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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:

HILTI, INC.

**7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024**

EVALUATION SUBJECT:

HILTI LOW-VELOCITY POWDER-ACTUATED X-CX CEILING CLIP ASSEMBLIES



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EVALUATION SUBJECT:

**HILTI LOW-VELOCITY POWDER-ACTUATED X-CX
CEILING CLIP 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.

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see [ESR-2184 LABC and LARC Supplement](#).

Property evaluated:

Structural

2.0 USES

Hilti low-velocity powder-actuated X-CX Ceiling Clip 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 either a Hilti X-AL-H or X-C 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 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 X-C Fastener: The X-C fastener is recognized in ESR-1663. It is formed from carbon steel and is heat-treated to a nominal core hardness of 56 HRC. The fastener has a zinc coating complying with ASTM B633, SC1, Type III. The fastener has a smooth straight shank, with a nominal diameter of 0.138 inch and a head diameter of 0.322 inch.

3.1.4 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 Substrate Materials:

3.2.1 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.

3.2.2 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 Figure 2 for panel configuration requirements.

3.2.3 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 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 Ceiling Clip Assembly to the base material only. Design of the connection of the attached material to the clip angle must comply with the applicable requirements of the IBC.

4.1.2 Seismic Considerations: The X-CX Ceiling Clip 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 Ceiling Clip 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.

4.2.2 Fastening to Concrete: Fasteners must not be driven until the concrete has reached the specified concrete strength noted in Table 2. Minimum spacing between embedded fasteners must be 5.1 inches (130 mm), and minimum edge distance must be 3.5 inches (90 mm). 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 Ceiling Clip Assemblies must comply with Figure 2. Minimum distances from fastener centerline to rolled deck panel flute edges must be as depicted in Figure 2.

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 $\frac{1}{2}$ inch (12.7 mm).

5.0 CONDITIONS OF USE

The Hilti X-CX Ceiling Clip 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 must comply 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 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 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 Ceiling Clip 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. 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 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 Steel	2, 3, 4
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-CX C27	0.138	1.063	7/8	Concrete Conc.-filled deck	2, 3

For SI: 1 Inch = 25.4 mm.

TABLE 2—ALLOWABLE LOADS FOR HILTI CEILING CLIP ASSEMBLIES INSTALLED IN NORMALWEIGHT CONCRETE^{1,2}

DESIGNATION	ALLOWABLE LOADS (lbf)					
	4,000 psi			6,000 psi		
	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-CX C27	90	—	125	—	—	—

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 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 ASSEMBLIES INSTALLED INTO MINIMUM 3,000 psi STRUCTURAL SAND-LIGHTWEIGHT CONCRETE FILLED COMPOSITE STEEL DECK PANEL^{1,2}

DESIGNATION	ALLOWABLE LOAD (lbf)					
	Lower Flute			Upper Flute		
	Tension	Shear	45-Degree	Tension	Shear	45-Degree
X-CX ALH22 ³	90	—	110	110	—	110
X-CX ALH27 ³	120	—	125	150	—	130
X-CX ALH32 ³	150	—	145	190	—	160
X-CX C27 ⁴	80	—	110	110	—	110

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 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 Figure 2 for deck configuration and required concrete topping thickness.

³ Fasteners must be installed with a minimum of 3.5 inches from the end of the deck, and a minimum spacing of 5 inches.

⁴ Fasteners must be installed with a minimum of 3 inches from the end of the deck, and a minimum spacing of 4 inches.

TABLE 4—ALLOWABLE LOADS FOR HILTI CEILING CLIP ASSEMBLIES INSTALLED IN STEEL^{1,2}

DESIGNATION	ALLOWABLE LOADS (lbf)								
	1/4			3/8			1/2		
	Tension	Shear	45-Degree	Tension	Shear	45-Degree	Tension	Shear	45-Degree
X-CX ALH22	270	—	270	270	—	270	270	—	270

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

¹ Steel must comply with Section 3.2.3 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.

