# ICC-ES Evaluation Report

**ESR-2024**

*Issued November 1, 2009*

*This report is subject to re-examination in one year.*

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

**DIVISION: 03—CONCRETE**
**Section: 03151—Concrete Anchoring**

**DIVISION: 05—METALS**
**Section: 05090—Metal Fastenings**

**DIVISION: 06—WOOD AND PLASTICS**
**Section: 06090—Wood and Plastic Fastenings**

**DIVISION: 09—FINISHES**
**Section: 09051—Fasteners**

**REPORT HOLDER:**

**POWERS FASTENERS, INC.**
**2 POWERS LANE**
**BREWSTER, NEW YORK 10509**
**(914) 235-6300 or (800) 524-3244**
**www.powers.com**
**engineering@powers.com**

**ADDITIONAL LISTEE:**

**MAX CO., LTD.**
**6-6 NIHONBASHI-HAKAZAKI-CHO**
**CHOU-KU, TOKYO**
**JAPAN**
**+ (03) 3669-8131**

**EVALUATION SUBJECT**

**POWERS POWER-DRIVEN FASTENERS, CEILING CLIP ASSEMBLIES AND SILL PLATE ANCHORAGES**

## 1.0 EVALUATION SCOPE

**Compliance with the following codes:**

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)
- 2003 *International Building Code*® (2003 IBC)*
- 2003 *International Residential Code*® (2003 IRC)*
- 1997 *Uniform Building Code*™ (UBC)*

*Codes indicated with an asterisk are addressed in Section 8.0.

**Property evaluated:**

Structural

## 2.0 USES

Powers power-driven fasteners are low-velocity power-driven fasteners for use in normal-weight concrete, structural sand-lightweight concrete, and structural sand-lightweight concrete filled steel deck panels, and steel base materials. The fasteners are alternatives to the anchors described in IBC Sections 1911 and 1912 for placement in concrete. The fasteners are also used as components of Powers ceiling clip assemblies, which are used to fasten suspended ceiling systems to the supporting structure, and for sill plate anchorage. The fasteners are also alternatives to standard bolts described in IBC Sections 2204 and 2205 used to attach materials to structural steel. The fasteners may be used under the IRC where an engineered design is submitted in accordance with IRC Section R301.1.3.

## 3.0 DESCRIPTION

### 3.1 General:

Powers power-driven fasteners are manufactured from hardened steel complying with the manufacturer's quality documentation.

**3.1.1 0.300-inch Head Drive Pins:** The 0.300-inch (7.62 mm) Head Drive Pins are power-driven fasteners manufactured from steel complying with ASTM A 510, Grade 1060, and austempered to a Rockwell C 53 to 55 core hardness. The 0.300-inch (7.62 mm) head drive pins have either a smooth or a knurled shank in a diameter of 0.145 inch (3.7 mm), and are available in lengths ranging from $^1/_2$ inch to 3 inches (13 mm to 76.2 mm). The single fasteners are premounted on plastic guide washers and are zinc-plated in accordance with ASTM B 695, Class 5, Type 1. Fasteners are illustrated in Figure 1 of this report. The power-driven fasteners are also sold by Max Co., Ltd., which labels them as Powerlite 0.300-inch (7.62 mm) head drive pins.

**3.1.2 8 mm Head Drive Pins:** The 8 mm (0.315 inch) Head Drive Pins are power-driven fasteners manufactured from steel complying with ASTM A 510, Grade 1060, and austempered to a Rockwell C 53 to 55 core hardness. The fasteners are zinc-plated in accordance with ASTM B 695, Class 5, Type 1. The 8 mm (0.315 inch) head drive pins have a smooth or knurled shank with a diameter of 0.145 inch (3.7 mm), and are available in lengths ranging from $^5/_8$ inch to $2^7/_8$ inches (16 mm to 72 mm). The single fasteners are premounted on plastic guide washers or are collated into plastic strips. The fasteners are illustrated in Figure 1. These power-driven fasteners are also sold by Max Co., Ltd., which labels them as Powerlite 8 mm Conversion Head Drive Pins.

