WAGNER®
Employee Owned

Designing a Wood Railing

Instructions

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Inside:

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Designing A Wood Railing With Cable As An Infill

Overview

There are eight considerations in designing a railing with cable infill:

1. Construction and location of your end posts
2. Configuration of any corners in your design
3. Location of intermediate posts
4. Location of additional cable supports
5. Cable diameter to use
6. Spacing of cables on your end post
7. Whether to cut cables and install fittings in the field, use factory-cut and swaged cables, or use retail kits
8. Hardware options

We will address these considerations in order.

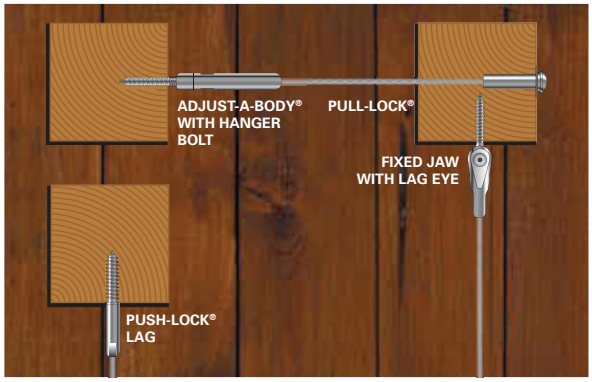
1. Construction and location of your end (terminating) posts.

An end post is a post to which terminating cable ends are attached with tensioning or non-tensioning hardware. Considerable tension is applied to the end posts, when the cable is properly tensioned. A substantial end post is necessary to prevent the end post from bending which will cause the cables to sag. In wood, a minimum 4x4 end post is required. End posts must be securely fastened to the top rail and deck or other surface to prevent the post from coming loose with the forces applied through the tensioned cables.

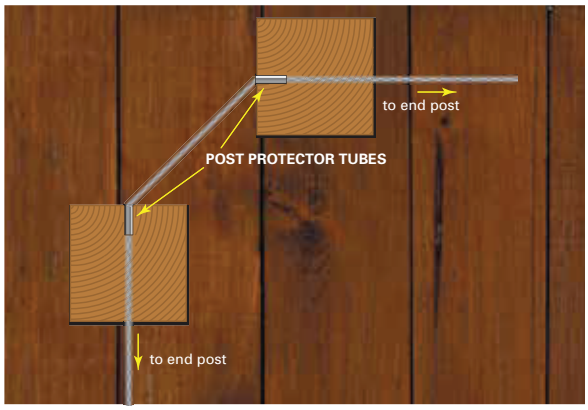
Support members between end posts are also necessary. In wood, we recommend support members running between posts, such as a 2x4 secured to the inside of each post, so you are not relying on the shear strength of the nails or screws to support the tension applied to the end post.

2. Configuration of any corners in your design.

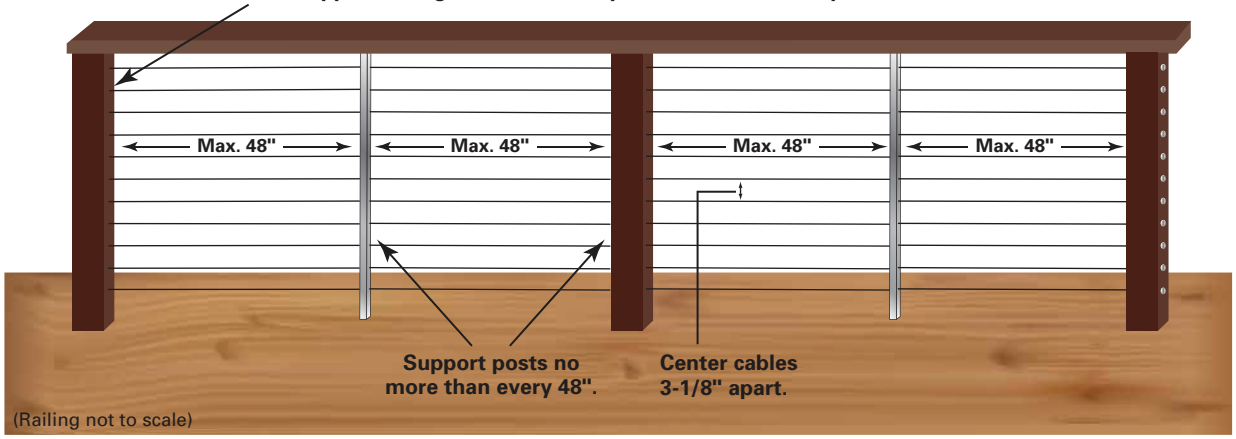
At corners or turns of more than approximately 45 degrees, it is best to terminate your runs in each direction with an end post (minimum of a nominal 4x4). The following illustrations demonstrate how this is done.



