ENGINEERS AUSTRALIA	PRACTICE NOTE NO: BL1.1			Version: R2	May	2026
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	Buildings and structures	Museum artefact	Operating object	Material specific	Intangible heritage	Sustainability

Fire Safety for Heritage Buildings-Part 1 of 2 – Overview of Typical Fire Safety Concerns

1. Introduction and background

Part 1 of this Practice Note provides an overview of the typical challenges encountered when carrying out new works in heritage buildings, balancing modern design and achieving compliance with Fire Safety provisions of the current Building Code of Australia (BCA) and the preservation of heritage fabric. It highlights some alternative pathways to retain heritage value without compromising life safety. Part 2 of the Practice Note provides an Understanding of Fire Resistance of common building materials in Heritage buildings.

A critical success factor in Fire Safety is the early involvement of a **Fire Engineer** working collaboratively with heritage consultants, design professionals and building owners or operators. Through a full understanding of the specific requirements and constraints of each stakeholder, the technical implications and heritage impacts of proposed upgrades can be assessed, and potential concessions can be explored to facilitate fire safety compliance with only minor upgrade works.

2. Purpose

To provide an overview of common fire safety concerns in Heritage buildings to support informed decision-making in developing **Performance Solutions** for fire safety compliance in heritage adaptive reuse projects.

3. Scope and applicability

This practice note is relevant to heritage consultants, architects, structural, hydraulic and services engineers, and building owners or operators seeking an understanding of how Fire Engineering solutions can help satisfy compliance to current Fire Safety requirements of older and heritage buildings constructed prior to the introduction of the Building Code of Australia (BCA), circa 1996

4. Overview of typical fire safety concerns in Heritage Buildings.

Fire compartmentation

Heritage buildings sometimes contain expansive open spaces, such as those found in churches or town halls, which lack modern fire separation. To comply with BCA requirements, new fire compartment walls may be necessary to limit the extent of a potential fire by restricting the area it can affect. However, implementing DtS compartmentation can have significant implications for the existing spatial configuration and usage. To maintain the aesthetic integrity and achieve minimal intervention, it is preferable to preserve the original space as much as possible and utilize existing internal walls to form compartments. This approach, however, may result in larger fire compartments and potentially lower the FRL for compartment walls.

The BCA provides the *DtS requirements* on compartment sizes based on different usage classifications, considering fire risks, fuel characteristics, and occupant profiles. However, these factors can vary significantly depending on the usage and its interior layout. For instance, a typical library, classified as Class 9b, requires fire compartments to be limited to 8,000 m^2 in floor area and 30,000 m^3 in volume. In public reading rooms, where combustible materials are mostly limited to a small amount of wooden furniture and electrical equipment (like computers), the fuel load is much lower compared to archive areas. If a fire starts in a reading room, it is unlikely to spread quickly throughout the entire compartment because circulation spaces subdivide it into several fuel zones. As a result, the fire behaviour would resemble that of a smaller archive compartment (for book storage) with respect to available fuel.

Larger compartments typically accommodate more occupants, increasing overall vulnerability during a fire, particularly due to heightened potential for smoke exposure. In such situations, measures such as installing a smoke exhaust system or ensuring sufficient means of egress may be more effective in facilitating rapid and safe evacuation than introducing additional fire separation. In addition, where smoke confinement is a key objective, smoke proof separation, with its less stringent requirements compared to full fire walls or fire doors, may be considered through a Performance Solution pathway.

External envelope materials

A heritage building's exterior typically features numerous elements that define its historical importance (eg key architectural components -façade, parapets, cornices, windows, and doors, along with original building materials and both decorative and practical details).

Under a *DtS solution*, combustible elements such as timber doors and door frames, window frames, and louvres are not permitted by the BCA. As a result, these features would be required to be removed or replaced, which may conflict with heritage conservation objectives.

Additionally, heritage buildings often contain unprotected window openings located closer to boundaries than permitted by the BCA, creating challenges related to potential fire spread between buildings. Under a *DtS solution*, these openings would need to be protected by passive measures (e.g., fire-rated windows or fire-rated shutters/curtains) or active systems such as drenchers, which may necessitate alterations to heritage features.

The intent of the BCA provisions is to limit the spread of fire between buildings, floors, or compartments via combustible external wall elements or unprotected openings in external walls. In fact, combustible components can only ignite when subjected to sufficiently high radiative heat flux or direct flame impingement. Therefore, the actual risk of fire spread depends on factors such as the credible heat source, ignition susceptibility of the heritage fabric, and the separation distance to adjacent buildings or compartments. These factors are conservatively disregarded in *DtS provisions* but can be more accurately assessed through a *Performance Solution*, allowing heritage fabric to be retained where risk can be demonstrated as acceptable.

Mechanical systems

The current BCA stipulates requirements for smoke exhaust, stair pressurisation, and zone smoke control. For example, in office buildings classified as Class 5, where the effective building height exceeds 25m, zone pressurisation systems must be provided between vertically separated compartments. As such, stair pressurisation and/or zone smoke control systems are required. In facilities such as art galleries or theatres (Class 9b), when the fire compartment exceeds 2,000 m2, the installation of a smoke exhaust system is mandated by DtS provisions.

