Australian Building Codes Board

Fire Safety Verification Method

Standard

PREVIEW

2022

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Preface

This Fire Safety Verification Method provides a process for engineering the design of fire safety Performance Solutions. The document provides the flexibility required to develop Performance Solutions while still maintaining the level of safety required by the NCC.

To ensure that the level of safety required by the NCC is maintained, the level of safety achieved using this Verification Method must be at least equivalent to the relevant NCC Volume One Deemed-to-Satisfy Provisions.

Section 1 of this document provides an introduction to the Verification Method and its application.

Section 2 describes the design fire scenarios.

Terms with a specific meaning: In this ABCB Standard, terms shown in italicised text have the meaning that they have in the NCC.

Part 1 Introduction

1.1 Purpose

[2019: Sch 7: 1.1]

This *Verification Method* presents specific *design scenarios* that must be considered in order to demonstrate that the fire safety aspects of a building design comply with the fire safety *Performance Requirements* of NCC Volume One set out in Table 1.4. The level of safety achieved by the building design must be at least equivalent to the relevant *Deemed-to-Satisfy Provisions*.

For the purposes of developing a *Performance Solution*, this *Verification Method* must only be used by fire safety engineers who are suitably qualified and experienced, and—

- have demonstrated competency in *fire safety engineering*; and
- are proficient in the use of fire engineering modelling methods; and
- are familiar with fire testing and validation of computational data.

This *Verification Method* is not a comprehensive guide to fire safety. The International Fire Engineering Guidelines (2005), provides more comprehensive guidelines on fire safety calculation procedures. The ABCB Fire Safety Verification Method Handbook provides specific guidance on the following as relevant to this *Verification Method*:

- Occupant characteristics.
- Rules and parameters of *design scenario*.
- Guidelines on modelling.
- Documentation.

Information

This *Verification Method* is one way, but not the only way, to demonstrate compliance with the *Performance Requirements* set out in Table 1.4. *Performance Solutions* developed from first principles, or meeting the relevant *Deemed-to-Satisfy Provisions*, remain acceptable ways to demonstrate compliance.

Also, other *Performance Requirements* not covered by this *Verification Method* may need to be considered in order to comply with A2G2(3) and A2G4(3) as applicable

1.2 How to use this Verification Method

[2019: Sch 7: 1.2]

This *Verification Method* sets out twelve *design scenarios* that must be considered in order to demonstrate that a building incorporating one or more *Performance Solutions* satisfies the *Performance Requirements* set out in Table 1.2.

Each *design scenario* must consider one or more locations in the building that capture the range of reasonable possibilities in relation to the threat to safety. The level of safety that the building design achieves must be at least equivalent to the relevant *Deemed-to-Satisfy Provisions*.

All *design scenarios* applicable to a *Performance Requirement* must be assessed to demonstrate compliance with that *Performance Requirement*.

This *Verification Method* is subject to the Governing Requirements, other than Part A8, set out in Section A of NCC Volume One.

Table 1.2: List of Performance Requirements and relevant design scenarios

Performance Requirement	*Design scenario*
C1P1	BE, UT, CS, FI, UF, CF, RC, SS
C1P2	BE, UT, CS, SF, HS, IS, FI, CF, RC, UF, VS
C1P3	BE, UT, CS, SF, CF, RC

Performance Requirement	*Design scenario*
C1P4	IS, VS
C1P5	FI, SS
C1P6	CS
C1P7	FI, VS
C1P8	BE, UT, CS, SF, CF, RC, VS
C1P9	FI, UF
D1P4	BE, UT, CS, SF, IS, CF, RC
D1P5	BE, UT, CS, SF, IS, FI, CF, RC
D1P6	BE, CS, SF, IS, CF, RC
D1P7	BE, RC
E1P1	SF, IS, CF, RC
E1P2	SF, CF, RC
E1P3	SF, FI, CF, RC
E1P4	BE, UT, CS, SF, IS, CF, RC
E1P6	FI
E2P1	BE, UT, CS, SF, IS, CF, RC
E2P2	BE, UT, CS, SF, IS, FI, CF, RC, VS
E3P3	FI
E4P1	BE, UT, CS, SF, IS, CF, RC
E4P2	BE, UT, CS, SF, IS, CF, RC
E4P3	BE, UT, CS, SF, IS, CF, RC

1.3 Performance-based design

[2019: Sch 7: 1.3]

Information

The entire content of Part 1.3 of the Fire Safety *Verification Method*, as shown below, has been replicated from the content of NCC Volume One, C1V4.

