

# **Building Risk Evaluation – Information for Commercial and Industrial Building Owners and Tenants**

*24th June 2011*

In the wake of the 22<sup>nd</sup> February earthquake, many commercial and industrial building owners and tenants in Christchurch have questions around what they need to do to assess if their building is safe enough to occupy, what changes to building design requirements might mean for their building, and what the chances are of another large earthquake. This information sheet aims to provide owners and tenants with the latest information about these and other issues.

Key questions addressed include:

- My building is green stickered – does this mean it is OK to reoccupy?
- My building came through the recent earthquakes undamaged – does this mean it will also cope well with future earthquakes?
- What changes have been made or proposed to building regulations in response to the recent earthquakes?
- What are the key questions I should be asking of my structural engineer?
- What are the chances of another large earthquake hitting Christchurch?
- What other factors should I take into consideration about how much to invest in building improvements?
- My building has only minor damage, but engineers advise me that it may not perform well in a future large earthquake - what should I do?
- I have had all of the detailed structural assessments done and the advice is that my building can be reoccupied, but my tenants/staff are still nervous - what should I do?

## **My building is green stickered – does this mean it is OK to reoccupy?**

The green sticker indicates that your building has had a rapid visual assessment and does not have any visible signs of significant structural damage. Note that structural damage may not always be visible. It is important therefore to engage a qualified structural engineer to undertake a more detailed assessment of your building.

The red, yellow and green stickers relate to the degree of hazard caused by adjoining buildings or earthquake damage to your building. When making these assessments, engineers take into account that normal patterns of aftershocks are likely to be occurring. A green sticker does not provide an indication of the building's ability to withstand future large earthquakes that may occur over its lifetime. For example, it is possible for a building to have been relatively undamaged by the recent earthquakes (in which case it would be green stickered) but perform poorly in a future large earthquake with different shaking characteristics.

Additional information on what a detailed engineering evaluation should include and important questions to ask of your structural engineer is currently being prepared for owners

and tenants of non-residential buildings. An advisory group convened by the Department of Building and Housing has prepared a draft document. Engineers who have been participating in the Canterbury Structural Group will be aware of this document and should know its current status.

In addition to reviewing the structural performance of your building, it is well worthwhile to review other elements of the building that may have been damaged, including the electrical systems (which may cause fire if there is hidden damage), fire protection systems, and the compliance schedule items such as lifts, escalators, building maintenance systems and mechanical systems. Much of this can be done by the IQPs that review your annual Building Warrant of Fitness, but you may need to engage a registered electrician for example, to review your electrical systems.

### **My building came through the recent earthquakes undamaged – does this mean it will also cope well with future earthquakes?**

The good performance of your building in recent earthquakes offers some evidence of its ability to withstand future earthquakes, but it does not tell the whole story. It is important to get a detailed engineering evaluation of your building.

Individual earthquakes each have their own characteristics. It is not only the earthquake magnitude that is important for understanding the damage caused. Location, depth, duration, soil conditions and directionality all affect how the shaking is experienced at one site compared to another. Shaking from an earthquake generated by significant faults located to the west of the city is expected to be quite different to the shaking caused by the recent earthquakes.

Similarly each building has its own characteristics in the way it performs during an earthquake. For example your building may withstand shaking from one direction much better than another; similarly a short sharp earthquake may be easier or harder on your building depending on its height, shape or configuration.

### **What changes have been made or proposed to building regulations in response to the recent earthquakes?**

In light of the recent earthquakes, both central and local government agencies are working together to review what, if any, changes are required to building regulations and best practice advice. These reviews are still in progress, but a summary of what has been decided to date:

- Following the 4 September earthquake the Christchurch City Council amended its policy on earthquake-prone buildings to require that any building assessed as less than 33% strength of current code and that requires a building consent to repair, should be brought up to a target strength of 67% of current building code. For more detail, see the [Earthquake-prone, Dangerous and Insanitary Buildings Policy](#).

- An Engineering Advisory Group (EAG) has been formed to provide expert advice to the Department of Building and Housing (DBH). Activities of the EAG particularly relevant to commercial buildings include:
  - A review of seismic design loads for Christchurch and its surrounds, taking into account the possible increase in seismic activity. This review recommended increasing seismic loads in Canterbury by approximately 40%. The proposed new design loads fall partway between the existing design loads in Canterbury and those used for Wellington. This new information has recently been added to the New Zealand Building Code requirements for the design of new buildings.
  - The EAG is currently developing guidance for the detailed engineering evaluation of earthquake damaged non-residential buildings.
  - Future considerations of the EAG include identifying critical weaknesses in buildings that may lead to collapse and considerations of a possible building safety rating, allowing the public to identify the level of safety of a building prior to entry.
- The Department of Building and Housing (DBH) website ([www.dbh.govt.nz/canterbury-earthquake](http://www.dbh.govt.nz/canterbury-earthquake)) is a good place to look for latest guidance information that has been released.
- With a Royal Commission of Inquiry, DBH investigations and significant amounts of research underway, there are likely to be further learnings from the recent earthquakes that may lead to changes in design and construction best practice. These could also potentially lead to changes in the Building Code.

