DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings
Section: 05 31 00—Steel Decking

REPORT HOLDER:
HILTI, INC.

EVALUATION SUBJECT:
STEEL DECK DIAPHRAGMS ATTACHED WITH HILTI S-MD 12-24 x 1 5/8 M OR S-RT5+ M9 FRAME FASTENERS AND HILTI S-SLC 01 M HWH, S-SLC 02 M HWH, OR S-MD 10-16 x 3/4 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, AND S-MD 12-24 x 7/8 HWH4 M9 SCREW SIDELAP CONNECTORS, VERCO VSC2 SIDELAP CONNECTIONS, OR BUTTON PUNCH SIDELAP CONNECTIONS

1.0 EVALUATION SCOPE
Compliance with the following codes:
For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-3693 LABC Supplement.

Property evaluated:
Structural

2.0 USES
Hilti’s S-MD 12-24 x 1 5/8 M and S-RT5+ M9 frame fasteners are used to attach B, BI, and Verco PLB steel roof deck panels to supporting steel framing. Hilti’s S-SLC 01 M HWH, S-SLC 02 M HWH, S-MD 10-16 x 3/4 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, and S-MD 12-24 x 7/8 HWH4 M9 screws, Verco’s VSC2 sidelap connections, and button punch sidelap connections are used to connect the steel deck panels together at the panel sidelaps.

3.0 DESCRIPTION
3.1 Frame Fasteners:
The Hilti S-MD 12-24 x 1 5/8 M self-drilling screw fasteners are case-hardened from carbon steel conforming to ASTM A510, Grade 1018 to 1022 with an electroplated zinc coating conforming to ASTM B633-13, SC 1, Type III. The fasteners also comply with ASTM C1513 and SAE J78 and have Hex Washer head styles. The fasteners are nominally 1.625-inch (41.3 mm) long and have a nominal 0.216-inch (5.5 mm) diameter with 24 threads per inch.

The Hilti S-RT5+ M9 self-drilling screw fasteners are case-hardened from carbon steel conforming to ASTM A510, Grade 1022 with a Zn-Ni coating. The fasteners are nominally 1.339-inch (34.0 mm) long and have a nominal 0.228-inch (5.8 mm) diameter with 24 threads per inch.

Table 1 provides an illustration and additional information on the fasteners. The fasteners are collated for use in a tool recommended by Hilti.

3.2 Steel Deck Panels:
Steel deck panels must be No. 16, 18, 20 or 22 gage Type B (nestable), Type BI (interlocking), or Verco PLB (interlocking) complying with Figure 4.

The B and BI steel deck panels must conform to the requirements of ASTM A653 SS, Grade 33 (minimum) with minimum G60 galvanized coating or must be painted or phosphatized steel complying with ASTM A1008-12 SS, Grade 33 (minimum).

The B and BI steel deck panels must be 36 inches (914 mm) in width with 1 1/2-inch-deep (38 mm) flutes spaced 6 inches (152 mm) on center. The B steel deck panels must have nestable sidelaps and the BI steel deck panels must have interlocking (standing seam) sidelaps.

The Verco PLB steel deck panels must comply with ASTM A653 SS Grade 50 Classes 1, 3, or 4 (minimum) steel, with a minimum G30 galvanized coating designation, or be phosphatized/painted, painted/painted, or mill-finished steel complying with ASTM A1008 SS Grade 50 (minimum).

3.3 Sidelap Connectors/Connections:
The steel deck panel sidelap connections must be made with either Hilti S-SLC 01, S-SLC 02 S-MD 10-16 x 3/4 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, or S-MD 12-24 x 7/8 HWH4 M9 screws; button punches as described in Section 4.1; or Verco VSC2 sidelap connections as described in ESR-2776. Table 2 provides illustrations and additional information on the sidelap connectors.

3.4 Steel Support Framing:
Structural steel supports of the steel deck panels (such as gage purlin, bar joists, and structural steel shapes) must be manufactured from a code-compliant steel having minimum strength requirements of ASTM A653 (minimum
yield strength of 33 ksi and minimum tensile strength of 45 ksi) for gage purlins or ASTM A36 for bar joists and structural steel shapes and minimum thicknesses as noted in the tables of this report.

4.0 INSTALLATION AND DESIGN

4.1 Installation:

4.1.1 General: The B and Bl steel deck panels must be attached to steel support framing with the Hilti S-MD 12-24 x 1 3/16 M or S-RT5+ frame fasteners in accordance with Table 1 and the steel deck panel sidelaps must be attached with Hilti S-SLC 01 or S-SLC 02 screws, S-MD 10-16 x 3/8 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, or S-MD 12-24 x 7/8 HWH4 M9 screws, button punches.

The Verco PLB deck is fastened to the structural supports with the Hilti 2-MD 12-24 x 1 3/16 M or S-RT5+ M9 frame fasteners in accordance with Table 1 and the sidelaps are connected with Verco’s VSC2 Connection in accordance with Table 2.

The Hilti fasteners must be installed in accordance with Hilti’s published installation instructions and the Verco VSC2 sidelap connections must be installed in accordance with Verco’s published installation instructions.

Steel deck panel ends must overlap a minimum of 2 inches (51 mm), as shown in Figure 3b. Endlap and corner lap conditions of two- and four-deck layers must be snug and tight to one another and the supporting steel frame, prior to frame fastener attachment. Standing seam interlocking-type sidelaps must be well engaged prior to sidelap connector installation.

Frame fasteners must be installed in the specified pattern, and sidelap connectors must be installed at the specified spacing (see Figure 2a) or number of connectors per span (see Figure 2b). The frame fastener patterns are shown in Figure 1. Figure 3 shows typical frame fastener and sidelap connector connection details.

Button-punching must be sharp and deep. The coating of the outer protruding nose of the punched lap should be “starred”, indicating a near-penetration of the button punching tool.

4.1.2 Frame Fasteners: The Hilti S-MD 12-24 x 1 3/16 M and S-RT5+ M9 frame fasteners:

• must be centered not less than 3/8 inch (9.5 mm) from the steel deck panel ends and not less than 3/16 inch (7.9 mm) from the steel deck panel edges parallel to corrugations at the sidelaps;
• must penetrate though the supporting steel with a minimum of three threads protruding past the back side of the supporting steel.

The number of diaphragm edge frame fasteners at walls or transfer zones parallel to the deck corrugations must be equal to or greater than the number of sidelap connectors at nearest interior sidelaps.

