The following pages are an excerpt from the North American Product Technical Guide, Volume 1: Direct Fastening Technical Guide, Edition 24.

Please refer to the publication in its entirety for complete details on this product including data development, base materials, general suitability, installation, corrosion, and product specifications.

Direct Fastening Technical Guide, Edition 24

To consult directly with a team member regarding our direct fastening products, contact Hilti's team of technical support specialists between the hours of 7:00am - 5:00pm CST.

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3.2.8 X-PN 37 MX STRUCTURAL WOOD PANEL FASTENERS

3.2.8.1 PRODUCT DESCRIPTION

The Hilti X-PN 37 G2/G3/B4 MX power-driven fasteners are a knurled shank fastener designed as an efficient solution for the attachment of structural wood panel materials such as plywood and OSB (Oriented Strand Board) to cold-formed steel (CFS) framing as part of shear wall assemblies and other applications such as parapet walls, siding, and roofing. These power-driven fasteners are installed with a Hilti GX 2 or GX 3 Gas-Actuated or the BX 4 Battery-Actuated Direct Fastening Systems increasing reliability, accuracy and productivity for the installer. Hilti X-PN 37 MX fasteners have a shank diameter of 0.102 inch (2.60 mm) and a total length of 1-1/2 inches (37 mm). The X-PN 37 MX fasteners are collated in strips of 10 to increase productivity with the Hilti Gas- and Battery-Actuated DIrect Fastening systems, which holds up to 40 collated fasteners in the their magazines. The fastener shank has a unique twist knurling geometry that increases holding power and strength of wood to CFS connections.

Product features:

- 0.102 inch (2.60 mm) shank diameter for optimal penetration through structural wood panels and into CFS base materials.
- Unique knurling geometry for improved reliability and load performance.
- One fastener length covers most common wood shear wall applications.
- Increased productivity using the latest Hilti Gas- and Battery-Actuated Tools
- Wide application range including 27-68 Mils (22-14 gauge) CFS.
- IBC / IRC 2015, 2018, and 2021 seismic recognition for use with Type I shear walls in all Seismic Design Categories (SDC) A–F (ESR-3059).