### **What are the key questions I should be asking of my structural engineer?**

It is important to ask the right sort of questions of your structural engineer so that you have the best information on which to make decisions about your building. We are preparing a separate information sheet for commercial and industrial building owners and tenants on what a detailed engineering evaluation should involve.

There are four key areas that your structural engineer should be able to advise you on, with respect to existing buildings:

- The nature and severity of damage to your building caused by the recent earthquake(s) and a plan for re-inspections following any further major events.
- The level of earthquake strength that your building has. Building strength will give you an indication of the severity of shaking your building can withstand.
- How your building would perform in a very large earthquake that exceeds your building's strength. Here the engineer will undertake a qualitative review of the building plans to look at the ways the building might fail and whether it would maintain its life-safety objective.
- Feasibility of repair and retrofit options. For some buildings, vulnerabilities identified during the above assessments may be relatively quickly and economically resolved, in a way that significantly enhances the building's performance during an earthquake. Other issues however may be much more difficult to resolve. An engineer will be able to provide advice on what options should be considered.

For the design of new buildings, it is clear that all building forms and construction types do not give the same performance, even if they all conform to the Building Code. Although the possible future changes to the Building Code cannot be predicted in detail, your structural engineer should be able to provide advice as to forms of building that will be more resistant to damage, and what future performance criteria you may like to consider for your new building. It is important to note that the Building Code sets out only the minimum performance standards and that it may be possible to provide extra levels of protection for relatively minimal additional expenditure.

### **What are the chances of another large earthquake hitting Christchurch?**

Unfortunately we can't predict when or where future earthquakes are going to occur. We can however estimate the chances of a future earthquake occurring in particular region.

We know from worldwide experience that aftershocks continue for several years following a major earthquake, and that these aftershock sequences tend to follow some broad patterns. For example, following a Magnitude 7 earthquake, we would expect on average one magnitude 6 aftershock, ten magnitude 5 aftershocks etc. These aftershocks taper off in frequency (though not necessarily in size) over time.

Sometimes however, a different pattern of behaviour is observed following a large earthquake, where a region enters into a period of enhanced seismicity and other nearby faults become more active. For example, since the 1929 Buller Earthquake, that region has experienced higher earthquake activity than we would otherwise expect.

It is important to factor the risk of ongoing earthquakes into our planning. As at the middle of June, seismologists estimate there is a 3 in 10 chance of another earthquake of magnitude 6 or greater, located somewhere in the Canterbury region over the coming year. Note that the chances of a magnitude 6 or greater earthquake located very close to Christchurch city would be much smaller than this. These numbers do not mean that another large earthquake in the Canterbury region is definitely going to happen. Putting the numbers another way, there is 7 in 10 chance of not experiencing an earthquake of magnitude 6 or greater over the next year. As time passes the likelihood of further large earthquakes reduces, but if one does occur, it generates a new series of aftershocks.

While earthquakes located close to the city are front of mind at present, it is important to not lose sight of the fact that there are also faults on the Canterbury Plains and Foothills, as well as the Alpine Fault, which runs along the Southern Alps. Although these faults are further away from Christchurch, some have the potential to generate large earthquakes. Very large, distant source earthquakes are of particular relevance for commercial building owners, as the long durations of such earthquakes can put greater stresses on tall buildings.

### **What other factors should I take into consideration about how much to invest in building improvements?**

There are a complex set of factors that both building owners and occupiers need to consider when deciding the level of seismic performance they require from their building; some of the factors to be thinking about include:

