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Practice Reviews of Structural Engineers

by Jim Warne, P.Eng., General Reviewer

"Why Me?" is your most likely reaction when the letter arrives from the Association, if you're like most engineers. You will find that a questionnaire has been enclosed, for you to fill it out as

I am one of 8 General Reviewers retained by the Practice Review Committee of the APEGBC.

As a structural engineer, I know that one day it'll be my turn to be reviewed. I know I'll be nervous, but I'll benefit. It's a good program. It's another reason (along with the recent bylaw changes) that most structural consultants have been re-assessing their quality control standards.

If you're assigned to me when your name comes up, I'll phone and set up a time for an interview at your office. I will reassure you that the review is confidential. You will be asked to involve your employer, as your firm's policies are an important factor in your practice. Our interview will be in private, however. We will follow the procedure set out in "A Member's Guide to Practice Review", published by the Association, so ask for a copy if you don't have one already.

I will tell you that the review is planned to be a positive process, designed to help you improve your practice. My questions will search for weaknesses, but the report I expect to produce will have a positive emphasis. I see myself as both "cop" and "consultant", but 80% "consultant" and only 20% "cop". You have opened your files to me, and you've been candid in describing your practice. I have an obligation to be fair, and to try to help you, in my report.

Of course, if a serious design weakness is discovered, or if I think you are putting the public in danger by practising improperly, some action to protect the public is required.

If you're a structural designer, one or more of your projects will be picked as a sample and reviewed by a Technical Reviewer. He will look at the set of drawings as an indicator of how you practice. Any checking performed is incidental, but he tries to be alert for weaknesses. You will help pick the Technical Reviewer, who will be a senior Principal of a structural consulting firm. You will be given a draft of both our reports and asked to comment, before they are finalized.

As you probably know, we really try to keep our review process confidential. We even destroy the first step of the Practice Review.

It's "you", because, like other reviewees, your name was selected at random from the first pool of names of engineers, most of whom have stamped structural documents for building permit applications in the lower mainland. These practice reviews are intended to serve as the first of the audits of structural engineering practices which were recommended by the Closkey Commission after the Station Square enquiry.

So far, I think we've helped all the practitioners we've reviewed. The reviewees seem to agree it's been helpful, even when our reviews are critical. Most reviews so far have judged the member to be in compliance, but there have been several recommendations of follow-up reviews, and a few judgements of non-compliance.

Some tips to get ready for your review:

Start keeping clear records, especially design notes and field review reports.

Make sure your work has been reviewed, and signed off by the reviewers.

Have you really detailed for earthquake effects? Watch the load paths!

When you stamp that drawing set for the permit submission, is it really finished? Read the "Rules for the Use of the Seal".

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Practice Review Experiences

Jim Warne

At the meetings where Specialist Qualifications was discussed, some DSE members have asked about the types of deficiencies that prevented structural engineers from being judged “In Compliance” when they were reviewed. Were they significant structural weaknesses in the members’ designs, or just clerical errors such as failure to keep good records?

As a General Reviewer, I’ve interviewed and written reports on over 75 engineers, most of whom are structural. I find that performance of engineers is all over the map. The weak practitioners are certainly not a majority, but they are a significant fraction.

the assessment files for each reviewed member, after the review process is complete. Consequently, the following examples are reported from my memory, and cannot be tied to individual engineers. Here are some of the common weaknesses I recall from technical reviews of structural engineers:

Gaps in the load path: In low rise steel frame buildings with open web steel joists, some designers have omitted connections between metal roof or floor deck diaphragms and the beams below, on brace lines. I guess they assume the joist seats can transfer seismic shears perpendicular to the joists, but joist seats usually can't. Other omissions have been the drag struts under a metal deck where shears have to be transferred to re-entrant corners of exterior walls, or to interior shear walls. In wood framed structures, we also encounter gaps between plywood roof diaphragms and exterior walls, where roof trusses bear on the walls.

Misunderstanding of seismic behavior: One of the most common weaknesses among designers, this may show up as a mix of incompatible systems in a structure. An example is using a steel moment frame along the open front wall of a building, and a masonry or tilt-up concrete wall at the back. The moment frame may be able to take the share of lateral load that the engineer has assigned, but it is so flexible compared with the back wall that floors or roof could separate from the support walls before the resistance develops.

In retail buildings we have seen an odd combination of masonry piers and nailed plywood spandrel panels. The piers and the panels were intended to resist lateral loads by working together as a moment frame, but the connection flexibility, and the flexibility of the nailed plywood, meant the masonry piers would have to lean over very far before moment resistance could develop. P- Delta effects would get worse with each seismic oscillation.

Unstiffened steel beam webs at bearing points.

I'm always surprised to see this weakness, because everyone knows about the Station Square collapse Some designers have shown steel beams continuing over columns with no web stiffeners at bottom flange bearing points, and no joist extensions or equivalent bracing. Timber beams are sometimes detailed this way as well, continuing over posts, with long overhangs and no compression edge bracing.