Figure 1: X-PN 37 Fastener

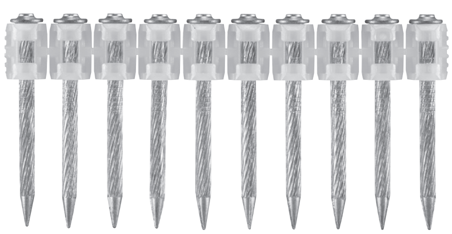


Figure 2: X-PN 37 G3 MX Fastener

Figure 3: X-PN 37 B4 MX Fastener

Approvals/Listings

ICC-ES (International Code Council)
ESR-3059 with LABC/LARC Supplement

2012 IBC® Compliant

2015 IBC® Compliant

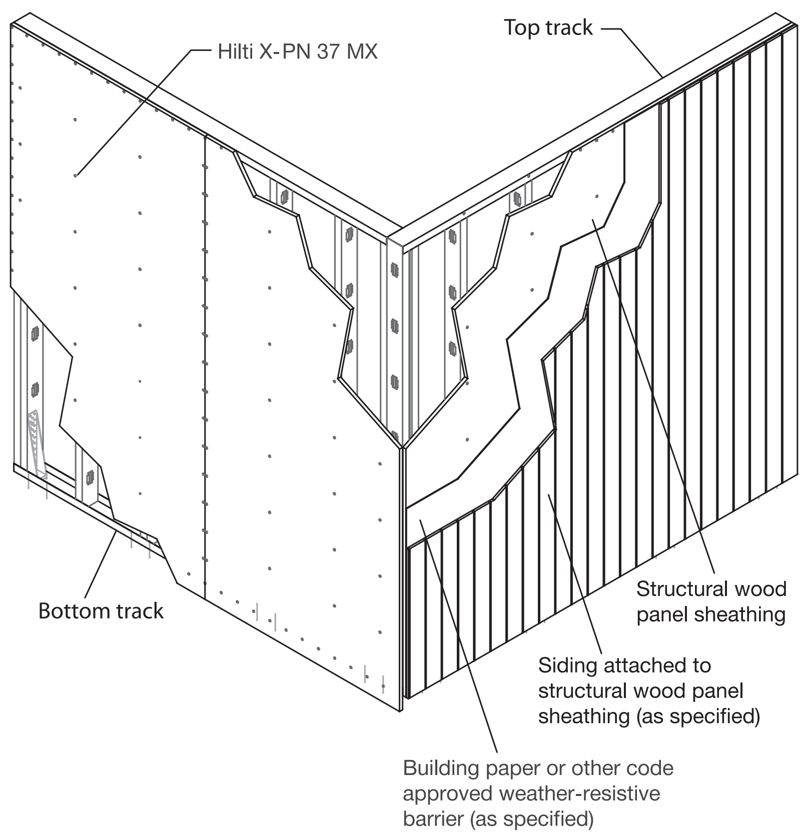


Figure 3: Typical shear wall assembly with cold-formed steel framing and structural wood panel sheathing attached with Hilti X-PN 37 MX Fasteners

3.2.8.2 Material specifications

Fastener designation	Fastener material	Fastener plating	Structural wood panels	Base material
X-PN 37 G2 MX X-PN 37 G3 MX X-PN 37 B4 MX	Carbon Steel	5 µm Zinc[1]	Exposure 1, structural 1 plywood complying with DOC PS-1 or oriented strand board (OSB) complying with DOC PS-2 for exposure 1	27-68 mils (0.0283-0.0713 inch) ASTM A1003 or ASTM A653 CFS Member

1 ASTM B633, SC1, Type III. Refer to Section 2.3.3.1 for more information.

3.2.8.3 SHEAR WALL DESIGN AND THEORY

3.2.8.3.1 Shear wall terminology and definitions

Shear wall terminology

AISI - American Iron and Steel Institute

AISI S240 -20 - North American Standard for Cold-Formed Steel Structural Framing

APA - American Plywood Association

CFS - Cold-Formed Steel

PN - Hilti fastener type used for attaching wood structural panel sheathing to cold-formed steel framing. The fasteners are installed using Hilti gas- and battery-actuated tools.

BX - Hilti Battery-Actuated Direct Fastening Systems

GX - Hilti Gas-Actuated Direct Fastening Systems

ICC-ES - International Code Council - Evaluation Service

Shear wall definitions

Cold-formed steel (cfs) structural member - Steel shape manufactured by press-braking blanks sheared from sheets, cut lengths of coils or plates, or by roll forming cold- or hot-rolled coils or sheets; both forming operations being performed at ambient room temperature, that is, without addition of heat, such as would be required for hot rolling.

Cold-formed steel (CFS) studs - Interior framing members. CFS framing studs are C-shaped steel members with a minimum thickness of 33 mils, minimum flange width of 1-5/8" (41.3 mm), a minimum web depth of 3-1/2" (89 mm) and a minimum edge stiffener length of 3/8" (9.5 mm).

Cold-formed steel (CFS) tracks - A U-shaped CFS track designed to accept a CFS stud member with a minimum thickness of 33-mils and a minimum flange width of 1-1/4" (31.8 mm) and a minimum web depth the same as the CFS stud members.

Exposure 1 - Panels that have full water-proof bond that will allow the panels to resist some corrosion effects on the jobsite until fully protected.

Fastener pattern - The spacing of fasteners along the perimeter and interior segments of the shear wall.

Hold-down connector - A device used to resist overturning of shear wall assemblies.

Lateral load - Fastener performance in shear.

Mils - A measure of thickness for CFS members. Reference Table 1 on page 54 for common CFS thickness designations.

OSB (Oriented Strand Board) - A mat-formed wood structural panel comprised of thin rectangular wood strands arranged in cross-aligned layers with surface layers normally arranged in the long panel direction and bonded with water proof adhesive.

Plywood - A wood structural panel comprised of plies of wood veneer arranged in cross-aligned layers. The plies are bonded with waterproof adhesive that cures on application of heat and pressure.

Self-drilling screws - Screws that are used to connect CFS members together and to attach hold-downs to CFS framing. Screws must be a minimum #8 Hilti self-drilling tapping screw recognized in ICC-ES ESR-2196.

Shear wall - Wall that provides resistance to lateral loads in the plane of the wall and provides stability for the structure.

Sill fasteners - Attachments to connect steel stud track members to concrete base material.

Structural 1 rated sheathing - An APA Rated Sheathing where the racking and cross sectional properties are higher for improved performance in demanding applications such as shear walls and diaphragms.

Transverse load - Fastener performance in direct tension (fastener pullout or pull-through).

