



BUILDING SERVICES ENGINEERING PLAN REVIEW GUIDELINES (PRG-2):

Guidelines Objective:

1. Improve communications between Building Services and the engineering design community that prepares construction documents.
2. Improve consistency and quality of engineering submittals and project reviews.
3. To promote objective and a systematic approach to the engineering plan review through the use of Structural Engineering Plan Review Guidelines as a means to communicate to the public.
4. To ensure that building and other structures within Building Services a jurisdiction are structurally safe and meets or exceeds code minimum standards.
5. To promote fairness, courtesy, and respect within the engineering team that promotes efficient use of Building Services limited resources in plan review work.

Abbreviations used in this document:

AOR / EOR – The architect or engineer in general responsible charge of the project (see OSSC provisions)

BSE – Building Services Engineering

BE – Building Engineer

LBE – Lead Building Engineer / Plan Review Supervisor

Guideline Summary:

The following should be used by engineering plan reviewers as a guide to how to approach our duties:

Purpose of Engineering Plan Review –To verify that projects engineering design are in substantial compliance with the code. The **BE's** job is to conduct a verification that the plans are in substantial compliance with the building code, with the goal of protecting the general health, safety, and welfare of the public.

Character of Plan Review – The permit approval process should be a collaborative effort between the design professional and the **BE**. 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. Through an open line of communication between the design engineer and the **BE**. The **BE** 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 – The focus of the **BE** should be on the approval of the construction documents per code. A plan reviewer's job is to review and approve the construction documents for permit issuance. Supporting documentation such as structural calculations submitted are aids to help the **BE** with his or her review, and are not part of the approved construction documents. Structural calculations are useful to determine if a design engineer has addressed a particular issue, but they are not part of the construction documents and should not be reproduced on the plans.

Level of Review – It is reasonable for the **BE** to require enough information in the construction documents or review aids to conduct a review of the plans. What constitutes a reasonable engineering review will vary, depending on many factors including:

- Project scope (e.g., a single family residence versus relatively a large commercial building)
- Structural systems complexity (e.g., conventional wood framing versus a mid-rise steel or concrete shear wall building)
- Plan clarity and completeness
- Whether or not the plans are prepared by a registered design professional versus a lay person.
- It is also recognized that the level of review should vary with the complexity of a project. To that effect a simple single family residence does not need the same level of review as a large commercial building or a school.

Engineering Judgment – The **BE** should consider the design engineer’s judgment, where there is no direct conflict with a code requirement. The following principles represent a balance between the design engineer’s and the **BE** 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 **BE** to ask the design 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 **BE** 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 **BE** 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.
- **BE** should keep in mind there can be several ways of solving design issues, and if reasonably justified as described 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).
- It is appropriate for a **BE** 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.

Building Engineer’s Judgment – The **BE** should exercise judgment in deciding which issues to address in conducting a review.

- In exercising his/her judgment, however, the **BE** 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.

LBE Duties: Under the general direction of the **Building Official** the **LBE** shall direct the work of Building Services engineering staff day to day performance of engineering plan review of construction documents submitted for permits. **LBE** essential duties are:

1. To promote and be accountable for customer satisfaction and quality of service through the spirit of partnership.
2. Assigned projects, organizes and coordinates engineering plan review and field engineering changes review activities consistent to engineering review guidelines.

3. Serve as facilitator on projects where there is a disputed comment(s) that cannot be resolved between the **BE** and the **A/E of Record**. In all such cases **LBE** shall provide guidance to move the respective projects forward to resolution consistent with stated objective above.
4. In disputed issues among **BE's** or between **BE** and **AOR / EOR**, the **LBE** shall make the final recommendation to the Building Official for approval.
5. Other additional task or assignments as directed by the Building Official.

A. General Engineering Plan Review Procedure

BSE is responsible to assure that building permit engineering documents including drawings, calculations and specifications comply with OSSC and other Building Services regulations. **BSE** role is to do efficient and timely engineering review necessary to comply with OSSC requirements.

