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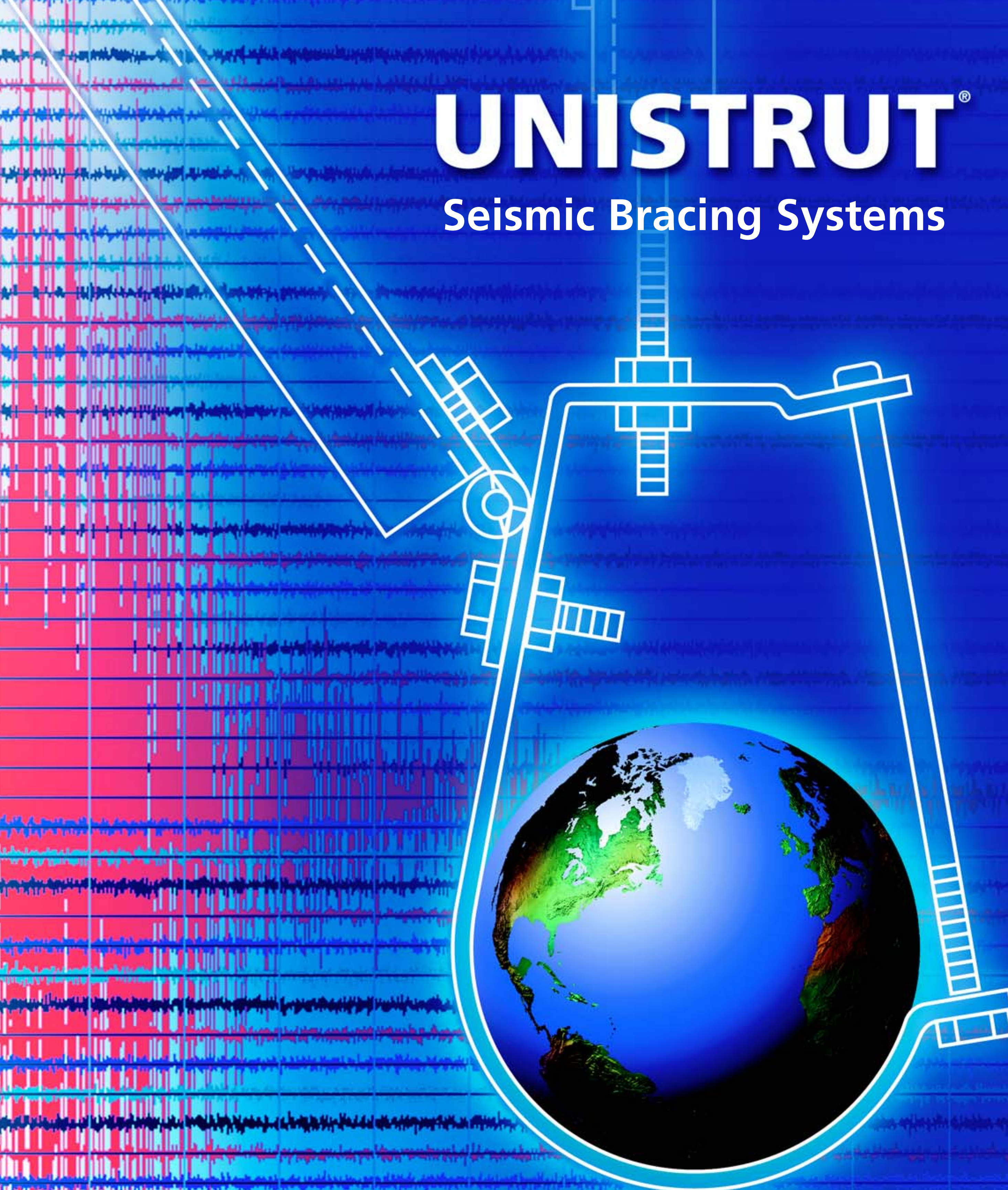
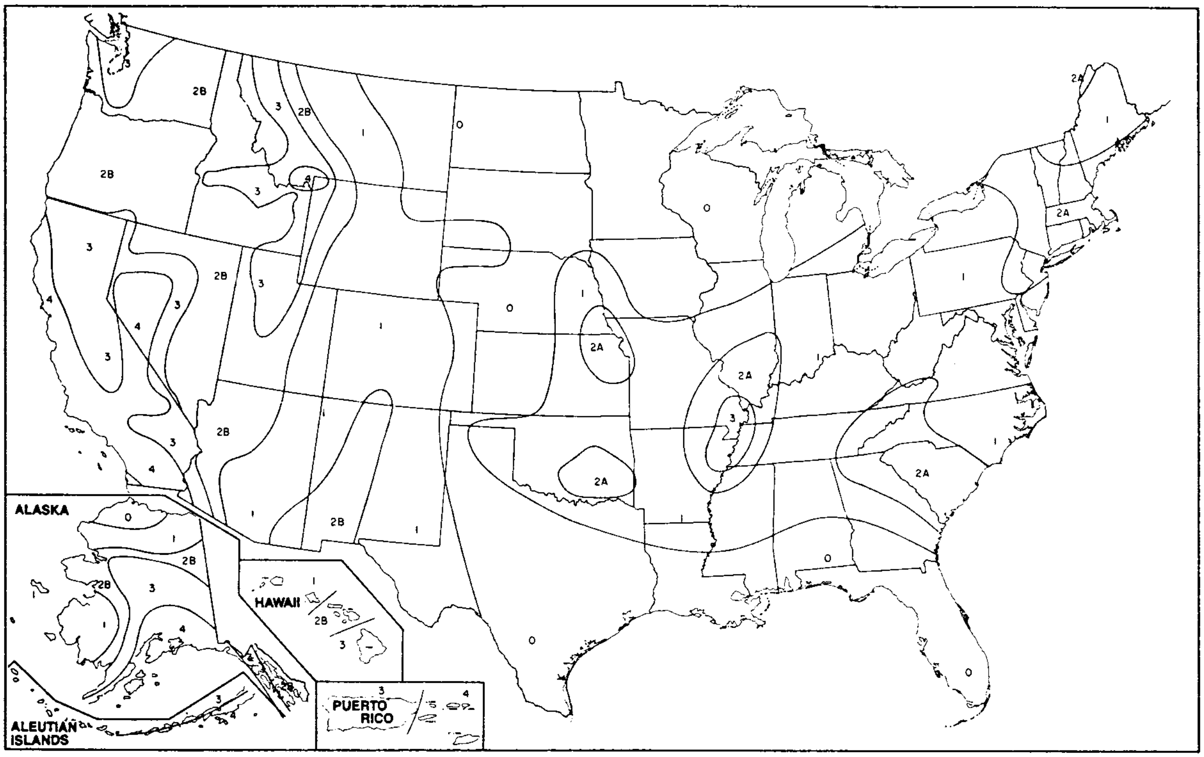
Seismic Bracing Systems



As Approved by the California Office of Statewide Health Planning and Development for Metal Framing Bracing Applications

SBS-3



SEISMIC ZONE MAP OF THE UNITED STATES

CONVERSION OF UNIFIED UNITS OF MEASURE INTO METRIC EQUIVALENTS		
To Convert From	***Into***	***Multiply By***
Inches (In)	Millimeter	25.4 (exactly)
Feet (Ft)	Centimeters (cm)	30.48 (exactly)
Square inches (In^2)	Square centimeters (cm^2)	6.4516 (exactly)
Cubic inches (In^3)	Cubic centimeters (cm^3)	16.3871
Pounds (advp.)(Lb)	Kilograms (kg)	.45359237 (exactly)
Pounds per square inch	Kilograms per square Millimeter (kgf/mm^2)	.00070307
Foot-pounds (Ft.Lbs)	Meter-kilograms (m-kg)	.138255
Pounds-force (Lbf)	Kilonewton (kN)	.004448
Pounds-force (Lbf)	Newton (N)	4.448222

1 These guidelines are intended to provide information for the seismic restraint of nonstructural components in buildings based on the California Code of Regulations (CCR), Part 2, Title 24. Nonstructural components may include hospital piping, electrical conduit, cable trays, and air handling ducts.

2. Seismic horizontal force factor $\mathbf{Z_p} = Z\mathbf{I}\mathbf{C_p}\mathbf{W_p}$.

Z	**=.4 for seismic zone 4**
I	**= 1.5**
$\mathbf{C_p}$	**= 0.75**
$\mathbf{W_p}$	**= Weight of Component**

3. When supporting pressure piping, spacing of seismic bracing should not exceed two (2) times the vertical support spacing. Stress in the pipes that are comparable to those required by ASME B31.1-1986 will be maintained.

4. The CCR, Part 2, Title 24, Table 23-P, Footnote 12 states the following:

Seismic restraints may be omitted from the following installations:

a. Gas piping less than one (1) inch inside diameter.
b. Piping in boiler and mechanical equipment rooms less than 1.25 inches inside diameter.
c. All piping less than 2.5 inches inside diameter.
d. All piping suspended by individual hangers twelve (12) inches or less in length from the top of pipe to the bottom of the support for the hanger.
e. All electrical conduit less than 2.5 inches inside diameter.
f. All rectangular air handling ducts less than six (6) square feet in cross-sectional area,
g. All round air-handling ducts less than 28 inches in diameter.
h. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the support for the hanger.

5. **Unistrut** nuts and bolts mounted to the Unistrut channels shall be tightened to the following minimum torques:

Bolt Diameter (In.)	Bolt Torque (Ft.-Lbs.)
¼	6
5/16	11
⅜	19

Bolt Diameter (In.)	Bolt Torque (Ft.-Lbs.)
½	50
⅝	100
¾	125

6. The charts and information presented on the following pages are intended as a guide only. Prior to installation, the user and/or project engineer shall determine structural adequacy of supports and the supporting structure and shall also determine compliance with applicable codes.

Use of this manual requires that layout drawings for the pipe/duct/conduit be used to determine brace locations, sizes, anchorage and forces. These drawings are an integral part of the approval of the lateral force bracing system. The layout drawings shall be submitted to OSHPD as a deferred approval item prior to the installation of the lateral bracing system.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

R-0120 February 1, 2002

****Valid for 3 Years Maximum****

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1. Determine the support spacing using the smallest pipe diameter
2. Calculate the total weight of the pipes plus contents (W) on each trapeze using the following equation:

   $W = S \times (p_1 + p_2 + p_3 + \ldots + p_n)$

   W = Total weight on trapeze (lbs.)
   p_n = Weight of pipe plus water (lbs./ft.)(page 2-1, table 1).
   S = Support spacing (ft) (page 2-1, table 1).

3. Select clamps (pages 3-3, 3-4, tables 6 & 7). Either style, P1100 Series or P2558 Series can be used. Maximum pipe support spacing should be as per chart 1, row 3 page 3-12.
4. Select trapeze member using the total weight on the trapeze and the length of trapeze required to fit the given pipe sizes and quantities (page 3-1, 3-2, tables 2-5).
5. Calculate horizontal seismic force (Fh) assuming braces on alternate trapeze supports (page 2-2, figure 1). Select a brace assembly (page 3-11, details I-V) that has an Fh value that meets or exceeds the horizontal seismic force.

   If necessary, seismic force can be recalculated with braces on every trapeze (see figure 2).

Pipe Data

Table 1
Data for Schedule 40 Standard Weight Pipe
Including Horizontal Seismic Force of .50 G

Pipe Size In	Pipe Section Modulus In	Max.Support Spacing Per ASME B31.1* (S) Feet	Weight Of Pipe Plus Water (P) Lbs./Ft.	Horizontal Seismic Force/Ft. of Pipe (.5 x Pipe Wt./Ft.) Lbs./Ft.
½	0.041	7	0.98	0.49
¾	0.071	7	1.36	0.68
1	0.133	7	2.05	1.03
1½	0.326	9	3.60	1.80
2	0.561	10	5.11	2.55
2½	1.060	11	7.87	3.94
3	1.720	12	10.78	5.39
4	3.210	12**	16.31	8.16
6	8.500	12**	31.51	15.76
8	16.800	12**	50.29	25.15

*ASME B31.1 does not list all sizes shown, therefore some sizes have been proportioned between.
**Spacing limited by CBC 1998.
For gas pipe and copper pipe see CBC 1998 for support spacing.

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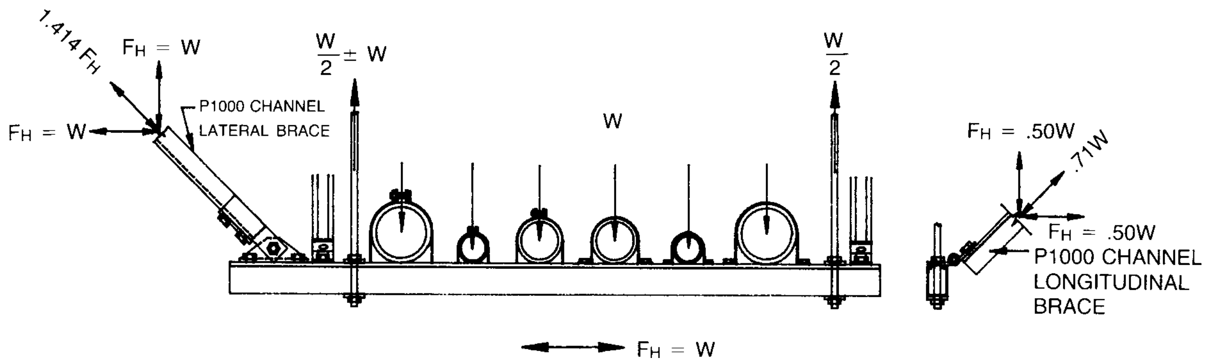
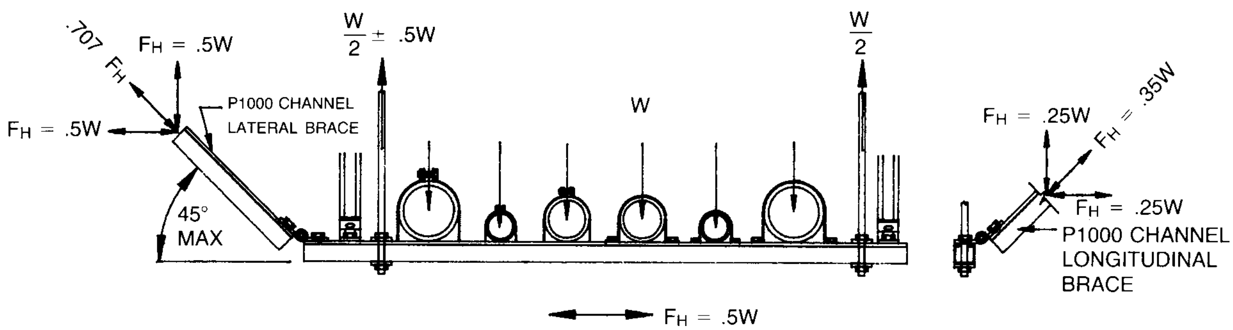


W = GRAVITY LOAD PER TRAPEZE
F_H = .5W x 2 = W
ROD TENSION MAX. = .5W+W = 1.5W
ROD COMPRESSION MAX = .5W

FIGURE 1
BRACE ON ALTERNATE HANGERS



NOTE: FOR LOAD REACTIONS SHOWN ON THIS PAGE, THE PIPE OR CONDUIT LOADS ON THE TRAPEZE SHOULD BE RELATIVELY UNIFORM AND SYMMETRICAL ALONG THE LENGTH OF THE MEMBER.

W = GRAVITY LOAD PER TRAPEZE
F_H = .5W
ROD TENSION MAX. = .5W+.5W = 1.0W
ROD COMPRESSION MAX = 0

FIGURE 2
BRACE ON EVERY HANGER

6. Check compression and tension in the rod. When diagonal braces are used to stabilize trapeze hangers, they will cause tension and compression forces to be added to the tension already in the rod (see figure 3).

   a. Select threaded rod that has a tension strength that meets or exceeds the required tension (page 3-14, table 10)

Brace on alternate hangers	$\mathbf{T_{max} = 1.5W}$ (page 2-2, figure 1)
Brace on every hanger	$\mathbf{T_{max} = 1.0W}$ (page 2-2, figure 2)

   b. Check compression in the selected threaded rod. When braces are used on every trapeze, no stiffener is required. If the rod is subject to compression, it may require a stiffener. Determine the percentage of full stress capacity on the rod using the following equation:

      Actual Compression Load / Allowable Compression Load (page 3-13, table 9)

   Select clip spacing (L) based on percentage above (page 3-13, table 9).

7. Determine if longitudinal braces are required using the following equation:

   Brace Spacing = Allowable $\mathbf{F_h}$ / .25W
   (# of bays)

   Allowable F_h = Determined by assembly selected (page 3-11, details I-V)

8. Check forces on pipe clamps using following equations:
   Vertical Force = Pipe Wt. per foot x Trapeze spacing
   Transverse Force = Pipe Wt. per foot x Lateral Brace Spacing x 0.5
   Longitudinal Force = Pipe Wt. per foot x Longitudinal Brace Spacing x 0.5

   See pages 3-3 and 3-4 for allowable design forces. Revise spacing of braces if necessary.

9. Check trapeze member for combined vertical and lateral seismic loads using the following interaction equation: (Revise trapeze spacing or brace if necessary).

$$\frac{\left[\text{Actual Vertical Force}\right]}{\left[\text{Lateral Reduction Factor}\right] \times \left[\text{Allowable Verticall Force}\right]} + \frac{\left[\text{Actual Horizontal Force}\right]}{\left[\text{Lateral Reduction Factor}\right] \times \left[\text{Allowable Horizontal Force}\right]} \leq 1.33$$

10. Select concrete anchors if they are used (See pages 5-1 and 5-2), check tension and shear interactions as per ICBO reports.

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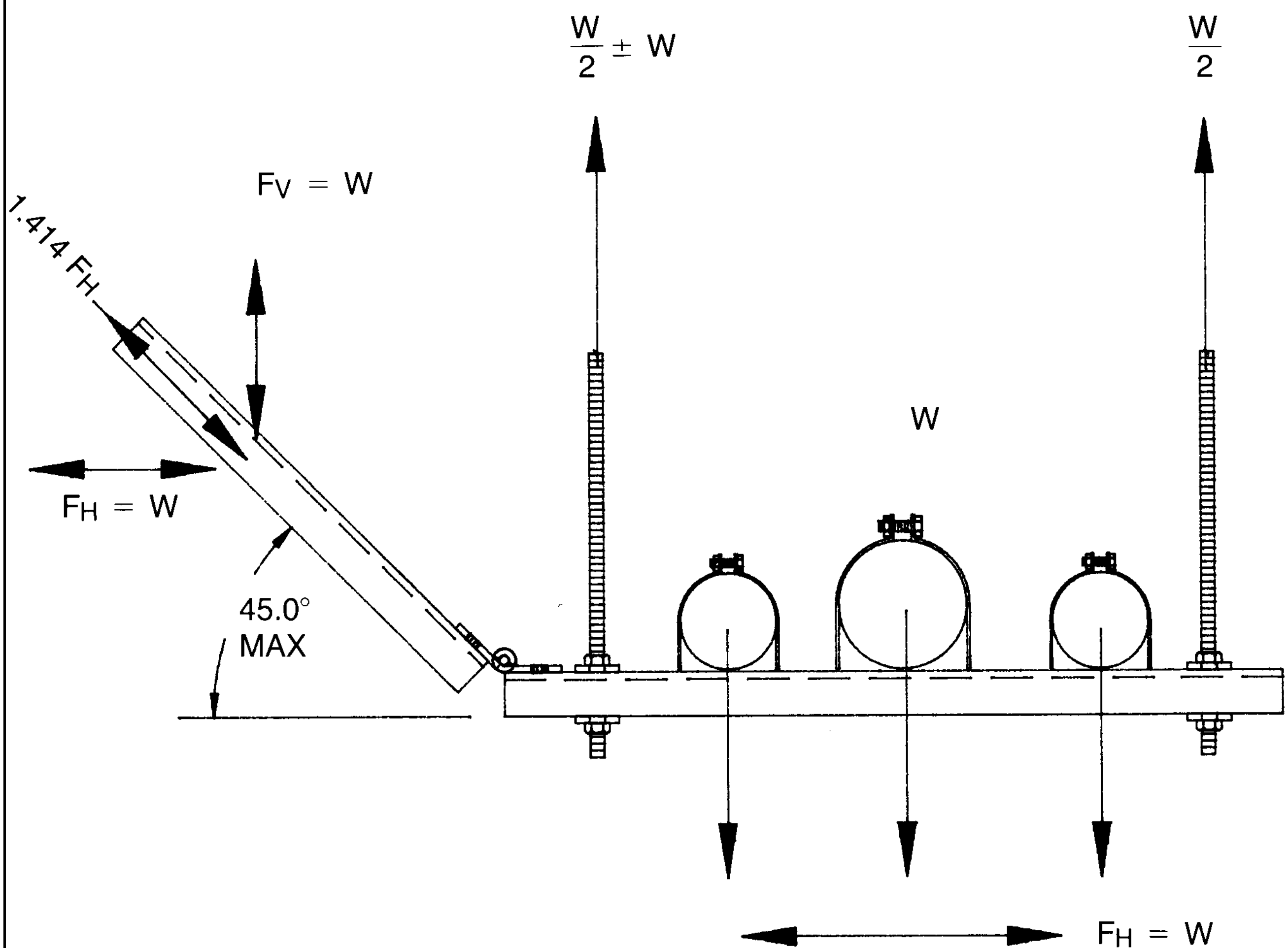

MAX ROD TENSION = W⁄2 + W = 1.5W
MAX ROD COMP. = W⁄2 - W = -.5W

FIGURE 3

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1. Select hanger type (pages 3-6, through 3-10) given the diameter of the pipe.

