MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
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Questions & Answers – Statistics House investigation

What did the original Statistics House investigation look at?

The aim of the original investigation into Statistics House was to understand the cause of the partial floor collapse in the Kaikōura earthquake and to identify implications for New Zealand's building regulatory system. It was a technical investigation that looked at the building design, construction and land influences that could have affected the performance of the building.

It did not look at any liabilities arising from the partial floor collapse.

Why did part of the flooring on the lower levels of Statistics House fall down?

The partial collapse of three precast floor units at Statistics House affected only a very small part of the overall floor area. It was caused by a combination of factors:

- the high level of flexibility in the building's design;
- the type of concrete floor system;
- the magnitude and duration (120 seconds) of the earthquake; and
- the amplification of ground shaking by the geological basin beneath Wellington (basin-edge effects).

This combination of factors meant the building moved considerably over many cycles of shaking. The building frame was designed to flex during an earthquake but this resulted in the end frames of the building stretching. The brittle ends of the floor units were also affected by this, resulting in some breakages to the ends of the floor units. The combination of the frames stretching and the floors shortening compromised the support of three precast floor units and resulted in them losing support.

Other nearby buildings, which did not have any floor collapse, did not have the same design features as Statistics House and therefore were not as vulnerable to the characteristics of this earthquake.

What did the original investigation find?

With regard to the first two factors under investigation, the design and construction of Statistics House, the original investigation found that the building was generally designed and constructed to the requirements of the design Standards in place in 2004/05.

With regard to the third factor, land influences, the fact the building is on reclaimed land was not found to be a significant factor. The ground shaking from the earthquake was amplified because seismic waves reflected/refracted off the edges of the geological basin beneath Wellington. This phenomena is referred to as a basin-edge effect. At present there is not sufficient international or national research to conclusively say where a basin-edge effect may occur.

Why was the Statistics House Investigation re-opened?

During the demolition of Statistics House, observations made by the engineering consultant who monitored the demolition indicated that the seating provided for some of the precast concrete floor units was less than what was shown on the original design documents. This new information led to MBIE reconvening the expert Panel to determine whether the new information impacted the original investigation findings.

What does the addendum cover?

The expert Panel was reconvened to determine whether the new information discovered during the demolition process could impact on the original investigation findings. The Panel was not engaged to

look at issues around liability. For more details please refer to the Terms of Reference in the addendum.

What findings are presented in the addendum?

The Panel concluded in the addendum that the presence of short seatings of the precast concrete floor units does not change the original conclusions regarding the primary factors that led to the partial floor collapse. These factors are detailed in the original report.

Does this change any of the original recommendations?

The addendum supports the conclusions and recommendations made by the Panel in its original investigation into the performance of Statistics House. None of the original recommendations required updating. The addendum has three new recommendations for MBIE's consideration.

Why wasn't this issue found sooner?

The information that was provided to MBIE, by the engineering consultant undertaking the monitoring of the demolition, was only discovered when the building was being demolished. This information was not discoverable prior to the building being demolished.

What action has been taken to address issues, such as those identified in Stats House?

MBIE has progressed work on all four of the recommendations made in the original investigation report. This includes:

- working with Wellington City Council on the 'targeted damage evaluation' programme to look more comprehensively at the levels of damage similar building in Wellington sustained in the Kaikōura earthquake
- citing the latest amendment of the Concrete Structures Standard (NZS3101) that has more stringent requirements for pre-cast floor systems
- issuing a warning on the use of loop bar details in double-tee precast concrete floor units
- reconvening the Standards committee that sets the requirements for earthquake actions (NZS1170.5) to review the Wellington seismic demand factors.

All of this work is part of MBIE's work programme to update and improve the Building Code system, taking on board acknowledging lessons from events such as the Kaikōura earthquake.

Does the Building Code factor in earthquake design?

Yes. Specific design standards are used by structural engineers to demonstrate compliance with the Building Code. These include the Earthquake Actions Standard (NS1170.5) which provides the specific earthquake demand criteria to be used in the design of buildings and material standards such as the Concrete Structures Standards (NZS3101) which provide methods for determining the capacity of specific structural elements.

The Building Code and the supporting design standards permit buildings to be designed to undergo controlled damage in earthquakes but still protect life.

The combination of factors that led to the partial collapse of floor units in Statistics House was not anticipated by the design standards in place, when it was built.

Design standards are regularly updated to incorporate new learnings. For example Amendment 3 of the Concrete Structures Standard, published in 2017, now contains specific provisions that acknowledge the impact of beam elongation on frame buildings and requires greater seating for pre-cast concrete floor units in flexible buildings.

MBIE has reconvened the committee for the Earthquake Actions Standard (NZS1170.5) and this committee will be considering further changes based on what the investigation has taught us. See Recommendation Three and Recommendation Four in the original report.

Can buildings like Statistics House be improved to an acceptable standard?

Yes, solutions can be developed to increase the robustness of a precast concrete floor system losing support. Research is ongoing to determine better ways of remediating floor systems. If a building owner is concerned about the potential earthquake performance of a floor system in their building they should seek professional engineering advice.

Potential performance issues had been identified by the owner of Statistics House, taking into account lessons learnt from the Canterbury earthquakes. Remedial work in Statistics House had been completed on some of the upper floors and they performed well during the Kaikōura earthquake.

Could this occur in other buildings?

The partial collapse of three precast floor units at Statistics House was caused by a combination of factors. Statistics House had been undergoing remediation work on its floor system at the time when the earthquake occurred, and the floors which had been remediated performed well.

Nearby buildings, which did not have any floors collapse, had different design features to Statistics House and therefore were not as vulnerable to the characteristics of this earthquake.

What should building owners do in light of the addendum?

Owners of buildings with precast concrete floors who are concerned about the potential earthquake performance of the floor system should seek professional engineering advice.

Was the nature of the Kaikōura earthquake unusual?

The Kaikōura earthquake is challenging scientists' understanding of how earthquakes work. According to the April 2017 write up in the Science Journal it is one of the most complex earthquakes ever studied globally. An important issue is the way the quake was able to rupture so far along its path (over 200km from its epicentre) on so many different faults.
Subsequent investigations have found that at least 12 separate faults broke during the quake, including some that had not previously been mapped.

John Hare, of the Holmes Group, explained in his You Tube clip that the high frequency shaking was largely filtered out in the Wellington region leaving lower frequencies that most affected our mid-rise buildings (and not low-rise buildings such as unreinforced masonry).

What are basin-edge effects?

Central Wellington is situated on the edge of a geologic basin in which softer alluvial soils have been deposited. This is called a sedimentary basin; not to be confused with reclaimed land. During earthquakes there can be an amplification of the ground shaking at the edge of the basin. Basin-edge effects resulted in concentrated areas of damage during the 1994 Northridge (California) and 1995 Kobe (Japan) earthquakes.

There is not sufficient international or national research to say conclusively where we can predict a basin-edge effect exists, which is why MBIE will be commissioning further research and working with other countries to better understand how basin-edge effects may impact buildings and infrastructure.