**3.1.3 Ballistic Point Drive Pins:** The ballistic point drive pins are power-driven fasteners manufactured from steel complying with ASTM A 510, Grade 1060, and austempered to a Rockwell C 53 to 55 core hardness. The ballistic point drive pins have a shank diameter of 0.150 inch (3.8 mm) and are single fasteners with premounted plastic guide washers. The fasteners are coated with a black polymer. The fasteners are available in lengths ranging from $^1/_2$ inch to $1^7/_8$ inches (13 to 47.6 mm), and are illustrated in Figure 1.

**3.1.4 $^3/_8$-inch Head Drive Pin:** The $^3/_8$-inch (9.52 mm) head drive pin is a power-driven fastener manufactured from steel complying with ASTM A 510, Grade 1060, and austempered to a Rockwell C 53 to 55 core hardness. The $^3/_8$-inch (9.52 mm) head drive pin has a shank diameter of 0.172 inch (4.37 mm) and is a single fastener with a premounted plastic guide washer. The fastener is zinc-plated in accordance with ASTM B 695, Class 5, Type 1.

**3.1.5 Threaded Studs:** Threaded studs are power-driven fasteners manufactured from steel complying with ASTM A 510, Grade 1060, and austempered to a Rockwell C 53 to 55 core hardness. Threaded studs are available in $^1/_4$-inch-20 and $^3/_8$-inch-16 thread diameters with a variety of thread and shank lengths. The $^1/_4$-inch-20 threaded studs have a shank diameter of 0.145 inch (3.7 mm), while the $^3/_8$-inch-16 threaded studs have a shank diameter of 0.205 inch (5.2 mm). The single fasteners have a premounted in a plastic guide washer and are zinc-plated in accordance with ASTM B 695, Class 5, Type 1.

**3.1.6 Ceiling Clips:** The power-driven ceiling clip assemblies are preassembled, power-driven fasteners with a steel angle clip. Standard and economy ceiling clips feature smooth shank head drive pins, described in Sections 3.1.1 and 3.1.2 of this report. The clips have either a standard (90 degrees) or economy (30 degrees) angle manufactured from 0.080-inch-thick (2.0 mm) steel conforming to ASTM A 635. The clips are zinc-plated in accordance with ASTM B 695, Class 5, Type 1.

**3.1.7 LADD Ceiling Clip:** The LADD ceiling clip is a preassembled power-driven fastener and clip assembly for LADD-type tools. The fastener is manufactured from steel complying with ASTM A 510, Grade 1060, and austempered to a Rockwell C 53 to 55 core hardness. The fastener has a head diameter of 0.310 inch (7.87 mm) and a shank diameter of 0.155 inch (3.93 mm). The fastener is zinc-plated in accordance with ASTM B 695. The clips have a 45-degree angle and are manufactured from 0.086-inch-thick (2.3 mm) steel conforming to ASTM A 635. The clips are zinc-plated in accordance with ASTM B 695, Class 5, Type 1.

**3.1.8 Washered Assemblies:** The washered assemblies are manufactured from 0.075-inch-thick (1.9 mm) low-carbon steel conforming to ASTM A 635. The clips are zinc-plated in accordance with ASTM B 695, Class 5, Type 1.

**3.2 Substrate Material:**

**3.2.1 Concrete:** Normal-weight concrete and structural sand-lightweight concrete must conform to IBC Section 1905 or IRC Section 402.2, as applicable. The minimum concrete compressive strength at the time of fastener installation is noted in Tables 1, 2 and 3 of this report.

**3.2.2 Steel:** Structural steel must comply with minimum requirements of ASTM A 36 and have a minimum thickness as shown in Table 4. Steel deck properties and configurations must be as described in the footnotes of Table 3 and in Figure 2 of this report.

**3.2.3 Sill Plates:** Wood members must have a 2-inch (51 mm) nominal thickness and a specific gravity of 0.5 or greater in accordance with Section 2308.6 of the IBC or Section R403.16 of the IRC, as applicable (for maximum two-story buildings).

## 4.0 DESIGN AND INSTALLATION

**4.1 Design:**

**4.1.1 General:** The allowable tension and shear loads for Powers power-driven fasteners installed in accordance with this report are shown in Tables 1 through 4.