2. Determine the support spacing (page 2-1, table 1) and corresponding rod diameter (page 3-12, chart 1, row 2). Calculate the total weight of the pipe and contents (page 3-12, chart 1, row 6) or use the following equation:

   W = S x p

   W = Total weight on hanger (lbs.)
   p = Weight of pipe plus water (lbs./ft.)
   S = Support spacing (ft)

3. Select a brace assembly (page 3-11, details I-V) with an allowable F_h greater than the applicable F_h (page 3-12, chart 1, row 7 or the following equation).

   Brace alternating Hangers $F_h = .5Wx2 = W$
   Brace every Hanger $F_h = .5W$

4. Check maximum tension of rod (page 3-12, chart 1, row 8).

5. Compression (see page 2-3, step 6b).

6. Determine if longitudinal braces are required using the following equation:

   Brace Spacing = Allowable $F_h / 0.5W$
   (# of bays)

   Allowable F_h determined by assembly selected (page 3-11, details I-V) and clamp allowable force in the longitudinal direction (page 3-7).

7. Select concrete anchors if they are used (See pages 5-1 and 5-2), check tension and shear interactions as per ICBO reports.

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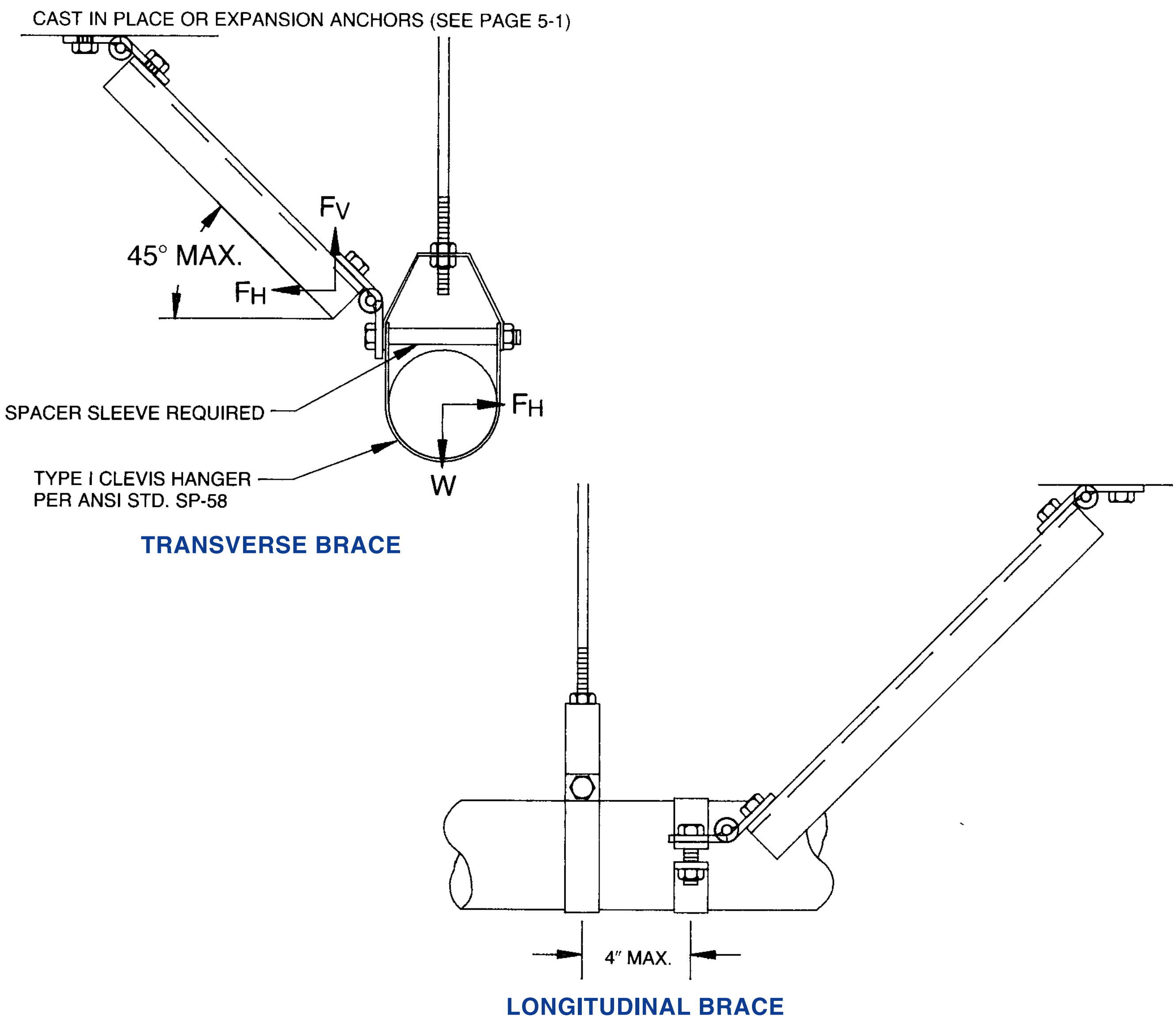

FIGURE 4

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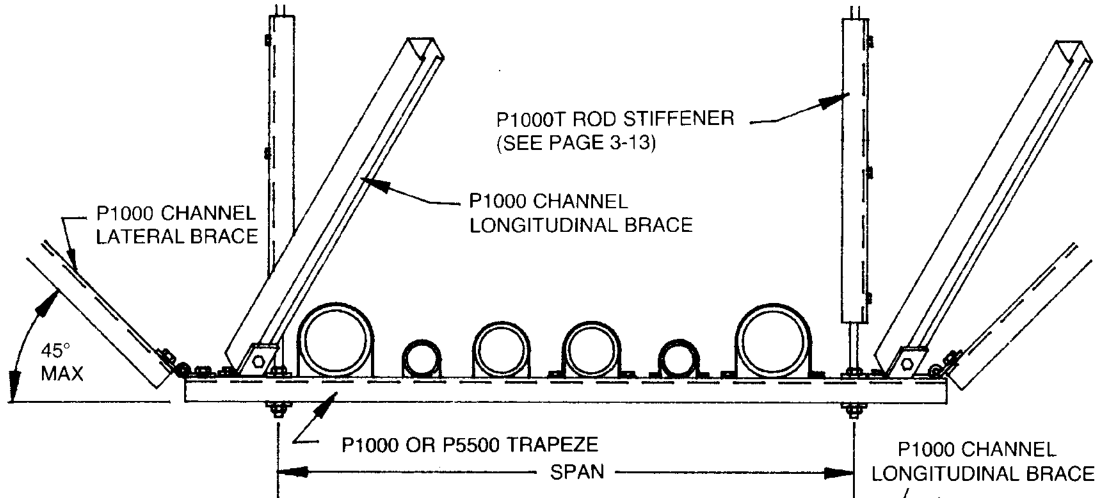

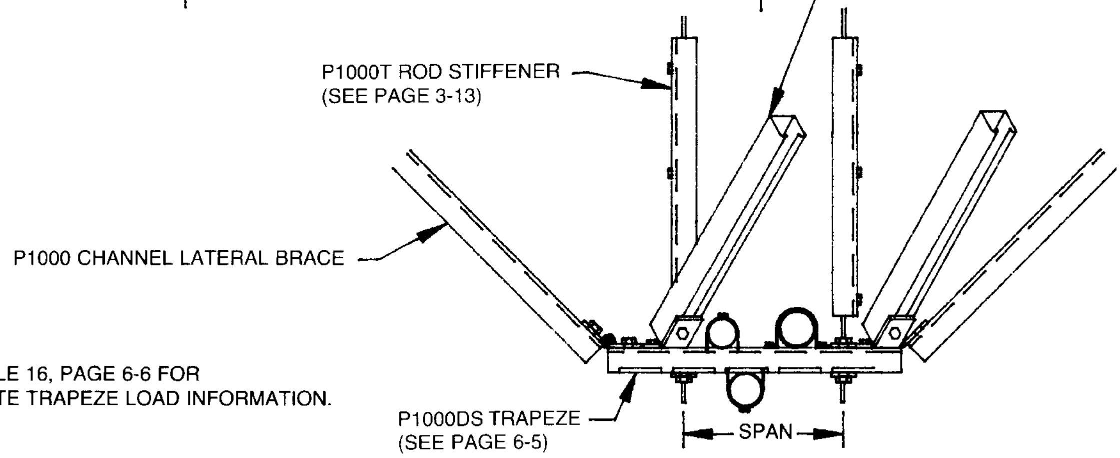

SEE TABLE 16, PAGE 6-6 FOR COMPLETE TRAPEZE LOAD INFORMATION.

Table 2 - P1000 Trapeze Load Data

Span In	Span mm	Maximum Uniform Design Load Lbs.	Maximum Uniform Design Load N	Concentrated Load @ Center of Span Lbs	Concentrated Load @ Center of Span N
24	610	1,690	7,520	450	2,000
36	914	1,130	5,030	560	2,490
48	1,219	850	3,780	420	1,870
60	1,524	680	3,020	340	1,510
72	1,829	560	2,490	280	1,250
84	2,134	480	2,140	240	1,070
96	2,438	420	1,870	210	930
108	2,743	380	1,690	190	850
120	3,048	340	1,510	170	760

Table 3 - P5500 Trapeze Load Data

Span In	Span mm	Maximum Uniform Design Load Lbs.	Maximum Uniform Design Load N	Concentrated Load @ Center of Span Lbs	Concentrated Load @ Center of Span N
24	610	3,280	14,590	1,620	7,210
36	914	2,190	9,740	1,080	4,800
48	1,219	1,640	7,300	810	3,600
60	1,524	1,310	5,830	656	2,920
72	1,829	1,090	4,850	540	2,400
84	2,134	940	4,180	460	2,050
96	2,438	820	3,650	400	1,780
108	2,743	730	3,250	360	1,600
120	3,048	660	2,940	320	1,420

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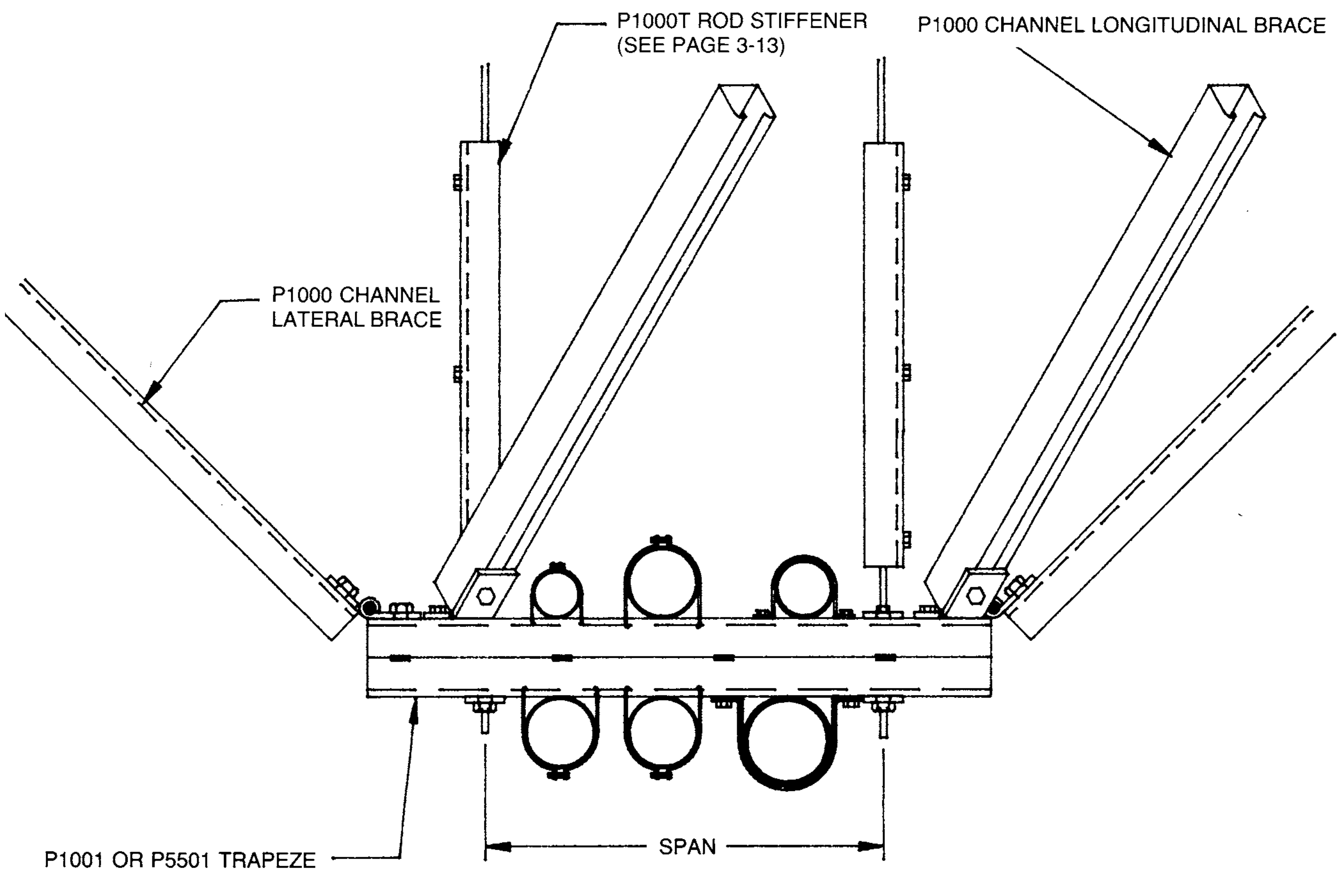

SEE TABLE 16, PAGE 6-6 FOR
COMPLETE TRAPEZE LOAD INFORMATION.

Table 4 - P1001-AW Trapeze Load Data

Span		Maximum Uniform Design Load		Concentrated Load @ Center of Span	
In	mm	Lbs.	N	Lbs	N
48	1,219	2,400	10,680	1,190	5,290
60	1,524	1,920	8,540	950	4,230
72	1,829	1,600	7,120	790	3,510
84	2,134	1,370	6,090	680	3,020
96	2,438	1,200	5,340	590	2,620
108	2,743	1,070	4,760	530	2,360
120	3,048	960	4,270	470	2,090

Table 5 - P5501-AW Trapeze Load Data

Span		Maximum Uniform Design Load		Concentrated Load @ Center of Span	
In	mm	Lbs.	N	Lbs	N
48	1,219	4,680	20,820	2,390	10,630
60	1,524	3,870	17,210	1,920	8,540
72	1,829	3,220	14,320	1,990	8,850
84	2,134	2,760	12,280	1,360	6,050
96	2,438	2,420	10,760	1,190	5,290
108	2,743	2,150	9,560	1,160	5,160
120	3,048	1,930	8,590	950	4,230

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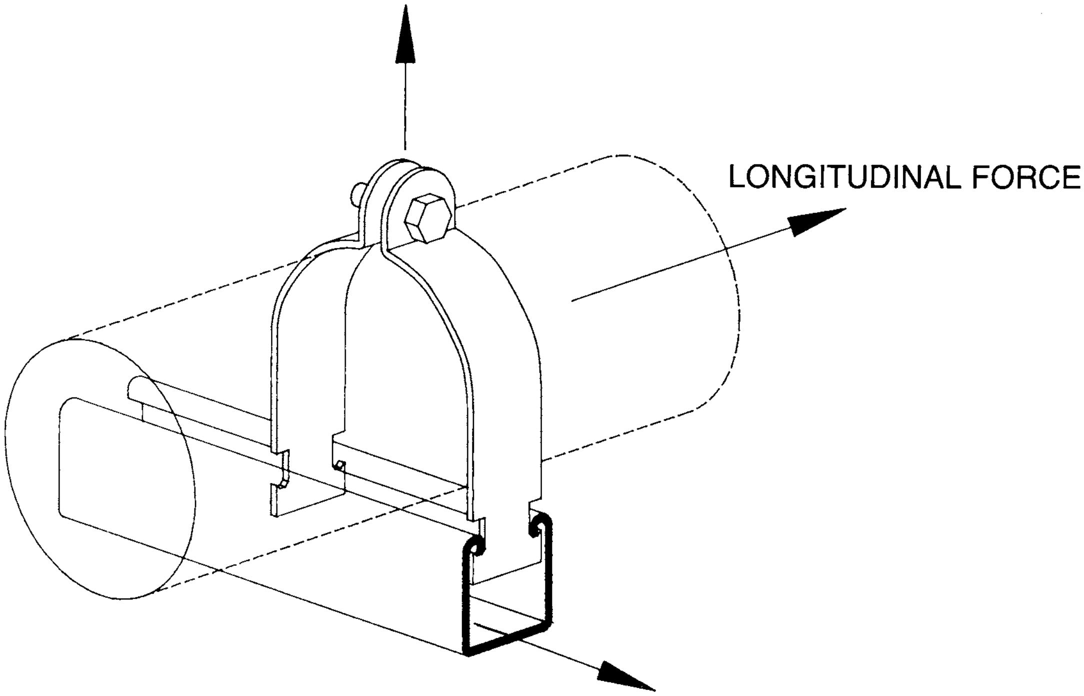

