ICC-ES Evaluation Report

ESR-3059

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DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings
Section: 05 40 00—Cold-Formed Metal Framing

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings
Section: 06 16 00—Sheathing

REPORT HOLDER:

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EVALUATION SUBJECT:

HILTI X-GPN 37 MX, X-PN 37 G2 MX AND X-PN 37 G3 MX POWER-ACTUATED FASTENERS USED TO ATTACH WOOD STRUCTURAL PANELS TO COLD-FORMED STEEL FRAMING

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

The Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX power-actuated fasteners (PAFs) are used to attach wood structural panels to cold-formed steel (CFS) framing. The fasteners may be used to transfer in-plane lateral loads between the panels and CFS framing, and to transfer out-of-plane transverse loads from the panels to the CFS framing. The fasteners may also be used as an alternative to screw fasteners prescribed by IBC Section 2211.6 to construct Type I shear walls (defined in Section C2 of AISI S213) comprised of wood structural panel sheathing and CFS framing in structures assigned to Seismic Design Categories (SDCs) A through F. For structures regulated under the IRC, the PAFs may be used when an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX:

The Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX products are collated PAFs made from hardened ductile steel complying with the manufacturer's quality documentation. The fasteners have a twist knurled shank with a nominal shank diameter of 0.102 inch (2.6 mm), a nominal head diameter of $^1/_4$ inch (6.4 mm), and a nominal shank length of $1^1/_2$ inches (38 mm). The fasteners have a proprietary corrosion-resistant coating and are collated in strips of ten replicate fasteners. Each product designation refers to a different collation design for use in a different tool. See Figure 1 for product images.

3.2 Shear Wall Assemblies:

3.2.1 General: Recognized shear wall assemblies are limited to a maximum height-to-width aspect ratio of 2:1. The walls must be constructed using wood structural panels fastened to one side of CFS framing using the Hilti X-GPN 37 MX, X-PN 37 G2 MX or X-PN 37 G3 MX PAFs. The shear wall must be connected to the supporting structure along its length at a maximum of 2 feet (610 mm) on center, and with a hold-down at each end. See Figure 2 for a depiction of a typical shear wall.

3.2.2 Fasteners for CFS Framing Connections: Fasteners used to connect CFS framing members together and to attach hold-downs to CFS framing must be minimum #8 Hilti self-drilling tapping screws recognized in ESR-2196.

3.2.3 CFS Framing: CFS studs must have a minimum web depth of $3^1/_2$ inches (89 mm), a minimum flange width of $1^5/_8$ inches (41 mm), and a minimum flange stiffener (lip) length of $^3/_8$ inch (9.5 mm). CFS tracks must have depth equal to the web depth of the CFS studs, and a minimum flange width of $1^1/_4$ inches (32 mm). CFS framing must have the minimum thickness designation shown in Table 1, 2 or 3, as applicable. CFS framing having a thickness designation of 43 mils or less must be manufactured from steel complying with ASTM A1003 ST33H or ASTM A653 SS Grade 33, with a minimum G60 coating designation. CFS framing having a thickness designation of 54 mils or greater must be manufactured from steel complying with ASTM A1003 ST50H or ASTM A653 SS Grade 50, Class 1, with a minimum G60 coating designation.

* Deleted by the City of Los Angeles

3.2.4 Wood Structural Panel Sheathing: Wood structural panels must be Exposure 1, Structural 1 plywood complying with DOC PS-1, or Oriented Strand Board (OSB) complying with the performance requirements in DOC PS-2 for Exposure 1, Structural 1 Sheathing, with sheathing thickness shown in Table 1, 2 or 3, as applicable.

3.2.5 Hold-downs: The hold-downs must be capable of providing adequate resistance to overturning of the shear wall assemblies. Hold-down capacity must be as indicated in an ICC-ES evaluation report. Adequacy of the hold-downs must be justified to the satisfaction of the code official.

3.2.6 Connection to Supporting Structure: The connectors used along the length of the shear wall must be capable of transferring the applied shear loads. Connector or anchor capacity must be as indicated in the IBC or an ICC-ES evaluation report, as applicable. Adequacy of the connectors (anchorage) must be justified to the satisfaction of the code official.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Single Fastener Connections: Allowable out-of-plane transverse loads and in-plane lateral loads for the Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX fasteners installed through wood structural panels into CFS framing are given in Tables 1 and 2, respectively. The transverse loads are based on a minimum edge distance of $^3/_8$ inch (9.5 mm). The lateral loads are based on a 1-inch (25.4 mm) end distance in the direction of loading and a minimum edge distance of $^3/_8$ inch (9.5 mm). Single fastener connection values must not be used to determine allowable loads for systems such as shear walls and diaphragms.

