research report

Arc Spot Welds in Sheet-to-Sheet Connections

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ARC SPOT WELDS IN SHEET-TO-SHEET CONNECTIONS

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Introduction

The current AISI Specification Section E2.2.1 contains design equations for assessing the structural performance sheet-to-structural connections using an arc spot weld. These design equations are based on research at Cornell University (Pekoz and McGuire, 1979; Yu, 1991). However, the Specification is silent regarding the structural performance of a sheet-to-sheet arc spot weld connection subject to shear.

This report addresses the sheet-to-sheet connection for an arc spot weld subjected to shear.

Impact on Industry

Sheet-to-sheet arc spot weld connections are commonly used to attach deck sections. Development of a sheet-to-sheet design equation would fill a void in the Specification for a commonly used connection.

Scope of Study

An analytical assessment of the current literature pertaining to sheet-to-sheet arc spot weld connections was performed and based on this assessment a design recommendation is proposed.

Although the AISI Specification has been silent regarding the structural performance of sheet-to-sheet arc spot weld connections in shear, the Steel Deck Institute (1987) has provided design guidance. The Steel Deck Institute's Diaphragm Design Manual (1987) stipulates that the shear capacity for a sheet-to-sheet arc spot weld connection be taken as 75% of the shear capacity of a sheet-to-structural connection. SDI stipulates that the sheet-to-structural connection strength be defined by AISI Eq. E2.2.1-2. Prior to accepting the SDI design recommendation, a review of the pertinent research by Luttrell was performed (Appendix A).

Based on the study summarized in Appendix A, the following design equation is proposed:

$$P_{nss} = 0.75\, P_n$$

where P_{nss} = the nominal weld capacity in shear for a sheet to sheet connection and P_n = the nominal weld capacity in shear for a sheet to structural (AISI Section E2.2.1(a)).

In addition to reviewing the work of Luttrell, statistical studies were conducted to determine the appropriate ϕ of 0.60 and Ω of 2.65.

References

Steel Deck Institute (1987), *Steel Deck Diaphragm Design Manual*, Canton, OH.

Specification for the Design of Cold-Formed Steel Structural Members (1996), American Iron and Steel Institute, Washington, D. C.

Yu, W. W (1991), *Cold-Formed Steel Design*, 2nd Edition, Wiley Interscience, New York, NY

Appendix A

Luttrell Data for Sheet to Sheet Connections
Shear Strength - Table 3-2 from first edition of the Diaphragm Design Manual

Thickness (In.)	Diameter (In.)	Fu (ksi)	Pu (kips)	da (In.)	da/t	Pn (kips)	Pu/Pn	0.75*Pn (kips)	Pu/0.75*Pn
0.0635	0.77	59	4.83	0.7065	11.126	5.823	0.829	4.367	1.106
0.0635	0.8	59	4.85	0.7365	11.598	6.070	0.799	4.553	1.065
0.0635	0.8	59	4.84	0.7365	11.598	6.070	0.797	4.553	1.063
0.0635	0.65	59	4	0.5865	9.236	4.834	0.827	3.626	1.103
0.052	0.8	59	4.49	0.748	14.385	5.049	0.889	3.787	1.186
0.052	0.85	59	4.68	0.798	15.346	5.386	0.869	4.040	1.159
0.052	0.75	59	3.95	0.698	13.423	4.711	0.838	3.533	1.118
0.052	0.7	59	3.6	0.648	12.462	4.374	0.823	3.280	1.097
0.052	0.8	59	4.4	0.748	14.385	5.049	0.872	3.787	1.162
0.0482	0.8	59	3.41	0.7518	15.598	4.704	0.725	3.528	0.967
0.0482	0.8	59	3.41	0.7518	15.598	4.704	0.725	3.528	0.967
0.0482	0.8	59	3.55	0.7518	15.598	4.704	0.755	3.528	1.006
0.0343	0.6	59	1.9	0.5657	16.493	2.519	0.754	1.889	1.006
0.0343	0.75	59	2.41	0.7157	20.866	2.835	0.850	2.126	1.133
0.0343	0.75	59	2.46	0.7157	20.866	2.835	0.868	2.126	1.157
0.0343	0.6	59	1.76	0.5657	16.493	2.519	0.699	1.889	0.932
0.0343	0.5	59	1.47	0.4657	13.577	2.073	0.709	1.555	0.945
0.028	0.75	59	1.89	0.722	25.786	1.953	0.968	1.465	1.290
0.028	0.7	59	1.63	0.672	24.000	1.930	0.845	1.447	1.126
0.028	0.75	59	1.86	0.722	25.786	1.953	0.952	1.465	1.270
0.028	0.6	59	1.4	0.572	20.429	1.883	0.743	1.413	0.991
0.028	0.6	59	1.45	0.572	20.429	1.883	0.770	1.413	1.026
0.028	0.65	59	1.7	0.622	22.214	1.907	0.892	1.430	1.189
0.0248	0.45	59	0.73	0.4252	17.145	1.369		1.027	
0.0248	0.6	59	1.33	0.5752	23.194	1.506	0.883	1.129	1.178
0.0248	0.55	59	1.12	0.5252	21.177	2.213	0.506	1.659	0.675
0.0248	0.47	59	0.84	0.4452	17.952	1.433	0.586	1.075	0.782
0.0248	0.5	59	0.91	0.4752	19.161	3.051	0.298	2.288	0.398
						Mean	0.780		1.041
						Std. Dev.	0.1399		0.1865
						COV	0.1792		0.1792

Proposed design equation:
Pn = 0.75 * Pn per AISI for sheet to structural

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