LBE shall assigned projects to a **BE**. The **BE** before commencing a detailed plan review, he or she shall:

- Make a preliminary review to become familiar with the overall project.
- Verify receipt of complete and legible plans, specifications, calculations, and geotechnical engineering report.
- Confirm that the drawings are complete enough to perform an engineering review.
- Confirm that calculations are complete enough to perform a plan review. “The calculations shall be sufficiently complete to establish that the structure will resist the loads and forces prescribed in OSSC provisions” by means of complete load path.
- There should be no major discrepancies or errors such as incorrect seismic factors, wrong wind load design, incorrect snow loading, etc. If any documents are missing, or incomplete, the **BE** should contact the **AOR / EOR** immediately so that deficiencies can be addressed as soon as possible.
- The **BE** must consult with **LBE** if there are any deficiencies in the project which could prevent commencement of detail engineering review.

B. General Engineering Plan Review Methodology: - There are many methods for the **BE to organize the progress of an engineering review. One suggested sequence is as follows:**

1. Start by developing an understanding of the working drawings and expected behavior of the structure,
2. Proceed to a technical review of the structural analysis and overall structural stability of the proposed structure.
3. Check the professional’s design calculations against the drawings.
4. The **BE** should perform his or her own calculations for a few elements in order to provide an independent calculations verification to the project designer's methods are valid.
5. Review drawings for conflicting details, dimensions, or notes are removed, and also that a complete and buildable set of drawings is approved for construction.

B.1 Specific Engineering Plan Review:

- The **BE** must use his or her own judgment, and independent paths of reasoning to verify the conclusion of the design engineer’s work whenever possible.
- It is recommended that the **BE** take a moment now and then to 'step back' from detailed review of the details and calculations that have been provided and think about what issues may be entirely missing from the documents.
- If the **BE** simply follows the designer's path and reviews the designer's calculations and details the **BE** may overlook the same aspects that the designer overlooked.

B.2 Computer Calculations

- A user's guide must be submitted with computer calculations if it is essential to performing the engineering project review.
- The **BE** shall verify all input – orientation, loading, member sizes, dimensions, etc.
- The **BE** should make every effort to verify submitted computer calculations whenever possible without running another program.
- The **BE** may spot-check computer outputs by verifying that the summation of forces is balanced or by making “ballpark” assumptions such as using portal or cantilever methods to check frames.
- The **BE** may run an independent computer analysis when the designer's user guide or input is disputed or is difficult to follow. Discuss with the **LBE** before commencing any extensive computer runs.

Note: If the designer's computer analysis is inconsistent or incorrect then it will have to be corrected: BUILDING SERVICES will not analyze the entire structure to prove that the designer's computer program is incorrect.

B.3 Architectural, Structural, Mechanical, Plumbing, and Electrical Plans Engineering Review

The **BE** should verify that architectural, structural, mechanical, plumbing, and electrical drawings (as well as specifications) are all coordinated. Since consultants usually work independently on these aspects of design it is common to find consistency errors.

For example, locations of doors, windows, interior walls, or even overall building dimensions may change on architectural drawings during the design of the project. If these changes were not picked up on the structural drawings shear wall lengths and locations may be incorrect.

Other examples of coordination problems include but not limited to:

- Rooftop unit location.
- HVAC ducts routed through structural elements.
- Pipe or conduit riser locations interfering with structural shearwalls.
- Fire rated gypsum board location conflicting with structural plywood location.

It is essential for the **BE** to use his or her structural engineering expertise to look for aspects of the design that may be *missing* from the drawings and/or specifications. The **BE** is encouraged to use standards, charts, computer programs, and spreadsheets as reviewing aids.

C. Communicating Engineering Plan Review Comments:

- The **BE** shall provide his or her phone number on the cover sheet for the **AOR / EOR**. This information is necessary for dialogue.
- The **BE** shall make comments that are clear, legible, and complete so that designers will easily understand it. Clear comments will alleviate confusion and reduce time spent in revisions review process to be known as “back-check process”.
- The **BE** should not specify any size of members, materials, details, or methods of construction in the comments, nor should calculations be provided to the **AOR / EOR**.
- The **AOR / EOR** is required to determine the remedy for any deficiency that may be discovered by the **BE**.
- If possible, the **BE** should word general comments which apply to numerous drawings so that the comments don't need to be repeated.
- The **BE** should avoid correcting spelling or grammar unless the meaning is not clear.
- Typical details on the drawings that are not used, and are in conflict with BUILDING SERVICES requirements, should be deleted from the drawings or corrected by the **AOR / EOR**.

