FIRE ENGINEERS

ATTUNGA SKI LODGE, THREDBO

FIRE SAFETY UPGRADE MASTER PLAN

DEVELOPED FOR CONSENT AUTHORITY SUBMISSION

DATE: 21 NOVEMBER 2023
REPORT NO: 1399 - REV A - FINAL
PREPARED FOR: ATTUNGA SKI CLUB
PREPARED BY: J² CONSULTING ENGINEERS | **FIRE SAFETY ENGINEERING**

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REVISION STATUS

REPORT NO.	REVISION	DATE	STATUS	WRITTEN	REVIEWED
1399	REV A	09/05/23	DRAFT	JA	JS
1399	REV A	21/11/23	FINAL	JA	JS

EXECUTIVE SUMMARY & RECOMMENDATIONS

J² Consulting Engineers have been commissioned to carry out a review of the fire safety provisions associated with the existing Attunga Ski Lodge accommodation building located at Thredbo Ski Resort and to develop a master plan outlining the proposed strategies for upgrade to suit the legislative requirements of the Building Code of Australia 2019 Amndt 1(BCA).

Whilst the current BCA was not legislated at the time that the existing developments were undertaken, the compliance assessment undertaken has been undertaken against this BCA as it represents a community accepted level of life safety. As the building is existing however, there are limitations associated with what upgrades are possible to be undertaken and this report therefore also provides a fire engineering assessment of a number of elements in order to achieve compliance with the Performance Requirements of the BCA. These 'Performance Solutions' can be summarised as follows:

#	Performance Solutions	BCA DTS Provision	BCA Performance Requirement	Assessment Methodology
1.	**Fire Resistance** It is proposed to develop a Performance Solution to permit the following non-compliances: • To permit the doors serving the SOUs to be solid core doors and not -/60/30 fire doors. • To permit the doors opening into the main stair shaft to be solid core doors and not -/60/30 fire doors. • To permit the walls separating the SOUs/corridors to be 60/60/60 in lieu of 90/90/90 required for type A construction. • To permit the walls separating the stair shaft to be 60/60/60 in lieu of 90/90/90 required for type A construction. • To permit roof lights in SOUs to be located within 3m of each other.	C3.8, C3.11, Spec C1.1	CP1, CP2 & CP4	Qualitative assessment demonstrating compliance with the performance requirements via a performance based deterministic approach.
2.	**Access and Egress** It is proposed to develop a Performance Solution to permit the following non-compliances: • To allow the main stair to not be contained in a compliant fire isolated shaft and to not discharge directly to open space and for the discharge to be past unprotected openings. • To permit stair treads which exceed the maximum width. • To permit a reduced width of travel to the stair from the basement to open space of 900mm once handrail installed.	D1.3, D1.6 & D2.13	DP2, DP4, DP5 & DP6	Qualitative assessment demonstrating compliance with the performance requirements via a performance based deterministic approach.

REQUIREMENTS OF PERFORMANCE BASED FIRE SAFETY UPGRADE STRATEGY

Considering the relevant provisions of the BCA, the Performance solution, subject to the provision of the following requirements, is considered to meet and comply with the Performance Requirements CP1, CP2, CP4, DP2, DP4, DP5 and DP6:

Performance Solution 1

1. The installation of a FPAA 101D compliant sprinkler system throughout the building.
2. The three sides of the door jambs serving the sole occupancy units are to be provided with medium

temperature smoke seals capable of restricting smoke up to 200oC for thirty minutes.

Performance Solution 2

1. An FPAA101D sprinkler system shall be installed throughout the building.
2. The doors to the fire stair are to be replaced with -/60/30 fire doors fitted with 200x300 vision panels. The doors may be installed into the existing steel jambs. The doors and jambs are not required to be tagged as fire doors. The doors are required to be fitted with door closers and medium temperature smoke seals, the three sides of the door jambs, which are capable of restricting smoke at a temperature of 200°C for thirty minutes.
3. To ensure occupants are aware of the alternative exit located to the basement level it is proposed to install signage stating, "SHOULD CONDITIONS BE UNSAFE, USE EXIT IN BASEMENT" on the lower ground floor level. Signage shall be installed to the stair side of the door either on the door under the vision panel or on the wall adjacent to the vision panel.
4. The installation of textured contrast strips to the treads of all stairs within and external to the building being not less than 50mm in width and in a colour which contrasts to the stair surface.
5. The installation of handrails to one side of the external stairs.