The allowable tension and shear loads with required embedment depths and spacings, for fasteners installed in normal-weight concrete, are shown in Tables 1 and 2. The allowable tension and shear loads for fasteners installed in structural sand-lightweight concrete and structural sand-lightweight concrete filled steel deck panels are shown in Table 3. The allowable tension and shear loads for fasteners installed into steel are shown in Table 4.

The stress increases and load reductions described in Section 1605.3.2 of the IBC are not allowed for wind loads acting alone or when combined with gravity loads. No increase is allowed for vertical loads acting alone.

Except for fasteners used for attachment of architectural, electrical and mechanical components as described in Section 13.1.4 of ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures (American Society of Civil Engineers/Structural Engineering Institute), under the IBC and IRC, use of fasteners to resist earthquake loads is beyond the scope of this report.

Allowable loads for fasteners subjected to combined shear and tension forces are determined by the following formula:

$$(P_s/P_t) + (V_s/V_t) \leq 1$$

where:

$P_s$ = Applied service tension load, lbf (N).

$P_t$ = Allowable tension load, pounds (N).

$V_s$ = Applied service shear load, lbf (N).

$V_t$ = Allowable shear load, lbf (N).

**4.1.2 Wood to Concrete and Steel:** Reference lateral design values for nails with diameters less than or equal to the diameter of the fasteners, and with penetration into the main member of 10D, determined in accordance with Part 11 and/or Table 11N of ANSI/AF&PA NDS, are applicable to the Powers fasteners. The wood element is the side member. The fastener bending yield strength is allowed to be taken as the value noted in the footnotes to Table 11N of the ANSI/AF&PA NDS, based on the diameter of the fastener.

**4.1.3 Sill Plate to Foundation Connections:**

**4.1.3.1 General:** The fasteners described in Sections 3.1.1, 3.1.2 and 3.1.4 of this report may be used to attach wood sill plates to a concrete foundation under the following conditions:

1. No cold joint exists between the slab and foundation, below the sill plate.
2. The sill plate is not installed on slabs supported by masonry foundation walls.

**4.1.3.2 Design:** Table 5 specifies the allowable fastener spacings for attachment of wood sill plates to concrete in structures located in areas classified as Seismic Design Category A or B, and in areas assigned basic wind speeds up to 100 mph (161 km/h) (3-second-gust wind speed).

**4.2 Installation:**

The installation of fasteners requires a powder-actuated fastening tool, recommended by Powers Fastener, Inc., used in accordance with the manufacturer's published instructions. Fastener installation is limited to dry, interior environments. The fastener size, minimum penetration, minimum spacing, and edge distances must comply with Tables 1 through 5 of this report, as applicable. For fasteners installed into concrete, the fasteners must not be driven until the concrete has reached the designated compressive strength.

## 5.0 CONDITIONS OF USE

The Powers power-driven fasteners, ceiling clip assemblies, and sill plate anchorages 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 identified and installed in accordance with this report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

**5.2** Calculations demonstrating that the applied loads are less than the allowable loads described in this report 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 to be constructed.

**5.3** Allowable tension and shear values must comply with Section 4.1.1 of this report.

**5.4** Use of fasteners is limited to dry, interior locations.

**5.5** The use of fasteners is limited to installation in uncracked concrete. Cracking occurs when $f_t > f_r$, due to service loads or deformations.

**5.6** Fasteners centered in wood sills must be a minimum of 1¾ inches (44.5 mm) from the concrete edge.

**5.7** Use of fasteners in contact with preservative-treated or fire-retardant-treated wood is not permitted.

**5.8** Except as noted in Sections 4.1.1 and 4.1.3.2 of this report, use of fasteners to resist earthquake loads is outside the scope of this report.

## 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Fasteners Power-driven into Concrete, Steel, and Masonry Elements (AC70), dated October 2006.

## 7.0 IDENTIFICATION

The Powers power-driven fasteners are identified by a "P" stamped onto the head of the drive pin. Packages bear the company name (Powers Fasteners, Inc., or Max Co., Ltd.), the fastener catalog number, length and diameter, and evaluation report number (ESR-2024).

