Harmony Timberworks

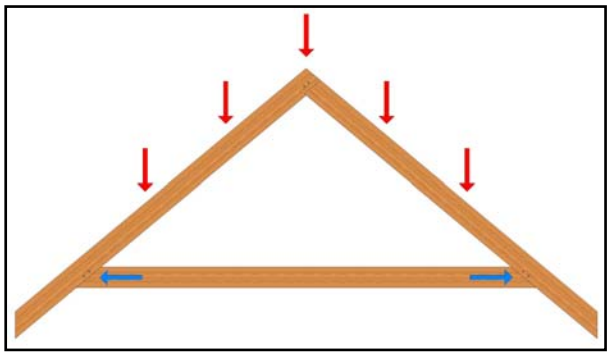
Design Bulletin Timber Frame Engineering

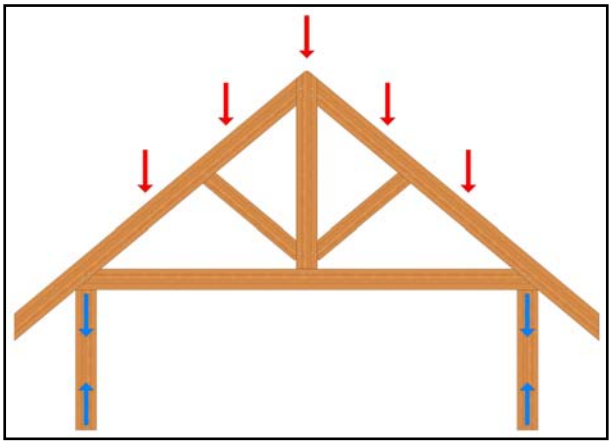
The building code was established to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings. Often, necessary construction methods for a portion of a structure are not prescriptive in the building code. It is the law that if construction is not prescriptive in the building code, an engineer must review and design a proper building method. Timber framing is not covered in the building code. Therefore, it is the law that any structural timber system must be reviewed by an engineer. Unfortunately, it is not typical of all timber framing companies to engineer their systems. At Harmony Timberworks, we pride ourselves on having every structural timber system we produce engineered.

To best describe what timber frame engineering consists of, the best place to start is with a few definitions:

Tension – the state of being stretched or strained.

The illustration to the right shows a standard collar tie truss. As load (red arrows) is applied from above, such as the weight of the roof and/or snow, tension (blue arrows) is increased in the collar tie.





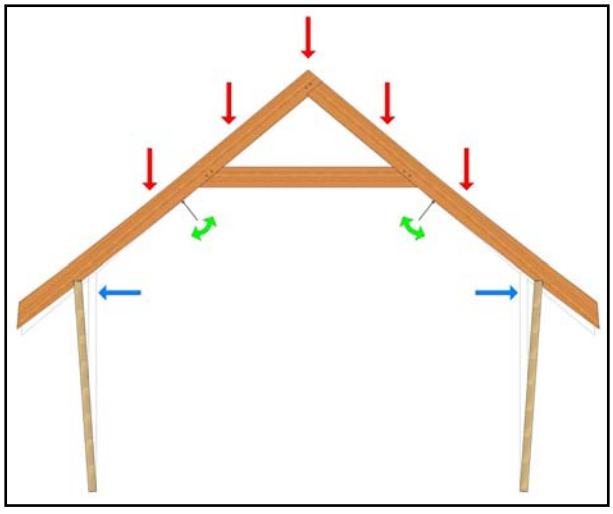
Compression – to press together; force into less space.

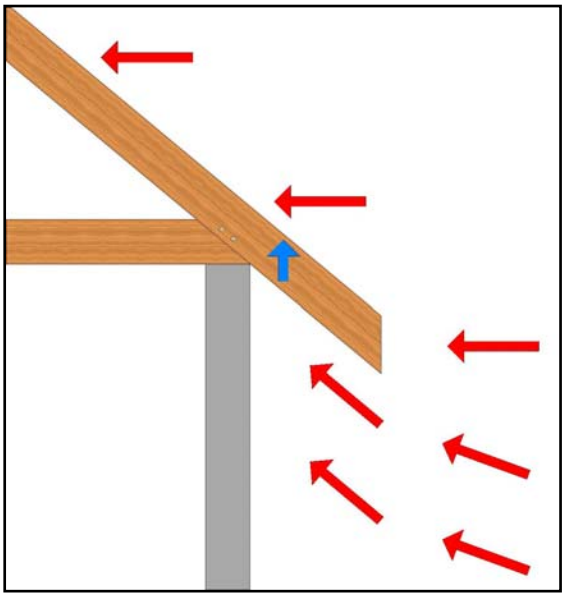
The illustration to the left shows a king post truss on posts. As load (red arrows) is applied from above, such as the weight of the roof and/or snow, compression (blue arrows) is increased in the posts.

Thrust – to push forcibly

Bending Moment– to force from a straight form into a curved or angular one

The illustration to the right shows a collar tie truss set on top of conventionally framed walls. As load (red arrows) is applied from above, such as the weight of the roof and/or snow, the rafters go into a bending moment (green arrows) below the collar tie. This causes the now deformed rafters to exert thrust (blue arrows) on the walls. The thrust has caused the once plumb walls to lean. In this case this truss would fail engineering. Obviously, it would be better for an engineer to catch this failure now than to build the system and end up with this situation.