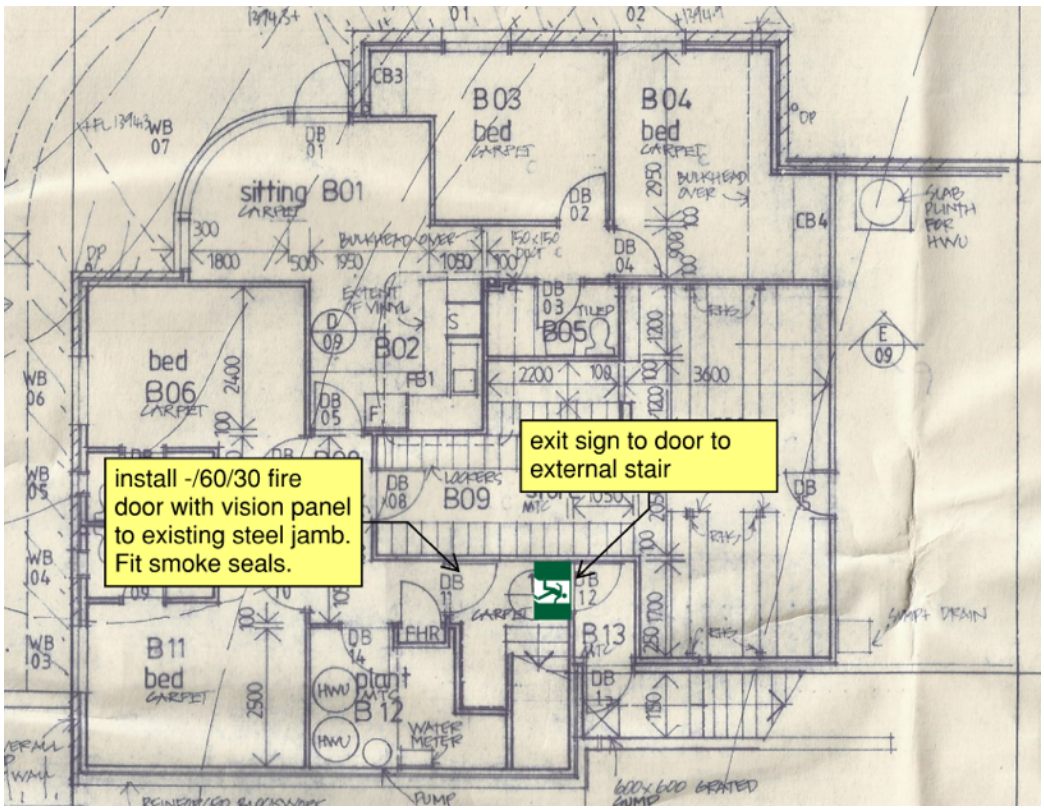


Figure 1 – Trial design requirements basement level

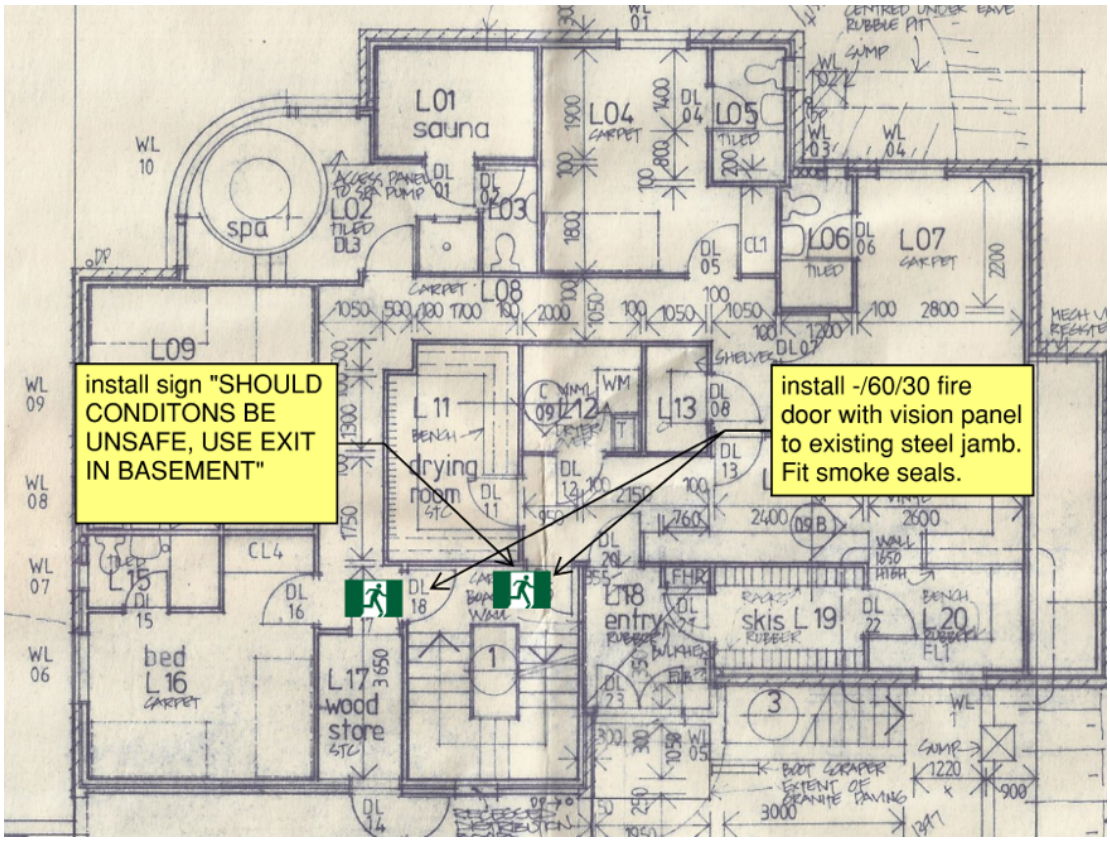


Figure 2 – Trial design requirements lower ground floor level

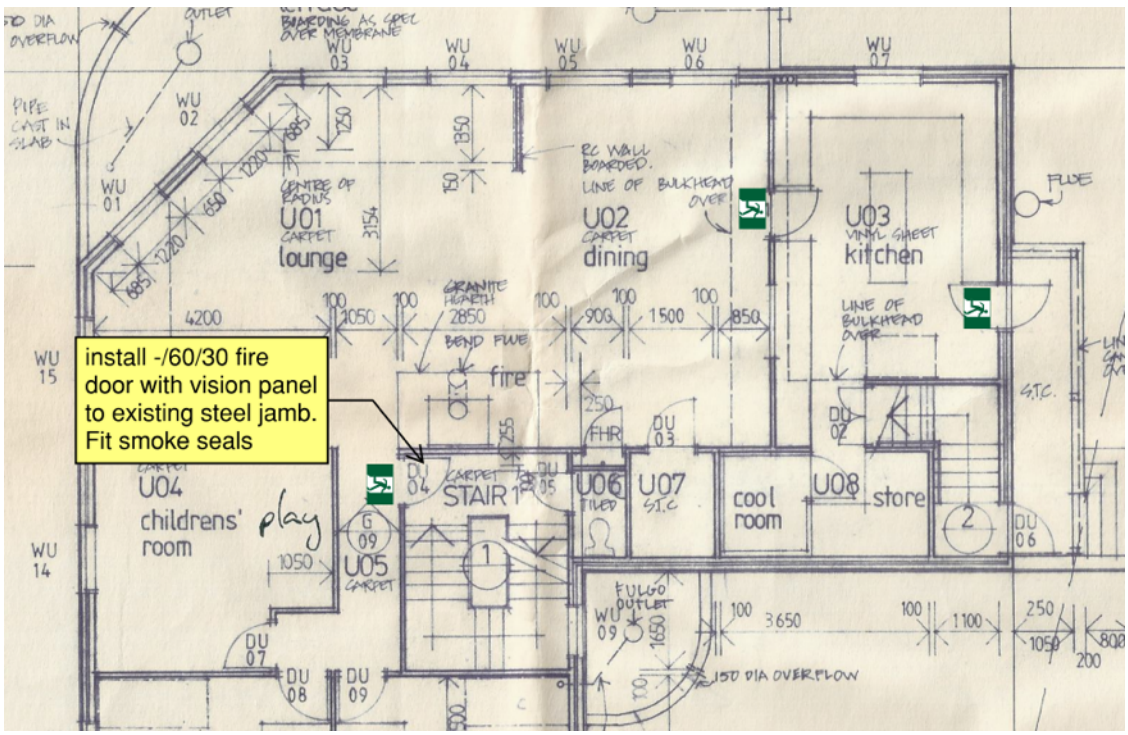


Figure 3 - trial design requirements ground floor

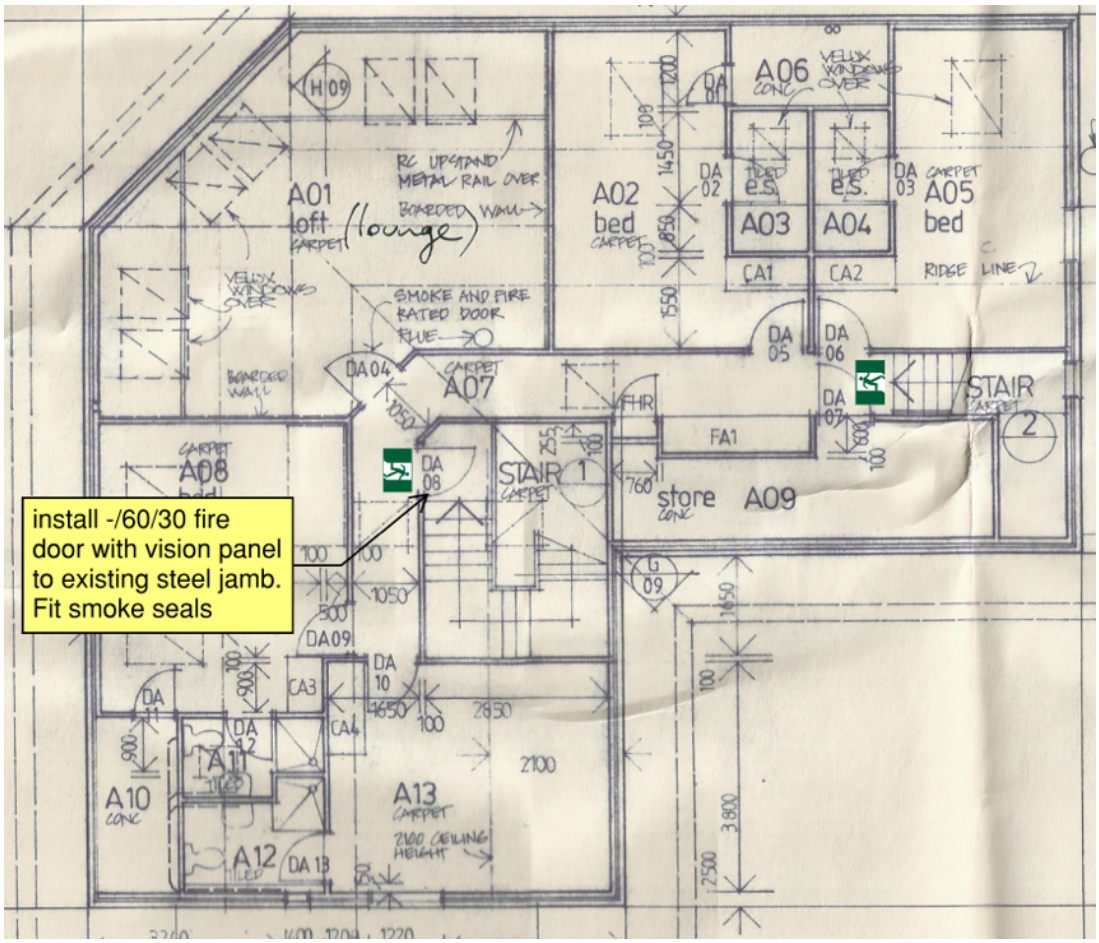


Figure 4 - trial design requirements attic level

REQUIREMENTS OF UPGRADE STRATEGY – DTS

In addition to the performance based upgraded strategy proposed the following deviations from the BCA's DtS provision have been identified with additional fire safety measure proposed which shall bring the existing building to partial compliance with the BCA.

C3.11 Bounding Construction
SOU Doors
The doors serving the SOUs throughout the building which are fitted with self-closing solid core doors whereas the BCA requires fire resistant door sets to SOUs in Type A construction. The inclusion of the solid core doors to the SOUs within the Class 3, where fitted with medium temperature smoke seals, is considered to be satisfactory subject to the installation of a FPAA101D compliant sprinkler system throughout the building.

Riser shaft
The non-fire rated riser shaft shall be lined with one layer of 16 thick fire rated plasterboard.

Figure F – Line over duct lining with 1/16 fore rated plasterboard.