1.3.1 Performance-based design brief (PBDB)

[2019: Sch 7: 1.3.1]

When using this *Verification Method*, the fire safety engineer must undertake a *performance-based design brief (PBDB)* that must involve all stakeholders relevant to the building design. The *PBDB* must also outline the fire strategy to be adopted.

While full agreement on all aspects of the *PBDB* is the preferred outcome, it is acknowledged that in some instances this may not be possible to obtain. In the event that full agreement cannot be achieved through the *PBDB*, dissenting views must be appropriately recorded and carried throughout the process and considered as part of the due processes of the *appropriate authority* when determining compliance and providing approval.

Consideration of whether a peer review (by an independent fire safety engineer) of some or all of the proposed *Performance Solutions* and the supporting analysis is required or not, must be undertaken at this *PBDB* stage.

Information

When developing a *Performance Solution*, a *PBDB* is an important step in the process. It allows all relevant stakeholders to be involved in the development of the building design and its *fire safety system*.

A *PBDB* is a documented process that defines the scope of work for the fire engineering analysis. Its purpose is to set down the basis, as agreed by the relevant stakeholders, on which the fire safety analysis of the proposed building and its *Performance Solutions* will be undertaken.

Relevant stakeholders will vary from design to design. However, some examples of relevant stakeholders are: a fire safety engineer, architect, developer, client, *appropriate authority* (some state legislation prevents *appropriate authorities* from being involved in the design process), fire authority and other stakeholders that fire safety design may affect such as insurers. Further information on the relevant stakeholders is provided in Clause 1.3.1.2.

Guidance on the development of a *PBDB* is presented in the International Fire Engineering Guidelines (2005) and referred to as a Fire Engineering Brief in that document.

1.3.1.1 Fire strategy

[2019: Sch 7: 1.3.1.1]

The *PBDB* must cover the fire safety strategy for the building, outlining the philosophy and approach that will be adopted to achieve the required level of performance. The fire safety strategy must pay particular attention to the evacuation strategy to be used and the management regimes necessary.

1.3.1.2 Stakeholder involvement

[2019: Sch 7: 1.3.1.2]

The *PBDB* must be developed collaboratively by the relevant stakeholders in the particular project. The following parties must be involved:

- Client or client's representative (such as project manager).
- Fire engineer.
- Architect or designer.
- Various specialist consultants.
- Fire service (public or private).
- *Appropriate Authority* (Authority Having Jurisdiction – subject to state legislation).
- Tenants or tenants representative for the proposed building (if available).
- Building operations management (if available).

Conducting a simple stakeholder analysis can be used to determine who must be involved in the *PBDB* process. This analysis must identify stakeholders with a high level of interest in the design process, and/or likely to be affected by the consequences of a fire should it occur in the building.

1.3.1.3 Required level of safety

[2019: Sch 7: 1.3.1.3]

Given the absence of specific safety targets in the NCC and the qualitative nature of the NCC fire safety *Performance Requirements*, for this *Verification Method* to ensure the level of safety expected, the proposed building design must be at least equivalent to the relevant *Deemed-to-Satisfy Provisions*.

As the NCC *Deemed-to-Satisfy Provisions* evolved originally from State and Territory regulations and are regularly updated to reflect technical advances and experience they are commonly accepted as providing an acceptable benchmark. It is accepted that the NCC *Deemed-to-Satisfy Provisions* reflect societal expectations in terms of fire safety, which address individual risk, societal risk and the robustness in the design by adopting a defence in depth approach.

In the majority of *design scenarios* the *Verification Method* requires a demonstration that the proposed level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*. In relation to the required level of safety the *PBDB* process must—

(a) identify the relevant *Deemed-to-Satisfy Provisions* to be used in the equivalency process to determine whether the relevant *Performance Requirements* have been met; and

(b) consider the specific size, complexity and use of the building with regards to the *Deemed-to-Satisfy Provisions* to be used in the equivalency process; and

(c) consider the specific occupant profile of the building, paying particular attention to occupants with a disability and the vulnerable, in regards to the *Deemed-to-Satisfy Provisions* to be used in the equivalency process.

