The Placarding of Buildings and Barricade Location

(The Perspective of a Volunteer Chartered Engineer)

Introduction

The purpose of this submission is to provide a personal perspective to the process of rapid building assessment and barricade location after the Canterbury earthquakes of September 2010 and February 2011. The writer is a Chartered Professional Engineer who served as a volunteer after both of these earthquakes.

Levels of Risk

The Canterbury earthquakes have, and are continuing to show, that once there has been an initial major earthquake then a period of "increased seismic activity" is likely. This means that the chances of people being affected by earthquakes are more likely than immediately perceived to be the case before a major earthquake.

Activities such as rapid building assessments and barricade location are crude methods of trying to minimise public safety risk whilst allowing the maximum amount of economic activity to continue – albeit at a higher level of perceived risk than before.

As such, we cannot assume that all initial rapid building assessments will be correct – most will be, (in the writer's experience they tended to be conservative – i.e. red where a restricted yellow would suffice), – the mechanisms exist to check buildings independently of the rapid assessment process – in fact even the owners of green carded buildings are advised to arrange for detailed structural checking to be completed.

The carding process does not mean that a green carded building will always withstand future earthquakes – this is because we cannot predict when, where, or how large future earthquakes could be.

The Process of Building Placarding

The process is well detailed in ENG.CCC.0002F. The Author was involved in Level 1 assessments on Riccarton Road, as it was deemed to be an important arterial route, after attending a briefing on Monday 6 September 2010. This was repeated on the morning of Tuesday 7th September and then the author and his team were tasked onto Level 2 assessments within and nearby to the CBD.

Level 1 and 2 assessments are rapid and are based on assessing whether the building is more at risk due to damage than it was before the earthquake. They are **visual** assessments that **do not** involve the calculation of the ability to withstand as earthquake nor a review of the building drawings.

It could be argued that there was an implicit assumption that the 4 September earthquake was the main event and aftershocks would be an order of magnitude less, (30 times less energy), but I do not recall that being mentioned at briefings.

A single detailed building assessment involving calculations and modern techniques such as a push analysis would take of the order of 50 – 100 professional engineering contact hours.

This assumes that the building structural drawings exist, that the building was built according to the design drawings, and that the building is in excellent repair so that no on-site or laboratory material testing is required. It also assumes that the professional engineer has access to his/her tools of trade – a reliable power supply, a calm office, and peers to discuss issues with. It also assumes that there are no soil foundation issues. (The structural analysis of a two-storied reinforced concrete building built in 1951 in Dunedin that was authorised by the author cost approximately $10,000. A preliminary site investigation was additional to this and cost approximately the same amount. The author also spent about a day completing very preliminary calculations before authorising this detailed analysis that indicated that this building would not meet the owner's future requirements, even though it would meet the current DCC minimum of 33% of modern earthquake code requirements.)

The proposition that buildings could be checked in this manner before access is given is not practicable.

The reasons for building rapid assessment are:

Building access (or not)

Utility worker access on road corridors (water, power, etc)

Safe routes for emergency services

Barricade placement for public safety

Resumption of economic activity

If these building assessments are not completed promptly; then economic activity will be needlessly delayed.

The inspection teams cannot be conservative – they must card the building as they see it – future earthquakes or detailed inspections could change the building status later.

The concept of assessing the affects of earthquakes originating in different directions was not considered explicitly by me – I would focus on the building's condition as it was viewed at the time and whether it was an immediate danger to the public due to observed earthquake damage. As such, cracks observed in a building do not automatically lead to yellow or red carding it – even if one has reservations about building structural adequacy due to the nature of the building – especially unreinforced masonry buildings. (See Appendix 2 for examples of buildings in Dunedin with cracking but with no earthquake damage).

Similar, (practically identical), procedures were followed in February/March 2011 in Operation Suburb and CBD inspections. My belief is that some of the initial assessments were too conservative – probably due to the fact that the inspection teams were

overwhelmed immediately after the 22 February earthquake. (Many of the assessors would have been untrained and doing this work for the first time). For example I recall, following reassessment by another engineer and me, changing the status of a building on Montreal Street from red to green after being tasked to mark out barricades because of the initial red carding.

Barricade Placement

September 2010

As at 8 September 2010, the Christchurch CBD was cordoned off with the boundaries being the area between Worcester Street, St Asaph Street, Colombo Street, and Madras Street. After the 5.1 magnitude aftershock at 7.49 a.m. David Brunsdon led a quick check on the indictor building situated on the South East corner of Manchester and Hereford Street to determine whether re-carding of buildings was immediately required. (It wasn't, although this building was later demolished).

