

As safe as houses

The public has for a long time accepted the concept of houses being safe even though this is a fallacy. As caves no doubt collapsed around our ancestors ears, houses today continue to be damaged and destroyed by a variety of natural phenomena (hazards).

Natural phenomena exist without man's influence but he ignores and aggravates them at his peril.

For the major land hazards — flood, earthquake, landslip and subsidence — the expertise is available for both broad-brush and detailed assessments. No individual or local authority should be unaware of potential hazards or risks because of technical constraints.

We believe that it is the role of the geotechnologist to identify the hazards and assess the risks so that individuals and local authorities can act in an informed manner, and the latter in the public interest.

Causes of damage

House can be damaged by many things including: Wind, rain, sun (weathering); runaway vehicles; fire; earthquake; flood; erosion; shrinkage and swelling of the ground; settlement; slope failure.

This paper is concerned with the last five which can be loosely grouped as "geotechnical", or land hazards, in their origin and which arise from natural hazards which are within the capability of scientists and engineers to evaluate, with varying degrees of uncertainty. The other "geotechnical" hazard, earth-

quake, is generally well perceived and apparently effective measures are enforced to protect houses from it. Whether damage to a house actually occurs depends upon our perception of the hazard and what action we choose to take if not to avoid it, then at least not to aggravate it.

A summary of natural hazards, predictability and proportions is given in Appendix A.

Recognising the risk and accepting it

Since Cornwallis coined the expression "as safe as houses" 125 years ago, houses have not been getting any safer despite our technological advances in land hazard identification and prediction. In New Zealand over the past 15 years the Earthquake and War Damage



This paper by Nick Rogers, MSc(Hons) (left) and Don Taylor, FIPENZ, MICE, of Tonkin and Taylor Ltd, was presented at the 1986 IPENZ Conference in Auckland.

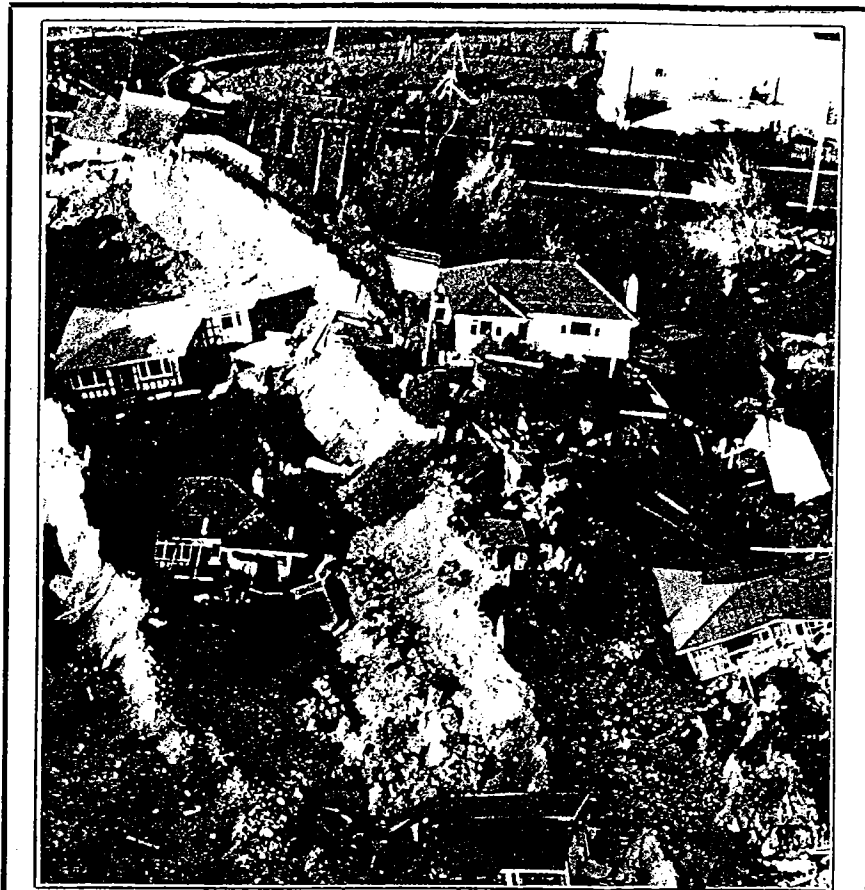
Commission⁴ has received over 3000 claims, and has paid out over \$5 million for landslip damage alone. In the past 12 months over 200 landslip claims have been registered for Auckland. Over the past 40 years over \$5 million has also been paid out for earthquake damage, and over \$120 million has been paid out for flood damage.

