ENG.HOP.0007.SUB.1

Canterbury Earthquakes Royal Commission

Hearings on Earthquake-prone Buildings

9 November 2011

Submission by

Dr David C Hopkins
Consulting Engineer, Wellington

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David Hopkins CV-1

1. BE(Hons) PhD CPEng IntPE(NZ) FIPENZ FNZSEE
2. Chartered Professional Engineer
3. 40 years experience as consulting engineer
4. Specialist in earthquake risk management
5. Senior Technical Advisor, Department of Building and Housing
6. Founding Chairman, Earthquake Engineering New Zealand
7. Director, International Association for Earthquake Engineering, 2000-2008
8. Former President of NZSEE
9. Director, World Seismic Safety Initiative

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David Hopkins CV-2

1. Wide experience on earthquake-related projects in New Zealand and overseas
2. Major contributor to NZSEE guidelines for earthquake risk buildings 1985 and 2006.
3. Largely responsible for development of IEP
4. Leading role in pushing for EPB Legislation through NZSEE
5. Advisor to DBH on EPB Policy development and implementation
6. Main author of DBH guidance document for TAs
7. Benefit-cost analyses for retrofit of EPBs NZ and Turkey
8. Organiser EQC/DBH Workshop on EPB Policies July 2010

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David Hopkins CV- 3

1. Member of CER Commission 2010 – 2011
2. Helped lead Critical Buildings Unit post 22 Feb
   - 6-storey + buildings stabilisation
   - Grand Chancellor / Copthorne Durham
   - Review of demolition options for major buildings
3. Project Manager for DBH on investigations into failures of CTV, PGC, Forsyth Barr, Grand Chancellor
4. Keen to see lessons learnt from the Canterbury earthquakes – technical, economic and social – for future benefit

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Submission

1. Personal submission. Not views of Department or any other organisation.
2. Comment on Ingham / Griffiths paper
3. Opportunity taken to comment on other issues regarding earthquake-prone buildings
4. Reservations re Royal Commission papers
   - For discussion but taken as more authoritative than intended
   - Comment received may be limited
5. Ingham / Griffiths paper on URM buildings – a subset of potentially EPBs

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Ingham / Griffiths Paper Comments -1

1. Valuable contribution
2. Historical perspective:
   - EPB Legislation for URM since 1968
   - Many buildings strengthened, albeit to ½ or 2/3 1965 standards
3. Case studies useful. In-depth study needed
   - Careful correlation of strengthening level and performance
   - Better knowledge of what works and what does not
   - May show that current assessments are conservative – which would be helpful
   - EQC / DBH case study project

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Ingham / Griffiths Paper Comments - 2

1. Benefit and costs
   - Paper highlights challenge for community
   - Legislation shown to be of limited success in earthquake risk reduction in NZ over four decades. How to improve?
2. Market forces needed as driver
   - NZSEE Grading Scale
   - Legislation + market forces
   - Purchasers / tenants role
   - Banks / insurance companies role
   - Taiwan example

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NZSEE Grading System for Earthquake Risk

%NBS	Letter Grade	Relative Risk	
More than 100	A+	Less than 1	No action needed
Design Earthquake Level = 100% NBS			
80 - **100**	A	**1** to 2 times	Market Forces
67 - 80	B	2 to 5 times	Market Forces
33 - 67	C	5 to **10** times	Market Forces
Moderate Earthquake Level = 33% NBS			
20 - 33	D	10 to 25 times	Legislation
Less than 20	E	More than 25 times	

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Ingham / Griffiths Paper Conclusions 1

1. Identify EPBs – Agree, needed to understand risk
2. Review successful retrofits – Agree, care needed
3. Staged retrofit – Agree but reservations
   - Staging can help – interim securing 1985 NZSEE
   - Not practical to impose specific staging
   - Involve TAs, owners, engineers in developing ideas
4. Action on first two stages – Reservations
   - Review practicality / achievability
   - Involve TAs, owners, engineers in developing ideas

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Ingham / Griffiths Paper Conclusions 2

5. National requirements / policies – Reservations
   - TA Policy ownership has advantages
   - Stronger / clearer national requirements would help, for example:
     - Higher strengthening level (ANAIRP 100%NBS?)
     - Active policies
     - URM parapets / gables / frontages
   - Build on benefits of last six years
   - Involve TAs, owners, engineers in developing ideas
6. Technical capabilities needed for assessment
   - Agree improved technical capabilities / resources needed but...
   - Economic and social drivers needed = market forces

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Ingham / Griffiths Paper Conclusions 3

7. Field testing of masonry
   - Testing useful
   - Review of performance of past retrofits in Canterbury earthquakes more productive
8. Budgeting constraints
   - Benefit-cost depends on when the benefit of retrofitting is assumed to be realised.
   - Works best if property market values good seismic performance

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Closing comments

1. Need public awareness initiative to underline the value of good seismic performance
2. Recommend Royal Commission supports moves to bring about market-driven seismic strengthening.
3. For example by supporting consideration of:
   - NZSEE (or other) Grading System to increase public awareness of likely seismic performance
   - Encouraging purchasers and tenants to ask questions about seismic performance
   - Exploring how bank lending criteria and approaches could assist in achieving market-driven strengthening
   - Incentives for owners, particularly of heritage buildings

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- **Building Act 2004**

Earthquake-prone Buildings Provisions

Some background

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New Zealand earthquake requirements 1

