X-Braces

BROOKS tradition of producing dependable engineered products is vividly evident in our diverse line of wood X-braces. Our solid engineering commitment and decades of wood structure design and testing provide the experience and knowledge necessary to select the proper bracing to meet both your strength and budget requirements.

A set of wood X-Braces is the most economical method of fully developing the transverse capacity of the H-frame structure. Wood members provide the required tensile and compressive strengths without sacrificing the “BIL” levels associated with wood construction. The wide range of BROOKS X-Brace styles provides the transmission designer an optimum match for the given pole spacing and pole class required for the specific job through 345kV construction. BROOKS Engineering Department will work with you on applications of these standard X-Braces or a custom designed X-Brace to meet your individual needs.

Our ready access to both solid sawn and reliable conventional glued laminated coastal region Douglas fir, combined with our flexibility in hardware designs, allows easy selection of BROOKS bracing to match your existing system standards.

X-Braces should be ordered by specifying center to center pole spacings. All X-Brace members are shipped factory assembled with static proof fittings locked securely in place. Unless specified otherwise, all necessary mounting hardware required to install the assembly is included. Typical length mounting bolts have been pre-selected as noted by each style and will be shipped with the braces unless specified differently on the order. Refer to the ordering codes on the next page which explain other variations of ordering available for special applications or component combinations.

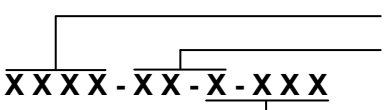
BROOKS has many other proven designs in addition to those illustrated. We welcome the opportunity to review your structure requirements or system standards to recommend the best X-Braces for your applications.

X-Brace Ordering Codes

For use when ordering by center to center (C/C) pole spacing

For 670, 671, 675, 677, 678, 6050, 6051, 6680, 6685, 6685A, 6695, 6696 & 41005 X-Brace Series

Ordering Information:



Additional Code Digits for Variable

NM …..No Mounting Hardware, Includes Center Clamp Assembly
NC ….. All Mounting Hardware, Less Center Clamp Assembly
NMC …No Mounting Hardware or Center Clamp Assembly
PC ……One Piece of X-Brace With Assembled End Fittings Only

Ordering Examples:

6685-15-6 = 1 set of X-Braces for 15'-6" C/C pole spacing, complete with (2) pieces of wood assembled to end fittings, all mounting hardware and center clamp assembly.

6685-15-6-NM = 1 set of X-Braces for 15'-6" C/C pole spacing, with (2) pieces of wood assembled to end fittings, with center clamp assembly only, less mounting hardware.

6685-15-6-NMC = 1 set of X-Braces for 15'-6" C/C pole spacing, with (2) pieces of wood assembled to end fittings, less mounting hardware and less center clamp assembly.

6685-15-6-PC = 1 piece of an X-Brace for 15'-6" C/C pole spacing (one piece of wood assembled to end fittings only, less mounting hardware and less center clamp assembly).

When mounting bolts are required in lengths other than those listed as standard for each style of X-Brace, indicate those lengths in a descriptive form along with the order number. As an example: 6685-15-6, mounting bolts 25% - 14", 50% - 16" and 25% - 18".

A variety of other ordering options is available which consider MHC of individual brace components as well as concerns for special mounting hardware combinations and bolt length arrangements. BROOKS welcomes the opportunity to assist in recommending the style of brace and confirm the appropriate catalog number which meets your system standards or structure requirements.

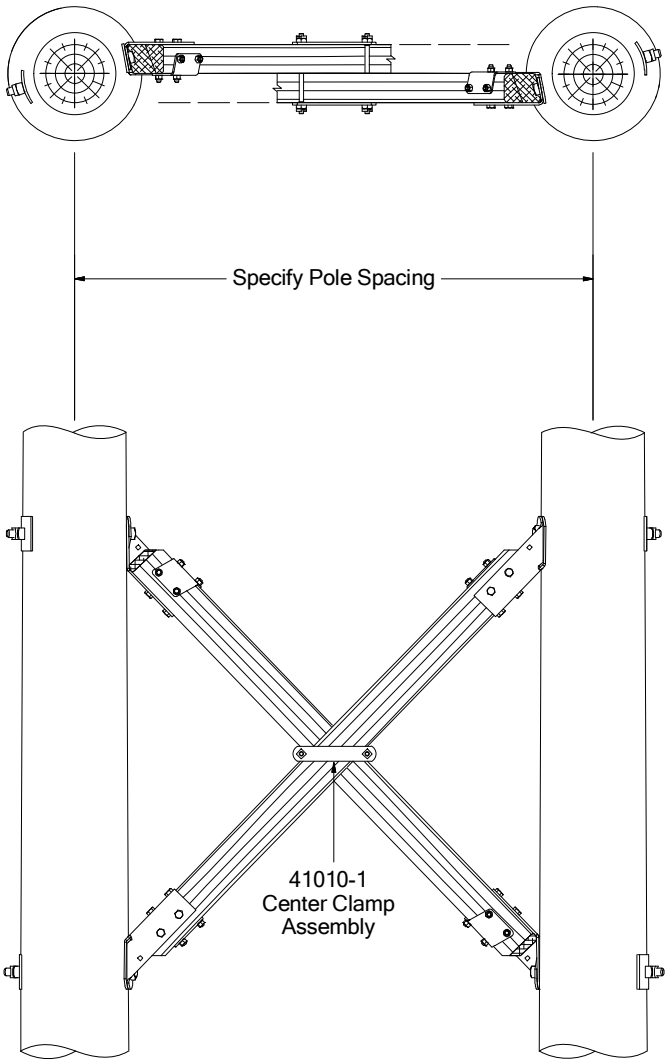
6680 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. **Wood Section - 3⅜" x 4⅜".** **Fitting thickness - ¼".**

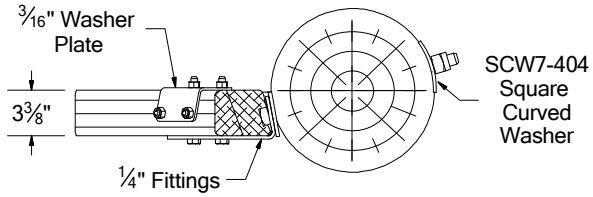
Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

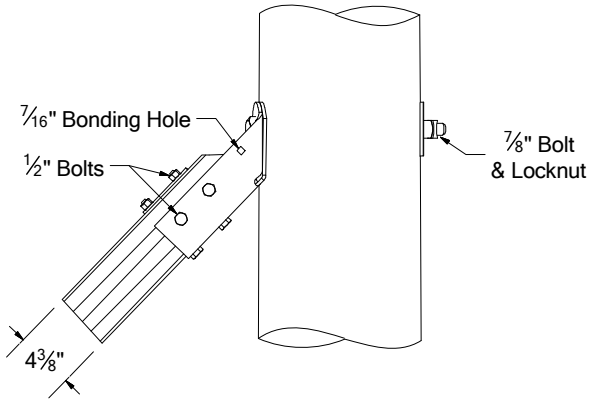
To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 10.2, then add 53 pounds.

REA TM110A



Assembly View





Detail View

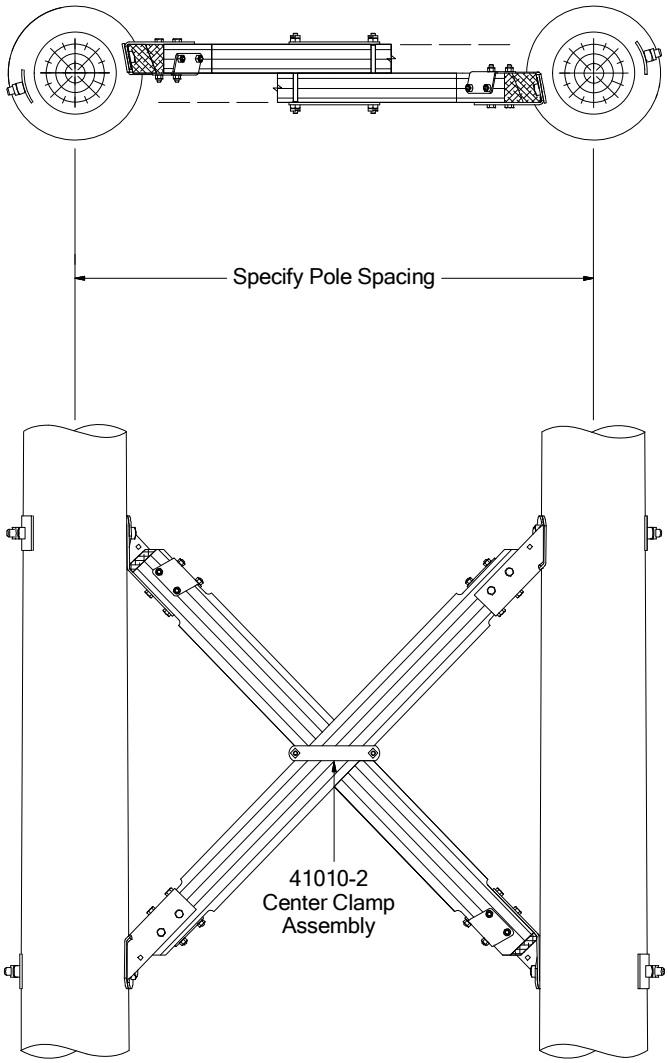
6685A Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3⅜" x 5⅜". Fitting thickness - ¼".

