

# Repairing Damaged Heritage Buildings

## Guidelines for building owners

### GUIDELINE 4 – Strengthening of buildings

These guidelines were developed after the Canterbury Earthquake, 4 September 2010. They are intended as guidelines for owners of heritage and character buildings, to assist with repair and maintenance of these buildings, and are applicable following any earthquake or building damage.

#### Resource consents:

The resource consent processes apply for work to damaged heritage buildings. In all instances property owners of listed heritage buildings need to contact the Council prior to undertaking any work. Where emergency works have been permitted to take place by Council, retrospective consent approval will be required.

#### Building consents:

Any building work normally requires a building consent. This includes work to alter or demolish a building. Exceptions include minor works. [Click here](#) to find out whether you need a building consent. Further information can also be found on the Department of Building and Housing website [www.dbh.govt.nz](http://www.dbh.govt.nz).

### Strengthening of buildings

Once a heritage building has been stabilised and made waterproof, a programme of permanent works should be instigated. This is likely to involve strengthening work and should be done with a structural engineer and an architect with experience in working on historic buildings.

Heritage staff at Christchurch City Council and the New Zealand Historic Places Trust will also wish to have involvement with any such proposals. Before any design work is undertaken, the structural engineer should have a discussion with Council to determine what level of upgrading may be required.

The 67% earthquake strengthening standard is a target – it is not a fixed level that must be met in all situations. Where the target of 67% is difficult or not practical to achieve, the building work that needs to be done to achieve the 67% target will be assessed by the Council. This assessment will be done on a case by case basis. The Council will work closely with building owners to achieve sensible, safe outcomes that are economically feasible. The Council will also take into account heritage values of listed heritage buildings.

The new target only applies to commercial buildings built before 1976 that are defined as earthquake-prone, dangerous

or insanitary. It does not apply to the average residential home and does not relate to chimney repairs. It does however apply equally to listed and unlisted heritage buildings.

Please refer to [Questions & answers: Earthquake-prone dangerous & insanitary buildings policy 2010](#). The heritage values of the building should always be taken into account when a proposal for strengthening is being developed. In general, the aim should be to leave the building with the same appearance as it had prior to the work being carried out. As much heritage material should be kept intact.

The heritage value of the building should always be taken into account when a proposal for strengthening is being devised. In general, the aim should be to leave the building with the same appearance as it had prior to the work being carried out. As much heritage material should be kept intact as possible.

To achieve this, structural elements should be concealed wherever possible, although there may be instances when this is not able to be achieved. In a building where the exterior is of high significance, it may be possible to have structural elements exposed within internal spaces, although their placement should avoid spaces with high heritage value.

## GUIDELINE 4 – Strengthening of buildings

There may be instances where strengthening work can be designed in a way that can be integrated into the character of a building and become part of its history. In a warehouse, for example, exposed steelwork may be acceptable, although such an approach is probably not appropriate within a historic church.

Work to structurally strengthen a heritage building may involve the following aspects:

- **Shear Walls**

Shear walls are reinforced concrete walls designed to transfer loads from the structure to the ground. Typically, they are 150mm in thickness but this may vary. If shear walls are placed over existing walls, the new walls will obviously be thicker and particular care will need to be taken around window and door openings to minimise their impact – e.g. the shear walls should be kept back from timber architraves.

Sometimes it may be possible to reduce the thickness of existing walls by removing an inner face of brick. In all instances, the face of the new shear wall should be finished to match existing finishes.

- **Diaphragms**

Diaphragms are horizontal elements designed to transfer horizontal loads into the vertical surfaces of a building. Typically they consist of reinforced concrete floor topping, plywood sheets or sometimes steel strap bracing. Typically, a diaphragm will be required at roof level and might consist of plywood sheets fixed directly below the roofing material.

Diaphragms may also be required at each floor level. Options include fixing it over the floor or removing the ceiling below and fixing it to the underside of the joists. For example, it may be preferable to fix it over a floor that will be carpeted rather than disturbing a plaster ceiling of high heritage value.

Diaphragms need to be connected to the outer walls and this is usually achieved by the use of steel angles bolted to the floor and wall. Such angles can be concealed behind skirting boards.