See Table 1 for applicable steel support framing thicknesses; Figure 1 for frame fastener patterns; and Figures 3a and 3b for frame fastener installation details.

4.1.3 Sidelap Connectors: The Hilti S-SLC 01 and Hilti S-SLC 02 screws, S-MD 10-16 x 3/8 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, and S-MD 12-24 x 7/8 HWH4 M9 screws, button punches, and Verco’s VSC2 sidelap connections:

• must penetrate though the steel deck panel not in contact with the sidelap connector or screw head with a minimum of three threads protruding (only applicable to sidelap screws);
• must not exceed 36 inches (914.4 mm) on center.

See Table 2 for applicable steel deck panel thicknesses; and Figures 3c, 3d, and 3e for sidelap connection details.

4.2 Design:

For symbols and definitions, see the American Iron and Steel Institute’s North American Standard for the Design of Profiled Steel Diaphragm Panels (AISI S310-16).

4.2.1 Diaphragm Shear and Stiffness by Calculations:

The allowable (ASD) or factored (LRFD) diaphragm shear strength must be determined in accordance with AISI S310-16 while using Tables 3, 4, 5, and 6. The diaphragm shear strength must also be multiplied by the correlation factors in Table 4. The allowable (ASD) or factored (LRFD) diaphragm shear strength must not be greater than the allowable (ASD) or factored (LRFD) diaphragm buckling strengths in Table 7.

Minimum sidelap spacing of fasteners noted in Table 11 must be considered.

An example calculation can be found at the end of this report.

4.2.2 Diaphragm Deflections: For the 2015 IBC and earlier codes, diaphragm deflection (Δ) must be calculated in accordance with the footnotes of Table 10. For seismic design, diaphragm deflection limits must comply with ASCE 7/SEI Chapter 12.

4.2.3 Uplift/Tension: For designs considering uplift/tension forces, see Tables 8 and 9.

5.0 CONDITIONS OF USE

The steel deck diaphragms attached with Hilti S-MD 12-24 x 1 3/16 M or S-RT5+ M9 frame fasteners and the sidelap connectors described in this report comply with, or are a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The fasteners are manufactured, identified and installed in accordance with this report, Hilti’s published installation instructions and the approved plans. If there is a conflict, this report governs.

5.2 Steel deck panels must comply with this report. When the steel deck panels are used as roof decks, the panel must be covered with an approved code-complying roof covering.

5.3 No adjustment for duration of load is permitted.

5.4 Steel deck diaphragms may be zoned by varying steel deck panel gage and/or connections across a diaphragm to meet varying shear and flexibility demands.

5.5 For intermediate steel deck panel thicknesses or panel steel strengths, diaphragm strength and stiffness values shall be based on straight-line interpolation between values determined in accordance with Section 4.2.

5.6 The design of the steel deck panels for vertical loads is outside the scope of this report.

5.7 Calculations demonstrating compliance with this report must be submitted to the code official for
5.8 Hilti fasteners may be used for attachment of steel deck roof systems temporarily exposed to the exterior during construction prior to application of built-up roof covering systems. The fasteners on permanently exposed steel deck roof coverings must be covered with a corrosion-resistant paint or sealant. For permanently exposed steel deck roof covering installations, the roof covering system’s compliance with Chapter 15 of the IBC must be justified to the satisfaction of the code official.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Steel Deck Roof and Floor Systems (AC43), dated October 2018, for recognition under the 2018 and 2015 IBC.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Steel Deck Roof and Floor Systems (AC43), dated October 2010 (editorially revised September 2013), for recognition under the 2012 and 2009 IBC.

6.3 Data in accordance with the ICC-ES Acceptance Criteria for Tapping Screw Fasteners (AC118), dated January 2018.

7.0 IDENTIFICATION

7.1 The S-MD 12-24 x 1⅛ M, S-RT5+ M9, S-SLC 01 M HWH, S-SLC 02 M HWH, S-MD 10-16 x ¾ M HWH3, S-MD 10-16 x ¾ HWH3 M9, S-MD 12-24 x ⅞ M HWH4, and S-MD 12-24 x ⅞ HWH4 M9 fasteners are identified by an “H” stamped on the fastener head. All fasteners are packaged in containers noting the fastener type, the report holder’s name and the evaluation report number (ESR-3693).

7.2 The report holder’s contact information is the following:

HILTI, INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.hilti.com
### TABLE 1—FRAME FASTENER SELECTOR GUIDE

<table>
<thead>
<tr>
<th>Steel Support Framing Thickness ($t_f$)</th>
<th>Fastener Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{8}$ in. $\leq t_f \leq \frac{3}{8}$ in.</td>
<td>S-RT5+ M9</td>
</tr>
<tr>
<td>$0.0598$ in. $\leq t_f \leq \frac{1}{4}$ in.</td>
<td>S-MD 12-24 x 1\frac{3}{8} M</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 2.54 mm

1Steel support framing must comply with the minimum strength requirements of ASTM A653 for gage purlins or ASTM A36 for bar joists and structural steel shapes as indicated in Section 3.4.

### TABLE 2—SIDELAP CONNECTOR SELECTOR GUIDE

<table>
<thead>
<tr>
<th>Steel Deck Panel Thicknesses</th>
<th>Fastener Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>No’s. 22, 20, 18 gage</td>
<td>Hilti S-SLC 01 M HWH</td>
</tr>
<tr>
<td>B and BI decks</td>
<td></td>
</tr>
<tr>
<td>No’s. 22, 20, 18, 16 gage</td>
<td>Hilti S-SLC 02 M HWH</td>
</tr>
<tr>
<td>B and BI decks</td>
<td></td>
</tr>
<tr>
<td>No’s. 22, 20, 18, 16 gage</td>
<td>Hilti No. 10 HWH Screw</td>
</tr>
<tr>
<td>B and BI decks</td>
<td></td>
</tr>
<tr>
<td>No’s. 22, 20, 18, 16 gage</td>
<td>Button Punch</td>
</tr>
<tr>
<td>BI decks</td>
<td>(As described in this report)</td>
</tr>
<tr>
<td>Verco PLB Deck decks</td>
<td></td>
</tr>
<tr>
<td>Verco’s VSC 2 Connection</td>
<td></td>
</tr>
</tbody>
</table>