Implementing new smoke control systems typically necessitates additional plant spaces, including plant rooms and often risers and ductwork throughout the building. Such interventions can significantly impact heritage features and may not always be feasible.

The smoke control system could be omitted or rationalised by utilising existing systems (e.g. other vents), through a *Performance Solution* adopted as part of an integrated fire safety strategy that incorporates other measures, including active and passive smoke compartmentation, early detection and alarm systems, adequate means of egress to facilitate timely evacuation, and efficient fire suppression systems.

Egress provisions

Heritage buildings often do not meet certain egress requirements—such as minimum clear widths and maximum travel distances—which is a common challenge. The BCA DtS provisions require egress paths to have a minimum clear width of 1 m, which may be difficult to achieve for some heritage stairs. However, these paths typically do not serve large occupant loads or are only needed to reduce travel distances when alternative egress routes are available. Performance Solutions are generally appropriate in these situations.

In practice, when addressing egress in heritage buildings, it is essential to balance fire safety objectives with the preservation of significant architectural features. Performance Solutions allow for a more nuanced approach by considering factors such as the building's occupancy profile, available alternative exits, and the actual risk posed by slightly reduced path widths or extended travel distances. For instance, if a stairway is of heritage value and cannot be widened without substantial loss of fabric, a fire engineering assessment may demonstrate that the existing arrangement is acceptable, provided supplementary measures, such as enhanced detection systems, additional signage, or improved lighting, are implemented.

Furthermore, where travel distances exceed prescriptive limits, a holistic fire safety strategy might incorporate features like compartmentation to delay the spread of fire, or the use of automatic fire suppression systems to lower the risk to occupants during evacuation. The key is to present a robust case that demonstrates the overall safety outcome meets the intent of the BCA, while respecting the building's heritage values. Collaboration with heritage consultants, fire engineers, and regulatory authorities is critical to achieving solutions that are both safe and sensitive to the building's historical significance.

Hydrants, sprinklers and detection systems

Public heritage buildings across Australia often face significant challenges in maintaining and upgrading their fire hydrant systems to meet current Australian Standards. Many of these buildings were constructed long before current fire codes existed, resulting in outdated infrastructure such as corroded pipework, inadequate water pressure, and insufficient hydrant coverage. These technical deficiencies compromise firefighting effectiveness and pose serious risks to occupant safety and property preservation.

Efforts to modernise hydrant systems are frequently hindered by stringent heritage preservation regulations. Modifications that alter the building's historic fabric, such as installing visible intrusive piping, are often restricted. Compliance with the BCA and Australian Standards (e.g. AS 2419.1:2021) is required, but heritage buildings often cannot meet these standards without compromising the heritage fabric.

A performance-based strategy for upgrading hydrant systems is often the most practical approach. For instance, older standards typically permitted hydrant outlets on the floor plate (to support prior fire-fighting techniques), whereas current codes typically require them within fire stairs. Relocating hydrants into stairwells can lead to coverage deficiencies, necessitating additional on-floor outlets, which often requiring a Performance Solution, or, alternatively, approval for the use of two hose lengths in lieu of DtS one length of hose. Such changes may also affect egress widths within stairwells, which must be carefully evaluated.

Sprinkler systems are frequently employed to offset deficiencies in other fire safety measures. However, their introduction must be carefully considered, weighing both the safety benefits and the potential impacts on the building's heritage fabric. While sprinklers can significantly enhance fire protection, their installation may involve intrusive works, such as cutting into decorative ceilings or exposing pipework, that could compromise the building's historical integrity. To mitigate this, alternative design strategies like side-throw or concealed sprinklers may be used to preserve delicate architectural features while still achieving compliance. Each intervention should be tailored to the building's unique characteristics to ensure both safety and conservation objectives are met.

Similarly, detection systems are typically installed on ceilings. In some heritage buildings, the ceilings are of particular heritage significance. Alternative design approaches to minimise or avoid ceiling mounted detection systems can be explored and may need to be supported by a *Fire Engineered Performance Solution*.

5. References

Building Code of Australia (BCA)- part of the National Construction Code (NCC), setting national standards for the design, construction, and performance of buildings to ensure safety, health, accessibility, and sustainability.

Ordinance 70 in NSW-Ordinance 70 is a regulatory framework under the Local Government Act 1919 governing building construction, occupancy, and essential fire safety measures in New South Wales. From 1/1/1992 to be cited as building Code of Australia (Administrative Provisions) Ordinance 1991.

Historic building Ordinances under Local Government Act 1919 - Government Legislation & Publications: New South Wales - Research Guides at State Library of New South Wales

Other EHA Practice Notes-references to be updated as they evolve

6. Definitions

Deemed-to-Satisfy Provisions (DtS)-Provisions which are deemed to satisfy the Performance Requirements of BCA/NCC.

Fire Engineer- Fire safety engineering deals with the protection of life, property, and environment through the application of engineering principles, rules and judgement to the phenomenon of fire, its physical effects and the reaction and behaviour of people to fire.

Fire Resistance Level (FRL)- The grading periods in minutes for the following criteria—structural adequacy; and integrity; and insulation and expressed in that order (**-/-/-**).

Performance Requirement- A requirement which states the level of performance which a Performance Solution or Deemed-to-Satisfy Solution must meet.

Performance Solution- A method of complying with the Performance Requirements other than by a Deemed-to-Satisfy Solution.