- **Core Drilling**

Core drilling involves drilling a hole from the top of the wall down to the foundations. Steel bars are then grouted in place and tensioned to hold the wall together. A concrete beam is often required at the level of the eaves to spread the load into the wall between bars and provide lateral support to the walls.

If the technique is appropriate it has the advantage of

being completely concealed, the rods within the wall and the beam within the roof framing. Part of the roof usually needs to be removed to allow the wall to be drilled, the rods to be grouted in place and the concrete beam installed.

- **Steel Frames and Braces**

In some instances, the use of steelwork in the form of frames or “K” braces is a relatively economical way of strengthening a building. However, the steelwork is usually exposed on the inside face of walls and so its use needs to be carefully considered. Steel frames crossing windows should be avoided.

The use of steel can be considered good conservation practice in that the work is reversible with the steel being able to be removed at a future date.

- **Securing of Elements**

Where architectural elements and features, such as brick or stone parapets or pinnacles, have become loosened they will need to be secured back to the main structure to prevent collapse in events such as future earthquakes.

Traditionally steel angle braces fixed back to roof framing have been used to support gable ends and parapets and there may be situations where this is still appropriate.

See [HERITAGE GUIDELINE 3 – Reconstruction of elements](#).

However, parapets can now be secured by drilling down through the parapet into the wall below and grouting stainless steel vertical rods in place. Horizontal elements, such as cornices may be secured in a similar way by epoxying horizontal rods in place.

Brick or stone gable ends can often be fixed to structural members within the roof. This may involve putting a steel rod through the masonry and attaching it to purlins or rafters within the roof. A steel disk is placed on the outside of the wall to prevent the rod pulling through. The disks will be seen on the wall surface and care needs to be taken with their placement and design to reduce their impact on the building’s architectural values.

- **Tying Together of Walls**

In 2010 the Canterbury Earthquake caused some outer walls to bow outwards. Cracks then appeared between them and internal walls extending back at right angles.

In general it is not possible to return a wall to its original location, other than by reconstruction, as mortar and debris may have fallen into cavities formed when the building moved. Outer walls can however be tied back to internal supporting walls using core drilling techniques.



### • Fibre Reinforced Systems

Unreinforced masonry can sometimes be strengthened by removing an inner layer of plaster and replacing it with a fibre reinforced system. A reinforced plaster system strengthens a wall by providing a thin but very strong tensile layer which can resist forces in plane (like a shear wall), and can also improve a wall's resistance to out of plane forces. One system involves the use of a reinforced plaster comprising water-based acrylics combined with fibres and mixed with plaster sand, commonly known as "polyplast". A stronger system involves the use of fabric that is impregnated with epoxy resin.

Once the reinforced plaster compounds have been applied, the surface can be finished with a thin coat of hardwall gypsum plaster and painted in the usual way.

### Securing of Chimneys

Some buildings in Christchurch have chimneys that may be weakened by an earthquake but remain standing. Providing they are not at imminent risk of collapse, it may be possible to strengthen them without demolishing them.

In some cases, it may be possible to strengthen the chimneys by installing a steel flue or liner down the centre. The space between the chimney and the flue liner can be filled with pea gravel or non-combustible foam. Chimneys can also be strengthened by fixing a carbon fibre "bandage" impregnated with resin into grooves in the brickwork. See [HERITAGE GUIDELINE 3 – Reconstruction of elements](#).

It is also possible to strengthen chimneys by core drilling.

In some instances, external steel strapping may be appropriate, depending on how visible the chimney is and its impact on the heritage value of the building. Chimneys may also need to have external braces back to the structure.

For more information or advice contact:  
[heritage@ccc.govt.nz](mailto:heritage@ccc.govt.nz) or call 941 8999.

Go to the complete series Damaged buildings -  
Guidelines for heritage building owners :  
[www.ccc.govt.nz/heritagepublications](http://www.ccc.govt.nz/heritagepublications)

Heritage Guideline 1 – Safe and secure

Heritage Guideline 2 – Repairs to the heritage building

Heritage Guideline 3 – Reconstruction of elements

Heritage Guideline 4 – Strengthening of buildings

Heritage Guideline 5 – Professional advice and tradespeople

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