Roles and Responsibilities

Submission by Dr David C Hopkins, Consulting Engineer Wellington

Professional background

This submission is made against my background of over 40 years as a consulting engineer in the structural and earthquake engineering field. The attached CV indicates the breadth of my involvement in these fields in New Zealand and overseas, including in technical and management roles. This involvement includes key roles in the development of legislation, regulations, the New Zealand Building Code and design guidelines for practitioners. Since 2003 I have been an almost full-time advisor to the Building Industry Authority, to its successor, the Department of Building and Housing and now to the Building and Housing Group of the Ministry of Business Innovation and Employment.

This broad range of consulting experience combined with the opportunity to work as part of the national regulatory authority have given me valuable insights into the roles and responsibilities of the various parties whose work contributes to the safety of buildings in earthquake.

Submission

The Canterbury earthquakes have been a shocking reminder just how important engineering is to the well-being of the community and to the economy of New Zealand. I respectfully submit the following observations relevant to the Roles and Responsibilities Discussion Paper published by the Royal Commission.

In the Appendix to this submission, I make some specific comments on the Discussion Paper.

1. National engineering resources

Observations

- Since the wind-up of the Building Industry Authority (BIA) and the establishment of the Department of Building and Housing (DBH) there has been a significant and increasing loss of focus on, and resource applied to, issues of building safety and quality, especially technical issues affecting major buildings.
- The technical resource at central government level is well short of that necessary to deliver reasonable and consistent standards of building safety throughout the country.
- The Canterbury earthquakes have been a reminder of the importance of the safety and structural performance of buildings and infrastructure.
- It is important that the leaders of the national regulatory body have the requisite design or construction experience to properly appreciate the technical implications of the Canterbury earthquakes and other issues as they arise.
- It is vital that there is a national regulatory body that is focused on the delivery of safe and healthy buildings. The industry and the issues are too important to be part of a government bureaucracy led by people with little or no experience in design and construction.

Recommendation

- Establish an independent national authority responsible for and focused on building safety.

- Establishment of this authority must be accompanied by a commitment to provide the funding and technical resources necessary to achieve requisite standards on a consistent basis.
- Governance and management of this authority must be in the hands of people with extensive direct experience in design and construction.

2. Building Consent Authority Resources

Observations

- Most building consent authorities lack the technical resources and skills to maintain reasonable oversight of important technical issues.
- Reviews of building consents are focused on consent process rather than the technical safety of the design.
- Timeliness of issue of the building consent is consistently quoted, including by politicians, as of prime importance. The Canterbury earthquakes have shown the community that the safety and integrity of buildings and infrastructure are really important. Engineering issues matter more than getting a consent on time.

Recommendations

- Action is needed to address the shortage of technical resources of building consent authorities for the review of building consent applications, issue of building consents, issue code compliance certificates and monitor the safety of design and construction.
- A review is needed of the number of building consent authorities with a view to reducing them to around five for the country. In this way, technical resources of the requisite skill levels can be made available to a wider area with greater efficiency.
- Engineering considerations need to be given more weight in decisions on building and infrastructure developments.

3. Education and Research

Observations

- Resources for education and research in issues affecting building safety, particularly civil and structural engineering, are well below that needed to maintain adequate competence of the profession, let alone to keep New Zealand's position as a leader in earthquake engineering.
- Resources available for professional development training in new requirements and methods are well below that needed to ensure that the intentions of policy, legislation, regulations and NZ Standards are met to an acceptable level.
- Policy makers appear to be focused on *process, accountability and productivity* apparently unaware of the fundamental need for people with *adequate technical skills* in the building and construction industry.
- Many standards and guidelines are produced but the resources need to be committed to making sure that those charged with implementing the guidelines are properly informed and trained in new processes. Education and training are very expensive, but without them, the money spent on developing standards and guidelines is largely wasted.

- The Canterbury Earthquakes are hugely important internationally as a source of learning on important earthquake engineering issues. Researchers from many countries have been studying the effects and will continue to do so for many years. To maximise the benefits to New Zealand and internationally, this research needs to be brought together into an integrated programme and data base.

