

| | |
|---|----------------------------------|
| <p>WABO/SEAW Liaison Committee Washington Association of Building Officials & Structural Engineers Association of Washington</p> | <p>WHITE PAPER 1-2020</p> |
|---|----------------------------------|

| | |
|---|---|
| <p>Title: Guideline – Structural Plan Review Philosophy</p> | <p>Dated: May 11, 2006 Issue Date: June 30, 2020¹</p> |
| <p>Abstract:</p> <p>This white paper is intended to establish a guideline for a uniform approach to structural plan review of the construction documents submitted for a building permit</p> | <p>Committee Members: <i>Matt Snook (SEAW Co-chair), Lee Kranz (WABO Co-Chair), Shalini Prochazka (SEAW), Nancy Devine (WABO), Larry Lindell (SEAW), Rick Fine (SEAW), Mary Kate McGee (WABO), Cheryl Burwell (WABO), Chris Ricketts (WABO), Steve Belzak (WABO), Charlie Griffes (SEAW).</i></p> |
| <p>Committee Mission Statement:</p> <ul style="list-style-type: none"> • <i>Improve communications between the public jurisdictions that administer building codes and the engineering design community that prepares construction documents.</i> • <i>Improve consistency and quality of engineering submittals and project reviews.</i> • <i>Build consensus between the engineering design community and building officials with regard to code interpretation and submittal requirements.</i> | |

¹Appendix A added by members of the 2020 committee.

INTRODUCTION:

SEAW and WABO share a common interest in building safety. Both organizations recognize the importance of plan review. However, individual engineers and reviewers may not always agree on what a plan reviewer should cover in his or her review. Although the level of review varies from jurisdiction to jurisdiction, some building departments feel they have a responsibility to verify to a high level of detail that the plans comply with the code. On the other side of the counter, some licensed engineers feel that since they are taking on the liability through their seal and signature, building departments should not review their work at all. The following guideline and commentary are intended to lay out a common approach by establishing a suggested uniform approach or philosophy that can be used by plan reviewers working for the local jurisdiction.

While the words “reasonable” and “adequate” are used many times throughout this white paper, they are not defined (other than in a dictionary), and deliberately so. The intent is that the commentary gives a general flavor for what the committee felt was “reasonable” or “adequate.”

It should be emphasized that this document is not a rule with the force of law behind it. Nobody

is forced to follow it, but a building official may adopt it as an operating policy or philosophy, if he or she so chooses. Anybody wishing to invoke the principles in this white paper should check with the building official for the local jurisdiction. The committee intended this white paper to give guidance on communication that would lead to a positive outcome for both a design engineer and a plan reviewer, with the hope of fostering increased recognition and mutual respect for the complexities each faces.

GUIDELINE:

The following should be used by reviewers as a guide to how to approach their duties:

- **Purpose of Plan Review** – Plans are reviewed by local jurisdictions in order to verify they are in substantial compliance with the code.
- **Character of Plan Review** – The permit approval process should be a collaborative effort between the design professional and the plan reviewer.
- **Scope of Review** – The focus of the plan reviewer should be on the approval of the construction documents, not on review aids.
- **Level of Review** – It is reasonable for the plan reviewer to require enough information in the construction documents or review aids to conduct a review of the plans.
- **Engineering Judgment** – The plan reviewer should consider the engineer’s judgment, where there is no direct conflict with a code requirement.
- **Plan Reviewer Judgment** – The plan reviewer should exercise judgment in deciding which issues to address in conducting a review.

COMMENTARY:

Purpose of Plan Review

A plan reviewer’s function is to perform a necessary third-party quality assurance effort to verify the designer has done an adequate job in complying with the code. The plan reviewer’s job is to conduct a verification that the plans are in substantial compliance with the code, with the goal of protecting the general health, safety, and welfare of the public.

Character of Plan Review

While the code says the building official is “authorized and directed to enforce” and interpret the provisions of the code, court cases also reinforce that the design professional is ultimately responsible for code compliance through the contract with the owner. Given the respective roles and responsibilities of the designer and the reviewer, the process of ensuring a building conforms to the code should be a collaborative effort between the two.