Examples of BE Comment Wording:

Department of Land Use & Transportation • Development Services Division • Building Services Section
 155 North First Avenue, Suite 350, MS-12, Hillsboro, OR 97124-3072
 Phone: (503) 846-3470 • Residential Fax: (503) 846-3993 • Commercial Fax (503) 846-8111

- Use specific comments such as: “*Show complete details in accordance with your 67” Calculation page 4*”.
- Do not use vague comments such as: “*Clarify welding*”
- Avoid personalized wording such as: “*Your calc. for this connection is in error*”
- Provide code references for comments whenever possible: “*Provide additional lath support at horizontal soffits per OSSC, Section xxxx*”
- The **BE** can make independent calculations when portions of the design professional’s calculations are difficult to follow or interpret: “*Shear wall is overstressed along gridline A, wall shears are 520#/ft by independent calculation*”

D. Suggested Do’s and Don’ts of Engineering Review:

- All major structural portions of the project must be substantiated by calculations as per OSSC provisions. Example: “*Provide complete calculations for bearing stresses and reinforcement requirements for column footings along gridline B*”
- A complete calculation would include checking punching shear in the concrete, bearing and bending stresses on the base plate, soil bearing stresses, required reinforcement in the footing, required embedment lengths, footing depths, etc...
- The **BE** should not be required to make calculations to verify the footing design.
- The **BE** should not request additional calculations for items where the capacity can be easily assessed or interpolated from similar conditions, or is adequate by observation.
- As a basic rule, the **BE** should not request additional calculations unless he or she has determined that the design is questionable. Engineering judgment should be used before asking for additional calculations.
- It is not necessary for the **BE** to comment on *errors* in calculations if drawings and specifications will result in compliant construction. For example, if calculations failed to take a reduction factor into account, but the element specified is adequate for the imposed loads anyway (as shown by independent analysis by the **BE**), it is not necessary to write a comment, since the supporting calculations are not part of the construction documents.

Suspension of Engineering Plan Review:

- In the event that a major design error is discovered by the **BE** after the reviewing is well underway, and this error will result in major redesign, engineering plan review will be suspended. Immediately consult with the **LBE** if such a condition is discovered.
- Reviewing will be resumed when revised documents which adequately address the issue are received.
- This procedure is to be used only under the special circumstances noted above.
- The **LBE** approval must be obtained before requesting a recheck set of drawings.

E. Responding to Engineering Plan Review Comments Process”

Scheduling and “Plan Review Comments Response Submittal”

- The **AOR / EOR** is required to call the **BE** in advance to make an appointment for *Plan Review Comments Response Submittal*.
- *Plan Review Comments Response Submittal* appointments have priority over engineering plan review work.
- The person or persons representing the **AOR / EOR** in the back-check must be thoroughly familiar with the project and the plan review comments/corrections.

- The *Plan Review Comments Response Submittal* will be terminated when it is determined by the **BE**, with the concurrence of the **LBE**, that more than three engineering plan review items have not been addressed in full, or that new items have been added that require additional plan review, or that the representative of the **AOR / EOR** is not adequately familiar with the project to address plan review comments.
- No more than two (2) engineering review letters should be sent by **BE** for the same items as found in the original review letter without the concurrence and approval of **LBE**. The **BE** should make every effort to get issue(s) resolved prior to initiating a third review letter for unresolved items.

In Matters of Differences in Code Interpretations and Opinion: When differences of opinion occur between **BE** and the **AOR / EOR**:

1. **BE** should respectfully and logically explain the reasoning behind the comment.
2. The **LBE** should be consulted if the disputed comment cannot be resolved.
3. For differences of opinion concerning matters of engineering judgment and not regulated ⁱby a specific provision of the code, the judgment of the **AOR / EOR** should prevail.

ⁱ Reference: Oregon Structural Specialty Cod; WABO/SEAW White Paper 1-2006; and others.