**Table 1a: Heavy Duty Pipe Brace Available Compressive Strength (Ω = 1.67; Φ = 0.90)**

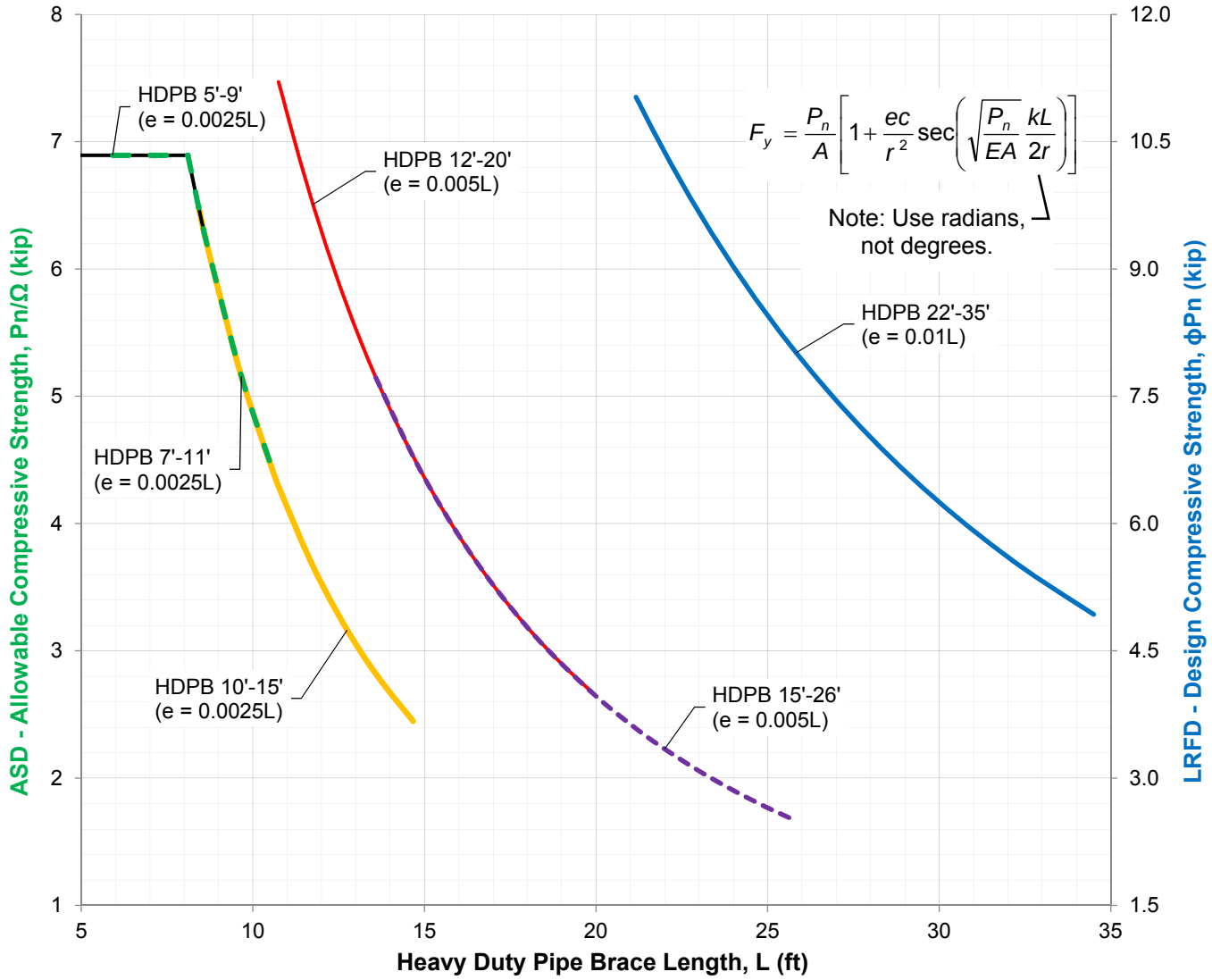


**Table 1b: Heavy Duty Pipe Brace Available Tensile Strength**

| Heavy Duty Pipe Brace (HDPB) | Allowable Tensile Strg., $P_n/\Omega$ | Design Tensile Strg., $\phi P_n$ |
|---|---|---|
| HDPB 3'-5'; HDPB 7'-11'; HDPB 10'-15' | 6.89 kip | 10.34 kip |
| HDPB 12'-20'; HDPB 15'-26' | 8.51 kip | 12.76 kip |
| HDPB 22'-35' | 13.10 kip | 19.65 kip |