Type I shear wall - A fully sheathed shear wall with hold-down anchors at each end of the wall segment. Type I shear walls are permitted to have openings, between hold-down anchors at each end of a wall segment, where details are provided to account for force transfer around openings.

Wood structural panels - A panel manufactured from veneers, wood strands or wafers or a combination of veneer and wood strands or wafers bonded together with waterproof synthetic resins or other suitable bonding systems.

3.2.8.3.2 General discussion

According to the International Building Code (IBC), a shear wall is a lateral force resisting structural system that provides resistance to wind, seismic and other lateral forces and provides stability to the overall structure. It is a structural assembly that can be modeled as a vertical cantilevered beam. A shear wall may be constructed using several methods. One common way of building shear walls is using CFS framing members covered with wood structural panels. An example of a CFS framed shear wall assembly is shown in Figure 3. Wood structural panels are attached to the CFS framing members with fastening systems that have been properly evaluated for this application.

Design of shear walls has traditionally been done using the available tables in AISI S240, which are based on full-scale shear wall testing. ICC-ES and the IBC allow for development of an analytical method based on the principles of mechanics to be used for the design of CFS framed wood structural panel sheathed shear walls. ICC-ES recognizes full-scale test analysis as an acceptable design approach in AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels. Shear wall analytical models are based on fastener shear connection data using the following parameters:

1. CFS member type and thickness
2. Wood structural panel type and thickness
3. Fastener spacing in the field and along the perimeter

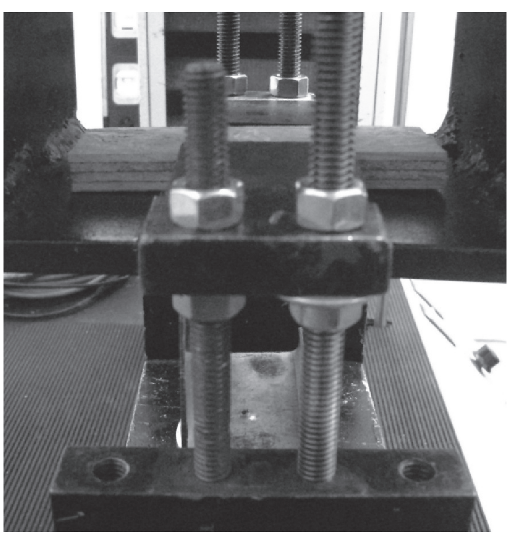


Figure 4: Small element transverse strength (pullout, pull-through) tests

3.2.8.3.3 Fastener test programs

Many ICC-ES small element connection tests and full-scale static and cyclic / simulated seismic load test programs have been conducted using Hilti X-PN 37 MX fasteners to determine the shear wall system performance.

1. Small element connection tests

Small element connection tests are conducted to determine fastener transverse strength (pullout or pull-through) and lateral strength (shear) with structural wood panels and CFS sections representative of typical shear wall construction. The data is analyzed and used in a predictive model to calculate the performance of the larger shear wall assemblies. These tests are conducted in accordance with following standards and shown in Figures 4 and 5.

- ICC-ES AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels
- ASTM E1190 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members
- ASTM D1761 Standard Test Methods for Mechanical Fasteners in Wood

Figure 5: Small element lateral strength (shear) tests

2. Full-scale shear wall assembly tests

Full-scale shear wall assembly tests are conducted to determine the strength and deflection of a larger shear wall assembly (Figure 6 and Figure 7). The data is analyzed and fit in a predictive analytical model to address varying configurations of cold-formed steel, wood thickness, specific fastener combinations and framing spans. See Figure 8 for a representative First Cycle Envelope Curve from a full-scale cyclic / simulated seismic shear wall assembly test. These tests are conducted in accordance with the following standards:

- ICC-ES AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels
- ASTM E2126 Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings, ASTM International
- CUREE Consortium of Universities for Research in Earthquake Engineering Basic Loading Protocol