## 8.0 OTHER CODES

**8.1 Scope:**

In addition to the IBC and IRC, the products described in this report were evaluated for compliance with the requirements of the following codes:

- 2003 *International Building Code*® (2003 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 1997 *Uniform Building Code*™ (UBC)

**8.2 Uses:**

The Powers power-driven fasteners are used to connect materials as described in Section 2.0. The fasteners are alternatives to the cast-in-place anchors described in 2003 IBC Sections 1912 and 1913 and UBC Section 1923.1 for placement in concrete. They are also alternatives to bolts used to attach materials to structural steel. The fasteners may be used where an engineered design is submitted in accordance with 2003 IRC Section R301.1.3.

**8.3 Description:**

**8.3.1 Fasteners:** See Section 3.1.

**8.3.2 Substrate Materials:** See Section 3.2

**8.3.2.1 Concrete**: See Section 3.2.1. Under the UBC, concrete must conform to Section 1903.

**8.3.2.2 Steel Substrates:** See Section 3.2.2.

**8.3.2.3 Sill plates:** Wood members must have a 2-inch (51 mm) nominal thickness with a specific gravity of 0.5 or greater in accordance with UBC Sections 1806.6 and 2320.6 and, as applicable, Section 2308.6 of the 2003 IBC or Section R403.16 of the 2003 IRC (for maximum two-story buildings).

**8.4 Design and Installation:**

**8.4.1 Design:** See Section 4.1. The stress increases described in Section 1612.3.2 of the UBC are not allowed for wind loads acting alone or when combined with gravity loads. Except for fasteners used with architectural, electrical and mechanical components as described in Section 9.6.1 of ASCE/SEI 7-02 (2003 IBC and 2003 IRC), use of the fasteners to resist earthquake loads is outside the scope of this report.

**8.4.1.1 General:** See Section 4.1.1.

**8.4.1.2 Wood to Steel or Concrete:** See Section 4.1.2. Reference lateral design values for fasteners determined in accordance with Part 11 of ANSI/AF&PA NDS (2003 IBC and 2003 IRC) or Section 2318.3 of the UBC, as applicable, are applicable to the Powers fasteners of equal or greater diameters.

**8.4.1.3 Sill Plate to Foundation Connections:**

**8.4.1.3.1 General:** See Section 4.1.3.1.

**8.4.1.3.2 Design:** Table 5 of this report specifies the allowable fastener spacings for attachment of wood sill plates to concrete in structures located in areas classified as Seismic Design Category A or B (2003 IBC or 2003 IRC), or Seismic Zones 0, 1, 2 and 3 (UBC), and in areas assigned basic wind speeds up to 100 mph (161 km/h) (3-second-gust wind speed) or 85 mph (137 km/h) (fastest mile wind speed).

**8.4.2 Installation:** See Section 4.2.

**8.5 Conditions Of Use:**

See Section 5.0.

**8.6 Evidence Submitted:**

See Section 6.0.

**8.7 Identification:**

See Section 7.0.

**TABLE 1—ALLOWABLE TENSION AND SHEAR VALUES FOR POWER-DRIVEN FASTENERS INSTALLED IN NORMAL-WEIGHT CONCRETE (pounds)[1,2,3,4,5]**

