Submission to the Royal Commission into the Christchurch Earthquakes

The Improvement of Building Design

Through the Modification of the Certification Process

Dr. Barry Davidson FIPENZ,

Critical Issues:

- Major failures in recent earthquakes have highlighted that buildings with key weaknesses have been, and continue to be built. For example, non-reliable load paths.
- Experience of recent years has shown that as a result of a lack of a truly independent checking process, many buildings constructed are poorly designed and/or inadequately documented.

Key Elements of the Solution:

- The current certification process would be overseen by the Department of Building and Housing assisted by a number of prequalified highly regarded designers/experts (New Zealand Design Reviewers) who will have the role to: (i) review/audit the design of key buildings (ii) choose design reviewers, (iii) provide design advice to designers and design reviewers.
- A national database will be developed into which Territorial Authorities (TAs) will enter at the time of Resource Consent Application (or prior to the application of Building Consent) details of the proposed structure, the designer, owner and/or developer. This database will help identify critical structures and poor design concepts at an early stage and alert the NZDR team as to where assistance is required.

The Submitter:

I, Dr Barry Davidson am the principal of a specialist structural engineering practice, Compusoft Engineering Ltd. Compusoft Engineering has for twenty years worked primarily as a support consultancy for structural design consultants by providing specialist knowledge and analytical skills. I am a Past President of SESOC (The Structural Engineering Society of New Zealand) and a Life Member of that society, a Fellow of IPENZ (Institution of Professional Engineers New Zealand) and past member of the Board of Practice of IPENZ, I

am a Fellow of the NZSEE (New Zealand Society for Earthquake Engineering) and a past board member of that Society. I was the President of SESOC when Mr John Scarry presented his "An Open Letter to IPENZ on the Parlous State of the Structural Engineering Profession and the Construction Industry in New Zealand" to IPENZ. At that time I was pondering on how to answer some of the questions posed in that letter as they were also being asked of me by members of SESOC. Since then, through submissions to IPENZ and the development of procedures that have been promoted by SESOC I have attempted to promote ways to assist in the improvement of the design of structures. The request for submissions from the Royal Commission into the Christchurch Earthquakes provides a further opportunity to assist in this cause. This submission is based upon personal experiences and discussions with other Engineers over a number of years as to "the best way forward". It is my belief that while this submission does not provide the "silver bullet" and must be implemented along with a number of other initiatives (improvements in education, improvement in quality of CPEng, the improvement in Standards. etc.), the implementation of the proposal contained in this submission will provide a secure gate through which only quality designs will be allowed through to construction.

Reason for Submission:

The Royal Commission has requested the input of ideas on how to improve the seismic safety of constructed buildings.

Current Building Consent Process with Regards to Structural Design:

(i) On application for a Building Consent by the owner or his/her agents, the structural designer usually provides two copies of the structural drawings, specification and calculations, and often a Producer Statement 1 – Design (PS1) stating that the design complies with the Building Code and all applicable structural Standards.

(ii) Often depending on the size of the project, prior to issuing a Building Consent the Territorial Authority (TA) may check the design documentation themselves, simply accept the PS1, or may it request that an 'independent' engineer carry out a design review, and when the reviewer is satisfied that the design complies with the Building Code, he/she will issue a Producer Statement 2 – Design Review, to that effect.

Notes:

(a) On many projects, there may be a number of PS1's issued by the design engineer, to cover a staged consent process that allows, for example, foundation

construction to proceed before the design of the superstructure is completed. In addition, sub-contractors supplying the likes of precast floor systems and timber roof trusses will issue PS1's to cover their proprietary designs.

(b) For more complex projects, discussion between the TA and the owner may take place at the beginning of the project to nominate a designer reviewer who can perform the review at stages during the development of the design, to match the staged consent process.

(c) For many projects, staged construction starts before all of the design (and review) is completed, but each stage is supposed to be fully consented before it starts on site.

Shortcomings:

(i) Not all designers have equal ability and knowledge.

(ii) All designers make mistakes at some time.

(iii) The reviewers are in many instances not independent of the designer or the owner or his agents.

(iv) The Producer Statement process overlooks the demands of the commercial world and human nature, and many of the parties that now dominate the design and construction process have sufficient knowledge only to be dangerous.

(v) The insurance industry provides negative incentives to the process.