Limited by Bearing Strength of 3/4"ø Bolt on Heavy Duty Pipe Brace Tube

$R_n = 1.8 F_y A_{pb}$ (AISC Steel Construction Manual 14th Edition; Specification J7; Equation J7-1)

Where: $F_y$ = 46 ksi

$A_{pb}$ = Design (t) x 0.75" Bolt x 2 walls

Allowable Bearing Strength $R_n/\Omega$ → Safety Factor (Ω) = 2.0

Design Bearing Strength $\phi R_n$ → Resistance Factor (ϕ) = 0.75


Forming and Shoring Equipment for Concrete Construction

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## Table 2a: PBS-1 Pipe Brace Shoe Available Strength

| Angle θ | Tension | | | | Compression | | | |
|---|---|---|---|---|---|---|---|---|
| | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) | Bolt Shear [5] (kip) | Bolt Tension [5] (kip) | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) | Bolt Shear [5] (kip) | Bolt Tension [5] (kip) |
| 0° | 5.80 | 8.70 | 6.0 | 3.5 | 6.00 | 9.00 | 6.0 | 5.5 |
| 15° | 7.20 | 10.80 | 7.0 | 4.5 | 5.30 | 7.95 | 5.5 | 1.5 |
| 30° | 8.60 | 12.90 | 7.5 | 5.5 | 4.70 | 7.05 | 4.5 | - |
| 45° | 10.00 | 15.00 | 7.5 | 9.5 | 4.00 | 6.00 | 3.0 | - |
| 60° | 8.00 | 12.00 | 4.0 | 11.5 | 4.70 | 7.05 | 2.5 | - |
| 75° | 6.00 | 9.00 | 2.0 | 11.5 | 5.30 | 7.95 | 1.5 | - |
| 90° | 4.00 | 6.00 | - | 9.0 | 6.00 | 9.00 | - | - |

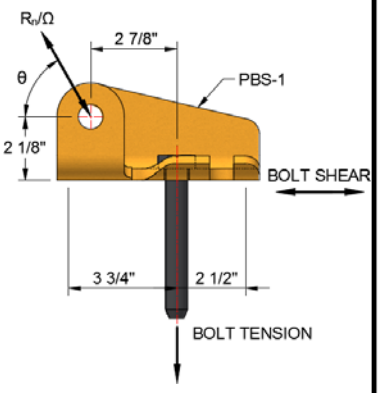



**Figure 2a: PBS-1 Shoe**

## Table 2b: PBS-2 Pipe Brace Shoe Available Strength

| Angle θ | Tension | | | | Compression | | | |
|---|---|---|---|---|---|---|---|---|
| | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) | Bolt Shear [5] (kip) | Bolt Tension [5] (kip) | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) | Bolt Shear [5] (kip) | Bolt Tension [5] (kip) |
| 0° | 3.20 | 4.80 | 2.0 | 2.5 | 3.00 | 4.50 | 1.5 | 2.5 |
| 15° | 4.10 | 6.15 | 2.0 | 4.0 | 5.30 | 7.95 | 3.0 | 3.5 |
| 30° | 5.10 | 7.65 | 2.5 | 5.0 | 7.70 | 11.55 | 3.5 | 3.0 |
| 45° | 6.00 | 9.00 | 2.5 | 5.5 | 10.00 | 15.00 | 4.0 | 1.5 |
| 60° | 5.70 | 8.55 | 1.5 | 1.0 | 10.00 | 15.00 | 2.5 | - |
| 75° | 5.30 | 7.95 | 1.0 | 2.0 | 10.00 | 15.00 | 1.5 | - |
| 90° | 5.00 | 7.50 | - | 3.0 | 10.00 | 15.00 | - | - |