1.3.2 Final report

[2019: Sch 7: 1.3.2]

Once the analysis of all relevant *design scenarios* for all the required *Performance Solutions* has been completed, the fire safety engineer must prepare a final report that includes the following:

- The agreed *PBDB*.
- All modelling and analysis.
- Analysis required to demonstrate that the proposed building provides a level of safety at least equivalent to the relevant *Deemed-to-Satisfy Provisions*.
- Any other information required to clearly demonstrate that the building and its *fire safety system* satisfies the relevant *Performance Requirements* as set out in Table 1.2.

1.4 Design scenarios: NCC Performance Requirements

[2019: Sch 7: 1.4]

This *Verification Method* presents specific *design scenarios* that must be considered in order to demonstrate that the fire safety aspects of a building design comply with the fire safety *Performance Requirements* set out in Table 1.4.

The *design scenarios* specified in Section 2 are summarised in Table 1.4.

Table 1.4: Design scenarios

Design scenarios	*Performance Requirements* Note 1	Outcome required Note 3	Typical method or solution
BE Fire blocks *evacuation route* (2.1). [A fire blocks an *evacuation route*]	C1P1, C1P2, C1P3, C1P8, D1P4, D1P5, D1P6, D1P7 Note 3, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Demonstrate that a viable *evacuation route* (or multiple *evacuation route* where necessary) has been provided for building occupants.
UT Fire in a normally unoccupied room threatens occupants of other rooms (2.2). [A fire starts in a normally unoccupied room and can potentially endanger a large number of occupants in another room].	C1P1, C1P2, C1P3, C1P8, D1P4, D1P5, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	*ASET*/*RSET* analysis or provide separating construction or fire suppression complying with a specified Standard. Solutions might include the use of *separating elements* or fire suppression to confine the fire to the room of origin.
CS Fire starts in concealed space (2.3). [A fire starts in a concealed space that can facilitate fire spread and potentially endanger a large number of people in a room]	C1P1, C1P2, C1P3, C1P6, C1P8, D1P4, D1P5, D1P6, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Demonstrate that fire spread via concealed spaces will not endanger occupants; and demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Solutions might include providing separating construction or fire suppression or *automatic* detection complying with a specified Standard.
SF Smouldering fire (2.4). [A fire is smouldering in close proximity to a sleeping area]	C1P2, C1P3, C1P8, D1P4, D1P5, D1P6, E1P1, E1P2, E1P3, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Solutions might include providing *automatic* detection and alarm system complying with a recognised Standard.

Design scenarios	*Performance Requirements*Note 1	Outcome required Note 3	Typical method or solution
HS Horizontal fire spread (2.5). [A *fully developed fire* in a building exposes the *external walls* of a neighbouring building]	C1P2	Demonstrate that the risk of fire spread between buildings is not greater than buildings complying with the *Deemed-to-Satisfy Provisions*.	C1V1, C1V2
VS Vertical fire spread involving cladding or arrangement of openings in walls (2.6). [A fire source exposes a wall and leads to significant vertical fire spread]	C1P2, C1P4, C1P7, C1P8, E2P2	Demonstrate that the building's external cladding / facade and arrangement of openings in the building do not increase the risk to life resulting from a fire beyond that for a similar building complying with the *Deemed-to-Satisfy Provisions*.	C1V3
IS Fire spread involving internal finishes (2.7). [Interior surfaces are exposed to a growing fire that potentially endangers occupants].	C1P2, C1P4, D1P4, D1P5, D1P6, E2P1, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Maintain tenable conditions to allow time for evacuation of occupants and to facilitate *fire brigade* intervention; and demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	*ASET*/*RSET* analysis or equivalent growth and species production rates.
FI *Fire brigade* intervention (2.8). [Consider *fire brigade* intervention]	C1P1, C1P2, C1P5, C1P7, C1P9, D1P5, E1P3, E1P6, E2P2, E3P2	Demonstrate consideration of potential *fire brigade* intervention; and demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Facilitate *fire brigade* intervention to the degree necessary.
UF Unexpected Catastrophic Failure (2.9). [A building must not unexpectedly collapse during a fire event]	C1P1, C1P2, C1P9	Demonstrate that the building, its critical elements and the *fire safety system* provide sufficient robustness such that unexpected catastrophic failure is unlikely; and demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Undertake review or risk assessment of critical elements within a building to determine unexpected catastrophic failure is unlikely.
CF Challenging fire (2.10). [Worst credible fire]	C1P1, C1P2, C1P3, C1P8, D1P4, D1P5, D1P6, E1P1, E1P2, E1P3, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	*ASET*/*RSET* analysis.