Recommendations

- Significantly increased funding and resources are required to support research in geotechnical and structural engineering, especially on issues affecting the earthquake performance of buildings and infrastructure.
- Greatly increased resources must be made available for the education and training of engineers, especially the ongoing professional development on issues affecting building safety. There must be greater use of experienced designers in the education of undergraduate engineering students
- A Canterbury Earthquakes Research Programme needs to be created with significant funding and resources to bring together lessons learned from the earthquakes and its impact on the physical, social and economic environment. (Note: The establishment of such a programme was recommended to Government by the Canterbury Earthquake Recovery Commission in January 2011 following a proposal from this submitter.)

4. New Zealand Standards for the Building Industry

Observations

- The approach to the development, maintenance and funding of the NZ Standards for building design needs to be overhauled.
- Funding needs to be sufficient to involve leading practitioners, industry representatives, government and local authorities, and researchers on a sustained basis. The funding model which requires sale of Standards to fund their development has seen inadequate resources applied and a lack of balance in representation on review committees. With pressure on fees, practitioners have found it increasingly difficult to spend pro-bono time on Standards development.
- Standing Committees need to be established for the major design and construction Standards. These Committees need to be responsible not just for development of the Standards but for ongoing maintenance and interpretation.
- Standards for building design have become far too detailed to be effective. There has been a tendency to consider that every detail of design must be covered in a Standard.
- There is a concern that the complexity and detail of some Standards has made structural "design" into a series of process steps on a series of apparently unrelated topics. The opportunity to see the "big picture" of the overall integrity of the building is lost.
- There is a need to review the complexity of building standards with a view to reducing them to definitions of key performance criteria for the building as a whole and its elements. For example definitions of loads to be used or general limits on displacement. The detail needed to define acceptable methods of demonstrating achievement of the requisite performance would be left to authorised guidelines, published papers and texts.

Recommendations

- A major overhaul is needed of the development, maintenance and funding of New Zealand Standards for the design and construction of buildings.

- Standing Committees must be established for the major design and construction standards. These must have a good balance of practicing designers, researchers, regulators, and industry representatives. They need to be charged with the responsibility of developing and maintaining the currency and effectiveness of the standards and assisting with their correct interpretation.
- Consideration needs to be given to making all major design standards less complex and detailed and using authorised guidelines and methods to demonstrate achievement of defined performance criteria.

5. Roles and responsibilities of the community and client bodies

Observations

- It is vital that proper attention is paid to engineering issues in the planning, design, consenting and construction phases of important infrastructure and buildings. Every building is a prototype (a one-off) and there is only one opportunity to get it right. This requires adequate resources and skills applied at all stages of the creation of a building.
- One of the most important parties in determining the safety of a building is the owner or client body. It is vital that the owner or client body responsible for major developments include people with experience and insights into the design and construction of buildings. Such people should be able to identify the implications of technical proposals, the likely effect of cost or time pressures and value of meeting more than the minimum required standard.
- Many buildings that survived well in the Canterbury earthquakes were designed and built above the minimum standards of the codes – including several "overdesigned" buildings designed and supervised by the former Ministry of Works. There is a lesson here for both engineers and their clients.
- Since the mid-1980s, fees paid for structural engineering services have steadily reduced as a percentage of the building value. Over the same time period the complexity of designs and the resulting demands on engineer time have increased. This has meant that structural engineers must minimise input (consistent with safety) and can afford less time to train less experienced staff or contribute to standards development.
- Structural engineers are now commonly paid less than 1% of the *building* value for designing a major building –even though they must retain responsibility for their designs for at least ten years. Meanwhile real estate agents seek 2% and more of the value of the *building plus land* for one sale. Is this a reasonable reflection of the value of engineering to the community? Applying adequate skilled resources to the design, checking and construction phases is an important factor in delivering safe buildings.

Recommendations

- Client bodies responsible for major developments need to demonstrate that they include people with sufficient experience in design and construction to recognise the long-term value of good engineering.
- An examination is needed of the effect of the reduction in fee levels for structural engineering services over the last thirty years and the implications this has had on building safety and on the in-service training of engineers.