Table 6 – P1100 Series Pipe Clamps													
Unistrut Part Number	Pipe Size		Strap thickness		Screw Size		Design Loads Vertical Force		Transverse Force		Longitudinal Force		
	In.	mm	Ga.	mm	In.	mm	Lbs.	N	Lbs.	N	Lbs.	N	
P1111	½	13	16	1.5	¼	6	400	1,780	70	310	50	220	
P1112	¾	19	14	1.9	¼	6	600	2,670	100	440	70	310	
P1113	1	25	14	1.9	¼	6	600	2,670	150	670	80	360	
P1114	1 ¼	32	14	1.9	¼	6	600	2,670	150	670	150	670	
P1115	1 ½	38	12	2.7	¼	6	800	3,560	240	1,070	150	670	
P1117	2	51	12	2.7	¼	6	800	3,560	240	1,070	200	890	
P1118	2½	64	12	2.7	5⁄16	8	800	3,560	240	1,070	200	890	
P1119	3	76	12	2.7	5⁄16	8	800	3,560	240	1,070	200	890	
P1120	3½	89	11	3.0	⅜	10	1,000	4,450	320	1,420	200	890	
P1121	4	102	11	3.0	⅜	10	1,000	4,450	320	1,420	200	890	
P1123	5	127	11	3.0	⅜	10	1,000	4,450	320	1,420	200	890	
P1124	6	152	10	3.4	⅜	10	1,000	4,450	450	2,000	375	1,670	
P1126	8	203	10	3.4	⅜	10	1,000	4,450	550	2,450	500	2,220	

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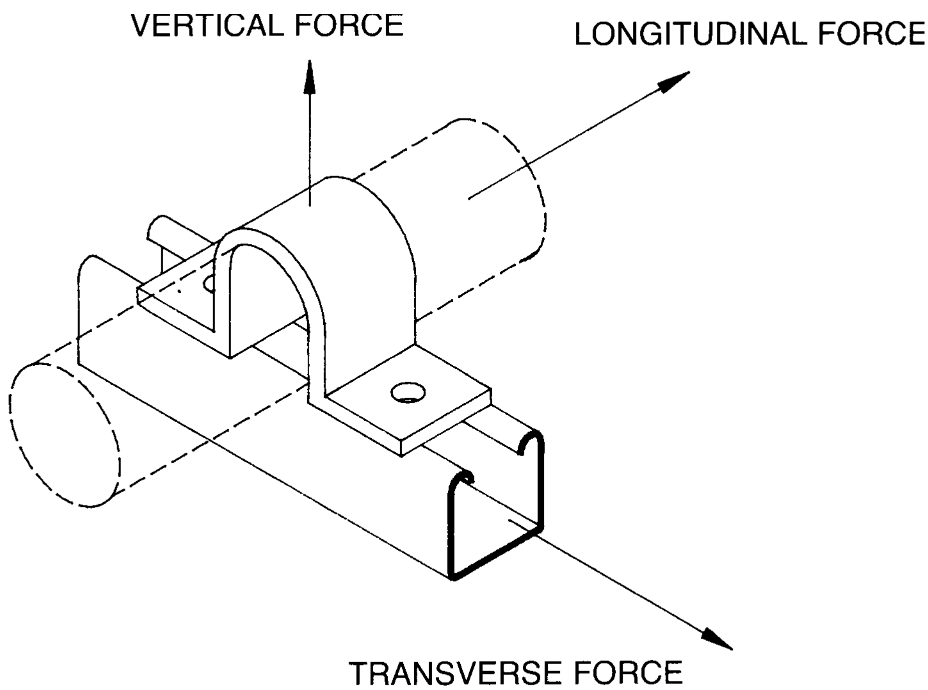

Table 7 – P2558 Series Pipe Clamps

Unistrut Part Number	Pipe Size In.	Pipe Size mm	Strap thickness Ga.	Strap thickness mm	Screw Size In.	Screw Size mm	Design Loads: Vertical Force Lbs.	Vertical Force N	Transverse Force Lbs.	Transverse Force N	Longitudinal Force Lbs.	Longitudinal Force N
P2558-05	½	13	⅛	3	¼	6	500	2,220	250	1,110	100	440
P2558-07	¾	19	⅛	3	¼	6	500	2,220	250	1,110	100	440
P2558-10	1	25	⅛	3	¼	6	500	2,220	250	1,110	100	440
P2558-12	1¼	32	⅛	3	¼	6	500	2,220	250	1,110	100	440
P2558-15	1½	38	⅛	3	¼	6	500	2,220	250	1,110	100	440
P2558-20	2	51	¼	6	⅜	10	1,000	4,450	1,000	4,450	200	890
P2558-25	2½	64	¼	6	⅜	10	1,000	4,450	1,000	4,450	200	890
P2558-30	3	76	¼	6	⅜	10	1,000	4,450	1,000	4,450	200	890
P2558-35	3½	89	¼	6	⅜	10	1,000	4,450	1,000	4,450	200	890
P2558-40	4	102	¼	6	⅜	10	1,000	4,450	1,000	4,450	200	890
P2558-50	5	127	¼	6	⅜	10	1,000	4,450	1,000	4,450	200	890
P2558-60	6	152	¼	6	⅜	10	1,000	4,450	1,000	4,450	375	1,670

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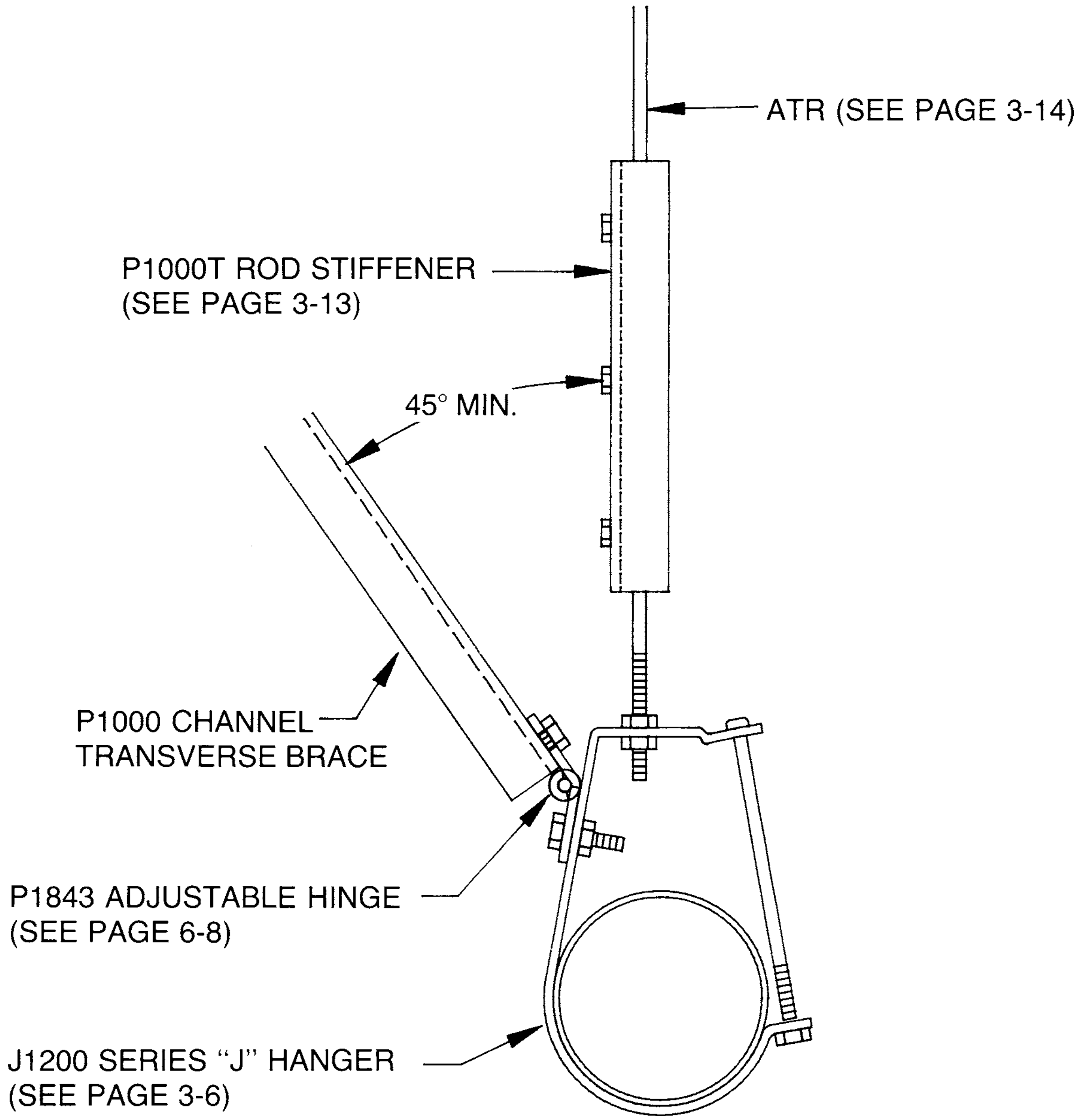

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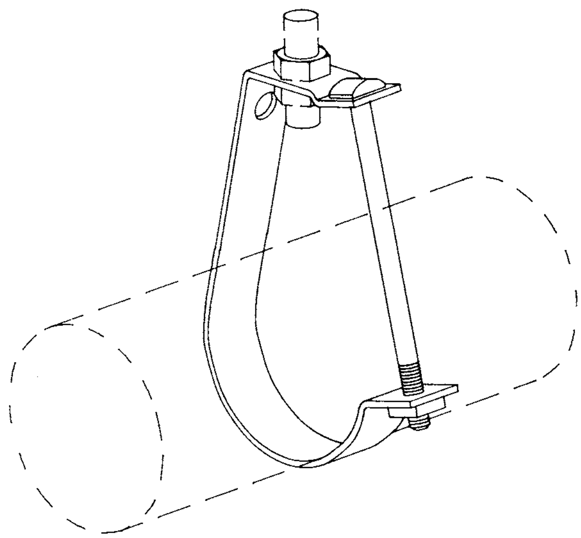

Table 8 – J1200 Series Pipe Clamps

Unistrut Part Number	Pipe Size In.	Pipe Size mm	Strap thickness Ga.	Strap thickness mm	Bolt Size In.	Bolt Size mm	Vertical Adjustment In.	Vertical Adjustment mm	Design Loads Lbs.	Design Loads N
J1205	½	13	⅛ x ¾	3 x 19	¼ x 2¼	6 x 57	⅞	22	300	1,330
J1207	¾	19	⅛ x ¾	3 x 19	¼ x 2¼	6 x 57	⅞	22	300	1,330
J1210	1	25	⅛ x ¾	3 x 19	¼ x 2¾	6 x 70	1	25	300	1,330
J1212	1¼	32	⅛ x ¾	3 x 19	¼ x 3¼	6 x 83	1 ⅜	35	300	1,330
J1215	1½	38	⅛ x ¾	3 x 19	¼ x 3½	6 x 89	1 ½	38	300	1,330
J1220	2	51	⅛ x ¾	3 x 19	¼ x 4	6 x 102	1 ⅝	41	300	1,330
J1225	2½	64	⅛ x 1¼	3 x 32	⅜ x 4½	10 x 114	1 ⅞	48	500	2,220
J1230	3	76	⅛ x 1¼	3 x 32	⅜ x 5	10 x 127	2 ⅞	73	500	2,220
J1235	3½	89	⅛ x 1¼	3 x 32	⅜ x 5½	10 x 140	2 ⅛	54	500	2,220
J1240	4	102	¼ x 1¼	6 x 32	⅜ x 6½	10 x 165	2 ¼	57	600	2,670
J1250	5	127	¼ x 1¼	6 x 32	⅜ x 7½	10 x 191	2 ¼	57	600	2,670
J1260	6	152	¼ x 1¼	6 x 32	⅜ x 8½	10 x 216	2 ⅝	67	600	2,670
J1280	8	203	¼ x 2	6 x 51	⅜ x 12	10 x 305	4 ⅝	117	700	3,110

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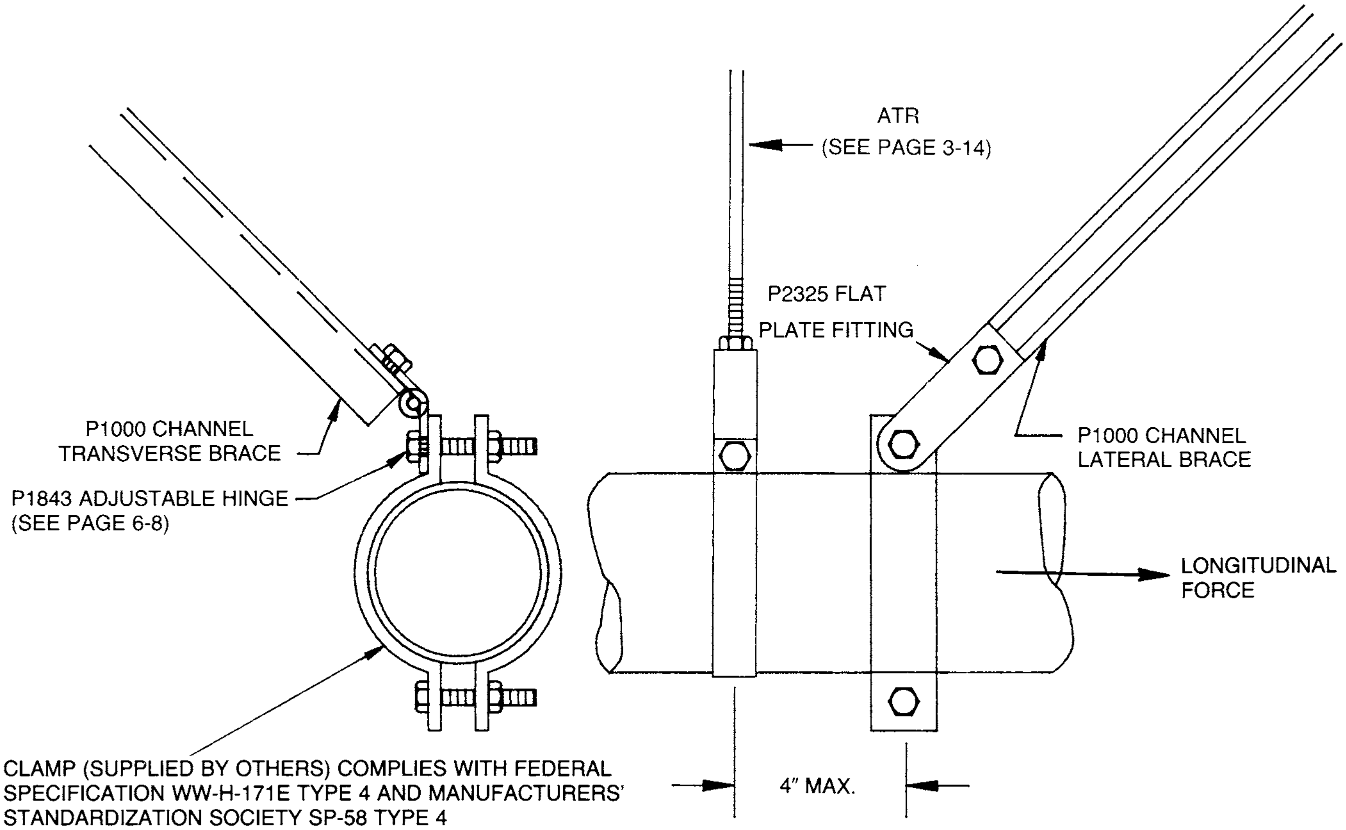

DESIGN LONGITUDINAL FORCE		
	Longitudinal Force	
Pipe Size	Lbs.	kN
½" thru 1½"	100	0.445
1¾" thru 5"	200	0.890
6"	375	1.670
8"	500	2.220

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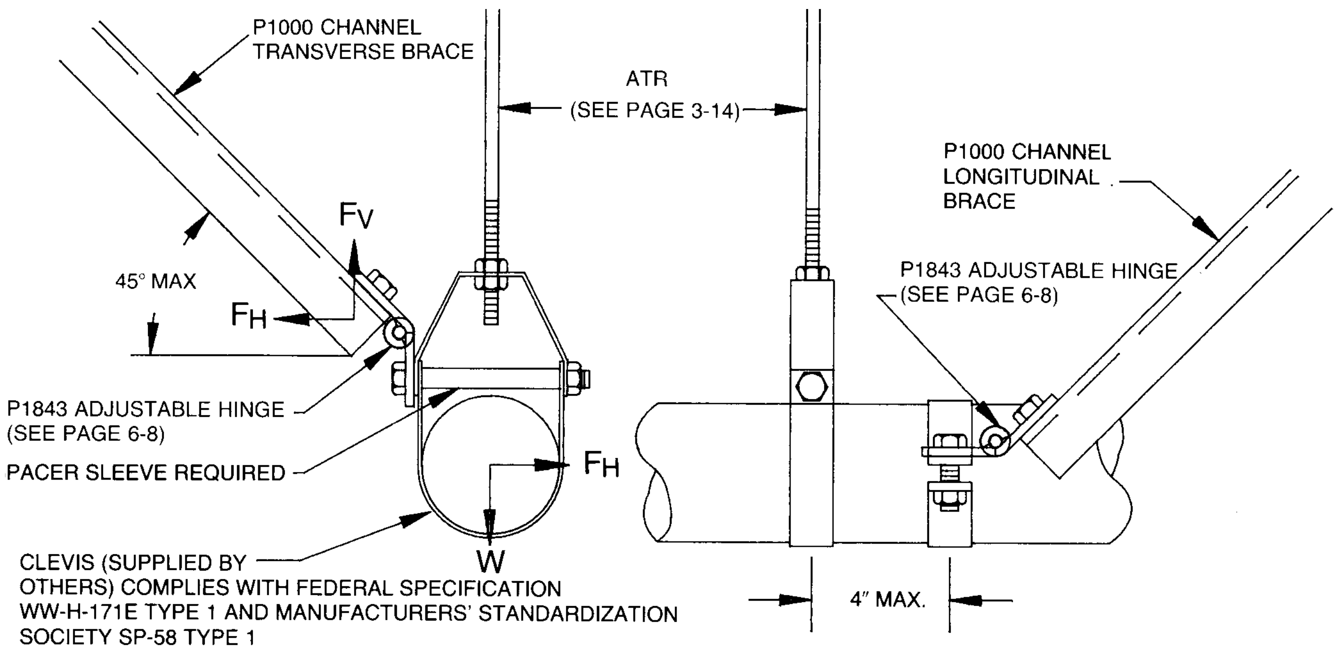

