

ICC-ES Evaluation Report

ESR-2938

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DIVISION: 03 00 00—CONCRETE
Section: 03 15 00—Concrete Accessories
Section: 03 21 00—Reinforcing Steel

REPORT HOLDER:

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EVALUATION SUBJECT:
SRL PUNCHING SHEAR RESISTOR SHEAR RAILS
1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2006 *International Building Code*® (2006 IBC)

Property evaluated:

Structural

2.0 USES

The SRL Punching Shear Resistor (PSR) Shear Rails are used as shear reinforcement in concrete slabs to replace stirrups, drop panels or column capitals to increase the punching shear resistance of the slabs.

3.0 DESCRIPTION
3.1 General:

The SRL PSR Shear Rails are reinforcement assemblies that are formed by welding large-headed shear studs to steel base rails. The studs are provided in $3/8$ -, $1/2$ -, $5/8$ - and $3/4$ -inch (9.5, 12.7, 15.9, and 19.1 mm) diameters. The stud dimensions are given in Table 1 and base rail dimensions are given in Table 2. The assembly configuration is shown in Figure 1.

The SRL PSR Shear Rails comply with the provisions of ASTM A 1044.

3.2 Materials:

3.2.1 Studs: Studs are produced from ASTM A 29 Grade 1010 through 1020 steel and must conform to the following physical and mechanical requirements in accordance with the prescribed values in Table 1 of ASTM A 1044.

- Tensile strength, min, psi [MPa]: 65,000 [450]

- Yield strength, min, psi [MPa]: 51,000 [350]
- Elongation in 2 in. [50 mm], min, %: 20
- Reduction of area, min, %: 50

3.2.2 Base Rails: Base rails are produced from ASTM A 36 steel plates and must conform to the following physical and mechanical requirements in accordance with the prescribed values in Table 2 of ASTM A 1044.

- Tensile strength, min, psi [MPa]: 65,000 [450]
- Yield strength, min, psi [MPa]: 44,000 [300]
- Elongation in 8 in. [200 mm], min, %: 20

4.0 DESIGN AND INSTALLATION
4.1 Design:

4.1.1 General: Structural design and installation of SRL PSR Shear Rails used as punching shear reinforcement in reinforced concrete slabs must comply with the applicable provisions of ACI 318-08 except under the 2006 IBC, where compliance must be with ACI 318-05 and Sections 3.5.5, 7.7.5, and 11.11.5 of ACI 318-08.

4.1.2 Design Considerations: The structural design of SRL PSR Shear Rails must determine and specify the following items, based on design requirements in this report:

- a. The number of studs per rail.
- b. Stud shank diameter.
- c. Plate length.
- d. Shear rail assembly overall height (OH).
- e. Stud spacing (s).
- f. Distance between column face and first line of studs.

4.1.3 Earthquake Loads: The stud/rail assembly may be used at slab-to-column connections of structures where the flat slab is used together with the primary seismic force-resisting systems in Seismic Categories C, D, E and F, such as concrete shear walls, under the following conditions:

4.1.3.1 General: Lateral force-resisting elements of the structure are designed using the IBC.

4.1.3.2 Shear Strength: The nominal shear strength provided by the concrete in the presence of the shear studs referenced in 11.11.5 of ACI 318-08 must be revised as follows,

$$V_c = 1.5\lambda\sqrt{f'_c}b_o d$$

This revision requires revisions to the nominal shear strength, V_n , and the maximum shear stress, v_n .

Two-way slabs without beams designated as part of the seismic force-resisting system, must comply with the provisions in Section 21.3.6.8 of ACI 318-08, except that V_c must be limited as set forth in Section 4.1.3.2 of this report.

Two-way slabs without beams, which are not designated as part of the seismic force-resisting system, must comply with the provisions in Section 21.13.6 of ACI 318-08, except that V_c must be limited as set forth in Section 4.1.3.2 of this report and the design story drift ratio specified in Section 21.13.6(b) ACI 318-08 must not exceed the drift ratio referenced in Table 12.12-1 of ASCE/SEI 7.

4.2 Installation:

Installation of the SRL PSR shear rails must comply with applicable provisions of the 2009 and 2006 IBC and the approved engineering plans. The SRL PSR shear rail assemblies must be positioned correctly around columns and set in accordance with the IBC and the approved engineering plans and details. Concrete cover must comply with IBC Section 1907.7. See Figure 1 for typical installation details.

4.3 Special Inspection:

Special inspection of shear rail reinforcement and its installation at the jobsite must comply with 2009 and 2006 IBC Section 1704.4. The special inspector is responsible for verifying identification of the shear rail assembly per Section 7.0 of this report, its condition, positioning, clearances, and concrete cover.

5.0 CONDITIONS OF USE

The SRL PSR Shear Rails described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The shear rails must be designed, manufactured, and installed in accordance with this report and the approved plans. In the event of a conflict between this report and the approved plans, this report governs.

5.2 Design details and drawings must be in compliance with the design requirements of Section 4.1 of this report and must be approved by the code official. The calculations and drawings must be prepared by a registered design professional when required by the statutes of the jurisdiction in which the project is to be built.

5.3 Special inspections must be provided in accordance with Section 4.3 of this report.

5.4 The shear rails are manufactured at the SRL Industries facility in Maple Ridge, British Columbia, Canada, under a quality control program with third-party inspections by Quality Auditing Institute, Ltd. (AA-635).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Headed Shear Stud Reinforcement Assemblies for Concrete Slabs and Footings (AC308), dated October, 2008 (editorially revised November 2009).

7.0 IDENTIFICATION

The SRL PSR shear rails are identified on the packaging with the part name, manufacturing date, manufacturer's name (SRL Industries Ltd.) and address, evaluation report number (ESR-2938), and the name of the inspection agency (Quality Auditing Institute, Ltd.).