A corner may be designed using two posts on the corner and running the cables between the posts as illustrated below.



When going around a corner, the cable will often enter or exit the post at an angle. To prevent



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the cable from biting into the wood when it is tensioned, the wood in the post must be protected. Post protector tubes are available from the factory (see the *Accessories* section of this publication for order information).

The post protector tube is a flared length (3/4") of tube that is pushed into the hole for the cable, so the cable rests against it as opposed to the wood itself. The inside diameter of the tube is just large enough for the cable to pass through, so its use requires either swageless fittings or on-site swaging; no pre-swaged fittings will pass through the post protector tube.

On a turn of less than approximately 45 degrees, you can run your cables through a single post, but you will still need to protect the post where the cable enters or exits the post at an angle to prevent the cable from biting into the wood when it is tensioned.

See **No. 8** for other hardware combinations that can be used on corner posts.

3. Location of intermediate posts.

Intermediate posts (or mid-posts) are placed between end posts. An intermediate post runs from the top rail to the lower mounting surface and is a structural element. Intermediate posts should be placed at intervals between end or corner posts as frequently as necessary to meet building code requirements. An engineer or design professional should be engaged, if you are unable to otherwise determine intermediate post spacing.

Cable is strung through holes drilled in the intermediate posts, so intermediate posts also become supports for the cable between end posts.

With cable spaced vertically on centers as recommended below (see **No. 6**), we recommend that the cable be supported in some manner no more than every 48" along its run. The support can be provided by an intermediate post or it can be something thinner such as a 2x4 or a thin steel or aluminum cable brace (see **No. 4** below).

4. Location of additional cable supports.

Regardless of the amount of tension you apply to the cables, there will be some flex in the cable when it is installed. When the cables are spaced vertically on your end post as recommended in **No. 6**, we recommend that the cable be supported in some manner no more than every 48" along its run, to meet code requirements that a 4" sphere cannot pass through the cables.

As indicated, this support can be provided with intermediate posts or a lighter material acting as a cable brace. As with an intermediate post, a cable brace also runs between the top rail and the lower mounting surface, but its purpose is only to support the cable. It is not intended to be an element providing structural support to the railing.

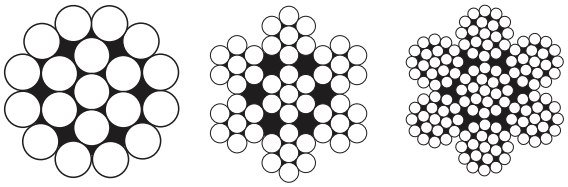
Cable braces can be much thinner and, therefore, less obtrusive than posts, as their primary purpose is only to support the cable.

A 1/4"x1" steel flat bar (stainless steel recommended) or 3/4"x3/4" aluminum tube, with holes drilled for the cables to pass through, makes an excellent cable brace. Both types of cable braces are available from the factory (see the *Accessories* section of this publication for order information).

5. Cable diameter to use.

It is important to use 1x19 construction cable as a railing infill, because it is attractive, smooth to the touch, and designed to support loads in tension with minimal stretch.

The individual wires in 1x19 construction cable are much larger than those used in more flexible constructions. This makes the cable less prone to damage from abuse, and it is also the reason why strand does not stretch as much as other constructions.



1 x 19
Non-Flexible

7 x 7
Flexible

7 x 19
Very Flexible

You will want to specify type 316 stainless steel, because it is the most corrosion resistant commercially available alloy used in manufacturing cable. Ultra-tec® hardware is made from type 316 stainless steel, so no material compatibility issues will arise when you use type 316 stainless steel cable with Ultra-tec® hardware.

For commercial railing, it is important to use at least a 3/16" diameter cable. Problems have been experienced with damage from abuse when 1/8" diameter cable has been used. Following are minimum breaking strengths for type 316 stainless steel cable.

