

Fire and heritage series

The fire resistance of ceiling-floor systems in heritage buildings

Who is this information sheet for?

Owners, designers and contractors of heritage buildings considering ceiling-floor upgrades to improve fire safety provisions in a heritage building.

[Fire and heritage buildings](#) and [Equitable access, fire safety and maintaining heritage significance](#) contain advice on a range of fire safety methods and regulations and their application to heritage buildings.

Overview

- Consent authorities (usually local councils) frequently require ceilings in heritage buildings to be upgraded to better resist fire and meet fire safety regulations.
- Many methods of fire protection reduce fire spread and fire damage in heritage buildings.
- Fire protection methods can be active (seek to extinguish or suppress a fire) or passive (to slow fire spread or compartmentalise fire). Active methods are generally more effective at reducing the fire spread and damage.
- Some methods have irreversible, negative impacts on significant heritage fabric, spaces and structures.
- Owners should discuss the most suitable fire methods for their heritage building with professionals experienced in fire safety and heritage.

Fire protection methods in heritage buildings

How fire protection methods can negatively impact heritage significant features

Fire protection methods that impact the significant fabric, spaces and structures include:

- replacing or covering heritage features with fire-rated materials
- disfiguring heritage elements by installing fire safety systems (i.e. sprinklers) that are not sympathetically designed or installed to minimise impact on heritage significance.

Fire safety is best addressed with an overall fire safety package

Fire protection methods that are sympathetic to the building's heritage significance should be considered as part of an overall fire safety package. Overall fire safety packages should:

- be designed by heritage practitioners working with accredited fire safety practitioners
- be based on a first principles analysis of the risk level and significance of the building
- consider a range of active and passive fire protection methods.

Designers of an overall fire safety package must satisfy themselves that the selected:

- fire protection methods are suitable for application in the building or to its parts and are being used within the field of application of any standard testing and that testing has not expired.
- systems or products to be applied have valid approval from the relevant Principal Certifying Authority.

Conserving heritage features and obtaining fire protection

Sympathetic passive methods to improve fire resistance in heritage buildings include the below.

- Intumescent paint applied as passive fire protection to structural steel. This paint is thick and unsuitable for conserving internal surfaces.
- Contemporary intumescent paint that is a low impact passive fire protection for interior surfaces. For more information see [Intumescent paint systems and heritage buildings](#).
- Upgrading floor-ceiling systems to improve fire resistance and leave heritage fabric uncovered.

The fire resistance of lath and plaster ceilings-floor systems

The most common floor-ceiling system in found in state heritage listed buildings in NSW are traditional lath and plaster ceilings.

- A lath and plaster ceiling in sound condition can give an acceptable level of fire safety, for buildings up to three to four storeys, if additional fire safety measures are in place.
- Sometimes upgrades to ceiling-floor systems:
 - are too costly
 - are not required
 - will cause greater heritage impacts than other fire protection measures.
- The heritage impacts of other methods should be considered and minimised.
- Information on different fire safety methods is found in [Fire and heritage buildings](#).
- Fire safety engineers or structural engineers working with a suitably skilled built heritage practitioner can advise you about appropriate methods for achieving fire safety in your building.

Example of upgrading ceiling-floor systems in heritage buildings

The Heritage Council of NSW has recommended a passive method for upgrading ceiling-floor systems to achieve a fire resistance level (FRL) of 60/60/60¹ (Heritage Council of NSW Fire, Access and Services Panel 2002).

The method is supported by CSIRO testing (Nicholls K 2017) and can be used on:

- lath and plaster
- fibrous plaster
- pressed metal
- tongue and groove timber boarding.

¹ The FRL (or fire rating) measures how long a building element can resist fire under test conditions. It is measured against structural adequacy/integrity/insulation (e.g. minimum of 60 minutes resistance is reflected as 60/60/60).

Before proceeding with this or other fire protection systems, an architect or structural engineer experienced in heritage conservation should determine whether the lath and plaster ceiling in your building conforms with the specifications for the test reports and opinions being relied upon.

The tested method of upgrading ceiling-floor systems to achieve an FRL of 60/60/60

In 2016, the modified upgrading method that was developed by LAF Group was validated and found compliant with AS 1530.4-2014.

The modified method involves:

- the removal of one to two (sometimes all) floorboards at approximately 1.2 metre centres
- reinforcement by inserting 50mm wide, 0.8mm U-shaped steel straps from joist to joist
 - The base of the U lies on the ceiling lining with the uprights fixed with 38mm nails at least 100mm above the top side of the ceiling lining.
 - The straps should be at a maximum of 1400mm centres.
- a 6mm steel rod being threaded midway between the joists that is supported by the straps (see the diagram below)
- pumping Foamed Vermitex AF into the voids between the joists to a depth of 70mm above the top of the ceiling lining (top of the bulbs in the case of lath and plaster)
- pumping Foamed Vermitex AF to the top of any service pipes or conduits above the ceiling.

