Fencing
FACTSHEET

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BRACE ASSEMBLIES FOR WIRE FENCES

End, Inline and Change-of-Direction Braces

This factsheet outlines brace construction for wire fences, ranging from single post to multiple post braces. Refer to Factsheet 307.220-1 for explanation of brace function, sizing and how braces fail.

TYPES OF BRACES

Refer to Table 1, page 2, for an outline of the types of braces being discussed. They include single-post, two-post and three-post styles with horizontal and diagonal rails, for end and inline requirements.

SINGLE-POST BRACES

These braces are the simplest and least expensive but are generally used for only the lowest fence loading conditions. They should be constructed in firm soil. There are three basic types all using a post diameter size one larger than the line posts.

Basic Single-Post Brace

A wooden post driven 3-1/2 to 4 feet in firm soil can be used as an end post. One to three wires can be tied off at this post. These wires should only be low tensioned wires such as in an electric fence. Because it lacks any bracing the single post relies only on post-to-soil friction. Effectiveness can be increased by burying a 2 foot long block of wood (pressure treated) just below ground level at right angles to the pull of the fence wires to act as a thrust block. Refer to Figure 1, below. This design is suitable for an end brace but not generally for a corner brace. (Refer to **Factsheet 307.600-1** for using single posts as "braces" when fencing around corners)

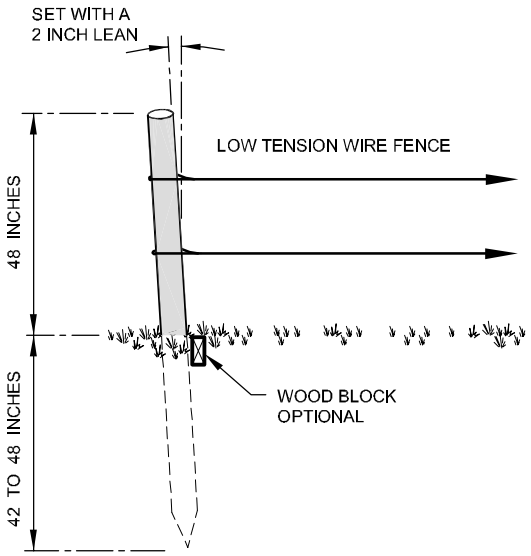
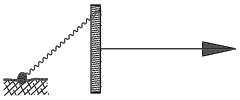
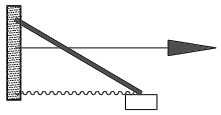
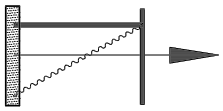
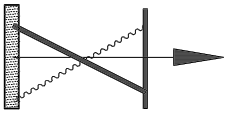
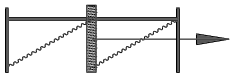
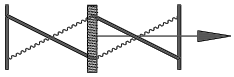
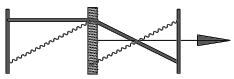


Figure 1 **Single-Post Brace**

Table 1 STANDARD END BRACE ASSEMBLIES

Type of Brace	Diagram	Comments	Page of this Factsheet
Single-post		For 1–3 low tension wires, such as electric fences.	page 1
Single-post, Deadman anchor		Requires suitable anchor. Simple with good load rating. Possibly equal to double span with suitable soil and deadman anchor.	page 2
Single-post, Diagonal brace ("Kiwi" brace)		Diagonal must be able to move freely on slider.	page 3
Two-post, Horizontal rail		**Standard for 6 wires or less. Easy to construct properly.**	page 4
Two-post, Diagonal rail		For 6 wires or less. Requires good rail-to-post connections.	page 6
Three-post, Horizontal rails		**Standard for over 6 wires or poor soils. Pull from centre.**	page 7
Three-post, Diagonal rails		For over 6 wires or poor soils. Requires good rail-to-post connections. Pull from centre.	pages 8
Three-post, Mixed rails		For over 6 wires or poor soils. Requires good rail-to-post connections. Pull from centre.	page 9

ALL BRACES HAVE FENCE WIRES TIED OFF ON THIS POST

Single-Post, Deadman Anchor Brace

Adding a deadman anchor to the single post increases the load rating (Figure 2, below). Buried steel or wood anchors or steel screw-type anchors are used. Firm soil is required for best results. Steel "foot and cable" anchors are available that are driven into the ground then pulled to set the foot. Screw-type anchors (manual or machine assisted installations) are difficult to install in rocky soil. In light soils, the post may tend to be driven downward by the interaction of the fence and anchor loads. This design can be used as either an end or corner brace. For corners, use two anchors to resist the fence loads of both fence lines.

This design can support loads equal to a double span brace with suitable soils and deadman anchors.