Design scenarios	*Performance Requirements*Note 1	Outcome required Note 3	Typical method or solution
RC Robustness check (2.11). [Failure of a critical part of the *fire safety systems* will not result in the design not meeting the Objectives of the BCA]	C1P1, C1P2, C1P3, C1P8, D1P4, D1P5, D1P7Note 3, E1P1, E1P2, E1P3, E1P4, E2P1, E2P2, E4P1, E4P2, E4P3	Demonstrate that if a key component of the *fire safety system* fails, the design is sufficiently robust that a disproportionate spread of fire does not occur (e.g. *ASET*/*RSET* for the remaining floors or fire compartments is satisfied); and demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Modified *ASET*/*RSET* analysis.
SS Structural Stability and other properties (2.12). [Building does not present risk to other properties in a fire event]	C1P1, C1P5	Demonstrate that the building does not present an unacceptable risk to other property due to collapse or barrier failure resulting from a fire; and demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.	Undertake analysis of structure and *fire safety system*.

Table Notes

(1) Not all of these requirements will always be applicable to this *design scenario*.

(2) The project specific *Performance Requirements* must be determined as part of the *performance-based design brief* process.

(3) Appropriate analysis of D1P7 is also required where a lift is intended to be used to assist occupants to evacuate.

(4) When *required* to demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions* refer to Clause 1.3.1.3.

1.5 Fire modelling to determine ASET

[2019: Sch 7: 1.5]

For particular *design scenarios*, the designer must demonstrate that the occupants have sufficient time to evacuate the building before being overcome by the effects of fire.

In *fire safety engineering* terms, the *ASET* must be greater than the *RSET*.

ASET is defined as the time between ignition of the *design fire* and the time when the first tenability criterion is exceeded in a specified room within the building. The tenability parameters measured at a height of 2 m above floor level, are—

(a) a *FED* of thermal effects greater than 0.3; or

(b) conditions where, due to smoke obscuration, *visibility* is less than 10 m except in rooms of less than 100 m^2 or where the distance to an *exit* is 5 m or less, where *visibility* may fall to 5 m.

Information

Visibility is generally the first tenability criterion exceeded in calculations unless any exception is applied.

Calculate the *ASET* by modelling the fire using the *design fire* as specified. In most cases there will be a number of locations for the fire that could produce the lowest *ASET* for a given escape route. Check a number of rooms to determine the limiting case.

It must be demonstrated that the proposed level of safety is at least equivalent to that provided by a building compliant with the *Deemed-to-Satisfy Provisions*.

Part 2 Design scenarios

2.1 Fire blocks evacuation route (BE)

[2019: Sch 7: 2.1]

Design scenario in brief

A fire starts in an *evacuation route* and can potentially block the *evacuation route*.

Required outcome

Demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.1.1 Design scenario description

[2019: Sch 7: 2.1.1]

This *design scenario* addresses concern that an *evacuation route* may be blocked due to proximity of the fire source.

For each room/space within the building, assume that the fire source is located near the primary *evacuation route* and that it prevents occupants from leaving the building by that route. Fire in *evacuation routes* can be the result of an accidental or deliberately lit fire.

In order to be regarded as alternative *evacuation routes*, the *evacuation routes* must be separated from each other and must remain separated until reaching a final *exit* in accordance with D2D6, or an demonstrated equivalent through analysis.

Active and passive *fire safety systems* in the building must be assumed to perform as intended by the design.

Information

The fire safety engineer needs to consider fire source locations that prevent the use of *exits* in *evacuation routes*.

Fire characteristics (e.g. HRR) and analysis need not be considered in this *design scenario* as the fire is assumed to physically block the *evacuation route*. It may be assumed that occupant tenability criteria cannot be met where fire plumes and flames block an *evacuation route*.

2.1.2 Typical method or solution

[2019: Sch 7: 2.1.2]

The requirements of this *design scenario* can be demonstrated by analysis that checks whether or not a second *evacuation route* is required.