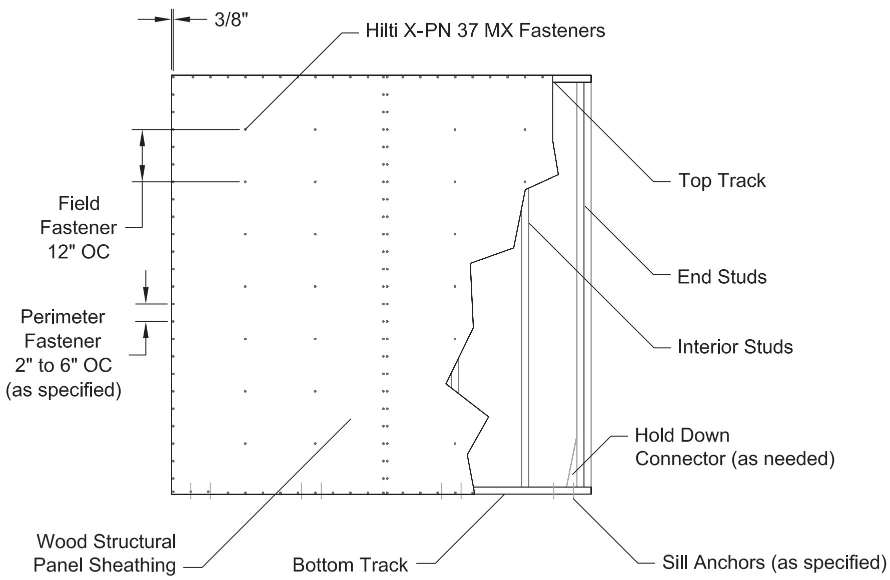


Figure 6: Shear wall assembly with CFS framing and structural wood panel sheathing

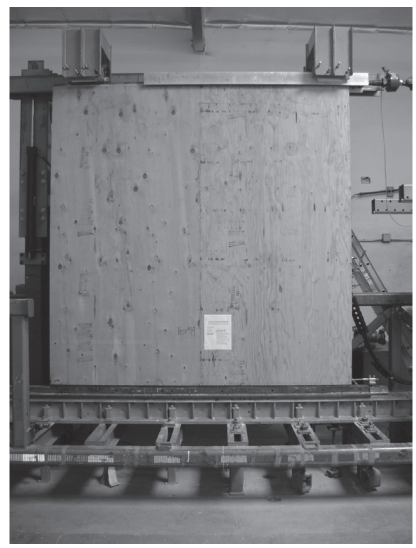


Figure 7: Full-scale shear wall cyclic / simulated seismic load test

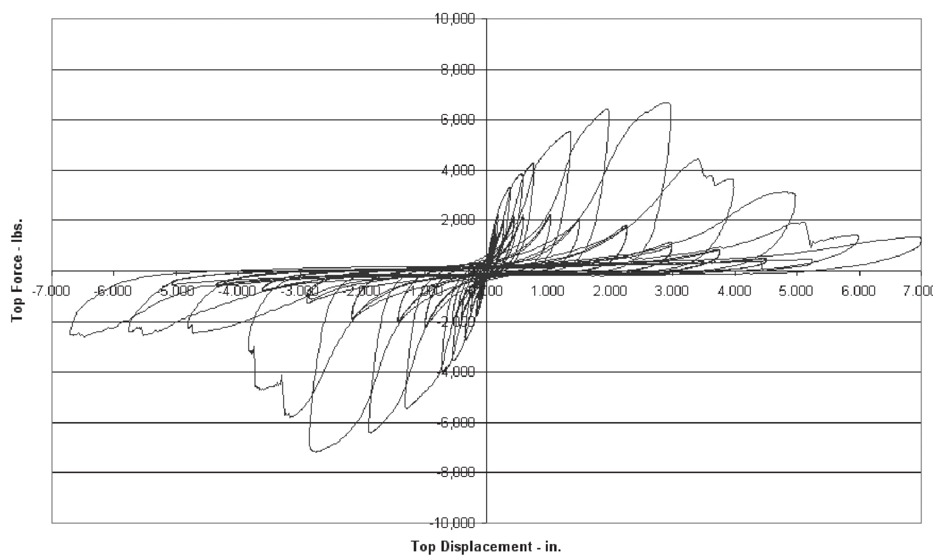


Figure 8: First cycle envelope curve from cyclic / simulated seismic load test

3.2.8.4 TECHNICAL DATA

An extensive ICC-ES AC230 independent laboratory test program was conducted to confirm the static and cyclic / simulated seismic performance of shear wall assemblies composed of CFS framing and wood structural panel sheathing attached with Hilti X-PN 37 MX power-driven fasteners. The program test scope consisted of static and cyclic / simulated seismic full-scale shear wall assembly tests, as well as comparative small element lateral strength (shear) tests and transverse strength (pullout and pull-through) tests conducted as discussed in Section 3.2.8.3.3. The resulting design data is published below and in ICC-ES ESR-3059.

