Fence Failures at Dog Legs and What to Do about Them

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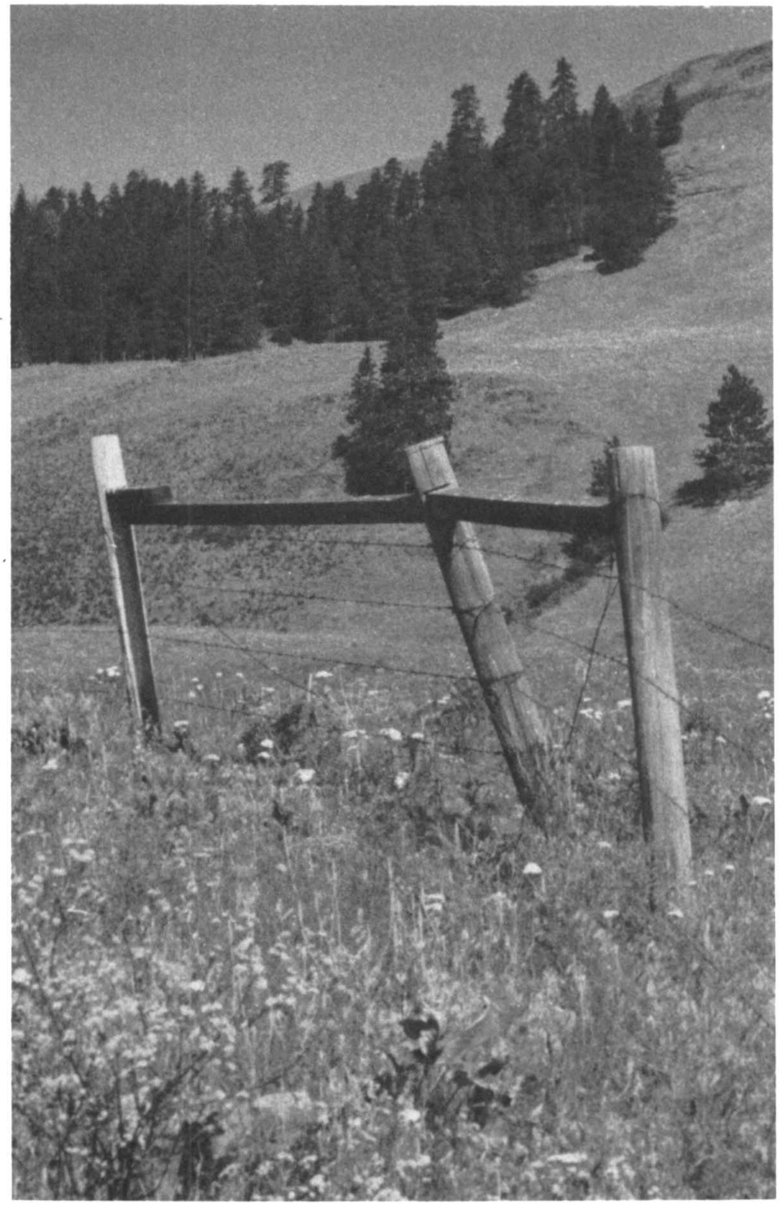

Fig. 1. *Fence failure at dog leg.*

Fence failures or post pullout at locations having a small change in fence alignment "dog legs", are well known to anyone who installs or repairs fencing (Fig. 1). Barbed-wire fence failures at dog legs are not as critical as with high-tensile, smooth-wire fencing, which must be maintained at the proper tension to be effective.

Why Fences Fail

Before a solution to the fence failures or post pullout problem at dog legs is presented, the reason for the problem should be understood. Fence braces or strainers generally fail for one of three reasons:

1. Structural failure
2. Soil movement or failure
3. Corner or end post pullout.

Structural failure of a fence end brace is usually due to improper design, poorly selected material, or overstressed members. With well-designed fence braces and proper proportioning and sizing of members, structural failures of fence braces should be eliminated.

Soil failures of fence braces occur when the soil is so weak that it cannot support the load placed on or against it and the fence brace moves through the soil. These failures can be eliminated by using larger and/or longer posts, or applying plates that have larger areas to bear against the soil.