| FASTENER DESCRIPTION | SHANK DIAMETER (inches) | EMBEDMENT DEPTH (inches) | f'c = 2,000 psi | | f'c = 3,000 psi | | f'c = 4,000 psi | | f'c = 5,000 psi | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tension | Shear | Tension | Shear | Tension | Shear | Tension | Shear |
| 0.300-inch head drive pin<br>8 mm head drive pin<br>1/4-inch-20 threaded stud | 0.145 | 5/8 | 25 | 45 | 60 | 95 | 45 | 95 | 25 | 95 |
| | | 3/4 | 60 | 95 | 95 | 125 | 95 | 125 | 100 | 125 |
| | | 1 | 100 | 140 | 130 | 155 | 155 | 155 | 180 | 200 |
| | | 1 1/4 | 110 | 155 | 155 | 165 | 195 | 165 | 235 | 200 |
| | | 1 1/2 | 115 | 175 | 180 | 175 | 235 | 175 | 290 | 200 |
| 3/8-inch head drive pin | 0.172 | 1 1/4 | 135 | 225 | 145 | 240 | 200 | 260 | 200 | 260 |
| | | 1 1/2 | 185 | 280 | 230 | 305 | 230 | 305 | 230 | 305 |
| 3/8-inch-16 threaded stud | 0.205 | 1 | 95 | 135 | 80 | 135 | 160 | 110 | 160 | 110 |
| | | 1 1/4 | 170 | 220 | 165 | 220 | 200 | 320 | 200 | 320 |
| | | 1 1/2 | 230 | 275 | 275 | 325 | 295 | 395 | 295 | 395 |

For **SI:** 1 lbf = 4.48 N, 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

[1]Fasteners must not be driven until the concrete has reached the minimum tabulated compressive strength.
[2]Concrete thickness must be a minimum of three times the embedment depth of the fastener.
[3]The tabulated allowable tension and shear load values are for the fastener only. Wood or steel members connected to the steel substrate must be investigated in accordance with applicable code.
[4]The minimum spacing is 3 inches center-to-center, and minimum edge and end distances are 3 inches for installation in concrete.
[5]The stress increases and load reductions described in Section 1605.3 of the IBC and the stress increases described in Section 1612.3.2 of the UBC are not allowed for wind loads acting alone or when combined with gravity loads. No adjustment is allowed for vertical loads acting alone.

**TABLE 2—ALLOWABLE TENSION AND SHEAR VALUES FOR POWER-DRIVEN FASTENERS INSTALLED IN NORMAL-WEIGHT CONCRETE (pounds)[1,2,3,4,5]**

| FASTENER DESCRIPTION | SHANK DIAMETER (inches) | EMBEDMENT DEPTH (inches) | f'c = 2,000 psi | | f'c = 3,000 psi | | f'c = 4,000 psi | |
|---|---|---|---|---|---|---|---|---|
| | | | Tension | Shear | Tension | Shear | Tension | Shear |
| Ceiling Clips – Standard | 0.145 | 3/4 | 40 | 65 | 65 | 105 | 70 | 145 |
| | | 1 | 40 | 110 | 95 | 120 | 100 | 160 |
| Ceiling Clips – Economy | 0.145 | 3/4 | 40 | 75 | 40 | 75 | 70 | 145 |
| | | 1 | 40 | 120 | 40 | 150 | 100 | 150 |
| Ceiling Clips – LADD pin | 0.152 | 1 1/8 | 50 | 50 | 50 | 130 | 135 | 160 |

For **SI:** 1 lbf = 4.48 N, 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

[1]Fasteners must not be driven until the concrete has reached the minimum tabulated compressive strength.
[2]Concrete thickness must be a minimum of three times the embedment depth of the fastener.
[3]The tabulated allowable tension and shear load values are for the fastener only. Wood or steel members connected to the steel substrate must be investigated in accordance with applicable code.
[4]The minimum spacing is 3 inches center-to-center, and minimum edge and end distances are 3 inches for installation in concrete.
[5]The stress increases and load reductions described in Section 1605.3 of the IBC and the stress increases described in Section 1612.3.2 of the UBC are not allowed for wind loads acting alone or when combined with gravity loads. No adjustment is allowed for vertical loads acting alone.

**TABLE 3—ALLOWABLE TENSION AND SHEAR VALUES FOR POWER-DRIVEN FASTENERS INSTALLED IN LIGHTWEIGHT CONCRETE (pounds) AND STRUCTURAL SAND-LIGHTWEIGHT CONCRETE FILLED STEEL DECK PANELS[1,2,3,4,5,6]**

