

Repairing, rebuilding and re-levelling foundations damaged by the Canterbury earthquakes

If you own a TC3 property, this information will help you understand how engineers and building professionals assess damage to the foundations of technical category 3 properties.

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Of interest to Homeowners, Engineers

Assessing damage to foundations

The first task for a building professional or engineer is to assess the extent of damage to your foundations and whether your foundations can be re-levelled and repaired, or must be rebuilt. MBIE's guidance says there are 3 aspects to consider:

- whether the building has settled by different amounts over its floor, and/or is tilting
- whether the foundations have been 'stretched'
- damage to specific parts of the foundations.

These aspects must be considered in relation to each other. Re-levels or rebuilds are triggered by excessive differential settlements or floor stretches. If the building has settled excessively then you may need to rebuild the foundations, even if damage to the piles or the slab does not exceed suggested limits. If you have cracks in the perimeter wall of your foundations, but the building hasn't settled, it may be possible to repair the foundations.

If the slope of the floor between 2 points more than 2 metres apart is more than 0.5% (10mm over 2m) or the variation in level over the floor plan is more than 50mm, it indicates the floor or foundation probably needs to be re-levelled or possibly rebuilt depending on the degree of tilt. Other indicators are cracks in ceramic floor tiles and distress in vinyl floor covering and carpet. Even if these limits are not exceeded, floor and superstructure repairs may be required.

How does the building professional decide if my foundations need structural repairs?

Table 2.2 from MBIE's guidance sums up the main factors your building professional will consider when deciding whether there is a need to carry out structural repairs. Each site is different. This table only gives an indication of what to look for. Your building professional or engineer will need to make a full assessment of the situation before deciding whether structural repairs are required.

Dwelling foundation type	Settlement status		Lateral stretch status		Crack widths/Other
Type A					Pile tilt <15 mm per 1 m height and no floor framing damage
Type B	Vertical differential settlement <50 mm and floor slope less than 1 in 200 between any two points >2 m apart	and	<20 mm	and	<5 mm cracks in perimeter foundation
Type C					<5 mm cracks in the floor slab

Note:

- Type A foundations: timber-framed suspended timber floor structures supported only on piles.
- Type B foundations: timber-framed suspended timber floor structures with perimeter concrete foundations.
- Type C foundations: Timber-framed dwelling on concrete floor.

For example, it is unlikely your foundations need structural repairs if:

- vertical differential settlement is less than 50 mm, and
- the floor slope is less than 1 in 200 between two points two metres apart, and
- the lateral stretch is less than 20 mm, and
- individual cracks in the perimeter foundation wall or floor slab are less than 5 mm (Types B and C foundations) OR the pile tilt is less than 15 mm per metre and no floor framing damage (Type A foundations)
- there is no other indication that the foundations and supporting ground are damaged or have deteriorated.

Why don't my foundations need structural repairs if the settlement and slope and stretch and cracking are below the figures given above?

Because this level of settlement, slope or stretch is usually imperceptible without slope instruments and could be caused over years by factors other than earthquakes. There are always initial tolerances when building foundations are constructed and foundations often move over the lifetime of the building. Cracks of less than 5mm can be caused by factors such as shrinkage (which is common), or foundation settlement that is not related to earthquake activity. Unless there are indications to contrary, it is likely that the building can be occupied without any loss of amenity.

Should cracks in my foundations be repaired in these circumstances?

Any damage caused by the Canterbury earthquakes should be repaired. The guidance advocates sealing cracks less than 5mm if they are caused by or exacerbated by the earthquakes. It simply distinguishes between cracks requiring structural repair and cracks that can be repaired without involving an engineer.

There are indicators that help in identifying if cracks have been caused by the earthquakes, such as the accumulation of debris in the crack and fretting of the edges of the crack, both of which suggest that the crack existed before the earthquake.

What about re-levelling or rebuilding my foundation?

MBIE's guidance includes Table 2.3 that provides criteria to indicate if your house is likely to need re-levelling. If your house needs re-levelling, the criteria indicate whether re-levelling is sufficient, or whether your foundations or house may need to be rebuilt.

This table only gives an indication of what to look for. Your building professional or engineer will need to make a full assessment of the situation before deciding whether to repair or rebuild. He or she will also need to use their expertise and judgment. For example, trying to re-level a house that has settled over time – even though the earthquakes may have exacerbated settlement – can cause additional damage to the superstructure, because allowance that was made for the settled condition (for example, eased doors and windows) will be nullified.

Column 1	Column 2	Column 3	Column 4	Column 5
Floor type	NO foundation re-level considered necessary	Foundation re-level indicated	Foundation rebuild indicated (Partial or full)	House rebuild may be indicated
Type A - Timber-framed suspended timber floor structures supported only on piles	The slope of the floor between any two points >2m apart is <0.5% (1 in 200) and The variation in level over the floor plan is <50mm	The variation in floor level is >50mm and <100mm Note that the floor re-level is expected to be achieved by packing the piles	The variation in floor level is >100 mm over the floor plan or The floor has stretched >50mm Note that full or partial re-levelling is expected to be undertaken to achieve a level floor	The house has fully or partially collapsed off the piles and repair may be uneconomic. This will relate to the degree of superstructure damage
Type B - Timber-framed suspended timber floor structures with perimeter concrete foundation	The slope of the floor between any two points >2 m apart is <0.5% (1 in 200) and The variation in level over the floor plan is <50mm	The variation in floor level is >50mm and <100mm	The variation in floor level is >100mm over the floor plan or The floor has stretched >20mm	The house has fully or partially collapsed off the piles and repair may be uneconomic. This will relate to the degree of superstructure damage
Type C - Timber-framed dwelling on concrete floor	The slope of the floor between any two points >2 m apart is <0.5% (1 in 200) and The variation in level over the floor plan is <50mm and There are no cracks in ceramic floor tiles and There is no distress in vinyl floor coverings or carpet	The variation in floor level is >50mm and <150mm. and Services are functioning	The variation in level over the floor plan is >150mm or There is irreparable damage to buried services within the house footprint	This will relate to the degree of superstructure damage.

Note: column 2 of the table is headed 'NO foundation re-level is considered necessary'. This only applies if ALL the criteria for each type of floor are met. For example, there are 4 criteria to meet for Floor type C (timber-framed dwelling on concrete floor).

What if my damage falls below the minimum criteria in Column 2?

Then it is unlikely your foundations need to be re-levelled or rebuilt, unless there are other indications to the contrary.

What if my damage exceeds the minimum criteria in Column 2?

If your damage exceeds the minimum in Column 2 but does not exceed the criteria in column 3, it is likely your foundations will need to be re-levelled. If your damage does not exceed the criteria in column 4 it is likely your foundations will need to be partially or fully rebuilt.

Do these criteria apply to all houses and all situations in TC areas?

They are intended for all existing houses on the flat that have been affected by liquefaction. For new houses being built since the earthquakes, some advice on complexity and cladding material weights is provided to guard against poor performance in future earthquake events.

If there is any question about the criteria applying to a certain situation, the guidance recommends seeking advice from a chartered professional engineer.

Consult the full guidance on repairs after earthquake.

All guidance related to Canterbury rebuild(<https://www.building.govt.nz/building-code-compliance/canterbury-rebuild/>)



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