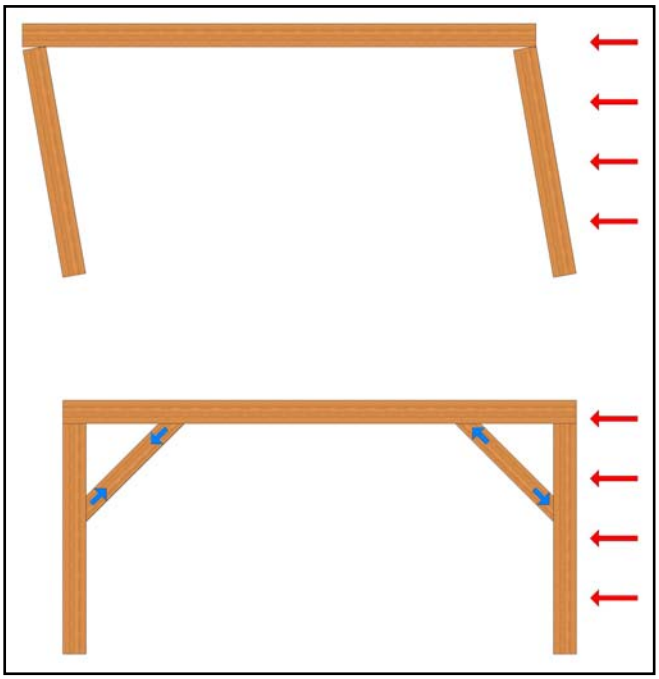


Uplift – to lift up; raise; elevate.

The illustration to the left shows a truss set on top of a conventionally framed wall. As load (red arrows) is applied from the side, such as wind load, two things happen. One, wind is caught under the eave, and two, the wind blowing over the roof creates a negative pressure on the outside of the structure. Both of these things create uplift (blue arrow) on the truss. If the truss has not been anchored adequately, it could be pulled off of the wall.

Lateral Strength - the level of ability to resist racking under load.

The illustration to the right shows two typical post and plate systems. As Load (red arrows) is applied from the side, such as wind load, the two systems react differently. The upper example racks under the wind load do to insufficient lateral resistance. The lower example affectively resists the wind load with the addition of braces. The braces work in a complimentary fashion, alternately going from compression to tension (blue arrows) to resist racking.



Once you, the client, and Harmony Timberworks have worked out the details of what you want in your timber system, Harmony will send your plans on to one of our specialty timber engineers. The timber Engineer will review the entire timber system for adequacy. He will check to make sure that all timbers are large enough to resist the loads that will be applied to them, such as tension, compression, bending, etc. There are reference materials he can use to look up the amount of snow, wind, seismic activity, etc. for your area. Once he knows that all the timbers are large enough to hold up to the weight of the structure plus all these extra loads, he will then review the adequacy of the connections between them. Each timber engineer has special computer software designed specifically to analyze these connections. It is at this point that the engineer will determine whether screws, mortise & tenon joinery, steel plates, etc. will be used to connect the timber components to one another.

If you have decided to go with a full structural timber frame, the timber system will be designed and engineered to be self supporting. Many times though, individuals will choose to build a hybrid home. A hybrid home is a home that uses a combination of structural building techniques. One of the most common types of hybrid homes consists of conventionally framed wall holding up a timber roof system and/or a timber floor system for a second floor. In this case the engineer will now dictate the loads to be exerted on the structure by the timber system. The most common load that a timber system exerts on a structure is called a point load. A point load is a concentrated amount of weight the structure will need to carry from a specific point all the way down to the foundation. A simple example of a point load would be where a timber truss, carrying a large amount of roof load, bears on top of a wall. The engineer would tell the amount of weight that will need to be carried by the structure at this point. He will not tell you how to resolve that weight. It is your responsibility to make sure this issue is resolved. If you or your architect feels unable to properly do so, it is recommended you acquire a Structural Engineer of Record (SER) for your project.

Another force that a timber system may exert on your structure is thrust. If this is the case there are two options. We can redesign the truss to eliminate this force on the structure or the timber engineer can dictate the amount of thrust the structure will need to be able to resist. If you choose the later option, it is your responsibility to make sure this issue is resolved. If you or your architect feels unable to properly do so, it is recommended you acquire an SER for your project.

One other force that a timber engineer may require the structure to resist is uplift. In higher wind areas, uplift can be a big problem. The roof can be torn off a structure if not properly attached. In many cases the client wishes to acquire (for a charge) an engineered solution for this connection. This is not required though. If this connection is not engineered, the timber engineer will specify the amount of uplift that will need to be resisted. It is your responsibility to make sure this issue is resolved. If you or your architect feels unable to properly do so, it is recommended you acquire a Structural Engineer of Record (SER) for your project.

The last force the timber engineer will cover is the lateral strength of a timber system. In some cases timber braces are added to resist lateral forces. In other cases the timber system can rely on the structure for the needed support. Lateral support of a timber system is very case specific. The details of each system's requirements can be found in the timber plans which come with each Harmony Timberworks timber system.

Essentially, when we do timber engineering for your project, every aspect of the timber system is engineered by our timber engineer. All connections and support of the timber system to your structure is your responsibility. Remember, as our timber engineer reviews your timber system, he does not become the SER for your project.