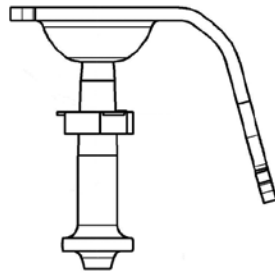
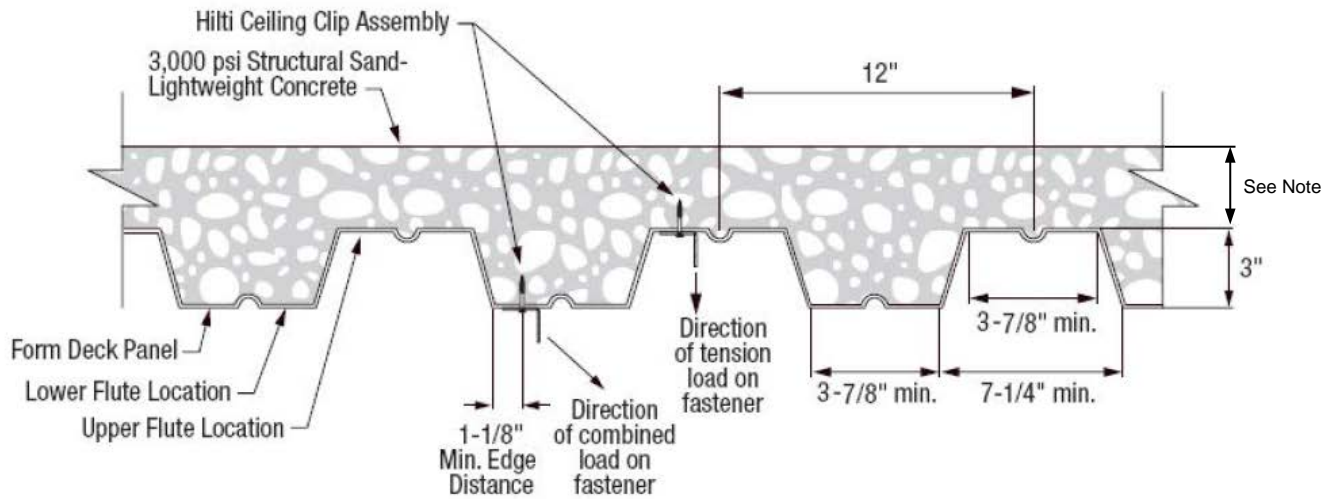


FIGURE 1A—HILTI X-CX CEILING CLIP ASSEMBLY



FIGURE 1B—HILTI X-CX CEILING CLIP



Note: Minimum thickness of concrete topping above deck must be as follows:
 3¹/₄ inches for the X-CX-ALH Assemblies
 2¹/₂ inches for the X-CX-C Assemblies

FIGURE 2—INSTALLATION LOCATIONS FOR HILTI X-CX CEILING CLIP ASSEMBLIES IN 3-INCH-DEEP STEEL DECK PANEL

ICC-ES Evaluation Report

ESR-2184 LABC and LARC Supplement

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EVALUATION SUBJECT:

HILTI LOW-VELOCITY POWDER-ACTUATED X-CX CEILING CLIP ASSEMBLIES

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Hilti low-velocity powder-actuated X-CX Ceiling Clip Assemblies, described in ICC-ES master evaluation report [ESR-2184](#), have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Hilti low-velocity powder-actuated X-CX Ceiling Clip Assemblies, described in Sections 2.0 through 7.0 of the master evaluation report [ESR-2184](#), comply with the LABC Chapters 19 and 22, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Hilti low-velocity powder-actuated X-CX Ceiling Clip Assemblies, described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report [ESR-2184](#).
- The design, installation, conditions of use and identification are in accordance with the 2015 *International Building Code*® (2015 IBC) provisions noted in the master evaluation report [ESR-2184](#).
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- For seismic applications, the Hilti low-velocity powder-actuated X-CX Ceiling Clip Assemblies must comply with Section 4.1.2 of the master report [ESR-2184](#).

- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable load values listed in the master evaluation report are for the connection of the ceiling clip assemblies to normalweight concrete, structural sand-lightweight concrete over metal decks, and steel base materials. The connection between the ceiling clip assemblies and the connected members must be checked for capacity (which may govern).

This supplement expires concurrently with the master report, reissued June 2017 and revised December 2017.

ICC-ES Evaluation Report

ESR-2184 FBC Supplement

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1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti X-CX Ceiling Clip Assemblies, recognized in ICC-ES master report ESR-2184, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2017 *Florida Building Code—Building*
- 2017 *Florida Building Code—Residential*

2.0 CONCLUSIONS:

The Hilti X-CX Ceiling Clip Assemblies described in Sections 2.0 through 7.0 of the master report comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2015 *International Building Code*® provisions noted in the master report.

Use of the Hilti X-CX Ceiling Clip Assemblies has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential* under the following condition:

The fasteners have not been evaluated for use as cast-in-place anchors for compliance with the High-Velocity Hurricane Zone provisions, and this use is outside the scope of this evaluation report.

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 master report, reissued June 2017 and revised December 2017.