hysteretic modeling of thin-walled circular steel columns under biaxial bending. J Struct Eng 128(3):319-327CrossRefGoogle Scholar. 15. Elchalakani M (2007) Plastic mechanism analyses of circular tubular members under cyclic loading. Thin Wall Struct 45(12):1044-1057CrossRefGoogle Scholar. 16. A series of tests on the behavior of circular thin-walled steel tubes have been carried out by O'shea and Bridge (1997, 2000), who concluded that a steel tube with a diameter-to-thickness ratio greater than 55 and filled with 110-120 MPa high-strength concrete provides insignificant confinement to the concrete. Brauns (1999) stated that effect of confinement exists at high stress levels when the structural steel acts in tension and the concrete in compression. The design for local buckling of concrete filled steel tubes, In: Composite Construction—Conventional and Innovative, Innsbruck, Austria, 319-324. O'Shea, M. D., and Bridge, R. Q. (2000). Design of circular thin-walled concrete filled steel tubes, Journal of Structural Engineering, 126:11, 1295-1303.

The concrete core and the steel tube in a cross-section are each divided into a large number of horizontal layers parallel to the neutral axis. The area of each layer of the concrete core and the steel tube is calculated based on the geometry of the cross-section. The stresses in the concrete and steel layers are determined using their respective constitutive models. The beneficial effects of post-tensioning on the flexural strength of a concrete-filled circular steel tube were observed in the bending tests. Due to post-tensioning, the moment capacity of PTCFT219 was larger than that of CFT219 (92.4 kN m and 87.6 kN m, respectively), as shown in Table I. Han et al.