As flood potential was illustrated in Mātaura a year before, the presence of urban land instability was dramatically highlighted in August 1979 by a landslip which occurred in Green Island Borough. It is rather ironical that just one month earlier, over the Telethon weekend of June 30-July 1 1979, more than twice as many houses were damaged in Auckland by landslipping than in Green Island Borough on August 8. The Auckland landslides went largely unnoticed by the media, but the Abbotsford landslip disaster grabbed the attention of the nation and public attitudes to urban land stability changed forever. What had previously been a case of *caveat emptor* — buyer beware — has now become *persequi machinator* — sue the engineer.

No amount of geotechnical expertise or planning control can produce absolute safety, or zero risk, in the urban setting and one doesn't believe that the community expects that to be achieved; not to say that they won't seek their pound of flesh from any arrogant technologist who says otherwise. What the community can rightly expect is that actual and potential land hazards are identified, in understandable terms.

All living involves risk taking, and from a geological point of view New Zealand is a dangerous place to live, with almost every part being at risk from some natural disaster or other. In Wellington the public seemingly accepts the earthquake risk, as Aucklanders accept the volcanic risk. Perhaps this is because few have experienced a serious seismic or volcanic event; or because the geotechnologists inform them that a serious event is unlikely to occur; or because of public ignorance. (Do the residents of Rotorua realise they are situated inside the crater of an active volcano?).

It is not the role of the geotechnologist to determine whether a risk is acceptable. We consider that it is firstly for the individual owner to decide whether a



'The Abbotsford landslip disaster grabbed the attention of the nation and public attitudes to urban land stability changed forever.'

risk is acceptable to him or her, and secondly for the local authority to decide whether that risk is acceptable for subsequent owners and in the wider public interest.

The land developer is often willing, on financial or other grounds, to accept considerable risks, but the risks are not his to accept. Developers also tend to be ephemeral phenomena — here today, gone tomorrow.

The recent barrage of litigation, however, indicates that the public is not nearly so willing to accept the risks of landslip, subsidence, flooding or coastal erosion — at least not when actually confronted by the hazard.

The experience of Tonkin and Taylor over the past 25 years, but more particularly over the past five years, is that individual property owners are often willing to accept a risk until the hazard eventuates. This is sometimes due to

poor communication — "you didn't tell me half the section would fall into the sea" (the report says minor regression and superficial mantle failure can be expected) — even low probability tigers should be recognised. Usually though, this stems from the public acceptance of risks which they consider will not happen to them. Then they seek someone to blame and recover costs from for their loss and misery.

Legislation

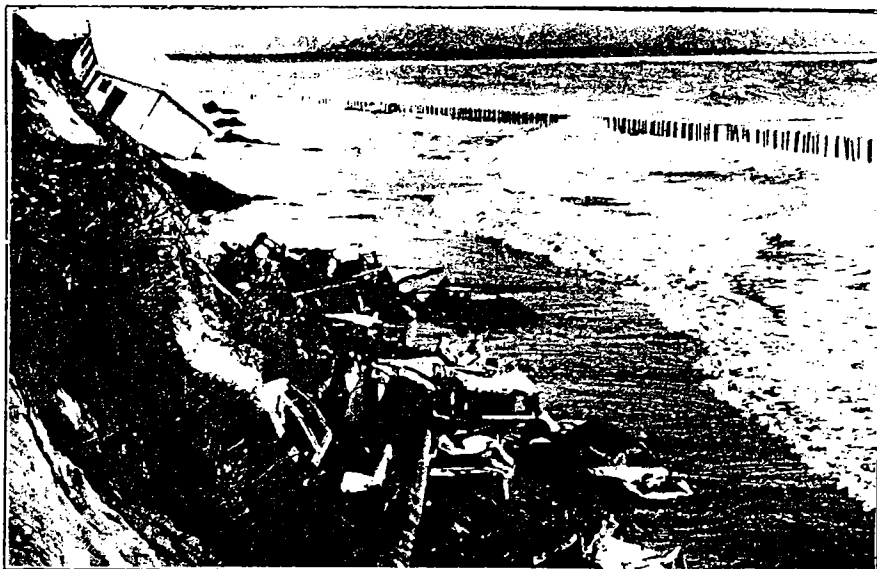
Under the Town and Country Planning Act (1977) the need to deal with the control of development in hazard-prone areas is recognised and district schemes are required to identify areas at risk, to state how the land is to be used, and to set down the ground rules indicating what an owner or occupier can or cannot do with property in hazard-prone areas.

