The Pros And Cons Of Camber

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Recently a customer asked for an explanation of camber requirements for wood roof trusses. This is not a simple task for there are cases where camber is desirable for structural or appearance reasons, and then there are also cases where built-in camber can cause more problems than it will solve.

Camber is a slight upward curve or arch intentionally built into the middle of a truss chord. Camber in trusses is usually intended to hide or compensate for dead load deflection. Typically, camber is built into a truss by adjusting the fabrication jigging to cause a slight upward bow in the truss before the connector plates are installed. Since the truss member cutting is usually based on the undeflected truss shape, cambering can distort the truss so that the members do not fit well. Web joints and chord splices are no longer as tight fitting as they should be. Adjusting the member cutting to the cambered shape is a potential solution, but this makes it difficult to build a truss to its proper finished dimensions in actual practice. Considering these difficulties, trusses that carry light dead loads, such as in triangular agricultural roofs, often don't merit camber since the dead load deflection is small compared to the total design load deflection.

Other problems resulting from camber happen at the time of installation and after a building is in service. Trusses designed with three or more bearings should not be cambered since this will redistribute the

Figure 1

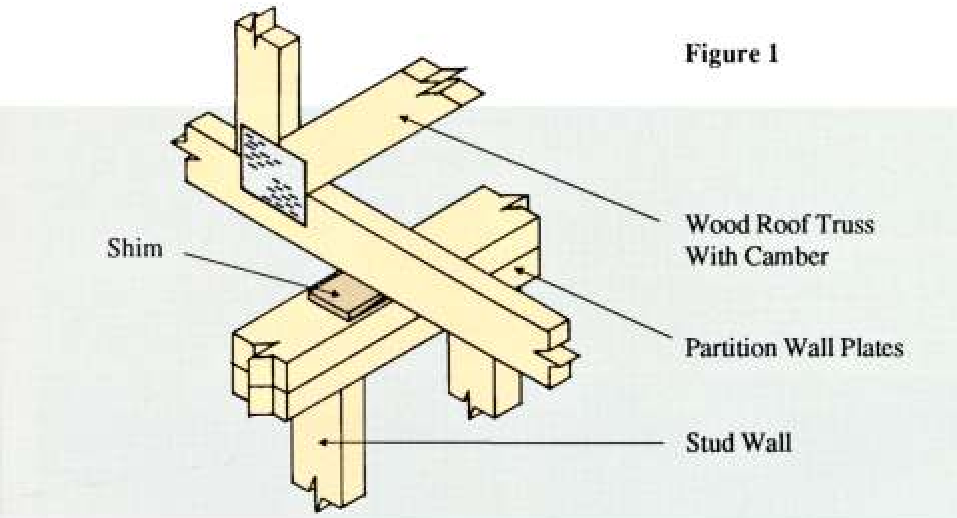
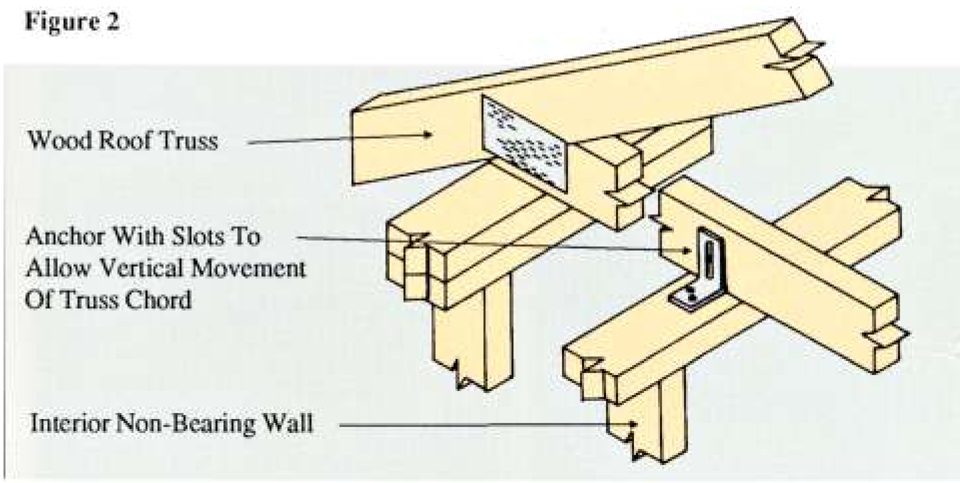


Figure 2



reaction loads unless the bearing elevations are carefully shimmed to match the cambered shape. Cambering just portions of a multi-bearing truss would be difficult, and it is not done in practice .