- **Lifecycle costs:** With a period of enhanced seismicity possibly ahead of us, there is likely to be an economic case for enhancing your building to suffer less damage in future earthquakes. This could involve going beyond the minimum strength requirements set out in the Building Code, and specifying building materials and fittings to minimise non-structural damage and speed repair times. If minimising downtime is a key requirement for organisations working within your buildings then make this clear to your design team. You may find that that certain design decisions have minimal cost implications but make a significant difference to the way the building performs during earthquakes.
- **Insurance cover:** In the aftermath of the Canterbury Earthquakes, the insurance industry has suffered significant losses. Although it is too early to know what all the future implications of this may be, it is inevitable that insurance costs will increase, and possible that insurance may be declined for high-risk buildings, including in particular those that are earthquake prone. This may extend to insurance for tenants of such buildings.
- **Ability to tenant:** With an increased awareness of the business impact of damaged premises, building owners that can demonstrate their building should perform well in future earthquakes may find it easier to tenant their buildings and be able to attract premium rentals.
- **Building systems:** Even in buildings that have performed well structurally, there has sometimes been significant disruption due to non-structural elements that have behaved poorly. Examples of possible issues include: movement of mechanical plant from its supports, failure of ceiling systems, damage to sprinkler systems and lift counterweights moving off their supports. Many of these are easy and inexpensive to remedy, but because they are not structural elements, may not be reviewed under the control of a structural engineer.
- **Contents damage:** Think about how you can minimise injuries, damage and potential down-time due to earthquakes when designing the fit-out your building. Examples include securing tall items and storing heavy things down low where they present less hazard, using lips on shelves and non-slip surfaces to prevent things moving around, and selecting materials that are likely to perform well in a shake.

**My building has only minor damage but engineers advise me that it may not perform as well in a future earthquake – what should I do?**

This is a difficult position for any building owner or tenant, but a position that some may find themselves in. Some buildings, because of their structural configuration, detailing or type have critical structural weaknesses that make them more vulnerable to earthquakes. Examples include short columns or other shape irregularities which can concentrate forces within a building, inadequate seating or support for floors and stairwells, or even a lack of

clearance to adjacent buildings which can lead to buildings pounding against each other. Of particular concern are buildings with characteristics that make them vulnerable to collapse or other catastrophic failure in an earthquake.

Legally, the only requirement on building owners to strengthen buildings is under Section 122 of the Building Act. If a building is assessed as earthquake prone (less than 33% of the building code capacity required for new buildings) then building owners are required, in time, to strengthen their buildings in accordance with their Local Authority's Earthquake Prone Buildings Policy. Where no building consent is required, building owners in Christchurch currently have 15-20 years to undertake this strengthening.

Some buildings may not be classed as earthquake prone but are still a collapse hazard in a large earthquake. At this stage there are no legal requirements to strengthen these buildings. There are obligations under Sections 7 – 10 of the Health, Safety and Employment Act to eliminate, isolate or mitigate known hazards in the workplace, but it is unclear the extent this applies to structural performance of a building in an earthquake. The Detailed Engineering Evaluation guidelines being prepared by the Engineering Advisory Group include consideration of this, and contain recommendations for the identification of such critical structural weaknesses. Although there may not be any legal requirement to remedy these defects, it is recommended that these are mitigated where they occur, particularly when they may be relatively inexpensive to fix.

If a building requires a building consent or a Certificate of Acceptance for repairs, maintenance or alterations, then the Christchurch City Council **Earthquake-prone, Dangerous and Insanitary Buildings Policy** sets a target for buildings to be earthquake strengthened to 67% of the current Building Code. This includes all buildings which have suffered damage as a result of the earthquakes or undamaged buildings needing consent for maintenance and/or alterations.

Many building owners may feel that, even if there is no legal requirement to strengthen their building, in light of the recent earthquakes, there is a moral case for doing so. A significant challenge presented by this situation is that, where the building has suffered only minor damage in recent earthquakes and does not require a building consent to repair, insurance will not contribute to the costs of strengthening the building.

**I have had all of the detailed structural assessments done and the advice is that my building can be reoccupied, but my tenants/staff are still nervous - what should I do?**

People have just experienced a traumatic event and it will take time for them to feel confident about living or working in multi-story buildings again. If you try to rush them or over-reassure them, this readjustment period may simply take longer. Instead, consider the following strategies:

- Don't ask them take your word for it. Let them know that they can read the full engineers report for themselves.

- Ask if they would like the opportunity to talk with the engineer directly. People are more likely to trust information provided when they know the person providing that information and can get their own questions answered. Consider organising a session where employees walk through the building with the engineer and talk about how it is designed, also have a question and answer portion where the employees can have their concerns addressed.
- Lead by example. Demonstrate the confidence that senior managers have in the building by asking them to be the first to reoccupy the building.
- For a proportion of the population, the above will not be enough. Wherever possible, provide people with options (such as working from home or from other premises) so that they do not feel forced to return to a building. Experience overseas indicates that giving people some choice about when or whether to return to a building increases their willingness to reoccupy that building.
- Get people involved in making their own workplace as safe as it can be. Identify non-structural items such as book cases, heavy ceiling tiles, glass balustrades, unsecured equipment etc that might become hazards during an earthquake and ensure these are either well fixed in or removed.