PRINCIPALS
James M. Fisher, Ph.D.
Curtis B. Miller
Michael A. West
Richard C. Kaehler
Thomas W. Whittow
John A. Rolfes
Jules P. Van de Pas
Michael P. Ryer
Gary A. Householder
Mark T. Bolens
James R. Michalek
Stephen M. Herlache
Mahmoud Maamouri, Ph.D.

Donald R. Buettner, Ph.D. – *Emeritus*
LeRoy A. Lutz, Ph.D. – *Emeritus*

COMPUTERIZED STRUCTURAL DESIGN, S.C.

CONSULTING ENGINEERS

SENIOR ASSOCIATES
George R. Batcha IV
James C. LaBelle, Doc.E.
Timothy S. Bickel

ASSOCIATES
Robert J. Neumann
Steven H. Schultz
Gene J. Galarowicz
Neil M. Elkins
Darin E. Riggleman
John A. Stolarczyk
Mark A. Edwards
Dennis L. Johnson
Thomas P. Getschman
Michael T. Kempfert
James R. Gerloff

DESIGN OF SUSPENDER FRAMING

Summary

The suspender framing system uses back-to-back angles, or channels, that are spaced apart by the rod fittings. Initially, the allowable load was assumed to be 1,000 lbs for a pair of angles. Analytically, the task then was to find the maximum spans for various sizes of angles. The AISC equations (Chapter F of the 2005 Specification) were used for a single angle, unbraced for its entire span and supporting 500 lbs at midspan. An unrestrained angle, subject to a vertical force parallel to one leg, will deflect both vertically and horizontally.

Subsequent testing demonstrated that this analytical approach was overly conservative. The rod fitting did provide a substantial amount of bracing.

Thus a more accurate analytical model was considered. This model included the benefit of symmetry: i.e., at the rod fitting, each angle exerted an equal but opposite horizontal force on the other. The net result is no net horizontal movement at the load point (rod). Load-deflection equations, for the principal axes of the angles, were used to find the horizontal force needed to prevent horizontal deflection of a single angle for a given vertical load. This horizontal force is a fixed percentage of the vertical force, for each angle size. For a particular vertical load, this combination of forces resulted in significantly less bending stress, and thus a higher bending strength, as compared to the first approach. In addition, to allow for the fact that the concentrated load could be placed anywhere in the span, the unbraced length was taken as 0.75 times the span. Chapter F of the 2005 AISC Specification was also used for this model.

With the second model, the predicted (nominal) load capacity was much closer to, but still less than, the factored maximum-capacity for load at midspan, for a given test span and angle size. A reduction factor (equal to the ratio of specified minimum-yield stress to test-coupon yield stress, for each angle size tested) was multiplied times the test-determined maximum load to determine a reduced maximum-capacity. This reduced maximum-capacity constitutes an expected lower-bound on the actual strength.

For back-to-back channels, analysis was based on Chapter F of the 2005 AISC Specification. Predicted strength values (adjusted to account for delivered versus minimum yield) were less than the test values.

The allowable load, based on strength for each span/size combination of both angles and channels, was taken to be the calculated, nominal-load capacity divided by a safety factor of 2.0. The unbraced length was taken as 0.75 times the span. For some combinations, the deflection limit of span/240 resulted in an allowable load less than the value based on strength alone.

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