ICC-ES Evaluation Report

ESR-2184

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings

DIVISION: 09 00 00—FINISHES
Section: 09 22 16.23—Fasteners

REPORT HOLDER:

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EVALUATION SUBJECT:

HILTI LOW-VELOCITY POWDER-ACTUATED X-CX AND X-CC CEILING CLIP ASSEMBLIES AND X-CW CEILING WIRE ASSEMBLIES

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2015, 2012 and 2009 *International Residential Code*® (IRC)
- * ~~2013 *Abu Dhabi International Building Code* (ADIBC)†~~

†~~The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.~~

Property evaluated:

Structural

2.0 USES

Hilti low-velocity powder-actuated X-CX and X-CC Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies are used as alternatives to cast-in-place anchors described in 2015 IBC Section 1901.3 (2012 IBC Section 1908; 2009 IBC Section 1911) for placement in concrete and the welds and bolts used to attach materials to steel described in IBC Sections 2204.1 and 2204.2, respectively. For structures regulated under the IRC, the assemblies may be used where an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 X-CX Ceiling Clip Assemblies:

3.1.1 General: Each X-CX Ceiling Clip Assembly consists of a steel angle (ceiling clip) premounted on a powder-actuated fastener. A typical assembly is illustrated in Figure 1A. See Table 1 for assembly designations, fastener dimensions, applicable base materials and applicable load tables.

3.1.2 Powder-actuated Fasteners: The powder-actuated fastener is a Hilti X-AL-H fastener. The X-AL-H fastener is formed from carbon steel and is heat-treated to a nominal core hardness of 58 HRC. The fastener has a zinc coating complying with ASTM B633, SC1, Type III. The fastener has a smooth tapered shank, with a nominal diameter beyond the taper of 0.177 inch and a head diameter of 0.322 inch.

3.1.3 Ceiling Clip: The ceiling clip is manufactured from carbon steel conforming to DIN EN 10346 grade S280GD with a Z140-N-A-C coating. The clip measures 0.79 inch (20 mm) wide and 0.059 inch (1.5 mm) thick. The outstanding leg has a tear-shaped hole with a nominal diameter of 0.3 inch (7.5 mm) through which the ceiling wire is attached. See Figure 1B for an image of the clip.

3.2 X-CC Ceiling Clip Assemblies:

3.2.1 General: Each X-CC Ceiling Clip Assembly consists of a steel angle (ceiling clip) premounted on a powder-actuated fastener. A typical assembly is illustrated in Figure 2. See Table 1 for assembly designations, fastener dimensions, applicable base materials and applicable load tables.

3.2.2 Powder-actuated Fasteners: The powder-actuated fasteners are Hilti X-AL-H fasteners described in Section 3.1.2; Hilti X-C fasteners recognized in ESR-1663; or Hilti X-U fasteners recognized in ESR-2269.

3.2.3 Ceiling Clip: The ceiling clip is manufactured from carbon steel conforming to ASTM A653M grade SS275, with a minimum Z180 coating; or DIN EN 10346 S320GD with Z200-N-A-C coating. The clip measures $^3/_4$ inch wide (18 mm) and 0.0728 inch thick (1.85 mm). The outstanding leg has a hole with a diameter of 0.43 inch (11 mm) through which the ceiling wire is attached.

3.3 X-CW Ceiling Wire Assemblies:

3.3.1 General: Each X-CW Ceiling Wire Assembly consists of a steel wire clamped to a powder-actuated fastener with a premounted clamping washer, as shown in

*Deleted by the City of Los Angeles

Figures 3 and 4. See Table 1 for assembly designations, fastener dimensions, applicable base materials and applicable load tables.

3.3.2 Powder-actuated Fastener: The powder-actuated fasteners used in the X-CW C27 and X-CW C32 ceiling wire assemblies are the Hilti X-C 27 and X-C 32, respectively, recognized in ESR-1663. The powder-actuated fasteners used in the X-CW U22 and X-CW U27 ceiling wire assemblies are the Hilti X-U 22 and X-U 27 fasteners, respectively, recognized in ESR-2269.