6. The role of structural engineers – the art of structural engineering

Observations

- Given the severity of the ground shaking, especially in the Christchurch CBD on 22 February 2011, the performance of modern buildings was generally better than expected. Even so, the 22 February event caused structural damage to many modern reinforced concrete buildings that required them to be demolished.
- On the other hand there were many reinforced concrete and other buildings that suffered little damage and continue to be used. Those that performed well appeared to have two key characteristics:
    - They had high integrity – they were tied together well and had good structural concepts and detailing.
    - They were designed conservatively and were well built.
- The modern buildings that were critically damaged had characteristics from which it was evident that they had been designed to provide little or no margin above code minimums.
- Particular questions were raised in the performance of structural walls and some precast flooring systems. Design and detailing of these elements will require close attention as the implications of the earthquakes are studied further.
- The particularly good performance of structures of high integrity highlights the need for structural integrity to be uppermost in structural engineers' minds. There is a concern that the complex and detailed nature of NZ Standards, particularly the reinforced concrete Standard, may be causing those using it to lose sight of the fundamental need for integrity of the structure. The main structural elements must be well tied together and careful detailing is necessary to achieve this. Earthquakes find the weakest links in seconds.
- The 22 February event was a reminder that the levels of ground acceleration may exceed those prescribed for design. This is a further reason to provide high integrity and a margin to cover the uncertainties involved. Capacity design principles exist to recognise this and need to be applied effectively.
- The building response to the ground shaking may not be the same as that estimated by analysis. Structural analysis computer programs, even those using sophisticated non-linear time history methods, provide only an estimate of the response of the structure. Structural designers need to be very conscious that such computer analyses have considerable limitations, especially when they are assigning capacities of members or connections to match calculated actions. (Refer attached diagram – *Earthquake Response Uncertaintree*.)
- Overall, these aspects are a reminder that *structural design is an art* not a just a calculation process. This needs to be reflected in the education and training of structural engineers and in the tools used in the design process. Structural engineers must develop a keen insight into the fundamentals of structural behaviour and to rely on this insight when using analysis results to determine design details. Technicians can do calculations and follow prescriptive standards and guidelines, but engineers with insight are needed to carry the overall responsibility for the design of important buildings.

Recommendation

- The response to the Canterbury earthquakes must be to see that those entrusted with the design of structures are skilled in the *art of structural engineering* and not just able to make computer calculations and follow prescribed formulae in Standards.

Appendix A

Comments on Discussion Paper: Roles and Responsibilities

These comments appear in the order the subject matter is presented in the discussion document.

1. Training of engineers (p3 line 1):

Overall responsibility for the training of sufficient engineers to deliver safe buildings to the community and responsibility for providing the resources needed must rest with the Government. These are vital roles and responsibilities that require knowledge of the industry, foresight and strong leadership.

2. Efficacy of the Building Regulatory Framework

The Discussion Paper says in Section 3.1 (p8):

There may be a lack of understanding as to how the Building Act 2004, Building Code, New Zealand Standards and guidance documents relate to one another and which documents regulate minimum standards and which are simply guidance. This results in potential inconsistency and a lack of innovation due to practitioners either following different documents, or overly following some documents due to a misconception that they are a regulated requirement. Overall, there seems to be confusion about the building regulatory framework and how it is to be followed in practise. This appears to be a communication issue rather than a systemic issue with the framework. Submissions received by the Royal Commission suggest that if improved and/or greater guidance were issued by MBIE, then the building regulatory framework would be more user-friendly.

I agree with the statement that confusion is a communication issue rather than a systemic one. Communication means education and training which will not happen if they are not funded.

I agree that greater guidance would help but simply issuing guidance material is not enough. There must be education and training to generate the requisite level of understanding.

I do not agree that MBIE is the appropriate organisation to issue guidance material or be responsible for it. A separate body, such as a Building and Construction Authority, is needed to provide the necessary background of experience and knowledge of design and construction, and to focus on issues affecting building quality and safety. Leadership, governance and management of such an authority must be in the hands of people with significant direct experience in design and construction.

3. National Policy Statement (Section 3.1.1 p8)

Development of a National Policy Statement may be helpful in communicating a vision and mission but it is not the most important task in applying the lessons from the Canterbury earthquakes experience.

4. IPENZ Proposals (p9)

I agree with the three bullet points quoted although I believe that a focused separate authority is needed for the actions recommended to be effective.

5. Identified issues with the Building Act 2004

Risk-based consenting (p10) is a good concept in principle but requires people with strong technical skills and experience in key roles. There are not enough of these at present.

6. National Standards Development (Section 3.1.4 p12)

I agree with the first two paragraphs of this section. Whether or not the members of Standards Committees (or groups that develop guidelines) are voluntary, measures need to be developed to limit the liability of the individuals and organisations involved. Exposure to liability has restricted the range of qualified people available to contribute.