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Cable Minimum Breaking Strengths

Cable Dia.	Minimum Breaking Strength (Lbs.) For Following Cable Constructions in Type 316 Stainless Steel		
	1x19	7x7	7x19
1/8"	1,780	1,360	1,300
3/16"	4,000	3,300	2,900
1/4"	6,900	5,500	4,900
5/16"	10,600	7,600	7,600
3/8"	14,800	11,700	11,000

NOTE: Ultra-tec® hardware is designed for use in pedestrian guardrailings. For other applications, consult the factory for suitability.

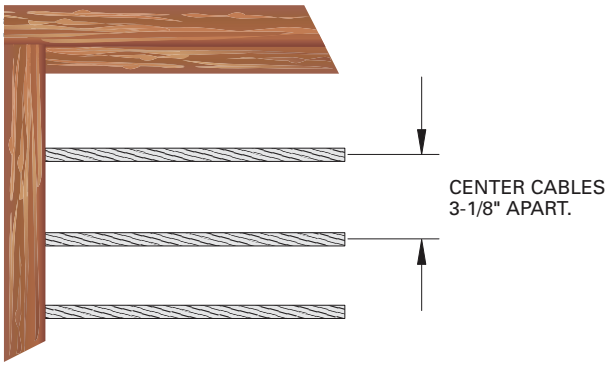
As the chart above illustrates, for a small increase in size (and cost) you can more than double the strength of your infill and ensure that damage from abuse is not an issue with your railing.

6. Spacing of cables on your end post.

Even though you use 1x19 construction cable and the cables are properly tensioned on a strong end post, there will be some flex in the cable when a load is applied.

The spacing of the cable on the end posts works together with the distance between points where the cable is supported, to minimize cable flex. The closer together the cables are spaced on the end posts, the longer the distance can be between cable support points. The reverse is also true.

Weighing the desire to use as few cables as necessary with the need to minimize cable flex, we recommend maximum vertical spacing of the cables on your end posts be 3-1/8" on center.



7. Whether to cut cables and install fittings in the field or use factory-cut cables.

There are three choices to consider for attaching fittings to the cables. Cables can be: 1) cut at the job site and the fittings attached using swageless fittings; 2) cut at the job site and swaged on the cables using equipment and tools rented or purchased from the factory or a distributor; or 3) supplied by the factory or a distributor cut to length with the fittings attached to the cable. Complete instructions are included with orders.

Swageless Fittings

Swageless fittings are installed by hand in the field. No special equipment is needed, except cable cutters. (As with any method of installing, we also recommend that you use special cable gripping pliers to keep the cable from turning when you tighten the fittings to tension the cable. Cable cutters and cable gripping pliers can be ordered from the factory and some distributors).

The first advantage is that the holes the cables pass through in your intermediate posts do not have to be any larger than is necessary for just the bare cable to pass through. If you have fittings already attached to both ends of the cable, your intermediate post holes must be at least as large as the diameter of the smallest fitting attached to the cable. The difference between the hole and cable diameters will be 1/16" or more, which will cause more cable deflection than the tighter fit obtained if the fittings are swaged on site.

The second advantage is that there is no need to provide accurate measurements to a second party who is doing the cutting and swaging of the cables. This eliminates the possibility for misinterpreting your dimensions. In the field, the cables are cut slightly longer than necessary and one end fitting is attached to the cable. This allows you to measure and cut the cable to exact length before attaching the Push-Lock® or Pull-Lock® fitting. One end of your cable will be a swaged-on tensioning device, which you will use to tension your cables once installed. You do not have to wait for someone else to make the cables and ship them to you and take the chance that some of them may not be cut correctly. Most importantly, you are in control of when the cables are made.

Field Swaging

Field swaging offers the advantage that you do not have in using swageless fittings, in that your choice of fittings is unlimited when you field swage. Field swaging requires the use of a swaging kit and an air

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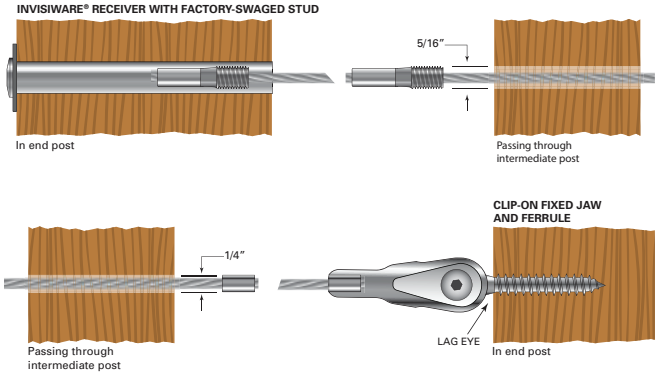
compressor (see our catalog or installation guide for compressor specifications) to attach the fittings to the cables. All of the equipment necessary is available for purchase or rental from the factory and through some distributors.