The Abbotsford landslip disaster and subsequent commission of enquiry highlighted the very much greater expectation the public has of local authorities, and the demand for councils to put more effort into their land subdivision and building permit control. Parliament, anxious to protect property owners from the considerable loss that could result if land disappeared underneath them, or if they were inundated by floodwaters, obliged with Sections 274 and 641² of the Local Government Amendment Act. This Act made it difficult, if not impossible, for local authorities to allow subdivision or to issue building permits on land that might be subject to subsidence, erosion, slippage or inundation.

It is recognised that the best way to reduce damage to buildings and minimise the danger and distress to people is to identify areas of hazard and prevent development upon them. However, remarkably few local authorities in New Zealand have undertaken even "broad-brush" land hazard mapping of their existing, or proposed, residentially zoned areas. It is evident that this is more through a lack of political will than through a lack of expertise or resources. If those are not available "in house", they are certainly available outside — in the consulting profession. Because of the relatively large initial lot sizes in New Zealand cities, a major densification of existing urban areas is occurring by "in-filling" (by subdivision, cross lease, strata title, etc). This raises an obvious (political) difficulty for councils in preparing land hazard mapping of existing developed areas, as it is indeed a courageous local authority which will inform its ratepayers (and voters) by producing nicely coloured maps in district schemes which show that council has (inadvertently) allowed them to build on landslides, in floodways, on eroding shorelines, or over collapsing mine shafts and active faults.

With the advent of the Local Government Amendment Act (1979), councils found administering subdivisional and building permit applications in terms of Sections 274¹ and 641² a bitter pill to swallow. Local authorities were suddenly faced with refusing building permits on land where they had earlier allowed subdivision to proceed, and developers and land owners saw potential profits threatened and brought pressure to bear.

The public who found themselves restricted in hazard prone areas resented



Coastal erosion at Ohiwa in the eastern Bay of Plenty.

the loss of land value and loss of "freedom" to do what they wanted.

Despite the clear conclusions and recommendations of the Commission of Enquiry into the Abbotsford Landslip Disaster which reported in November 1980, less than a year later the Local Government Amendment Act was yet again amended with Section 641A³ which allows a local authority to issue a building permit where the land is subject to erosion, subsidence, slippage or inundation and not be under any civil liability.

Accountability

Whilst the geotechnology for hazard identification and prediction has been available (certainly commercially) in New Zealand for at least 25 years, the legislation has been slow to support the public desire for safety in the urban environment.

The public clearly expect the responsibility for sanctioning development in hazard-prone areas to lie with the local authority. The Town and Country Planning Act (1977) and the Local Government Act (1979 amendment) gave councils explicit statutory authority to act responsibly in the wider public interest.

Local authorities thus have a statutory responsibility to undertake a duty of care in matters of natural hazards, but it is common practice to pass this responsibility on to consulting engineers by requiring prospective developers, sub-

dividers and builders to submit stability reports of sloping ground, and flood potential reports on the remainder. It is very easy for a gullible engineer (or other geotechnologist) to accept, or to be coerced into accepting, considerable risks on behalf of individual property owners with great expectations, or local authorities. This should not be occurring, and is due in large part to local authorities not having the spine to (a) undertake land hazard assessments and to prepare land use management criteria and then (b) saying "no" to development proposals in high risk hazard-prone areas.

Councils are required to exercise reasonable care about landslip and erosion hazards, to help protect individual owners and occupiers (present and future) of property, to protect neighbours and to protect those who may provide insurance cover.