The process as described on pages 29 and 30 of ENG.CCC.0002F are broadly correct. There were various changes of staff with Inspector Craig McKay and I being the only ones present from Wednesday to Friday inclusive.

The assessment of where barricades should be was **crude estimation** – this was done by looking at buildings and assessing what was likely to fail and fall and thus how far out would it fall. Each building was looked at, including all the green carded ones, with there being an ongoing conversation as to what could fail – parapet, part of parapet, a whole level of facade etc, and then the likely fall zone was assessed. This was **not sophisticated** – estimating the fall zone was often done by standing side on to the building frontage with a pencil held out at arm's length and rotating it to imitate the assumed collapse mechanism.

All streets and walkways were inspected and marked up and on Friday a complete walk though was done with the contractor, (Fulton Hogan staff), and as each street had its barricade positions checked Civil Defence were told that they were "good to go" once CCC traffic requirements, such as the placement of cones or speed restriction signs were put in place. I believe that this took until the early afternoon to be completed, not the morning as stated on page 30 of ENG.CCC.0002F.

I completed another brief check on the morning of Saturday 11 September 2010 and asked for a couple of barricades in a pedestrian lane to be moved slightly.

My understanding, based on conversations with CCC traffic staff, is that the 2010 Boxing Day shaking demonstrated that the barricades were effectively positioned for the foreseeable (or anticipated) aftershocks. They said that there had been building owner pressure to remove or shrink some of the barricades before this event but this had been resisted.

February/March 2011

After the February 2011 earthquake, the requirement for barricades was several orders of magnitude higher than immediately after the September 2010 one.

For example the main streets of Lyttleton were assessed and marked out on Saturday 26 February 2011 as requiring 700 m of barricading.

Again, crude estimation of the area affected by potential building collapse was the order of the day – although it was easier to do than in September 2010 as more buildings had collapsed or suffered severe damage.

The same process of barricade placement evaluation took place with minor recording process refinements being made as the days progressed.

This enabled the progressive shrinking of the CBD cordon towards its present position.

The Role of the Historic Places Trust

I have had limited contact with the Historic Places Trust (HPT) in Dunedin in seeking resource consents. From this I believe that their style is unnecessarily confrontational and their modus operandi appears to be a case of them saying "my way or the highway".

For example, after the February 2011 earthquake there was a shortage of barricades. CCC traffic staff wanted to eliminate the need for barricading around the Harvey Norman building which was required because of unstable ornamentation on the roof. My recommendation was to remove the ornamentation – this would have freed up barricades which were needlessly pushing pedestrians closer to traffic flow – on a constrained section of road that was partially shut due to damage on the Moorhouse Road over-bridge. As I understand it, the HPT refused permission and so this had not happened by the time I left Christchurch (Thursday 3 March 2011).

The role of the HPT is a necessary social good as the preservation of heritage, (or often modified heritage), assets provide an important link with the past.

"Demolition by neglect" due to buildings not being fit for modern usage and thus able to generate revenue needs to be avoided. To that end I believe that the HPT's efforts to retain historic buildings would be better directed to advocate for accelerated taxation write-offs for structural strengthening or even the granting of tax credits in excess of 100% for the strengthening of historic buildings.

In my opinion HPT staff need to get away from an adversarial stance whereby they hide behind their empowering legislation.

Other Issues

<u>Seismicity</u>

The continuing aftershocks are showing that our state of knowledge, particularly regarding the location of "near faults" is incomplete.

I believe that further research is required throughout New Zealand to locate faults and re-assess the frequency and magnitude of events.

Appendix 1 shows the current state of knowledge for Dunedin. From a layperson's perspective it would appear logical that the Akatore fault goes further north and could even be the root cause of the Otago harbour.

Earthquake Duration

The February 2011 and subsequent earthquakes have been short duration earthquakes. If the February 2011 earthquake had lasted longer the damage would almost certainly have been more severe than what occurred. This has been mentioned by Assoc. Prof Ingham and no doubt will be the subject of further research.

% of Earthquake Strength

The use of terms such as "33% of New Building Standards" (NBS) is simplistic. It relates to "design earthquakes" whose magnitude varies across New Zealand and which will vary with time. (Christchurch's standard design earthquake was increased in 2011 by 30%).

