

ICC-ES Evaluation Report

ESR-2577

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DIVISION: 03 00 00—CONCRETE
Section: 03 15 00—Concrete Accessories

REPORT HOLDER:

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EVALUATION SUBJECT:
TRU-WELD SHEAR CONNECTOR STUDS
1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2006 *International Building Code*® (2006 IBC)
- Other Codes (see Section 8.0)

Property evaluated:

Structural

2.0 USES

Tru-Weld Shear Connector Studs are intended for use in steel and concrete composite construction.

3.0 DESCRIPTION

Tru-Weld Shear Connector Studs are manufactured from ASTM A 108 or ASTM A 29, Grades C-1010 through C-1020, cold-drawn steel, and are Type B studs conforming to the requirements of AWS D1.1-04 and Section I1.3 of the 2005 AISC Specification for Structural Steel Buildings (AISC 360). The shear connector studs are provided in $\frac{1}{2}$ -, $\frac{5}{8}$ -, $\frac{3}{4}$ -, $\frac{7}{8}$ -, and 1-inch (12.7 mm, 15.9 mm, 19.1 mm, 22.2 mm, and 25.4 mm) diameters.

4.0 DESIGN AND INSTALLATION
4.1 Design:

The nominal horizontal shear strength of stud shear connectors is given in Table 3-21 of the AISC Steel Construction Manual (13th edition), in accordance with AISC 360. Alternatively, the nominal shear strength of one stud shear connector may be calculated in accordance with Sections I2.1g and I3.2d(3) of AISC 360. The design of composite members with shear connectors must comply with the provisions of Sections 2203, 2204, and 2205 of the IBC and Chapter I of AISC 360.

4.2 Installation:

Tru-Weld Shear Connector Studs are automatically end-welded directly to steel shapes or through steel deck panels with equipment and in accordance with procedures recommended by Tru-Weld Division, Tru-Fit Corporation. Welding must comply with AWS D1.1. Steel deck material must be galvanized steel complying with ASTM A 653 SS Grade 40, unless field qualification tests in accordance with AWS D1.1 are conducted to the satisfaction of the code official. Base-metal thickness of the deck must conform to Section 7.2.7 of AWS D1.1. Prior to welding, steel deck surfaces and supporting beams must be clean, unpainted, and free of heavy rust and mill scale, dirt, sand, oil, water or other deleterious materials. The deck material must be tightly secured on the top flange of beams. No air gaps are permitted at welded areas. The ambient temperature must be above 32°F (0°C). No welding is permitted at temperatures below 0°F (-21.3°C). At temperatures between 0°F and 32°F (-21.3°C to 0°C), detailed welding instructions in the Tru-Weld applications manual must be followed.

The following through-steel-deck welding applications are recognized in this report:

1. Three-quarter-inch-diameter (19.1 mm) stud through one layer of No. 20 gage thick steel deck panels with a maximum 0.8-ounce-per-square-foot (244 g/m²) galvanizing.
2. Three-quarter-inch-diameter (19.1 mm) stud through one layer of No. 16 gage thick steel deck panels with a maximum 1.15-ounce-per-square-foot (351 g/m²) galvanizing.
3. Three-quarter-inch-diameter (19.1 mm) stud through two layers of No. 18 gage thick steel deck panels with maximum 1.15-ounce-per-square-foot (351 g/m²) galvanizing on each deck panel layer.
4. Three-quarter-inch-diameter (19.1 mm) stud through two layers of No. 20 gage thick steel deck panels with 0.8-ounce-per-square-foot (244 g/m²) maximum galvanizing on each deck panel layer.

4.3 Special Inspection:

Special inspection during installation of shear connector studs is required in accordance with IBC Sections 1704.3 and 1704.4 and IBC Tables 1704.3 and 1704.4. Inspector responsibilities include verifying:

1. Identification of studs.
2. Concrete mix design.

3. Quality of concrete.
4. Stud bracing.
5. Stud clearances between edges, base and adjacent studs.
6. Stud size.
7. Concrete placement.
8. Concrete testing.
9. Sampling materials.
10. Welder qualifications.
11. Weld-joint preparation.
12. Weld procedure and process.
13. Tolerances.

5.0 CONDITIONS OF USE

The Tru-Weld Shear Connector Studs described in this report comply with the code noted in Section 1.0, subject to the following conditions:

- 5.1 Installation must comply with this report and the manufacturer's instructions. In the event of a conflict between this report and the manufacturer's installation instructions, this report governs.
- 5.2 Nominal shear strength of shear connectors must be designed in accordance with references given in Section 4.1 of this report.
- 5.3 Designs of composite beams and concrete slabs on formed steel deck panels must comply with the provisions of Section 4.1 of this report.
- 5.4 Design of composite construction consisting of concrete slabs on formed steel deck panels connected to steel beams is limited to shear connectors $\frac{3}{4}$ inch (19 mm) or less in diameter.
- 5.5 Special inspection must take place in accordance with Section 4.3 of this report.

6.0 EVIDENCE SUBMITTED

- 6.1 Reports of tests specified in AWS D1.1-2004 and the manufacturer's product data.
- 6.2 Quality documentation.