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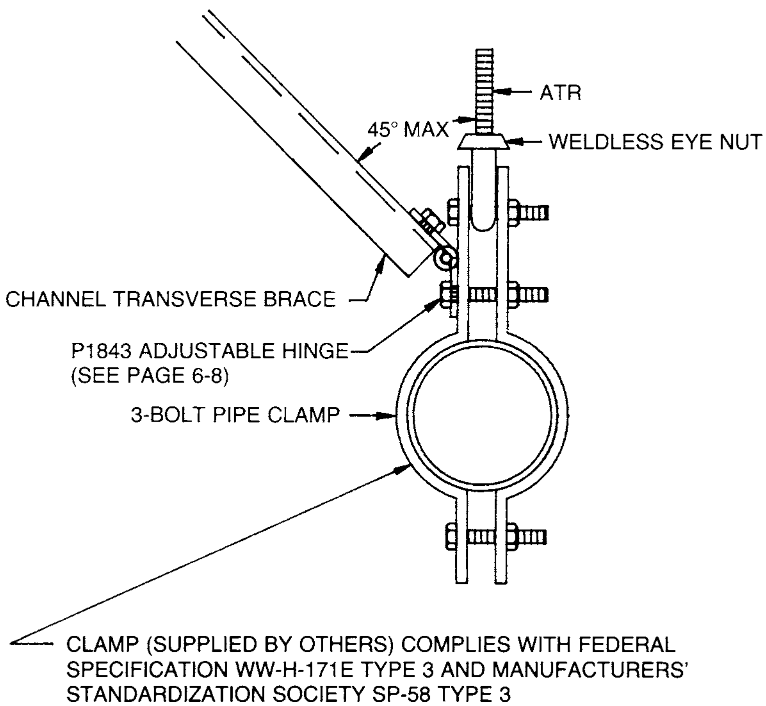
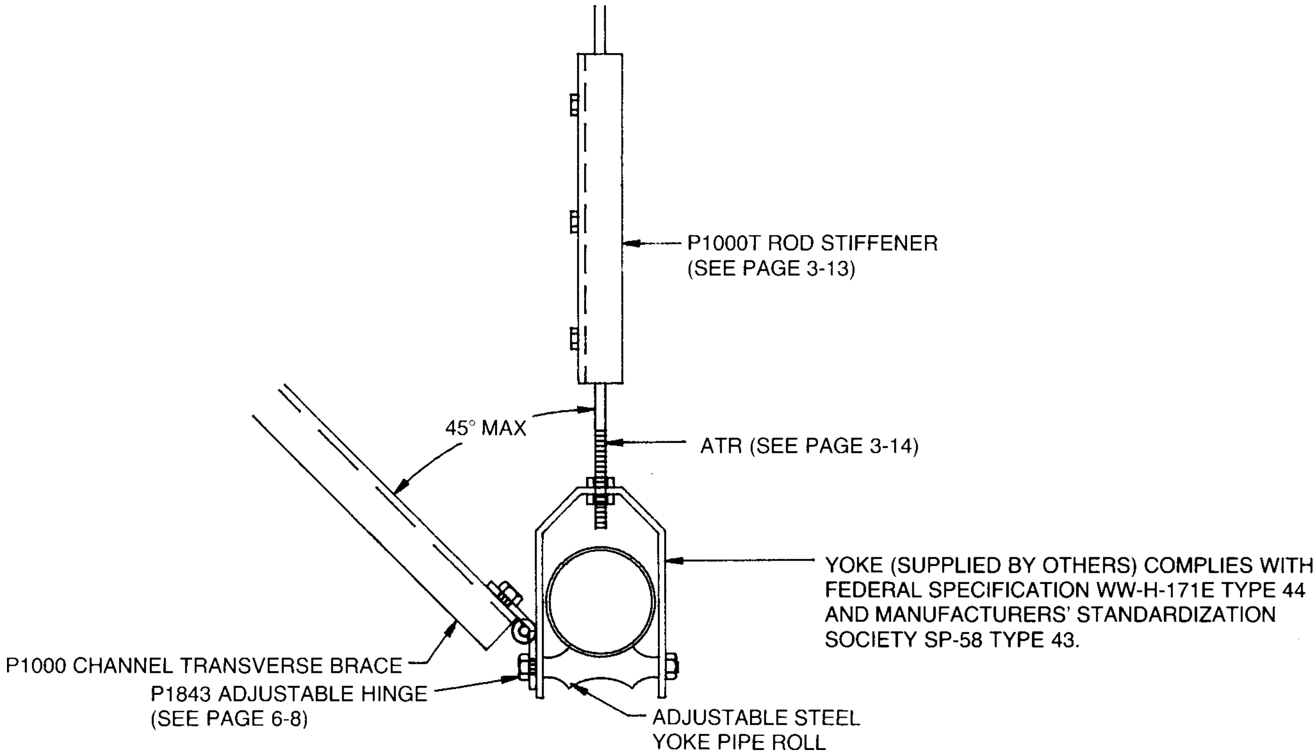
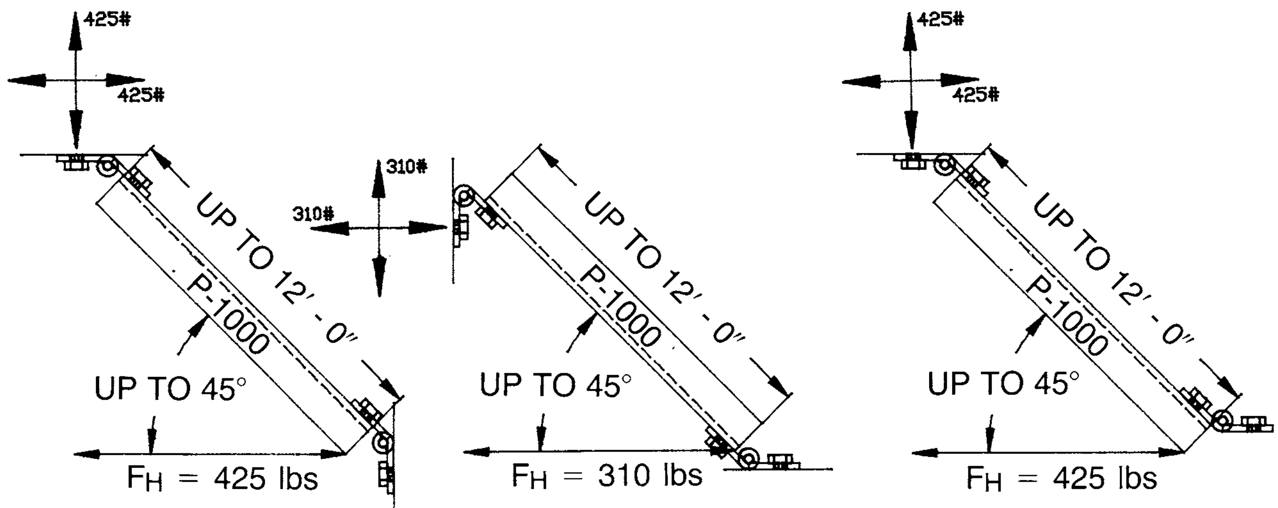
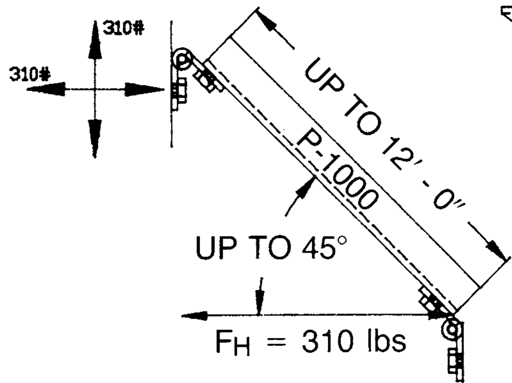

ATR
45° MAX
WELDLESS EYE NUT
P1000 CHANNEL TRANSVERSE BRACE
P1843 ADJUSTABLE HINGE
(SEE PAGE 6-8)
3-BOLT PIPE CLAMP
CLAMP (SUPPLIED BY OTHERS) COMPLIES WITH FEDERAL SPECIFICATION WW-H-171E TYPE 3 AND MANUFACTURERS' STANDARDIZATION SOCIETY SP-58 TYPE 3

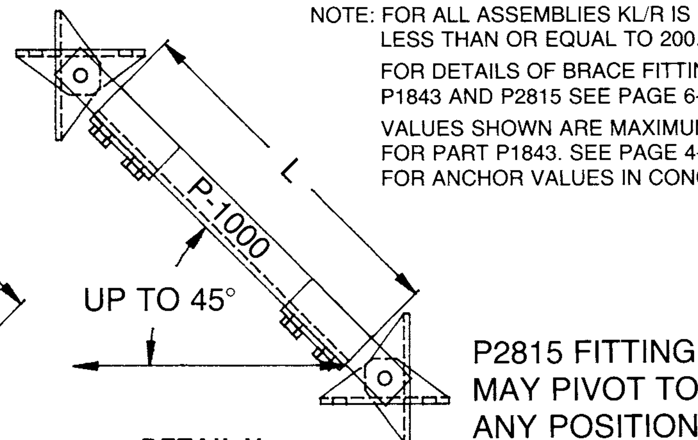

P1000T ROD STIFFENER
(SEE PAGE 3-13)
45° MAX
ATR (SEE PAGE 3-14)
YOKE (SUPPLIED BY OTHERS) COMPLIES WITH
FEDERAL SPECIFICATION WW-H-171E TYPE 44
AND MANUFACTURERS' STANDARDIZATION
SOCIETY SP-58 TYPE 43.
P1000 CHANNEL TRANSVERSE BRACE
P1843 ADJUSTABLE HINGE
(SEE PAGE 6-8)
ADJUSTABLE STEEL
YOKE PIPE ROLL



DETAIL I **DETAIL II** **DETAIL III**



DETAIL IV



DETAIL V

NOTE: FOR ALL ASSEMBLIES KL/R IS LESS THAN OR EQUAL TO 200.

FOR DETAILS OF BRACE FITTINGS P1843 AND P2815 SEE PAGE 6-8.

VALUES SHOWN ARE MAXIMUM FOR PART P1843. SEE PAGE 4-5 FOR ANCHOR VALUES IN CONCRETE

L Ft.	F_H Lbs.	R_V Lbs.	R_H Lbs.	P2815 Connect To
6 8 9	2,000 1,590 1,250	1,000 795 625	1,000 795 625	P3200 Series Concrete Insert (Page 6-2)
9 MAXIMUM	1,000	500	500	Concrete Anchors (Page 5-1)

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Chart 1 - SUPPORT BRACING

1. Standard Pipe Size	In	½	1	1	1 ½	2	2 ½	3	4	6	8
Schedule 40 Pipe	mm	13	19	25	38	51	64	76	102	152	203
2. Minimum Threaded	In	⅜	0	⅜	⅜	⅜	½	½	⅝	¾	⅞
Rod Size	mm	10	10	10	10	10	13	13	16	19	22
3. Maximum Spacing of	Ft	7	7	7	9	10	11	12	14	17	19
Vertical Supports	m	2.13	2.13	2.13	2.74	3.05	3.35	3.66	4.27	5.18	5.79
4. Maximum Brace Spacing	Ft	N/A	N/A	14	18	20	22	24	28	17	19
	m			4.27	5.49	6.10	6.71	7.32	8.53	5.18	5.79
5. Weight of Pipe	Lbs/Ft	0.98	1	2.05	3.6	5.11	7.87	10.78	16.31	31.51	50.29
Plus Water	Kg/m	1.46	2.02	3.05	5.36	7.60	11.71	16.04	24.27	46.89	74.84
6. Maximum Hanger	Lbs	7	10	14	32	51	87	129	228	536	956
Rod Load (W)	N	31.1	44.5	62.3	142	227	387	574	1,014	2,384	4,252
7. Horizontal Seismic	Lbs	7	10	14	32	51	87	129	228	268	478
Force (Fh)	N	31.1	44.5	62.3	142	227	387	574	1,014	1,192	2,126
8. Maximum Tension in	Lbs	14	20	28	64	102	174	258	456	804	1,434
Rod (W + Fh)	N	62.3	89	124.6	284	453	774	1,148	2,028	3,576	6,379
9. Brace Selection Details (See Page 3-11)		I-V	I-V	I-V	I-V	I-V	I-V	I-V	I-V	I-V	Use Two Braces or Shorter Spacing

Notes:
1. Minimum rod sizes (row 2) are as given in MSS SP-69.
2. Spacing of vertical supports (row 3) is as given in ANSIASME B31.1-1986 Table 121.5 "Suggested Pipe Support Spacing".
3. Transverse brace spacing (row 4) has been determined to keep bending stresses in the pipe during a seismic event below 4000 PSI.
4. Maximum hanger rod load (row 6) equals (row 3) x (row 5).
5. Horizontal seismic force (row 7) equals (row 4) x (row 5) x 0.5 (Seismic Factor).
6. Chart must be applied separately to main line or branch piping.

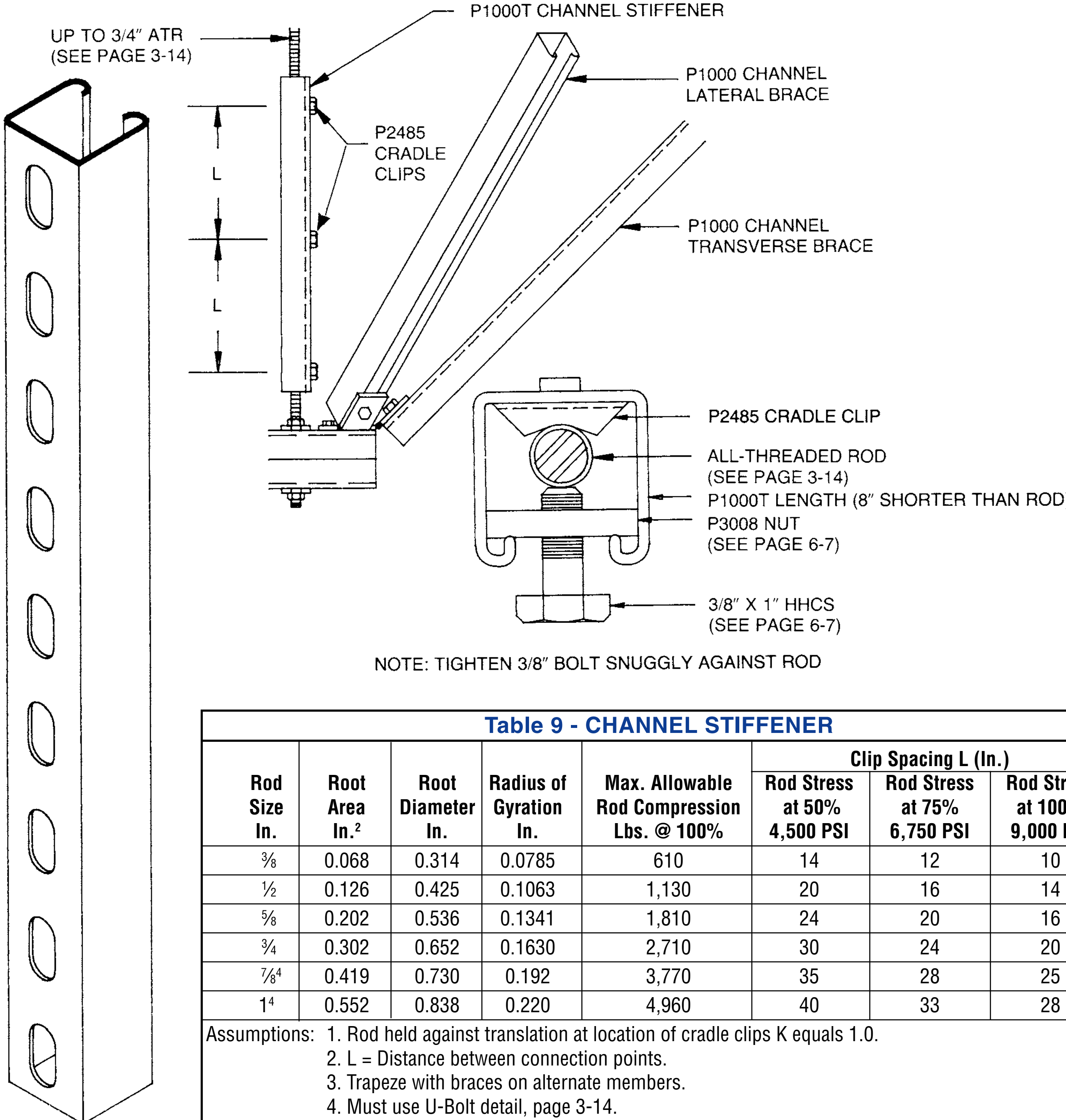

Table 9 - CHANNEL STIFFENER

Rod Size In.	Root Area In.^{2}	Root Diameter In.	Radius of Gyration In.	Max. Allowable Rod Compression Lbs. @ 100%	Clip Spacing L (In.) Rod Stress at 50% 4,500 PSI	Rod Stress at 75% 6,750 PSI	Rod Stress at 100% 9,000 PSI
⅜	0.068	0.314	0.0785	610	14	12	10
½	0.126	0.425	0.1063	1,130	20	16	14
⅝	0.202	0.536	0.1341	1,810	24	20	16
¾	0.302	0.652	0.1630	2,710	30	24	20
⅞[4]	0.419	0.730	0.192	3,770	35	28	25
1[4]	0.552	0.838	0.220	4,960	40	33	28

Assumptions:
1. Rod held against translation at location of cradle clips K equals 1.0.
2. L = Distance between connection points.
3. Trapeze with braces on alternate members.
4. Must use U-Bolt detail, page 3-14.

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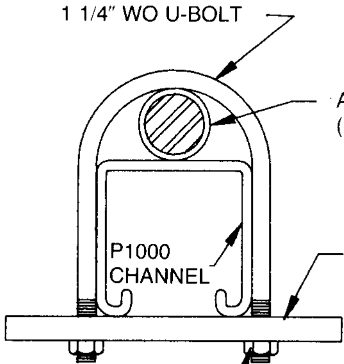
USE FOR 7/8″ & 1″ DIAMETER ATR
(REF. TABLE 9, PAGE 3-13)



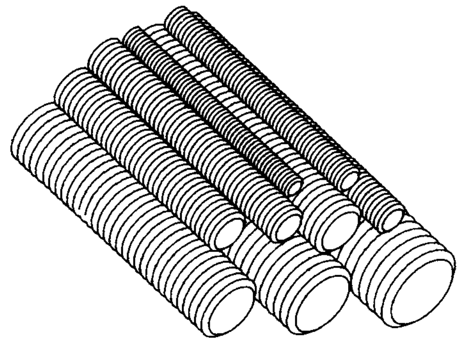


Table 10
CARRYING CAPACITIES OF THREADED ROD
per ASTM A35, A575 or A576
Hot Rolled Carbon Steel

Root Dia.	Maximum Safe Load*		Maximum Safe Force During Seismic Event**	
In.	Lbs.	kN	Lbs.	kN
⅜	610	2.71	810	3.60
½	1,130	5.03	1500	6.67
⅝	1,810	8.05	2410	10.72
¾	2,710	12.05	3610	16.06
⅞	3,770	16.77	5030	22.37
1	4,960	22.06	6610	29.40

Notes: * Loads are based on the root area of the thread and at a stress of 9,000 PSI.
** Safe seismic forces are determined by increasing allowable safe loads by 33%

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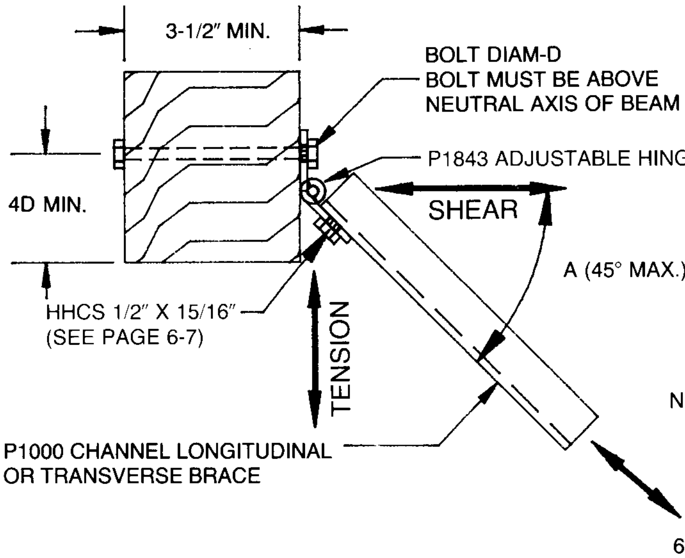
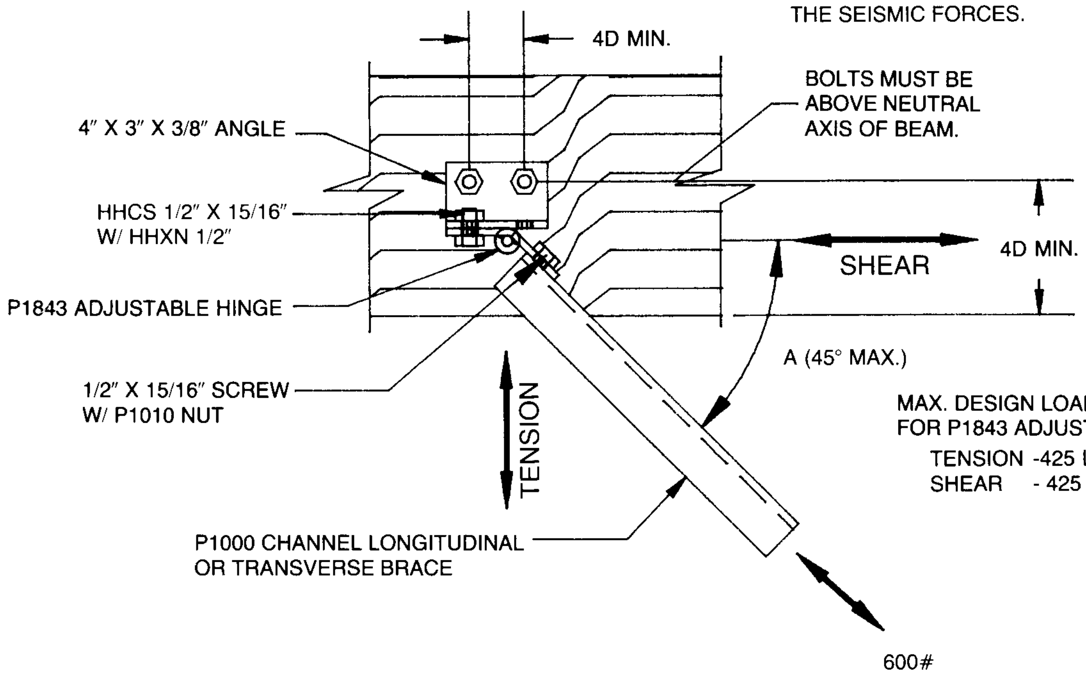


MAX. DESIGN LOADS
FOR P1843 ADJUSTABLE HINGE:
TENSION - 425 LBS.
SHEAR - 425 LBS.

