Special Loads On Trusses: Folding Patterns

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Each type of structure has its own typical and characteristic loading conditions. Many types of structures have loads that are unique to them due to their construction, usage or location. In the case of churches, schools and offices, movable and folding partition walls are special loads that are often found in these buildings but not in others. Partitions can add a significant amount of weight to these structures so it is essential that they be located during the plan's take-off stage and that provisions be made for supporting them. Otherwise, structural problems will probably arise and it will later be discovered that these special loads were forgotten during the design process.

TYPICAL LOADS

Where trusses are used, folding partition walls are usually carried by the roof trusses, while moveable partitions are usually carried by the floor trusses. Folding partitions often weigh between 2 and 10 pounds per square foot of wall area, and can be 20 feet high. A tall, heavy partition could weigh 200 pounds per linear foot which is 1000 pounds for every 5 feet of wall. If such a partition were 50 ft. long it would weigh a total of 10,000 pounds, and when it is folded this load could all be located at one point on a truss. The point is that these partitions can be heavy. The actual weight of each partition product, plus its track and hanging hardware, must be known to design the truss and the hanger attachments properly.

LOAD CASES TO CONSIDER

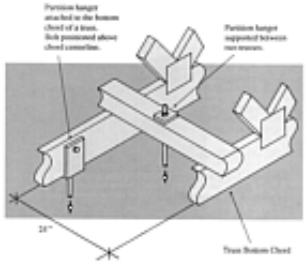


Figure 1

Folding partitions can be oriented both parallel and perpendicular to the trusses. They can be fully extended (closed) or folded up for storage (open), and some can be moved around on their track while folded. The hangers can be frequently spaced in order to uniformly load the truss chord (parallel to truss) or attach to every truss (perpendicular to trusses) the hangers can be spread apart and be concentrated loads along the chord (parallel to trusses) or they can only attach to every second or third truss (perpendicular to trusses). Each of these conditions presents a different load case for the truss

Trusses that carry partitions running perpendicular to them are relatively simple to design. They should have a bottom chord joint (panel point) located above the track. Then, if the partition can be folded so that all of its weight is supported by one track hanger, then each truss carrying a hanger must be able to support the full weight at that joint. To avoid the situation where one truss must carry the entire weight, the hangers can be supported between the trusses from framing as shown in figure 1. This detail lets two trusses share the weight. Some partitions cannot be folded as compactly as the hanger spacing so more than one hanger will always act to support the total weight. In this case, it may be possible for several trusses to share the weight.

Many partitions are anchored to a wall at one end and cannot be moved along their track in the folded position. With this type of partition, the trusses over the area where it is folded for storage must be designed to carry the total load themselves. The rest of the trusses only have to carry the uniformly distributed load of the closed partition, and may be designed for this lighter load. Trusses that carry partitions running parallel to them will have more loading situations to consider than those with perpendicular partitions. If the partition can be moved along its track in the folded position, then the truss must be able to carry the total weight at any one place along the bottom chord. The load is applied at the hanger locations. The amount of load on each hanger depends on how compact the door can be folded and the hanger spacing. Typically, there is no one position for this large concentrated load that is critical for all chord members, webs and plated connections at the same time. This means designing the truss for all possible load placements separately, and then combining the controlling features of each into one. The composite design must work for every case and should be rechecked if there is any doubt as to which one is critical for a particular member.

For example, a 4" x 10" plate may work at a web joint in one case but a 5" x 8" plate works for another. Both plates have the same area, but the final design must have one plate that works for both cases which might be 5" x 10" . When a parallel-to-truss partition is the type that only folds for storage at one place, there are fewer load cases to consider. Basically there is a uniform load case when the partition is closed and a concentrated load case when it is open. But if a

partition can be partially folded at its leading end, then there may be combinations of uniform and concentrated loads to consider. It may be advantageous to use smaller chord panels in the storage area to reduce bending stresses. This is especially true for triangular trusses where the storage area is usually under the heel panel. The heel panel often has the highest chord stresses in the truss, so reducing its length can improve the design.

Since trusses carrying partitions have a large amount of dead load, the load duration factor merits some attention. Usually, dead loads do not exceed 50 percent of the total load. The design is only checked for the total load case using the duration factor associated with the live load. This may not be the critical case when there is a high percentage of dead load. To find the worse case, the truss design is first checked with dead loads only and a load duration factor of 0.9. Then, the design is checked with the live load added and with the load duration factor for that live load (1.15 for snow, 1.33 for wind, etc.). It is possible for dead loads acting alone to be the worst case.

DEFLECTION CONSIDERATIONS

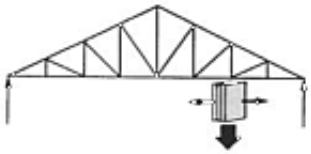
Hanging partitions need to maintain a small gap at the floor line so they won't bind when being folded, and so they won't apply a load to the floor. There may be a flexible skirt at the base to fill this space and allow for slight differences in the gap. The deflection of the supporting trusses is limited by the operational requirements of the partition. This is an absolute limit and not a span ratio limit of say L/240, for example. The gap requirement should be obtained from the partition specifier or supplier. Making a truss stiff enough to meet the deflection limits may actually control the entire design.

Creep must be considered when checking the truss deflection. Creep is a deflection that happens over time due to sustained loads. It is in addition to the deflection that happens immediately when the load is first applied. The usual approximation for the amount of creep in seasoned lumber is one half of the immediate deflection due to dead loads. Creep is not usually a problem for common trusses, but under the sustained load of a heavy partition it could eventually cause a binding problem. The truss can be cambered for the dead load deflection or the track can be leveled after the dead loads are applied, so it is the creep and live load deflection components that cause the trouble.

Figure 2

Fully extended (closed) partition hung parallel to the truss. Load distributed uniformly.

Figure 3



Folded up (open) partition. Moveable load concentrated at one spot.

Figure 4A & 4B

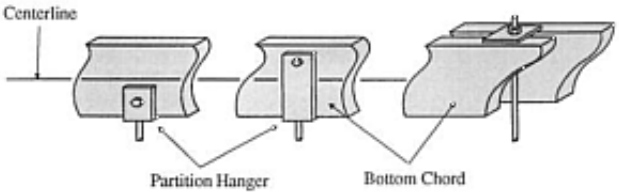


Figure 5

HANGING DETAILS

Partitions impart a series of loads that act perpendicular to the grain of the truss bottom chord. To avoid high shear stresses and tension perpendicular-to-grain stresses, the attachment should be made as far above the chord centerline as possible as shown in figures 4A & 4B.

It is always preferable to mount hangers on top of the bottom chord from a beam that spans between adjacent trusses as in figure 1. This can even be done where only one two-ply truss is needed by separating the plies slightly and blocking between them to provide a hanger space as in figure 5.

Making sure that movable partitions are hung from specially designed trusses and not just from common trusses is the most important thing. Knowing the partition's weight, folded size, hanger spacing and movement characteristics is essential to proper truss design. Detailing hanger connections to minimize cross-grain stresses will add durability to the truss system. If partition loads are not ignored today, then they won't be a problem tomorrow.