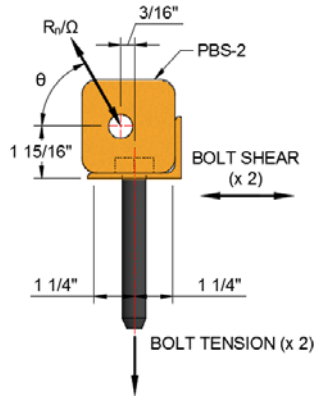



**Figure 2b: PBS-2 Shoe**

## Table 2c: PBS-4 Pipe Brace Shoe Available Strength

| Angle θ | Tension | | | | Compression | | | |
|---|---|---|---|---|---|---|---|---|
| | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) | Bolt Shear [5] (kip) | Bolt Tension [5] (kip) | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) | Bolt Shear [5] (kip) | Bolt Tension [5] (kip) |
| 0° | 4.00 | 6.00 | 4.0 | 7.5 | 6.00 | 9.00 | 6.0 | 11.0 |
| 15° | 4.30 | 6.45 | 4.5 | 9.0 | 5.50 | 8.25 | 5.5 | 8.5 |
| 30° | 4.70 | 7.05 | 4.5 | 10.0 | 5.00 | 7.50 | 4.5 | 5.5 |
| 45° | 5.00 | 7.50 | 4.0 | 10.0 | 4.50 | 6.75 | 3.5 | 3.0 |
| 60° | 6.00 | 9.00 | 3.0 | 11.0 | 5.70 | 8.55 | 3.0 | 0.5 |
| 75° | 7.00 | 10.50 | 2.0 | 10.5 | 6.80 | 10.20 | 2.0 | - |
| 90° | 8.00 | 12.00 | - | 8.0 | 8.00 | 12.00 | - | - |

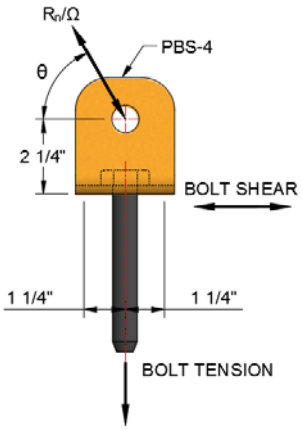



**Figure 2c: PBS-4 Shoe**

Notes:

1) $R_n$ = Nominal Tensile/Compressive Strength
2) Ω = Safety Factor = 2.0
3) Φ = Resistance Factor = 0.75
4) The limit state is based on Available Strength and Serviceability (0.100” deflection in line with the force direction) by testing.
5) Bolt Shear and Bolt Tension Loads based on Allowable Strength (ASD) working loads.
6) Pipe Brace Shoe capacity may be limited by the member the shoe is connected to (i.e. Form Rib, Form Side Rail, Form End Rail, etc.).

## Table 3a: Heavy Duty Pipe Brace Clevis to Rib

| Plate Thickness, t | Form Rib | Available Bearing Strength | |
|---|---|---|---|
| | | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) |
| 1/8" | EL 6'-0"R & 8'-0"R<br>PG 2'-0"R thru 3'-0"R<br>Redi-Radius Jr. | 6.52 kip | 9.78 kip |
| 3/16" | PG 3'-6"R thru 10'-0"R<br>Redi-Radius Sr. | 9.14 kip | 13.71 kip |
| 1/4" | PG 11'-0"R thru 12'-0"R | 9.14 kip | 13.71 kip |

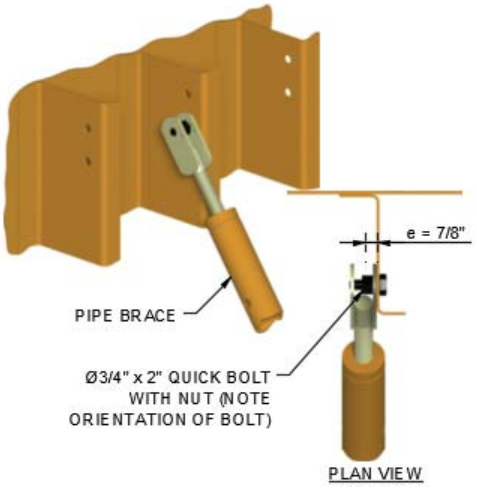



**Figure 3a: HDPB to Rib Connection**
**(Preferred Method)**

Notes:

1) $R_n$ = Nominal Bearing Strength
2) $\Omega$ = Safety Factor = 2.0
3) $\Phi$ = Resistance Factor = 0.75
4) The limit state is based on Available Bearing Strength, $R_n/\Omega$ and $\Phi R_n$, at bolt holes. (AISC 14th Edition, Equation J3-6a)

$$R_n = 1.2 l_c t F_u \le 2.4 dt F_u$$

Rib: $F_u$ = 58 ksi; d = 0.75"; t = varies
HDPB Clevis: $F_u$ = 65 ksi; $l_c$ = 15/16"; t = 1/4"