Cambering of trusses that clear span over non-load bearing partition walls can also cause problems. Framers have been known to pull the camber out of such trusses by pulling down on them and then nailing the bottom chord to the top of the partition wall. After a period of time, these nails can pull out and the truss will return to its original cambered position. The result can be cracks in the wall/ceiling drywall joint, or the wall can even be lifted up off of the floor. Partition walls should be shimmed up to cambered trusses (Figure 1), or else a sliding framing clip should be used (Figure 2).

There are situations where camber is desirable or required. Flat roofs, for example, have the potential for ponding, and camber may be required to reduce this potential. Long span trusses, and in general any truss where deflections will be large, are situations where camber may be desirable to hide or even out truss movement. Where different types of trusses, that is trusses with different stiffness, are placed next to each other, camber can be used to help maintain an even ridgeline or roof plane. This could happen where a common truss is next to a gable wall, or where a common is next to a girder, or where a scissors truss is next to a flat bottom chord truss (Figure 3). Everyone experienced with truss construction can probably think of other situations where camber built into a truss might have improved a finishing problem.

The recommended camber for wood trusses is based on provisions found in the *National Design Specification For Wood Construction (NDS).* Trusses under long-term loading can be expected to have a permanent set due to creep. This set is about equal to half of the initial deflection from long-term loads for seasoned lumber. The set can be twice this amount for green lumber. To compensate for the initial deflection due to dead loads and creep, the camber should be about 1.5 times the expected initial deflection. The chart shown in Figure 4 shows camber recommendations for various types of trusses based on the *NDS* provisions and past experience. Note that the actual weight of materials and not the design dead load should be used to compute camber.

Whether or not camber should be used, and how much it should be, are ultimately decisions that are based on experience. Factors such as the moisture content of the truss lumber, the type of building construction, the magnitude of the dead loads, the potential for finishing problems and the shape and stiffness of the truss all need to be considered. When the right importance is given to each factor, the camber can be tuned to minimize deflection related problems.

Figure 4

RECOMMENDED MINIMUM CAMBER §		
Floors	Residential	1.5 × Dead Load ‡ Deflection
	Public	1.5 × Dead Load ‡ Deflection
Roofs	Snow Load Areas Flat	2 × Dead Load ‡ Deflection
	Snow Load Areas Sloped (1/4″–12″ min.)	Dead Load + 1/2 ‡ Live Load Deflection
	Non-Snow Load Areas, All Roofs	1.5 × Dead Load ‡ Deflection

§ - For some truss types and or useage conditions no camber is recommended.
‡ - Use "Actual" dead load (not design dead load) in deflection calculation.

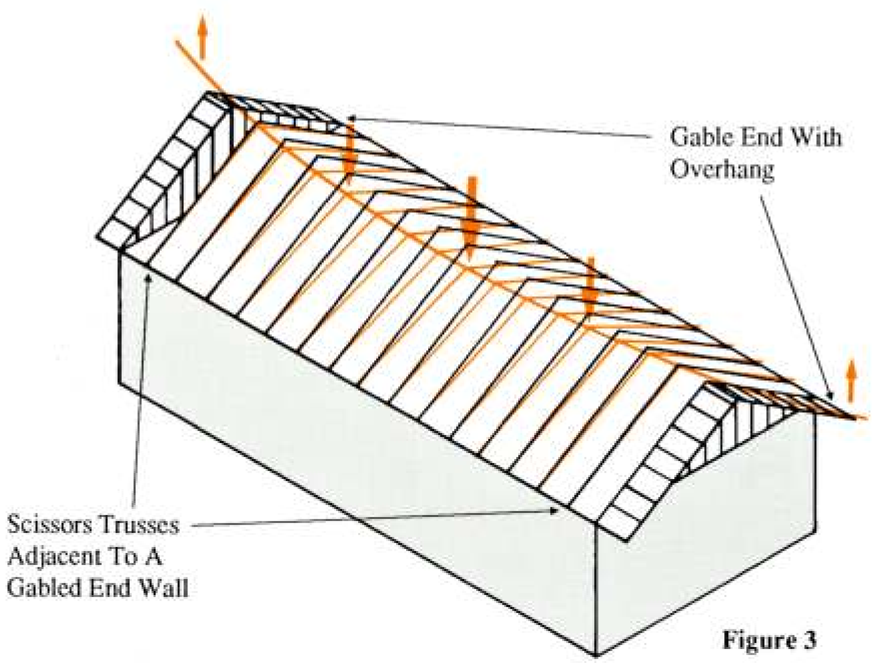


Figure 3

Trusses deflect but the gable wall does not. Camber can help to hide this differential movement. Arrows indicate the relative magnitude of movement.