C3.12 Openings in Floors and Ceilings for Services

The penetrations through floors and walls required to achieve an FRL are to be protected with tested passive fire systems. It is recommended that a passive consultant carry out an audit of the penetrations for rectification where required and develop penetrations register for annual certification.

The laundry ventilation duct which passes through the bounding walls is to be wrapped across the corridor with fire rated wrap such as Promat Supawrap.

Exit signage to be reinstalled as to identify the available exits to the egressing occupants being installed in accordance with AS/NZS 2293.1-2018 and "OPEN INWARDS" signage shall be reinstated in accordance with G4.3 of the BCA.

D2.16 Barriers to Prevent Falls

The balustrade to the internal stairway does not comply. The existing balustrade allows for a 150mm sphere to pass through the opening between the rail and the floors thereby deviating from the DtS requirements of D2.16.

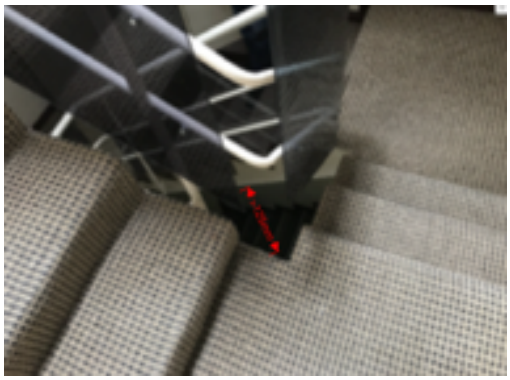


Figure I - Balustrade to Stair Incorporates Openings which allow for a 150mm Sphere to Pass Through.

D2.13 Stair construction
All stair treads are required to be provided contrast strip, 50mm wide and set back no more than 20mm from nosing in a colour contrasting to the tread by at least 30%.

Figure K – External Barriers to be Upgraded as to Comply with D2.16.

It is proposed to require the existing barriers to be upgraded to be in accordance with Table D2.16a Barrier Construction **(see Appendix C for Table D 2.16a)**

D2.21 Operation of Latch
The doors serving as required exits do not have lever handle latches and are not considered to be readily openable from the inside by a single hand downward action.

It is proposed that all existing doors within the evacuation route be fitted with lever type hand latches which are openable from the inside by a single hand downward action in accordance with D2.21.

E1.4 & G4.8 Fire Hose Reels
Fire hose reels have been installed throughout the building in accordance with past versions of the BCA. Notably, the fire hoses reels, in some instances, are not located within 4m of an exit. Notably, the current BCA does not require the installation of fire hose reels however, their installation does impact upon the occupant life safety within the building.

Decommission fire hose reels which are not located within 4m of exit doors. Replace subject fire hose reels with applicable portable fire extinguishers in accordance with AS 2444-2001.

E1.6 Portable Fire Extinguishers
Portable fire extinguishers must be provided as listed in Table E1.6. In this instance, the location of extinguishers is not in accordance with AS 2444-2001.

Existing and proposed portable fire extinguishers shall be installed, selected and located in accordance with AS 2444-2001, see figure below.

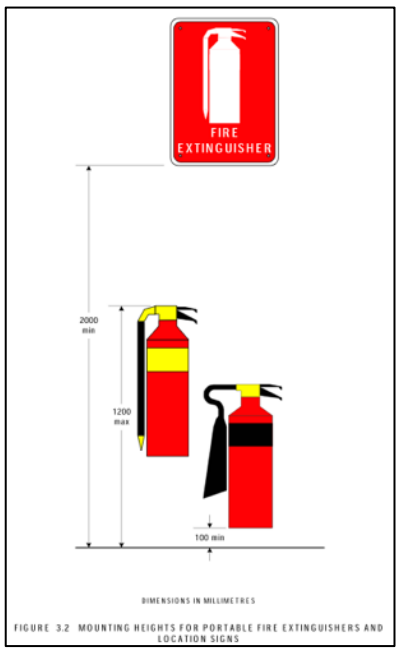


Figure L - Extract from AS 2444-2001 Figure 3.2 Mounting Heights for Portable Fire Extinguishers and Location Signs.

E2.2 & G4.8 Smoke Detection and Alarms
The building is currently fitted with a smoke detection system addition to the system will be required to ensure compliance with BCA Spec 2.2a.

Certification to be provided of required additions by a suitably qualified trades person.