3.3.3 Clamping Washer: The premounted clamping washer is formed from galvanized steel complying with ASTM A653M SS, Grade 255, with a Z120 coating designation. The steel has a base-metal thickness of 0.06 inch (1.5 mm).

3.3.4 Wire: For assemblies designated as Class 1, the ceiling wire is No. 12 gage diameter [0.106 inch (2.7 mm)], zinc-coated carbon steel wire complying with ASTM A641, soft temper, with a Class 1 zinc coating designation. For assemblies designated as INT, the ceiling wire is No. 12 gage diameter [0.106 inch (2.7 mm)], zinc-coated carbon steel wire complying with ASTM A641, with a tensile strength of 50 to 85 ksi and a regular coating.

3.4 Substrate Materials:

3.4.1 Concrete: Normal weight and sand-lightweight concrete must comply with IBC Chapter 19 or IRC Section R402.2, as applicable. The minimum concrete compressive strength at the time of fastener installation must be as noted in the applicable allowable load table.

3.4.2 Steel Deck Panels: Steel deck panels must conform to a code-referenced material standard, with the minimum thickness and minimum yield and tensile strengths noted in Table 3. See Figures 5 and 6 for panel configuration requirements.

3.4.3 Steel: Structural steel supports must comply with the minimum requirements of ASTM A36, ASTM A572 Grade 50 or ASTM A992, and must have the minimum thickness, yield strength and tensile strength as shown in Table 4.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Allowable Loads: The applicable allowable load tables for Hilti ceiling clip and ceiling wire assemblies driven into different base materials may be determined by referencing Table 1.

The most critical applied loads, excluding seismic load effects, resulting from the load combinations in IBC Section 1605.3.1 or 1605.3.2 must not exceed the allowable loads given in this section. For fasteners which are subjected to seismic loads, see Section 4.1.2 for additional requirements. The stress increases and load reductions described in IBC Section 1605.3 are not allowed.

Allowable loads in this report apply to the connection of the X-CX or X-CC Ceiling Clip Assembly or the X-CW Ceiling Wire Assembly to the base material only. Design of the connection of the attached material to the clip angle or ceiling wire must comply with the applicable requirements of the IBC.

4.1.2 Seismic Considerations: The X-CX and X-CC Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies are recognized for use when subjected to seismic loads as follows:

1. The assemblies may be used for attachment of nonstructural components listed in Section 13.1.4 of ASCE 7, which are exempt from the requirements of ASCE 7.
2. The assemblies fastened to concrete may be used to support acoustical tile or lay-in panel suspended ceiling systems, distributed systems and distribution systems where the service load on any individual assembly does not exceed the lesser of 90 lbf (400 N) or the allowable load shown in Table 2 or 3, as applicable.
3. The assemblies fastened to steel may be used where the service load on any individual assembly does not exceed the lesser of 250 lbf (1112 N) or the allowable load shown in Table 4.

4.2 Installation:

4.2.1 General: The X-CX and X-CC Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies must be installed in accordance with this report and the Hilti, Inc. published installation instructions. A copy of these instructions must be available on the jobsite at all times during installation. Installation must be limited to dry, interior locations.

Installation requires the use of a low-velocity powder-actuated tool in accordance with the Hilti, Inc. recommendations. The X-CW Ceiling Wire Assembly fastener standoff distance must be as shown in Figure 3.

4.2.2 Fastening to Concrete: Fasteners must not be driven until the concrete has reached the specified concrete strength noted in Table 2.For the X-CC Ceiling Clip Assemblies and the X-CW Ceiling Wire Assemblies, minimum spacing between embedded fasteners must be 4 inches (102 mm), and minimum edge distance must be 3 inches (76 mm). For the X-CX Ceiling Clip Assemblies, minimum spacing between embedded fasteners must be 5.1 inches (130 mm), and minimum edge distance must be 3.5 inches (90 mm). Unless otherwise noted, concrete thickness must be a minimum of three times the embedment depth of the fastener.