- 1935 – earthquake requirements first introduced
  - Same load for all buildings over all New Zealand
- 1965 - three risk zones:
  - Load depends on location and building height
- LGA Act 1968 – Earthquake-prone buildings requirements
  - Applied to unreinforced masonry or concrete buildings only
  - 50% of 1965 standard = about 15% New Building Standard

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New Zealand earthquake requirements 2

- 1976 – New loadings standard
  - Better detailing for resilience (ductility)
- 1984, 1992 – Revised loadings standards
  - Refinements on 1976 standard
  - Changes to seismic zones and coefficients
  - Capacity design (strong column – weak beam concept)

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New Zealand earthquake requirements 3

- 2005 – AS / NZS 1170.5 Loadings Standard
  - Wide variation of load according to location
  - Some significant changes in seismic coefficient
- 2004 – Building Act 2004 EPB provisions
  - Earthquake-prone building threshold raised
  - **All buildings except small residential**
  - 33% of New Building Standard (not locked in to 2004)
  - Each TA able to adopt its own policy.

Seismic design coefficients for new buildings - 2004

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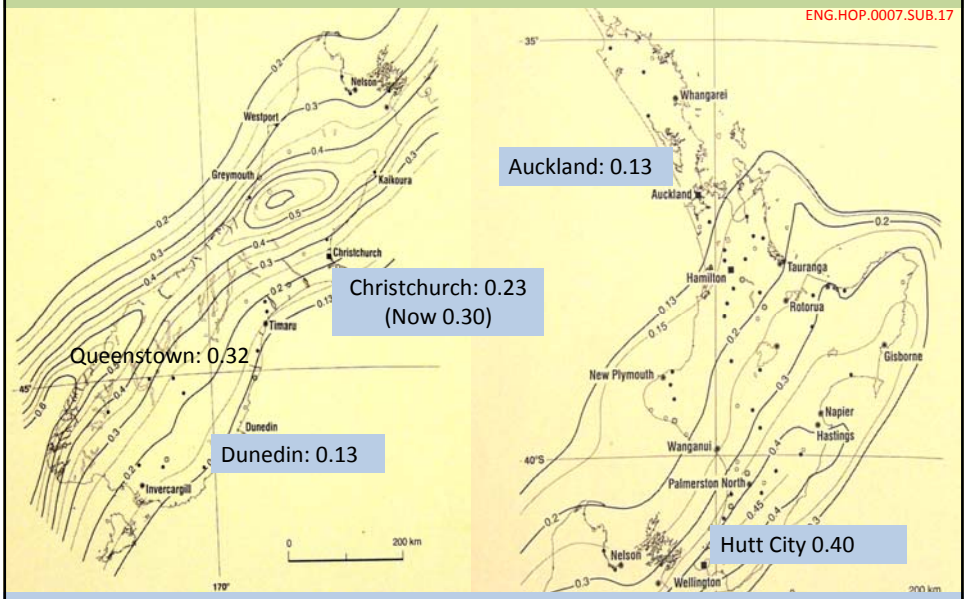

Note: 100%NBS varies according to coefficient

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New Zealand Society for Earthquake Engineering (NZSEE) – 1994 onwards

- Concerned about Kobe, Northridge and other earthquakes
  - More modern buildings – 50s, 60s, 70s, 80s - collapsed
  - Similar to New Zealand buildings
- 50% of 1965 standard is low and inappropriate
- Need to extend earthquake-prone building definition
- Critical Structural Weaknesses of particular concern…..

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Building Act 2004

- Covers all existing buildings (except small residential)
- Trigger level is 33% of new building standard (NBS)
- Requires Territorial Authorities (TAs) to have a policy on EPBs
- TAs *may* require owner to reduce or remove the danger

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TA Policies on Earthquake-prone buildings

Requirements:

- Approach / priorities / heritage
- Public consultation
- Submit to DBH
- Review every 5 years

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TA Policies on Earthquake-prone buildings

Related aspects:

- Allows local consideration of risks
- Allows local "ownership" of policy
- Allows for regional variation in seismic hazard
- 33% NBS aimed to capture worst buildings only
- No strengthening level stated. 34% NBS default
- 67% NBS or more desirable

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Required strengthening standard

Minimum required by Building Act

- 34% of new building standard (NBS)
- Building no longer earthquake-prone
- No margin for future changes

Desirable level

- As nearly as is reasonably practicable to that of a new building (100% NBS) (DBH)
- Minimum target 67% NBS (NZSEE)

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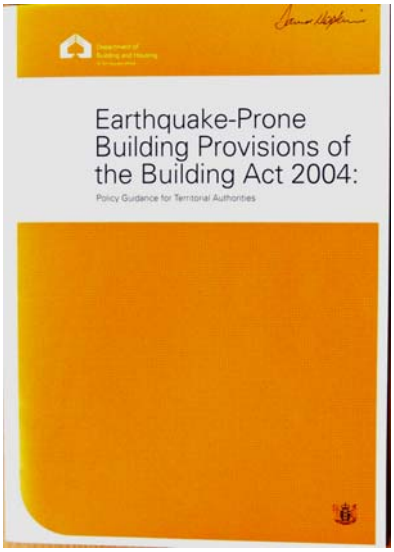
DBH Policy Guidance for Territorial Authorities

- Widely used by TAs



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NZSEE Guidelines

Assessment and Improvement of the Structural Performance of Buildings in Earthquakes

- Technical support to Act and policies
- Initial Evaluation Procedure (IEP)
- Detailed evaluation methods