4.1.2 Shear Walls:

4.1.2.1 Shear Strength: The shear walls described in Section 3.0 may be used to resist in-plane lateral forces, including wind and seismic forces in structures assigned to SDCs A through F. The shear walls must comply with the requirements of Section C of AISI S213, except as specifically described in this report. For seismic design, the response modification coefficient, R = $6^1/_2$, the system overstrength factor, Ω_o = 3, and the deflection amplification factor, C_d = 4. Shear walls must comply with height limitations prescribed in Chapter 5 of the IBC and in ASCE 7 Table 12.2-1, and must comply with the special seismic requirements for shear walls in accordance with Section C5.1 of AISI S213.

Table 3 provides nominal shear strength values for the wall assemblies. For ASD, the values in Table 3 must be divided by a safety factor, Ω, of 2.5 for seismic loads or 2.0 for wind loads, as applicable. For LRFD, the values in Table 3 must be multiplied by a resistance factor, Φ, of 0.60 for seismic loads or 0.65 for wind loads, as applicable.

The hold-downs and anchorage along the bottom of the shear wall must be selected by the design engineer. The hold-downs must comply with Section 3.2.5, and the connection to the supporting structure must comply with Section 3.2.6. In multistory applications, accumulative overturning forces must be accounted for in the selection of the hold-downs. The attachments at the bottom track of the shear wall must be capable of transferring the applied shear loads to the supporting structure.

4.1.2.2 In-plane Lateral Deflection: In-plane lateral deflection of Type I shear walls due to the applied shear load may be calculated using the equations shown in Figure 3, as applicable.

The variables and constants in the equations are defined in Section C2.1.1 of AISI S213. Values for $G*t_{sheathing}$ may be taken from IBC Table 2305.2(2).

4.2 Installation:

4.2.1 General: The Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX fasteners must be installed through the wood structural panel sheathing into the CFS framing using a gas-actuated tool in accordance with Hilti, Inc. recommendations. A copy of the Hilti instructions for the use of the tool must be available on the jobsite at all times during installation.

4.2.2 Shear Walls: The shear wall assemblies must be constructed in accordance with the IBC, this report and the approved plans. A copy of the approved plans must be available on the jobsite at all times during shear wall construction.

At each end of the shear wall, two replicate CFS studs must be placed back-to-back, and fastened together at a maximum screw spacing of 12 inches (305 mm) on center. The remainder of the studs must be spaced at 16 inches (406 mm) on center or 24 inches (610 mm) on center, as specified in Table 3. The studs must be fastened to the tracks with one screw through each flange of the track. Hold-downs must be installed at each end of the shear wall, and fasteners or anchors connecting the bottom track to the supporting structure must be installed in accordance with the approved plans.

Wood structural panel sheathing may be installed parallel or perpendicular to the CFS studs. All panel edges must be supported by blocking complying with Item 8 of Section C2.2 of AISI S213. Panels must be no less than 12 inches (305 mm) wide.

The fasteners must be installed a minimum of $^3/_8$ inch (9.5 mm) from the edges of the wood structural panel sheathing. The spacing of the fasteners must be a maximum of 12 inches (305 mm) on center in the field of the sheathing panels. The spacing of the fasteners at the edges of the sheathing panels must be a minimum of 2 inches (51 mm) on center and a maximum of 6 inches (152 mm) on center, as shown in the approved plans, based on Table 3.

4.3 Special Inspection:

Special inspection of the fastening and anchoring of the shear walls described in this report is required in accordance with 2015 IBC Sections 1705.1.1, 1705.11.2 including Exception 2, and 1705.12.3 including Exception 2 (2012 IBC Sections 1705.1.1, 1705.10.2 including Exception 2 and 1705.11.3 including exception 2; 2009 IBC Sections 1704.15, 1706.3 including Exception 2 and 1707.4 including Exception 2). A Statement of Special Inspections must be submitted to the code official in accordance with 2015 and 2012 IBC Section 1704.3 (2009 IBC Section 1705).