E4.2 Emergency Lighting Requirements
Additional emergency lighting shall be provided to all external exits in accordance with AS/NZS 2293.1-2018. Shortfalls in compliance with AS/NZS 2293.1-2018 have been identified throughout the building. It is proposed to install emergency lighting throughout the building in accordance with AS/NZS 2293.1-2018.

It is proposed to increase floor to ceiling heights at the bulkhead by 50mm to achieve the required 2m in accordance with F3.1 of the BCA.

G4.3 External Doors
Existing external doors throughout the subject building which are subject to the building up of snow and open inwards shall be marked “OPEN INWARDS” on the inside face of the door in letters not less than 75mm high in a colour contrasting with the background.

It is proposed to install signage stating “OPEN INWARDS” on the inside face of the door in letters not less than 75mm high in a colour contrasting with the background.

G4.8 Fire-fighting Services and Equipment

The existing fire alarm system within the subject building shall be upgraded to comply with AS 1670.1-2018. Therefore, the existing alarm at the primary building entrance shall be upgraded to incorporate a strobe type visual alarm in accordance with AS 1670.1-2018.

G4.9 Fire Orders

The subject building has not been provisioned with Fire Orders in accordance with G4.9 of the BCA. Existing evacuation plans do not detail locations of PFEs and compliant FHRs. It is proposed to install Fire Orders in accordance with G4.9 of the BCA.

1.0 INTRODUCTION

J² Consulting Engineers have been commissioned to carry out a review of the fire safety provisions associated with the existing Attunga Ski Lodge located at Thredbo Ski Resort and to develop a master plan outlining the proposed strategies for upgrade to suit current legislative requirements as outlined in the BCA.

Whilst the current BCA was not legislated at the time that the existing development was approved and constructed, the compliance assessment undertaken has been undertaken against the BCA as it represents a community accepted level of life safety. As the building is existing however, there are limitations associated with what upgrades are possible to be undertaken and this report therefore also provides a fire engineering assessment of a number of elements in order to achieve compliance with the Performance Requirements of the BCA. The existing building is located within the Kosciusko National Park of NSW, see figure below.

Figure 5 - Attunga Ski Lodge Located within the Kosciuszko National Park.

1.1 Basis of the Report

This report is based upon the following:

- Site inspection undertaken 13 November 2019.
- Architectural drawings by LYCENKO & ASSOCIATES dated January 1986 as listed below.

Drawing title	Number	Date
Lower Ground and Basement	8552.02	Jan 1986
Plans	8552.02	Jan 1986
Sections / Elevation	8552.04	Jan 1986

1.2 Purpose of the Report

This report has been prepared to identify BCA non-compliance fire and life safety issues at the existing building, and to determine the optimum method of addressing each of these compliance issues through either a retrospective upgrade, Performance Solution or a combination of both.

The report also purports to outline the proposed upgrades and provide timelines for upgrade for the purposes of obtaining an agreed master plan with the relevant certifying and fire authorities moving forward.

1.3 Limitations of the Report

This report excludes any works not outlined above, however specifically excludes the following:

- Consideration of any structural elements or geotechnical matters relating to the building, including any structural or other assessment of the existing fire resistance levels of the building;
- This report does not provide concessions for any Performance Solution or exemptions from the requirements of the BCA, other than that identified in the Executive Summary of this report;
- Determining compliance with the Disability Discrimination Act 1992 or Part D3 of the BCA;
- Reporting on hazardous materials, OH&S matters or site contamination;
- Any energy efficiency assessment; however if necessary proposals can be obtained from suitably qualified and accredited assessors.
- Reimbursement of losses caused by business interruption.
- Protection of Property (other than directly adjoining property)
- Fires caused by arson (other than as a potential source of fire initiation) or terrorist attacks.
- Multiple ignition sources for fire initiation.
- Operational checks of the fire safety equipment unless specified in this report.

1.4 Assumptions of the Report

This report provides a Performance Solution for the Deemed-to-Satisfy deviations identified in the Executive Summary. The remainder of the building is assumed to comply with the Deemed-to-Satisfy Provisions of the BCA for the purpose of this report.

The report is provided on the basis that:

- The Performance Solution only applies to property detailed in Section 2.2.
- The Performance Solution is applicable to the design documentation provided for assessment and as listed in
- Section 1.1. Any future alteration, enlargement or addition will require re-assessment to determine the application of this solution to those changes.
- The Building will generally comply with the Deemed-to-Satisfy Provisions of the BCA, except where modified specifically by this report.