Corner post pullout is when the corner post lifts out of the ground. Pullout-type failure is related to the effective length of the fence brace and the coefficient of friction between the fence post and the ground. Corner post pullout failures can be eliminated by using longer effective length fence braces, and/or by placing cleats on the post. Cleats inecase the coefficient of friction between the post and the soil. *There is a critical length of a fence brace beyond which corner or end post pullout will not occur.* The reason for this critical length is that the fence post bears against the ground; and because it bears against the ground, a downward force resisting pullout can be generated. The maximum value of this downward force is limited to the horizontal force bearing against the post by the ground times the coefficient of friction (approximately 0.1 to 0.5) between the fence corner post and ground. The critical length of a brace is also dependent on fence height. For a rule of thumb, when the brace length along the ground is 2 to 2 1/2 times the fence height, the brace length is usually beyond the critical length and will not fail by pullout. The critical length under some conditions can be longer than 2 1/2 times fence height.

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If the upward vertical force trying to pull the post out of the ground is greater than the downward resisting force which can be generated by the post pushing against the ground, the post will pull out. By doubling the length of the brace, the upward vertical force trying to pull the post out of the ground will be reduced by one half. If the upward vertical force trying to pull the post out of the ground is less than the maximum downward resisting force which can be generated, the brace will not fail by pullout.

In any fence brace, the critical length can vary depending on the moisture condition of the soil which affects the coefficient of friction between the fence post and the soil. Generally, as the soil moisture increases, the coefficient of friction decreases. This may increase the critical length of the fence brace above the actual length of the fence brace, and the corner or end post may pull out. Post pullout is generally the reason why fences fail at dog legs. Dog legs are small changes in the fence alignment—up to, say, 60 degrees. Small angle changes are the most difficult to hold and are where the most pullouts are seen.

In a dog leg, there is an equal pull on the corner post, along each fence alignment. This causes a resultant force which bisects the dog leg angle. This resultant force in a dog leg which is less than 60 degrees is smaller than the two equal forces along each fence alignment (Fig. 2). The resultant effective brace assembly length is also shorter than the actual brace lengths which are in alignment with the fence. If this resultant effective brace assembly length is below the critical length, the fence will fail by pullout.

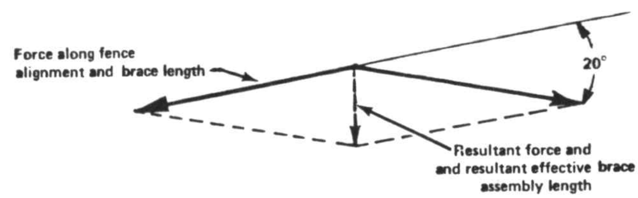

Fig. 2. *Forces and resultant force at a 20-degree dog leg. The resultant force and the resultant brace assembly length are much smaller than the forces and brace assembly lengths in alignment with the fence.*

At a dog leg of 60 degrees, the resultant effective length of the brace assembly is equal to the length of the braces which are in alignment with the fence (Fig. 3). If the braces are longer than the critical length, pullout will not occur. At 90-degree corners, the resultant effective length of the brace assembly is about 50 percent greater than the braces which are in alignment with the fence (Fig. 4). When a fence corner is less than 90 degrees, the resultant effective length of the brace assembly becomes much greater than the braces which are in alignment with the fence (Fig. 5).

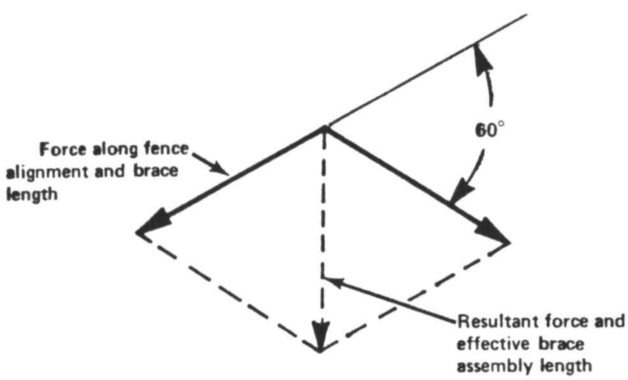

Fig. 3. *At a 60-degree change in fence alignment, the resultant force and resultant effective brace assembly length is equal to the forces and braces in the alignment of the fence.*

Preventing Fence Failure at Dog Legs

To prevent fence failures at dog legs, the resultant effective length of the brace must be greater than the critical length of the brace. This can be done by actually installing a diagonal brace which bisects the angle of the dog leg, that is longer than the critical length (Fig. 6). A horizontal brace can also be used (Fig. 7), but the easiest to install and lowest cost brace is the diagonal brace (Fig. 6).

