



• TIMBER FRAME •
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Abstract

This bulletin presents some of the issues associated with the practice of engineering timber frame structures as a Specialty Structural Engineer, and presents recommendations for standards of practice that are specific to the timber frame industry. This bulletin supplements the CASE *National Practice Guidelines for Specialty Structural Engineers*, 2nd edition 2006 (1).

Introduction

The traditional role of a structural engineer on a building project is that of Structural Engineer of Record (SER) responsible for the design of all of the structural and foundation elements of the building. While timber frame structures are sometimes designed by a SER, it is far more common for the design responsibility to be delegated to a Specialty Structural Engineer (SSE) engaged by the timber frame contractor.

Timber frame contractors have become accustomed to furnishing a design-build package that includes the engineering of the timber structure. It is not uncommon for the timber frame contractor's package to also include the Structural Insulated Panel (SIP) system. On residential projects, the timber frame contractor is sometimes responsible for the design of the entire building including full architectural services, even though they are only supplying one of the many building systems.

A few timber frame contractors have in-house design departments with structural engineers on their staff. Most timber frame contractors engage outside consulting engineers to provide the engineering services.

Delegated Design Responsibility

It has become common practice for design responsibility to be delegated to a SSE. In addition to timber frame construction, SSEs are routinely responsible for engineering the following structural systems:

- Pre-engineered metal buildings
- Prefabricated wood trusses
- Precast concrete
- Post-tensioned concrete
- Cold-formed metal framing

There are several reasons why delegating design responsibility to a SSE has become so popular in the building industry:

- Often the SER is not experienced or competent to engineer a particular structural system
- Some SERs delegate design responsibility to a SSE when detailing and fabrication of a particular system's components vary from shop to shop. The SER thereby avoids wasted effort developing design details that the selected system supplier may not use. This may allow the SER to provide a reduced fee for reduced scope of services to the client.
- There is a belief the SER can avoid the liability associated with practicing outside their area of expertise by shifting design responsibility to a SSE for items they are not competent to engineer.
- A more cost efficient design can be achieved if building system suppliers are allowed to design-build their system in a competitive bidding situation
- Sometimes architects or building owners wish to avoid paying the fees associated with engaging a SER and believe that if the contractor provides engineering services with a SSE there is no need for a SER

When design responsibility is delegated to a SSE, the SER is responsible for:

- Preparing a schematic structural layout and identifying the load path for the delegated structural system
- Engineering the primary structural system and foundations
- Specifying the loading criteria
- Reviewing shop drawings and submittals for compliance with above

When both the SER and the SSE work as a team and respect each other's roles and responsibilities, the process functions efficiently. When conflicts arise between the SER and SSE, they can best be resolved by direct communication. Unfortunately, the SSE is sometimes prohibited from speaking directly to the SER and must rely on indirect communication.

Professional Liability

When things go wrong on a building project, disputes can often escalate to litigation and the SSE can find himself in the direct line of fire. Defending a claim of professional negligence can be costly, time consuming and demoralizing. It is prudent for the SSE to maintain Professional Liability Insurance (PLI) to help cover the cost and to assist in the defense of any claim that may arise.

Timber frame contractors should also carry liability insurance. Some insurance companies will exclude coverage for professional liability in their general liability or builder's risk policies. This can leave a staff engineer employed in a timber frame contractor's design department without coverage in the event of a claim. An engineer can be held personally liable for his acts even if he is an employee of a timber frame contractor. Claims may occur years after a project is completed and the engineer may no longer be employed by the same company.

It is prudent for the SSE and the timber frame contractor to ascertain what insurance coverage the other carries prior to entering into a business relationship. It is not unreasonable to request a certificate of insurance.

When a dispute arises, it has become commonplace for every professional involved in the project to be drawn into the litigation, even if they had no direct involvement in the situation that precipitated the dispute. It is probable that both the SER and the SSE will be held liable. This should provide a strong incentive for the SER and SSE to work as a team to try to avoid conflicts.

It is unrealistic for a SER to believe that he can shield himself from liability by delegating design responsibility to a SSE. It is also unrealistic for a SSE to believe that his liability is limited to issues associated with the timber framing that he was responsible for engineering.

The SSE is particularly at risk on projects where there is no SER. Case law has demonstrated that the courts will view a SSE as the SER by default if there is no other professional involved in the project. For instance, there are a plethora of cases where a SSE designed a foundation for a pre-engineered metal building and was held liable for defects in the metal building design.

When a timber frame contractor provides a complete architectural design for a house, the SSE may be assuming responsibility for the adequacy of the architectural design as well as the timber frame structure. This is particularly true when the drawings are prepared by designers that are not licensed architects. The SSE should attempt to contractually limit his liability exposure to the timber frame. The SSE should recognize that contract language may not shield him from claims and it may be prudent to also review the architectural Building Code issues such as stair configurations, egress windows, smoke detectors, etc.

Structural Analysis and Design

Establishing the appropriate loading criteria for a timber frame can sometimes be challenging. Information is needed on the character of the site and the building construction that may not be available to the SSE. The site location, topography and wind exposure influence the magnitude of the design loads as do details of the building construction such as roofing material and venting. The *TFEC Loading Criteria Checklist* can be used to acquire some of this critical information.