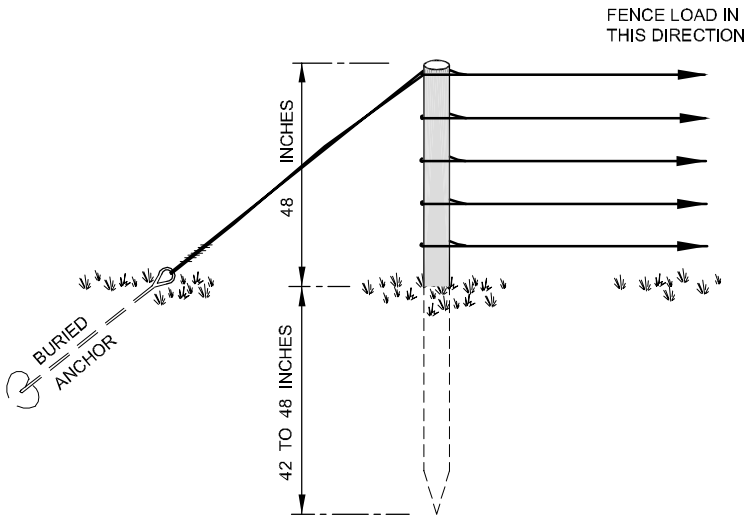


Figure 2 Single-Post, Deadman Anchor Brace

Single-Post, Kiwi Brace

The third single driven post brace design is one termed the "Kiwi" brace from its use in New Zealand. It's both simple and effective with load capacity equal to the single span braces. It is a modification of a diagonally supported post without the tendency for the diagonal to "jack-out" the end post. **It is most important that the lower end of the diagonal rail be allowed to move freely to reduce this "jacking-out" tendency.** A slider block is used for this as shown in Figure 3, page 4.

Two versions are used; one with a steel rod for a lower member and one with two wraps of htsw fence wire. Both are effective; the rod is likely more expensive but will resist side-to-side movement better. In either case a slider is used that will allow free movement of the diagonal in response to fence loads. Note that side to side movement of this rail is **not** desirable and a short stake may be required on either side of the lower end of the rail.

The lower tension member (rod or wire) should not be over tightened, only enough to remove any slack. The two wraps of htsw do not need to be twisted together. Once the fence wires are tied off to the brace and tensioned, the brace will "set".

This design is suitable as an end and inside brace. When constructed as a corner brace, two diagonal braces and tension wires are used to resist the fence load in the two directions.

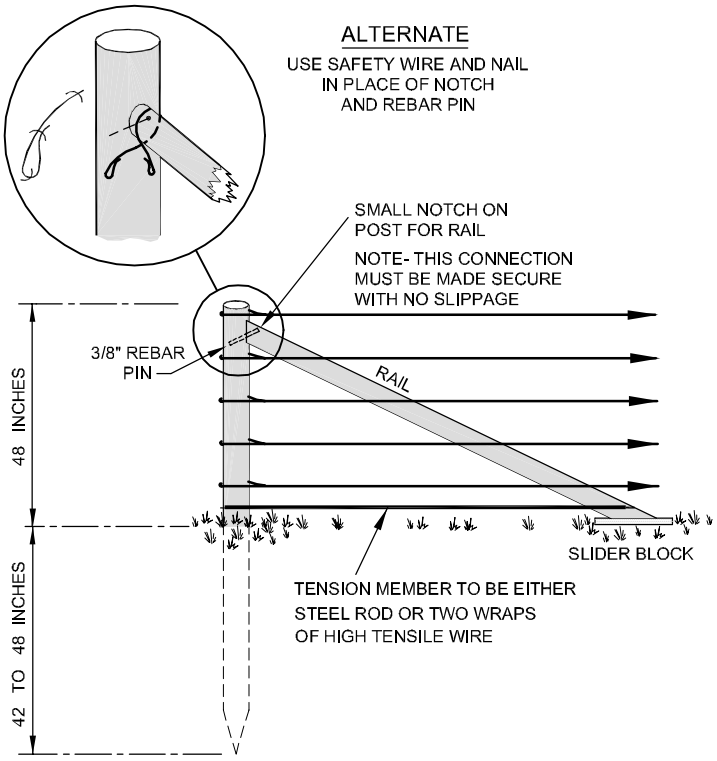


Figure 3 **Single-Post, "Kiwi" Brace**

TWO-POST BRACES

These are the most commonly used braces and are built using either a horizontal or diagonal rail. Where soil conditions are suitable (firm, not sandy) they can be used in virtually all livestock fences. Generally the driven posts are one diameter size larger than the line posts and the rail the same diameter size as the line posts. They are simple to construct and effective if the following points are considered.

Two-Post Brace Recommendation

The two types of two post braces (horizontal rail - page 5 and diagonal rail - page 6) can be considered to have very similar load capacities (in similar soils). However, the construction of the diagonal brace **requires good connection of the rail ends to each post.** These take more time and poor joints will allow movement and encourage failures. As well, the horizontal rail design can be loaded in both directions (as an inline brace) simply by locating the brace wire(s) in the correct direction. The diagonal rail design can only be loaded in one direction (reverse loading will cause the brace wire to slacken).

It is for these reasons that the easier-to-construct horizontal rail design is usually recommended and the most often built brace assembly.

Two-Post, Horizontal Rail, End Brace

This is the standard design for fences of 6 wires or less in suitable soils (Figure 4, below). The construction sequence is given below.