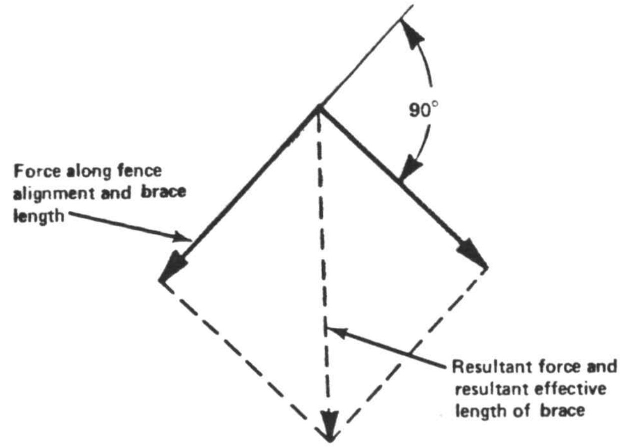

Fig. 4. *At a 90-degree corner, the resultant force and the resultant effective length of the brace is about 50 percent greater than the brace assemblies in alignment with the fence.*

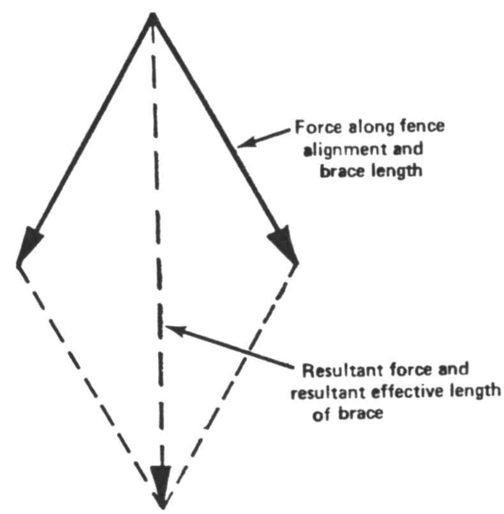

Fig. 5. *When the fence corner is less than 90 degrees, the resultant force and resultant effective length of the brace assembly becomes much greater than the braces in alignment with the fence.*

The diagonal brace is equal in strength and holding force to a horizontal brace. *A fence brace (both horizontal and diagonal) should be as long as possible for best holding. When using a diagonal brace, do not block the end of the diagonal resting on the ground by a stake or post.* **THIS IS IMPORTANT**. The end of the diagnonal of a diagonal brace that is resting on the ground must be free to move in the direction the diagonal brace is pointing. If the end of the diagonal which rests on the ground is prevented by a stake or post from moving in the direction the diagonal brace is pointing, the diagonal brace holding ability will be significantly reduced. When the end of a diagonal brace is blocked by a stake or post, the diagonal brace is no longer equal in holding force to the horizontal brace.

Other methods can and have been used to make the resultant effective length of a brace greater than the critical length at a dog leg. Methods that have been used are: (1) Ending the fence with an end or gate brace and starting in the new