When the loading criteria has been specified by the SER, it is prudent for the SSE to verify that the specified loading is correct and he should resolve any discrepancies with the SER.

The engineering of timber structures must comply with the requirements of the American Wood Council *National Design Specification (NDS)* and should also comply with *TFEC 1 Standard for Design of Timber Frame Structures*. These codes and standards are not cookbooks for timber engineering. While the sizing of timber members is fairly straightforward, the engineering of timber joinery requires considerable experience.

The SSE must have an understanding of the proposed joinery details in order to adequately engineer the frame. The SSE must identify all members and joints that form part of critical load paths, and must review the design of these members and their proposed joinery. Notches,

mortises and housings at timber joints can have a significant impact on timber sizes. The SSE must have a clear understanding of all notching being proposed by the frame fabricator and how those notches may affect performance of elements or joints. Critical joints such as tension joints and truss joints should be fully detailed by the SSE and should be included on the sealed drawing set.

In those cases where the responsibility of the SSE is limited to the engineering of the timber frame and sometimes the SIP system, it is recommended that the SSE review the related structural elements to verify that there is a continuous load path down to the foundations, that the foundations are adequate and that there is a reliable lateral force resisting system provided in the design.

The SSE is sometimes required to submit his calculations for review by the SER. This can occasionally result in conflicts. The responsibility of the SER is limited to confirming that the correct loading criteria and appropriate or contractually required Codes and Specifications have been used. Since the SER may not be qualified to review the SSE's detailed calculations, satisfying the SER's review responsibilities can best be accomplished by indicating on the sealed shop drawings the codes and standards used in design, the loading criteria, the systems used to carry gravity and lateral loads, the materials of structural components and their mechanical properties, species and grades of timber and pegs, ASTM specifications for metal components, and other information as is typically found in a good set of General Notes. This should alleviate the need for submitting a set of calculations.

Professional Engineer Licensing Issues

The laws and regulations that govern the practice of Professional Engineering vary from jurisdiction to jurisdiction, as does the interpretation of those laws and regulations. The SSE should only provide engineering services for projects located in jurisdictions where the SSE holds a valid license to practice engineering and he should become familiar with the local requirements.

Professional Engineers are required to limit their practice to their field of expertise. Engineering of timber frame structures should only be done by structural engineers with experience in timber engineering. Timber frame contractors will occasionally engage engineers who are not qualified

in the belief that “all they need is a stamp.” Practicing outside an engineer’s field of competence is a blatant violation of the licensing laws.

In most instances, the timber frame shop drawings that the SSE is required to sign and seal have been prepared by designers or draftsmen employed by the timber frame contractor. The licensing laws and regulations prohibit a Professional Engineer from sealing drawings that were not prepared under the engineer’s supervision. This is often referred to as “plan stamping.” The engineer must have been in responsible charge of the drawing preparation.

It is important that the SSE be in a position to direct the individual preparing the timber frame shop drawing and to require that the drawings be revised as needed to satisfy engineering requirements. The relationship between the SSE and the designer should be similar to that of a draftsman in the employ of the SSE.

The following are some recommended practices for the SSE to avoid claims of “plan stamping”:

- Put your company logo on all drawings that you will seal.
- Perform complete structural calculations for the timber frame.
- Document all changes and revisions that you had made to the drawings prior to sealing them.
- Avoid sealing drawings that contain non-structural information such as architectural floor plans.
- Do not seal drawings that were completed prior to your involvement.
- Do not advertise that your firm stamps drawings.

If the SSE cannot justify that he was in responsible charge of the preparation of the timber frame drawings then he should decline sealing the drawings. For instance the SSE is sometimes engaged after the drawings have been completed and timber fabrication is underway. Under these circumstances the SSE could issue a sealed letter certifying that he has reviewed the timber frame shop drawings prepared by others, performed structural calculations and verified that the timber frame design is sound.

The limits of the analysis and design work performed should be clearly defined. If the SSE is sealing drawings, the drawings themselves should clarify these limits in a statement included in the General Notes (for example, whether the design of dimensional lumber components or

foundations incorporated into the structure are included or by others, or whether the design of a lateral load resisting system has been part of the SSE's work or is to be provided by others). In the case of the SSE issuing a sealed letter, it is even more important to state explicitly the limits of the design work and responsibility.

Timing

There is often a question as to when is the appropriate time to involve the SSE in the timber frame design. The SSE brings the most value to the project if he is involved early.

If the SSE performs an initial review and analysis prior to bidding, the timber sizing and configuration can be optimized resulting in a more cost efficient design. Timber frame contractors are often reluctant to expend engineering fees prior to being awarded the project.

If the SSE is not involved until after the timber order has been sent to the mill, the timber frame contractor cannot benefit from downsizing oversized timbers and the additional cost of upsizing any undersized timbers must either be absorbed or result in an unpleasant Change Order.

Clearly engaging the SSE after fabrication has commenced is too late.

Conclusion

Being a specialty timber frame engineer can be a very rewarding experience but it also comes with its fair share of potential pitfalls.

The key to a successful timber frame project is teamwork. Both the SSE and the SER must communicate, cooperate, and coordinate their efforts.

References

1. Council of American Structural Engineers (CASE) *National Practice Guideline for Specialty Structural Engineers*, 2nd edition 2006

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