1These sidelap connectors require BI deck to be screwable.
### TABLE 3—DIAPHRAGM STRENGTH (S) AND STIFFNESS FACTOR (G) EQUATION VARIABLE VALUES

<table>
<thead>
<tr>
<th>DECK TYPE</th>
<th>FRAME FASTENER PATTERN</th>
<th>(a_1) or (a_2)—END DISTRIBUTION FACTOR</th>
<th>(a_3) or (a_4)—PURLIN DISTRIBUTION FACTOR</th>
<th>(\Sigma x_{iso}^2) or (\Sigma x_{iso}^2) in.(^2)</th>
<th>s/d</th>
<th>A</th>
<th>N ft(^{-1})</th>
<th>D — WARPING CONSTANT, IN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-</td>
<td>36/11</td>
<td>3.667</td>
<td>3.667</td>
<td>1,944</td>
<td>1,944</td>
<td>1.365</td>
<td>2</td>
<td>3.000</td>
</tr>
<tr>
<td>B-</td>
<td>36/9</td>
<td>3.000</td>
<td>3.000</td>
<td>1,656</td>
<td>1,656</td>
<td>1.365</td>
<td>2</td>
<td>2.333</td>
</tr>
<tr>
<td>B-</td>
<td>36/7</td>
<td>2.000</td>
<td>2.000</td>
<td>1,008</td>
<td>1,008</td>
<td>1.365</td>
<td>1</td>
<td>2.000</td>
</tr>
<tr>
<td>B-</td>
<td>36/5</td>
<td>1.667</td>
<td>1.667</td>
<td>936</td>
<td>936</td>
<td>1.365</td>
<td>1</td>
<td>1.333</td>
</tr>
<tr>
<td>B-</td>
<td>36/4</td>
<td>1.333</td>
<td>1.333</td>
<td>720</td>
<td>720</td>
<td>1.365</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>B-</td>
<td>36/3</td>
<td>1.000</td>
<td>1.000</td>
<td>648</td>
<td>648</td>
<td>1.365</td>
<td>1</td>
<td>0.667</td>
</tr>
<tr>
<td>B- or Verco PLB</td>
<td>36/11</td>
<td>3.667</td>
<td>3.667</td>
<td>1,944</td>
<td>1,944</td>
<td>1.365</td>
<td>2</td>
<td>3.667</td>
</tr>
<tr>
<td>B- or Verco PLB</td>
<td>36/9</td>
<td>3.000</td>
<td>3.000</td>
<td>1,656</td>
<td>1,656</td>
<td>1.365</td>
<td>2</td>
<td>3.000</td>
</tr>
<tr>
<td>B- or Verco PLB</td>
<td>36/7</td>
<td>2.000</td>
<td>2.000</td>
<td>1,008</td>
<td>1,008</td>
<td>1.365</td>
<td>1</td>
<td>2.333</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 in.\(^2\) = 645 mm\(^2\), 1 ft\(^1\) = 3.28 m\(^2\).

See Figure 4 for applicable steel deck panels.

### TABLE 4—DIAPHRAGM STRENGTH EQUATION VARIABLE VALUES

<table>
<thead>
<tr>
<th>CONFIGURATION</th>
<th>STEEL DECK PANEL GAGE THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 22</td>
</tr>
<tr>
<td></td>
<td>(P_{nf}) (lbf)</td>
</tr>
<tr>
<td></td>
<td>Correlation Factor, (c)</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 ksi = 6.89 MPa.

See Figure 4 for applicable steel deck panel thicknesses in inches [(mils), (mm)].

For steel deck panel thicknesses applicable to the specific panel sidelap connector, see Table 2.

Screws must be Hilti S-MD 10-16 x \(\frac{3}{4}\) M HWH3, S-MD 10-16 x \(\frac{3}{4}\) M9, S-MD 12- M HWH4, or S-MD 12- HWH4 M9.
<table>
<thead>
<tr>
<th>CONFIGURATION</th>
<th>STEEL DECK PANEL GAGE THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 22</td>
</tr>
<tr>
<td></td>
<td>Pnf (lbf)</td>
</tr>
<tr>
<td></td>
<td>Correlation Factor, c</td>
</tr>
<tr>
<td>S-RT5+ M9</td>
<td>2/16 ≤ t &lt; 3/16</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>S-RT5+ M9</td>
<td>3/16 ≤ t ≤ 3/8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>S-RT5+ M9</td>
<td>3/16 ≤ t ≤ 3/8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>S-RT5+ M9</td>
<td>3/16 ≤ t &lt; 1/8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 in = 25.4 mm, 1 lbf = 4.45 N, 1 ksi = 6.89 MPa.

1See Figure 4 for steel deck panel thicknesses in inches [(mils), (mm)].
2For steel deck panel thicknesses applicable to the specific panel sidelpaw connector, see Table 2.
3Screws must be Hilti S-MD 10-16 x 3/16 M HWH3, S-MD 10-16 x 7/8 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, or S-MD 12-24 x 7/8 HWH4 M9.
### TABLE 5—DIAPHRAGM STIFFNESS (G) EQUATION VARIABLE VALUES

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Steel Deck Panel Gage Thickness¹</th>
<th>No. 22 gage</th>
<th>No. 20 gage</th>
<th>No. 18 gage</th>
<th>No. 16 gage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sf, in./kip</td>
<td>Sf, in./kip</td>
<td>Sf, in./kip</td>
<td>Sf, in./kip</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ss, in./kip</td>
<td>Ss, in./kip</td>
<td>Ss, in./kip</td>
<td>Ss, in./kip</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deck Type</th>
<th>Minimum Deck Tensile, F_u (Yield, F_y) Strengths, ksi</th>
<th>Frame Fastener</th>
<th>Sidelap Connector²</th>
</tr>
</thead>
<tbody>
<tr>
<td>B or BI</td>
<td>45 (33)</td>
<td>S-RT5+ M9</td>
<td>S-SLC 01 M HWH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-SLC 02 M HWH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. 10 or 12 screws³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-S, in./kip</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-S, in./kip</td>
</tr>
<tr>
<td></td>
<td>45 (33)</td>
<td>S-MD 12-24 x 1⅛ M</td>
<td>S-SLC 01 M HWH</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>S-SLC 02 M HWH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. 10 or 12 screws³</td>
</tr>
<tr>
<td></td>
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<td>S-S, in./kip</td>
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<td></td>
<td></td>
<td>S-S, in./kip</td>
</tr>
<tr>
<td>BI</td>
<td>45 (33)</td>
<td>S-RT5+ M9</td>
<td>Button Punch</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>S-SLC 01 M HWH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-SLC 02 M HWH</td>
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<td></td>
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<td></td>
<td>No. 10 or 12 screws³</td>
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<td>S-S, in./kip</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>S-S, in./kip</td>
</tr>
<tr>
<td>Verco PLB</td>
<td>65 (50)</td>
<td>S-RT5+ M9</td>
<td>Verco VSC2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-SLC 01 M HWH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-SLC 02 M HWH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. 10 or 12 screws³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-S, in./kip</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S-S, in./kip</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 in/kip = 5.7 mm/kN, 1 ksi = 6.89 MPa.