A part of collaboration is the maintenance of open lines of communication between the design engineer and the reviewer. A reviewer should be aware of different levels of appropriate communication, based on levels of complexity—a phone call could be sufficient to handle easy issues, although written follow up may be needed

Scope of Review

A plan reviewer's job is to review and approve the construction documents for permit issuance. Supporting documentation such as structural calculations may be submitted as aids to help the reviewer with his or her review and are not part of the approved construction documents. That is, all information necessary to determine a design complies with the code should be on the plans. While submitting clear and complete review aids may aid in expediting the review, they should only be relied upon to support the information on the plans. For example, while structural calculations may be useful to determine if a design engineer has addressed a particular issue, they are not part of the construction documents and should not be reproduced on the plans. As such, it should not necessarily be the reviewer's primary focus to check the mathematical accuracy of the submitted calculations. However, any details that are included in the calculations and are necessary for construction should be shown on the plans.

Level of Review

What constitutes a reasonable plan review will vary, depending on many factors including:

- Project scope (e.g., a single family residence versus a large commercial building)
- Structural complexity (e.g., conventional wood framing versus a 450 foot tall concrete shear wall building)
- Plan clarity and completeness
- Whether the plans are prepared by a registered design professional versus a lay person.

It is recognized that the level of review will vary with each jurisdiction, depending on the resources and time they have available. It is also recognized that the level of review should vary with the complexity of a project—a simple single family residence does not need the same level of review as a large commercial building or a school. Often, building departments receiving permit applications for the more complex structures have engineering expertise on staff, and will tend to conduct more in-depth reviews than those who lack that expertise. However, it is not unreasonable for a reviewer to ask for enough information on the plans or in review aids to conduct a review of the plans.

Engineering Judgment

Many engineers feel that a reviewer should defer to his or her judgment on engineering issues, particularly reviewers without engineering backgrounds. However, reviewing a set of structural plans inherently involves looking at the engineering methods employed by the designer, and those methods reflect the engineer's judgment. The following principles represent a balance between the engineer's and the reviewer's responsibilities:

- In general, a design engineer should be able to articulate his or her rationale as to how a particular engineering issue is addressed. It is appropriate for a reviewer to ask the engineer

how he or she arrived at his or her design. However, if the design engineer is able to give a reasonable (i.e., rational and technically justified) explanation, the reviewer should defer to the engineer's judgment, particularly if the issue under discussion is not directly addressed in the code. Design engineers' responses to issues raised by the plan reviewer should address the concerns expressed and promote a collaborative effort. "Because I say so" or "Because I'm an engineer and you're not" or similar ways of avoiding answers are not reasonable nor collaborative explanations.

- Reviewers should keep in mind there can be several ways of solving design issues, and if reasonably justified as described in the bullet above, deference should be given to a design engineer's unique solution to a problem (e.g., using a method or detail that hasn't been seen before).
- Incorrect application of engineering principles is always an appropriate issue for a reviewer to raise. For instance, if an engineer calculates overturning moments on a multi-story shear wall by summing the shears at the first story and then multiplying by the height of the first story, engineering judgment cannot make the incorrect application of the principles of static equilibrium disappear. This is not compliance with the code. However, in general, if there is a disagreement between the design engineer and the plan reviewer regarding the application of engineering principles, but the design engineer is able to give a reasonable explanation as described in the first bullet above, then deference should be given to the design engineer, since he or she carries the responsibility and liability.
- It is appropriate for a reviewer to ask an engineer to justify a design that directly contradicts a code requirement. For example, a reinforced concrete column that does not have ties or spirals at the code-required spacing should be questioned, since ductile detailing is an important design feature that helps structures to survive earthquakes. Most of the requirements such as this are in the code as a result of tests, studies, debate, compromise, and ultimately, a consensus of experts in the field. If the design engineer wants to provide a design that is different, he/she must be able to provide a rationale that takes the engineering issues into account.