Services that penetrate the floor/ceiling system must incorporate an approved fire stopping system or must be enclosed in fire resisting shafts with a minimum FRL of 60/60/60.

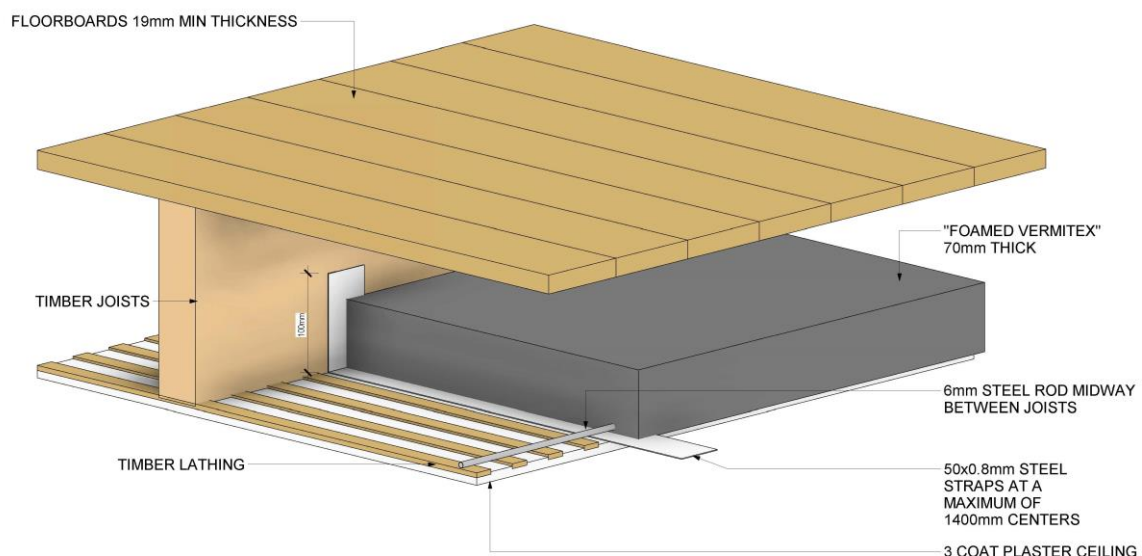


Diagram showing the application of Foamed Vermitex AF above a lath and plaster ceiling to give a fire resistance level of 60 minutes.

The proposed upgrading method is also applicable to fibrous plaster, pressed metal and tongue and groove timber board ceilings.

Image: Eric Martin and Associates Architects



1. Steel trap
2. Screw point
3. Steel rod
4. Foamed Vermitex® AF

The foamed vermitex mix used in this method is a proprietary material known as Foamed Vermitex AF. It was successfully tested by the CSIRO (in 1993 and 2016).

The material must be installed by LAF Group or a licensed installer in accordance with LAF Group specifications.

Image: L&A Fazzini Manufacturing Pty Ltd

Alternate tested method of upgrading to achieve an RFL of 180/180/180

A new method was tested in 2016 and found to give an RFL of 180/180/180. In this method:

- the 6mm metal rod is replaced by mechanical reinforcement in the form of Quikmesh positioned over the ceiling surface and returned up the joists
- Foamed Vermitex AF is mechanically spray applied at a reduced thickness

This method is suitable for lath and plaster, pressed metal or timber linings (Nicholls 2017).

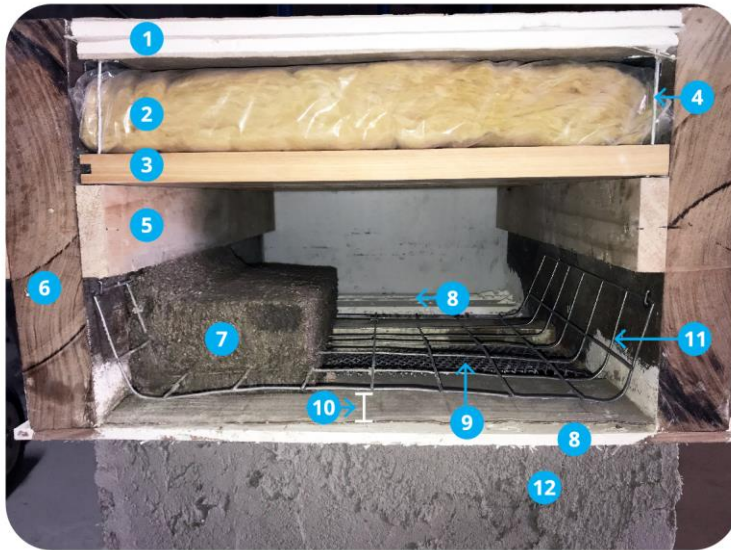
Alternate tested method of upgrading to address sound transmission

- LAF Group, with the assistance of a sound engineer, have developed a modified method that addresses sound issues without losing fire protection properties.
- Engineers and heritage professionals seeking to address fire safety and sound issues within ceiling-floor systems could consider this method to determine if it appropriate for their client's heritage building.
- The system:
 - complies with National Construction Code 2016 for airborne and impact performance²
 - is five-star rated by the Association of Australasian Acoustic Consultants.