The equivalent dimensions for CFS base material thicknesses are given in Table 1. Allowable transverse (pullout or pull-through) loads and allowable lateral (shear) loads are presented in Tables 2 and 3, respectively. For material thicknesses not listed, the load data corresponding to the next thinner base material may be used. The shear wall load data is presented in Table 4 for Type I shear wall assemblies.

Table 1 — Steel thickness and equivalent dimensions[2]

Minimum thickness[1], Mils	**Nominal design thickness, in.** (mm)	**Gauge**
68	**0.0713** (1.811)	14
54	**0.0566** (1.438)	16
43	**0.0451** (1.146)	18
33	**0.0346** (0.879)	20
27	**0.0283** (0.719)	22

1 Minimum Thickness represents 95% of the design thickness and is the minimum acceptable thickness delivered to the jobsite.
2 Steel thickness equivalents are taken from Steel Stud Manufacturers Association (SSMA) Product Technical Information.

Table 2 — Allowable transverse loads for connections of structural wood panels to CFS framing using Hilti X-PN 37 G2/G3/B4 MX Power-Driven Fasteners, lb (N)[3,4,5,7]

Nominal panel thickness, in. (mm)	**Pull-through capacity[1,6]**	**Pullout capacity[2] CFS framing thickness designation, Mils** (gauge)				
		27 (22)	**33** (20)	**43** (18)	**54** (16)	**68** (14)
3/8 (9.5)	**57** (253)	**17** (75)	**21** (93)	**55** (245)	**93** (414)	**93** (414)
15/32 (12)	**87** (387)	**21** (93)	**21** (93)	**55** (245)	**112** (498)	**112** (498)
19/32 (15)	**87** (387)	**21** (93)	**21** (93)	**55** (245)	**112** (498)	**112** (498)

1 The safety factor for pull-through capacity is 5.0 in accordance with ICC-ES AC230.
2 Safety factors for pullout capacity determined in accordance with AISI S100.
3 The lower of allowable pull-through capacity and pullout capacity must be used for design.
4 Panel thicknesses shown are minimums. Thicker panels, up to 3/4" (19 mm) thick, may be used.
5 Allowable transverse loads are based on a minimum panel edge distance of 3/8" (9.5 mm).
6 The tabulated values are for plywood. For connections of OSB having thicknesses equal to or greater than to those noted in the table, the allowable pull-through capacity is equal to the applicable value from the table multiplied by 0.915.
7 Multiple fasteners are recommended for any attachment.

Table 3 — Allowable lateral loads for connections of structural wood panels to CFS framing using Hilti X-PN 37 G2/G3/B4 MX Power-Driven Fasteners, lb (N)[1,2,3,4,5]

Nominal panel thickness, in. (mm)	**Minimum thickness of CFS framing, Mils** (gauge)				
	27 (22)	**33** (20)	**43** (18)	**54** (16)	**68** (14)
3/8 (9.5)	**68** (302)	**88** (391)	**128** (569)	**128** (569)	**155** (689)
15/32 (12)	**68** (302)	**88** (391)	**138** (614)	**155** (689)	**155** (689)
19/32 (15)	**68** (302)	**88** (391)	**150** (667)	**193** (859)	**193** (859)

1 Safety factors determined in accordance with AISI S100.
2 Panel thicknesses shown are minimums. Thicker panels, up to 3/4" (19 mm) thick, may be used.
3 Allowable shear loads are based on a minimum panel edge distance of 3/8" (9.5 mm) and a minimum plywood end distance in the direction of loading of 1" (25.4 mm).
4 The tabulated values are for plywood. 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.
5 Multiple fasteners are recommended for any attachment.

Table 4 – Nominal shear resistance to seismic and wind loads for type i shear wall assemblies constructed with Hilti X-PN 37 G2/G3/B4 MX Power-Driven Fasteners, plf (N/mm)[1,2,3,4,5,6,9,10]