Factory Swaging

If the cables are cut and the fittings swaged by us, you do not need to use special equipment. There is a charge for factory cutting and swaging, but for smaller jobs the cost will be less than renting the equipment required to field swage the cables.

Some Ultra-tec® hardware is designed to pass through holes in your intermediate posts that are drilled as little as 1/16" larger than the diameter of the cable, when both ends are swaged by us.



Where the cable will not pass through any intermediate posts, you can order factory-cut and -swaged cables using any hardware. You are not limited as to the fittings you can use.

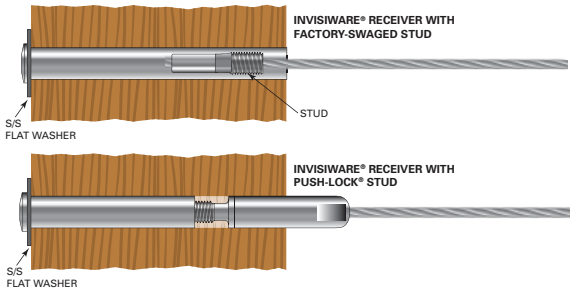
If you can use our Push-Lock® or Pull-Lock® fitting on one end of your cable, we can supply your cable with one of our tensioning devices (see **8-A**) on one end and only bare cable on the other end to which the Push-Lock® or Pull-Lock® fitting will be attached by hand. The advantage is that you can drill your intermediate post holes just large enough for the cable to pass through.

8. Hardware options.

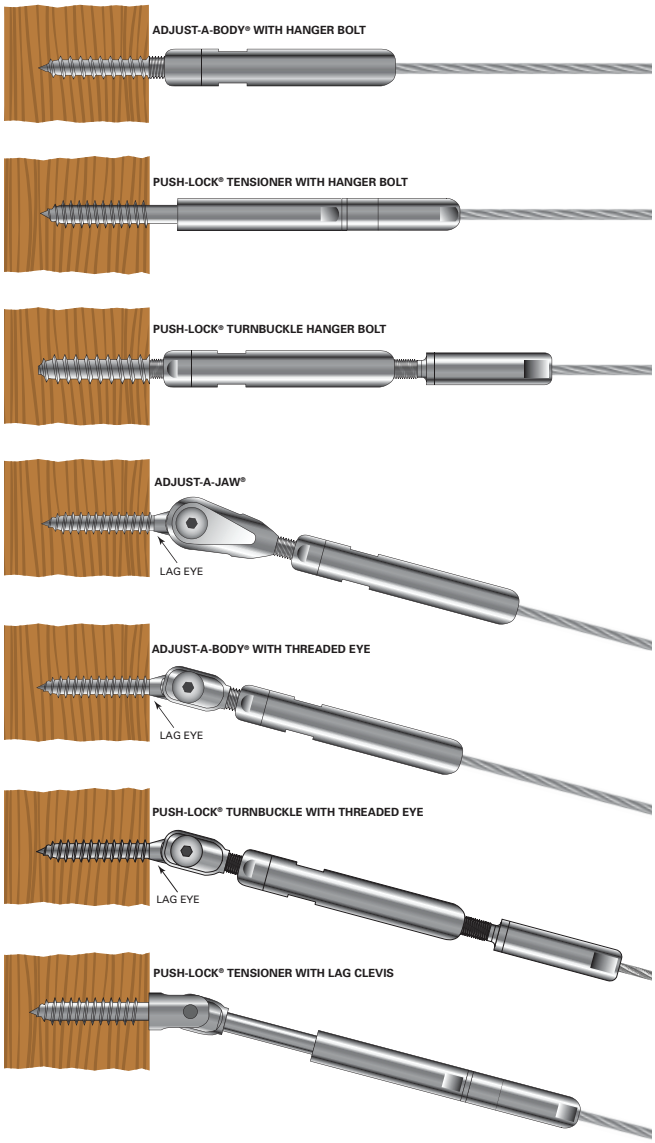
If your cables will be cut and the fittings swaged on at the factory, you will need to provide the factory with measurements for your cable runs after the posts have been installed. The factory will incorporate those measurements into a layout sheet for you to approve so the cable is cut to the correct length.