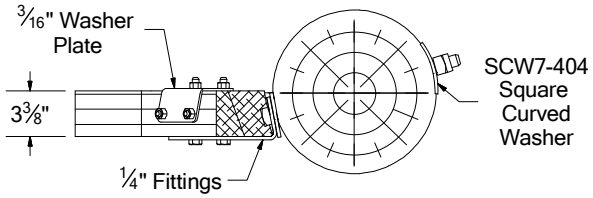
Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

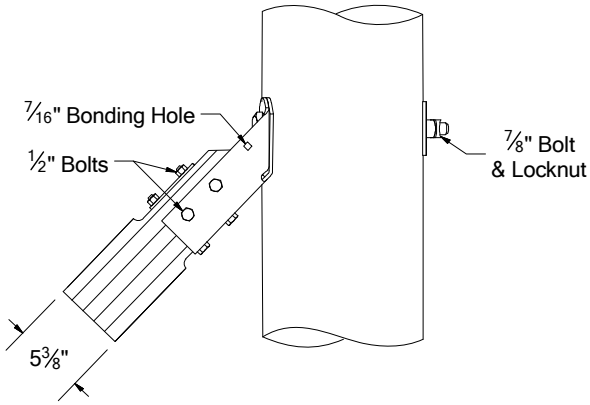
To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 12.5, then add 54pounds.

REA TM110B



Assembly View





Detail View

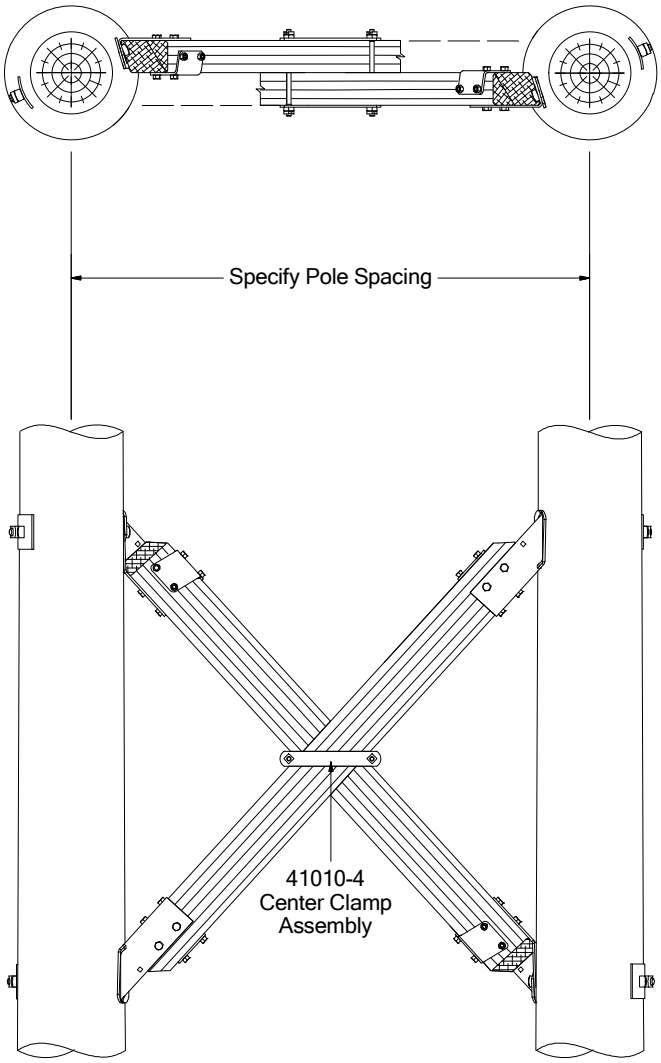
6685 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3¾" x 5¾". Fitting thickness - ¼".

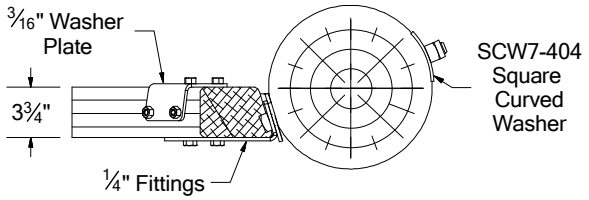
Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

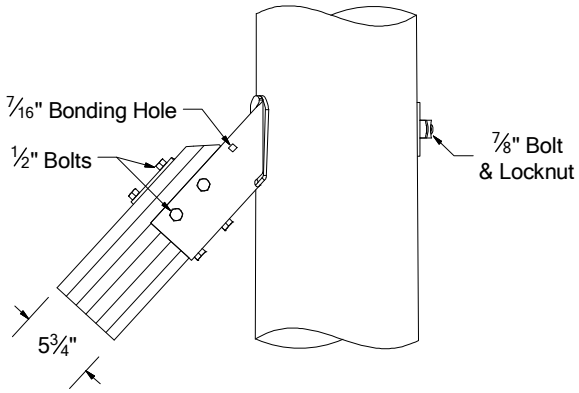
To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 15.1, then add 60 pounds.

REA TM110B



Assembly View





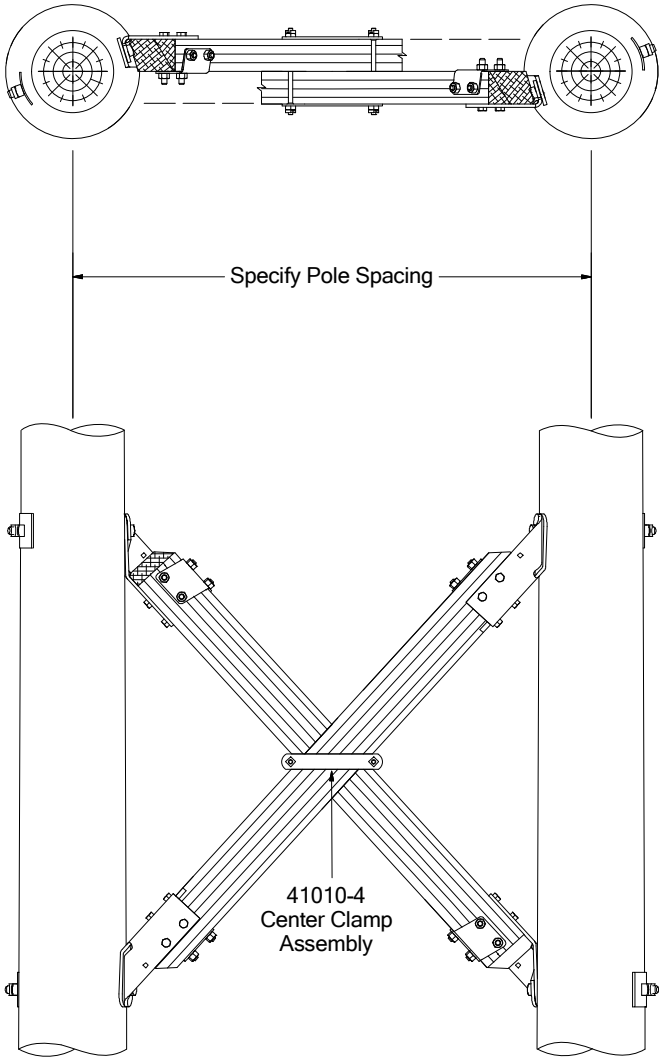
Detail View

6050 Series X-Braces

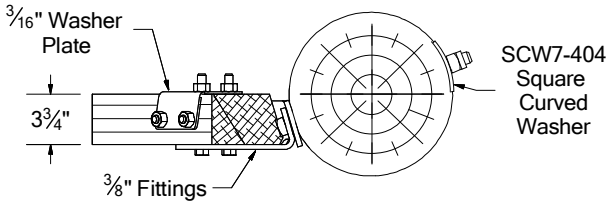
Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3¾" x 5¾". Fitting thickness - ⅜".

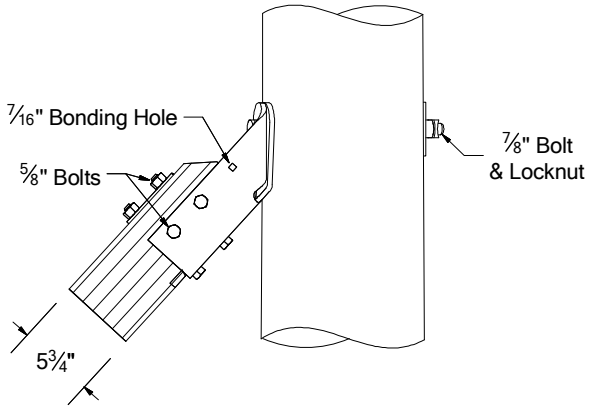
Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 15.1, then add 76 pounds.