Plan Reviewer Judgment

The plan reviewer must always exercise judgment in conducting a review. Judgment is used to decide what issues are important and need to be addressed on the plans, and whether or not the designer has done a reasonable job (see "Purpose of Plan Review", above). He or she should avoid delving into the minutiae of details and losing sight of the primary life-safety issues. If the plans examiner expresses serious concerns about the design, the engineer should respond with information that addresses the code issues. After the important issues have been addressed, the reviewer should use his or her judgment and consider concluding the review.

In exercising his/her judgment, however, the plan reviewer should refrain from imposing his/her own idea of what constitutes "best practices" on the design engineer. If a design complies with the code, it should be approved, regardless of whether or not the plan reviewer would have designed it differently based on his or her experience.

Thank you to the following original committee members for their contributions to this white paper: Jerry Barbera (WABO), Preston Burris (WABO), Sue Coffman (WABO), Mark D'Amato (SEAW), Charlie Griffes (SEAW), Peter Hart, Lee Kranz(WABO), Chun Lau (SEAW), Mary Kate Martin (WABO), Chuck Morris, Chris Ricketts (WABO), Jon Siu (WABO), Mike Wright.

Appendix A:

The following is an article related to structural plan review philosophy that was published on the WABO and SEAW websites early in 2019. The focus of the article is on “engineering judgement” and its impact on the building code plan review process, permit timelines, cost of design and client/reviewer relationships.

STRUCTURAL PLAN REVIEW PHILOSOPHY

By the 2019 WABO-SEAW Liaison Committee including: *Charlie Griffes (SEAW-Cochair), Rick Fine (SEAW), Lee Kranz (WABO – Cochair), Chris Ricketts (WABO), Larry Lindell (SEAW), Cheryl Burwell (WABO), Shalini Prochazka (SEAW), Mary Kate McGee (WABO) and Matt Snook (SEAW).*

The WABO- SEAW Liaison Committee has been discussing “Structural Plan Review Philosophy” in light of a potential update to White Paper 1 – 2006 on the subject. The inspiration for the update is with regards to the back and forth that sometimes happens between the design engineer and the reviewer and the question of when it is appropriate for the reviewer to defer to the engineer’s judgement on a particular issue. The committee decided to produce the following article to illustrate the issues as we see them and to open the discussion with the community for comments or questions prior to addressing an update to the White Paper. We welcome your comments or questions.

Engineering judgment can be defined as *“The evaluation of available pertinent information, and the application of appropriate principles, provisions for the purpose of deciding upon the applicability, design, operation, or installation of structures and buildings. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.”* Pretty clear definition, right? Well maybe not so clear when it comes to deciding if calculations are necessary to justify that a design complies with the building code.

What does the term “engineering judgement” mean to you? The following is an example of a building code plan review correction with 3 potential responses by the structural engineer.

The purpose of this article is to highlight that there may be times when it is necessary for the engineer to prove that the design complies with the code through calculations or there may be less time-intensive responses that achieve the same results.

After reviewing the following real-life case, ask yourself what you would have done.

CONTAINED IN ORIGINAL CALCULATIONS

The concrete frame for this structure is a box type with nearly complete perimeter walls. (See Fig. 1.) Therefore, a two-stage analysis is appropriate and torsion will be minimal. The lateral analysis was conservative with the base elevation assumed at the parking level. A simplified analysis was used and shows that the average shear stress is less than $\frac{1}{2} * \sqrt{f'c}$. All code minimum reinforcing has been met and boundary elements are not required.

PLAN REVIEW CORRECTION COMMENT

“The structural calculations are unclear as to whether accidental eccentricity has been included in the design of the concrete base structure. The magnitude of the eccentricity should be specified. In addition, the lateral analysis does not clearly indicate if torsional effects have been evaluated and whether additional amplification of the accidental eccentricity is required. Supplemental documentation substantiating the design should be provided. See IBC Section 1613.1 and ASCE 7-10 Sections 12.8.4.2 and 12.8.4.3.”