A. Mounting hardware on your end posts. If you are mounting hardware on two sides of your corner posts, then your corner posts are considered end posts for this discussion.

You will need to put tensioners on at least one end of each cable run. Following are ***tensioning devices.***



Note: With the Invisiware® Receiver or Receiver with Push-Lock® stud tensioner, you will need up to 3-3/4" of space between the back of your end post and any structure in order to insert the fitting into the end post from the back side.



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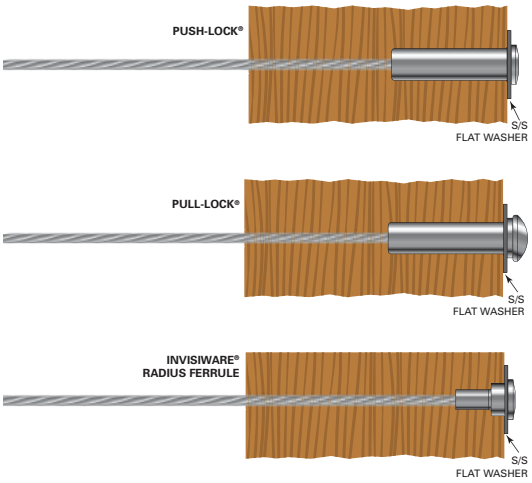
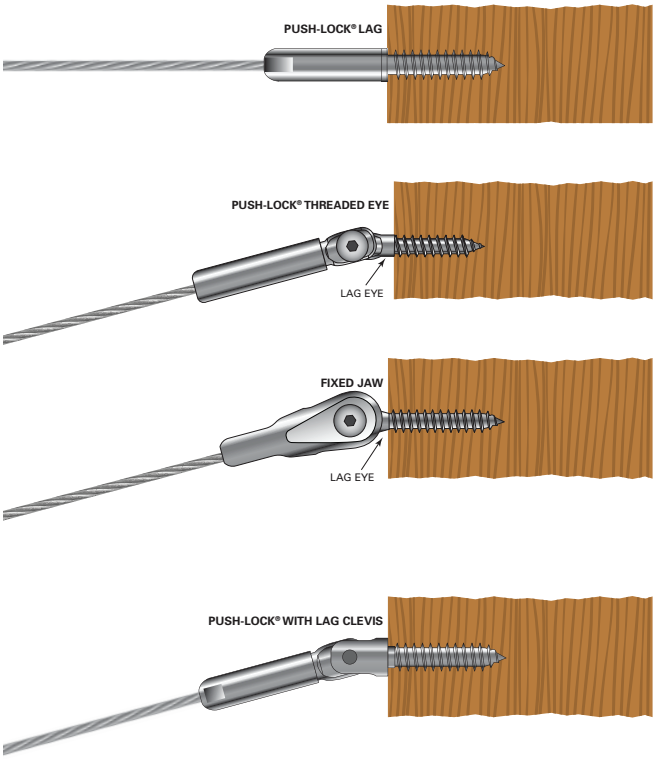
The other end of each cable run can be either a tensioner or a non-tensioning device. Following are ***non-tensioning devices.***