NOTE:
1) ABOVE DETAILS INDICATE HOW BRACES MAY BE ATTACHED TO THE STRUCTURE. IF BRACE ANGLE (A) IS GREATER THAN 45° WITH THE HORIZONTAL, ALLOWABLE LOADING MUST BE DETERMINED BY THE PROJECT ENGINEER.
2) LOADING GIVEN IS BASED ON CAPACITY OF P1843. THE PROJECT ENGINEER SHALL DETERMINE THAT THE WOOD MEMBERS AND ATTACHMENTS ARE ADEQUATE TO RESIST THE SEISMIC FORCES.



MAX. DESIGN LOADS
FOR P1843 ADJUSTABLE HINGE:
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SHEAR - 425 LBS.

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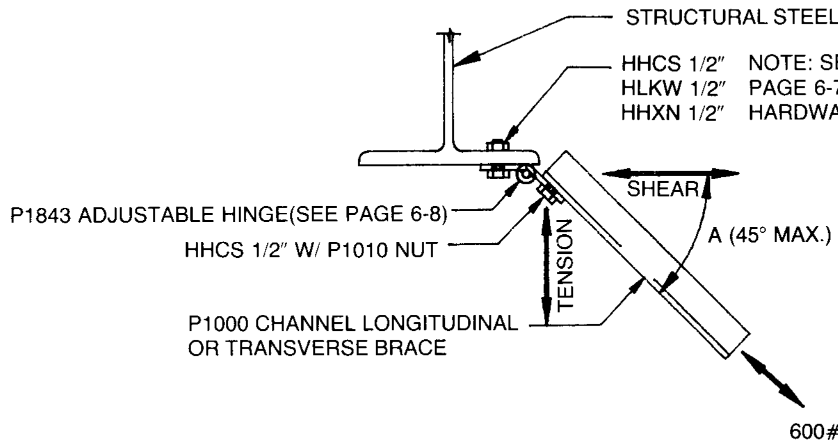
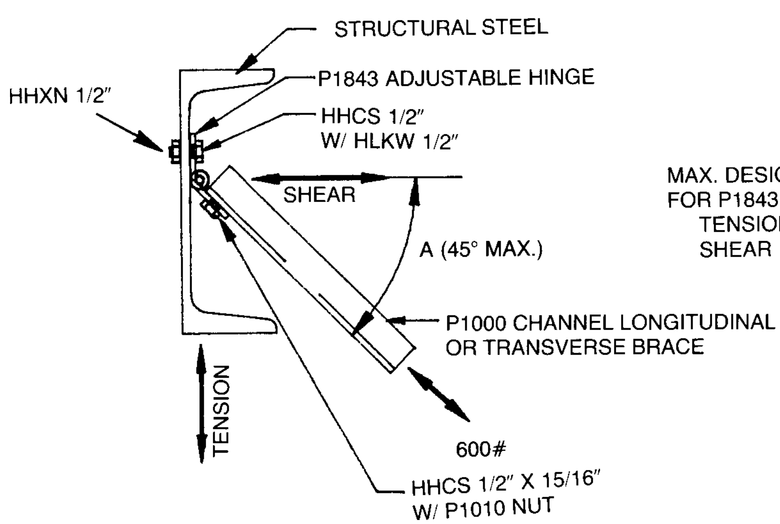


MAX. DESIGN LOADS
FOR P1843 ADJUSTABLE HINGE:
TENSION - 425 LBS.
SHEAR - 425 LBS.

NOTE:
1) ABOVE DETAILS INDICATE HOW BRACES MAY BE ATTACHED TO THE STRUCTURE. IF BRACE ANGLE (A) IS GREATER THAN 45° WITH THE HORIZONTAL, ALLOWABLE LOADING MUST BE DETERMINED BY THE PROJECT ENGINEER.
2) THE PROJECT ENGINEER SHALL DETERMINE THAT THE STEEL MEMBERS ARE ADEQUATE TO RESIST THE SEISMIC FORCES.



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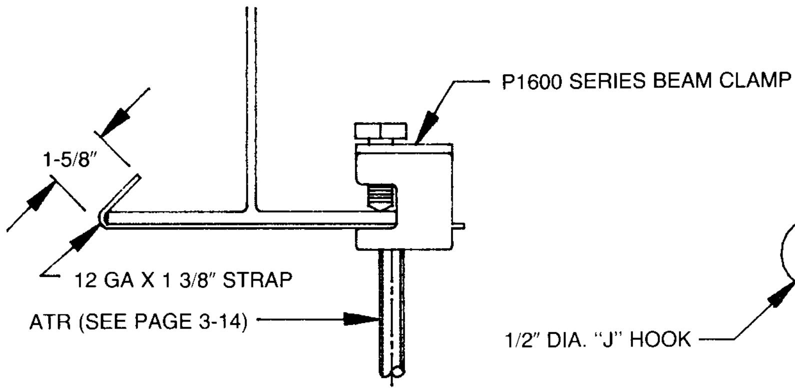

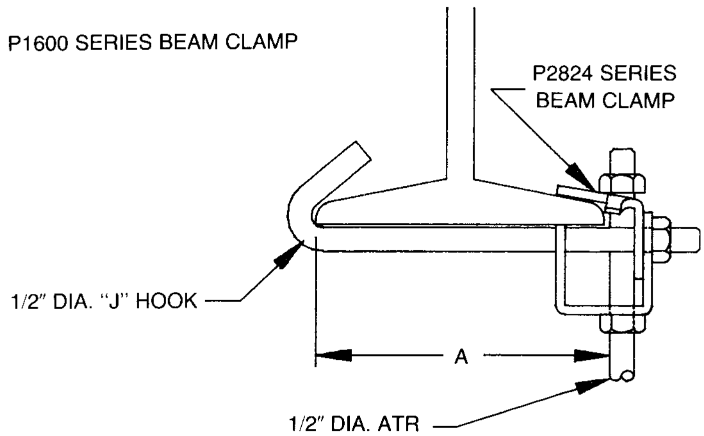

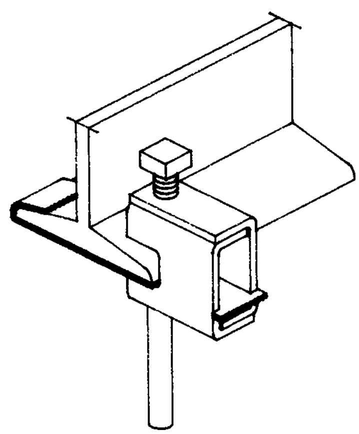

Clamp No.	Rod Size	Set SC. Size	Design Load
P1649AS	⅜"	⅜"	650#
P1650AS	½"	½"	1,100#
P1651AS	⅝"	½"	1,600#

Strap No.	"A" Dim.
P1656A	6"
P1657A	9"
P1658A	12"

Design Load - 500#	
Clamp No.	**"A" Dim.**
P2824-6	2 ½" TO 6"
P2824-9	5 ½" TO 9"
P2824-12	8 ½" TO 12"

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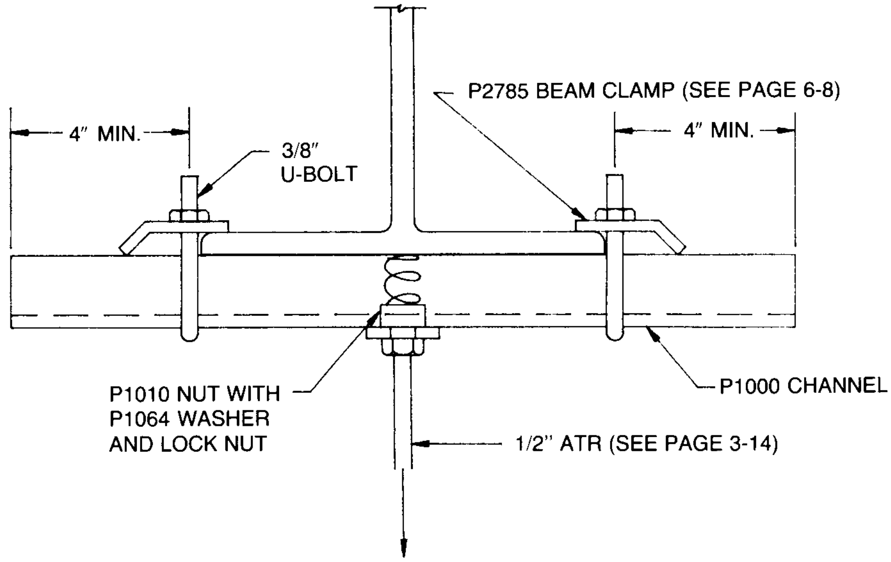
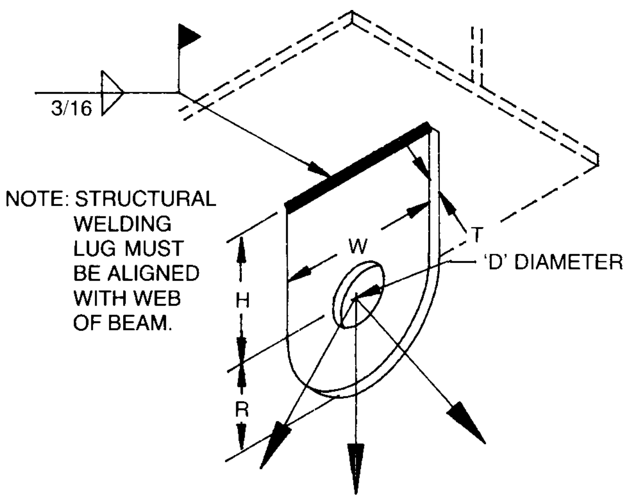


NOTE: THE ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STEEL BEAMS.

Structural Welding Lug



Approvals: Complies with Manufactures' Standardization Society SP-69 Type 57.

Design Load: 1130 Lbs. (5.02kN). Load must be in plane of welding lug.

Note: Welding shall be performed by qualified welders and shall be inspected by an independent laboratory. Support the existing beam while field welding lug.

Hole Dia.	D	11⁄16"	17mm
	H	1-½"	38mm
	R	1-¼"	32mm
	T	¼"	6mm
	W	2-½"	64mm

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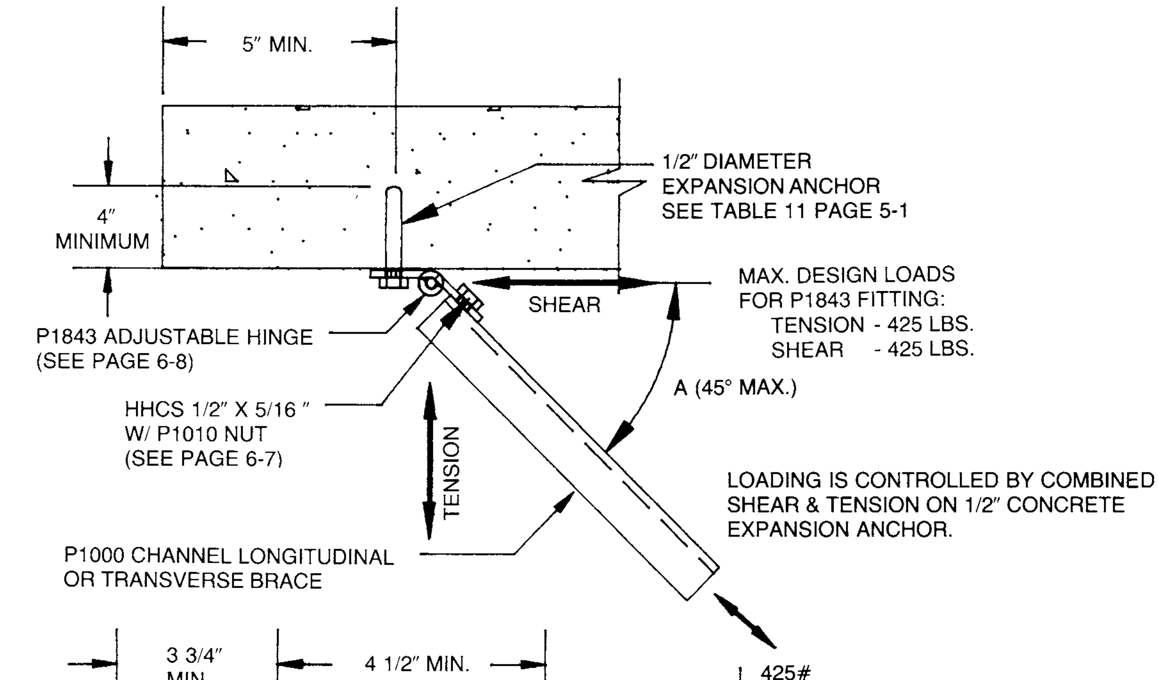

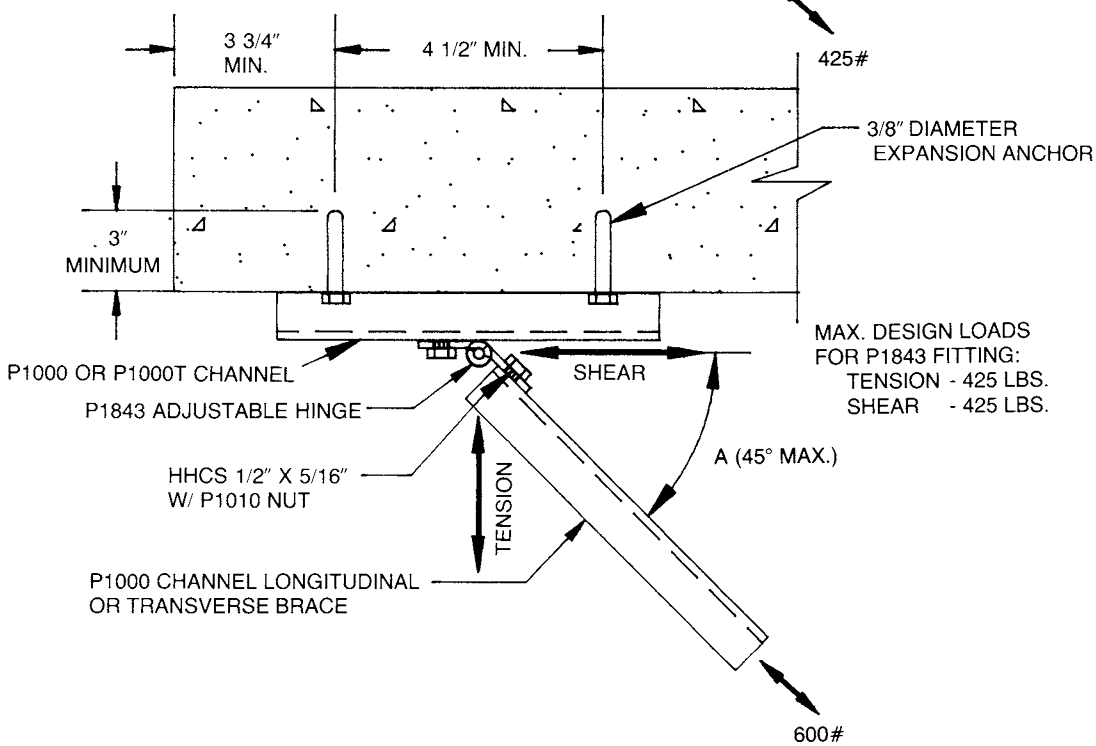

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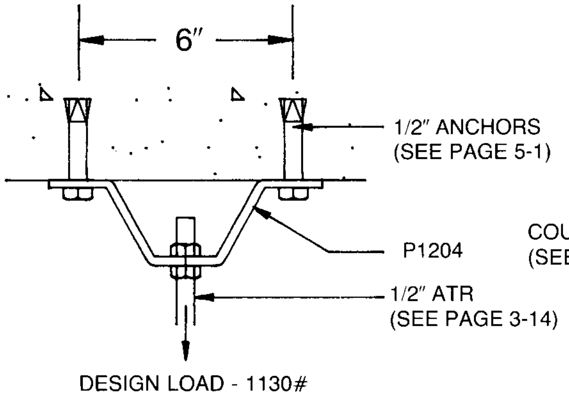
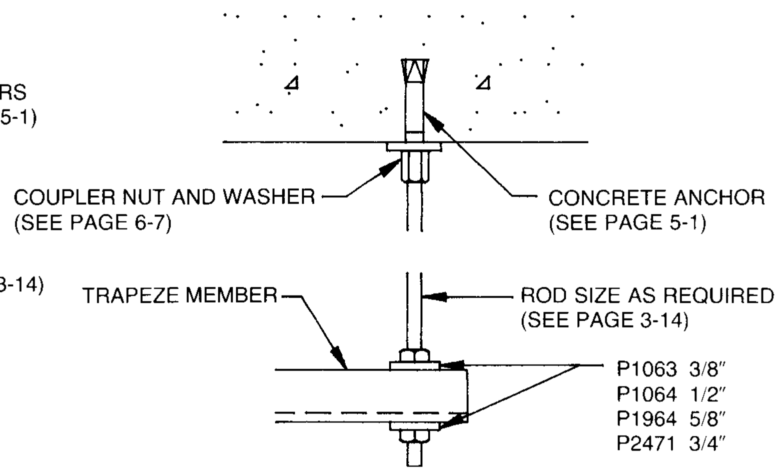
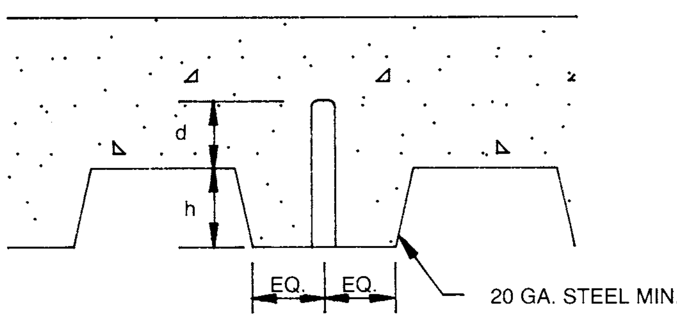




TYPICAL EXPANSION ANCHOR – In Metal Deck Form Work



d = LARGER OF 1 1/2″
OR (3 1/2″ - h/3)

WHEN INSTALLING ANCHORS IN METAL DECK THEY SHOULD BE PLACED IN THE BOTTOM OF THE FLUTES AS SHOWN ABOVE.