This brace can be used as an inline brace where long runs of straight fence have no corners for tie off. In this case, fence wires will be pulling from t**wo directions** (not one as in an end brace) so **two brace wires** are required. The brace wires should be free to move independently, **not** twisted together. Note that double span braces are often used as inline braces because of their added strength (Figure 7, page 8 and in Figure 9, page 9).

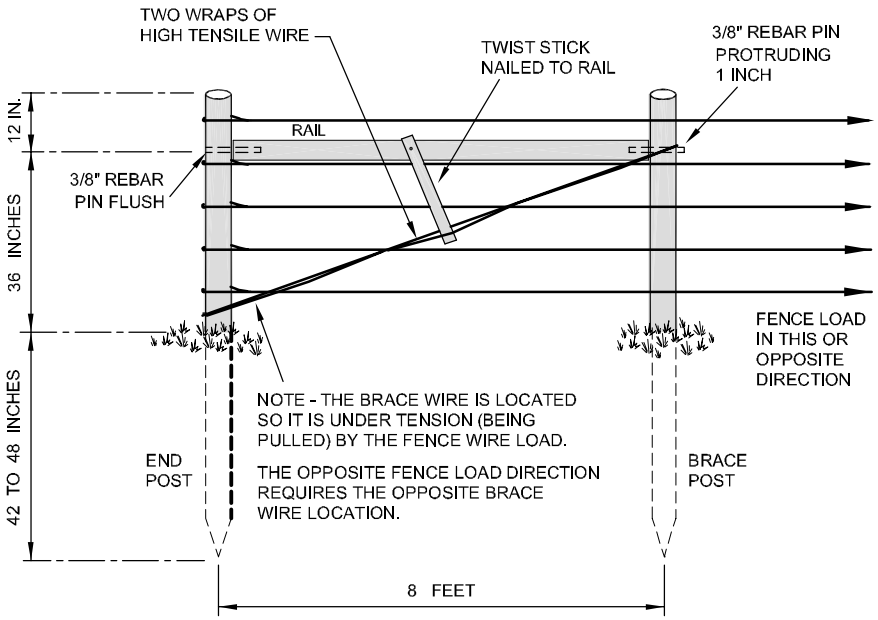


Figure 4 Two-Post, Horizontal Rail, End Brace

Two-Post Brace Construction

Two driven posts are connected by a rail and tensioned together by a brace wire. The rail-to-post connections are drilled (to prevent splitting) and pinned or nailed. Two diagonal wraps of 12 ½ ga high tensile smooth wire complete the brace giving it the required strength while maintaining flexibility under shock loads (i.e. falling trees).

The two-post, horizontal rail is the standard brace for fences of 6 wires or less in suitable soils. Construction steps are:

- drive the end post with a 2 inch lean away from the fence load
- drive the brace post spaced twice the fence height from the end post
- mark the drill holes on both posts at approximately ¾ fence height from the ground (i.e. 3 ft on a 4 ft fence)
- drill a 3/8 inch diameter hole through each post in line with the fence
- cut the rail length to fit snug at this ¾ point
- drill a 3/8 inch diameter hole 3 inches deep in the center at each end
- place the rail in position lining up the drilled holes
- drive a 3/8 inch rebar pin through the posts and into each end of the rail
- leave pin protruding 1 inch from the brace post; drive pin flush in the end post
- drive a staple into the base of the end post about 4 inches from the ground
- bend the end of the brace wire into a “U” shape and hook onto the protruding brace post pin

- wrap two full turns around the staple and the pin
- pull all slack out of the brace wire
- hook the remaining end of brace wire around the pin
- staple off both hooked ends of the brace wire
- twist the brace wire using a twist stick to remove the wire slack
- secure the twist stick to the rail (nail or wire on)
- attach the line wires

Two-Post, Diagonal Rail, End Brace

This design is very similar to the previous except the rigid rail is placed diagonally instead of horizontally between the two driven posts (Figure 5, below). When loaded by the fence wires, this brace reacts as a horizontal rail brace except the diagonal rail applies its load to the bottom of the brace post rather than the top. The brace wire is under tension as the brace post is moved in the direction of the load. Good connection of the rail to the post is important to prevent the diagonal rail from slipping under load.

This brace tends to have less end post movement in the direction of the load (compared to the horizontal rail brace) but has a greater uplifting force on the end post. Deeper placement of this end post is recommended for all diagonal braces.