Notes:

(a) While the first statement is self-evident, the current process of using the 'CPEng' quality mark attempts to insist that designers with this stamp of approval are capable of designing a complex structure and/or reviewing the design of one. This is NOT correct. In addition, under the current process (when a designer repeatedly uses the same design reviewer), a very common mistake that is made is in thinking that because someone has designed a lot of one type of building, they are actually expert at it. It is possible that particular design/review team are consistently getting the design wrong.

(b) Statements (iv) needs amplification.

a. Firstly the Producer Statement process was developed to provide a more cost effective procedure than the previous mandatory review of calculations by TA's. In its development was an assumption that all designers are capable, 'Professional' and act as 'Gentlemen'. Many engineers who helped develop and promote the Producer Statement system were educated and schooled in a time when the construction industry was dominated by the Government through the Ministry of Works and various construction related Government Departments. Then there was time to consider the design, develop skills within their practice and train younger staff. Fees in the private sector were often two to

three times what they are now, for far less complex design requirements. For most designers now, that world no longer exists.

b. Building owners tend not to be truly knowledgeable with regards to the building design and construction process, and particularly with regard to seismic design and detailing. Typically they buy buildings that have already been constructed by a 'developer,'" or they engage a 'project management group' to procure the design and construction of a new building for them. Quantity surveyors also play a dominant role in selecting what construction techniques will be used and which engineers will be engaged. Neither developers, project managers nor quantity surveyors as they presently exist in New Zealand have the depth of knowledge to make sound engineering decisions. They all promote their buildings or services as representing construction for the cheapest price, when in fact what is produced does not represent the lowest 'life cycle cost,' and is all too often fundamentally flawed from a seismic perspective. The developer is doubly compromised as he has little responsibility for the performance of the building after it has been sold. The designer, and the design reviewer, have to respond to the time and financial demands of the developer and/or project manager. Not even the 'best' buildings designed by 'leading engineers' for 'blue chip clients' have escaped the long term degrading effects of this environment.

c. While final acceptance of the choice of design reviewer is at the discretion of the TA, all too often the process 'rubber stamps' the engagement of a design reviewer who is known and agreeable to the designer or owner, and not necessarily the best reviewer for the job. The decision as to who will perform the review will be a designer who satisfies one or more of the following qualities: the most qualified, the cheapest, the fastest, the one who will create the least disruption and agree with the design, a friend of the designer, or the reviewer who "we always use". Project managers and developers are most likely to choose the cheapest, fastest and the one who does not ask difficult (picky) questions of the designer. (I can provide actual examples of all of the above situations)

(c) The insurance industry negatively influences a positive long term outcome for quality designs in two ways.

a. Through the provision of Professional Indemnity (PI) insurance. All designers and design reviewers are required by their clients to carry this insurance. While I understand the need for this insurance "in the current climate", a cynic could see that especially in the case of a design review, unscrupulous or pressured reviewers could produce a PS2 after the cursory of investigations. The reasons for doing this are; the money is good, he may have faith in the designer (a friend), and as long as it does

fall down during construction (a number have failed in recent times !) there is nothing to worry about because “earthquakes don’t happen” and “we have PI”. Engineers are typically no longer ‘partners’ with unlimited liability, but shareholders in limited liability companies. Also, the whole concept of PI is misleading, because most engineers do not carry anywhere near enough to fully cover a full claim on one large job.

b. After a building failure, the negotiation process between insurance companies ensures that information about the situation is buried. In the situation when a building does fail, the process of the insurance companies is one where there are nondisclosure agreements signed and settlements made out of court. Consequently, the names of the designers and design reviewers involved are not published, so project managers and developers with best intentions officially don’t learn the names of those professionals that they might like to shy away from. What caused the failure is not published and little is learnt by the profession.

Proposed Recommendations:

Objective of the Recommendations

To improve the process of checking to ensure better structural safety for a larger number of building designs.

Requirements of the Recommendations

1. To ensure that the design is fundamentally structurally sound at the earliest stage.
2. To ensure that a strategic range and number of buildings are independently reviewed before construction.
3. To ensure that the design reviewers are adequately qualified to perform the design review.
4. To ensure that the design reviewers are independent of both the designer and the owner/developer.
5. To promote better designs throughout the industry.

