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Tests on cold formed steel studs for the American Iron and Steel Institute

American Iron and Steel Institute

SCHOOL OF CIVIL ENGINEERING, CORNELL UNIVERSITY

TESTS ON COLD FORMED STEEL STUDS

FOR THE AMERICAN IRON AND STEEL INSTITUTE

Thirteenth Progress Report
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I. SCOPE OF THIS REPORT

In the 12th Report, Section III, a method was proposed for the determination of the required strength of collateral attachments. In addition, a test procedure was suggested to test the validity of the theoretical considerations on which this determination was based. In the present report two more formulae are developed which will serve for the experimental verification of this approach. Preparations for these tests are now under way.

II. FORMULAE FOR THE ULTIMATE STRENGTH OF COLLATERAL ATTACHMENTS INTENDED FOR EXPERIMENTAL VERIFICATION OF DESIGN FORMULA (14) OF THE 12th REPORT

On the basis of the general equation (11) (p. 15) a design formula (equ. 14, p. 14) has been developed in the 12th Report for the determination of the necessary strength of closely spaced collateral attachments. It was stated in that report that a direct experimental proof of that formula was exceedingly difficult. Instead of attempting such a test procedure it was proposed to verify the general basis of this formula by testing studs with one and with two individual lateral supports. Formula (6) on p. 8 of that report has been developed for the first of these two cases. Similar formulae

developed by Dr. Lee for studs with two supports at the third points and these formulae are given herein. The derivations of these formulae follow exactly the same procedure as those of the 12th Report. For this reason only the final formulae are given.

An initially straight stud supported at the third points by elastic supports with a small spring constant k buckles in one half wave as shown in table I, (c), of the 10th Report. If the stud is initially curved into one half wave, the deflection d at any load P can be determined from equ. (11) of the 12th Report. With "e" representing the maximum initial eccentricity at mid-span, it follows that the deflection "d" at the points of collateral support is

$$d = 0.866 \frac{P \cdot e}{E I \pi^2/l^2 + 0.3045 k l - P} \qquad (1)$$

A similar stud with medium spring constants of the supports buckles in two half waves as shown in table I, (c) of the 10th Report. If the stud is initially curved into two half waves, the deflection at any load P can be determined in a similar way. With "E" representing this time the maximum initial eccentricity at the quarter points, it follows that the deflection "d" at the points of collateral support is

$$d = 0.866 \frac{P \cdot e}{4 E i \pi^2/l^2 + 0.076 k l - P} \qquad (2)$$

For a large spring constant k of the two collateral supports the stud buckles into three half waves (10th Report,

table I (e),) or, in other words, it buckles in the same way as a stud rigidly supported at the third points would do. The behavior of the stud, therefore, is no longer dependent upon the properties of the collateral support and the procedure proposed herein is no longer applicable. However, this third case is of no practical interest since under working conditions collateral attachments will be spaced closely enough to prevent free buckling of the studs between points of attachment (see formula (4), p. 4 of 12th Report and comments thereto). It is, therefore, proposed to choose the spring constants so as to obtain buckling in one or in two half waves.

In order to obtain buckling in one half wave the spring constant k has to be smaller than

$$k' = 13.1\pi^2 E\, I/l^3 \qquad (3)$$

In order to obtain buckling in two half waves the spring constant k should be larger than k' but smaller than

$$k'' = 81\pi^2 E\, I/l^3 \qquad (4)$$

(The value of k' has been determined from an approximate computation using the energy method, whereas the value for k" has been taken from equ. (72). p. 107, Timoshenko, Elastic Stability).

III. SUMMARY

(1) Two formulae have been developed for determining the displacements d of points of lateral support for studs with two such supports.

(2) In order to test the validity of design formula (14) of the 12th Report, it is proposed to verify experimentally equ. (6) of the 12th Report and equs. (1) and (2) of the

present report.

(3) It is believed that, if the tests bear out the validity of these equations, equ. (14) of the 12th Report can be recommended as basis for design specifications.

(4) Attention is drawn to the fact that in many of the tests carried out so far local crushing of the ends of the studs rather than any other cause was responsible for failure of the studs. It is believed that this fact requires further investigation and that a program to this effect should be agreed upon in the near future.