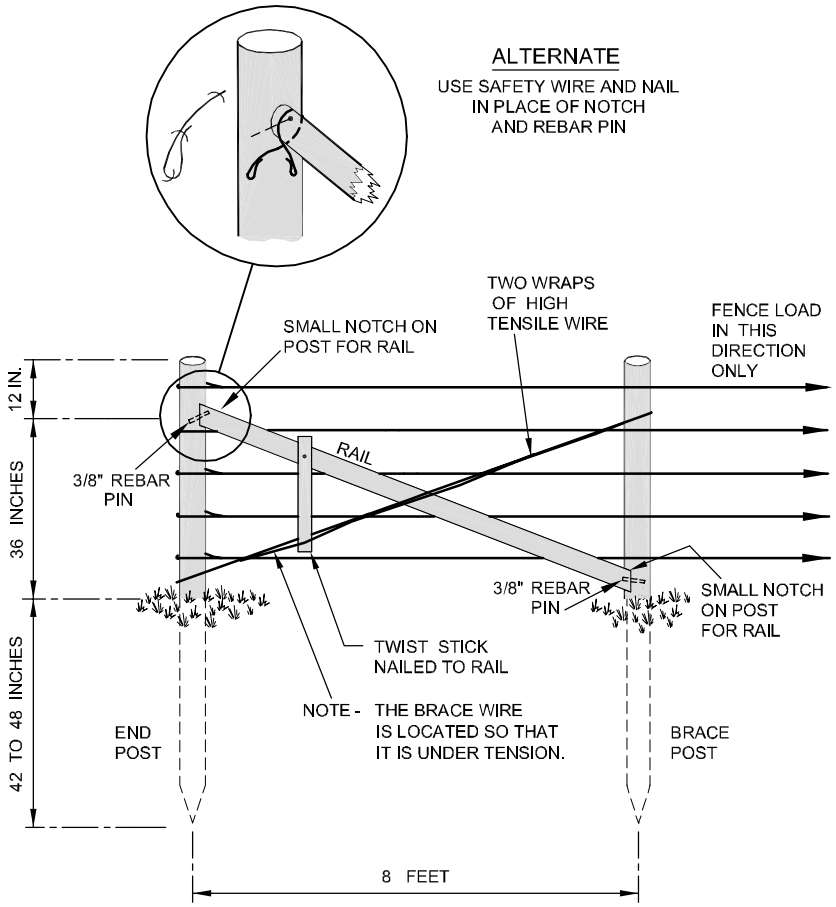


Figure 5 Two-Post, Diagonal Rail, End Brace

THREE-POST BRACES

When either fence loads or soil conditions require increased brace strength, a two-post brace is expanded by using three driven posts. Because of the difficulty in driving these three posts in direct line with the pull of the fence wires, **three-post braces can fail prematurely if the incorrect tie off point for the fence wires is used.**

Looking at Table 1, page 2, it can be seen that a three-post brace is really just a two-post brace with additional rear bracing. The tie off point is clear: it is the **centre post**. Three end brace designs are traditionally used; double horizontal rail, double diagonal rail or mixed rail. The double horizontal rail brace can also be used as an inline brace when the extra brace wires are added. Other (non-traditional) three-post braces are also possible. These mainly combine a single span brace with additional support from a deadman anchor or the kiwi brace.

As for two-post braces, three-post braces generally have brace posts are one diameter size larger than line posts and the rails the same diameter size as line posts.

Three-Post, Horizontal Rail, End Brace

This is the standard design for fences of more than six wires or in poor soil conditions. Three driven posts are connected by two rails and two brace wires as in Figure 6. The construction sequence is similar to the two-post sequence on page 5:

- drive the end post, preferably with a 2 inch lean away from the fence load
- drive the center post, preferably with a 1 inch lean away from the fence load
- drive the brace post
- space these three posts using the 2:1 minimum distance rule between **each** post
- drill the posts and rails and pin together
- leave 1 inch of pin protruding from the brace post
- wire both panels with the brace wires
- fence line wires will be tied off at the center post
- "slack" wire the rear panel

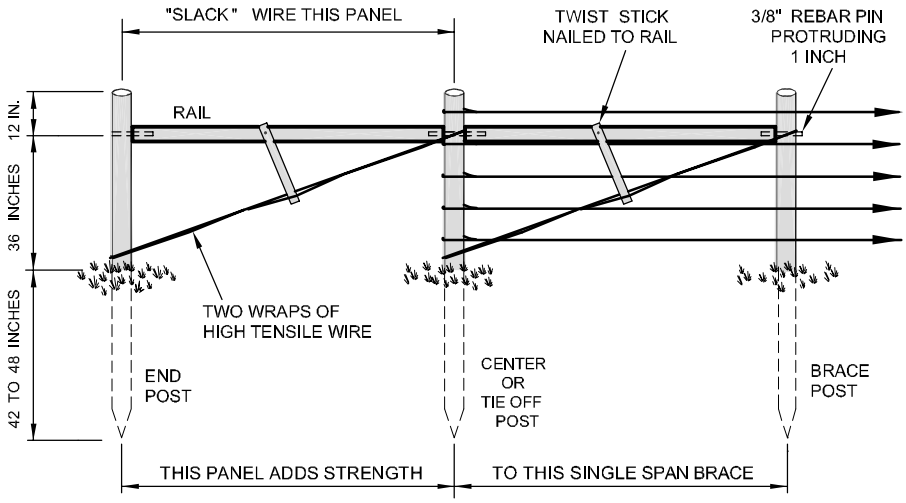


Figure 6 Three-Post, Horizontal Rail, End Brace

Three-Post, Horizontal Rail, Inline Brace

As with two-post, horizontal rail braces, this three-post brace can also be used as an inline brace (Figure 7, below). Fence wires from two directions will be tied off at the center post. To resist this loading, brace wires must be installed in both panels, in both directions, forming two "X"s. As with the two-post brace, these must be free to move independently, **not** twisted together.