It, by itself, does not give an appreciation as to the type of potential failure. For example, unreinforced masonry building failures tend to be brittle ones leading to partial or total collapse whereas a modern building detailed for ductility that "fails" should not collapse but may be no longer fit for purpose.

Existing Building Stock

Appendix 2 shows examples of buildings in Dunedin with potential issues including cracks in unreinforced masonry, water ingress, vegetation growing in buildings, and potentially unstable items.

The current earthquake prone provisions in the Building Act in relation to earthquake prone building policies are typically not proving to be effective. Councils appear to be choosing to take a very passive approach to the situations shown in these photographs.

Conclusions and Lessons for the Future

The methods of building assessments and barricade positioning are "quick and dirty" and by necessity are **crude but not inappropriate**.

Speed of building assessment and related activities such as barricading is essential as delays to a return to maximum economic activity must be avoided.

This means that society will **knowingly need to accept a higher level of perceived risk** that that existed before the earthquakes took place.

Economically effective measures, such as taxation credits, need to be put in place to **encourage the preservation** of historical buildings.

The Canterbury earthquakes have tragically demonstrated that the knowledge within the various branches of applied science, (geology, seismicity, civil and structural engineering) is limited. Whilst this will improve with time and research society will always be at risk from earthquakes and as such should realise that tragedies are likely to reoccur.

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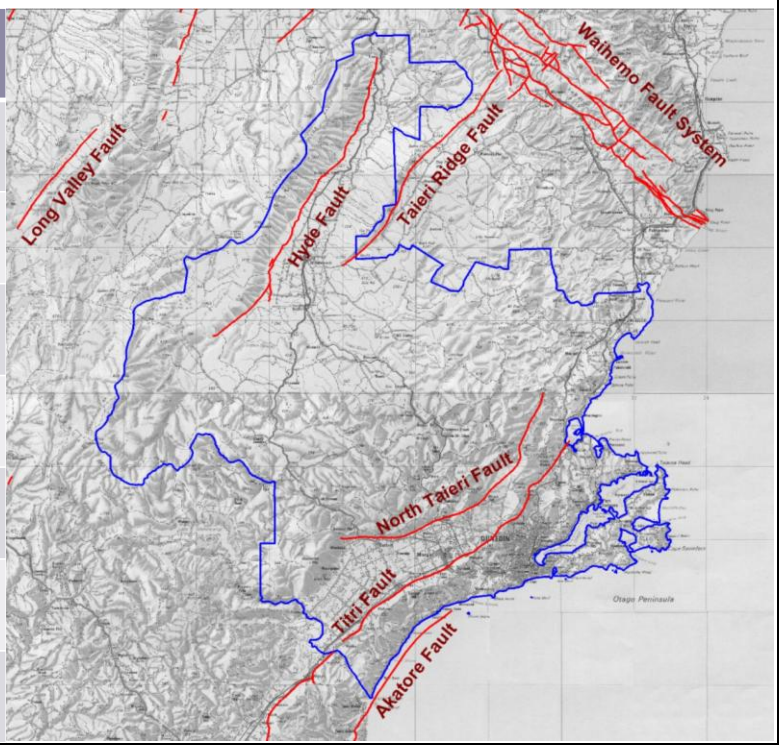
Appendix 1 – Active Fault Location – Dunedin

Active faults (known) – Dunedin

Active Fault (Recurrence)	Est. Magnitude	Fault Rupture
Akatore Fault (2,000-3,000 Years)	7.1	0.8-2.3m
Titri Fault (70,000-80,000 Years)	Unknown	0.8-2.3m
Nth Taieri Fault (Unknown)	Unknown	Unknown
Taieri Ridge Fault (Unknown)	Unknown	Unknown
Hyde Fault (15,000)	7.0	3.0
Long Valley Fault (2,000-3,500 Years)	Unknown	Unknown
Waihemo System (3,176 Years)	7.1	Unknown



Source – not known (internet search in April 2011)

Note the location of the Akatore Fault; it is my belief that this fault, or another one carries through the Otago Harbour.

Appendix 2 Photographs of Buildings in Dunedin

(These photographs were part of the writer's submission to the DCC regarding their Draft Proposed Dangerous, Insanitary, and Earthquake Prone Buildings Policy 2011).

These photos were taken in less than an hour and were of buildings in the CBD.