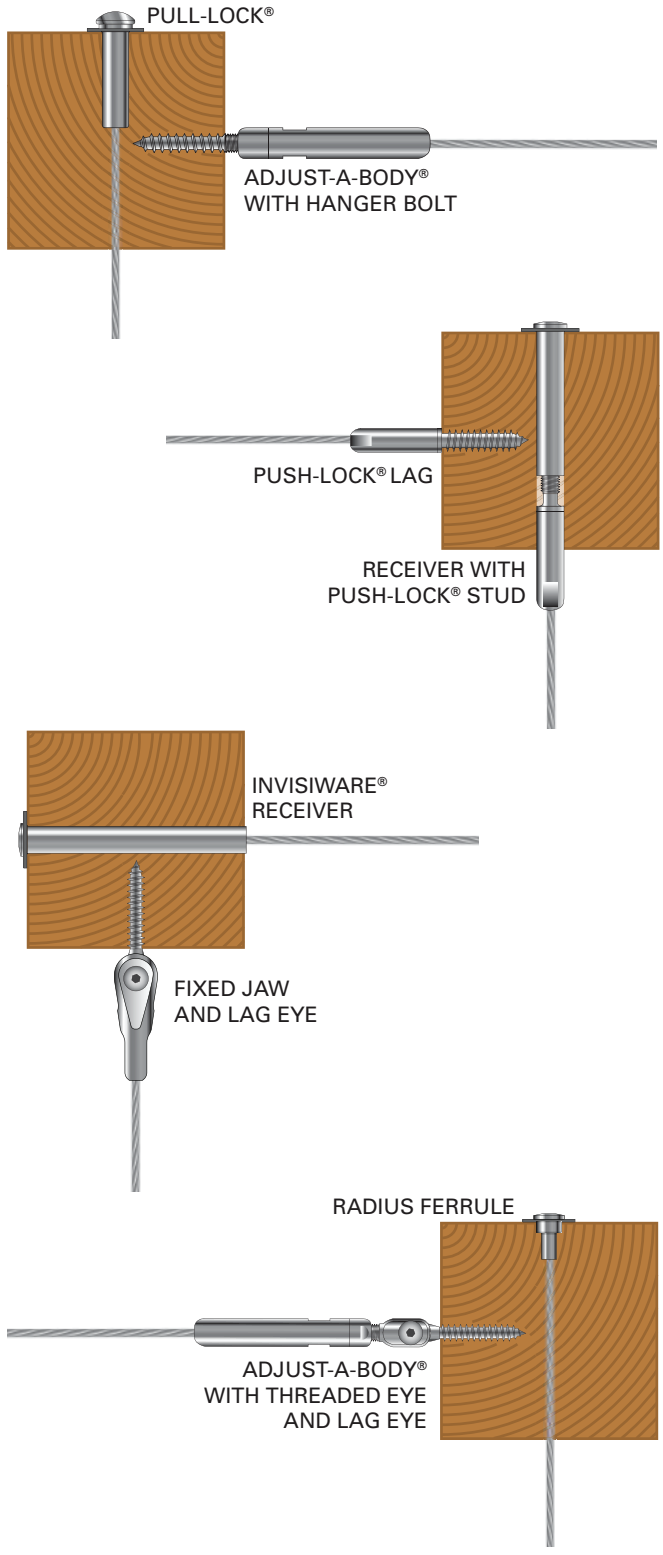


Note: With the Push-Lock®, Pull-Lock®, or Radius Ferrule fittings, you will need approximately 2-1/2" of space between the back of your end post and any structure to insert the fitting into the end post from the back side.



B) How you wish to configure your corners (if applicable). See **No. 2.** *Configuration of any corners in your design* for ways to treat your corners.

The following illustrations demonstrate how the hardware can be used on a single corner post. Not all combinations are shown here. If the hardware and cable run all the way through the post in one direction, you will need to use a hanger bolt end or hardware that is mounted to a lag eye for the perpendicular direction, as shown in the first four illustrations that follow.