7. National Standards Development (Section 3.1.4 p13 NZCIC views)

I am generally in agreement with the proposals of the NZCIC. A separate focused Building and Construction Authority is needed to provide the required knowledge, leadership and focus.

A change in approach the structure of Standards, particularly those for structural design is needed. Many current Standards are too voluminous, complex and detailed to be effective. They seek to prescribe a formula to resolve every imaginable detail. A shift to shorter, clearer Standards is needed. These would be supported by approved guidelines defining methods required to demonstrate compliance with the (higher level) performance criteria.

8. Ministry of Business Innovation and Employment (Section 4.1.1 p14)

The bullet points are a list of functions. There is no suggestion that this organisation should provide ***leadership*** *to the building and construction industry. I believe that the Ministry's mandate is far too broad to provide effective leadership and that a more focused entity is required for the vital task of delivering safe buildings to communities in New Zealand.*

9. Territorial Authorities (Section 4.1.3 p15)

The bullet points are a list of tasks, not responsibilities. The Canterbury Earthquakes have highlighted the importance of these tasks and posed the question as to what the community's expectations are of territorial authorities and building consent authorities.

10. Institution of Professional Engineers New Zealand (Section 4.1.9 p17)

IPENZ has two roles, one to represent the best interests of members and the other to act as "regulator" through the Chartered Professional Engineers Act. Consideration should be given to separating these roles so they are not the responsibility of one organisation.

11. Questions - responsibilities (Section 4.2 p19)

The key to developing an effective building regulatory framework lies in the establishment of a separate authority focused on building quality and safety. Governance and management of this organisation must be in the hands of people experienced in design and construction activities and responsibilities.

12. **Capability** (Section 4.3 p 20)

The building consent process needs more effective application of skilled technical resources. There should be far fewer building consent authorities, perhaps about five regional authorities and a national body. Even so, many more skilled people are required to improve the overall effectiveness of

the consenting process. A reduced number of BCAs with regional responsibilities should be able to make more efficient use of available technical resources.

13. Questions – resourcing Standards development

Answers:

1) *Funding for the development of national standards should come from Government. Standards for the building industry may be better under the control of a body responsible for building quality and safety, such as the Building and Construction Authority suggested above.*

2) *Risks involved in using Standards can be managed by making them simpler and clearer – and investing in the education and training needed to make them effective.*

3) *People contributing to Standards development (and guidelines development) should all be paid at least at a statutory rate. This will allow the right people to be appointed and will remind each person of the importance of the role.*

4) *The lesson from the Canterbury Earthquakes is that engineering matters to the community. Funds need to be found for such vital activities as Standards development. At the same time, there needs to be constant review of the applicability of existing overseas standards and guidelines to reduce the cost of standards development.*

5) *Standards need to be simpler and clearer in stating objectives and setting out the basic performance expectations / criteria. This would allow use of guidelines and other methods in support. Such guidelines could be developed by industry or professional organisations provided that they were subject to appropriate peer review, including international input.*

***Leadership** of this process is vital and needs to be in the hands of an authority focused on building quality and safety.*

14. Building Consents (Section 4.5.1 p23)

Whatever else is required, I strongly recommend a mandatory requirement for a succinct Structural Design Features Report. The SESOC and ACENZ have worked on this and based on their efforts I developed the attached example for discussion and further development. Preparation of a Structural Design Features Report is a very good discipline for design engineers, plays an important part in quality assurance and can give building consent authorities a good starting point for their consent process. The Ministry of Works used similar forms to good effect in the 1970s and 80s.

15. National Regulatory Body to process building consents (p24)

IPENZ and the NZCIC have put forward this idea. As noted above it has merit, perhaps in conjunction with regional BCAs. There is room for a small number of regional BCAs reporting to the suggested Building and Construction Authority. Whatever structure is favoured, the key challenge is to find sufficient people with technical skills and experience.

16. Peer review, quality assurance (p25)

A Design Features Report can be part of the suite of documents required as part of a quality assurance programme.

The suggestion that a matrix be produced showing when a peer review should be conducted is a good idea. A starting point might be the ACENZ table describing the five levels of Construction Monitoring. There has been much work done already by ACENZ on peer review processes and they should be closely involved in the development of any peer review matrix.