These are examples of <u>technical weaknesses</u> - where the designer doesn't appear to understand structural behavior.

Next issue: Weaknesses in Quality Control.

<u>DSE Newsletter March, 2000</u>

Practice Review Experiences - by Jim Warne

More examples of the "weaknesses" that Reviewers find, when doing Practice Reviews of structural engineers:

In the last issue we discussed "Technical Weaknesses," reported in Technical Reviews. This month I'll describe some "Quality Control" weaknesses I've encountered when reviewing the practices of Structural Engineers.

No Concept Review: This is still the most common weakness encountered, but it has become rarer, as more and more engineers realize that most of their colleagues are now obtaining concept reviews that comply with the Association's bylaw.

Getting Independent Concept Reviews is just common-sense checking. Without them, how can we catch our own mistakes? Getting an independent review seems to be a dispensable luxury in some firms.

You can't avoid getting your design reviewed, if you work for a big industrial firm like Sandwell or Simons. It's an ingrained part of the culture. But it's less likely if you're a sole practitioner, or an engineer in a small firm. If you are in an intensely competitive market, perhaps designing wood frame apartments, you may feel pressed to cut back on concept reviews. But many small firms have found they can exchange review services with other, similar firms.

When we visit structural engineers and find they have not been getting concept reviews of their designs, we treat the omission seriously. The good news is that the follow- up reviews that we do a year later almost always show that concept reviews are being obtained. Even sole practitioners find they can comply with the Association's Guideline.

Cursory Checking: Checking practices among structural designers seem to be "all over the map." The industry a designer works in makes a big difference, but good checking isn't a monopoly of big firms. Some small firms do good checking, and some don't. The ones that don't are often unaware there's a weakness.

While an engineer will admit it if he doesn't get concept reviews, everyone seems to say: "We do good checking." When I hear that claim, I expect to see samples of check prints with every member on the plans, and every number, crossed off in yellow or red. Systematic, thorough checking seems rare these days.

A minimum acceptable standard is one where I can see a record of the checker's calculations, showing that he or she has followed the load paths and tested the strength of most of the critical members. I don't consider a visual scan of the design drawings by a senior partner, just before printing for an issue, to meet the definition of "checking."

Delegation: When I see notes delegating part of the design to the contractor, as in notes like "Provide roof trusses (or steel connections, or steel studs) designed by a professional engineer," I also expect to see review copies of (stamped) shop drawings bearing review marks by the designer. They should show that the drawings have been reviewed for stated design loads, and for suitability of critical details such as connections. We can't "cop out" of our responsibility for any part of the structure by saying "another engineer has stamped it." The suppliers' engineers won't understand the structure as well as the original designer does, and they can make big mistakes, too.

Field Reviews: We don't go onto job sites when we review an engineer's practice. However, we phone references, and look at field review reports. Most structural engineers, or the inspectors who report to them, write clear, explicit reports. When a construction deficiency is reported, there should also be an instruction in the report about verifying the correction, before it's covered. This is usually a note requiring a call for re-inspection. There should be follow-up reports of re-inspections in the file, as well.

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Practice Review Experiences - by Jim Warne

In previous issues I tried to give examples of weaknesses I've encountered in engineers' practices, such as a lack of checking or not understanding seismic behavior.

This time I'd like to report on some **good examples**.

Most reviews are not negative. While I can usually find some aspect of a practice that can be improved, I find that most structural engineers are conscientious and do good work.

Sometimes I'm really impressed. I have visited firms who do great work. Their designs, and their documents are excellent, even though they may be produced under pressures of time and budget that I don't experience.

I think the best example I saw was work done by a structural engineer in a sawmill design firm. The design drawings for log handling chutes were literally beautiful. The platework was drawn with several views, including small scale "GA"s and large scale details. Stiffening gussets seemed to be just the right shape, in just the right places. Weld symbols were complete and appropriate. Drawings of the supporting beams, columns and bracing were just as well done.

The engineer I reviewed was diligent and competent, but I think it was something in the culture of the firm that made them stand out in my perception. Everyone in that design office seemed to be knowledgeable about their industry, and steeped in a culture of accuracy and practicality. They were long term employees who worked as a team in what seemed to be a relaxed environment. Their sawmill clients seemed to be very loyal. I guessed that they had succeeded in selling the benefits of good design, and were presumably able to charge profitable fees.

Some engineers leave me envious after I finish my interview. "Why can't I have a practice like that?" I say to myself. I call this example a "niche practice."

"Niche" engineers have developed expertise that is rare and respected. It may be a skill at designing a certain kind of industrial product, that takes a special awareness of material properties, or a difficult analytical method, or knowledge of an industry dominated by a few large corporations. Of course I can't tell you the details of specific practices, because Practice Reviews are confidential. One reviewee, when describing his niche, even told me: "Don't tell a soul about this specialty! I do all the design for these manufacturers, and they treat me far better than my building clients do!"

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