The local authority must be responsible, and accountable, for handling development in hazard-prone areas. At the end of the day they, and they alone, must accept the consequences of their actions. This does not infer that the engineer or other geotechnologist cannot be held to account, but only if negligent in their investigation and advice. Engineers in ever increasing numbers are accompanying local authorities into court. It will be interesting to see whether the local authority accompanies the engineer into court, or whether he stands alone, after a disaster involving a building permitted under Section 641A.³

1. now section 106 of the Resource Management Act 1991
2. now section 36 of the Building Act 1991
3. now section 36(2) of the Building Act 1991

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TABLE 1: SUMMARY OF MAIN NATURAL HAZARD AND THEIR RELATIVE RISK LEVELS

Natural Hazard	Hazard Detection & Evaluation	Scale of Hazard	RISK LEVEL IN NZ		Periodicity	PREDICTABILITY	
			Property	Life		In Space	In Time
FLOOD	hydrological, topographical	Large	High	Moderate	Frequent	Confident	Fair
LANDSLIP	geological & geotechnical	Small to Large	High	Moderate	Frequent	Fair	Uncertain
EROSION (COASTAL & RIVER)	coastal and fluvial geomorphological	Small	Moderate	Low	Continuous	Fair	Uncertain
EARTHQUAKE	geological & seismological	v. large	high	high	Infrequent	Fair	Uncertain
VOLCANIC ERUPTIONS	volcanological, geological & seismological	v. large	Moderate	Moderate	Infrequent	Fair/ Uncertain	Uncertain
SUBSIDENCE/SETTLEMENT	geological & geotechnical	Small	Moderate	Low	Frequent	Confident	Fair
SHRINK/SWELL	pedological & geotechnical	v. small	Moderate	v. low	Frequent	Confident	Fair
TSUNAMI	seismological, topographical	Moderate	Moderate	Moderate	Infrequent	Uncertain	Uncertain

Appendix to Table 1

State of the Art

<p>Flooding: Longer term and better hydrological records available. Flood plain mapping done in a few places. Major flood protection stop banks are too expensive for urban land. Waterway efficiency can be improved for moderate floods. New houses can be kept clear. Too expensive to relocate existing houses.</p>	<p>Earthquake: Well researched. Structural design standards established and enforced. Risk zoning published.</p>
<p>Landslip: Risk less easily quantified than settlement and shrink/swell. Contributing factors are well known and documented. Designs of development to avoid deterioration of stability, are well established. Stabilisation of failed ground generally too expensive to be acceptable.</p>	<p>Volcanic Eruption: Public doesn't believe it will happen. High risk areas in path of existing vents can be avoided.</p>
<p>Erosion: Recent better appreciation of coastal mechanisms. Effective protection from coastal erosion by artificial structures is very expensive. Land management techniques well established.</p>	<p>Settlement: Mechanisms well known. Appreciation in housing industry insufficient. Easily avoided with sound planning.</p> <p>Shrink/Swell: Problem not sufficiently recognised. Mechanism long understood. Some susceptible localities identified many years ago. Time delay is deceiving. Much greater protection possible at relatively small cost.</p>

The human factor

Disasters for man occur when he is hurt by natural phenomena. Many of these disasters are caused by a failure to either recognise or heed the potential hazard, and further human contribution in the shape of:

- (a) greediness, of land developers
- (b) gutlessness, of voter conscious local authorities, and
- (c) gullibility, of eager to please engineers.

When natural disasters occur, insurance (if available) is of only material consolation. The human tragedy and personal suffering natural disasters in-

flict is a cost which few individuals, or the public at large, find "acceptable". Elderly or handicapped people and householders of small financial means, even with the most understanding help from insurers, face great anguish.

A working party has recently examined the aspect of development in hazard-prone areas with the obvious intention of further amending the current legislation. The purpose of legislation should be to (a) protect the uninformed from the consequences of their ignorance and from exploitation by the greedy, and to (b) protect the community from unreasonable cost in helping the victims. The purpose of legislation should not be to allow anyone to act irresponsibly or to ignore the warnings hazard-prone areas present. □