² Bestec acoustic consultants' modelling results for a generic hard surface system:

Airborne Performance, Rw (C, Ctr) 69 (-3, -11)

Impact Performance, Ln,w 45.



1. 10mm and 13mm plasterboards
2. 75mm insulation
3. Deafening board
4. 25x15mm steel angle support
5. 75mm batten
6. 275mm joist
7. 75mm Vermitex® TH acoustic and fire coating
8. Lath plaster
9. XPM bridging mesh
10. 5mm void former
11. 50mm²x2mm Quickmesh™
12. Beam encasement

Image demonstrating installation of an alternate tested method for upgrading a ceiling-floor system to achieve an RFL of 180/180/180 and addresses sound transmission issues.

Image: L&A Fazzini Manufacturing Pty Ltd

Preparing for an upgrade

An architect or builder experienced in heritage conservation should inspect the ceilings and the floor or roof structure before considering the application of Foamed Vermitex AF.

- Ceilings must be in reasonably sound condition with minimal service conduits and penetrations.
- Inspect the voids of ceiling or floor joists for archaeological relics (such as coins, bottles, etc).
 - If relics are found contact Heritage NSW on +61 2 9873 8500 or heritagemailbox@environment.nsw.gov.au.
- Remove obstructions that are not:
 - part of the ceiling-floor system
 - essential services installed in accordance with Australian Standards.
- Stabilise lath and plaster ceilings with the 'Westox Ceiling Reinstatement System' before the application of Foamed Vermitex AF.
 - In testing, this product had no negative impact on the fire safety of the ceiling-floor system.
- For lath and plaster and fibrous plaster ceilings:
 - patch minor penetrations
 - seal wall or duct junctions with a suitably tested and approved fire stopping system.
- For pressed metal ceilings:
 - replace badly corroded sections
 - patch minor penetrations with a non-combustible filler.
- For timber boards damaged by insects or rot:
 - replace

- inject epoxy to match the existing.
- If the structural integrity of the ceiling has failed:
 - replace the ceiling
 - consider alternate fire upgrading solutions, such as applying fire resisting plasterboard that can have decorative ceiling linings re-applied below.

Curing and certification of Foamed Vermitex AF

Foamed Vermitex AF takes at least six weeks to cure before the FRL of 60/60/60 is achieved.

LAF or the licensed installer can certify the ceiling when the correct water content of the Foamed Vermitex AF is reached, provided the correct installation procedures have been followed.

Reference list

Heritage Council of NSW (2021) [Equitable access, fire safety and maintaining heritage significance](#) [online document], Heritage NSW, accessed 6 July 2021.

Heritage Council of NSW (2021) [Intumescent paint systems and heritage buildings](#) [online document], Heritage NSW, accessed 6 July 2021.

Heritage Council of NSW (2021) [Fire and heritage buildings](#) [online document], Heritage NSW, accessed 6 July 2021.

Heritage Council of NSW Fire, Access and Services Panel (2002) *The fire resistance in ceiling-floor systems commonly found in heritage buildings*, Heritage Branch of NSW Department of Planning, Parramatta.

L&A Fazzini Manufacturing Pty Ltd (2019) *Foamed Vermitex® passive fire proofing for heritage buildings installation guide*, L&A Fazzini Manufacturing Pty Ltd, Greenacre.

Nicholls K (2017) *Fire resistance performance of an LAF Foamed Vermitex AF fire protection system for floor ceilings tested in accordance with AS 1530.4-2014*, CSIRO Infrastructure Technologies, North Ryde.

Westgate Pty Ltd (n.d.) [Westox Ceiling Reinstatement System](#) [online document], Westgate Pty Ltd, accessed 27 January 2021.

Further information

For further information please contact Heritage NSW. Requests for assistance in balancing fire safety requirements and heritage considerations may be referred to the Heritage Council of NSW's Technical Advisory Panel (TAP).

Testing certificates for the 2016 LAF commissioned testing, *Foamed Vermitex® passive fire proofing for heritage buildings installation guide*, and detailed information on the method to address sound transmission issues may be obtained by from [LAF Group](#).

Version

Originally published as Heritage Council of NSW Fire, Access and Services Panel (2002) *The fire resistance in ceiling-floor systems commonly found in heritage buildings*, Heritage Branch of NSW Department of Planning, Parramatta.

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