4.2.3 Fastening to Sand-lightweight Concrete-filled Steel Deck Panels: Fasteners must not be driven until the concrete has reached the specified concrete strength noted in Table 3. Installation of the X-CX and X-CC Ceiling Clip Assemblies and the X-CW Ceiling Wire Assemblies must comply with Figures 5 and 6, respectively. Minimum distances from fastener centerline to rolled deck panel flute edges must be as depicted in Figure 5 or 6, as applicable.

4.2.4 Fastening to Steel: Minimum spacing between fasteners must be 1 inch (25.4 mm) on center, and minimum edge distance must be $^1/_2$ inch (12.7 mm).

5.0 CONDITIONS OF USE

The Hilti X-CX and X-CC Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies 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 fasteners and assemblies must be manufactured and identified in accordance with this report.

5.2 Assembly installation complies with this report and the Hilti, Inc. published installation instructions. In the event of a conflict between this report and the Hilti, Inc. published installation instructions, the more restrictive requirements govern.

5.3 Calculations demonstrating that the actual loads are less than the allowable loads described in Section 4.1 must be submitted to the code official for approval. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.4 Refer to Section 4.1.2 for seismic considerations.

5.5 The use of ceiling clip and ceiling wire assemblies is limited to dry, interior locations, which include exterior walls which are protected by an exterior wall envelope.

5.6 The use of ceiling clip and ceiling wire assemblies is limited to installation in uncracked concrete. Cracking occurs when $f_t > f_r$ due to service loads or deformations.

5.7 Installers must be certified by Hilti, Inc., and have a current, Hilti-issued, operator's license.

5.8 The X-CX and X-CC Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies are manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Power-actuated Fasteners Driven into Concrete, Steel and Masonry Elements (AC70) dated February 2016.

7.0 IDENTIFICATION

The word "Hilti" and the designation "X-CX" are stamped on the X-CX ceiling clips. The word "Hilti" and the designation "CC-27" are stamped on the X-CC ceiling clips. All fasteners are imprinted with an "H" on the top of the head. The packaging for all assemblies is labeled with the assembly type and size, the report holder's name (Hilti, Inc.) and the evaluation report number (ESR-2184).

TABLE 1—HILTI CEILING CLIP AND CEILING WIRE ASSEMBLY TYPES

DESIGNATION	FASTENER SHANK DIAMETER (inch)	FASTENER SHANK LENGTH (inch)	EMBEDMENT OF FASTENER IN CONCRETE (inch)	APPLICABLE BASE MATERIAL	APPLICABLE LOAD TABLES
X-CX ALH22	0.177	0.866	3/4	Concrete Conc.-filled deck	2, 3
X-CX ALH27	0.177	1.063	7/8	Concrete Conc.-filled deck	2, 3
X-CX ALH32	0.177	1.260	1	Concrete Conc.-filled deck	2, 3
X-CC27 C27	0.138	1.063	1	Concrete Conc.-filled deck	2, 3
X-CC27 C32	0.138	1.260	1 1/8	Concrete Conc.-filled deck	2, 3
X-CC27 U22	0.157	0.866	3/4	Steel Concrete	2, 4
X-CC27 U27	0.157	1.063	1	Concrete Conc.-filled deck	2, 3
X-CC27 ALH22	0.157	0.866	3/4	Concrete	2
X-CC27 ALH27	0.177	1.063	1	Concrete Conc.-filled deck	2, 3
X-CW C27 Class 1 X-CW C27 INT	0.138	1.063	7/8	Concrete Conc.-filled deck	2, 3
X-CW C32 Class 1 X-CW C32 INT	0.138	1.260	1 1/8	Concrete Conc.-filled deck	2, 3
X-CW U22 Class 1 X-CW U22 INT	0.157	0.866	3/4	Concrete	2
X-CW U27 Class 1 X-CW U27 INT	0.157	0.866	7/8	Concrete Conc.-filled deck	2, 3

For **SI:** 1 Inch = 25.4 mm.