| FASTENER DESCRIPTION | SHANK DIAMETER (inches) | EMBEDMENT DEPTH (inches) | f'c = 3,000 psi | | | | | | f'c = 3,500 psi | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Directly Into Concrete | | | Through Steel Deck Panel | | | Directly Into Concrete | | | Through Steel Deck | | |
| | | | Tension | 45° | Shear | Tension | 45° | Shear | Tension | 45° | Shear | Tension | 45° | Shear |
| 0.300-inch head drive pin | 0.145 | 1 | 70 | — | 125 | 65 | — | 170 | 75 | — | 135 | 70 | — | 185 |
| | | $1^1/_4$ | 130 | — | 180 | 105 | — | 175 | 140 | — | 195 | 115 | — | 190 |
| $^1/_4$-inch-20 threaded stud | 0.145 | $^3/_4$ | 70 | — | 35 | 35 | — | 160 | 75 | — | 40 | 40 | — | 175 |
| | | 1 | 70 | — | 125 | 65 | — | 170 | 75 | — | 135 | 70 | — | 185 |
| $^3/_8$-inch head drive pin | 0.172 | $1^1/_4$ | 65 | — | 195 | 35 | — | 225 | 70 | — | 210 | 40 | — | 245 |
| | | $1^1/_2$ | 155 | — | 205 | 105 | — | 240 | 165 | — | 220 | 115 | — | 260 |
| $^3/_8$-inch-16 threaded stud | 0.205 | 1 | 70 | — | 130 | 45 | — | 165 | 75 | — | 140 | 50 | — | 180 |
| | | $1^1/_4$ | 170 | — | 265 | 85 | — | 225 | 185 | — | 285 | 90 | — | 245 |
| Ceiling Clips – Standard | 0.145 | $^3/_4$ | 50 | 40 | 25 | 35 | 40 | 120 | 55 | 45 | 30 | 40 | 45 | 130 |
| | | 1 | 60 | 40 | 80 | 45 | 70 | 120 | 65 | 45 | 85 | 50 | 75 | 130 |
| Ceiling Clips – Economy | 0.145 | $^3/_4$ | 35 | 45 | 30 | 30 | 40 | 135 | 40 | 50 | 35 | 35 | 45 | 145 |
| | | 1 | 55 | 90 | 115 | 55 | 45 | 135 | 60 | 95 | 125 | 60 | 50 | 145 |
| Ceiling Clips – LADD pin | 0.152 | $1^1/_8$ | 95 | 105 | 145 | 55 | 80 | 125 | 100 | 115 | 155 | 60 | 85 | 135 |

For **SI:** 1 lbf = 4.48 N, 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

[1]Fasteners must not be driven until the concrete has reached the minimum designated compressive strength.
[2]The steel deck must have a minimum base material thickness of No. 20 gage and, minimum yield strength, Fy, of 33 ksi, and conform to the Steel Deck Institute requirements for Standard Wide Rib Deck, Type B.
[3]Concrete thickness must be a minimum of three times the embedment depth of the fastener with a minimum concrete thickness of 3¼ inches.
[4]The minimum spacings are 3, 3, 4 and 6 inches center-to-center for the 0.300-inch head drive pin, ¼-inch-20 threaded stud, $^3/_8$-inch head drive pin and $^3/_8$-inch-16 threaded stud, respectively. Minimum edge and end distances are 3-inches for installation in concrete.
[5]The tabulated allowable load values are for the fastener only. Wood or steel members connected to the steel substrate must be investigated in accordance with accepted design criteria.
[6]The stress increases and load reductions described in Section 1605.3 of the IBC and the stress increases described in Section 1612.3.2 of the UBC are not allowed for wind loads acting alone or when combined with gravity loads. No adjustment is allowed for vertical loads acting alone.

**TABLE 4—ALLOWABLE TENSION AND SHEAR VALUES FOR POWER-DRIVEN FASTENERS INSTALLED IN ASTM A 36 STEEL[1,2,3,4]**

| FASTENER DESCRIPTION | SHANK DIAMETER (inches) | SHANK TYPE | 3/16-INCH THICK STEEL | | 1/4-INCH THICK STEEL | | 3/8-INCH THICK STEEL | | ½-INCH THICK STEEL | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tension | Shear | Tension | Shear | Tension | Shear | Tension | Shear |
| 0.300-inch head drive pin | 0.145 | Smooth | 355 | 565 | 410 | 560 | 465 | 390 | 390 | 520 |
| 8 mm head drive pin | 0.145 | Knurled | 340 | 610 | 445 | 560 | 520 | 605 | 490 | 575 |
| Ballistic point pin | 0.150 | Smooth | — | — | 310 | 545 | 450 | 525 | — | — |

For **SI:** 1 lbf = 4.48 N, 1 inch = 25.4 mm.