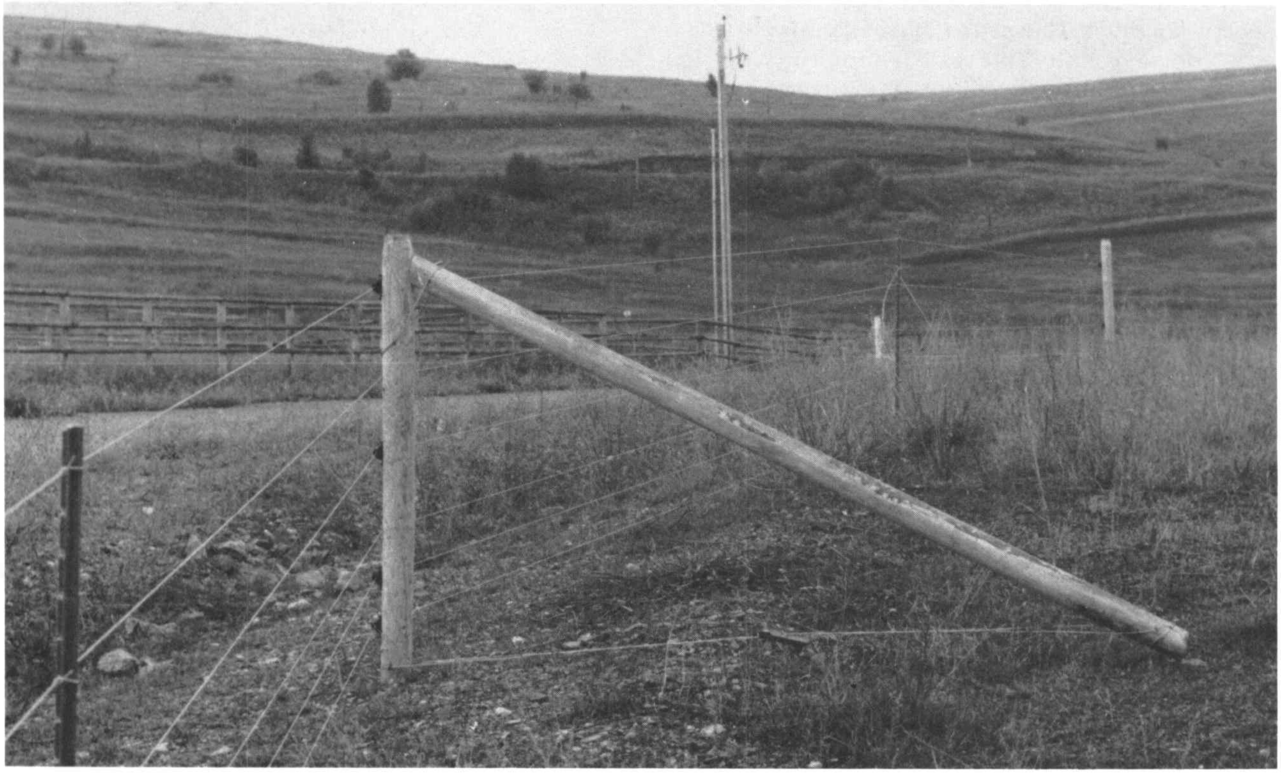

Fig. 6. *The use of one diagonal brace in a dog leg. The single diagonal brace could be a problem from livestock rubbing on it and moving it. If this is a problem, stakes can be driven on each side of the brace near the end that is resting on the ground and tied together at the top to prevent the brace from being moved sideways.*

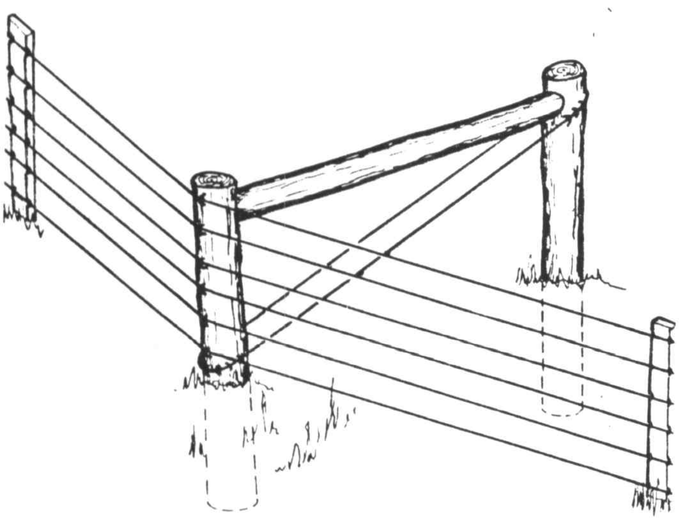

Fig. 7. *Horizontal brace bisecting the angle of a dog leg.*

direction, also with an end or gate brace (Fig. 8); (2) installing four or six panel brace assemblies to increase the resultant effective length beyond the critical length (Fig. 9); and (3) installing a deadman anchor tie back (Fig. 10). These methods do work, but are generally more costly to install than a single diagonal brace. A single diagonal brace is easy to install and works very well in repairing or correcting an impending fence post pullout problem at a dog leg.