TABLE 2—ALLOWABLE LOADS FOR HILTI CEILING CLIP AND CEILING WIRE ASSEMBLIES INSTALLED IN NORMALWEIGHT CONCRETE [1,2,3]

DESIGNATION	ALLOWABLE LOADS (lbf)					
Concrete Compressive Strength:	4,000 psi			6,000 psi		
Load Direction:	Tension	Shear	45-Degree	Tension	Shear	45-Degree
X-CX ALH22	90	—	125	90	—	125
X-CX ALH27	125	—	165	110	—	150
X-CX ALH32	160	—	210	145	—	200
X-CC27 C27	160	205	210	—	—	—
X-CC27 C32	220	270	260	—	—	—
X-CC27 U22	—	—	—	80	175	90
X-CC27 U27	160	205	210	125	205	150
X-CC27 ALH22	—	—	—	80	175	70
X-CC27 ALH27	150	205	145	125	205	130
X-CW C27 Class 1, X-CW C27 INT	210	—	210	—	—	—
X-CW C32 Class 1, X-CW C32 INT	210	—	210	—	—	—
X-CW U22 Class 1, X-CW U22 INT	—	—	—	100	—	90
X-CW U27 Class 1, X-CW U27 INT	210	—	210	130	—	150

For **SI:** 1 inch = 25.4 mm; 1 lbf = 4.448 N; 1 psi = 6895 Pa.

[1]Allowable load values are for assemblies installed in concrete having the designated compressive strength at the time of installation.
[2]For X-CC Ceiling Clip Assemblies, the concrete thickness at the point of penetration must be a minimum of the fastener embedment depth plus $1^1/_2$ inches.
[3]For X-CX Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies, the concrete thickness at the point of penetration must be a minimum of three times the fastener embedment depth.

TABLE 3—ALLOWABLE LOADS FOR HILTI CEILING CLIP AND CEILING WIRE ASSEMBLIES INSTALLED INTO MINIMUM 3,000 psi STRUCTURAL SAND-LIGHTWEIGHT CONCRETE FILLED COMPOSITE STEEL DECK PANEL [1,2,3,4]

DESIGNATION	ALLOWABLE LOAD (lbf)					
Fastener Location:	Lower Flute			Upper Flute		
Load Direction:	Tension	Shear	45-Degree	Tension	Shear	45-Degree
X-CX ALH22	90	—	110	110	—	110
X-CX ALH27	120	—	125	150	—	130
X-CX ALH32	150	—	145	190	—	160
X-CC27 C27	50	275	120	105	285	240
X-CC27 C32	65	325	130	130	325	265
X-CC27 U27	150	275	160	170	285	240
X-CC27 ALH27	70	240	145	160	240	240
X-CW C27 Class 1, X-CW C27 INT	110	—	210	100	—	145
X-CW C32 Class 1, X-CW C32 INT	150	—	210	100	—	145
X-CW U27 Class 1, X-CW U27 INT	170	—	210	150	—	160

For **SI:** 1 inch = 25.4 mm; 1 lbf = 4.448 N; 1 psi = 6895 Pa, 1 ksi = 6.895 MPa.

[1]Allowable load values are for assemblies installed in concrete having the designated compressive strength at the time of installation.
[2]For X-CC Ceiling Clip Assemblies, the concrete thickness at the point of penetration must be a minimum of the fastener embedment depth plus $1^1/_2$ inches.
[3]For X-CX Ceiling Clip Assemblies and X-CW Ceiling Wire Assemblies, the concrete thickness at the point of penetration must be a minimum of three times the fastener embedment depth.
[4]Deck panel must be 3-inch deep composite floor deck and have a minimum 0.0358 inch base-metal thickness, a minimum yield strength of 40 ksi and a minimum tensile strength of 55 ksi. See Figures 5 and 6 for deck configuration.

TABLE 4—ALLOWABLE LOADS FOR HILTI CEILING CLIP ASSEMBLIES INSTALLED IN STEEL [1,2]

DESIGNATION	ALLOWABLE LOADS (lbf)								
Steel Thickness (inch):	$^1/_4$			$^3/_8$			$^1/_2$		
Load Direction:	Tension	Shear	45-Degree	Tension	Shear	45-Degree	Tension	Shear	45-Degree
X-CC27 U22	375	410	375	375	410	375	375	410	375

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N.

