The Education of Engineers; Submission to the Royal Commission

Response to Discussion paper: Training and education of engineers and organisation of the engineering profession

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1. It has for some decades been evident that New Zealand is a country with exceptionally dynamic geology and land-surface processes (e.g. Davies, 1982). The recent Manawatu Gorge landslides and Nelson floods, and the 2005 Matata debris flow, demonstrate the substantial effects that geodynamic processes can have on structures and infrastructure.

2. The recent Canterbury earthquakes emphasised dramatically that geological processes can affect infrastructure and buildings in a number of ways; damage by seismic shaking, weakening of foundations and settlement, liquefaction and lateral spreading, cliff collapse and boulder rolling. The potential for these effects in Christchurch appears to have been seriously underestimated in engineering design and decision-making prior to the 2010-2011 earthquakes.

3. **The education of engineers in New Zealand needs to acknowledge that the dynamic geological setting of New Zealand is a crucial factor in the selection of sites and designs. Presently it does not.**

4. The training of (particularly civil and natural resources) engineers in New Zealand therefore needs to be underpinned by adequate knowledge and understanding of the geological and geomorphological processes at work in and beneath the New Zealand landscape.

5. Given the unpredictable nature of the larger and less frequent geological (e.g. earthquakes) and geomorphological (e.g. floods, landslides, debris flows) events, engineering education must also include adequate treatment of geodynamic risk assessment, analysis and management.

6. While geotechnical engineering maintains a strong presence in engineering curricula, the need for increased geology and geomorphology is counter to recent trends that have replaced these inputs with engineering subject matter. Geotechnical engineering deals very well with engineering soils, but there is a lack of understanding and training with respect to larger-scale geodynamics and engineering geological site modelling, rendering engineering designs vulnerable to phenomena initiated below the soil and off-site.

7. The topics of risk assessment, risk analysis and risk management do not have a high profile in undergraduate engineering curricula in New Zealand. While risk is discussed as it applies to some specialisations, such as earthquakes and flooding, it would be better taught as a coherent discipline applicable to all specialisations.

8. We contend that unless it is based on an adequate foundation of geology and geomorphology, and understanding of the nature of risk, engineering practice will neither realise the potential benefits from more advanced technologies nor prevent disasters from increasing as population, investment and commercial activity grow. Recent experiences in New Zealand, Chile and Japan demonstrate the relatively low precision of information

available on geodynamics, and this constitutes a serious obstacle to realising the potential benefits of high-precision engineering. By contrast, adequate understanding of how NZ landscapes and geology behave, and of the nature and management of risks, would allow geodynamic risks to be avoided or managed by corresponding site selection and engineering design.

9. **We recommend that curricula in Civil and Natural Resources Engineering incorporate adequate learning around engineering geology, geomorphology and risk management so that graduate engineers appreciate the dynamic nature of New Zealand and its implications for engineering practice, and are equipped to deal with these implications.**

Reference:

Davies, T.R.H. (1982). Engineering in the Dynamic Landscape. In: *Engineering and Society*, Ed. R. B. Keey. University of Canterbury Press, 158p.

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