2.2 Fire in a normally unoccupied room threatening occupants of other rooms (UT)

[2019: Sch 7: 2.2]

Design scenario in brief

A fire starts in a normally unoccupied room and can potentially endanger a large number of occupants in another room.

Required outcome

Demonstrate that the level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.2.1 Design scenario description

[2019: Sch 7: 2.2.1]

This *design scenario* only applies to buildings with rooms or spaces that could be threatened by a fire occurring in another normally unoccupied space. Such rooms or spaces must include those rooms or spaces physically adjacent to the unoccupied room as well as rooms or spaces that are a farther distance and are not fire separated; or rooms or spaces from which occupants or slower evacuees have to pass through a potentially threatened room or space adjacent to the unoccupied room. It does not need to be satisfied for any other rooms or spaces in the building.

A fire starting in an unoccupied space can grow to a significant size undetected and then spread to other areas where people may be present or where people are young, elderly or have a disability and will take longer to evacuate. This *design scenario* is intended to address concern a fire starting in a normally unoccupied room and then migrating into space(s) potentially holding occupants.

The analysis must assume that the target space containing occupants is filled to capacity under normal use or otherwise contains occupants with longer evacuation times.

For analysis, select a *design fire* for the applicable occupancy. Active and passive *fire safety systems* in the building must be assumed to perform as intended by the design.

2.2.2 Typical method or solution

[2019: Sch 7: 2.2.2]

Either—

(a) carry out *ASET*/*RSET* analysis to show that occupants within target spaces are not exposed to untenable conditions; or

(b) include *separating elements* or fire suppression to confine the fire to the room of origin.

2.3 Fire starts in a concealed space (CS)

[2019: Sch 7: 2.3]

Design scenario in brief

A fire starts in a concealed space that can potentially endanger people in another room or in the room of fire origin.

Required outcome

Demonstrate that fire spread in concealed spaces will not endanger occupants located in other rooms/spaces.

Demonstrate that the proposed level of safety is at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.3.1 Design scenario description

[2019: Sch 7: 2.3.1]

This *design scenario* only applies to buildings with rooms or spaces that could be threatened by a fire occurring in a concealed space. Such rooms or spaces must include those rooms or spaces physically adjacent to the concealed room or space as well as rooms or spaces that are a farther distance and not fire separated; or rooms or spaces where slower evacuees have to pass through a potentially threatened room or space adjacent to the concealed space. It does not need to be satisfied for any other rooms or spaces in the building.

A fire starting in a concealed space can develop undetected and spread to endanger a large number of occupants in another room. This *design scenario* addresses concern that a fire originating in a non-separated concealed space without either a detection system or a suppression system could spread into a room within the building potentially holding a large number of occupants.

Active and passive *fire safety systems* in the building must be assumed to perform as intended by the design.

Information

Fire spreading in concealed spaces may also compromise the ability of firefighters to assess the threat to themselves whilst undertaking rescue and firefighting operations.

2.3.2 Typical method or solution

[2019: Sch 7: 2.3.2]

If a calculation approach using this *Verification Method* is used, the expected solution will most likely be to—

(a) use *separating elements* or suppression to confine fire to the concealed space; or

(b) include *automatic* detection of heat or smoke to provide early warning of fire within the concealed space; or

(c) a combination of (a) and (b).

2.4 Smouldering fire (SF)

[2019: Sch 7: 2.4]

Design scenario in brief

A fire is smouldering in close proximity to a sleeping area.

Required outcome

Provide a safe sleeping area.

Demonstrate that the level of safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.4.1 Design scenario description

[2019: Sch 7: 2.4.1]

This *design scenario* addresses concern regarding a slow, smouldering fire that causes a threat to sleeping occupants. Assume that active and passive *fire safety systems* in the building perform as intended by the design.

2.4.2 Typical method or solution

[2019: Sch 7: 2.4.2]

The expected methodology is to either—

(a) use *separating elements* to confine the fire to the space of origin (assuming it is a separate space from the sleeping area); or

(b) include *automatic* detection of smoke in adjacent spaces to provide early warning of fire within an adjoining space.

The *separating elements* must prevent all smoke ingress which, for almost all situations requires a pressure differential between the two spaces in addition to a physical barrier. The pressure differential will have to be sufficient to prevent smoke ingress into the sleeping area.