5.0 CONDITIONS OF USE

The Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX PAFs and the shear walls 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 must be manufactured and identified in accordance with this report.

5.2 Other components of the shear walls must comply with this report, the applicable code, the approved plans and applicable ICC-ES evaluation reports.

5.3 Fastener installation must comply with this report and the Hilti, Inc., instructions. In the event of conflict between this report and the Hilti, Inc., published instructions, this report governs.

5.4 Installation is limited to structures four stories or less in height with interior walls, partitions, ceilings and exterior wall systems that have been designed to accommodate story drift. Building height must also be limited in accordance with Chapter 5 of the IBC and ASCE 7 Table 12.2-1.

5.5 The aspect ratio (wall height/wall length) of the shear wall must not exceed 2:1. Shear walls with greater aspect ratios are outside the scope of this report.

5.6 Only Type I shear walls (defined in Section C2 of AISI S213) are recognized in this evaluation report. Type II shear walls (defined in Section C3 of AISI S213) are outside the scope of this report.

5.7 The shear wall assemblies described in Section 3.2 must be used throughout the structure to resist in-plane lateral loads and must not be combined with other types of lateral load–resisting systems, such as wood framed shear walls.

5.8 Calculations demonstrating that the applied in-plane shear loads are less than the available shear wall strength must be submitted to the code official for approval. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is constructed.

5.9 Calculations and details showing that the sheathing, the CFS framing, and connections at perimeters of the shear walls, including the foundation anchorage, are adequate to resist the applied transverse loads and comply with the applicable provisions in Sections C2 and C5 of AISI S213, must be submitted to the code official. The CFS framing must also be adequate to support the applied gravity loads. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.10 Calculations and details must be submitted to the code official showing how the in-plane lateral loads are transferred from the roof or floor diaphragm into the shear wall, and from the shear wall into the supporting foundation structure. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.11 When the shear wall assemblies are used above the first story, calculations and details must be submitted to the code official showing the complete load path(s) for the transfer of lateral and overturning forces from the upper story shear walls to the foundation. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.12 Use of the fasteners is limited to dry locations.

5.13 The wood structural panel sheathing used on exterior walls must be protected by a weather-resistant exterior wall envelope.

5.14 Fasteners may be used in contact with fire-retardant-treated wood in dry, interior locations only, in accordance with 2015 IBC Section 2304.10.5.4 (2012 and 2009 IBC Section 2304.9.5.4) and Hilti's recommendations. Use of fasteners in contact with preservative-treated wood is outside the scope of this evaluation.

5.15 The Hilti X-GPN 37 MX, X-PN 37 G2 MX and X-PN 37 G3 MX fasteners 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 for Shear Wall Assemblies with Cold-formed Steel Framing and Wood Structural Panels (AC230), dated September 2015.

7.0 IDENTIFICATION

7.1 PAFs:

Each package of fasteners must be labeled with the product name, manufacturer's name (Hilti) and the evaluation report number (ESR-3059). An "H", for Hilti, is marked on the head of each fastener as shown in Figure 1.

7.2 CFS:

Each CFS stud and track must be identified with the minimum base steel thickness in decimal inches or mils, the minimum specified yield strength, and the galvanized coating designation.

7.3 Wood Structural Panels:

Wood structural panels must be identified in accordance with DOC PS-1 or DOC PS-2, as applicable.

7.4 Hold-downs:

Hold-downs must be identified in accordance with an applicable ICC-ES evaluation report.

TABLE 1—ALLOWABLE TRANSVERSE LOADS FOR CONNECTIONS OF PLYWOOD TO CFS FRAMING USING HILTI X-GPN 37 MX, X-PN 37 G2 MX OR X-PN 37 G3 MX POWER-ACTUATED FASTENERS (lbf)[1,2,3,7]

NOMINAL PLYWOOD[4] THICKNESS (in.)	PULL-THROUGH CAPACITY[4,5]	PULL-OUT CAPACITY[6]				
		CFS FRAMING THICKNESS DESIGNATION, mils (gage)				
		27 (22)	33 (20)	43 (18)	54 (16)	68 (14)
$^3/_8$	57	17	21	55	93	93
$^{15}/_{32}$	87	21	21	55	112	112
$^{19}/_{32}$	87	21	21	55	112	112

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.44N. 1 mil = 0.001 inch = 0.025 mm.