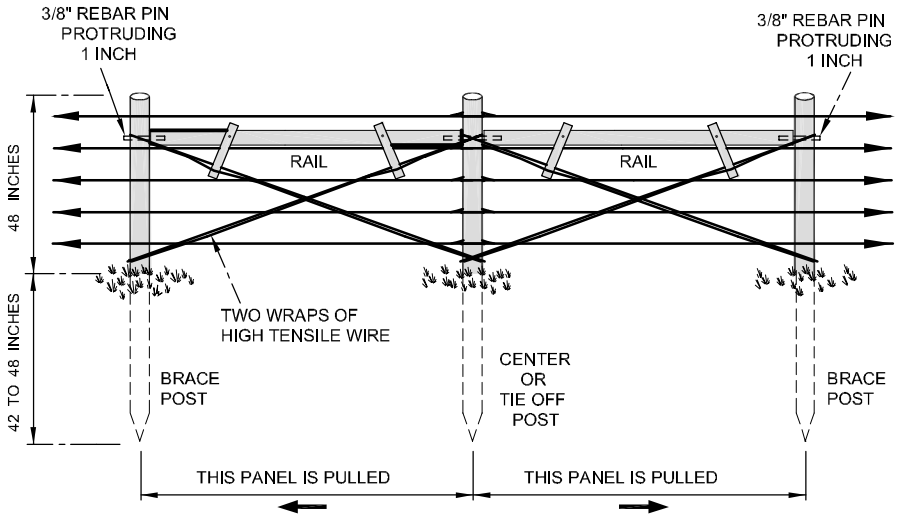


Figure 7 Three-Post, Horizontal Rail, Inline Brace

Three-Post, Diagonal Rail, End Brace

This design is very similar to the previous except the rigid rails are placed diagonally instead of horizontally between the three driven posts (Figure 8, below). Brace strength is approximately equal in both. The same points discussed on page 4 regarding two-post horizontal versus diagonal braces applies to three-post braces as well; diagonal rails are more difficult to install correctly and can be loaded in one direction only (and can only be used as an inline brace as shown in Figure 9, page 9).

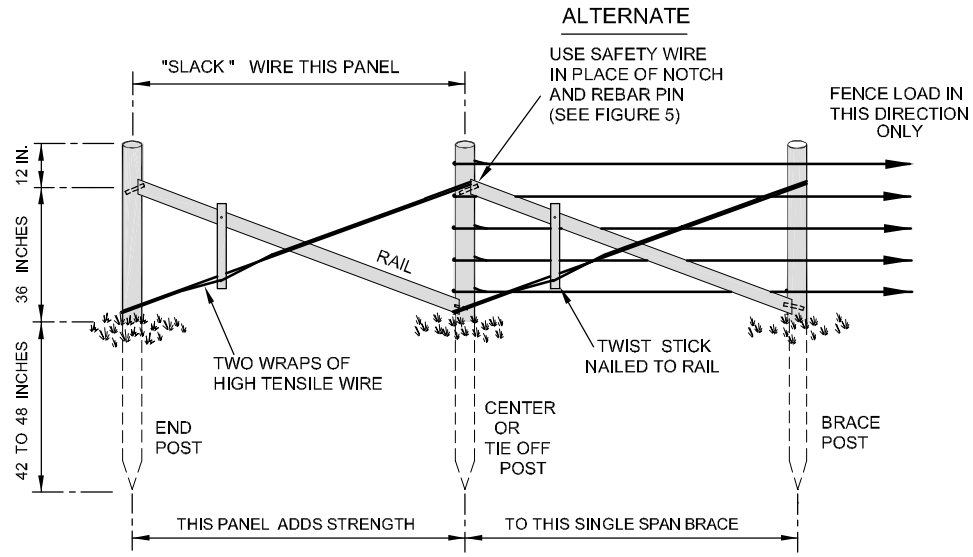


Figure 8 Three-Post, Diagonal Rail, End Brace

Three-Post, Diagonal Rail, "Inline" Brace

This is actually not a true three-post brace (as only the brace strength of a two-post brace is supporting either fence wire load) but rather two, two-post braces sharing an end post (Figure 9, below). Brace strength in either direction is **not equal to other double span braces.** This design is not normally recommended because for about the same materials and effort a three-post - horizontal rail inline brace has greater strength.