7.0 IDENTIFICATION

The label on the packages of Tru-Weld Shear Connector Studs displays the name and address of Tru-Weld Division, TFP Corporation; product name, size, and heat number; and the ICC-ES evaluation report number (ESR-2577). In addition, the shear connector studs are identified by the Tru-Weld logo (see Figure 1) inscribed in an indented circle on the head of each connector.

8.0 OTHER CODES

8.1 Evaluation Scope:

In addition to the code referenced in Section 1.0, the Tru-Weld Shear Connector Studs were evaluated for compliance with the 1997 *Uniform Building Code*TM (UBC).

8.2 Uses:

See Section 2.0.

8.3 Description:

See Section 3.0.

8.4 Design and Installation:

8.4.1 Design: Allowable shear connector stud values for Tru-Weld Studs directly connected to steel beam flanges (no decking) are set forth in Table 1 and are applicable only to concrete with ASTM C 33 aggregates (stone). Steel beam material must comply with the requirements for Group I or II materials listed in Table 3.1 of AWS D1.1-98. For concrete with rotary kiln produced aggregates conforming to ASTM C 330 and having a unit weight of not less than 90 pounds per cubic foot (1442 kg/m^3), allowable values for studs directly connected to steel beam flanges (no decking) are determined by multiplying values in Table 1 by the reduction coefficients shown in Table 2. Shear connectors for steel decks and composite beams must be designed in accordance with Chapter 22, Division III, of the UBC. Steel deck material must be galvanized steel complying with ASTM A 653 SS Grade 40, unless field qualification tests in accordance with AWS D1.1-1998 are conducted to the satisfaction of the code official.

8.4.2 Installation: See Section 4.2 of this report.

8.4.3 Special Inspection: Special inspection during installation of Shear Connector Studs is required in accordance with Sections 1701.5.2 and 1701.5.5 of the UBC. See Section 4.3 of this report for the balance of the requirements.

8.5 Conditions of Use:

The Tru-Weld Shear Connector Studs described in this report comply with the UBC, subject to the following conditions:

- 8.5.1 Installation must comply with this report and the manufacturer's instructions. In the event of a conflict between this report and the manufacturer's installation instructions, this report governs.
- 8.5.2 The shear connector studs' maximum allowable horizontal shear loads shown in Tables 1 and 2 are not exceeded.
- 8.5.3 Designs of composite beams and concrete slabs on formed steel deck comply with the provisions of Chapter 22, Division III, of the UBC, and the maximum shear connector diameter is $\frac{3}{4}$ inch (19.1 mm).
- 8.5.4 Special inspection occurs in accordance with Section 8.4.3 of this report.

8.6 Evidence Submitted:

See Section 6.0.

8.7 Identification:

See Section 7.0.

TABLE 1—ALLOWABLE HORIZONTAL SHEAR LOAD^{1,2}, *q* (kips), PER SHEAR CONNECTOR STUD FOR DIRECT ATTACHMENT, *q*—ASTM C 33 AGGREGATES (UBC ONLY)

TRU-WELD SHEAR CONNECTOR		ALLOWABLE HORIZONTAL SHEAR LOAD		
Diameter (inch)	Minimum Length (inches)	Stone-Aggregate Concrete Strengths, <i>f'c</i>		
		3,000 psi	3,500 psi	≥ 4,000 psi
1/2	2	5.1	5.5	5.9
5/8	2 1/2	8.0	8.6	9.2
3/4	3	11.5	12.5	13.3
7/8	3 1/2	15.6	16.8	18.0

For **SI**: 1 inch = 25.4 mm, 1 kip = 4.45 kN, 1 psi = 6.895 kPa.

¹The loads tabulated may also be used for studs longer than shown.

²For studs installed through steel decking, the tabulated allowable values must be reduced in accordance with Chapter 22, Division III, of the UBC.

TABLE 2—REDUCTION COEFFICIENTS FOR USE WITH CONCRETE MADE WITH ASTM C 330 AGGREGATES (UBC ONLY)

SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE (<i>f'c</i>)	AIR DRY UNIT WEIGHT OF CONCRETE (pcf)						
	90	95	100	105	110	115	120
≤ 4,000 psi	0.73	0.76	0.78	0.81	0.83	0.86	0.88
≥ 5,000 psi	0.82	0.85	0.87	0.91	0.93	0.96	0.99

For **SI**: 1 psi = 6.895 kPa, 1 pcf = 16.018 kg/m³.

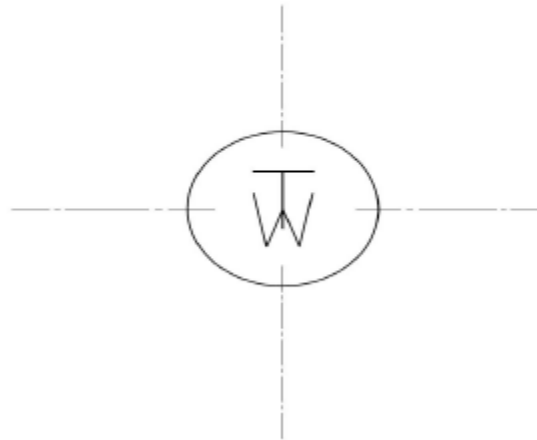


FIGURE 1