- It is assumed that the building will be subject to ongoing annual maintenance and the fire safety measures required by this report and the BCA will be maintained to a standard not less than their installation standard.

2.0 FIRE ENGINEERING BRIEF

The development of this report follows a consultative process with the client and is proposed to be provided to the Department of Planning for review and acceptance prior to implementation of the proposed fire and life safety upgrades. Given that the building is an existing building, a formal Fire Engineering Brief (FEB) has not been developed for this project. The basis of the solution was discussed with all stakeholders via a meeting.

2.1 Relevant Stakeholders

Stakeholder/Role	Name
Client	Craig Calder – Attunga Ski Lodge
Consent Authority	NSW Dept of Planning
Fire Engineer	J² Consulting Engineers – James Alexander

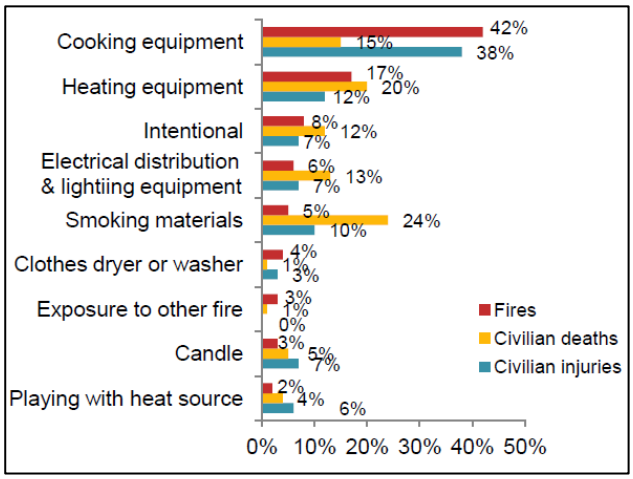
2.2 Building and Occupant Characteristics

General Building Characteristics

Building Characteristic	Description
Occupancy/Use Building Class/es: Rise in Storeys Type of construction: Effective Height:	Ski Club holiday accommodation Class 3 4 Type A Approximately 8.1m
Location: General description of development:	Attunga Ski Club – Thredbo Village - Kosciuszko National Park The existing development consists of a four-storey holiday ski lodge, containing 13 sole occupancy units (SOUs) with a communal lounge, dining, kitchen and games room. It is of masonry construction with concrete suspended slab floors and timber windows and doors. Al levels are connected by a central stair and additional exits direct to the outside are available on the lower ground floor levels. The walls bounding the SOUs and the main stair shaft are single skin masonry. The doors to the SOUs are solid core doors in non-fire rated metal frames. There is a small carpark consisting of 5 spaces on the western side of the lodge adjacent to Brindle Bull.

Occupant Characteristics

Occupant Characteristic	Description
Type and number	The lodge is licenced to sleep 26 persons. It is unlikely that the subject building will exceed this number.
Occupant state	Building occupants may be awake or asleep, intoxicated, sober or under the influence of other inhibiting substances consistent with community expectation.

Occupant Characteristic	Description
Physical and mental attributes	Occupants would generally be mobile given the nature of the building and surrounding access to the road; however some occupants may be of limited mobility. This is unlikely however given access to the lodge requires a person to descend uneven ground to the entry and stairs within the lodge to the sleeping accommodation, kitchen and dining areas. Children and mobility impaired persons are likely to be cared for by parents, relatives or friends. It is also expected that other mobile occupants or club members may be able to assist in the event of a fire.
Training and Roles	It is not expected that building occupants would be subject to any training specific to this building however once occupants have reached the door of their SOU, they are essentially in an open balcony with direct access to open space. Fire orders shall be posted on each level providing information relating the exits and fire safety systems.
Hazards	The primary fire hazards within the building would be consistent with those from typical residential dwellings given that the building is a Class 3, typically consisting of fires eventuating from cooking, electrical faults, heating equipment, saunas or smoking. Refer image below from the National Fire Protection Association in the USA (Ahrens 2011).  Figure 6 - Major Causes of US Home Structure Fires 2006-2010 (Ahrens 2011)