Minimum CFS framing thickness designation, Mils (Gauge)	**Wood structural panel thickness, in.** (mm)[7,8]	**Maximum stud spacing, in.** (mm)	**Fastener spacing at panel edges, in.** (mm)			
			6 (152)	**4** (102)	**3** (76)	**2** (51)
33 (20)	**3/8** (9.5)	**24** (610)	**395** (58)	**540** (79)	**650** (95)	**765** (112)
		16 (406)	**475** (69)	**655** (96)	**805** (117)	**1000** (146)
	15/32 (12)	**24** (610)	**395** (58)	**540** (79)	**650** (95)	**765** (112)
		16 (406)	**475** (69)	**655** (96)	**805** (117)	**1000** (146)
	19/32 (15) & **23/32** (18)	**24** (610)	**395** (58)	**540** (79)	**650** (95)	**765** (112)
		16 (406)	**475** (69)	**655** (96)	**805** (117)	**1000** (146)
43 (18)	**3/8** (9.5)	**24** (610)	**400** (58)	**545** (80)	**655** (96)	**775** (113)
		16 (406)	**475** (69)	**665** (97)	**815** (119)	**1010** (147)
	15/32 (12)	**24** (610)	**435** (63)	**600** (88)	**720** (105)	**850** (124)
		16 (406)	**525** (77)	**725** (106)	**890** (130)	**1105** (161)
	19/32 (15) & **23/32** (18)	**24** (610)	**485** (71)	**660** (96)	**795** (116)	**935** (136)
		16 (406)	**580** (85)	**805** (117)	**985** (144)	**1225** (179)
54 (16)	**3/8** (9.5)	**24** (610)	**610** (89)	**830** (121)	**1000** (146)	**1180** (172)
		16 (406)	**730** (107)	**1010** (147)	**1240** (181)	**1540** (225)
	15/32 (12)	**24** (610)	**710** (104)	**975** (142)	**1170** (171)	**1380** (201)
		16 (406)	**850** (124)	**1185** (173)	**1450** (212)	**1800** (263)
	19/32 (15) & **23/32** (18)	**24** (610)	**835** (122)	**1140** (166)	**1370** (200)	**1615** (236)
		16 (406)	**995** (145)	**1385** (202)	**1700** (248)	**2110** (308)

1 For Allowable Stress Design (ASD), the nominal shear resistance values listed in this table should be divided by a safety factor Ω of 2.0 for wind loads and 2.5 for seismic loads per AISI S213.
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 0.65 for wind loads. For Limit States Design (LSD), the nominal shear resistance values listed in this table must be multiplied by a resistance factor Φ of 0.70 for seismic and wind loads per AISI S213.
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" (9.5 mm).
5 Fastener spacing must be a maximum of 12" (294 mm) on center in the field of the wood structural panel.
6 Hold-downs, end posts and sill fasteners must be designed to resist the required lateral loads.
7 Panel thicknesses shown are minimums. Thicker panels, up to 3/4" (19 mm) thick, may be used.
8 Tabulated values are for plywood panels. 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.
9 Tabulated design data for use in all Seismic Design Categories A-F.
10 Type I shear wall assemblies are limited to a height-width aspect ratio of 2:1.

Deflection

Deflection of Type I shear walls fastened with Hilti X-PN 37 MX power-driven fasteners, as described in this supplement, due to the applied shear loads may be calculated using the following equations, as applicable:

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

For SI:

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

Variables and constants in the equations are as defined in Section C2.1.1 of AISI S213. Values for $G^*t_{sheathing}$ are typically taken from IBC Table 2305.2(2).

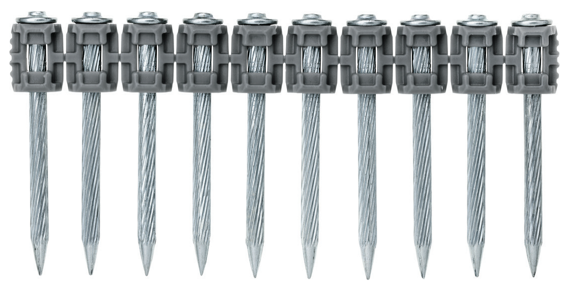
3.2.8.5 ORDERING INFORMATION

Power driven fasteners:

Fastener description	**Shank length in.** (mm)	**Shank Ø in.** (mm)	**Guidance washer Ø**
X-PN 37 G2 MX X- PN 37 G3 MX X-PN 37 B4 MX	**1-1/2** (37)	**0.102** (2.60)	8 mm

Hilti GX 3 Gas-Actuated
Fastening Tool

Hilti GC 41
Gas Canister for GX 3



Hilti X-PN 37 G3 MX Fasteners

Hilti GX 2 Gas-Actuated
Fastening System

Hilti GC 52
Gas Canister for GX 2

Hilti X-PN 37 G2 MX Fasteners

Hilti BX 4 Cordless
Fastening Tool

Hilti 22V
Nuron Battery

Hilti X-PN 37 B4 MX Fasteners