Table 11
ALLOWABLE LOADS1 FOR KWICKBOLT II CONCRETE ANCHORS by Hilti, Inc., Tulsa, Oklahoma

Allowable Diameter In.	Depth of Embedment In.	Design Loads (fc = 3,000 PSI) With Special Inspections		Proof Test[3] Load Lbs.	Torque Ft./Lbs.
		Tension[2] Lbs.	Shear Lbs.		
⅜	1⅝*	300	975	1,100	20
⅜	2½	600	1,100	1,100	25
½	2¼*	480	1,840	2,000	30
½	3½	1,000	1,470	2,000	45
⅝	2¾*	845	2,300	2,300	95
¾	3¼*	1,040	3,100	3,700	150

*Only long-thread style KB-11 anchors installed at this embedment depth

Table 12
ALLOWABLE LOADS[1] FOR ITW RAMSET/RED HEAD WEDGE ANCHORS by Ramset/Red Head, Michigan City, Indiana

Allowable Diameter In.	Depth of Embedment In.	Design Loads (fc = 3,000 PSI) With Special Inspections		Proof Test[3] Load Lbs.	Torque Ft./Lbs.
		Tension[2] Lbs.	Shear Lbs.		
⅜	1⅝	240	495	1,100	25
⅜	3	580	814	1,100	25
½	2¼	610	952	2,000	55
½	4⅛	890	1,445	2,000	55
⅝	2¾	860	1,425	2,300	90
¾	3¼	1,120	2,380	3,700	175
⅞	3¾	1,500	2,975	4,500	250

[1]The tabulated tension and shear values are for anchors installed in stone aggregate concrete having a minimum compressive strength of 3000 PSI at the time of installation. Concrete aggregate must comply with UBC Standard No. 26-2. Allowable loads are based on allowable loads listed in the ICBO Reports 4627 dated February 2001 and 1372 dated March 2000. Tabulated loads are for anchors installed in the tension (underside) zone of structural members (beams and slabs) and have been reduced to 80% shear per OSHPD guidelines. Anchor diameter refers to the thread size.

[2]These tension values are only applicable when the anchors are installed with special inspection as set forth in section 306 of the Uniform Building Code and apply to anchors installed a minimum of 12 diameters on center and a minimum edge distance of 10 diameters. When installing anchors in tension zone of concrete, see OSHPD IR26-6.

[3]Fifty percent of the drilled-in expansion type anchor bolts shall be proof tested to the tabulated proof test load.

[4]See page 5-2 for combined shear and tension interaction.

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Table 13 ALLOWABLE LOADS[1&2] FOR ITW RAMSET/RED HEAD WEDGE ANCHORS by ITW Ramset/Red Head, Michigan City, Indiana Lightweight Aggregate Concrete					
Allowable Diameter In.	Depth of Embedment In.	Design Loads (fc = 3,000 PSI) With Special Inspections		Proof Test[3] Load Lbs.	Torque Ft./Lbs.
		Tension[2] Lbs.	Shear Lbs.		
3⁄8	1 11⁄16	265	745	1,100	25
½	2¼	450	1,408	2,000	45
5⁄8	2 13⁄16	750	1,840	2,300	95
¾	3⅜	895	2,520	3,700	175

[1] The tabulated shear and tensile values are for anchors installed in lightweight aggregate concrete having the designated ultimate compressive strength at the time of installation.

[2] The tabulated values are for anchors installed at a minimum of 12 diameters on center and a minimum edge distance of six-diameters for 100 percent anchor efficiency. Spacing and edge distance may be reduced to six-diameter spacing and three-diameter edge distance, provided the values are reduced 50 percent. Linear interpolation may be used for intermediate spacing and edge margins.

[3] These tension values are applicable only when the anchors are installed with special inspection as set forth in section 306 of the code. When installing anchors in tension zone of concrete, see OSHPD 1626-6.

[4] Combined tension and shear interaction shall be checked as follows:

$$\frac{\text{Actual Shear}}{\text{Allowable Shear}} + \frac{\text{Actual Tension}}{\text{Allowable Tension}} \leq 1.0$$

If any anchor fails testing, test all anchors of the same category not previously tested until twenty (20) consecutively pass, then resume the initial testing frequency.

Apply proof test loads to anchors without removing the nut if possible. If not, remove nut and install a threaded coupler to the same tightness of the original nut using a torque wrench and apply load.

Reaction loads from test fixtures may be applied close to the anchor being tested, provided the anchor is not restrained from withdrawing by the fixture(s).

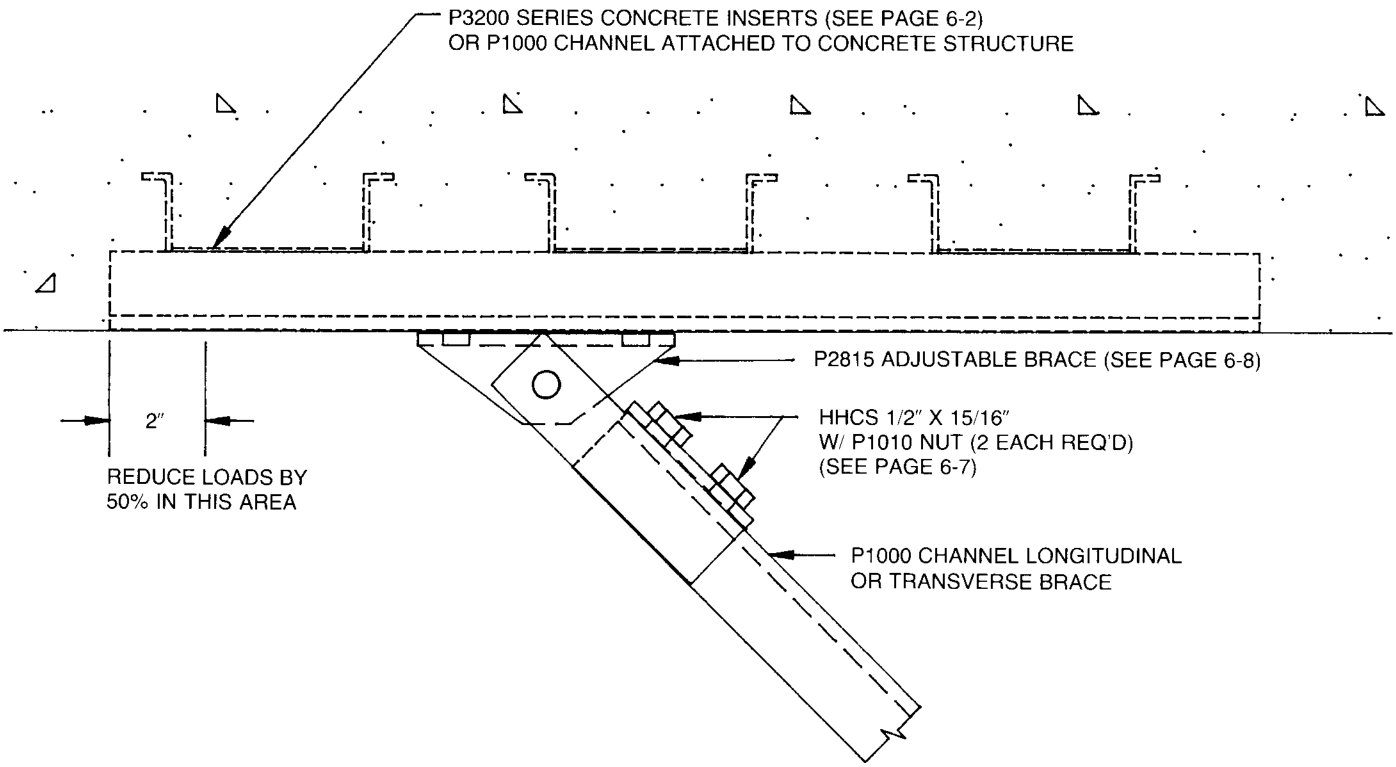
Test equipment is to be calibrated by an approved testing laboratory in accordance with standard recognized procedures.

The following criteria apply for the acceptance of installed anchors:

> **Hydraulic Ram Method:** The anchor should have no observable movement at the applicable test load. For wedge and sleeve type anchors, a practical way to determine observable movement is that the washer under the nut becomes loose.
>
> **Torque Wrench Method:** For wedge anchors, the applicable test torque must be reached within one-half (½) turn of the nut.

Testing should occur a minimum of 24 hours after installation of the subject anchors.

When installing drilled-in anchors and/or power driven pins in existing non-prestressed reinforced concrete, use care and caution to avoid cutting or damaging the existing reinforcing bars. When installing them into existing prestressed concrete (pre- or post-tensioned), locate the prestressed tendons by using a non-destructive method prior to installation. Exercise extreme care and caution to avoid cutting or damaging the tendons during installation. Maintain a minimum clearance of one inch between the reinforcement and the drilled-in anchor and/or pin.



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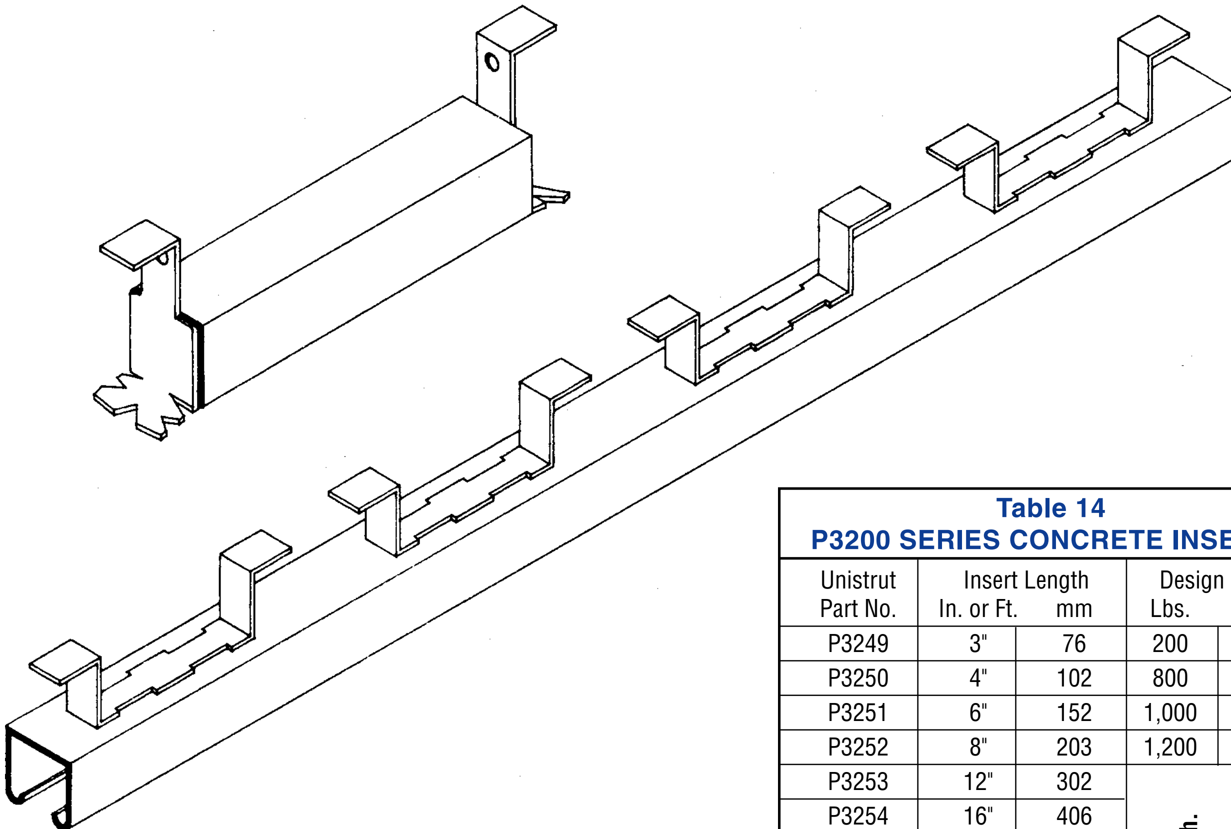

NOTE: RECOMMENDED LOADING ON INSERTS IN 3000 PSI CONCRETE. SUFFICIENT CONCRETE MUST SURROUND INSERTS TO CONFORM TO DESIGN SHEER STRESS. THE DISTANCE BETWEEN THE INSERT CENTERLINE AND THE CONCRETE EDGE MUST BE A MINIMUM OF 3".

VALUES IN TABLE 14 ARE BASED ON A SAFETY FACTOR OF 3 TO 1. FOR INSTALLATION IN HOSPITALS, MULTIPLY DESIGN LOAD FROM TABLE 14 BY 3/5. WHEN INSTALLING IN UNDER-SIDE OF SLAB, MULTIPLY DESIGN LOAD FROM TABLE 14 BY ⅜.

Table 14
P3200 SERIES CONCRETE INSERTS

Unistrut	Insert Length		Design Load	
Part No.	In. or Ft.	mm	Lbs.	kN
P3249	3"	76	200	2
P3250	4"	102	800	3.5
P3251	6"	152	1,000	4.4
P3252	8"	203	1,200	5.3
P3253	12"	302	2,000 Lbs. (8.9 kN) Load Allowed in Each Foot of Length.	Reduce to 1,000 Lbs. (4.4 kN) Load within 2" of Each End.
P3254	16"	406		
P3255	20"	508		
P3256	24"	610		
P3257	32"	813		
P3257A	36"	914		
P3258	40"	1,016		
P3259	4'	1,224		
P3260	5'	1,524		
P3261	6'	1,824		
P3262	7'	2,136		
P3263	8'	2,436		
P3264	9'	2,748		
P3265	10'	3,048		
P3266	12'	3,660		
P3267	14'	4,272		
P3268	16'	4,872		
P3269	18'	5,484		
P3270	20'	6,096		

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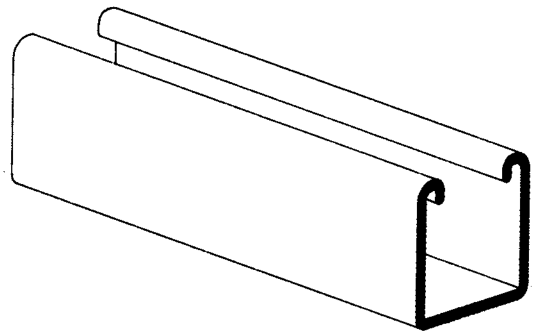
P1000



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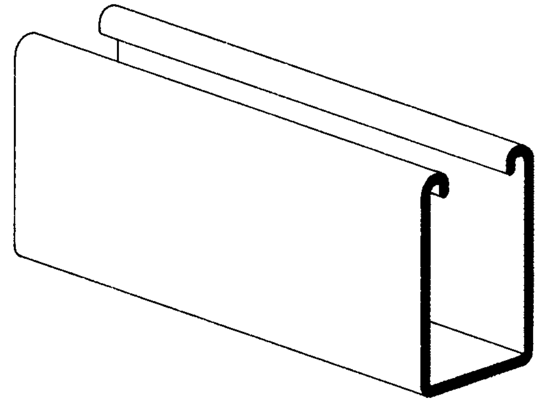

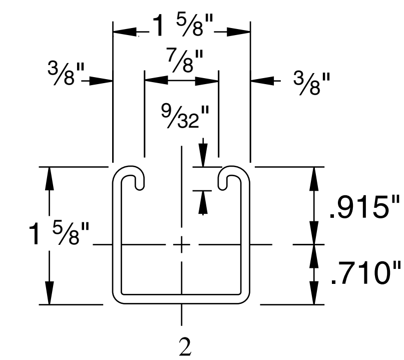

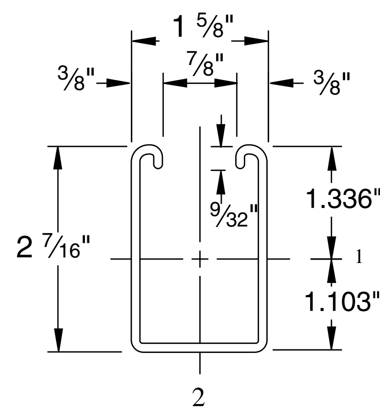

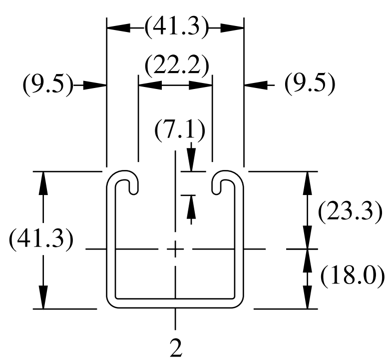

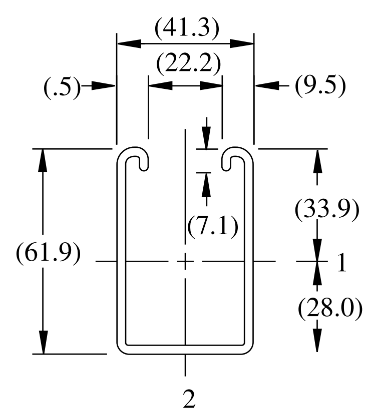

NOTE: CHANNEL WALL THICKNESS IS 12GA. (.105")
UNITS IN PARENTHESIS ARE METRIC

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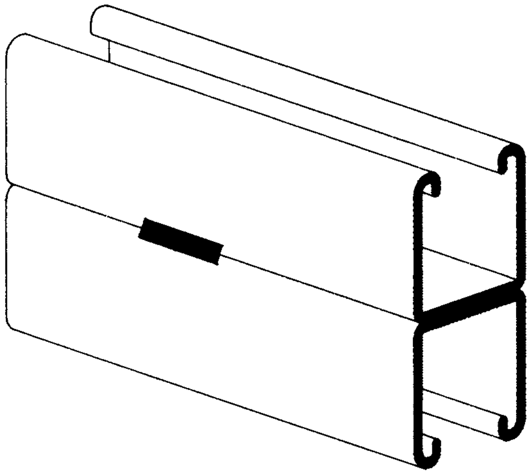
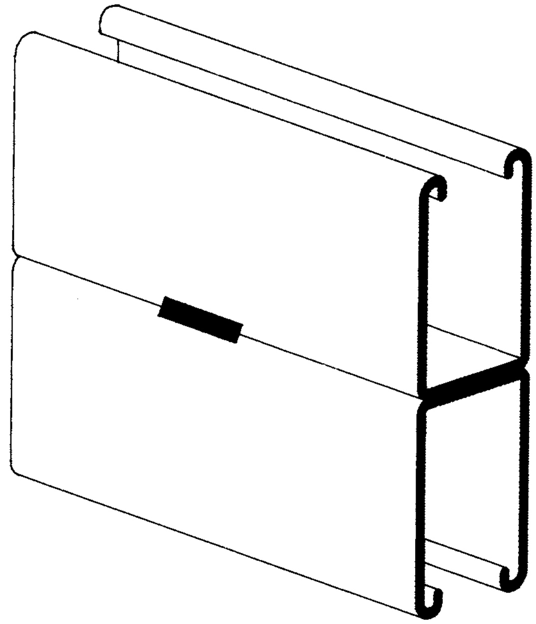
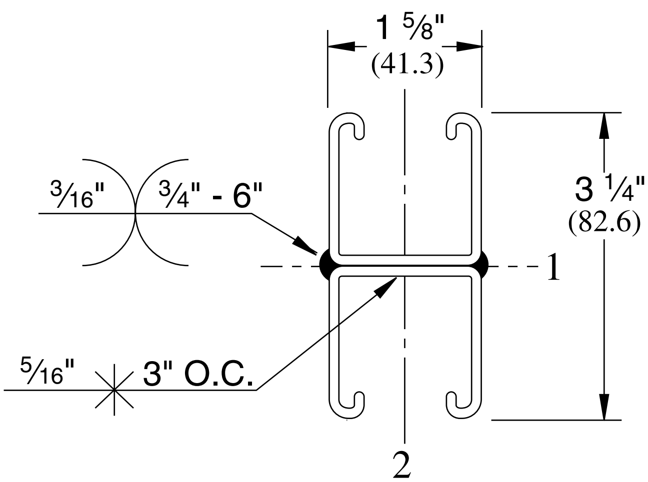
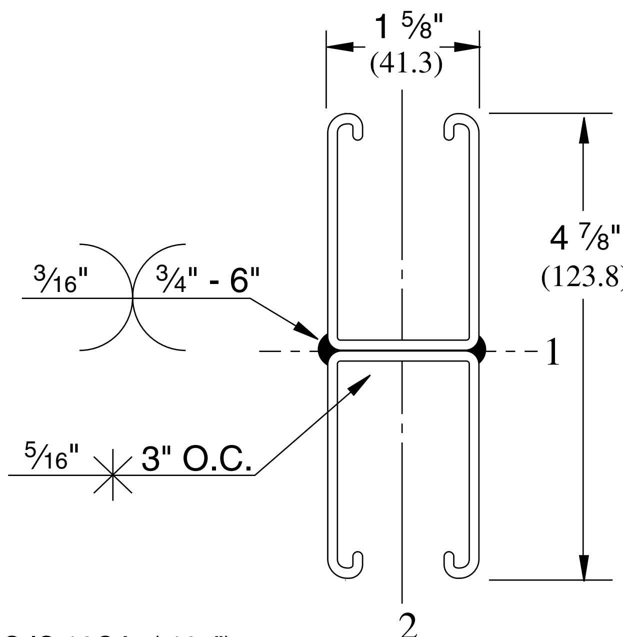
P1001AW