[1]Steel must comply with Section 3.3.4 of this report.
[2]Allowable load capacities are based on base steel with a minimum yield strength (F_y) of 36 ksi and a minimum tensile strength (F_u) of 58 ksi.

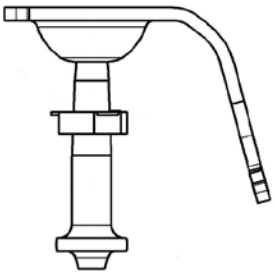


FIGURE 1A—HILTI X-CX CEILING CLIP ASSEMBLY

FIGURE 1B—HILTI X-CX CEILING CLIP

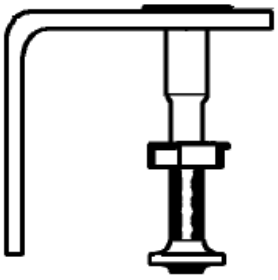


FIGURE 2—HILTI X-CC CEILING CLIP ASSEMBLY

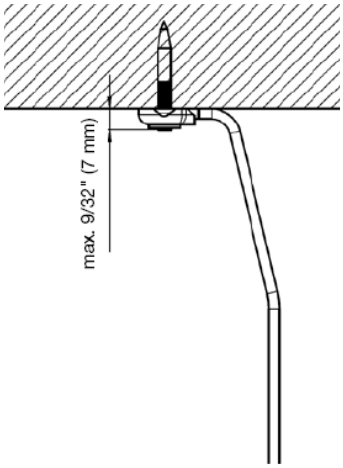


FIGURE 3—HILTI X-CW CEILING WIRE ASSEMBLY STAND-OFF DIMENSION

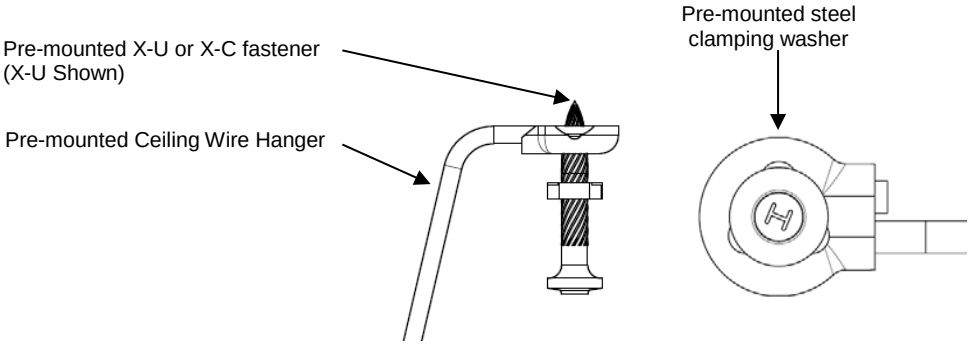
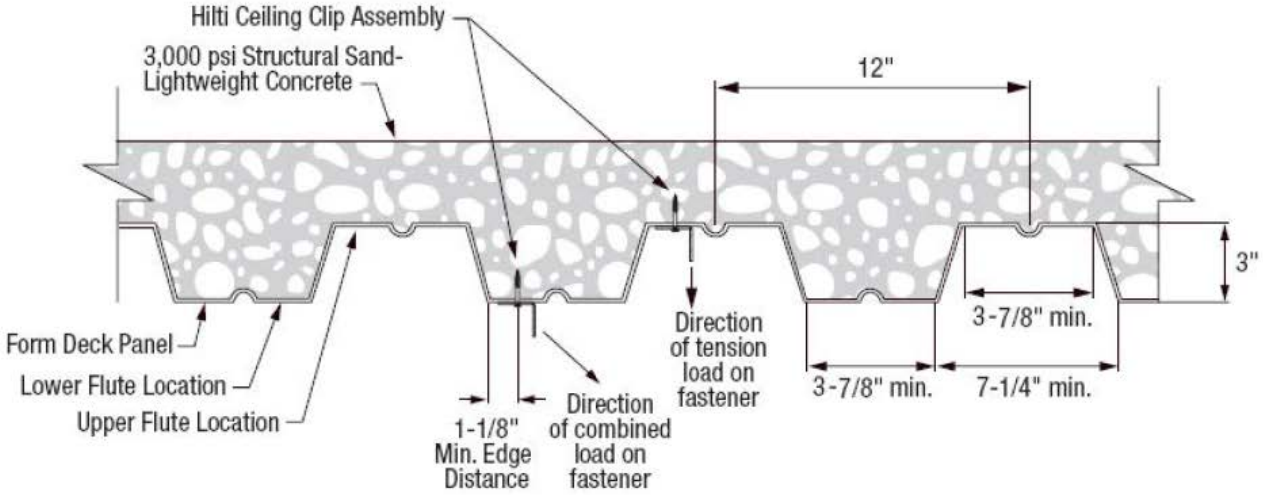