TABLE 1—SRL PSR STUD DIMENSIONS

SHANK DIAMETER, D [in. (mm)]	HEAD DIAMETER, H [in. (mm)]	H/D RATIO	SHANK AREA, S _A [in. ² (mm ²)]	HEAD AREA, H _A [in. ² (mm ²)]	H _A /S _A RATIO	HEAD THICKNESS, T [in. (mm)]
³ / ₈ (9.5)	1.19 (30.1)	3.17	0.110 (71)	1.112 (712)	10.1	0.26 (5.3)
¹ / ₂ (12.7)	1.58 (40.2)	3.16	0.196 (127)	1.961 (1,269)	10.0	0.33 (7.1)
⁵ / ₈ (15.9)	1.98 (50.2)	3.17	0.307 (199)	3.079 (1,979)	10.0	0.40 (8.9)
³ / ₄ (19.1)	2.37 (60.2)	3.16	0.442 (287)	4.412 (2,846)	10.0	0.47 (10.7)

TABLE 2—RECTANGULAR SHEAR REINFORCEMENT PLATE DIMENSIONS

STUD SHANK DIAMETER, D [in. (mm)]	PLATE WIDTH, W [in. (mm)]	PLATE THICKNESS, TH [in. (mm)]	PLATE LENGTH
³ / ₈ (9.5)	1.00 (25.4)	0.188 (4.8)	Determined by the registered design professional
¹ / ₂ (12.7)	1.25 (31.8)	0.250 (6.5)	
⁵ / ₈ (15.9)	1.75 (44.5)	0.313 (7.9)	
³ / ₄ (19.1)	2.00 (50.8)	0.375 (9.5)	

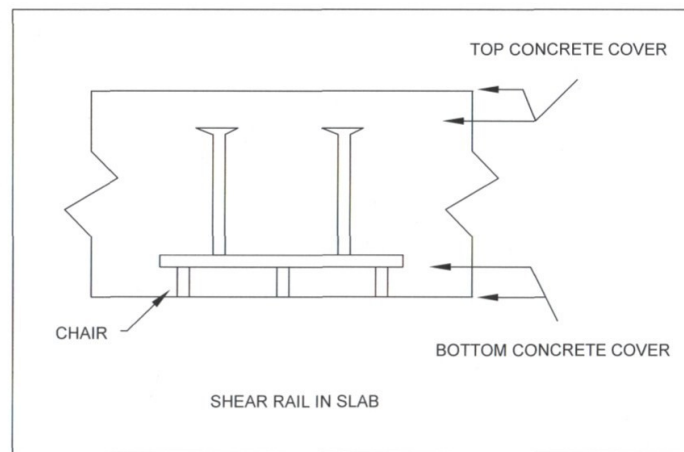
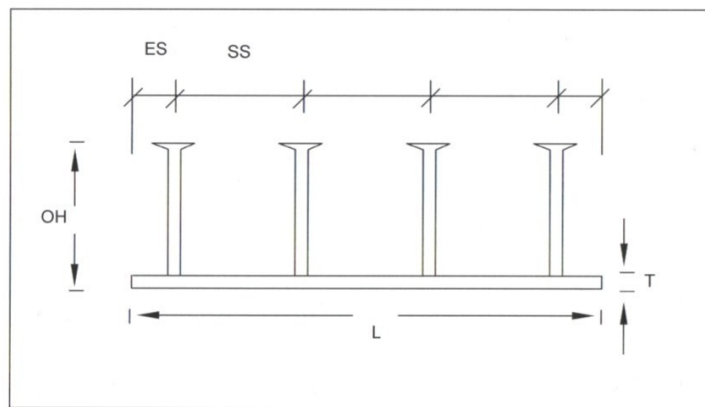
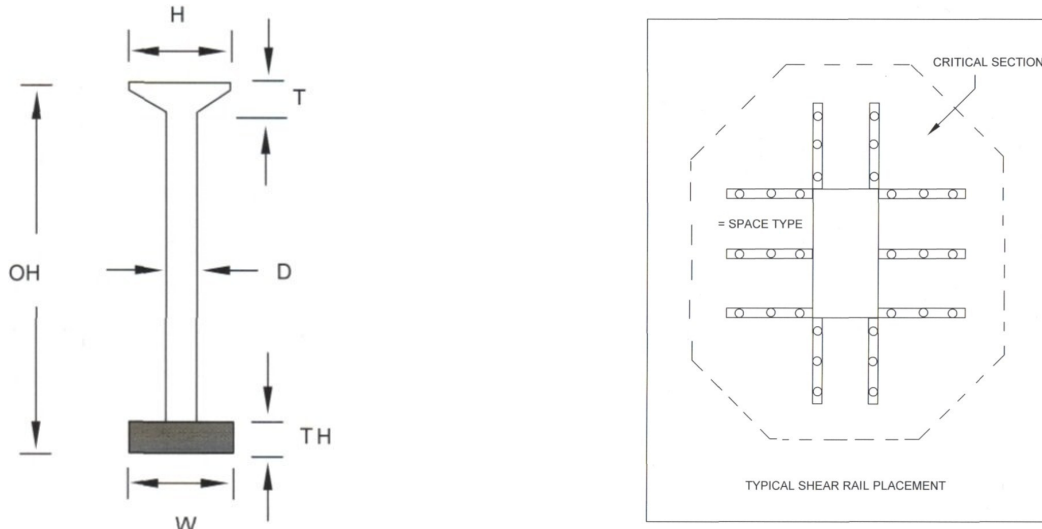


FIGURE 1—SRL PSR SHEAR RAIL DIAGRAM AND INSTALLATION