Assembly View





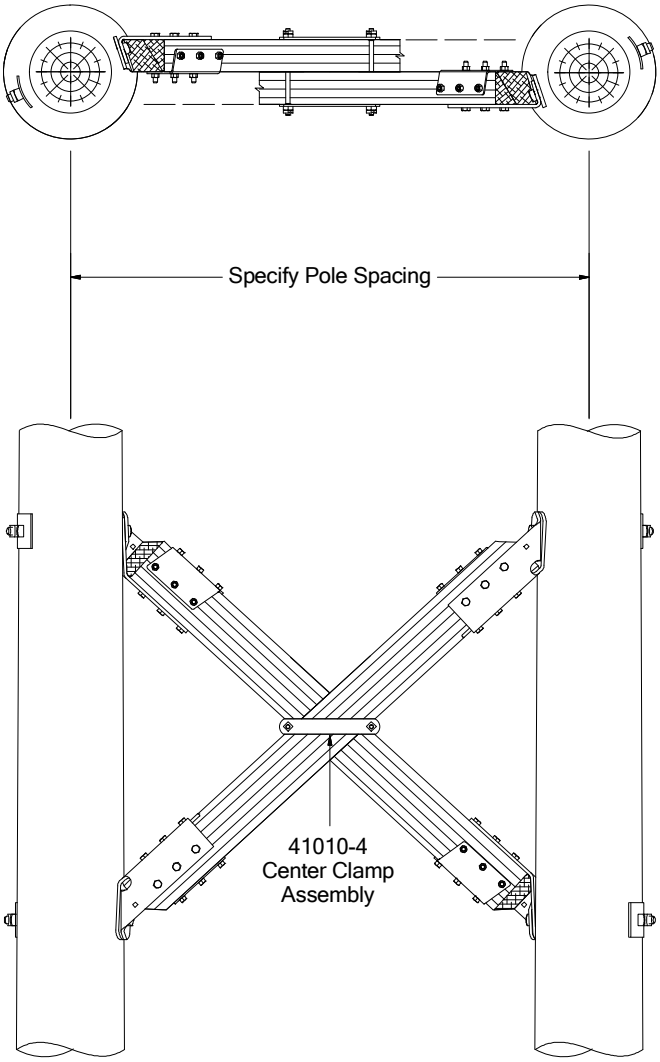
Detail View

6051 Series X-Braces

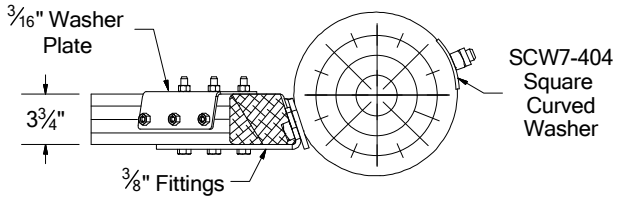
Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3¾" x 5¾". Fitting thickness - ⅜".

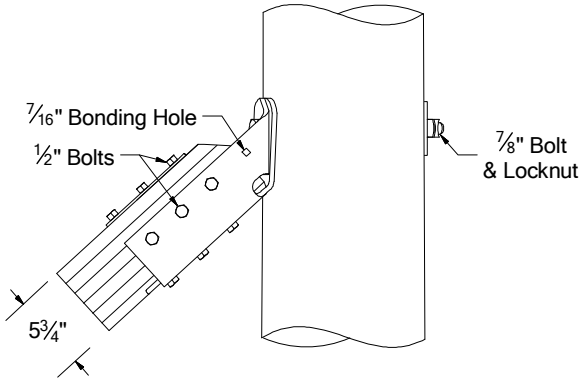
Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 15.1, then add 96 pounds.



Assembly View





Detail View

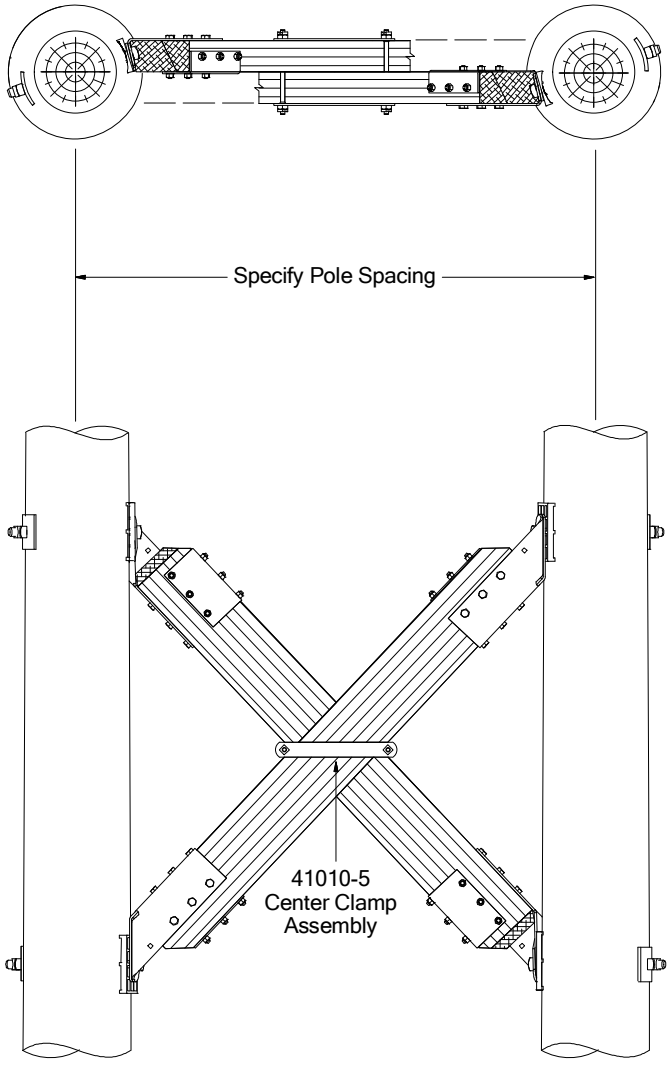
6695 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3⅝" x 7½". Fitting thickness - ¼".

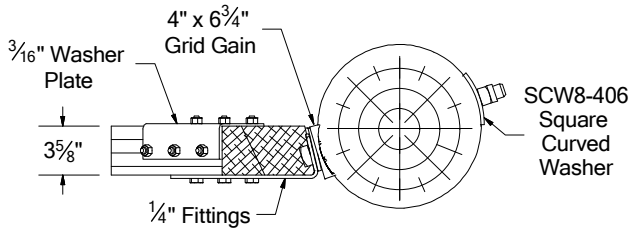
Mounting bolt diameters - 1". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

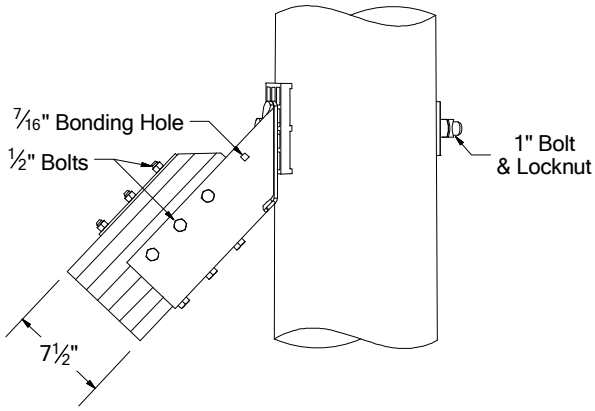
To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 19.1, then add 92 pounds. Grid gains are furnished standard, unless otherwise specified.

REA TM110C



Assembly View





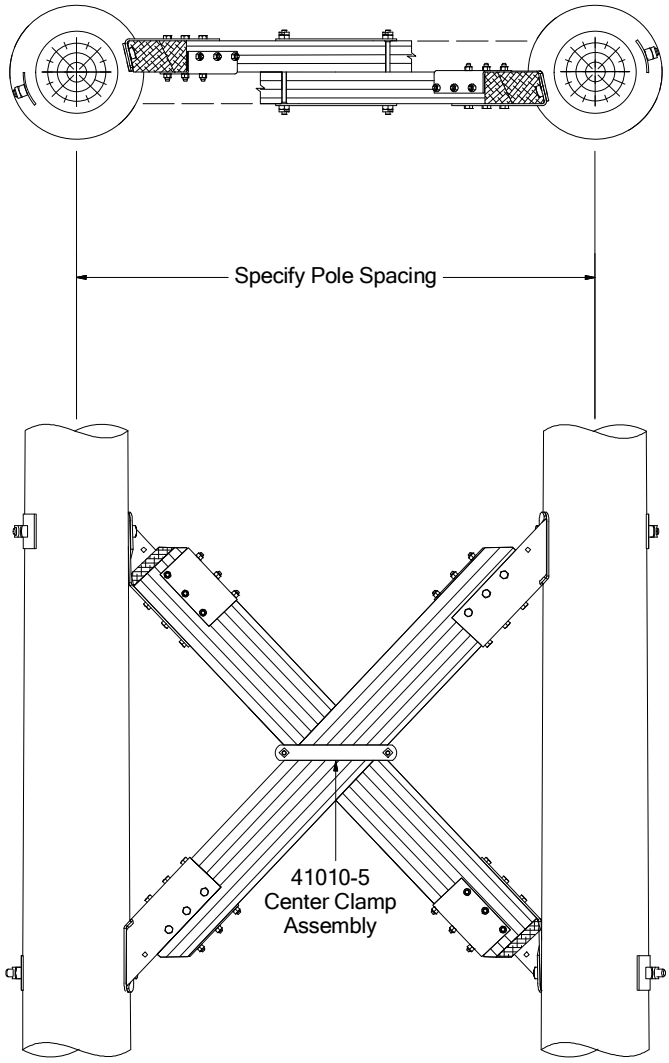
Detail View

6696 Series X-Braces

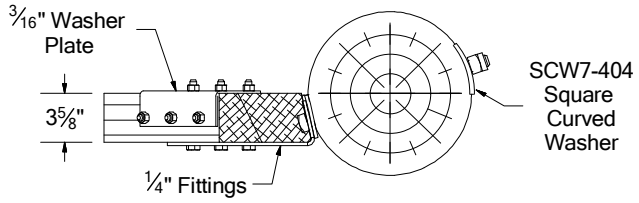
Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3⅝" x 7½". Fitting thickness - ¼".

