GOVERNMENT OF WESTERN AUSTRALIA

Department of **Energy, Mines, Industry Regulation and Safety**

Building and Energy Western Australia

Mitigating risks and ensuring the safety of pre-1990's brick buildings

Brick buildings constructed before the 1990's have several possible weaknesses affecting their strength. Weaknesses include deterioration and design issues that have been addressed in newer Australian Standards. As a result, inspection and maintenance regimes are recommended to ensure risks are identified, managed, and mitigated.

This document provides guidance to help building owners and managers keep the public safe from structural building defects and fulfil their health and safety obligations. This document forms part of a body of work that Building and Energy, building managers and recognised experts across Australia are undertaking, utilising Australian Research Council funding.

Introduction

Around the world brick masonry remains one of the most common construction types. Where these brick walls are unreinforced, as is the case with much of Australia's building stock, the following can occur suddenly and may pose significant risk:

- Chimney stacks breaking-off due to weaknesses from their historic design.
- Collapse of parapet walls (walls that stick out past the roof line) due to historic design flaws.
- Bricks falling out due to corrosion of hidden wall ties that allow the building frame to keep the outer wall steady.
- Brickwork failure under earthquake or severe wind conditions (particularly gable walls).
- Failure of connections supporting awnings.

Most of the above risks are made worse as buildings degrade over time. Moisture and the action of rust in areas that experience sea breezes are typical causes. The importance of inspection by suitably qualified persons is key to increasing the longevity and safety of buildings. This is emphasised in Engineers Australia's article The vital role of building maintenance in Australia's ageing infrastructure

Engaging suitably qualified professionals is crucial for the effective inspection and maintenance of pre-1990's brick buildings. Qualified professionals include structural engineers and those experienced in historic structures. Their expertise is invaluable in identifying, assessing, and rectifying specific causes of concern for such buildings.

Background

Defects in older buildings have been commonly addressed in many countries with older building stocks than Australia or where extreme events have led to widespread damage. For example, New Zealand building regulations require the upgrade of buildings designed before the threat of earthquakes was adequately quantified.

The Christchurch Earthquake of 2011 tragically killed 185 people, many of who were killed by falling brickwork. It led to requirements for all aged buildings to be upgraded to achieve a minimum earthquake resistance. The Australian Earthquake Engineering Society note that an earthquake of similar magnitude to Christchurch 2011, occurs in Australia every 10 years. Though our large magnitude earthquakes typically occur in unpopulated areas, it is possible that they will impact Australian cities. To save loss of life and massive economic losses, Australian buildings can be improved in earthquake safety through the minimal comparative cost of upgrades.

Multi-storey brick buildings generally pose a bigger threat under earthquake actions. They also experience stronger winds which is the other major cause of the risks noted above.

What to do about it

Examples of ways to recognise whether a building is at risk of a structural defect and guidance on common approaches to fix them are provided below. Examples and guidance can also be found in Geoscience Australia's Resisting the Shake: Resources for Owners of Older Masonry Buildings brochure.

Key areas of concern are provided below as a useful reference, however other defects can apply. These examples aim to inform further conversations and actions with suitably qualified persons in protecting buildings and the people that gather in and around them.

Strengthening chimney stacks

Older chimneys sticking out of roofs pose a threat to breaking off under sideways forces from strong winds or earthquakes.

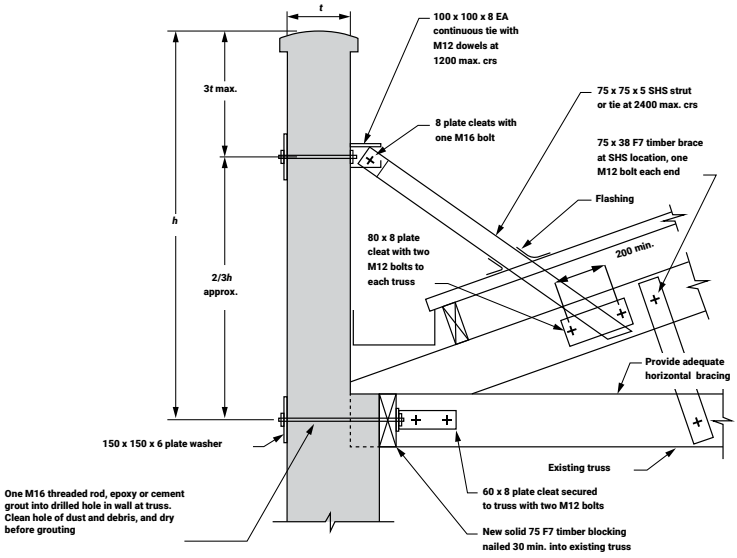
Common ways to restrain the chimney and prevent failure is to brace the chimney back to the roof structure. A strap or rod is also used to squeeze the chimney together, preventing cracks that can allow part of the chimney to separate due to bending caused by sideways forces.

An example of a strengthened chimney is provided below:

Strengthening gable walls, parapet walls and awning connections

Building and Energy investigated the collapse of a gable wall onto the building's awning during a strong wind event. The awning also collapsed. Awnings collapsed by falling walls have resulted in loss of life in Australia, in Newcastle (1989) and Bathurst (1998).

Such failures are commonly prevented by tying the wall areas back to the roof and ensuring connections to the wall fix all the way through and use plates to spread the load out. Below is an indicative (only) example from the now withdrawn Australian Standard AS3826 - 1998.



Strengthening walls with corroded wire ties

The corrosion of wall ties (the metal ties that are built into the brickwork to tie it to the stable structure behind) is a growing concern affecting the stability of brick buildings. There are resources available online, particularly in the United Kingdom providing some history, background, and treatment methods for addressing this concern.

Corroded wall ties can be difficult to detect as they typically exhibit the heaviest corrosion within the mortar of the external brick wall leaf (see below for corrosion visible only after the removal of bricks).

Methods of identifying the condition of wall ties involve visual inspection through borescope cameras guided through the wall cavity. These look for corrosion in the exposed part of the brick tie but can underestimate how rusted the parts built into the mortar are. Another relatively inexpensive method involves removing bricks from the wall. How rusted the wall ties can become along their length will depend which wall on a building they are in, how exposed that part of the wall is and how wet/dry that wall stays. For this reason, adequate sampling around the full perimeter and height of the building is recommended.

Depending on the severity of corrosion and future building use, several options may be considered for rectification. These range from placement of new retrofit ties that are drilled through the walls, to the rebuilding of part or whole sections of walls, to demolition. Where corrosion of wall ties is advanced, as rusted steel can expand to several times its original volume, wall expansion may result in cracking, outwards bowing and the vertical movement of walls. Additional work will be required to fix such walls.

Building and Energy Initiatives

Building and Energy, in collaboration with recognised experts across Australia from The University of Newcastle, Curtin University, private industry and government are actively working to understand the risk profile of buildings related to corroding wall ties. Recognising that this issue is often a hidden defect, efforts are aimed to develop a toolkit aiding identification, assessment, and rectification of buildings using efficient available methods. The research team welcomes any available information to inform this study, particularly related to the condition of aged brick wall ties.

Conclusion

The risks associated with pre-1990's brick buildings may require regular inspections and maintenance, particularly for larger buildings or with the specific vulnerabilities noted above. There are methods available to preserve the structural integrity of these buildings, with novel approaches being explored. Ongoing initiatives by Building and Energy to address hidden defects, such as corroding wall ties, underscore the importance of collaboration between building owners/managers, industry professionals and regulatory bodies to ensure the safety and longevity of these structures.

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