P5501AW









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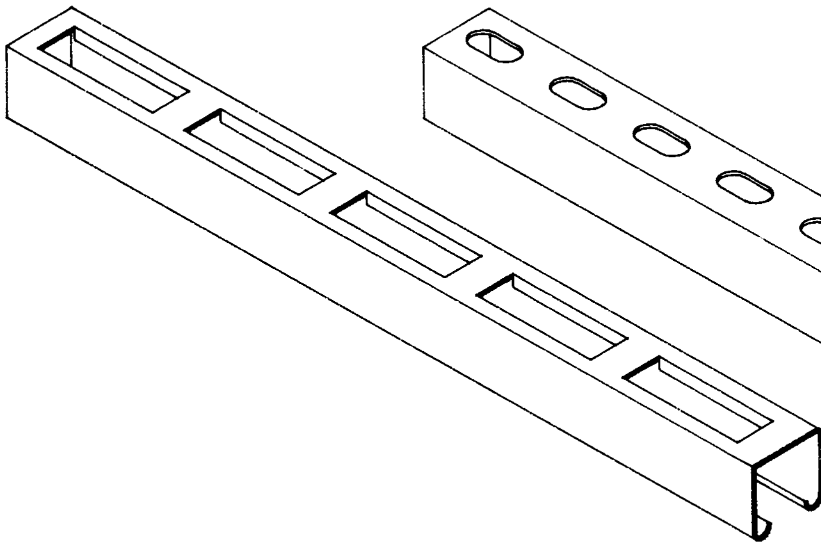
P1000DS



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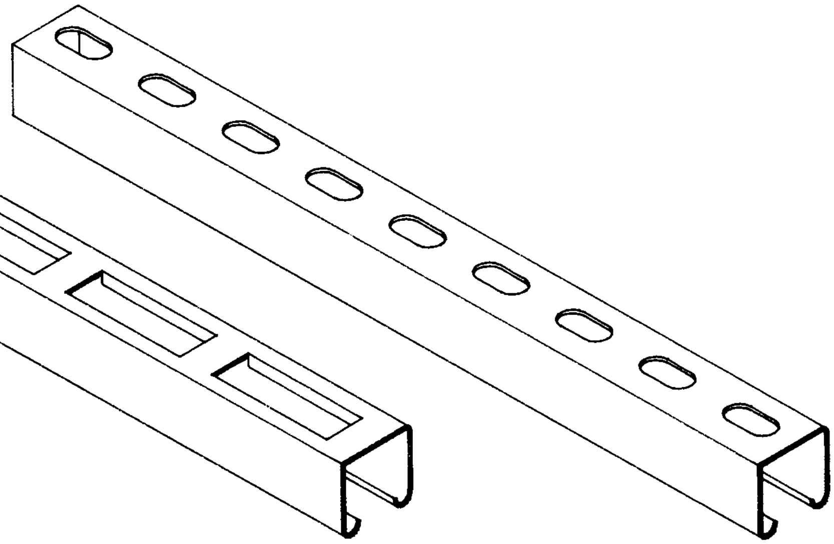

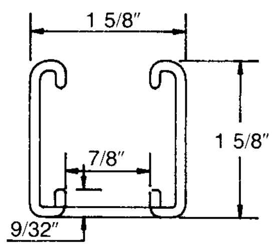

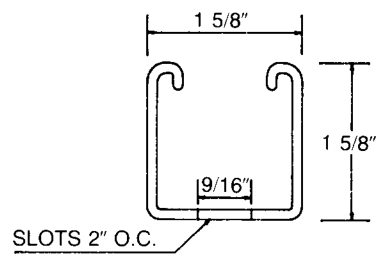

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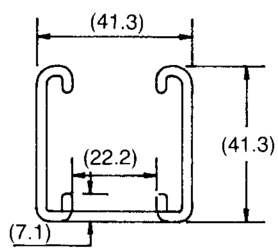

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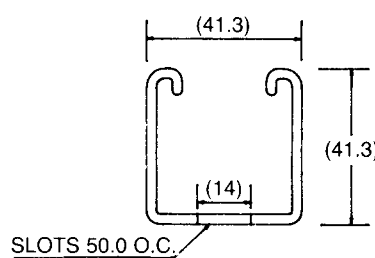

NOTE: FOR BEAM LOAD CAPACITY, USE 70% OF P1000 TABLE 16 PAGE 6-6. CHANNEL WALL THICKNESS IS 12 GA. (.105″).

NOTE: FOR BEAM LOAD CAPACITY, USE 85% OF LOAD TABLE 16 PAGE 6-6. CHANNEL WALL THICKNESS IS 12 GA. (.105″).

(UNITS IN PARENTHESIS ARE METRIC)

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Table 15 – ELEMENTS OF SECTION

Channel	Weight		A		Axis, 1 - 1						Axis, 2 - 2					
					I		S		R		I		S		R	
Type	Lbs./Ft.	Kg/m	in2	cm2	in4	cm4	in3	cm3	in	cm	in4	cm4	in3	cm3	in	cm
P1000	1.89	2.81	0.556	3.59	0.185	7.70	0.202	3.31	0.577	1.466	0.236	9.82	0.290	4.75	0.651	1.65
P1001	3.78	5.62	1.112	7.17	0.930	38.71	0.572	9.37	0.915	2.324	0.472	19.65	0.580	9.50	0.651	1.65
P5500	2.47	3.68	0.726	4.68	0.523	21.77	0.391	6.41	0.848	2.154	0.335	13.94	0.412	6.75	0.679	1.72
P5501	4.94	7.35	1.453	9.37	2.811	117.00	1.153	18.89	1.391	3.533	0.669	27.85	0.824	13.50	0.679	1.72

Table 16 – Static Beam Load (X-X Axis)

		Max Allowable Uniform Load (Lbs)		Deflection at Uniform Load (In)		Max Allowable Horizontal Load (Lbs)		Lateral Buckling Reduction
Span	Channel	Lbs.	N	in.	mm	Lbs.	N	Factor
	P1000	1,690	7,520	0.06	1.5	2,430	10,800	0.92
24in	P1001	3,130 *	13,920 *	0.03	0.8	3130 *	13,900 *	0.98
(610 mm)	P5500	3,280	14,590	0.04	1.0	3450	15,300	0.91
	P5501	4,680 *	20,820 *	0.02	0.5	4680 *	20,800 *	0.98
	P1000	1,130	5,030	0.13	3.3	1,620	7,200	0.86
36	P1001	3,130 *	13,920 *	0.07	1.8	3130 *	13,900 *	0.96
(914mm)	P5500	2,190	9,740	0.09	2.3	2300	10,200	0.82
	P5501	4,680 *	20,820 *	0.05	1.3	4610	20,500	0.95
	P1000	850	3,780	0.22	5.6	1,220	5,400	0.81
48	P1001	2,400	10,680	0.13	3.3	2430	10,800	0.93
(1,219mm)	P5500	1,640	7,300	0.15	3.8	1730	7,700	0.74
	P5501	4,680 *	20,820 *	0.08	2.0	3450	15,300	0.92
	P1000	680	3,020	0.35	8.9	970	4,300	0.76
60in	P1001	1,920	8,540	0.20	5.1	1940	8,600	0.9
(1,524mm)	P5500	1,310	5,830	0.24	6.1	1380	6,100	0.66
	P5501	3,870	17,210	0.13	3.3	2760	12,300	0.88
	P1000	560	2,490	0.5	12.7	810	3,600	0.73
72in	P1001	1,600	7,120	0.28	7.1	1620	7,200	0.87
(1,829mm)	P5500	1,090	4,850	0.34	8.6	1150	5,100	0.6
	P5501	3,220	14,320	0.19	4.8	2300	10,200	0.84
	P1000	480	2,140	0.68	17.3	690	3,100	0.7
84in	P1001	1,370	6,090	0.39	9.9	1390	6,200	0.84
(2,134mm)	P5500	940	4,180	0.47	11.9	990	4,400	0.55
	P5501	2,760	12,280	0.26	6.6	1970	8,800	0.8
	P1000	420	1,870	0.89	22.6	610	2,700	0.67
96in	P1001	1,200	5,340	0.5	12.7	1220	5,400	0.81
(2,438mm)	P5500	820	3,650	0.61	15.5	860	3,800	0.5
	P5501	2,420	10,760	0.34	8.6	1730	7,700	0.75
	P1000	380	1,690	1.13	28.7	540	2,400	0.65
108in	P1001	1,070	4,760	0.64	16.3	1080	4,800	0.78
(2,743mm)	P5500	730	3,250	0.77	19.6	770	3,400	0.46
	P5501	2,150	9,560	0.42	10.7	1540	6,900	0.71
	P1000	340	1,510	1.4	35.6	490	2,200	0.63
120in	P1001	960	4,270	0.79	20.1	970	4,300	0.74
(3,048mm)	P5500	660	2,940	0.96	24.4	690	3,100	0.43
	P5501	1,930	8,590	0.52	13.2	1380	6,100	0.66

* Load Limited by Weld Shear

Notes:

1. Calculations of section properties are based on metal thicknesses as determined by AISI. Cold-Form Steel Design Manual.
2. Prevent end rotation of beams that have vertical loads and lateral forces.
3. When loads are concentrated at or near midspan, allowable uniform loads should be multiplied by 0.5 and deflections by 0.8.
4. Laterally unbraced beams should have allowable loads reduced by multiplying by the load reduction factor given in the last column.

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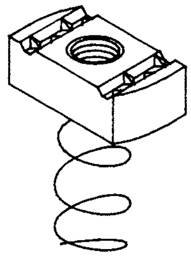
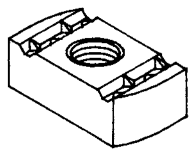


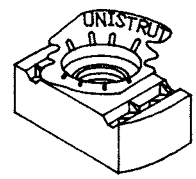
SPRING NUT

P1006-1420
P1008
P1010



NUT WITHOUT SPRING

P3006-1420
P3008
P3010



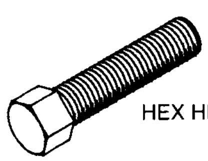
NUT WITH TOP RETAINER

P1006-1420T
P1008T
P1010T

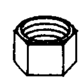
Table 17 – UNISTRUT NUT DIMENSION & DESIGN LOADS

Channel nut	Thread Size	Nut Thickness in.	Nut Thickness mm	Resistance to Slip 12 Ga. Channel Lbs.	Resistance to Slip 12 Ga. Channel N	Pull-Out Strength* 12 Ga. Channel Lbs.	Pull-Out Strength* 12 Ga. Channel N
P1010 P3010 P1010T	½" - 13	½"	13	1500	6,670	2000	8,900
P1008 P3008 P1008T	⅜" - 16	⅜"	10	800	3,560	1000	4,450
P1006-1420 P3006-1420 P1006-1420T	¼" - 20	¼"	6	300	1,330	600	2,670

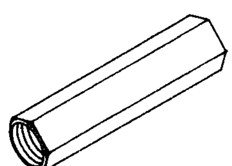
*Safety factor of 3



HEX HEAD CAP SCREWS
HHCS

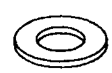


HEX NUTS
HHXN



COUPLER NUTS
HRCN

LOCK WASHER
HLKW



FLAT WASHER
HFLW

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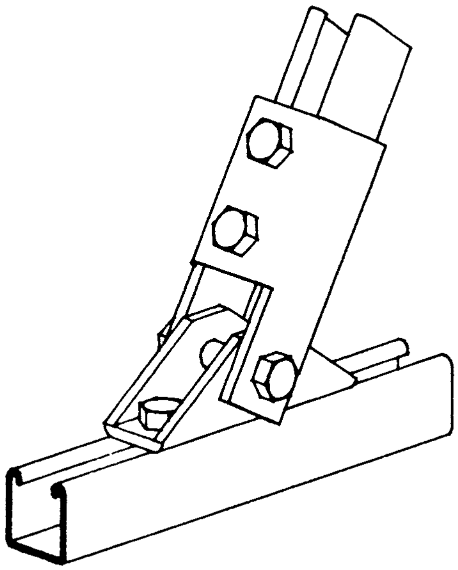
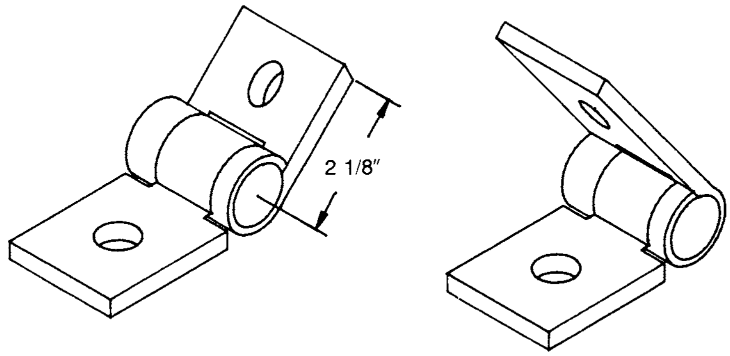
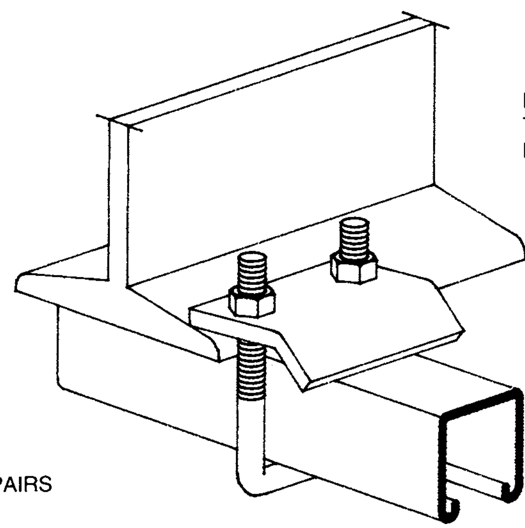
P2815 ADJUSTABLE BRACE



P1843 ADJUSTABLE HINGE



P2785 BEAM CLAMP



NOTE: P2010 TUBING CLAMP MUST BE USED TO SUPPORT U-BOLT WHEN CHANNEL DOES NOT EXTEND MIN. 4″ BEYOND BEAM FLANGE.

USE IN PAIRS

R E N E W E D

Fixed Equipment Anchorage

Office of Statewide Health Planning and Development

R-0120 February 1, 2002

****Valid for 3 Years Maximum****

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Date:

Problem:

Design a brace for a single pipe hanger with 8" diameter pipe and hangers spaced at maximum distance (see figure E-1).

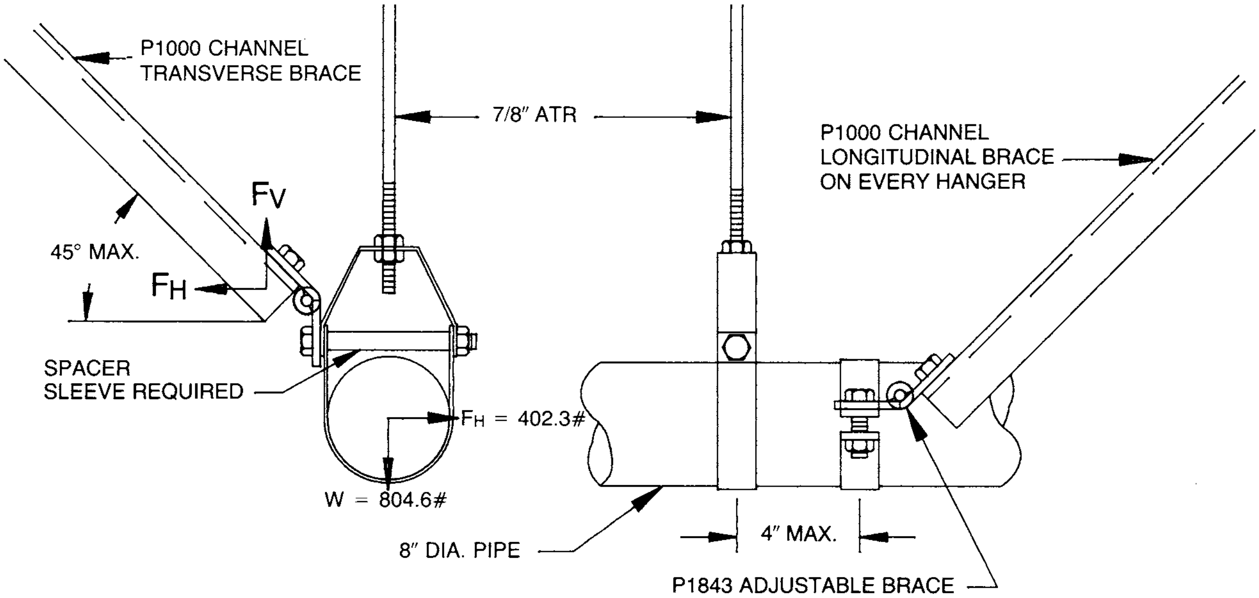

FIGURE E-1

Solution:

Step 1 Select hanger type (page 3-6, 3-7, 3-8, 3-9, 3-10) given the pipe diameter of 8".

Step 2 Determine the maximum hanger spacing, to be 19 ft. on center (page 2-1, table 1). The corresponding rod diameter is ⅞" (page 3-12, chart 1). Calculate the weight of the pipe full of water (W) with hangers at 19 ft. on center (page 3-12, chart 1):

W = 50.29 lbs./ft. x 19 ft. = 955.5 lbs.

(Continued next page)

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Step 3 Select a brace assembly (page 3-11, Details I-V) with a Fh value greater than the 478 lbs. found on (page 3-12, chart 1, row 7):

Fh = .5 x W = .5 x 955.5 lbs. = 478 lbs.

None of the applicable assemblies have an adequate Fh. Try a hanger spacing of 16 ft. and recalculate the equation in step 2 and step 3.

W = 50.29 lbs./ft. x 16 ft. = 804.6 lbs.

Fh = .5 x 804.6 lbs. = 402.3 lbs.

402.3 lbs. is less than 425 lbs. (for assembly 1)

Therefore, use hangers and assembly I braces 16 ft. on center.

Step 4 The maximum allowable load for $\frac{7}{8}$" diameter threaded rod is 5030 lbs. (page 3-14, table 10) which is greater than the actual of 804.6 lbs., therefore it is correct.