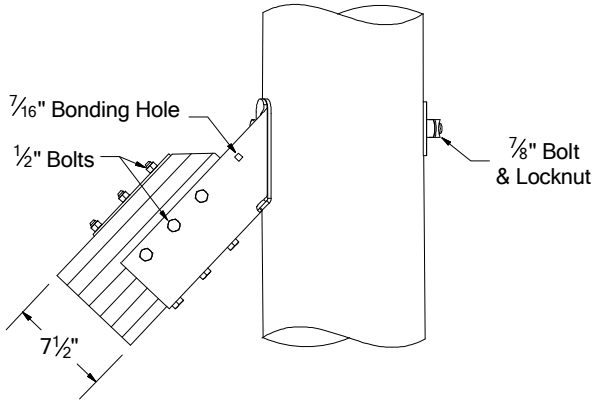
Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 19.1, then add 81 pounds.



Assembly View





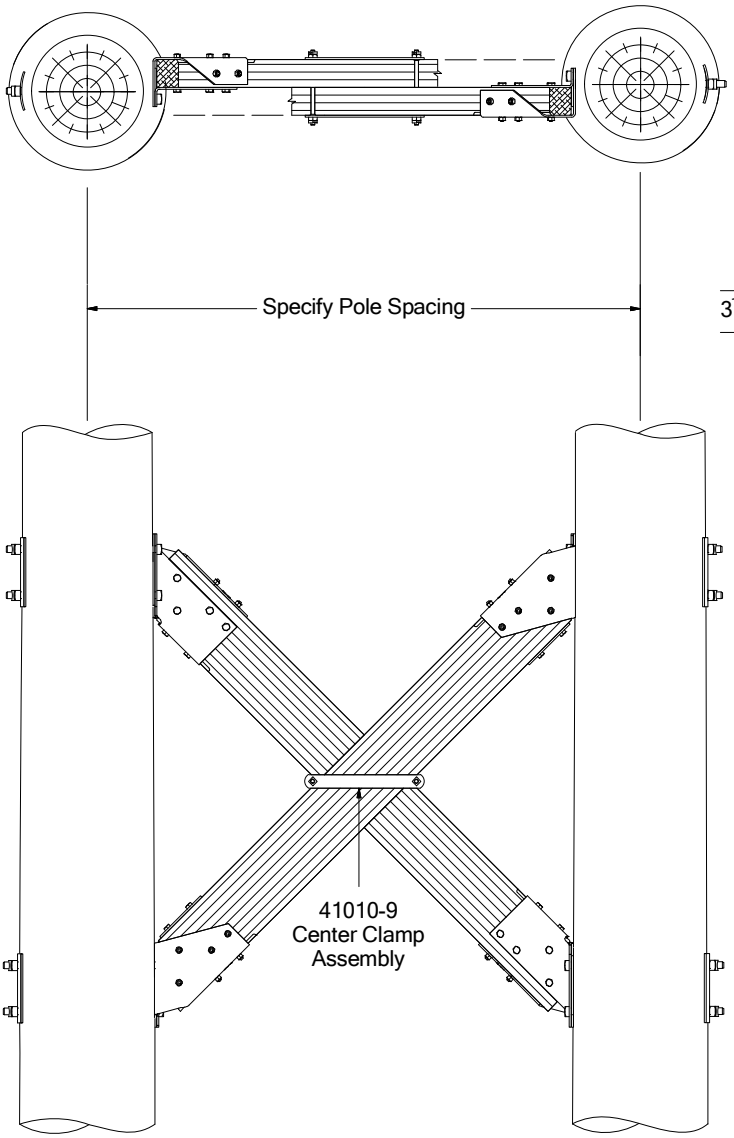
Detail View

41005 Series X-Braces

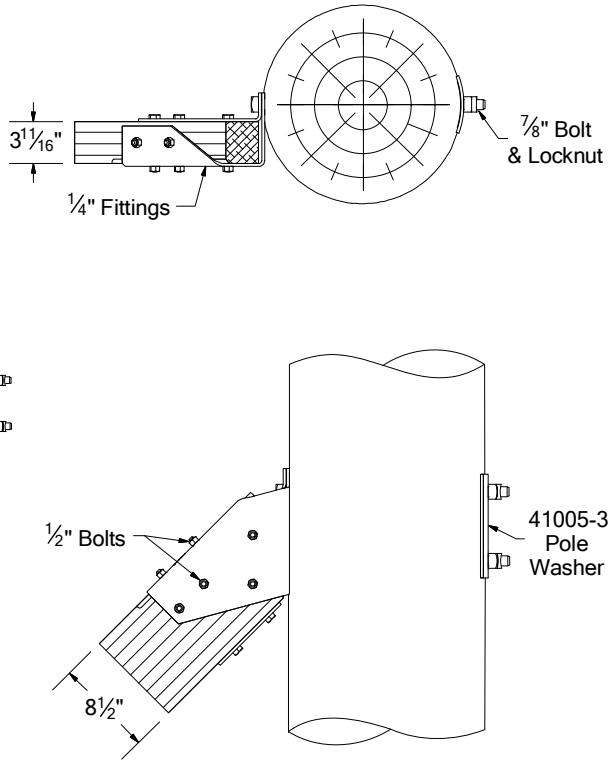
Reference pages B3.5.16 to B3.5.18 for strength
Single Bolt Connection, Cut Thread. Wood Section - 3⅝ " x 8½". Fitting thickness - ¼".

Mounting bolt diameters - ⅞". Unless specified otherwise, standard bolt length furnished are 50% - 14" and 50% - 16".

To estimate shipping weight of the assembly complete with all mounting hardware, multiply C/C pole spacing by 22.2, then add 137 pounds.



Assembly View



Detail View

670 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength Pin Connection.

Fitting thickness - Straight $\frac{3}{8}$", Bent $\frac{1}{4}$".

Cut thread mounting bolt diameters - $\frac{7}{8}$". Unless specified otherwise, standard bolt length furnished are 50% - 16" and 50% - 18".

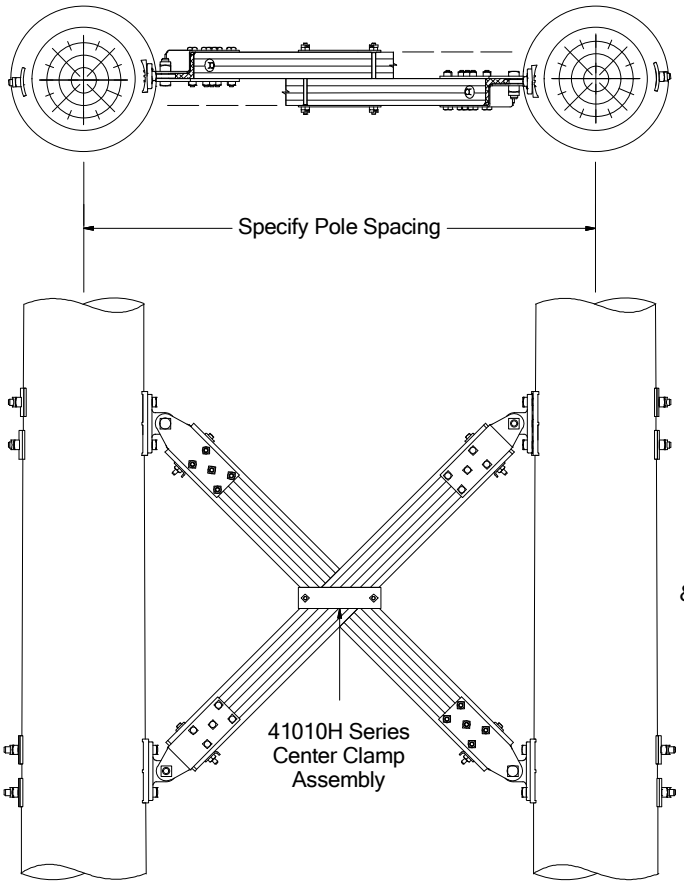
Unless specified otherwise, assembly is furnished complete with standard mounting hardware including mounting bolts, tees, pin bolts, washers, nuts and locknuts. To include grid gains, add suffix "-G" to part number when ordering.

Catalog Number	Wood Size W		D	Center Clamp Assembly No.
670A	$3\frac{3}{4}$"	x	$5\frac{3}{4}$"	41010H-4
670B	$5\frac{1}{8}$"	x	6"	41010H-11
♦ **670C**	$4\frac{5}{8}$"	x	$5\frac{5}{8}$"	41010H-12
670D	$4\frac{1}{2}$"	x	$5\frac{1}{2}$"	41010H-16

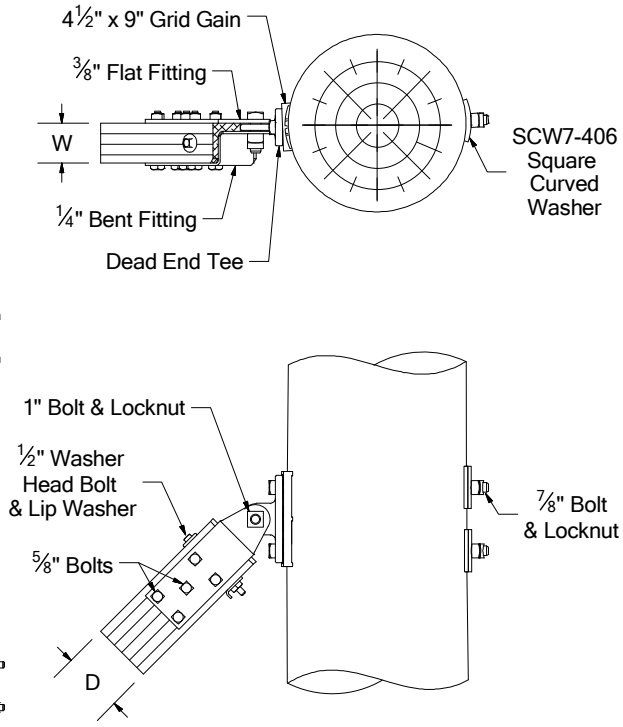
♦ REA TM-110D ($4\frac{5}{8}$" x $5\frac{5}{8}$")

To estimate complete assembly shipping weight:

C/C Pole Spacing Multiplied By				Approx. Shipping Wt. Lbs.
14.9	plus	134 lbs.	=	_____
20.5	plus	138 lbs.	=	_____
18.0	plus	135 lbs.	=	_____
17.5	plus	135 lbs.	=	_____



Assembly View



Detail View

671 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength Pin Connection.