Example of cracked parapet

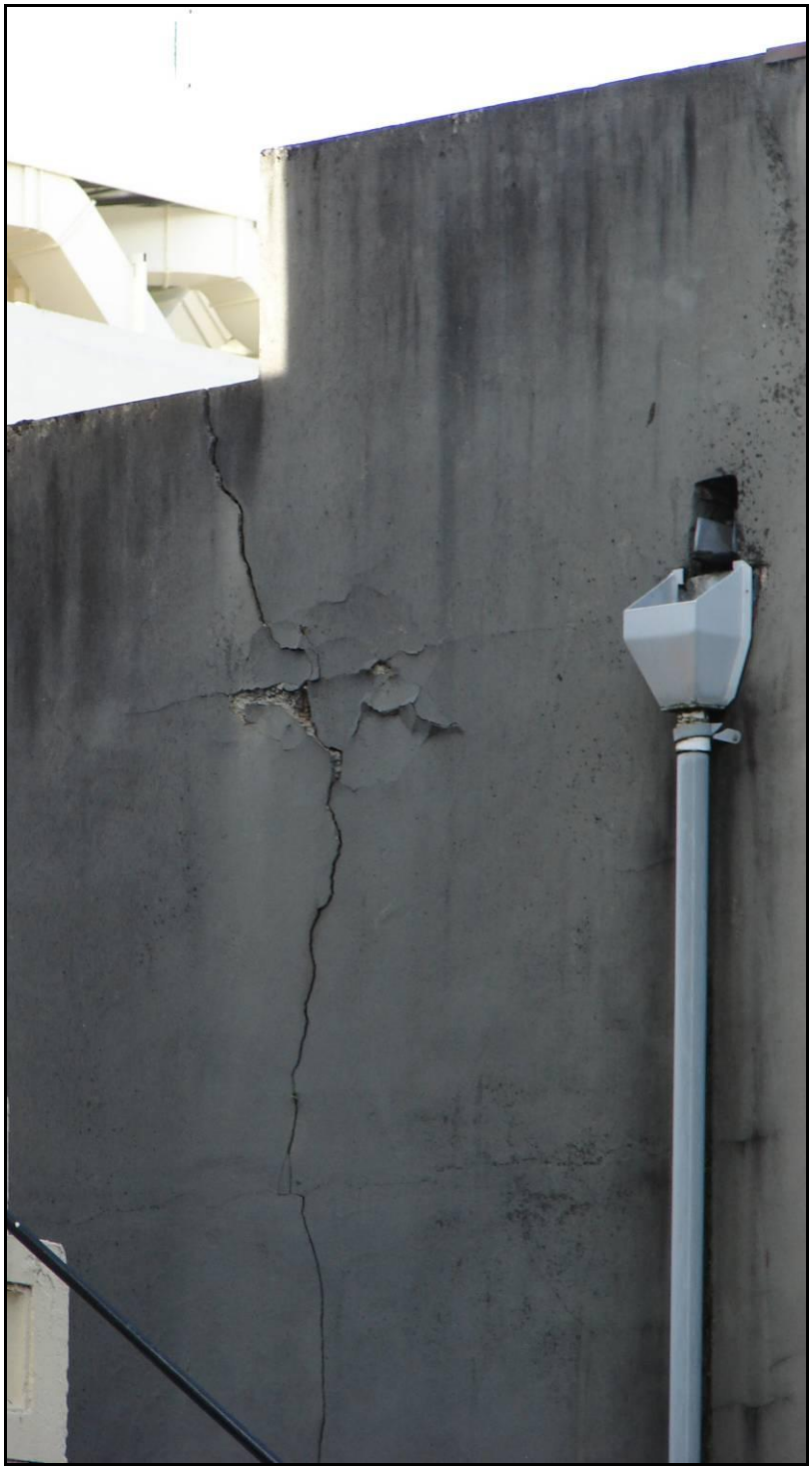
This is a single storied building. Observance of this crack in isolation would not be a reason not to green card this building.

Is this masonry secure? If seen in Christchurch after the earthquakes, this building would almost certainly be green carded.

However, under the new DCC Earthquake prone building policy (33% Modern Design Standard) a building check could require strengthening works.

Cracks in a building; again this in isolation is not a reason not go green card this building as this building would have withstood “moderate earthquakes” in the past.

An example of cracking and vegetation growth. There does not appear to be an effective mechanism in law to ensure buildings are not neglected.



An example of long term cracking and thus presumably poor maintenance.

Long term building movement – green carding would still be reasonable.

Evidence of water ingress and thus deterioration that current legislation does not appear to be able to rectify

An example of what now cannot be seen in Christchurch. A chimney on a property boundary that appears to be made of unreinforced masonry