

# TECHNICAL NOTE NUMBER 134

FOREST PRODUCTS LABORATORY U. S. FOREST SERVICE - MADISON, WISCONSIN

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## THE CRATE CORNER

The corner is the weakest part of the ordinary crate. Some facts about crate corners observed in tests at the Forest Products Laboratory may be of assistance to crate builders in strengthening this weak part by better arrangement of members and methods of nailing or bolting.

An example of inexpert crating frequently met with is that shown in Figure 1. This construction is poor because the nails holding one member are driven into end grain and so have comparatively low holding power. Another common example of the same fault is shown in Figure 2. This construction may be improved (Fig. 3) by lengthening the member to permit nailing into the side grain.

The corner construction shown in Figure 4 is very weak, because the only nailing possible is through one member into the end grain of the other two. This style of corner is frequently used in crates which are to be entirely covered with sheathing. In a crate without sheathing it would, of course, be worthless.

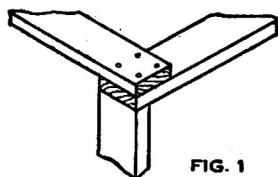


FIG. 1

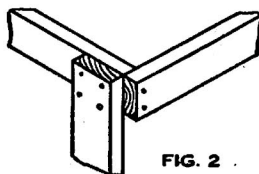


FIG. 2

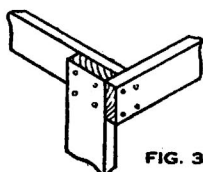


FIG. 3

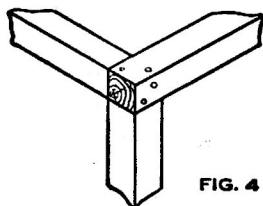


FIG. 4

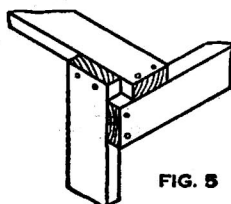


FIG. 5

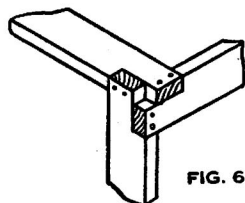


FIG. 6

In Figure 5 each member is nailed to another member and has the third member nailed to it. This is a very effective arrangement. It is called the "3-way" corner, and the distinguishing feature is that each member is held by nails or bolts in two directions. Figure 6 is suggestive of further variations of the 3-way principle, with the members notched together.

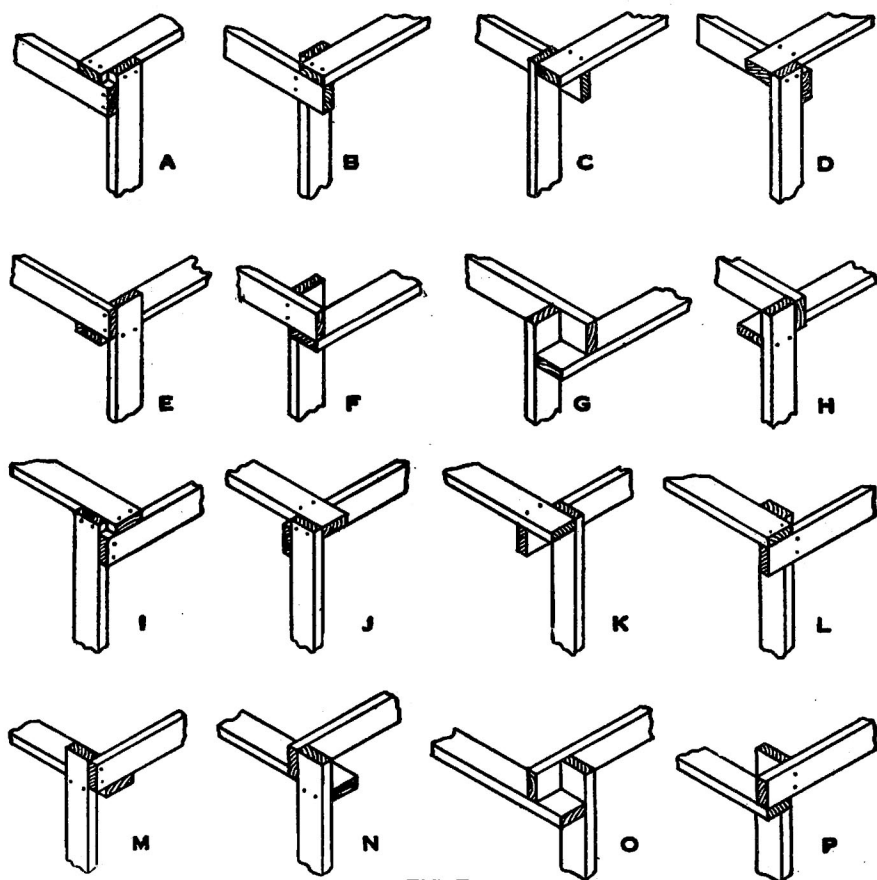


FIG. 7  
ARRANGEMENT OF MEMBERS AT 3-WAY CORNER

Seldom if ever does the 3-way corner construction increase the volume of the crate. On the contrary it usually reduces the space occupied. When properly nailed or bolted, this type of corner has a considerable bracing effect, although it does not do away with the need for diagonal bracing.

The sixteen possible arrangements of members at a 3-way corner are given in Figure 7. It will be seen that A and I are the most practical when the object to be crated is a box-like form, such as a filing case. When the object is of irregular form, such as an electric motor, one of the other arrangements may have the advantage of permitting better bracing and blocking.

Proper arrangement of members will not in itself produce a good corner. They must be properly fastened together. Whether bolts or nails should be used depends principally on (1) the thickness of the members, (2) the amount of stiffening afforded by sheathing, and (3) labor costs.

### NAILING

NAILS DRIVEN IN HOLES slightly ( $1/32$  to  $1/16$  inch) smaller than their diameter have considerably more resistance both to direct pull and to shear than nails driven without holes.

CEMENT COATED NAILS are superior to uncoated nails.

LENGTH OF NAILS should be somewhat more than twice the thickness of the member holding the heads.

SLENDER NAILS are likely to hold better than thick nails under the repeated shocks and constant weaving action to which crates are subjected, because the slender nail bends near the surface of the pieces joined without loosening the friction grip towards the point.

NUMBER OF NAILS or bolts joining one member to any other member should not be less than two. Usually as many nails as can be driven without splitting should be used.

DANGER OF SPLITTING will be reduced if nails are staggered. Boring holes for nails also reduces the danger of splitting.

### BOLTING

Bolts have the advantages of holding after the friction grip of the wood on the shank is destroyed. The following schedule of bolt sizes is suggested as a guide:

| Thickness of crate members | Diameter of bolts |
|----------------------------|-------------------|
| Up to 1-1/2 inches         | 3/8 inch          |
| 1-1/2 to 3 inches          | 1/2 inch          |
| 3 to 5 inches              | 5/8 inch          |

MACHINE BOLTS should have washers and the heads should be countersunk.

CARRIAGE BOLTS are preferred to machine bolts and may be used without washers under their heads.

NUTS should if possible be on the inner side.

LOCKNUTS should be used on all bolts; or, if there is no expectation of using the crate a second time, the threads may be deformed to prevent loosening of nuts.

HOLES FOR BOLTS should be bored to the same diameter as the bolts - or 1/32 inch smaller.