¹See Figure 4 for steel deck panel thicknesses in inches [(mils), (mm)].
²For steel deck panel thicknesses applicable to the specific panel sidelap connector, see Table 2.
³Screws must be Hilti S-MD 10-16 x ¾ M HWH3, S-MD 10-16 x ¾ HWH3 M9, S-MD 12-24 x 7/8 M HWH4, or S-MD 12-24 x 7/8 HWH4 M9.

### TABLE 6—SAFETY FACTORS FOR ALLOWABLE STRENGTH DESIGN (ASD) AND RESISTANCE FACTORS FOR LOAD AND RESISTANCE FACTOR DESIGN (LRFD) IN ACCORDANCE WITH AISI S310¹

<table>
<thead>
<tr>
<th>Connection Type</th>
<th>Load Type or Combinations Including</th>
<th>Ωₜₐₜ (ASD)</th>
<th>Φₜₐₜ (LRFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRAME</td>
<td>SIDEKAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-RT5+ M9</td>
<td>S-SLC 01 M HWH, S-SLC 02 M HWH, No. 10 or 12 screws²</td>
<td>Wind</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Verco VSC2</td>
<td>Wind</td>
<td>2.34</td>
</tr>
<tr>
<td>S-MD 12-24 x 1⅛ M</td>
<td>S-SLC 01 M HWH, S-SLC 02 M HWH, No. 10 or 12 screws² Button Punch</td>
<td>Wind</td>
<td>2.35</td>
</tr>
<tr>
<td></td>
<td>Verco VSC2</td>
<td>Wind</td>
<td>2.30</td>
</tr>
</tbody>
</table>

¹The available shear strength or factored shear resistance must be the lesser of the values determined using Table 6 and the tabulated values in Table 7.
²Screws must be Hilti S-MD 10-16 x ¾ M HWH3, S-MD 10-16 x ¾ HWH3 M9, S-MD 12-24 x 7/8 M HWH4, or S-MD 12-24 x 7/8 HWH4 M9.
### TABLE 7—DIAPHRAGM SHEAR STRENGTHS (plf) FOR BUCKLING\(^1,2\)

<table>
<thead>
<tr>
<th>DECK TYPE</th>
<th>MINIMUM MOMENT OF INERTIA(^3), (I_{kg}) (in(^4)/ft)</th>
<th>SPAN, (l) (ft-in)</th>
<th>(3'-0'')</th>
<th>(4'-0'')</th>
<th>(5'-0'')</th>
<th>(6'-0'')</th>
<th>(7'-0'')</th>
<th>(8'-0'')</th>
<th>(9'-0'')</th>
<th>(10'-0'')</th>
<th>(11'-0'')</th>
<th>(12'-0'')</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, Bl, and Verco PLB</td>
<td>No. 22 gage</td>
<td>0.173</td>
<td>7.750</td>
<td>4.360</td>
<td>2.790</td>
<td>1.938</td>
<td>1.424</td>
<td>1.090</td>
<td>0.861</td>
<td>0.698</td>
<td>0.576</td>
<td>0.484</td>
</tr>
<tr>
<td></td>
<td>No. 20 gage</td>
<td>0.210</td>
<td>10.363</td>
<td>5.829</td>
<td>3.731</td>
<td>2.591</td>
<td>1.903</td>
<td>1.457</td>
<td>1.151</td>
<td>0.933</td>
<td>0.771</td>
<td>0.648</td>
</tr>
<tr>
<td></td>
<td>No. 18 gage</td>
<td>0.279</td>
<td>15.829</td>
<td>8.904</td>
<td>5.698</td>
<td>3.957</td>
<td>2.907</td>
<td>2.226</td>
<td>1.759</td>
<td>1.425</td>
<td>1.177</td>
<td>0.989</td>
</tr>
<tr>
<td></td>
<td>No. 16 gage</td>
<td>0.353</td>
<td>22.479</td>
<td>12.644</td>
<td>8.092</td>
<td>5.620</td>
<td>4.129</td>
<td>3.161</td>
<td>2.498</td>
<td>2.023</td>
<td>1.672</td>
<td>1.405</td>
</tr>
<tr>
<td></td>
<td>No. 22 gage</td>
<td>0.173</td>
<td>12.401</td>
<td>6.975</td>
<td>4.464</td>
<td>3.100</td>
<td>2.278</td>
<td>1.744</td>
<td>1.378</td>
<td>1.116</td>
<td>0.922</td>
<td>0.775</td>
</tr>
<tr>
<td></td>
<td>No. 20 gage</td>
<td>0.210</td>
<td>16.581</td>
<td>9.327</td>
<td>5.969</td>
<td>4.145</td>
<td>3.046</td>
<td>2.332</td>
<td>1.842</td>
<td>1.492</td>
<td>1.233</td>
<td>1.036</td>
</tr>
<tr>
<td></td>
<td>No. 18 gage</td>
<td>0.279</td>
<td>25.327</td>
<td>14.246</td>
<td>9.118</td>
<td>6.332</td>
<td>4.652</td>
<td>3.562</td>
<td>2.814</td>
<td>2.279</td>
<td>1.884</td>
<td>1.583</td>
</tr>
<tr>
<td></td>
<td>No. 16 gage</td>
<td>0.353</td>
<td>35.966</td>
<td>20.231</td>
<td>12.948</td>
<td>8.992</td>
<td>6.606</td>
<td>5.058</td>
<td>3.996</td>
<td>3.237</td>
<td>2.675</td>
<td>2.248</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 ft = 0.3048 m, 1 plf = 0.0146 N/mm, 1 in\(^4\)/ft = 1,368 mm\(^4\)/mm
\(^1\)Load values are based on AISI S310-16 Eq. D-1 and Eq. D2.1-1.
\(^2\)The available shear strength or factored shear resistance must be the lesser of the values determined using Table 6 and the tabulated values in Table 7.
\(^3\)\(I_{kg}\) is the moment of inertia of the fully effective panel.