1. Formation of a Team of New Zealand Design Reviewers (NZDR)

There will be a relatively small number of designers/experts appointed as “New Zealand Structural Design Reviewers” (NZDR) throughout the country. They will be appointed by the

government (DBH), but continue to work for their current organisations. The characteristics of these reviewers will be:

(i) They will be generally accepted within the engineering industry as being superior designers and leaders in the structural design fraternity. They should be approved by the DBH and SESOC. (This is to minimise the criticism that could arise from an unfavourable review)

(ii) As a group they will encompass most specialities; reinforced concrete design, seismic isolation, fracture mechanics etc (This will help ensure that all critical issues of a design are reviewed)

(iii) They will be active designers/analysts/researchers in their own right and they (and the companies they work for, if appropriate) will not rely on design review work as the only source of income. (This is to ensure their currency).

(iv) They will work at an hourly rate. (The strength of this approach, along with the cost being borne by the owner/developer, is that if a designer is chosen who is incompetent and/or provides poor quality documentation it will cost more to get the design approved than if a more superior designer was chosen in the first instance. Consequently, the owner/developer will be wary about reemploying the same designer who will have to improve his ability to ensure his viability)

(v) It is important that they are seconded to a project in groups of three or more. This is to ensure that they act without prejudice on a project, AND if they have an adverse recommendation to make, they (and there company) are not victimised by the developer and/or builder.

2. Proposed Procedure for Design Approval:

(i) On application for Resource Consent (or prior to Building Consent in the situation where Resource Consent is not required), the applicant will supply along with current requirements: the name of the structural engineer, the owner (project manager) or developer and with assistance from the structural engineer, a design features report that would describe the proposed structural form, proposed load paths, expected seismic performance etc. It is not intended to have any details such as member sizes supplied at this stage.

(ii) This information will be entered by the TA into a national database. This information will assist in the decision as to whether this building needs: (a) to be reviewed, or (b) needs to be reviewed by the New Zealand Design Reviewers(NZDR)

(iii) On application for a Building Consent (or at an earlier date), the structural designer will discuss with the TA the name of the design reviewer. The final choice will be that of the NZDR (with reference building information and track records recorded on the national database) articulated through the TA.

(iv) The design reviewer will perform the review of the design, and issue a PS2 only when fully satisfied that the design meets the requirements of the Building Code and sound engineering practice. (If not acting in that role, the NZDR may choose to audit the design following the issue of the design review. This latter approach is the more likely as there will be a large resistance from developers and builders to have members of NZDR perform the review!)

(v) The cost of the design review (not the re-review) will be paid for by the applicant. This will be charged at an hourly rate.

(vi) In addition to ensuring critical designs are correctly performed, results of design reviews performed by the NZDR will be recorded on the national database .

Notes:

1. Structural designers will be chosen by owners/developers/project managers and terms and conditions negotiated as normal.
2. The decision of to the extent of involvement of a NZDR and the choice of designer reviewer will be made following a review of the profile of the proposed structure and the designer/ developers(project management) team. This decision will be made by the DBH. The approach proposed here would be to ensure all critical (life safety) structures such as those with large spans and irregular structures with more than say three storeys are reviewed. They may be reviewed by a NZDR or reviewed by a design reviewer approved by the NZDR. This decision would be influenced not only by uniqueness of the structure but the track record of the designer/owner/developer/(builder) team. Key to this approach would be that for non-residential structures, the designs of first time designers would be reviewed by a NZDR. It is intended that this nationwide approach, with the help of the database, allows trends to be observed and focus the design review effort to where it is needed.
3. In the situation where the DBH elect to have the NZDR review a design, three members will be chosen fro the reasons described above. That group of NZDR members may elect to request help from other NZDRs if needed for specialist help.
4. NZDRs will be known to each other and may meet in an organised forum to compare notes and report back to designers. This could take the form of an annual conference.

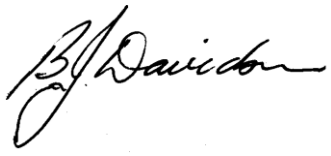
Advantages of the Proposed Procedure:

1. It has incentives to encourage developers and project managers to use designers that cost the least for the overall design/design review fee.
2. It encourages and assists designers to improve their abilities.
3. It ensures that designs are independently reviewed by competent reviewers.
4. It will provide a nationwide description of our building infrastructure.

Final Comments:

The above is a description of a proposal of which acceptance of the key elements features would assist in greatly improving structural design in this country.

I am available and willing to appear before the Royal Commission to discuss this submission should the Commissioners so desire.



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