17. Information about building performance (p28)

Provision of information on building performance as indicated is an important task. It requires considerable technical resources and a strong focus on matters affecting building performance (quality and safety). The MBIE lacks the relevant technical resources to carry out this function. There is need for a separate authority which is ***technically driven and resourced*** *not just to carry out the functions indicated,* ***but to provide leadership*** *to the design and construction sector.*

Design Features Report - ***Primary Structure***

Project:	Aardvark Apartments and Office Complex - Quaketown		Page:	1	of n
By:	SESOC Structural Design Limited - William Brown CP Eng 1234		Date:	dd	mm yy
	PO Box 5678 Quaketown : Ph +64 3 456 7890 : williambrown@ssdl.co.nz : www.ssdl.co.nz				

Primary Structure	Design Life	50	Site	Level, on reclamation / steeply sloping etc

Level / Area:	*Use*	*Structure*	*FRR*	*DL*	*LL*	*SDL*
Roof	No access	RC column / Steel truss / ply diaphragm	0.5	0.5	1.5	0.5
Levels N to 3	Office	RC column / RC beam / PCC floor	2	1.0	2.5	0
Level 2	Retail	RC column / RC beam / PCC floor	2	1.0	2.5	0
Level 1	Retail	RC column / RC beam / PCC floor	2	1.0	2.5	0
Ground	Retail	RC column / RC beam / PCC floor	2	1.0	2.5	0
Basement 1	Car park	RC wall / RC beam / PCC floor	2	1.0	3.0	0
Basement 2	Car park	RC wall / RC beam / PCC floor	2	1.0	3.0	0
Foundations	RC bored piles. 750 and 900mm					

Significant Design Features: 1. Base isolated above Basement 1; 2. Curtain-wall glazing; 3. Etc

Design Standards: 1. AS/NZS 1170 2. NZS 3101 3. NZS3404 4. Etc

Soils and foundations	Founded on:	Fractured greywacke	Ground Floor RL	100.00

Soil properties	qu =	10	ø =	0.5	øeq =	0.8	Water table (max/min)	RL 98.500	RL 95.000
Retaining values	ρs =	100	Ka =	0.5	Ko =	0.8	Kp = 0.8	Seismic design req'd	Yes

Earthquake	1170 / SS	Z =	0.13	Nr Fault	>100km	Soil Cat	C	Analysis	Time History

Lateral load system:	X-direction (N-S)			RC Frame			Y-direction (E-W)			RC Wall		
Key parameters	Tx =	0.9	μx =	4	Δmax	2.50%	Ty =	0.3	μy =	4	Δmax	1.20%

Wind	Region	A6	Terrain	2	Elev'n	3,456m	Ht, z	18m	VR (m/s)	50	Δmax	100mm

Md values:	N	0.8	NE	0.8	E	0.8	SE	0.7	S	0.6	SW	0.5	W	0.4	NW	0.3	Any

Multipliers:	Terrain, Mzcat	0.6	Shielding, Ms	0.6	Topographic, Mt	0.6			1.0

Directional Site Wind Speeds		Dir 1		Dir 2		Dir 3		Dir 4		Table C1 D limit
	SLS / ULS (m/s)	45	91	46	92	47	93	48	96	L /250

Wind Pressure Coefficients:	Cpi max	0.6	Cpi min	-0.3	Canopies	1.2

Cpe wall	Wind	0.9	Lee	0.8	Side	0.7	Cpe roof	Up	0.9	Down	0.8	Cross	0.7

Snow and Ice				Region	N1	Elevation (m)	1234	Sg =	0.9	S(design)	0.6
Other data											

Creep and Shrinkage	Kp = (2-1.2*As'/As)	Walls	1.2	Floors	1.4	Columns	1
Other data							

Durability	Design Life:	Found'n	50	Structure	50	Roof	15	Cladding	15
Other data									

Serviceability	Floor Prim	L/200	Floor Sec	L/300	Roof Prim	L/100	Roof Clad	L/300	Other	L/300
Transient Vibration:	BRANZ SR14 / Murray method / Allen method within acceptable limits									

Notes:

Design Features Report - ***Secondary Structure***

Project: Aardvark Apartments and Office Complex - Quaketown Page: 1 of n

By: SESOC Structural Design Limited - William Brown CP Eng 1234 Date: dd mm yy

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Earthquake - Parts and Portions

Cp values for parts (g)