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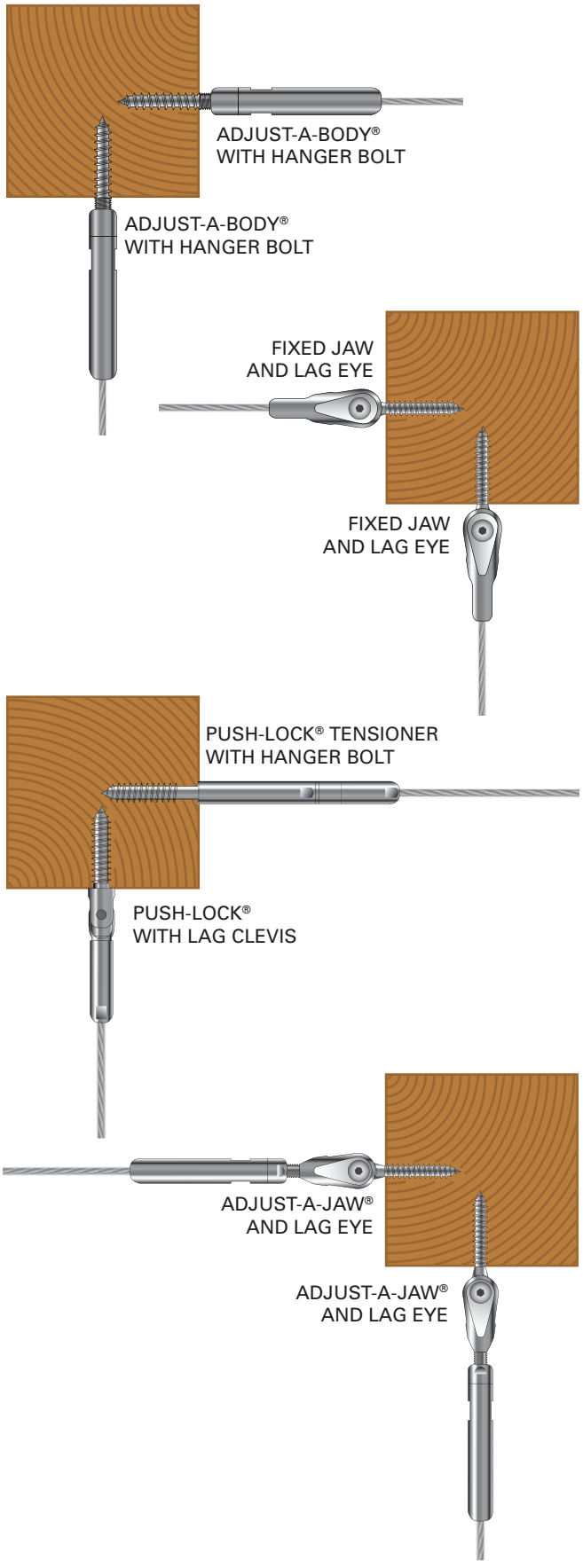
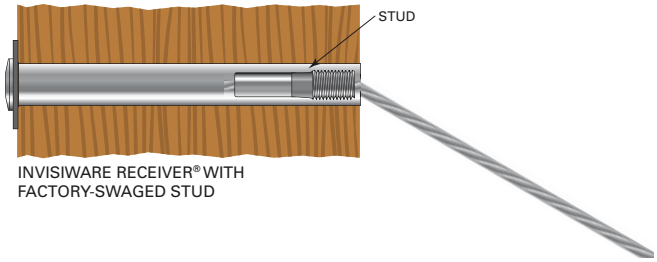
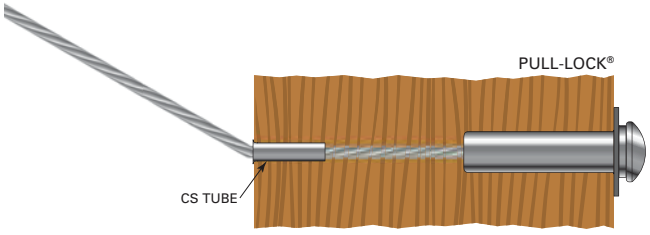


C) Hardware used for stairs or angled runs.
You can use any of the articulating fittings in conjunction with a lag eye to accommodate stairs and runs that angle out of the end post. These fittings are Adjust-A-Jaw®, Adjust-A-Body® with Threaded Eye, Push-Lock® Tensioner with Lag Clevis, and Push-Lock® Turnbuckle with Threaded Eye tensioners. Non-tensioners for use in these applications include the Fixed Jaw, Push-Lock® with Threaded Eye, and Push-Lock® with Lag Clevis.

You can also use R-6-62 Invisiware® Receivers and Pull-Locks® on your 4x4 (3.5" square) end posts *without having to drill your holes at an angle.*



Invisiware® Receivers are less expensive than articulating fittings and do not require lag eyes and screws to mount them. When installed, they are hidden inside the end post to help preserve that special view. The R-6-62 Invisiware® Receivers are especially designed for 4x4 wood posts and can be an excellent choice for stairs and angled runs as well as straight runs.



Pull-Lock non-tensioners work well opposite the Receiver in stair and angled runs from wood posts. When coupled with a post-protector tube, they complement the Receiver while allowing the cable to be trimmed on site.

Conclusion

Cable as a railing infill is attractive, easy to install and virtually maintenance free. Understanding the above considerations when designing your cable railing will go a long way toward ensuring that code requirements are met with a railing that you and your customer will be proud of.

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