Fitting thickness - Straight 3/8", Bent 1/4".

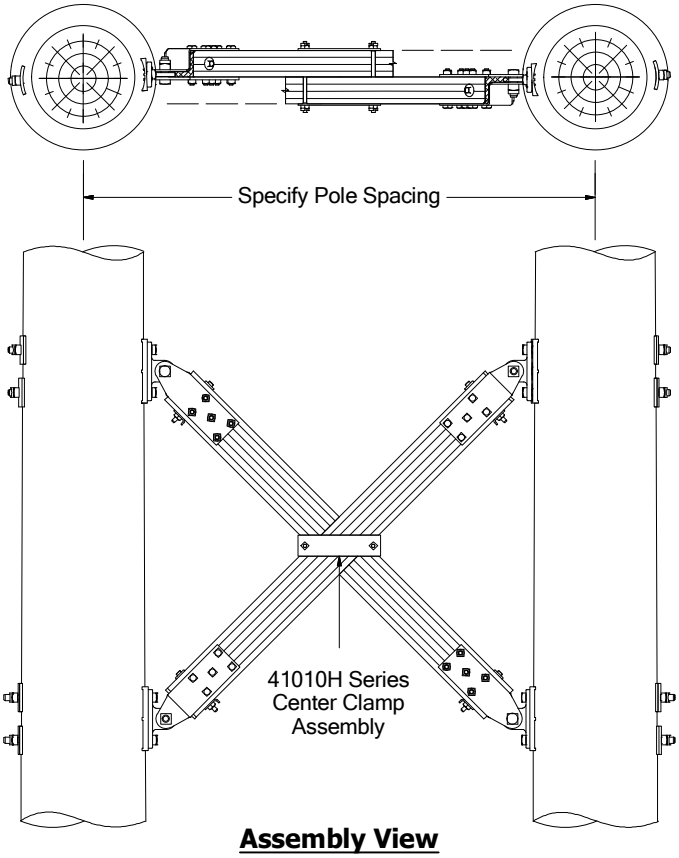
Cut thread mounting bolt diameters - 7/8". Unless specified otherwise, standard bolt length furnished are 50% - 16" and 50% - 18".

Unless specified otherwise, assembly is furnished complete with standard mounting hardware including mounting bolts, tees, pin bolts, washers, nuts and locknuts. To include grid gains, add suffix "-G" to part number when ordering.

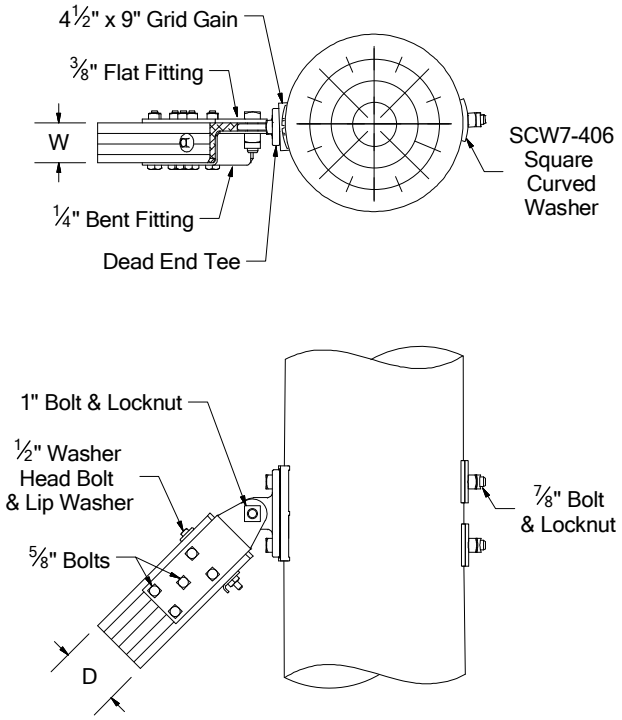
Catalog Number	Wood Size W		D	Center Clamp Assembly No.	C/C Pole Spacing Multiplied By				Approx. Shipping Wt. Lbs.
671A	3 5/8"	x	7 1/2"	41010H-5	19.2	plus	144 lbs.	=	_____
671B	3 5/8"	x	8 1/2"	41010H-9	21.9	plus	153 lbs.	=	_____
671C	5 1/2"	x	7 1/2"	41010H-13	28.9	plus	159 lbs.	=	_____
♦ **671D**	5 1/8"	x	7 1/2"	41010H-8	26.2	plus	156 lbs.	=	_____
671E	4 1/2"	x	6 3/4"	41010H-10	21.2	plus	153 lbs.	=	_____
671F	6"	x	6 3/4"	41010H-7	27.6	plus	153 lbs.	=	_____
671G	5 1/8"	x	9"	41010H-6	32.9	plus	153 lbs.	=	_____

To estimate complete assembly shipping weight:

♦ REA TM-110E (5 1/8" x 7 1/2")



Assembly View



Detail View

675 Series X-Braces

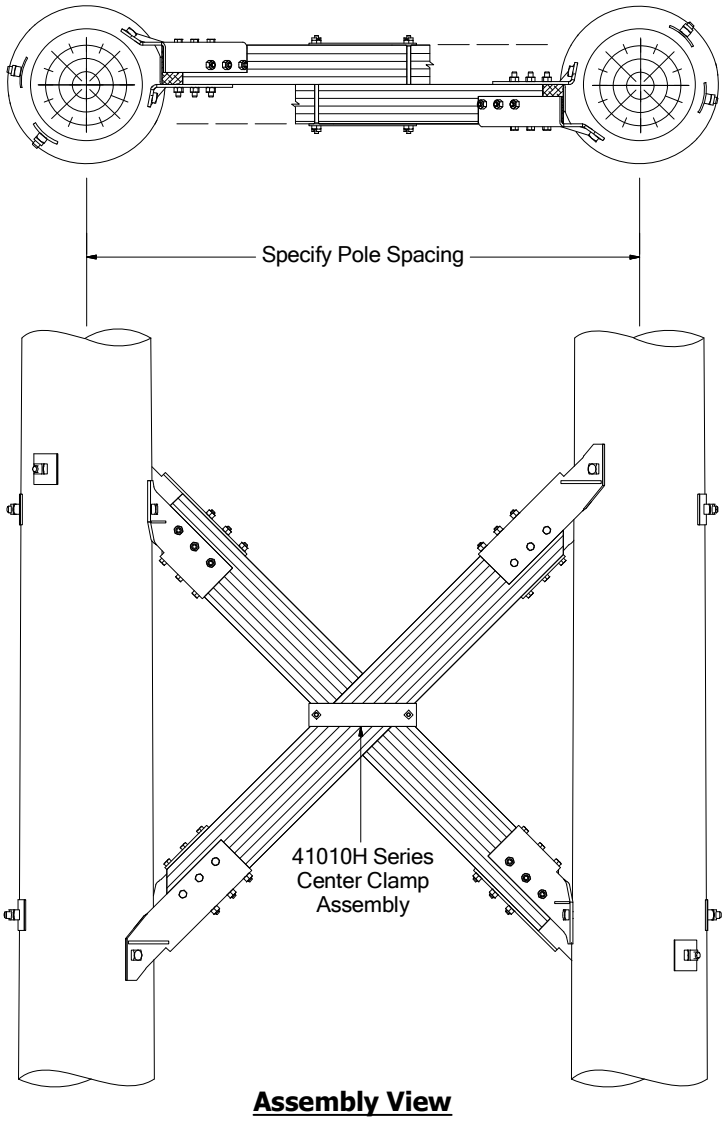
Reference pages B3.5.16 to B3.5.18 for strength
Wrap Around Two Bolt Connection, Cut Thread. **Fitting thickness - 3/8".**

Mounting bolt diameters - 7/8". Unless specified otherwise, standard bolt length furnished are 50% - 16" and 50% - 18".