### TABLE 8—ALLOWABLE (ASD) TENSION PULLOUT LOADS TO RESIST TENSION (UPLIFT) LOADS FOR STEEL ROOF DECK PANELS ATTACHED WITH S-MD 12-24 X 1\(\frac{5}{8}\) M OR S-RT5+ M9 FASTENERS (lbf)\(^1\)

<table>
<thead>
<tr>
<th>STEEL SUPPORT FRAMING</th>
<th>FASTENER</th>
<th>STEEL DECK PANEL GAGE THICKNESS, in. (GAGE)</th>
<th>0.0598 (16)</th>
<th>0.0747 (14)</th>
<th>0.1046 (12)</th>
<th>1/8</th>
<th>3/16</th>
<th>1/4</th>
<th>5/16</th>
<th>3/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A36 ((F_y = 36) ksi, (F_u = 58) ksi)</td>
<td>S-RT5+ M9</td>
<td>S-MD 12-24 x 1(\frac{5}{8}) M</td>
<td>215</td>
<td>265</td>
<td>370</td>
<td>505</td>
<td>505</td>
<td>505</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 lbf = 4.45 N.
\(^1\)Tabulated allowable (ASD) values based upon a \(\Omega\) safety factor of 3.0. To obtain LRFD pullout capacities, the tabulated values must be multiplied by 1.6.

### TABLE 9—ALLOWABLE (ASD) TENSION PULLOVER LOADS TO RESIST TENSION (UPLIFT) LOADS FOR STEEL ROOF DECK PANELS ATTACHED WITH S-MD 12-24 X 1\(\frac{5}{8}\) M OR S-RT5+ M9 FASTENERS (lbf)\(^1\)

<table>
<thead>
<tr>
<th>STEEL SUPPORT FRAMING</th>
<th>FASTENER</th>
<th>STEEL DECK PANEL GAGE THICKNESS (in)(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A36 ((F_y = 36) ksi, (F_u = 58) ksi)</td>
<td>S-RT5+ M9</td>
<td>S-MD 12-24 x 1(\frac{5}{8}) M</td>
</tr>
<tr>
<td></td>
<td>No. 22 (0.0295)</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>No. 20 (0.0358)</td>
<td>560</td>
</tr>
<tr>
<td></td>
<td>No. 18 (0.0474)</td>
<td>445</td>
</tr>
<tr>
<td></td>
<td>No. 16 (0.0598)</td>
<td>335</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 lbf = 4.45 N.
\(^1\)Tabulated allowable (ASD) values based upon a \(\Omega\) safety factor of 3.0. To obtain LRFD pullout capacities, the tabulated values must be multiplied by 1.6.
### TABLE 10—DIAPHRAGM FLEXIBILITY LIMITATION\(^{1,2,3,4,5}\)

(Only applicable to 2015 IBC and earlier codes)

<table>
<thead>
<tr>
<th>( F )</th>
<th>MAXIMUM SPAN IN FEET FOR MASONRY OR CONCRETE WALLS</th>
<th>SPAN-DEPTH LIMITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum span in feet for masonry or concrete walls</td>
<td>Rotation Not Considered in Diaphragm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Masonry or Concrete Walls</td>
</tr>
<tr>
<td>More than 150</td>
<td>Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>70 – 150</td>
<td>200</td>
<td>2:1 or as required for deflection</td>
</tr>
<tr>
<td>10 – 70</td>
<td>400</td>
<td>2(\frac{1}{2}):1 or as required for deflection</td>
</tr>
<tr>
<td>1 – 10</td>
<td>No limitation</td>
<td>3:1 or as required for deflection</td>
</tr>
<tr>
<td>Less than 1</td>
<td>No limitation</td>
<td>As required for deflection</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 plf = 14.594 N/m, 1 psi = 6894 Pa.

1Diaphragms must be investigated regarding their flexibility and recommended span-depth limitations.

2Diaphragms supporting masonry or concrete walls must have their deflections limited to the following:

\[
\Delta_{\text{wall}} = \frac{H^2 f_c}{0.01 E t}
\]

For SI: \[
\Delta_{\text{wall}} = \frac{694,000 H^2 f_c}{Et}
\]

where:

- \( H \) = Unsupported height of wall in feet or millimeters.
- \( t \) = Thickness of wall in inches or millimeters.
- \( E \) = Modulus of elasticity of wall material for deflection determination in pounds per square inch or kilopascals.
- \( f_c \) = Allowable compression strength of wall material in flexure in pounds per square inch or kilopascals. For concrete, \( f_c = 0.45 f'_c \). For masonry, \( f_c = F_b = 0.33 f'_m \).

3The total deflection \( \Delta \) of the diaphragm may be computed from the equation: \( \Delta = \Delta_f + \Delta_w \).

where:

\[
\Delta_f = \text{Flexural deflection of the diaphragm determined in the same manner as the deflection of beams.}
\]

\[
\Delta_w = \text{The web deflection may be determined by the equation:}
\]

\[
\Delta_w = \frac{q_{\text{ave}} L F}{10^6} \quad \text{For SI: } \Delta_w = \frac{q_{\text{ave}} L F}{175}
\]

where:

- \( L \) = Distance in feet between vertical resisting element (such as shear wall) and the point to which the deflection is to be determined.
- \( q_{\text{ave}} \) = Average shear in diaphragm in pounds per foot or newtons per meter over length \( L \).
- \( F \) = Flexibility factor: The average microinches or micrometers (μm) a diaphragm web will deflect in a span of 1 foot (m) under a shear of 1 pound per foot (N/m).

4When applying these limitations to cantilevered diaphragms, the allowable span depth ratio will be half that shown.

5Diaphragm classification (flexible or rigid) and deflection limits must comply with Section 4.2.