Level / Area:	*Floor acc'n*	*Part*	*Cp*	*Part*	*Cp*	*Part*	*Cp*
Roof	1.2	Aerial	2.5	Chimney	2.5	PC Panel	2.5
		Insert or delete rows as necessary to cover all relevant levels					
Level 5	1.1	PC Panel	2.5	Equipment	2.5	Lift	2.5
Level 4	1.1	PC Panel	2.5	Equipment	2.5	Lift	2.5
Level 3	1.1	PC Panel	2.5	Equipment	2.5	Lift	2.5
Level 2	0.4	PC Panel	2.5	Equipment	2.5	Ceilings	2.5
Level 1	0.3	PC Panel	2.5	Equipment	2.5	PC Panel	2.5
Ground	0.3	PC Panel	2.5	Equipment	2.5	PC Panel	2.5
Basement 1	0.3	PC Panel	2.5	Equipment	2.5	PC Panel	2.5
Basement 2	0.3	PC Panel	2.5	Equipment	2.5	PC Panel	2.5

Wind Coefficients for Parts

Cp values for parts (Insert as appropriate)

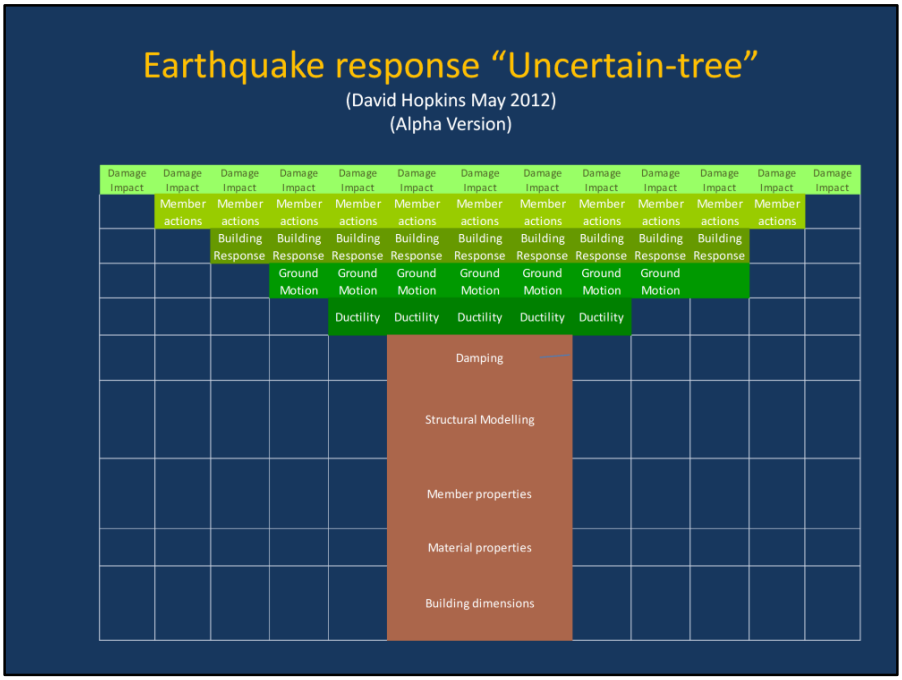
Level / Area:	*$V_{R\,(h)}$*	*Ht, z*	*Vdes*	*Part*	*Cpn*	*Cpl*	*Cfig*	*Cw*	*C_L*	*Cdyn*	*Cxx*	*Cyy*
Roof	54	20	45	Aerial	0.8	0.4	0.7	0.6	0.5	na	na	na
				Insert or delete rows as necessary to cover all relevant levels								
Level 5	48	18.0	48	Glazing	0.8	0.4	0.7	0.6	0.5	na	na	na
Level 4	44	14.5	44	Glazing	0.8	0.4	0.7	0.6	0.5	na	na	na
Level 3	40	11.0	40	Glazing	0.8	0.4	0.7	0.6	0.5	na	na	na
Level 2	40	7.5	40	Glazing	0.8	0.4	0.7	0.6	0.5	na	na	na
Level 1	40	4.0	40	Glazing, sign	0.8	0.4	0.7	0.6	0.5	na	na	na
Ground	50	0.0	50	Glazing	0.8	0.4	0.7	0.6	0.5	na	na	na