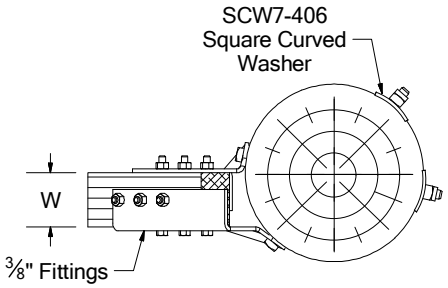
Catalog Number	Wood Size W		D	Center Clamp Assembly No.
675	5 1/8"	x	7 1/2"	41010H-8
675A	5 1/2"	x	7 1/2"	41010H-13
675B	5 1/8"	x	6"	41010H-11
675C	4 5/8"	x	5 5/8"	41010H-12

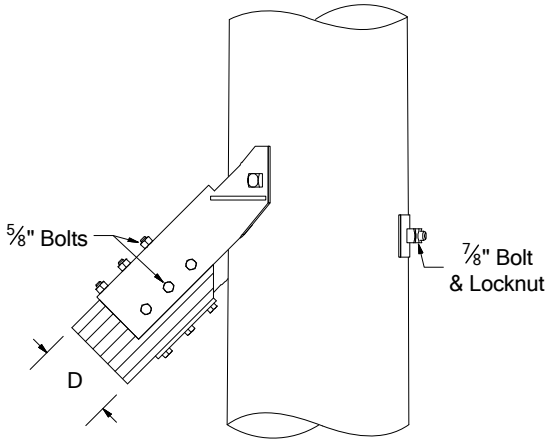
To estimate complete assembly shipping weight:

C/C Pole Spacing Multiplied By				Approx. Shipping Wt. Lbs.
26.5	plus	173 lbs.	=	_____
29.4	plus	174 lbs.	=	_____
22.2	plus	166 lbs.	=	_____
18.8	plus	176 lbs.	=	_____



Assembly View





Detail View

677 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength Pin Connection.

Fitting thickness - 3/8".

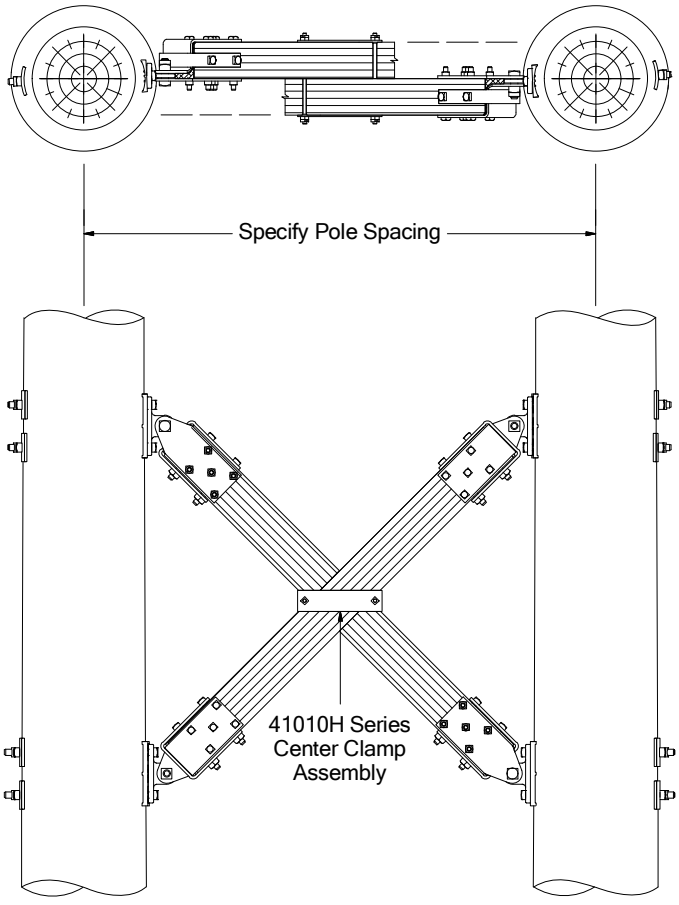
Cut thread mounting bolt diameters - 7/8". Standard bolt length furnished are 50% - 16" and 50% - 18".

Unless specified otherwise, assembly is furnished complete with all mounting hardware including tees, grid gains, pin bolts, washers, nuts and locknuts.

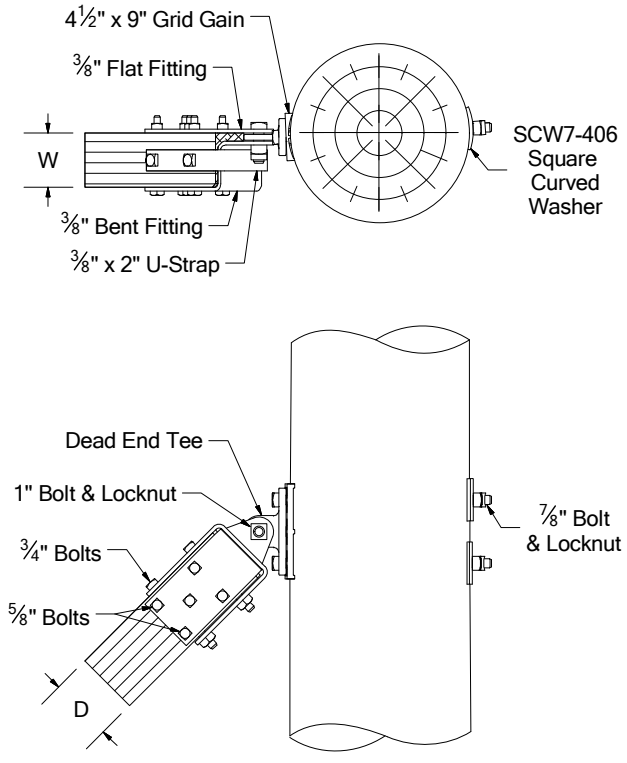
Catalog Number	Wood Size W		D	Center Clamp Assembly No.
677A	5 1/8"	x	6"	41010H-11
677B	5 1/8"	x	7 1/2"	41010H-8
677C	6"	x	6 3/4"	41010H-7
677D	6 3/4"	x	7 1/2"	41010H-17

To estimate complete assembly shipping weight:

C/C Pole Spacing Multiplied By				Approx. Shipping Wt. Lbs.
20.8	plus	198 lbs.	=	_____
26.1	plus	200 lbs.	=	_____
27.5	plus	198 lbs.	=	_____
34.1	plus	203 lbs.	=	_____



Assembly View



Detail View

678 Series X-Braces

Reference pages B3.5.16 to B3.5.18 for strength
Pin Connection. **Fitting thickness - 3/8".**

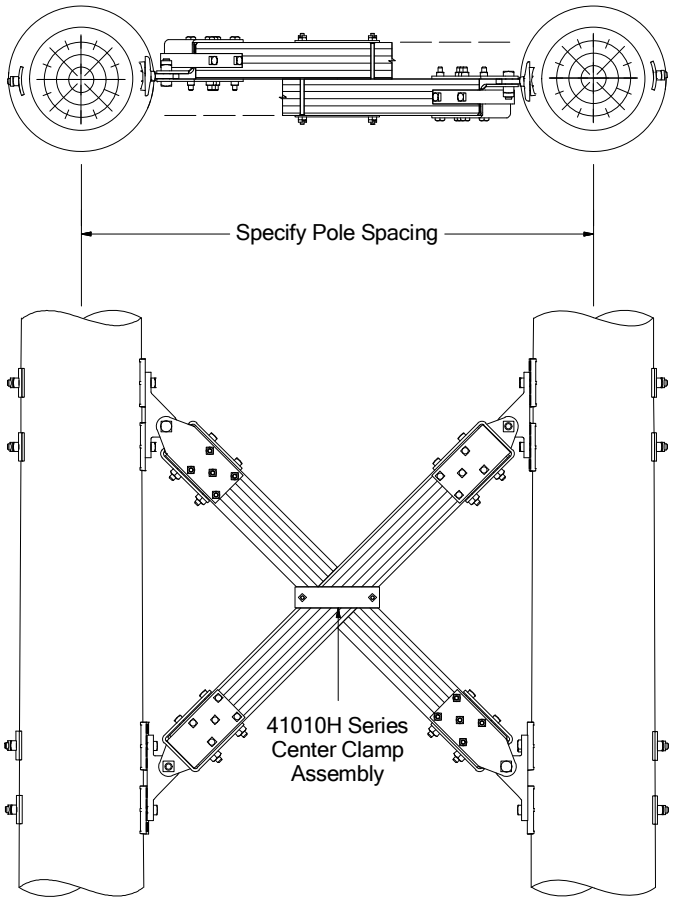
Cut thread mounting bolt diameters - 1". Standard bolt length furnished are 50% - 18" and 50% - 20".

Unless specified otherwise, assembly is furnished complete with all mounting hardware including tees, grid gains, pin bolts, washers, nuts and locknuts.