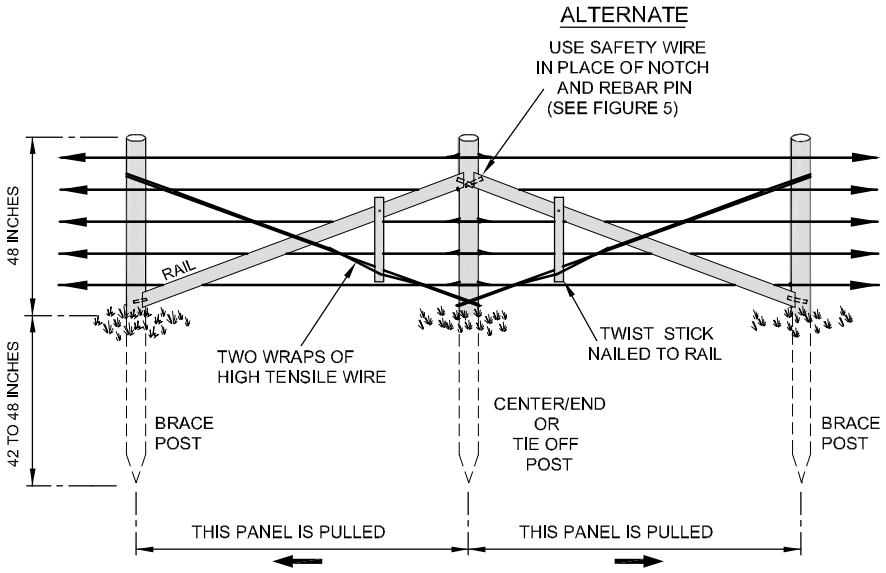


Figure 9 Three-Post, Diagonal Rail, Inline Brace

Three-Post, Mixed Rail, End Brace

This design is a mixture of the previous three-post braces. The center post is still the tie off location. The forward section has a diagonal rail and the rear section has a horizontal rail (Figure 10, below). Disadvantages are once again construction difficulty and one direction loading. This brace has strength equal to the previous three-post braces discussed.

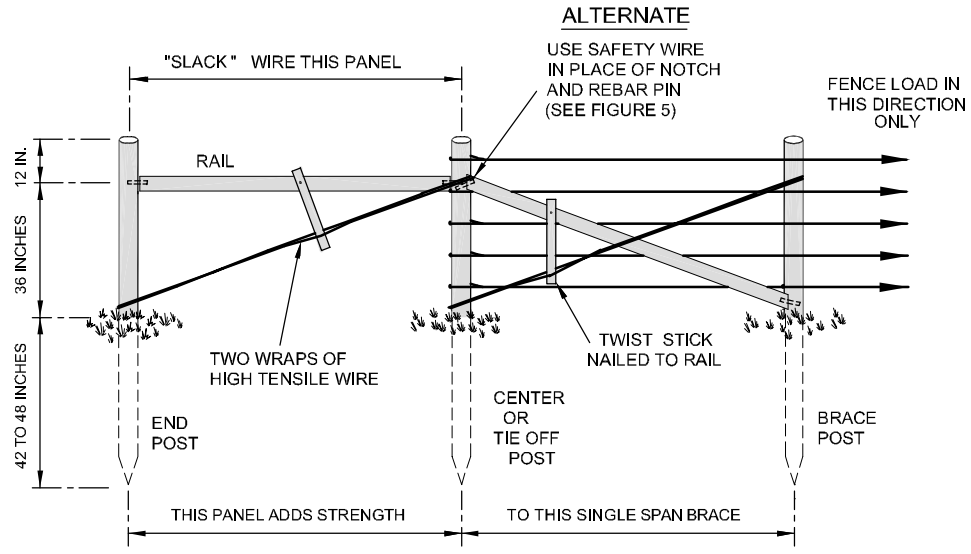


Figure 10 Three-Post, Mixed Rail, End Brace

CHANGE OF DIRECTION BRACES

The previous braces have been at either the end of the fence or along a straight line section. Those braces had loads applied directly in line with the brace as outlined in **Factsheet 307.220-1**.

A change of direction, however, produces reactive forces that are not inline with the brace that can cause leaning or complete brace failure. This is commonly seen at fence "dog legs." The amount of force is proportional to the degree of angle change and acts through the center of the corner (Figure 11, below). Although a small change of direction produces a small force, a standard brace is not usually able to resist it. At a 90° corner, the brace is better able to resist it due to the alignment of brace members.