Barriers and handrails

Top edge (TE)/ Rail (R) / Intermediate(Int) *Infill*

Area	*Part*	*Ht*	Rail Ht	Horz (kN/m)		*Vert (kN/m)*		*Point (kN)*		*Horz (kPa)*		*Point (kN)*	
				Load	*At*	*Load*	*At*	*Load*	*At*	*Load*	*At*	*Load*	*At*
Roof	Barrier	1.6	1.2	1.0	R	1.0	R	0.6	R	0.8	R	0.8	R
				0.5	TE	0.5	TE	0.3	TE	0.5	TE	0.5	TE
Offices	Barrier	1.6	na	1.0	1.2m	0.8	TE	0.8	TE	0.8	TE	0.8	TE
					na		na		na		na		na
Apartments	Barrier	1.2	1.2	1.0	R	0.8	R	0.8	R	0.8	R	0.8	R
				0.5	TE	0.5	TE	0.5	TE	0.5	TE	0.5	TE
Car Parks	Barrier	0.3	0.3	3.0	R	0.0	R	4.0	R	na	na	na	na
				0.5	TE	0.5	TE	0.5	TE	0.5	TE	0.5	TE
Other	Barrier	1.6	1.2	1.0	R	0.8	R	0.8	R	0.8	R	0.8	R
				0.5	TE	0.5	TE	0.5	TE	0.5	TE	0.5	TE

Notes: 1. For further detail refer Drawings S101 to 108 inclusive.



Earthquake response "Uncertain-tree"

This is a crude representation of an important point that was particularly evident from the investigations into the collapse of the CTV building.

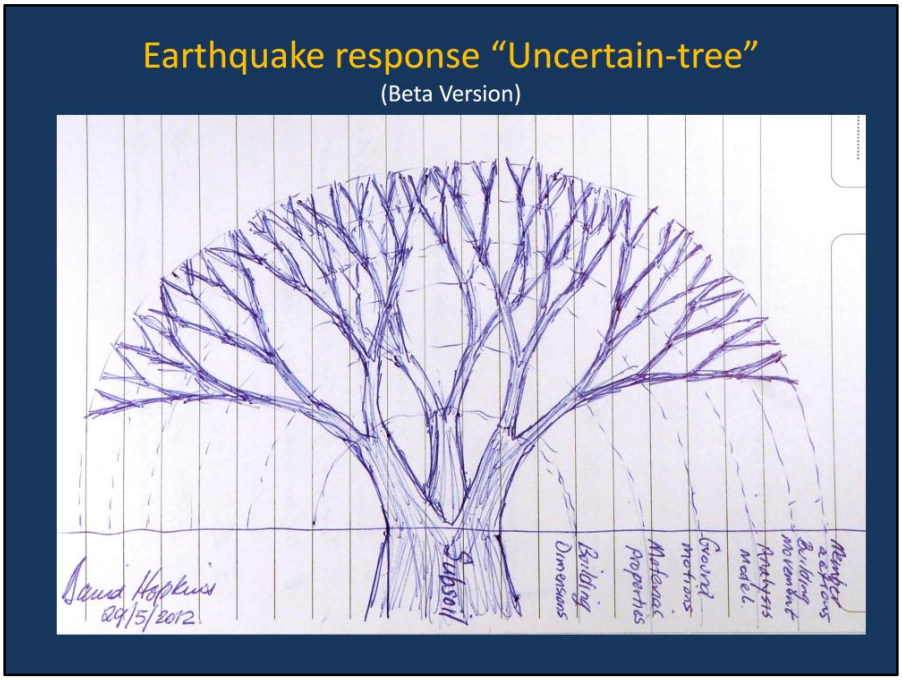
It is intended to show that each assumption is equivalent to a fork in a tree.

This means that the estimated effect on a particular element depends on the assumptions made in the analysis.

It is important to remember this dependence on assumptions when designing for any particular calculated result. Reality could be markedly different.

This is the "Alpha" version. Further development of this idea is shown as the "Beta" version in the next slide.

But no matter how elegant or crude the diagram, the underlying message cannot be ignored and must be taken on board by all those involved in earthquake engineering design.



Earthquake response "Uncertain-tree"

This "Beta" version shows different components.

It is not the detail that is important, but the concept that different assumptions made in our increasingly sophisticated analyses can yield markedly different results.

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- Director, World Seismic Safety Initiative
- Founding Chairman Earthquake Engineering New Zealand
- Former Director, International Association for Earthquake Engineering

Dr David Hopkins has over 30 years international experience in structural and earthquake engineering in a multi-discipline context. He has written numerous articles on earthquake engineering topics and has made significant contributions to the field. David has a wide network of contacts internationally as a result of his involvement as a director of the International Association for Earthquake Engineering and the World Seismic Safety Initiative.