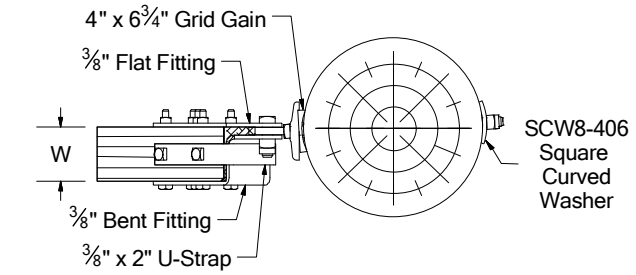
Catalog Number	Wood Size W		D	Center Clamp Assembly No.
678A	5 1/8"	x	7 1/2"	41010H-8
678B	6"	x	6 3/4"	41010H-7
678C	6 3/4"	x	7 1/2"	41010H-17
678D	5 1/2"	x	7 1/2	41010H-13

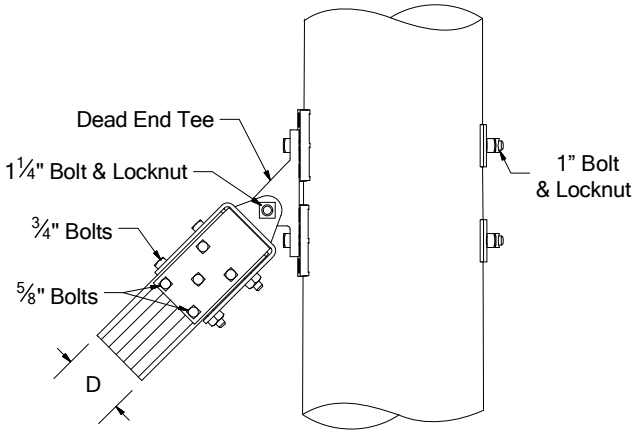
To estimate complete assembly shipping weight:

C/C Pole Spacing Multiplied By				Approx. Shipping Wt. Lbs.
27.5	plus	289 lbs.	=	_____
27.6	plus	289 lbs.	=	_____
33.2	plus	293 lbs.	=	_____
29.8	plus	285 lbs.	=	_____



Assembly View





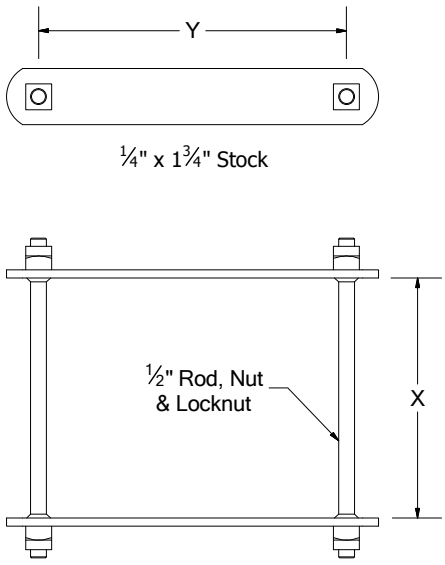
Detail View

X-Brace Center Clamps

Center clamps are furnished as sets of 2 straps and 2 shoulder rods, shipped complete with nuts and locknuts.

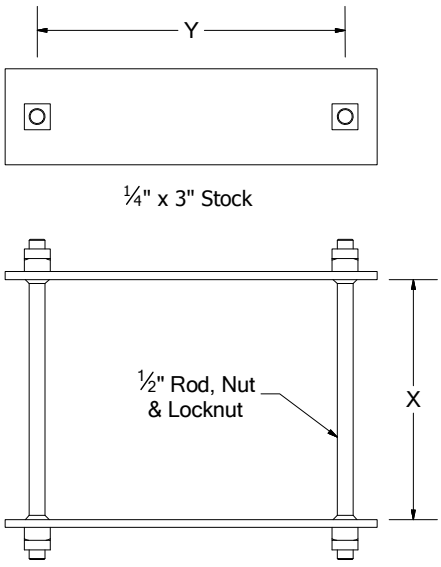
Center clamps function equally well when installed in either the vertical or horizontal plane. However, by mounting the center clamp straps in a horizontal plane, risk of damaging fallen conductor at the center phase is reduced.

41010 Series Center Clamps



Catalog Number	Rod Shoulder Width "X"	MHC Strap "Y"	Wood Section	Approx. Wt. Lbs.
41010-1	6¾"	7⅝"	3⅜" x 4⅜"	3.7
41010-2	6¾"	9"	3⅜" x 5⅜"	4.1
41010-3	7⅜"	13½"	3 11/16" x 8½"	5.1
41010-4	7½"	9⅝"	3¾" x 5¾"	3.9
41010-5	7¼"	12"	3⅝" x 7½"	4.9
41010-6	10¼"	14¼"	5⅛" x 9"	5.7
41010-7	12"	11"	6" x 6¾"	5.9
41010-8	10¼"	12"	5⅛" x 7½"	5.3
41010-9	7¼"	13½"	3⅝" x 8½"	5.1
41010-10	9"	11"	4½" x 6¾"	4.9
41010-11	10¼"	9⅞"	5⅛" x 6"	4.8
41010-12	9¼"	9⅜"	4⅝" x 5⅝"	4.4
41010-13	11"	12"	5⅝" x 7½"	5.2
41010-14	7½"	12"	3¾" x 7½"	4.7

41010H Series Center Clamps



Catalog Number	Rod Shoulder Width "X"	MHC Strap "Y"	Wood Section	Approx. Wt. Lbs.
41010H-4	7½"	9⅝"	3¾" x 5¾"	6.2
41010H-5	7¼"	12"	3⅝" x 7½"	7.5
41010H-6	10¼"	14¼"	5⅛" x 9"	8.8
41010H-7	12"	11"	6" x 6¾"	8.0
41010H-8	10¼"	12"	5⅛" x 7½"	7.8
41010H-9	7¼"	13½"	3⅝" x 8½"	8.1
41010H-10	9"	11"	4½" x 6¾"	7.2
41010H-11	10¼"	9⅞"	5⅛" x 6"	7.8
41010H-12	9¼"	9⅜"	4⅝" x 5⅝"	6.5
41010H-13	11"	12"	5⅝" x 7½"	7.8
41010H-15	9½"	9⅝"	4¾" x 5¾"	6.7
41010H-16	9"	9⅜"	4½" x 5½"	6.5
41010H-17	13½"	12"	6¾" x 7½"	8.4

The 41010H Series Heavy Center Clamps have ¼" x 3" straps and are used with BROOKS series 670, 671, 675, 677 and 678 Series X-Braces where heavier loading is imposed.

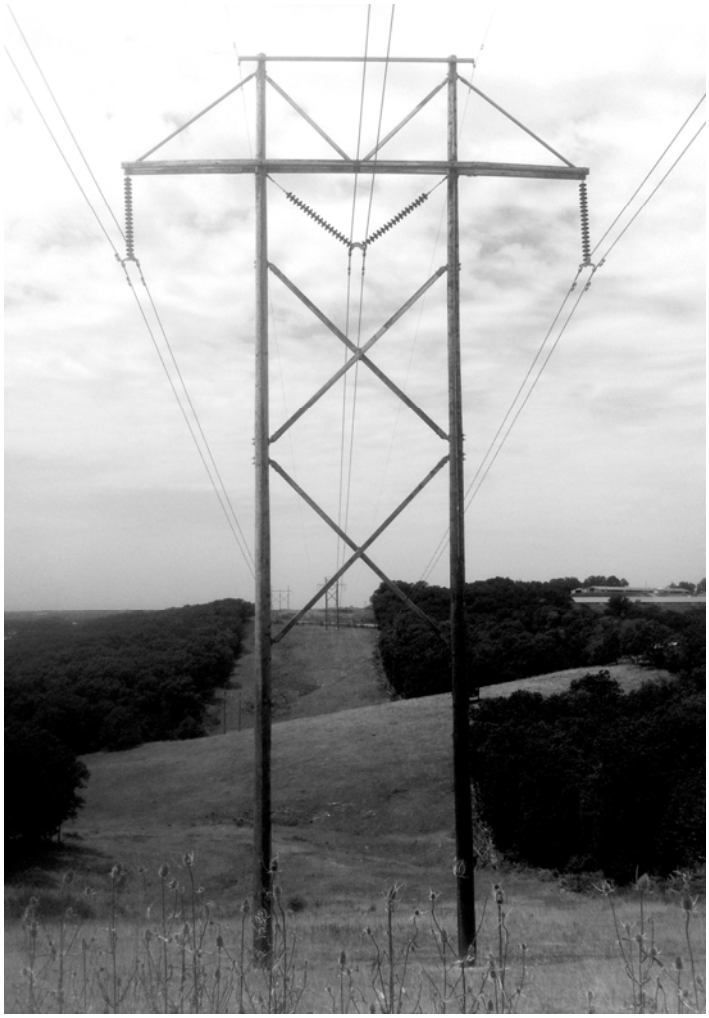
X-Brace Strength

X-Brace Axial Forces

X-braces are effective framing components for H-frame structures. Brace axial forces can be either tensile or compressive, and are a function of the specific structure configuration and the total imposed wind and gravity loads. Factors which affect X-brace axial forces include pole spacing, structure height, pole species and class, the quantity and position of the braces, stiffness of the upper H-frame truss, and class of soil.

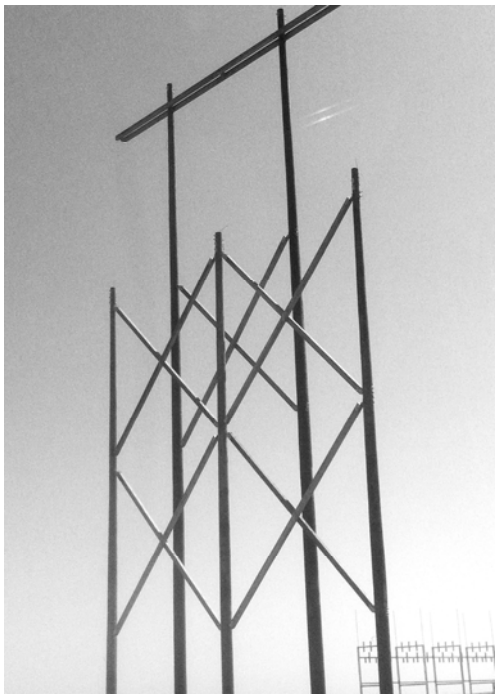
Strength & Stiffness Considerations

Several limiting factors must be balanced when selecting the most economical X-brace design for a given set of structure and loading parameters. Limits for these factors have been determined for a wide variety of connection designs and wood sizes, using data developed by the testing of components and full scale structures. Final brace selection is controlled by the most restrictive of these factors.