5) Heavy Duty Pipe Brace Available Compressive Strength, $P_n/\Omega$ and $\Phi P_n$, varies depending on length, eccentricity (e), and size of Heavy Duty Pipe Brace. See Table 3b below for reduced HDPB Available Compressive Strength based on the additional 0.875" of eccentricity from the single side connection. See Table 1b for HDPB Available Tensile Strength.

| HDPB | Eccentricity, e | k |
|---|---|---|
| 3'-5'; 5'-9'<br>7'-11'; 10'-15' | 0.0025L + 0.875" | 1.0 |
| 12'-20'<br>15'-26' | 0.005L + 0.875" | 1.0 |
| 22'-35' | 0.01L + 0.875" | 1.0 |

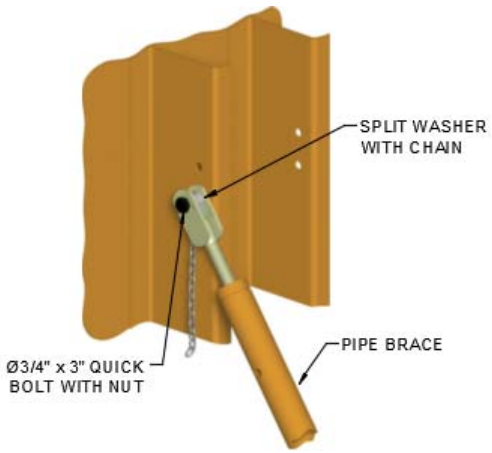
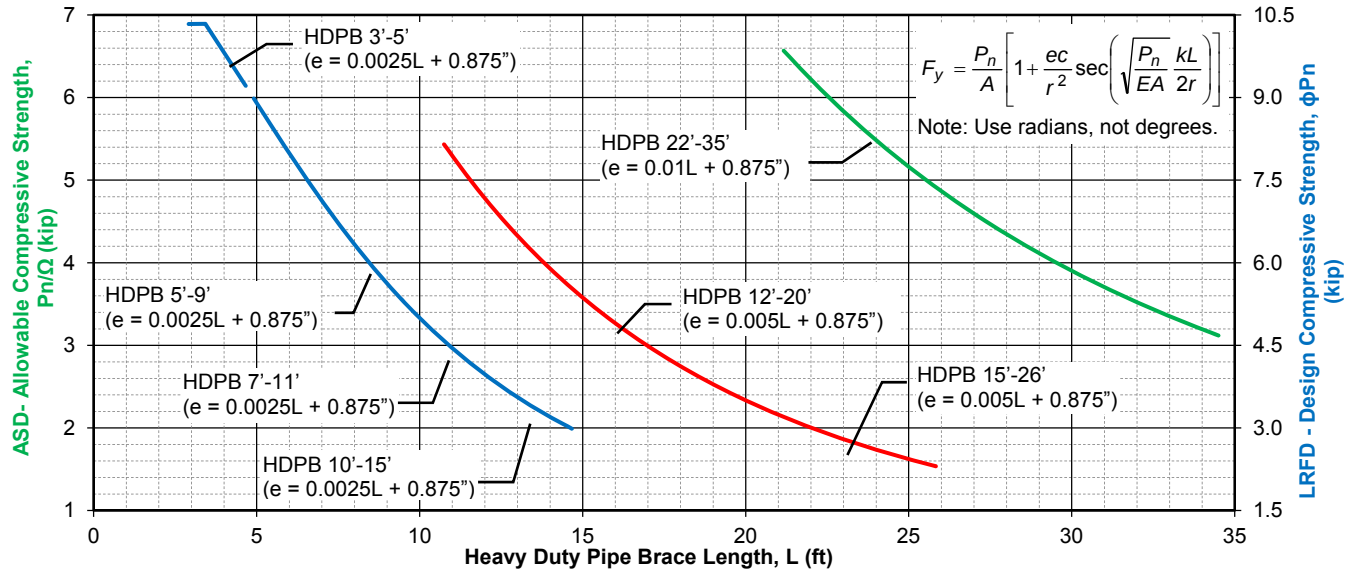



**Figure 3b: HDPB to Rib Connection**

## Table 3b: HDPB Available Compressive Strength - Single Clevis Connection ($\Omega$ = 1.67; $\Phi$ = 0.90)



## Table 4a: CBC Strut Clevis to Rib

| Plate Thickness, t | Form Rib | Available Bearing Strength | |
|---|---|---|---|
| | | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) |
| 1/8" | EL 6'-0"R & 8'-0"R PG 2'-0"R thru 3'-0"R | 6.52 kip (5) | 9.78 kip (5) |
| 3/16" | PG 3'-6"R thru 10'-0"R & CBC (built after 01Mar02) | 7.15 kip (6) | 10.72 kip (6) |
| 1/4" | PG 11'-0"R thru 12'-0"R | 7.15 kip (6) | 10.72 kip (6) |