Dr Hopkins has been responsible for many commercial, industrial and infrastructure development projects and his wide range of consulting experience includes technical, management and business development roles.

Following the Baguio earthquake in July 1990, David spent 18 months as Specialist Technical Consultant to the government of the Philippines on the World Bank and ADB funded reconstruction project. He advised six local consultants on technical aspects on the reconstruction of numerous public buildings, schools, hospitals, water supply facilities and bridges.

Since 2003 he has advised the New Zealand Department of Building and Housing, providing leadership and technical advice, particularly on earthquake-prone building legislation, structural engineering issues and building code development.

Over the last 15 years David has personally carried out assessments of earthquake damage losses to building and infrastructure assets for major New Zealand organizations. Assets include hospitals, port facilities, airports, rail networks, hydro-electric dams, water supply networks and industrial complexes.

In 2005 he was Resident Project Manager in Turkey for a World Bank funded feasibility study for retrofitting 369 residential apartment buildings in Istanbul. Work included building surveys, assessment of structural performance, preliminary retrofit designs, a detailed benefit-cost study and a social impact survey. David developed and implemented a methodology for the benefit-cost study which was specially designed to suit the Turkish and Istanbul context.

From December 2009 David spent two months in Padang, West Sumatra advising authorities on the rehabilitation of damaged buildings following the earthquake of 30 September 2009.

David was the only technical member of the Canterbury Earthquake Recovery Commission, established to advise central government on recovery issues following the magnitude 7.1 Darfield earthquake on 4 September 2010. Following the devastating aftershock of 22 February 2011, this has been replaced by the Canterbury Earthquake Recovery Authority, CERA.

From 23 February, David was one of the leaders of the Critical Buildings team in Christchurch that determined stabilisation measures for major buildings that were damaged, including the Grand Chancellor and Copthorne Durham hotels. On behalf of the Department of Building and Housing, David is currently managing investigations into collapses of the CTV, PGC, Grand Chancellor and Forsyth Barr buildings in the 22 February earthquake.

David is a former Director of the International Association for Earthquake Engineering (2000 to 2008), received the Institution of Professional Engineers of New Zealand (IPENZ) Professional Commitment Award in 2000 and received the IPENZ Supreme Award for Technical Achievers in 2007. He is a past president of the New Zealand Society for Earthquake Engineering and has been on earthquake reconnaissance visits to Mexico, Philippines, California, Japan and Peru, being leader on two occasions.

Since 1997 David has led the Earthquake Engineering Technology Business Cluster, a business network to promote New Zealand expertise overseas.

Key achievements in earthquake engineering

- Reducing earthquake risk in existing buildings.
  - Key contributions to the development of approaches and assessment methods in the NZSEE Recommendations 1985, (Red Book). These Recommendations helped promote consistency and practical approaches to strengthening buildings for earthquake.
  - Major contributions to the development and promulgation of NZSEE Recommendations for the Assessment and Improvement of the Structural Performance of Buildings in Earthquake, 2006.
  - Key advisor on the implementation of the earthquake prone building legislation in the New Zealand Building Act 2004.
- Lifeline Earthquake Engineering
  - Wellington Lifelines in Earthquake Project. Director of this internationally recognised project that raised knowledge and awareness throughout New Zealand.
- Precast Concrete Structures Guidelines
  - Key role in developing recommendations for the design of structural precast concrete, which helped improve practice and gained international recognition.
- Design / advice on structural and earthquake engineering on major projects in New Zealand and overseas.
- Earthquake risk analysis / risk management / insurance
  - Development of practical benefit-cost analysis of retrofitting buildings, notably for New Zealand Department of Building and Housing and the Turkish Government.
  - Assessment of resources to rebuild Wellington following a major earthquake and promotion of implications to key decision makers.
  - Development of Wellington Regional Council Combined Earthquake Hazard Maps.
  - Promotion of better use of engineering and scientific information by insurers
- Building Code Compliance Issues
  - Key roles in addressing concerns on structural engineering matters in New Zealand
  - Leadership in developing structural aspects in a review of the New Zealand Building Code
- Raising public awareness of seismic safety
  - Author of numerous presentations, papers, reports, newspaper and magazine articles.