HALBERG ENGINEERING LLC

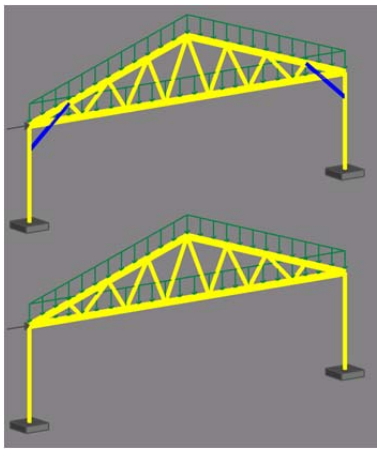
Reducing the Use of Knee Braces in Post Frame Construction

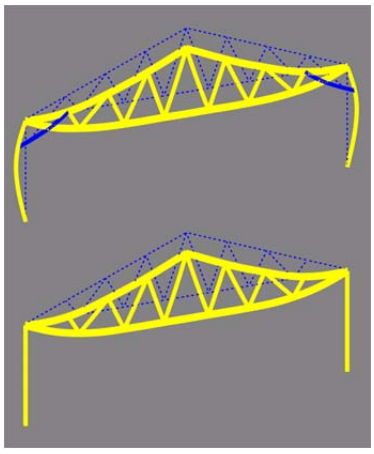
Figure 1 - Knee Braces in a Post Frame Building

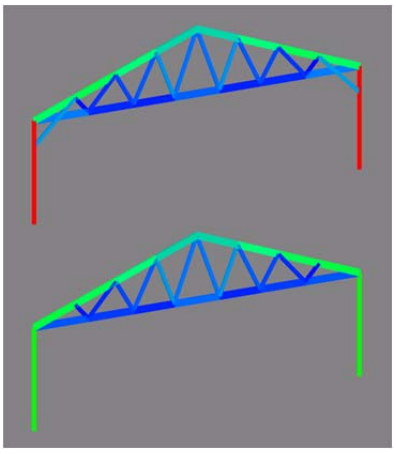
While the use of Knee Braces was quite common in Post Frame Construction in the growth of this construction method during the 60's and 70's, an increased understanding of the strong diaphragm systems inherent within the building's sheathing has resulted in a decreased use of these diagonal braces and even revealed some reasons these braces should not be utilized in most Post Frame structures.

Knee Braces are the diagonal brace, commonly a piece of 2x6 dimensional lumber, attached at approximately a 45° angle to the post and then to the truss or rafter in an effort to provide some horizontal stability and strength to the post frame structure. While this brace may have a positive impact on the stiffness of the structure during construction by serving as temporary bracing, once the sheathing is through-fastened to the structural framing members of the building, structural diaphragms are created in the roof and wall planes and the structure has inherent rigidity and stiffness that typically far exceeds the stiffness provided by a Knee Brace.

When Knee Braces remain in a building with a structural diaphragm system, the problems caused will often outweigh the benefits provided. When a roof truss experiences vertical loads (snow, for example), it will deflect (sag) in the middle of the span and rotate slightly at the ends because of it (see bottom of the middle image below). When knee braces are present in this situation, these braces become compression members and transmit vertical load into a horizontal outward thrust in the columns (top middle image). In the illustrations below, a structural frame model of a 60' truss on 16' tall columns is shown with knee braces (top) and without. All loads and members are identical between the two frames except for the (2) 2x6 knee braces in the top version. From left to right, the images show loads applied to the frames, the deflected frame shapes under snow and dead loads (displacement is exaggerated), and a color-coded result of the maximum stresses for each member (dark blue = low stress, green = close to limit, red = over-stressed). Note that the columns are within stress limits without knee braces but fail with the knee braces in place. This increase in stress is consistent across all my experience in post frame structural analysis: Knee Braces add stress bending stress to the columns at the same time maximum axial loads are applied and drastically reduce their load carrying capacity.







In certain situations where a structural diaphragm is not available in the building, knee braces or other bracing members may be helpful to provide lateral stability to the overall building structure, but the impact the knee brace has on the columns and the trusses is fairly complex and must be accounted for by a competent designer of Post Frame structures.

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