Fig. 9. *Using a six-panel brace assembly to increase the resultant effective length of a brace beyond the critical length at a dog leg.*

Summary

Fence failures or post pullout at dog legs (alignment changes of 60 degrees or less) are caused by the resultant effective brace length being less than the critical length (6 ft to 8 ft, but may be as long as 10 ft for a 4-ft high fence). The post pullout problem at dog legs can be eliminated by installing a diagonal brace bisecting the dog leg angle with an actual length greater than the critical length. For a rule of thumb, if the brace length along the ground is 2 1/2 times the fence height, the brace length probably will be beyond the critical length and will not fail by post pullout. If the dog leg is 60 degrees or less, use a single brace bisecting the dog leg angle (Fig. 11). If the fence change of direction is greater than 60 degrees, either a single brace, bisecting the fence angle or two braces, one in each fence alignment, can be used.

Fig. 8. *Fence failures at dog legs can be eliminated by ending the fence with an end or gate brace and starting in a new direction with an end or gate brace. Either a horizontal or diagonal brace can be used, for both are equal in strength and holding force.*

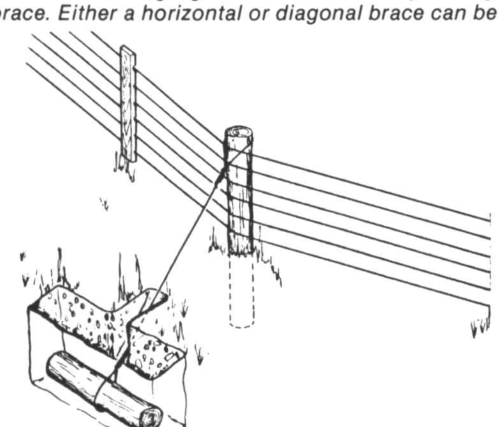

Fig. 10. *Installation of a deadman anchor tie back to prevent fence failure at a dog leg by fence post pullout.*

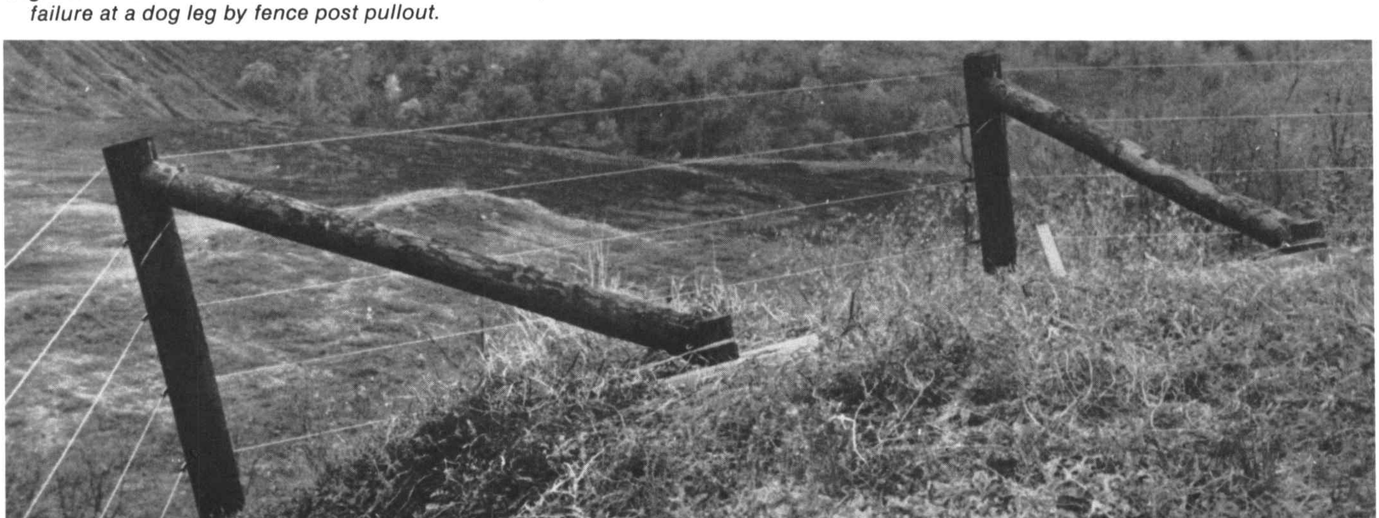

Fig. 11. *Diagonal braces in use at dog legs, (each brace is preventing fence failure at a dog leg).*