If the *automatic* detection methodology is chosen, then an *automatic* smoke detection and alarm system must be installed throughout the sleeping and adjoining spaces.

2.5 Horizontal fire spread (HS)

[2019: Sch 7: 2.5]

Design scenario in brief

A *fully developed fire* in a building exposes the *external walls* of a neighbouring building or *fire compartment* and a *fully developed fire* in the neighbouring building exposing the opening in the *external walls* of the building.

Required outcome

Demonstrate that the risk of fire spread between buildings is not greater than for buildings complying with the *Deemed-to-Satisfy Provisions*.

2.5.1 Design scenario description

[2019: Sch 7: 2.5.1]

This *design scenario* describes the requirements for a building to prevent horizontal fire spread to and from an adjacent building or *fire compartment*.

2.5.2 Typical method or solution

[2019: Sch 7: 2.5.2]

Demonstrate compliance with C1V1 and C1V2.

2.6 Vertical fire spread involving external cladding or external openings (VS)

[2019: Sch 7: 2.6]

Design scenario in brief

A fire source exposes the *external wall* or arrangement of openings in a building and leads to significant vertical fire spread.

Required outcome

Demonstrate that the building's external cladding / facade and arrangement of openings in the building do not increase the risk to life resulting from a fire beyond that for a similar building complying with the *Deemed-to-Satisfy Provisions*.

2.6.1 Design scenario description

[2019: Sch 7: 2.6.1]

This *design scenario* applies to all buildings where the is a risk of vertical fire spread.

Comments

This *design scenario* is not concerned with building-to-building fire spread across a relevant boundary, as this is addressed in the *design scenario*: HS (see 2.5).

2.6.2 Method

[2019: Sch 7: 2.6.2]

Demonstrate compliance with C1V3.

2.7 Fire spread involving internal surface linings (IS)

[2019: Sch 7: 2.7]

Design scenario in brief

Interior surfaces are exposed to a growing fire that potentially endangers building occupants.

Required outcome

Demonstrate that the level of safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.7.1 Design scenario description

[2019: Sch 7: 2.7.1]

The performance criteria required for lining materials will depend on their location within a building, and the use of the building.

2.7.2 Typical method or solution

[2019: Sch 7: 2.7.2]

Linings, materials and assemblies in Class 2 to 9 buildings must comply with the appropriate provisions in Specification 7, Table S7C2 or be demonstrated to provide equivalent performance with respect to the performance criteria prescribed in the referenced test standards.

2.8 Fire brigade intervention (FI)

[2019: Sch 7: 2.8]

Design scenario in brief

This *design scenario* allows for *fire brigade* intervention.

Required outcome

Demonstrate that the *fire brigade* can undertake *fire brigade* intervention until completion of search and rescue activities.

Demonstrate that the level of safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.8.1 Design scenario description

[2019: Sch 7: 2.8.1]

The purpose of this *design scenario* is to describe—

(a) the fire event the *fire brigade* is expected to face at its estimated time of arrival; and

(b) the scope of available firefighting facilities relative to the risk to building occupant safety and adjacent buildings; and

(c) the ability for the *fire brigade* to complete search and rescue relevant to the available firefighting activities; and

(d) the ability of the *fire brigade* to control or supress a fire.

Information

This *design scenario* is intended to be used in conjunction with the UF *design scenario* (see 2.9). These two *design scenarios* will demonstrate that facilities for *fire brigade* intervention are appropriately incorporated.

2.8.2 Typical method or solution

[2019: Sch 7: 2.8.2]

This *design scenario* only applies to buildings located with 50 km road travel of a fire station.

Compliance with this *design scenario* is demonstrated via application of the Australasian Fire and Emergency Service Authorities Council's (AFAC) Fire Brigade Intervention Model and modelling smoke and fire development, in accordance with the CF *design scenario* (2.10).

Facilities for firefighting must be provided in accordance with Table 2.8, appropriate to the fire and smoke development at the estimated time of suppression activities.