6The general deflection equation for rectangular symmetrical diaphragms only:

\[
\frac{(d^2 y)}{(dx^2)} = \frac{M}{EI} + \frac{q}{BG'}
\]

For a uniformly loaded rectangular diaphragm on a simple span, the maximum deflection at the centerline of the diaphragm is:

\[
\Delta = \frac{5(1728)qL^4}{384EI} + \frac{qLF}{10^6} \quad \text{For SI: } \Delta = \frac{5(1000)qL^4}{384EI} + \frac{qLF}{10^6}
\]

where:

- \( \Delta \) = Diaphragm deflection, inches (mm).
- \( q \) = Wind or seismic load, kips per lineal foot (N/m)
- \( L \) = Length of diaphragm normal to load, feet (m).
- \( B \) = Width of diaphragm parallel to load, feet (m).
- \( E \) = Modulus of elasticity of supporting steel.
- \( I \) = Moment of inertia, inches\(^4\) (mm\(^4\)).

Nonrectangular diaphragms, nonsymmetrical diaphragms with re-entrant corners or diaphragms subjected to torsional loadings require special design consideration.
TABLE 11—MINIMUM SIDELAP CONNECTOR SPACING (SS) FOR HILTI S-SLC 01 M HWH, S-SLC 02 M HWH, AND
HILTI S-MD 10-16 x 1/4 M HWH3, S-MD 10-16 x 1/4 HWH3 M9, S-MD 12-24 x 1/4 M HWH4, OR
S-MD 12-24 x 1/4 HWH4 M9 SCREW SIDELAP CONNECTORS, VERCO VSC2 SIDELAP CONNECTIONS, AND
BUTTON PUNCH SIDELAP CONNECTIONS INSTALLED IN B-DECK, BI-DECK, OR VERCO PLB DECK
(INCHES CENTER ON CENTER)\(^1\)

<table>
<thead>
<tr>
<th>Frame Fastener/Steel Support Framing Thickness, in.</th>
<th>Frame Gage No.</th>
<th>Deck Gage No.</th>
<th>Frame Fastener Pattern(^2)</th>
<th>36/3</th>
<th>36/4</th>
<th>36/5</th>
<th>36/7(^3)</th>
<th>36/9(^3,4)</th>
<th>36/11(^3,4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S-RT5+ M9</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\frac{1}{4} \leq t_s \leq \frac{3}{16})</td>
<td>22</td>
<td>-</td>
<td></td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S-RT5+ M9</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\frac{3}{16} \leq t_s \leq \frac{1}{8})</td>
<td>22</td>
<td>12</td>
<td></td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 ksi = 6.89 MPa.

\(^1\)When the specified sidelap connector spacing is less than those tabulated, the tabulated spacing shall be used in the calculation of diaphragm strength and stiffness when using the values for \(P_{nf}\), \(P_{ns}\), and \(c\) from Table 4. As an alternate, when the specified sidelap connector spacing is less than those tabulated, but not less than 3 inches, the following values for \(P_{nf}\), \(P_{ns}\), and \(c\) may replace the values from Table 4.

**S-RT5+ M9** – All deck types, strengths, and steel support framing thicknesses listed in Table 4
No. 22 Gage (0.0295 in.) – \(P_{nf} = 1,489\) lbf, \(P_{ns} = 716\) lbf, \(c = 1.000\)
No. 20 Gage (0.0358 in.) – \(P_{nf} = 1,795\) lbf, \(P_{ns} = 869\) lbf, \(c = 1.000\)
No. 18 Gage (0.0474 in.) – \(P_{nf} = 2,348\) lbf, \(P_{ns} = 1,151\) lbf, \(c = 1.000\)

\(^2\)Frame fastener patterns recognized for specific deck type, frame fastener, sidelap combinations are shown in Table 4.

\(^3\)Noted minimum recommended sidelap connection spacings given for Hilti S-SLC 01 M HWH, S-SLC 02 M HWH, S-MD 10-16x3/4 M HWH3, S-MD 10-16x3/4 HWH3 M9, S-MD 12-24x7/8 M HWH4, and S-MD 12-24x7/8 HWH4 M9 screw sidelap connectors and button punch sidelap connections. For Verco VSC2 connections, the minimum recommended sidelap connection spacing for these configurations is 4 inches.

\(^4\)For 36/9 and 36/11 patterns, when allowable seismic (or wind) diaphragm shear capacities exceed the values as shown below, the fastening pattern must be increased at the building perimeter, chords, collectors, or other shear transfer elements to two fasteners per rib (i.e. 36/14 pattern). The allowable seismic (or wind) diaphragm shear capacity must not be greater than that determined from the 36/9 and 36/11 patterns, as applicable.

**S-RT5+ M9** – with steel support framing thicknesses < \(\frac{3}{16}\) inch
No. 22 Gage (0.0295 in.) – 1,200 plf (1,275 plf)
No. 20 Gage (0.0358 in.) – 1,500 plf (1,600 plf)
No. 18 Gage (0.0474 in.) – 1,700 plf (1,825 plf)

**S-RT5+ M9** – with steel support framing thicknesses ≥ \(\frac{3}{16}\) inch
No. 22 Gage (0.0295 in.) – 1,300 plf (1,400 plf)
No. 20 Gage (0.0358 in.) – 1,600 plf (1,700 plf)
No. 18 Gage (0.0474 in.) – 2,100 plf (2,250 plf)
No. 16 Gage (0.0598 in.) – 2,600 plf (2,775 plf)
Example: A 4'-0" span with a 12 in. sidelap connector spacing will typically start 6 in. from the first joist / beam line at the diaphragm zone perimeter, and then have equal spacings of 12 in. across the entire diaphragm length or width, off-set at the interior joist / beam locations. The interior joist / beam fastening locations are frame fasteners and not sidelap connectors. This convention of specifying sidelap connectors by spacing does not consider each deck span independently as a discrete element, but rather as a larger steel deck diaphragm system consisting of 3 or more spans.

Note: If the sidelap connector spacing does not divide evenly into the span length, some spans may have more sidelap connectors than adjacent spans. For this reason, $n_s$ and $n_i$ may not be whole numbers.

2a: SPECIFIED BY SIDELAP CONNECTOR SPACING (SS)

Example: A 4'-0" span specified with 3 sidelap connectors per span will have 3 sidelap connectors evenly spaced 12 in. from each joist/beam line and each other making 4 equal 12 in. spaces per span. This convention of specifying sidelap connectors by the number of sidelap connectors per span considers each deck span independently as a discrete element.