FIGURE 4—HILTI X-CW CEILING WIRE ASSEMBLY



Note: Unless otherwise noted, minimum concrete thickness at the point of penetration must be the embedment depth plus $1^1/_2$ inches. Concrete cover must be a minimum of $3^1/_4$ inches for the X-CX assembly.

FIGURE 5—INSTALLATION LOCATIONS FOR HILTI X-CC AND X-CX CEILING CLIPS IN 3-INCH-DEEP COMPOSITE STEEL DECK PANEL

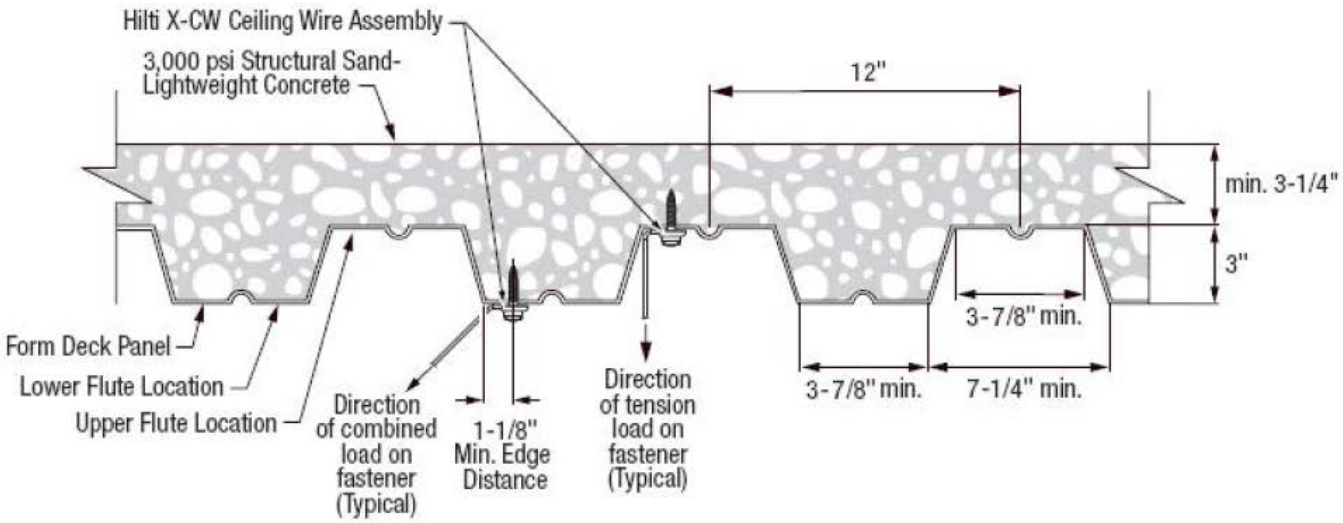


FIGURE 6—INSTALLATION LOCATIONS FOR HILTI X-CW CEILING WIRE HANGER ASSEMBLIES IN 3-INCH-DEEP COMPOSITE STEEL DECK PANEL