[1]To obtain the tabulated values, the entire pointed portion of the fastener must penetrate the steel.
[2]The tabulated allowable load values are for the fastener only. Wood or steel members connected to the steel substrate must be investigated in accordance with accepted design criteria.
[3]The stress increases and load reductions described in Section 1605.3 of the IBC and the stress increases described in Section 1612.3.2 of the UBC are not allowed for wind loads acting alone or when combined with gravity loads. No adjustment is allowed for vertical loads acting alone.
[4]The minimum spacing is $1^1/_2$ inches center-to-center, and minimum edge and end distances are $^1/_2$ inch for installations in ASTM A 36 steel.

**TABLE 5—SPACING REQUIREMENTS FOR SILL PLATE ANCHORAGE**

| FASTENER DESCRIPTION | SHANK DIAMETER (inches) | EMBEDMENT DEPTH (inches) | MINIMUM LENGTH (inches) | MAXIMUM SPACING IN FEET[1,2,3,4,5,6,7] | | |
|---|---|---|---|---|---|---|
| | | | | Interior Shear Walls[3,5] | Interior Nonshear Walls[2] | Exterior Shear and Nonshear Walls[3,5] |
| 0.300-inch head drive pin 8 mm head drive pin | 0.145 | 1½ | 3 | 1.5 | 3 | 1.5 |
| 3/8-inch head drive pins | 0.172 | 1½ | 3 | 2 | 4 | 2 |

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

[1]Spacings are based on the attachment of 2-inch (51 mm) nominal thickness wood with specific gravity of 0.5 or greater to concrete floor slabs or footings. For lumber with a lower specific gravity, multiply the required spacing of fasteners for shear walls by 0.81 for lumber with a minimum specific gravity of 0.42, and 0.65 for lumber with a minimum specific gravity of 0.35. For other species of lumber, the required spacing of fasteners require special calculations complying with the NDS.
[2]Walls must have fasteners placed at 6 inches from ends of sill plates with maximum spacing between, as shown in the table.
[3]Walls must have two pins placed at 6 inches and 10 inches, respectively, from each end of sill plates with maximum spacing between, as shown in the table.
[4]Fasteners must not be driven until the concrete has reached a minimum compressive strength of 2000 psi.
[5]Bearing walls must have bracing in accordance with IBC Section 2308.9.3, IRC Section R602.10 or UBC Section 2320.11.3, as applicable. Interior and nonbearing partitions are not assumed to be braced.
[6]Fasteners must not be used to attach shear walls having a unit shear exceeding 100 pounds per foot to other building elements.
[7]All fasteners must be installed with a minimum ¾-inch-diameter (19.1 mm), No. 16 gage (0.0598-inch) washer.