[1]The lower of allowable pull-through capacity and pull-out capacity must be used for design.
[2]Plywood thicknesses shown are minimums. Thicker plywood, up to $^3/_4$ inch thick, may be used.
[3]Allowable transverse loads are based on a minimum plywood edge distance of $^3/_8$ inch.
[4]For connections of OSB having thicknesses equal to or greater than those noted in the table, the allowable pull-through capacity is equal to the applicable value from the table multiplied by 0.915.
[5]Allowable pull-through capacity based upon a safety factor of 5.0.
[6]Allowable pull-out capacity based upon a safety factor calculated in accordance with Section F1.1 of AISI S100.
[7]Multiple fasteners are recommended by the fastener manufacturer for any attachment.

TABLE 2—ALLOWABLE IN-PLANE LATERAL LOADS FOR CONNECTIONS OF PLYWOOD TO CFS FRAMING USING HILTI X-GPN 37 MX, X-PN 37 G2 MX OR X-PN 37 G3 MX POWER-ACTUATED FASTENERS (lbf)[1,2,3,4,5]

NOMINAL PLYWOOD[3] THICKNESS (in.)	CFS FRAMING THICKNESS DESIGNATION, mils (gage)				
	27 (22)	33 (20)	43 (18)	54 (16)	68 (14)
$^3/_8$	68	88	128	128	155
$^{15}/_{32}$	68	88	138	155	155
$^{19}/_{32}$	68	88	150	193	193

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.44N. 1 mil = 0.001 inch = 0.025 mm.

[1]Plywood thicknesses shown are minimums. Thicker plywood, up to $^3/_4$ inch thick, may be used.
[2]Allowable lateral loads are based on a minimum plywood edge distance of $^3/_8$ inch and a minimum plywood end distance in the direction of loading of 1 inch.
[3]For connections of OSB having thicknesses equal to or greater than those noted in the table, the allowable lateral capacity is equal to the applicable value from the table multiplied by 0.915.
[4]Allowable lateral loads based upon a safety factor calculated in accordance with Section F1.1 of AISI S100.
[5]Multiple fasteners are recommended by the fastener manufacturer for any attachment.

TABLE 3—NOMINAL SHEAR RESISTANCE TO SEISMIC AND WIND LOADS FOR SHEAR WALL ASSEMBLIES CONSTRUCTED WITH HILTI X-GPN 37 MX, X-PN 37 G2 MX OR X-PN 37 G3 MX POWER-ACTUATED FASTENERS (plf)[1,2,3,4,5,6]

MINIMUM CFS FRAMING THICKNESS DESIGNATION [mils (gage)]	WOOD STRUCTURAL PANEL[7,8]	MAXIMUM STUD SPACING (in.)	FASTENER SPACING AT PANEL EDGES[5] (in.)			
			6	4	3	2
33 (20)	3/8" plywood[8]	24	395	540	650	765
		16	475	655	805	1000
	15/32" plywood[8]	24	395	540	650	765
		16	475	655	805	1000
	19/32" & 23/32" plywood[8]	24	395	540	650	765
		16	475	655	805	1000
43 (18)	3/8" plywood[8]	24	400	545	655	775
		16	475	665	815	1010
	15/32" plywood[8]	24	435	600	720	850
		16	525	725	890	1105
	19/32" & 23/32" plywood[8]	24	485	660	795	935
		16	580	805	985	1225
54 (16)	3/8" plywood[8]	24	610	830	1000	1180
		16	730	1010	1240	1540
	15/32" plywood[8]	24	710	975	1170	1380
		16	850	1185	1450	1800
	19/32" & 23/32" plywood[8]	24	835	1140	1370	1615
		16	995	1385	1700	2110

For **SI:** 1 inch = 25.4 mm, 1 mil = .001 inch = 0.025 mm, 1 plf = 14.6 N/m.