Table 2.8: Facilities for fire brigade intervention

Facilities for *fire brigade* intervention	Building with sprinkler protection	Building without sprinkler protection
Fire brigade external access	Yes	Yes

Facilities for *fire brigade* intervention	Building with sprinkler protection	Building without sprinkler protection
Tenability to enable identification and access to seat of fire	Yes	Yes
Fire hydrants – internal required	Yes, if > 100 m to all points and/or > 3 levels	Yes, if > 70 m to all points and/or > 3 levels
Fire hydrants – external required	Yes	Yes
Command and control provisions	Yes if > 3 levels	Yes
Access to normally occupied areas for search and rescue	Yes if more than 50 persons occupy building	Yes

2.9 Unexpected catastrophic failure (UF)

[2019: Sch 7: 2.9]

Design scenario in brief

The design will be suitably robust to prevent catastrophic structural failure in a fire.

Required outcome

Demonstrate that disproportionate failure does not occur for the duration of the fire event.

Demonstrate that the level of safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.9.1 Design scenario description

[2019: Sch 7: 2.9.1]

The fundamental principles of the UF *design scenario* are that the building structure and/or critical elements should not suffer unexpected disproportionate failure during a fire event. This *design scenario* for the prevention of unexpected catastrophic failure aligns with principles of structural robustness.

The unexpected catastrophic failure *design scenario* is intended to prevent unexpected catastrophic failure of a building component as a result of a fire event.

This *design scenario* assessment must be undertaken in conjunction with the structural engineer, to ensure that unexpected catastrophic failure should not occur for all critical elements. Ductility of the structure must also be considered so that visual cues that act as a warning prior to collapse.

Comments

This *design scenario* is intended to be used in conjunction with the fire brigade intervention (FI) *design scenario*. These two *design scenarios* will that facilities for *fire brigade* intervention are appropriately incorporated.

2.9.2 Typical method or solution

[2019: Sch 7: 2.9.2]

Compliance with this *design scenario* is achieved by demonstrating that the building structure and components have considered the following elements during a fire event:

(a) Assessment of the building structure and critical components such that upon their notional removal, in isolation, due to the fire event the probability of unexpected catastrophic failure of the entire element, or a significant proportion, is unlikely to occur.

(b) Demonstrating that if a component of the building is relied upon to carry a significant portion of the total structure, a systematic risk assessment of the building is undertaken and critical high risk components are identified. High risk components are designed to cope with the identified hazard or protective measures chosen to minimise the risk during a fire event. The proportion of the structure that triggers this analysis will have a range that the designer will have to identify and justify.

2.10 Challenging fire (CF)

[2019: Sch 7: 2.10]

Design scenario in brief

A fire starts in a normally occupied space and presents a challenge to the building's *fire safety systems*, threatening the safety of occupants.

Required outcome

Demonstrate that the level of safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.10.1 Design scenario description

[2019: Sch 7: 2.10.1]

The challenging fires are intended to represent the credible worst case *design scenario* in normally occupied spaces that will challenge the fire protection features of the building.

The *design scenario* requires the use of *design fires* in various locations within the building.

The *design fires* must be characterised with a steady state fire, or a power law HRR, peak HRR and FLED. Design values for *yields* are specified for soot/smoke.

The *design fires* must be modified using an analysis (depending on the methodology used) to account for building ventilation and the effects of *automatic* fire suppression systems (if any) on the fire. The *design scenario* RC (2.11) will require the overall robustness of the design to be examined separately.

The designer must—

(a) for each location of the challenging fire, use a single source to evaluate the building's protection measures; and

(b) consider the impact on occupants who may be using escape routes external to the building as well as internal routes; and

(c) assume that active and passive *fire safety systems* in the building will perform as intended by the design.

Information

Both CS and SS *design scenarios* refer to credible worst case *design fires*. These may not necessarily be the same *design fire*, as they relate to different safety systems of the building.

2.10.2 Typical method or solution

[2019: Sch 7: 2.10.2]

This *design scenario* requires *ASET*/*RSET* analysis of the impact on all building occupants with *design fires* located in various locations within the building, except for those rooms or spaces excluded in the *design scenario* described above.

The designer must calculate the fire environment in the *evacuation routes* over the period of time the occupants require to escape. Assess the fire environment based on *FED* and *visibility* at the location of the occupants.

The designer must select a fire calculation model appropriate to the complexity and size of the building/space that allows the *FED* and *visibility* to be determined.

2.11 Robustness check (RC)

[2019: Sch 7: 2.11]

Design scenario in brief

The fire design will be checked to ensure that the failure of a critical part of the *fire safety system* will not result in the design not meeting the *Performance Requirements*.