Step 5 Compression is not considered.

Step 6 Determine if **longitudinal** bracing is required:

For detail III (page 3-11) Fh	**= 425 lbs.**
Brace Spacing	**= allowable Fh / .5W**
(# of bays)	**= 425 lbs. / (.5(804.6 lbs))**
	= 1.06 bays

Therefore, longitudinal bracing (detail III, page 3-11) should be used on every 16 feet.

Step 7 Select concrete anchors for:

Vertical Supports - The maximum tension load is 804.6 pounds. Select a $\frac{1}{2}$" diameter 3-$\frac{1}{2}$" embedment anchor (Table 11 on page 5-1) with a maximum allowable tension of 1,000 pounds.

Braces - The maximum shear load is 402.3 pounds and the maximum tension load is 402.3 pounds. Select a $\frac{1}{2}$" diameter 2-$\frac{1}{4}$" embedment anchor (Table 11 on page 5-1) with a maximum allowable tension of 600 lbs. and shear of 1,470 pounds.

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Problem:

Design transverse and horizontal bracing for, a single 4” pipe and hangers spaced at maximum distance (see figure E-2).

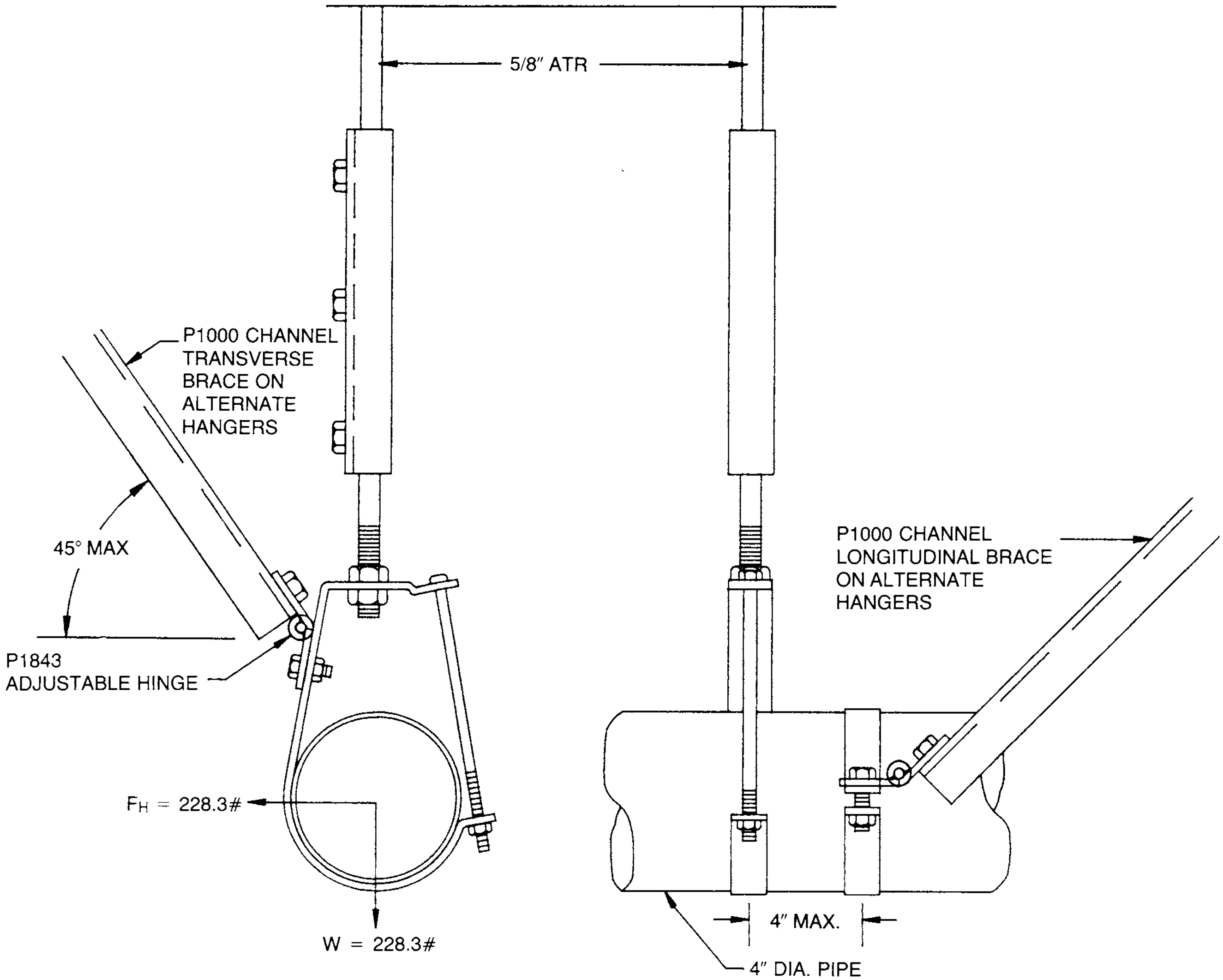

FIGURE E-2

Solution:

Step 1 Select hanger type J1240 (page 3-6, table 8) given the pipe diameter of 4".

Step 2 Determine the maximum hanger spacing to be 14 ft. on center (page 2-1, table 1). The corresponding rod diameter is ⅝" (page 3-12, chart 1). Calculate the weight of the pipe full of water (W) with hangers 14 ft. on center (page 3-12, chart 1):

W = 16.31 lbs./ft. x 14 ft. = 228.3 lbs.

Step 3 Use the following calculation to find Fh with braces on alternating hangers:

Fh = .5 x W x 2 = .5 x 228.3 lbs. x 2 = 228.3 lbs.

Select a brace assembly (page 3-11, detail IN) with a Fh value greater than 228.3 lbs.

228.3 lbs. less than 425 lbs. (for assembly 1)
228.3 lbs. less than 310 lbs. (for assembly IV)

Therefore, use either brace assembly on alternating hangers.

Step 4 The allowable load for ⅝" diameter threaded rod is 1810 lbs. (page 3-14, table 10) which is greater than the actual of 228.3 lbs., therefore it is correct.

Step 5 Compression is not considered.

Step 6 Determine if **longitudinal** bracing is required:

For detail I-IV (page 3-11) min. FH	**= 310 lbs.**
Brace spacing	**= allowable Fh / .5W**
(# of bays)	**= 310.0 lbs. / (.5(228.3 lbs.))**
	= 2.7 bays

Therefore, longitudinal bracing (detail I-IV, page 20) should be used every 28 feet.

Step 7 Select concrete anchors for:

Vertical Supports - The maximum tension load is 228.3 pounds. Select a ½" diameter 2-¼" embedment anchor (Table 11 on page 5-1) with a maximum allowable tension 600 pounds.

Braces - The maximum shear load is 228.3 lbs. and the maximum tension load is 228.3 pounds. Select a ½" diameter 2-¼" embedment anchor (Table 11 on page 5-1) with a maximum allowable tension of 600 lbs. and shear of 1,470 pounds.

R E N E W E D
Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
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Problem:

Trapeze hanger spanning 24” hung from rods with a seismic brace to be used on left end (see figure E-3). There is one 2½" diameter pipe, one 3" pipe, and one 4" pipe with the load evenly distributed on the trapeze.

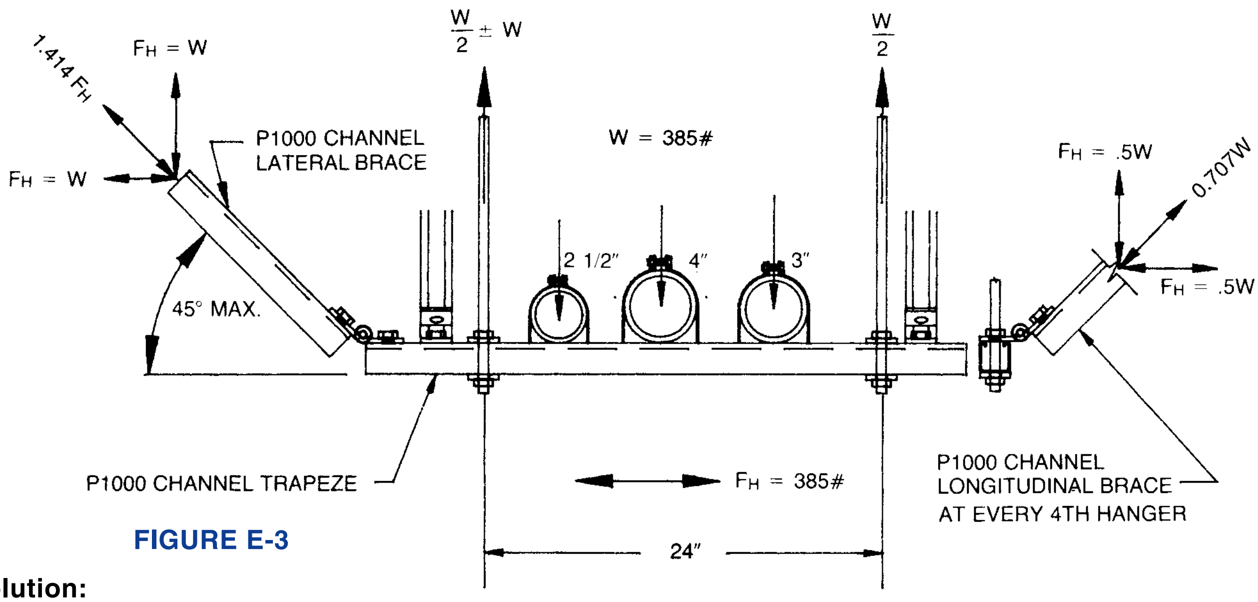

FIGURE E-3

Solution:

Step 1 Determine the trapeze spacing (S) using the smallest pipe diameter which is 2 ½" (page 2-1, table 1). Trapeze spacing is 11 feet.

Step 2 Calculate the weight of the pipes plus contents (W) on each hanger (page 2-1, table 1 and use the calculation):

W = S x (p1 + p2 + p3) = 11 ft. x (7.87 + 10.78 + 16.31)lbs./ft. = 385 lbs.

Step 3 Select clamps (page 3-3 & 3-4, tables 6 & 7). Either style, P1 100 series or P2558 series, can be used.

Step 4 Select a trapeze member. A P1000 spanning 24" will carry 1690 lbs. (page 3-1, table 2) which is greater than the calculated 385 lbs. (from above step 2).

Step 5 Calculate horizontal seismic force (Fh) assuming braces on alternate trapeze supports.

F_h = .5 W x 2 = W = 385 lbs.

Select brace assembly III (page 3-11) which has an allowable Fh value of 425 lbs. This is satisfactory since it exceeds the calculated horizontal seismic force.

(Continued next page)

Step 6 Check compression and tension forces in the rod.

a. Select threaded rod that has a tension strength that meets or exceeds the required tension (use page 2-2, figure 1):

T_{max} = 1.5W = 1.5 x 385 lbs. = 578 lbs.

A ⅜" rod will carry 810 lbs. (page 3-14, table 10)

b. Calculate the maximum rod compression (use page 2-2, figure 1):

Cmax = .5W = .5 x 385 Lbs. = 193 lbs.

Check buckling due to compression by determining the percentage of full stress capacity:

Actual Compression Load / Allowable Compression Load = 193 / 810 = 0.24

Since 24% is less than 50% use P1000T stiffener with P2485 clips spaced 14" on center (page 3-13, table 9).

Step 7 Determine if longitudinal braces are required using the following equation (For detail B-111, see page 3-11) Fh = 425 lbs.:

Brace spacing - Allowable Fh / .25W = 425 lbs. / .25 x 385 = 4.4 bays (# of bays)

Therefore, use longitudinal braces (detail 111, page 3-11) on every fourth trapeze.

Step 8 Check clamps against transverse and longitudinal seismic forces. Use largest pipe - 4" diameter.

Transverse Force 16.31 x 22 x .5 = 179 lbs.
Longitudinal Force 16.31 x 44 x .5 = 359 lbs.

Allowable transverse force is 320 x 1.33 = 425 lbs.
Transverse force is less than allowable therefore o.k.

Allowable longitudinal force is 200 x 1.33 = 266 lbs.
Longitudinal force exceeds allowable therefore try braces every third hanger.

Longitudinal force = 16.31 x 33 x .5 = 269 lbs.
Longitudinal force only 3 pounds over allowable and would be close enough to be considered o.k.
Therefore use longitudinal braces every third trapeze hanger.

(Continued on next page)

Step 9 Check combined vertical and lateral bending using interaction formula given on page 2-3:

$$385 / (.92 \times 1{,}690) + (385 \times .5 \times 3) / (.92 \times 2{,}450) \leq 1.33$$

$$.248 + .256 = .504 < 1.33 \text{ therefore o.k.}$$

Step 10 Select concrete anchors from pages 5-1 and 5-2.
Max load = 578 lbs.
Use ⅜" Kwikbolt 11 anchor embedded 2-½" , or
Use ⅜" Red Head Wedge anchor embedded 3".

Problem:

Trapeze hanger spanning 48" hung from rods with a seismic brace to be used on left end (see figure E-4). There are five 4" diameter pipes with the load evenly distributed on the trapeze.

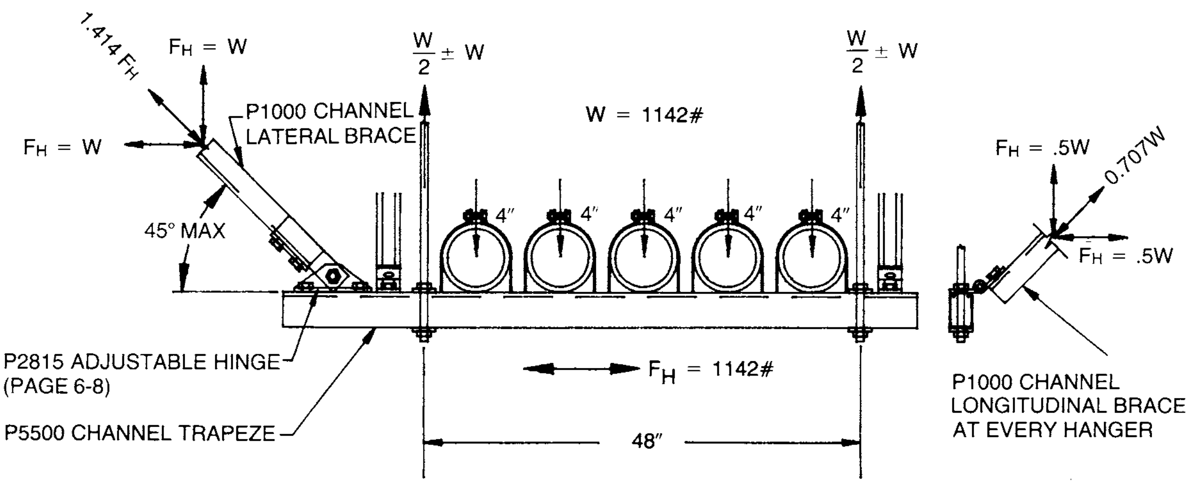

FIGURE E-4

Solution:

Step 1 Determine the trapeze spacing (S) using the smallest pipe diameter which is 4" (page 2-1, table 1). Trapeze spacing is 14 feet.

Step 2 Calculate the weight of the pipes plus contents (W) on each hanger (page 2-1, table 1 and use the calculation):

W = S x (5 x p1 + p2) = 14 ft. x (5 x 16.31)lbs./ft. = 1,142 lbs.

(Continued next page)

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Step 3 Select clamps (page 3-3 & 3-4, tables 6 & 7). Either style, P1100 series or P2558 series, can be used.

Step 4 Select a trapeze member. A P5500 spanning 48" will carry 1620 lbs. (page 3-1, table 3) which is greater than the calculated 1142 lbs. (see above step 2).

Step 5 Calculate horizontal seismic force (F_h) assuming lateral braces on alternate trapeze supports.

F_h = .5W x 2 = W = 1,142 lbs.

Select brace assembly V (page 3-11), which has an allowable Fh value of 1590 lbs. up to 8 feet long. This lateral brace is satisfactory.

Step 6 Check compression and tension forces in the rod.

a. Select threaded rod that has a tension strength that meets or exceeds the required tension (see page 2-2, figure 1):

Tmax = 1.5W = 1.5 x 1142 lbs. = 171-3 lbs.

A ⅝ inch rod will carry 2410 lbs. (page 3-14, table 10).

b. Calculate the maximum rod compression (see page 2-2, figure 1):

Cmax = .5W = .5 x 1142 lbs. = 571 lbs.

Check buckling due to compression by determining the percentage of full stress capacity:

Actual Compression Load -i-Allowable Compression Load = 571 - 2410 = 0.24

Since 24% is less than 50%, use P1 OOOT stiffener with P2485 clips spaced 24 inches on center (page 3-13, table 9).

Step 7 Determine longitudinal bracing requirements using assembly III (page 3-11) and the equation:

Brace spacing = Allowable F_h / .25W = 425 lbs. / (.25 x 1,142 lbs.) = 1.5 (# of bays)

Therefore, use longitudinal braces on both sides of every trapeze.

(Continued on next page)

Step 8 Check clamps for transverse and longitudinal seismic forces.

Transverse Force 16.31 x 28 x .5 = 228 lbs.
Longitudinal Force 16.31 x 14 x .5 = 114 lbs.

Allowable transverse force is 320 x 1.33 = 425 lbs.
Transverse force is less than allowable therefore o.k.

Allowable longitudinal force is 200 x 1.33 = 266 lbs.
Longitudinal force is less than allowable therefore o.k.

Step 9 Check combined vertical and lateral bending using interaction formula given on page 2-3:

1,142 / (.74 x 1,620) + (1,142 x .5) / (.74 x 1,770) ≤ 1.33
.953 + .436 = 1.389 > 1.33

1.389 exceeds 1.33 therefore try trapeze spacing of 13 feet instead of 14 feet.
Load will then be 16.31 x 13 x .5 = 1,060 lbs. The interaction equation will be:

1,060 / (.74 x 1620) + (1,060 x .5) / (.74 x 1770) ≤ 1.33
.884 + .405 = 1.29 < 1.33 therefore o.k.

Use trapeze spacing of 13 feet maximum.

Step 10 Select clamp or anchor for vertical ⅝" rods.

Max load = 1,713 x 13/14 = 1,591 lbs.
Use P1651AS beam clamps - Allowable load = 1,600 lbs.

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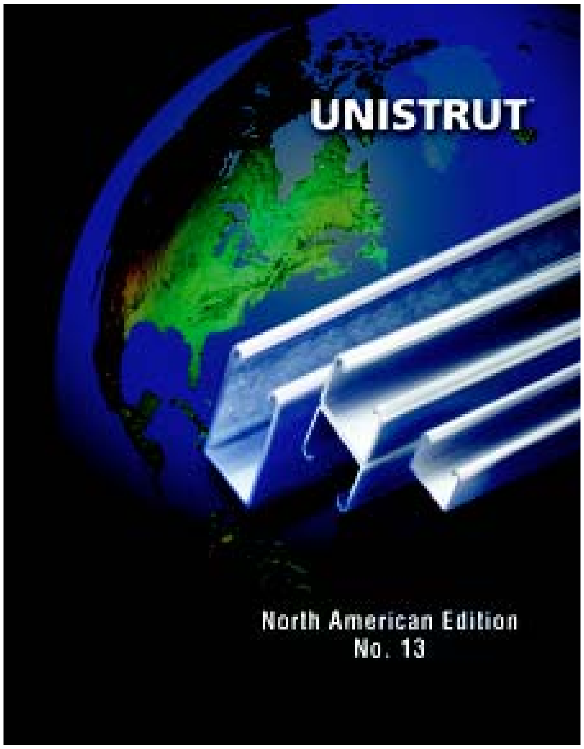

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