Axial Tension - End fittings must distribute the axial load into the wood member, controlling wood bearing stresses and fitting deformation.

Bearing On The Pole - Bearing stresses parallel or perpendicular to the grain in the wood pole are species sensitive, and must be limited under the fittings, washers, and bolts.

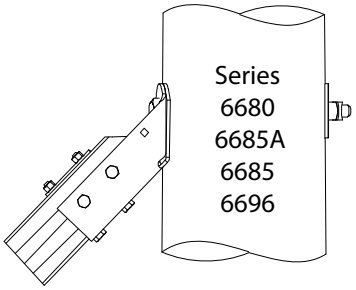


Compressive Buckling - The accepted industry method for determining the ultimate theoretical compressive strength of a wood X-brace, either solid or laminated, is an adjusted Euler buckling equation. It is dependent on the slenderness ratio and material modulus of elasticity, and is affected by end fitting relative fixity and load eccentricity.

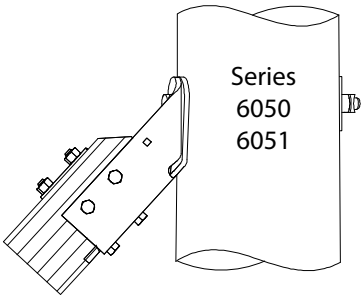
Vibration - Extremely slender compression members are subject to wind induced vibration. This can cause fatigue, and should be avoided.

X-Brace Strength continued..

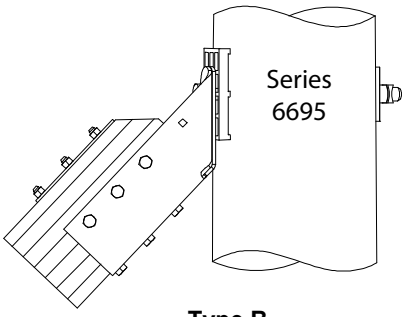
The curved portions of the nomograph on page B3.5.18 indicate relative X-Brace member compressive buckling strength for various wood sizes and pole spacing. Parameters selected for the curve plot include braces at 45 degrees, a conservative modulus of elasticity, a consistent adjustment factor for the Euler buckling equation, and a slenderness ratio maximum of 50. The curve position will vary with these parameters according to your specific application.



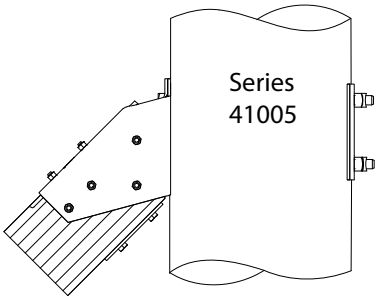
Type A
$\frac{7}{8}$" Bolt, $\frac{1}{4}$" Fitting



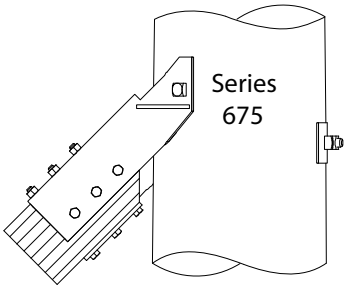
Type A1
$\frac{7}{8}$" Bolt, $\frac{3}{8}$" Fitting



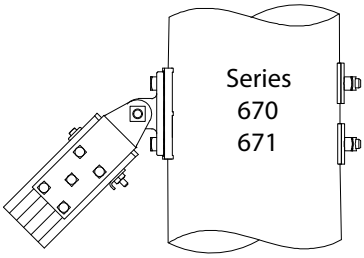
Type B
1" Bolt, $\frac{1}{4}$" Fitting



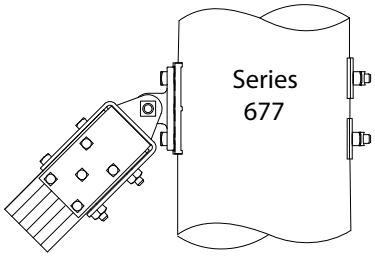
Type C
Double $\frac{7}{8}$" Bolt, $\frac{1}{4}$" Fitting



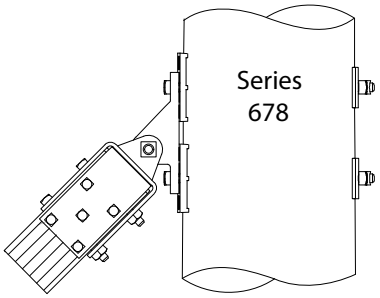
Type D
Wrap Around



Type E
Pinned



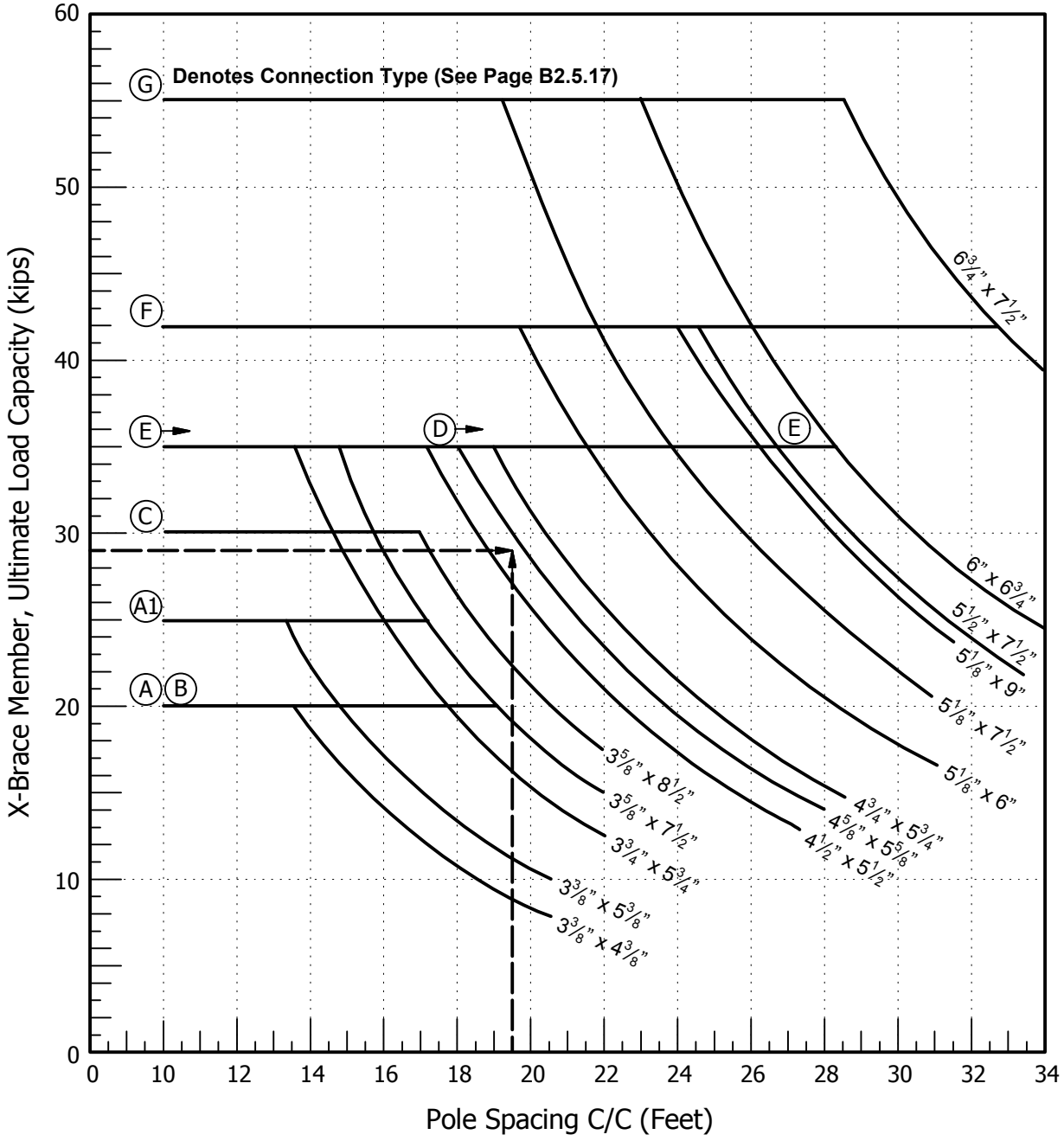
Type F
Heavy Pinned



Type G
Extra Heavy Pinned

The braces are also limited by the combination of axial tension in the connection and bearing on the pole. The various X-Brace Series connection designs have been classed as Types A through G as shown above. The member load limit for each connection type is indicated by a horizontal line on the page B3.5.18 nomograph.

X-Brace Member Axial Strength Limitations



Example for Preliminary Selection of X-Braces

Given: Pole Spacing = 19'-6" and X-Brace load = 29 kips

1. Enter pole spacing axis and project a vertical line up from 19.5 feet.
2. Enter X-brace ultimate load capacity axis and project a horizontal line right from 29 kips.
3. The intersection of the projected vertical and horizontal lines indicates that the minimum required section size is $4\frac{5}{8}$" x $5\frac{5}{8}$".
4. This intersection point also indicates that connection types D and E have a connection capacity in excess of 29 kips.
5. Refer to page B3.5.17. Initial selections would be 670C (page B3.5.10) or 675C (page B3.5.12).

Contact BROOKS Engineering Department for assistance in selecting the brace which will best serve your application.