[1]For Allowable Stress Design (ASD), the nominal shear resistance values listed in this table must be divided by a safety factor, Ω, of 2.0 for wind loads and 2.5 for seismic loads.
[2]For Load and Resistance Factor Design (LRFD), the nominal shear resistance values listed in this table must be multiplied by a resistance factor, Φ, of 0.60 for seismic loads and Φ of 0.65 for wind loads.
[3]Tabulated values are applicable for seismic and wind loads. For other in-plane lateral loads of normal or permanent load duration as defined in AF&PA NDS, the values in the table must be multiplied by 0.63 (normal) or 0.56 (permanent).
[4]The minimum distance from the fastener to the wood structural panel edge must be 3/8 inch.
[5]Fastener spacing must be a maximum of 12 inches on center in the field of the wood structural panel.
[6]Hold-downs, end posts and sill anchors must be designed to resist the required lateral loads.
[7]Wood structural panel sheathing thicknesses shown in this table are minimums. Thicker sheathing may be used without an increase in the shear resistance.
[8]For shear wall assemblies constructed with OSB having thicknesses equal to or greater than those noted in the table, the nominal shear resistance is equal to the applicable value in the table multiplied by 0.915.

FIGURE 1—HILTI X-GPN 37 MX, X-PN 37 G2 MX OR X-PN 37 G3 MX FASTENERS

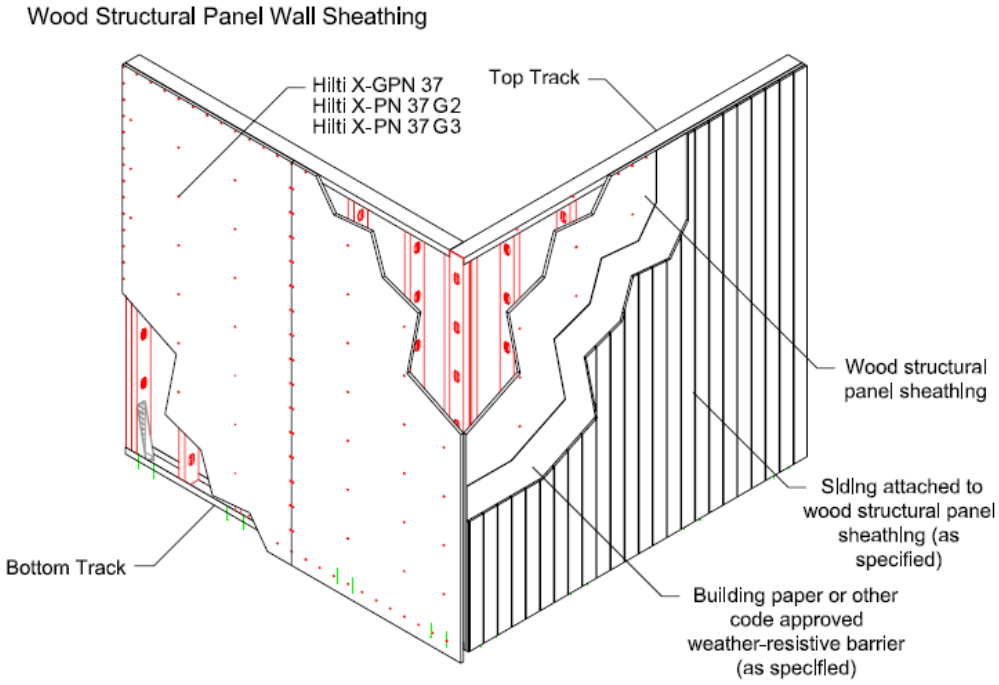

FIGURE 2—TYPICAL SHEAR WALL ASSEMBLY WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS ATTACHED WITH HILTI X-GPN 37 MX, X-PN 37 G2 MX OR X-PN 37 G3 MX POWER-ACTUATED FASTENERS

$$\delta = \frac{8vh^3}{E_s A_c b} + \omega_1\omega_2\frac{vh}{\rho G t_{sheathing}} + \omega_1^{9/4}\omega_2\omega_3\omega_4\left(\frac{v}{\beta}\right)^2 + \frac{h}{b}\delta_v, \text{ in.}$$

For **SI:** $$\delta = \frac{2vh^3}{3E_s A_c b} + \omega_1\omega_2\frac{vh}{\rho G t_{sheathing}} + \omega_1^{9/4}\omega_2\omega_3\omega_4\left(\frac{v}{0.00290\beta}\right)^2 + \frac{h}{b}\delta_v, \text{ mm}$$

FIGURE 3—DEFLECTION EQUATIONS
(See Section 4.1.2.2 for definition of terms)