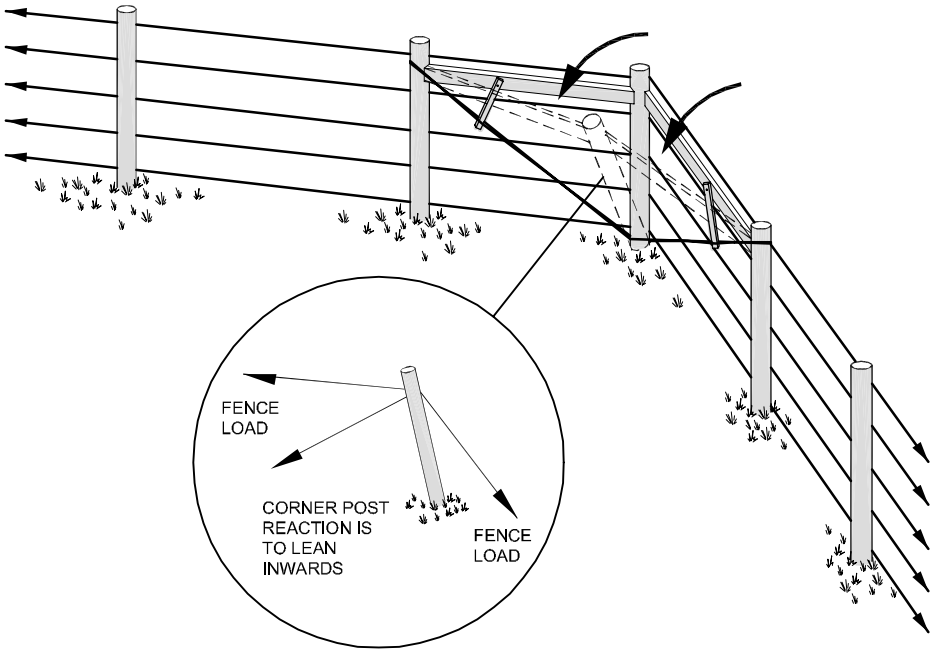
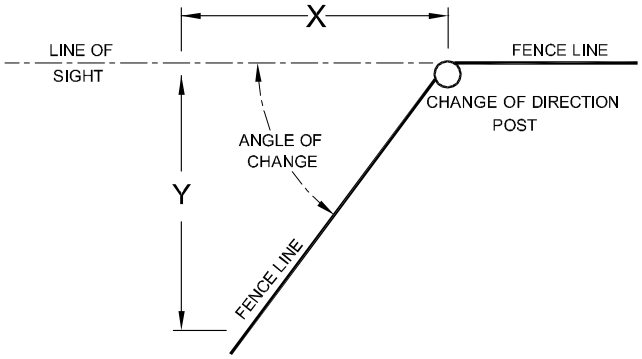


Figure 11 Forces in a Brace Assembly at Changes of Direction

The post at the change of direction must be supported and, although the loads are similar, different solutions are available for different situations. In the following discussions, the angle of change of fence direction is:

- defined as the angle between the line of sight of one fence to the other fence line
- can be estimated by the measurements given in Figure 12, below



FOR X = 10 FEET	
Y	ANGLE
1 FT. 9 IN.	10°
3 FT. 8 IN.	20°
5 FT. 9 IN.	30°
8 FT. 5 IN.	40°
11 FT. 11 IN.	50°
17 FT. 4 IN.	60°

Figure 12 Estimating Fence Line Angle of Change

Change of Direction:

At Tie Off Points

If it's appropriate to tie the fence wires off a **separate** end brace can be constructed for each fence section as in Figure 13 below. Rather than 'share' a common tie off post, each section is tied off to a separate end post producing no forces out of line with the braces. This requires an extra driven post per corner and 'slack' wiring the opening between posts but ensures a stable corner.

- for corners less than 60° use either separate corner posts, Figure 13, or brace the corner post, Figure 15
- for 60° to 90° corners use a standard shared-post corner brace as in Figure 14

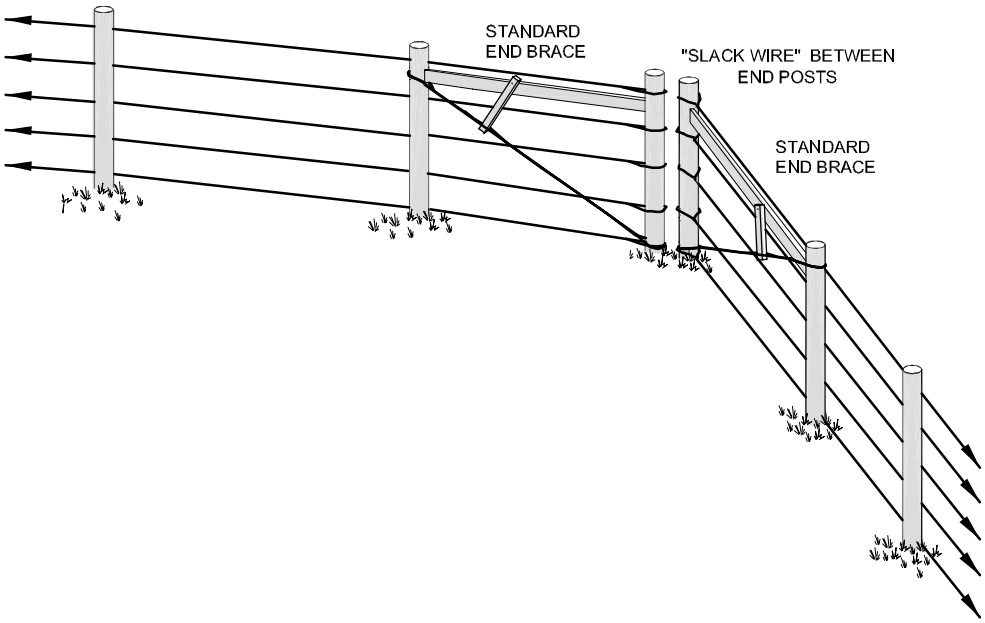


Figure 13 Separate Braces at a Tie-Off Corner (changes less than 60^0)

For changes of fence direction from 60° to 90°, a normal shared-post corner will be effective (Figure 14, below). This brace can be used at a tie off corner or used between tie points with the fence wires continuous around the brace (in this case special stapling techniques are used to reduce wire-to-post friction around the corner post ensuring flexibility of the wires when loaded; refer to **Factsheet 307.100-2**).