Required outcome

Demonstrate that if a single *fire safety system* fails, the design is sufficiently robust that disproportionate spread of fire does not occur (e.g. *ASET*/*RSET* for the remaining floors or *fire compartments* is satisfied).

Demonstrate that the level of fire safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.11.1 Design scenario description

[2019: Sch 7: 2.11.1]

This *design scenario* applies where failure of a key *fire safety system* could expose occupants to untenable conditions. The key fire safety systems must be agreed as part of the *PBDB*.

This particular *design scenario* focusses on the *ASET*/*RSET* life safety calculation performed as part of the *design scenario* CF challenging fire (2.10).

The robustness of the design must be tested by considering the *design fire* with each key *fire safety system* rendered ineffective in turn.

Where the probability of failure of a single system is low and it is impractical to provide additional redundancies it may be acceptable to accept some exposure of occupants to untenable conditions. An appropriate deemed-to-satisfy building should be used as a benchmark.

Comments

The key fire safety systems to be considered must be agreed as part of the *PBDB*.

Information

Ideally, a comprehensive quantitative probabilistic risk assessment would have been used to assess the safety of a design. However, the risk assessment tools and supporting data have not been included in this *Verification Method*. The framework currently permits a simple deterministic *ASET*/*RSET* approach with additional checks and balances.

As a general rule, when calculating *ASET* times, *fire safety systems* may be assumed to operate as designed, provided they are manufactured and installed in accordance with recognised national or international standards. However, in the situations designed above, additional *fire safety systems* provide the redundancy and robustness to fire safety designs.

2.11.2 Typical method or solution

[2019: Sch 7: 2.11.2]

In the circumstances described in the *design scenario*, assume the failure of each key *fire safety system* in turn as determined by the *PBDB*. If *ASET* cannot be shown to be greater than *RSET* for the building, apart from the room of fire origin, then the design must be altered until the requirements of *ASET* and *RSET* are achieved.

2.12 Structural stability and other property (SS)

[2019: Sch 7: 2.12]

Design scenario in brief

This fire design is used to demonstrate that the structural response of a building in a credible worst case *design scenario* does not present an unacceptable risk to *other property*.

Required outcome

Demonstrate that the building does not present an unacceptable risk to other property due to collapse or barrier failure resulting from a fire.

Demonstrate that the level of safety be at least equivalent to the *Deemed-to-Satisfy Provisions*.

2.12.1 Design scenario description

[2019: Sch 7: 2.12.1]

Unlike the CF *design scenario*, the worst credible case fire for this *design scenario* must be located within any space of the building rather than only within an occupied space. It is likely that several different fire design locations will be required to be tested to determine the location of the worst credible case fire.

The designer must—

(a) for each location of the *design fire*, use a single fire source to evaluate the building's protection measures; and

(b) consider the impact on occupants who may be using *evacuation routes* external to the building as well as internal routes.

Comments

A fundamental requirements of C1P1 and C1P2 is that a building should not present a risk to *other property* in a fire event. The purpose of this *design scenario* is to demonstrate that a building does not present a risk to *other property* during a fire event that has the potential to impact on the building's structure.

Information

Both CF and SS *design scenarios* refer to credible worst case *design fire*. These may not necessarily be the same *design fire*, as they relate to different safety systems of the building.

2.12.2 Typical method or solution

[2019: Sch 7: 2.12.2]

The impact of a fully developed fire in the worst-case location on the structural stability of a building must be assessed.

Simultaneous and individual failures of active fire suppression systems (if provided), delayed *fire brigade* intervention and premature failure of structural fire protection should be considered and probabilities assigned to the occurrence of each of the events and the outcomes predicted.

If a simplistic approach is adopted the outcomes and probabilities of each combination of outcomes should be predicted and compared with a deemed-to-satisfy benchmark building.

Information

Typically the fire safety engineer, with the assistance of a structural engineer, would demonstrate that appropriate features have been incorporated into the building which either—

(a) ensure the risk of collapse is equivalent or less than a similar deemed-to-satisfy structure; or

(b) there is no increased risk from outward structural collapse compared to a similar deemed-to-satisfy structure; or

(c) the risk to life for the subject building is no greater than that for a similar deemed-to-satisfy structure.

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