RATIONAL ANSWER

The code references noted in the reviewer’s response (IBC 1613.1 and ASCE 7-10 12.8.4.2 and 12.8.4.3) were taken into account in the design. The structure is a squat building with low stresses in the lateral elements. Given our experience with this type of building, using the more detailed analytical approach, the additional torsion requirements outlined in table ASCE 7-10 table 12.3-1 would not result in design changes nor warrant additional analysis. A project with similar design configurations was analyzed in detail complying with ASCE 7-10 and found no modifications were needed to the lateral force-resisting system.

Commentary: The engineer has demonstrated that he/she understands and has considered the code requirements for this structure and in a short form calculation has shown how this conclusion was reached. Here is where some deference to the engineer should be made as they have shown by means of a similar project that additional analysis is not necessary. If he/she has a significant record of designing this type of structure successfully, his/her judgment should be respected, unless, there is a sincere concern by the reviewer that the structure is unsafe.

DETAILED ANSWER

This concrete building is a small squat structure. As demonstrated in the calculations, the shear stresses in the walls are very low. Since the shear stresses are $\frac{1}{4}$ of the nominal shear capacity of the shear walls and diaphragm to shear wall connections, accidental torsion adjustments will be small as shown below.

Accidental eccentricity is $0.05 \times 76.7 \text{ ft} \times 238.3 \text{ k} = 913.9 \text{ ft-k}$

Using minimum building width of 65 ft. and dividing torsion into 4 equal parts.

Shear due to torsion would be: $V_T = 913.9 / (4 \times 65/2) = 7.02 \text{ k}$

Increase over base shear; $7.02 / (238.3/2) \times 100 = 5.9\%$

Diaphragm shear Capacity: #5 @ 12” (min. dowels from wall), $f'_c = 5,000 \text{ psi}$

$V_c = 2 * \sqrt{f'_c}$ $V_s = A_{vs} * f_y * d$; $d = 0.8 * 12” = 9.6”$ (code minimum)

$\Phi V_n = \Phi * (V_c + V_s) = 0.75 * (20.37 + 14.88) = 26.43 \text{ kips}$

The equivalent wall shear stress = $26.43 / 8 / 12 * 1000 = 275 \text{ psi}$

This is equal to $4.35 * \sqrt{f'_c}$. This value will double at an interior wall (double shear)

Also, this is for a reinforced concrete slab, a post tensioned slab would probably have higher strength values.

Even at the worst case for “Torsional Amplification” (extremely irregular structure) the wall shear stresses would be well within their shear capacity and the diaphragm to shear wall connections adequate.

The current design is compliant with the code references noted above, as well as those sections triggered by torsional irregularity per ASCE 7 Table 12.2.1. Therefore, further analysis is not warranted.

Commentary: Here additional calculations have been provided to illustrate the engineer’s understanding and code compliance. Though crude, they demonstrate that his/her initial logic is sound and that the structure is compliant. Again, with some deference to the engineer’s experience, this should be deemed a sufficient response.

POOR ANSWER

In my 30 years’ experience designing podium structures, further analysis is not required.

Commentary: On this basis alone, this is not an acceptable response.

DISCUSSION

The code is complex, especially in the lateral force design requirements. It is desired that this process be a team effort to produce a safe and code compliant structure, rather than an adversarial one between the building official and engineer.

Engineer of Record’s Perspective

The engineer of record (EOR) has invested a great deal of resources into a structural design by the time it is submitted to the authority having jurisdiction (AHJ) for permit. They may have designed similar structural system configurations and are familiar with the intended building’s performance and applicable code requirements. The EOR is ultimately liable for the design and takes full responsibility. Engineers are typically appreciative of any comments that assist in making sure that the design complies with the applicable code requirements. However, it may come across as offensive to have their engineering judgement questioned by a jurisdiction for code compliance. Correction comments that do not add value to the design use unnecessary resources to resolve which may not be reimbursed by the owner or result in increased project costs and delays. It is desired to resolve correction comments with minimal resources as quickly as possible.