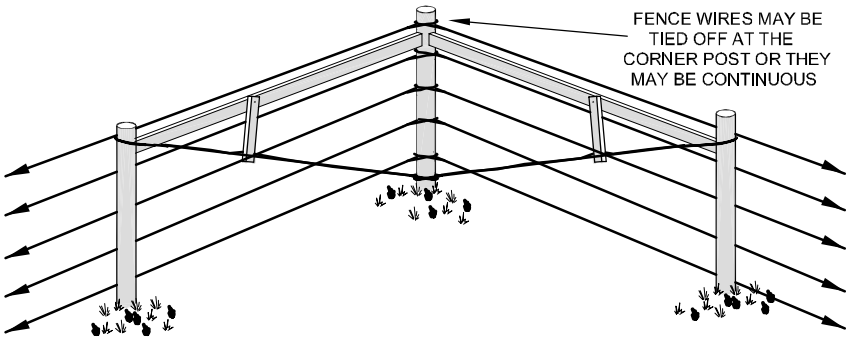


Figure 14 Shared-Post Brace at a Corner (for changes greater then 60^0)

Change of Direction:

Between Tie Off Points

Often the fence change of direction occurs when it is not appropriate to tie off the fence wires (i.e. less than the 660 feet or 1320 feet rule for tensioning wire). Rather than have many short sections of fence, the wires can continue around the change of direction post provided the post can be adequately supported and special stapling methods are used. Figure 15, below, illustrates three possible braces. Refer to **Factsheet 307.100-2** for wire tie-off distances and special stapling methods.

For changes of direction greater than 60° use the brace in Figure 14, previous page.

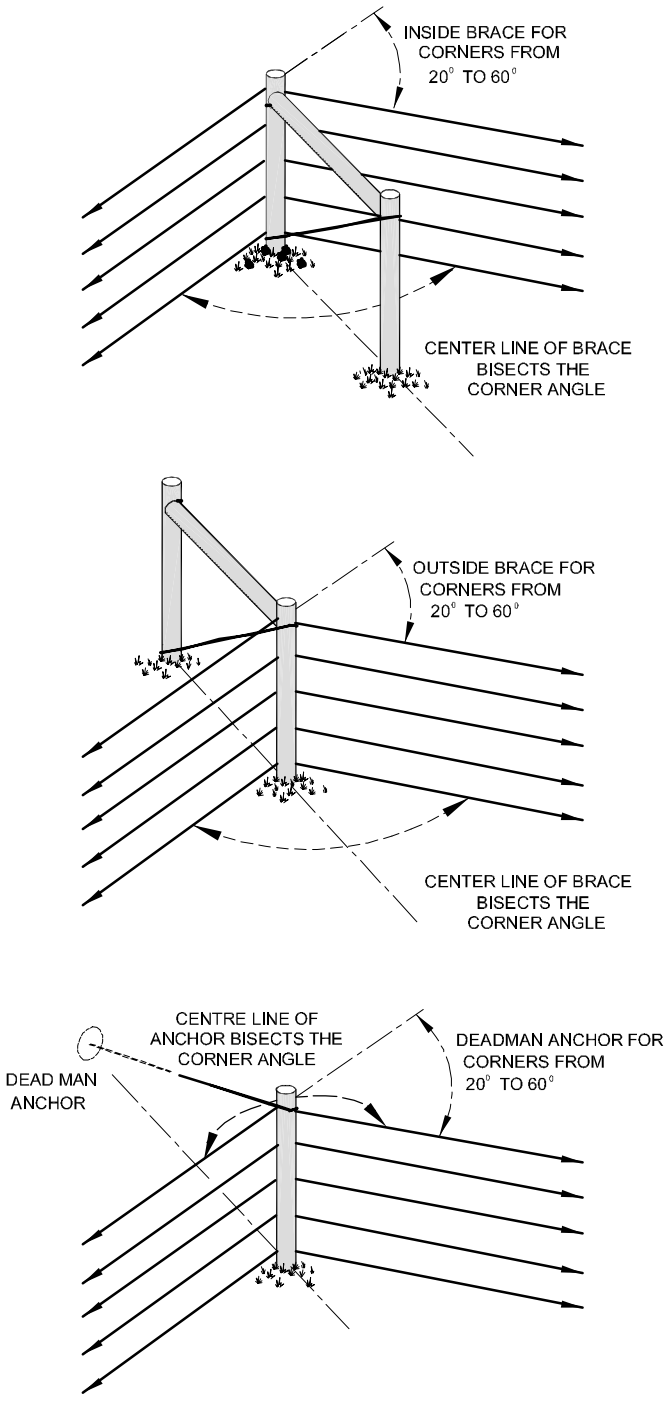


Figure 15 Change of Direction Braces (for changes less than 60^0)

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