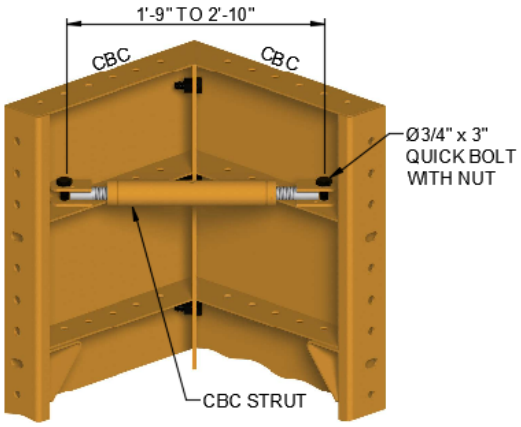



**Figure 4a: CBC Strut to Rib Connection**

Notes:

1) $R_n$ = Nominal Bearing Strength
2) $\Omega$ = Safety Factor = 2.0
3) $\Phi$ = Resistance Factor = 0.75
4) The CBC Strut to Plate Connection is considered a "bolted" rather than a "pin" connection because the Ø1 1/4" Rod extends flush with the hole and is clamped in between the bolt head and nut.
5) The primary limit state is based on Available Bearing Strength, $R_n/\Omega$ and $\Phi R_n$, at bolt holes. (AISC 14th Edition, Equation J3-6a)

$$R_n = 1.2 l_c t F_u \le 2.4 d t F_u$$

Rib: $F_u$ = 58 ksi; d = 0.75"; t = varies
CBC Strut Clevis: $F_u$ = 65 ksi; $l_c$ = 15/16"; t = 1/4"

6) The secondary limit state is based on the Available Weld Strength of a single CBC Strut Clevis welded to the Ø1 1/4" Rod.
7) CBC Strut Available Tensile and Compressive Strength = 14.3 kip.

## Table 4b: HD Pipe Brace to Super Stud

| Plate Thickness, t | Connection Type | Available Bearing Strength | |
|---|---|---|---|
| | | Allowable Strength $R_n/\Omega$ (kip) | Design Strength $\Phi R_n$ (kip) |
| 2 x 1/8" | Pin Bearing (Fig 10.14b) | 8.43 kip | 12.65 kip |

Notes:

1) $R_n$ = Nominal Bearing Strength
2) $\Omega$ = Safety Factor = 2.0
3) $\Phi$ = Resistance Factor = 0.75
4) The limit state is based on Available Bearing Strength, $R_n/\Omega$ and $\Phi R_n$, at pins in reamed, drilled, or bored holes.

$R_n = 1.8 F_y A_{pb}$ (AISC 14th Edition, Equation J7-1)

Where: $F_y$ = Minimum Yield Stress = 50 ksi
$A_{pb}$ = Projected Bearing Area
= Bolt Diameter (3/4") x Plate Thickness, t (2 x 1/8")

5) See Tables 1a and 1b for Heavy Duty Pipe Brace Available Compressive and Tensile Strength.

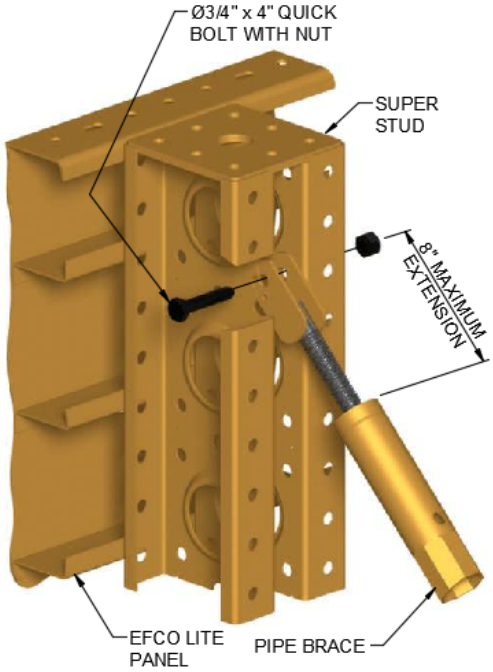



**Figure 4b: HD Pipe Brace to Super Stud**