Jurisdiction’s Perspective

The AHJ is responsible for enforcing compliance with the building code. Plan review comments are intended to point out significant code compliance issues. In exercising their regulatory authority, building officials, plans examiners, and building inspectors tend to lean toward being conservative. However, being too cautious and requesting detailed technical justification will add cost and may delay a project, or in some cases make the project infeasible. Many jurisdictions have interacted with licensed professionals whose designs do not meet code, even when the EOR

may have the best of intentions. Codes change frequently, and even though an engineer has done something for many years, their approach may no longer be code compliant. It may therefore be difficult for an AHJ to accept only the EOR's word that a design complies without technical justification. Jurisdictions recognize that EOR's have the ability to make engineering judgments as part of their professional practice. There are times, however, when additional clarity is needed, and it is appropriate for the AHJ to ask for additional supporting information. It is important that reviewers have good cause to require additional calculations for technical justification and use engineering judgment when conducting a review.

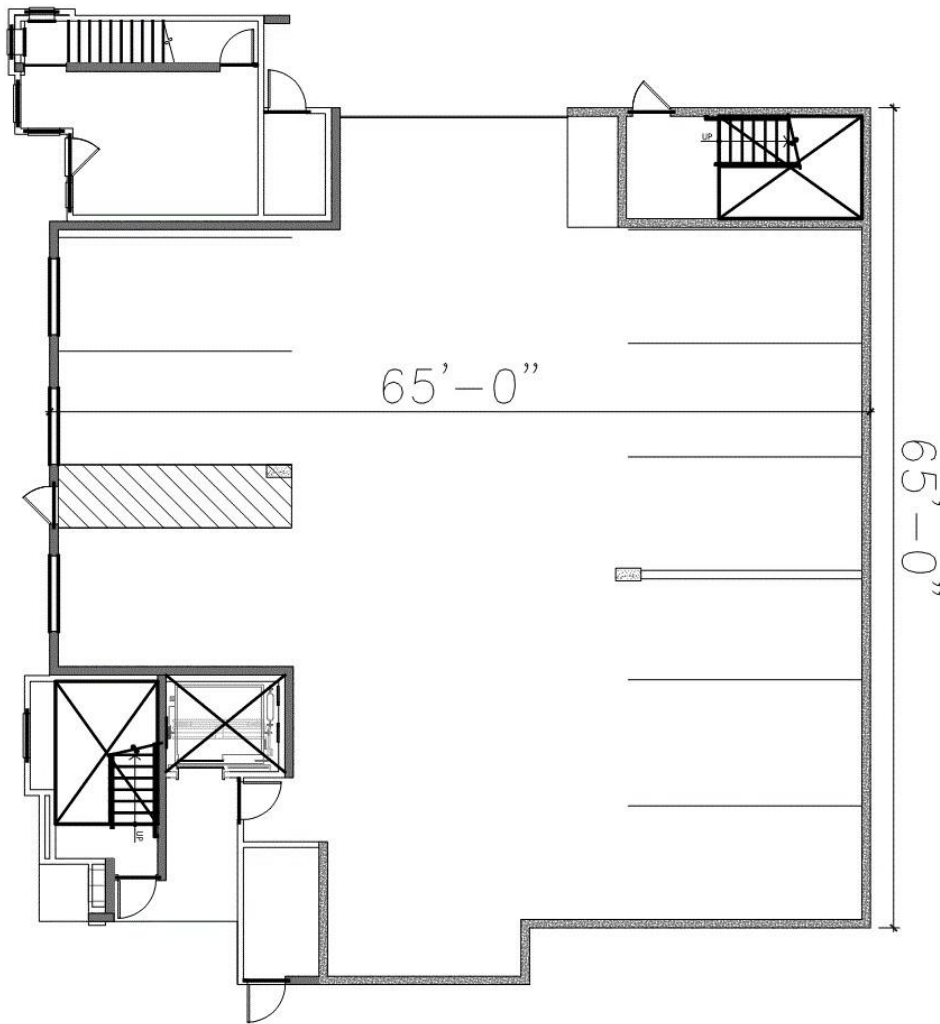


FIG. 1 - 3 Story Wood Frame Over
12" Podium Slab Plan