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ALLOWABLE TENSILE STRENGTH OF ARC SPOT WELDS WITH WELD WASHERS

In the CCFSS Technical Bulletin, Vol. 2, No. 2, published in August 1993, a design table was included for determining the allowable tensile strength of arc spot welds under wind uplift conditions using A446 and A611 steels with thicknesses ranging from 0.0295 to 0.0598 in.

According to Section E2.2 of the AISI Specification(1), weld washers are required for thicknesses less than 0.028 in. Because some deck products are furnished in metal thicknesses ranging from 0.0149 to 0.0269 in., weld washers are required for arc spot welded connections (puddle welds). The following design table for determining allowable tensile strength of arc spot welds with weld washers was prepared by Richard B. Heagler of United Steel Deck and is published in this Technical Bulletin with his permission. All design values were calculated for A446 and A611 grade E steels and based on weld washers having a thickness of 0.0598 in. with a prepunched hole of 3/8 in. diameter. The weld should overfill the hole to produce a visible weld diameter of 1/2-in. E70 electrode was used for preparing this table.

ALLOWABLE TENSILE STRENGTH OF ARC SPOT WELDS WITH WELD WASHERS

Steel	Base Metal Thickness (in.)	Design Wind Uplift (Tensile) Value(2) (lbs.)		
		I	II	III
A446 grade E A611 grade E	0.0149	740	850	510
	0.0179	760	890	530
	0.0239	810	980	560
	0.0269	830	950	580

Note:

I - Weld washer with one deck thickness.
II - Weld washer with two deck thicknesses.
III - Weld washer with edge lap (at support) - weld is eccentrically loaded.

Values for I, II, and III are based on a safety factor of 2.5 with the 33% increase of allowable values for wind loading.

References:

(1) American Iron and Steel Institute, "Specification for the Design of Cold-Formed Steel Structural Members," 1986 Edition with the 1989 Addendum.

(2) LaBoube, R.A. and Yu, Wei-Wen (1991), "Tensile Strength of Welded Connections," Final Report, Department of Civil Engineering, Center for Cold-Formed Steel Structures, University of Missouri-Rolla, Rolla, Missouri, 65401.

REVISED AISI PROVISIONS FOR WALL STUDS

The following revised design provisions for wall studs were prepared by Subcommittee 4 on Wall Studs Design and Perforated Elements of the AISI Committee on Specifications. These revised provisions with Commentary were approved by the AISI Committee on Specifications at the February 5, 1994 meeting held in Myrtle Beach, South Carolina and, after public review, may be included in future editions of the AISI Specifications.

D4 Wall Studs and Wall Stud Assemblies

Wall studs shall be designed either on the basis of an all steel system in accordance with Section C or on the basis of sheathing in accordance with Sections D4.1 through D4.3. Both solid and perforated webs shall be permitted. Both ends of the stud shall be connected to restrain rotation about the longitudinal stud axis and horizontal displacement perpendicular to the stud axis.

(i) All Steel Design

Wall stud assemblies using an all steel design shall be designed neglecting the structural contribution of the attached sheathings and shall comply with the requirements of Section C. In the case of circular web perforations, see Section B2.2 and for non-circular web perforations, the effective area shall be determined as follows:

The effective area, A_e at a stress F_n, shall be determined in accordance with Section B, assuming the web to consist of two unstiffened elements, one on each side of the perforation or the effective area, A_e, shall be determined from stub-column tests.

When A_e is determined in accordance with Section B, the following limitations related to the size and spacing of perforations and the depth of the stud shall apply:

1. The center-to-center spacing of web perforations shall not be less than 24 inches.

2. The maximum width of web perforations shall be the lesser of 0.5 times the depth, d, of the section or $2^1/_2$ inches.

3. The length of web perforations shall not exceed $4^1/_2$ inches.

4. The section depth-to-thickness ratio, d/t, shall not be less than 20.

5. The distance between the end of the stud and the near edge of a perforation shall not be less than 10 inches.

(ii) Sheathing Braced Design

Wall stud assemblies using a sheathing braced design shall be designed in accordance with Sections D4.1 through D4.3 and in addition shall comply with the following requirements:

In the case of perforated webs, the effective area, A_e, shall be determined as in (i) above.

Sheathing shall be attached to both sides of the stud and connected to the bottom and top horizontal members of the wall to provide lateral and torsional support to the stud in the plane of the wall.

Sheathing shall conform to the limitations specified under Table D4. Additional bracing shall be provided during construction, if required.

The equations given are applicable within the following limits:

Yield strength, $F_y \leq 50$ ksi
Section depth, $d \leq 6.0$ in.
Thickness, $t \leq 0.075$ in.
Overall length, $L \leq 16$ ft.
Stud spacing, 12 in. $\leq B \leq 24$ in.

D4.1 Wall Studs in Compression

D4.2 Wall Studs in Bending

Note: In these two sections, no revisions were made except that the footnotes have been moved to the Commentary.

D4.3 Wall Studs with Combined Axial Load and Bending

Note: No revisions were made in this section.

REVISIONS OF THE COMMENTARY ON SECTION D4 OF THE AISI SPECIFICATION

In the Commentary on Section D4 of the AISI Specification appearing on pages II-31 and II-32 of the AISI 1986 Design Manual, the following revisions were approved by the Committee on Specifications:

1) Under the title of D4 - Wall Studs and Wall Stud Assemblies, the following sentence was deleted from the first paragraph of the Commentary:

"Other cases, such as studs with sheathing on one flange only, dissimilar sheathing materials on each flange, or the evaluation of the effect of rotational restraint, are covered in footnotes to Specification Sections D4.1 and D4.2."

2) The following paragraph was added to the end of the Commentary on Section D4:

"In order to be effective, sheathing must retain its design strength and integrity for the expected service life of the wall. Of particular concern is the use of the gypsum sheathing in a moist environment. The values given in Table D4 for gypsum are based on dry service conditions."

3) Under the title of D4.1 - Wall Studs in Compression, the following four paragraphs were added to the end of the Commentary:

"The approach of determining effective areas in accordance with Section D4(i) is currently being used in Reference 1 for the design of perforated rack columns and was verified extensively for such structures as reported in Reference 2. The validity of this approach for wall studs was verified in a Cornell University project on wall studs reported in References 3 and 4.

The limitations in Section D4(i) are based on the parameters of the test program. The effective area, A_e, for sections with perforations which do not meet these limits can be determined by stub column tests.

The web is the component element of the section perpendicular to the wall and the flange is parallel to the plane of the wall.

Studs with sheathing on one flange only, or with unidentical sheathing on both flanges, or having rotational restraint that is not neglected, or having any combination of the above, can be designed in accordance with the same basic analysis principles used in deriving the provisions of this section (Reference 59).

4) The following four references are used in the revised Commentary:

1) "Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks," 1990 Edition, Rack Manufacturers Institute, Charlotte, North Carolina.

2) Pekoz, T., "Design of Perforated Cold-Formed Steel Columns," Proceedings of the Ninth International Specialty Conference on Cold-Formed Steel Structures, St. Louis, Missouri, University of Missouri-Rolla, Dept. of Civil Engineering, Rolla, Missouri 65401, November 1988.

3) Miller, T.H., and Pekoz, T., "Unstiffened Strip Approach for Perforated Wall Studs," Journal of Structural Engineering, Vol. 120, No. 2, ASCE, New York, New York, February 1994.

4) Miller, T.H., and Pekoz, T., Project Director, "Studies on the Behaviour of Cold-Formed Steel Wall Stud Assemblies," Report, Cornell University, School of Civil and Environmental Engineering, Ithaca, New York 14853, November 1989.

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