2b: SPECIFIED BY NUMBER OF SIDELAP CONNECTORS PER SPAN (SPS)
3a. S-MD 12-24 x 1\(^{1/4}\) or S-RT5+ M9 Fastener
Attachment of Steel Deck to Frame

3b. Steel Deck Endlap Condition

3c. Sidelap Connector with B Deck

3d. Sidelap Connector with BI Deck with screwable sidelap

3e. Verco VSC 2 Connection for use with PLB only

FIGURE 3—TYPICAL FRAME, ENDLAP AND SIDELAP CONNECTIONS

<table>
<thead>
<tr>
<th>Deck Type</th>
<th>Nominal Dimensions</th>
<th>Deck Type</th>
<th>Nominal Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Deck</td>
<td></td>
<td>BI-Deck and Verco PLB Deck</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5&quot; x 6&quot;</td>
<td></td>
<td>8&quot; x 1.75&quot;</td>
</tr>
<tr>
<td></td>
<td>1.75&quot; x 36&quot;</td>
<td></td>
<td>36&quot;</td>
</tr>
</tbody>
</table>

Notes:

1. B-Deck (nestable) and BI-Deck (interlocking) deck panel thicknesses must be 16, 18, 20 or 22 gage steel ([54, 43, 33 or 27 mil designations] [0.0598, 0.0474, 0.0358 or 0.0295 inch] [1.51, 1.21, 0.91 or 0.76 mm]), respectively. Intermediate steel deck panel thicknesses may be used (Reference Section 5.5 of this report).

2. PLB (interlocking) deck panel thicknesses must be 16, 18, 20 or 22 gage steel ([54, 43, 33 or 27 mil designations] [0.0598, 0.0478, 0.0359 or 0.0299 inch] [1.51, 1.21, 0.91 or 0.76 mm]), respectively. Intermediate steel deck panel thicknesses may be used (Reference Section 5.5 of this report).

3. BI-Deck (interlocking) deck panels must have screwable sidelap edges for use with Hilti SLC01 and SLC02 sidelap connectors and Hilti No. 10 x \(3/4\) HWH screws.

FIGURE 4—STEEL DECK PANELS
Given:
Load Type: Seismic Design
Support Span, $L_v$: 6 ft
Number of Spans: 3
Total Length, $L$: 18 ft (not including allowance for end laps)
Deck: No. 20 gage (t = 0.0358 in) 1-1/2 B-Deck (Fy = 33 ksi)
Support Framing: Steel Bar Joist with 1/4 in. Thick Top Chord
Frame Fastener: S-RT5+ M9
Frame Fastener Pattern: 36/7
Sidelap Fastener: S-SLC 02 M HWH
Sidelap Fastener Spacing: 12 in. o.c.

Problem:
Determine allowable (ASD) diaphragm design shear strength ($\frac{S_n}{\Omega}$) and stiffness ($G'$) for the given steel deck diaphragm.

Step 1: Calculate Nominal Diaphragm Shear Strength Limited by Interior Panel Fasteners:

$$S_{ni} = \left[2A(\lambda - 1) + \beta\right] \frac{P_{nf}}{L} = \left[2 \times 1(0.802 - 1) + 16.99\right] \frac{2107}{18} = 1942 \text{ plf}$$

Where:
- $A = 1$
- $P_{nf} = 2,107 \text{ lb}$
- $L = 18 \text{ ft}$
- $D_d = 1.5 \text{ in}$
- $L_v = 6 \text{ ft}$
- $t = 0.0358 \text{ in}$
- $SS = 12 \text{ in}$
- $n_p = 2$
- $P_{ns} = 1,260 \text{ lb}$
- $w = 36 \text{ in}$

$$\lambda = 1 - \frac{D_d L_v}{240 t} = 1 - \frac{1.5 \times 6}{240 \times 0.0358} = 0.802 \geq 0.7$$

$$n_s = \frac{SS}{12} = \frac{12 \times 18}{12} = 18$$

$$\alpha_s = \frac{P_{ns}}{P_{nf}}$$

$$\alpha_p^2 = \left(\frac{1}{w^2}\right) \sum x_p^2$$

$$\alpha_e^2 = \left(\frac{1}{w^2}\right) \sum x_e^2$$

$$\beta = n_s \alpha_s + 2n_p \alpha_p^2 + 4\alpha_e^2 = n_s \frac{P_{ns}}{P_{nf}} + 2n_p \left(\frac{1}{w^2}\right) \sum x_p^2 + 4 \left(\frac{1}{w^2}\right) \sum x_e^2$$

$$= 18 \frac{1260}{2107} + 2 \times 2 \left(\frac{1}{36}\right) \frac{1,008}{1,008} + 4 \left(\frac{1}{36}\right) \frac{1,008}{1,008} = 16.99$$

Step 2: Calculate Nominal Diaphragm Shear Strength Limited by Corner Fasteners:

$$S_{nc} = \left(\frac{N^2 \beta^2}{1^2 N^2 + \beta^2}\right)^{0.5} \times P_{nf} = \left(\frac{2^2 \times 16.99^2}{18^2 \times 2^2 + 16.99^2}\right)^{0.5} \times 2107 = 1798 \text{ plf}$$

Where:
- $N = 2$
- $\beta = 16.99$ (from Step 1)
- $L = 18 \text{ ft}$
- $P_{nf} = 2,107 \text{ lb}$

Step 3: Calculate Nominal Diaphragm Shear Strength Limited by Edge Fasteners:

$$S_{ne} = \left(\frac{2\alpha_1 + n_p \alpha_p}{L}\right) \frac{P_{nf} + n_e P_{nf}}{18} = \left(\frac{2 \times 2 + 2 \times 2}{2} \frac{2107}{18}\right) + 18 \times 2,107 = 3,043 \text{ plf}$$

Where:
- $\alpha_1 = 2$
- $n_p = 2$
\[ a_2 = 2 \]
\[ P_{nf} = 2,107 \text{ lb} \]
\[ P_{nfs} = 2,107 \text{ lb} \]
\[ L = 18 \text{ ft} \]
\[ SS = 12 \text{ in} \]
\[ n_e = \frac{12L}{SS} = \frac{12 \times 18}{12} = 18 \]

**Step 4: Calculate Nominal Diaphragm Shear Strength Controlled by Connections and Adjusted by the Correlation Factor:**

\[ S_{nf} = \min\{S_{ni}, S_{nc}, S_{ne}\} \]
\[ c = \min\{1,942, 1,798, 3,043\} \times 1.102 = 1,981 \text{ plf} \]