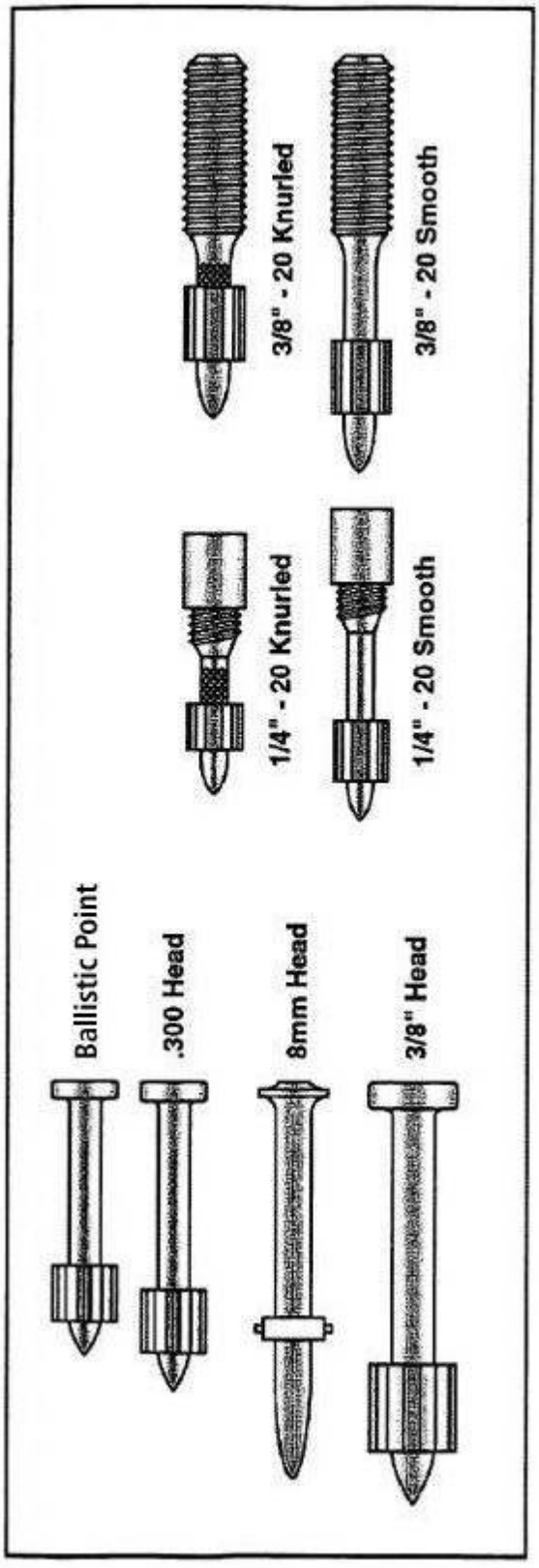


**FIGURE 1**

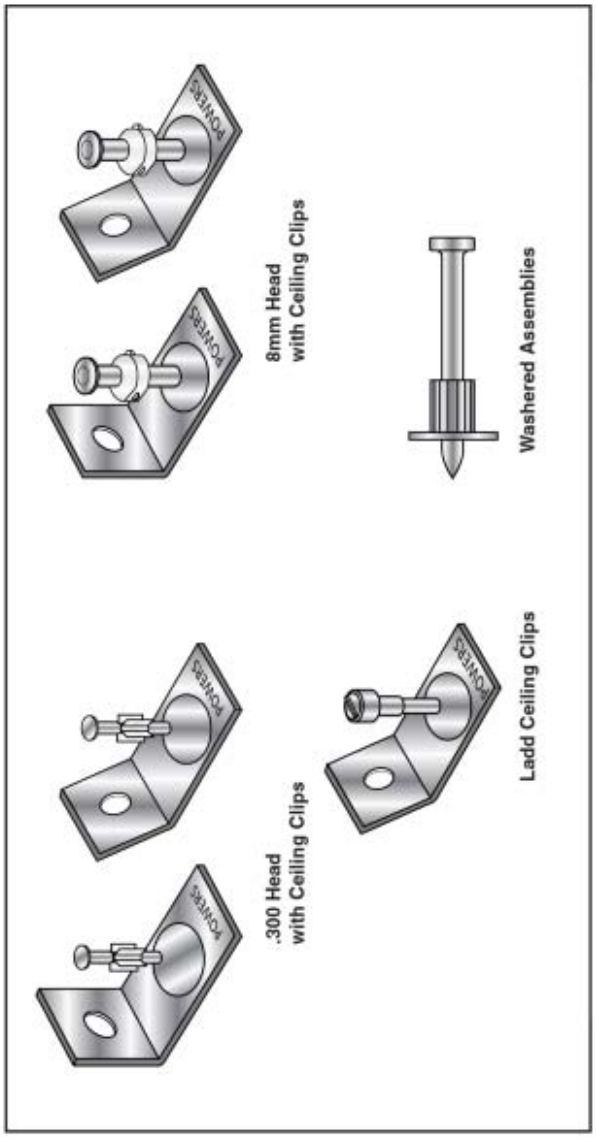


**FIGURE 2**