Where:
- \( S_{ni} = 1,942 \text{ plf (from Step 1)} \)
- \( S_{nc} = 1,798 \text{ plf (from Step 2)} \)
- \( S_{ne} = 3,043 \text{ plf (from Step 3)} \)
- \( c = 1.102 \)

**Step 5: Calculate Allowable Diaphragm Shear Strength:**

\[ S_{nf} \Omega_{nf} = \frac{1,981}{2.34} = 847 \text{ plf} \]

Where:
- \( S_{nf} = 1,981 \text{ plf (from Step 4)} \)
- \( \Omega_{nf} = 2.34 \)

**Step 6: Select Allowable Diaphragm Buckling Strength:**

\[ S_{nb} \Omega_{nb} = 2,591 \text{ plf} \]

**Step 7: Determine Controlling Allowable Diaphragm Shear Strength:**

\[ \frac{S_n}{\Omega} = \min\left[\frac{S_{nf}}{\Omega_{nf}}, \frac{S_{nb}}{\Omega_{nb}}\right] = \min\{(847), (2,591)\} = 847 \text{ plf} \]

Where:
- \( S_{nf} \Omega_{nf} = 847 \text{ plf (from Step 5)} \)
- \( S_{nb} \Omega_{nb} = 2,591 \text{ plf (from Step 6)} \)

**Step 8: Determine Diaphragm Stiffness:**

\[ G' = \left( \frac{Et}{2(1 + \mu)^2} + \frac{y_c D_n + C}{2} \right) K = \left( \frac{29,500 \times 0.0358}{2(1 + 0.3)1.365 + 0.9 \frac{924}{216} + 3.65} \right) 1 = 95.6 \text{ kip/in} \]

Where:
- \( E = 29,500 \text{ ksi} \)
- \( t = 0.0358 \text{ in} \)
- \( \mu = 0.3 \)
- \( s = 1.365 \)
- \( d = 216 \text{ in} \)
- \( y_c = 0.9 \)
- \( K = 1 \)
- \( w = 36 \text{ in} \)
- \( L = 216 \text{ in} \)
- \( a_3 = 2 \)
- \( n_p = 2 \)
- \( a_4 = 2 \)
- \( n_e = 18 \text{ (from Step 1)} \)
- \( S_f = 0.0066 \text{ in/kip} \)
- \( S_x = 0.0159 \text{ in/kip} \)
- \( D_n = \frac{D}{L} \)
- \( D = 924 \text{ in} \)

\[ C = \left( \frac{Et}{w} \right) \left( \frac{2L}{2a_3 + n_p a_4 + 2n_e S_f} \right) S_f = \left( \frac{29,500 \times 0.0358}{36} \right) \left( \frac{2 \times 216}{2 \times 2 + 2 \times 2 + 2 \times 2 \times 18 \times 0.0066} \right) = 3.65 \]

FIGURE 5—DIAPHRAGM DESIGN EXAMPLE
1.0 REPORT PURPOSE AND SCOPE

Purpose:
The purpose of this evaluation report supplement is to indicate that Steel Deck Diaphragms attached with Hilti S-MD 12-24 x 1 5/8 M or S-RT5+ M9 Frame Fasteners and HILTI S-SLC 01 M HWH, S-SLC 02 M HWH, or S-MD 10-16 x 3/4 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, AND S-MD 12-24 x 7/8 HWH4 M9 Screw Sidelap Connectors, VERCO VSC2 Sidelap Connections, or Button Punch Sidelap Connections, described in Sections 2.0 through 7.0 of the evaluation report ESR-3693, comply with the LABC Chapter 22, and are subjected to the conditions of use described in this supplement.

Applicable code editions:

- 2020 City of Los Angeles Building Code (LABC)

2.0 CONCLUSIONS

The Steel Deck Diaphragms attached with Hilti S-MD 12-24 x 1 5/8 M or S-RT5+ M9 Frame Fasteners and HILTI S-SLC 01 M HWH, S-SLC 02 M HWH, or S-MD 10-16 x 3/4 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, and S-MD 12-24 x 7/8 HWH4 M9 Screw Sidelap Connectors, VERCO VSC2 Sidelap Connections, or Button Punch Sidelap Connections, described in Sections 2.0 through 7.0 of the evaluation report ESR-3693, comply with the LABC Chapter 22, and are subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Steel Deck Diaphragms attached with Hilti S-MD 12-24 x 1 5/8 M or S-RT5+ M9 Frame Fasteners and HILTI S-SLC 01 M HWH, S-SLC 02 M HWH, or S-MD 10-16 x 3/4 M HWH3, S-MD 10-16 x 3/4 HWH3 M9, S-MD 12-24 x 7/8 M HWH4, and S-MD 12-24 x 7/8 HWH4 M9 Screw Sidelap Connectors, VERCO VSC2 Sidelap Connections, or Button Punch Sidelap Connections described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3693.
- The design, installation, conditions of use and identification are in accordance with the 2018 International Building Code® (2018 IBC) provisions noted in the evaluation report ESR-3693.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Diaphragm shear strength values in the evaluation report must not be increased for load combinations that include wind or seismic loads.
- For diaphragms that are used to provide wall anchorage, the adequacy of the steel deck panel end and side seam connections must be verified by a registered design professional to the satisfaction of the code official.

This supplement expires concurrently with the evaluation report, reissued May 2019 and revised January 2020.
1.0 REPORT PURPOSE AND SCOPE

Purpose:
The purpose of this evaluation report supplement is to indicate that the fasteners, recognized in ICC-ES master evaluation report ESR-3693, have also been evaluated for compliance with the code noted below.

Applicable code edition:
2017 Florida Building Code—Building

2.0 CONCLUSIONS

The fasteners described in Sections 2.0 through 7.0 of the master evaluation report, ESR-3693, comply with the Florida Building Code—Building, provided the design and installation are in accordance with the 2015 International Building Code® provisions noted in the master report.

Use of the fasteners has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the Florida Building Code—Building and must comply with the following Condition of Use:

When the fasteners are used with 22 gage or less (thinner) steel decking, the steel decking must be minimum G90 galvanizing in accordance with Section 2222.6.1 of the FBC.

For products falling under Florida Rule 9N-3, verification that the report holder’s quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued May 2019 and revised January 2020.