2.3 Hazards, Preventative and Protective Measures Available

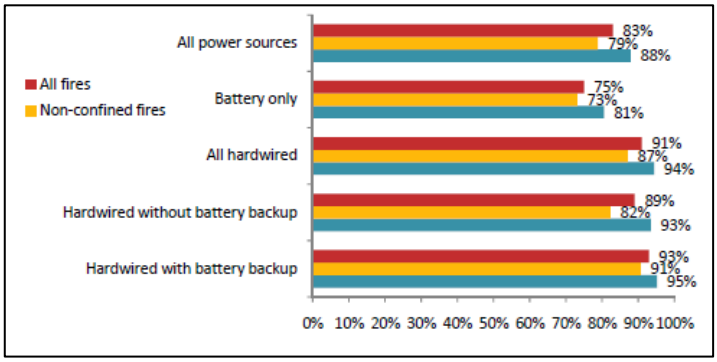
The following hazards have been identified.

Hazard	Details/Precaution
General Layout and Design	The subject building incorporates a partially fire-isolated stairway which connects all three storeys however, the installation of an FPAA101D sprinkler system and the provisions of exits which discharge directly to open space from the lower two levels offset this issue.
Activities	Information is not available to suggest that activities outside those normally undertaken in a similar building will be undertaken. The subject building provides self-care cooking, dining, sleeping and storage facilities to the occupants. It is expected that occupants of the building would be more familiar with their surroundings when compared to a standard Class 3 boarding house or hotel.

Hazard	Details/Precaution
Cooking	The lodge provides a large self-care kitchen, which present as a primary fire hazard to the subject building. However, the inclusion of FPAA101D sprinkler system throughout and the incorporation of portable fire extinguishers shall reduce the hazard.
Smoking	Smoking is strictly not permitted within the building.
Electrical Equipment	Failure of heating and other electrical equipment present as another primary hazard to the building. Clothing draped over heaters and near open fireplace also resent as an ignition source.
Multiple arson attack, malicious acts, and acts of terrorism.	The resulting impact of fires from these hazards has not been addressed in this report.

The hazards that are present in the building have been removed or reduced by six sub-systems of preventative and protective measures.

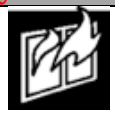
Sub-System	Present in Building/Requirements
A Fire initiation, development and control	Fire loads or heat release rates are not expected to be in excess of a typical Class 3 Ski Lodge building constructed at a similar time period. The proposal to install a FPAA101D sprinkler system shall provide a higher degree of control to any fire event originating within the building.
B Smoke development, spread and control	Smoke development and spread will not be inconsistent with that of a normal Class 3 Ski Lodge.
C Fire spread, impact and control	SOUs are provided with bounding construction which does not appear to achieve current BCA requirements but achieves a level equal to that required for a type B building. The intention behind the fire safety strategy is to ensure that occupants all evacuate simultaneously in the event of a fire through activation of the building occupant warning system designed to arouse sleeping occupants or warn those remote from a fire start elsewhere in the lodge..
D Fire detection, warning and suppression	The building will be provided with a sprinkler system in accordance with FPAA101D system and this will act to control and suppress and fire start. The building is provided with an AS1670.1 smoke detection and alarm system to provide occupant warning throughout the building configured to awake sleeping occupants. Little data is available on the reliability of smoke detectors however residential smoke alarms are considered to be reliable when they are properly maintained. Research indicates that the smoke alarm system has a reliability in the order of 93% for contained fires as per the figure below (Ahrens 2010). It is expected that the smoke detection system would have further increases in reliability.

Sub-System	Present in Building/Requirements
	 **Figure 7 - Smoke Alarm Operation in Reported Home Fires 2003-2006 (Ahrens 2010).**
E Occupant evacuation and control	The central stair connect all levels of the building and is contained in a masonry shaft which does achieve the required FRL. Exits are provided to open space from each level without the use of the main fire stair.
F Fire services intervention	The building is served by a retained fire brigade during the off-season and a full-time station at Thredbo during the ski season. The fire station is located within 1km of the building. Response times during winter are expected to be faster than a typical metropolitan or rural brigade response due to the close proximity of the fire station.  **Figure 8 - Attunga Ski Lodge 9km from Perisher Fire and Rescue Station.**

*International Fire Engineering Guidelines 2005 (IFEG)
Sub-system A – Fire Initiation and Development and Control
Sub-system B – Smoke Development and Spread and Control
Sub-system C – Fire Spread and Impact and Control
Sub-system D – Fire Detection, Warning and Suppression
Sub-system E – Occupant Evacuation and Control
Sub-system F – Fire Services Intervention

2.4 Directly relevant IFEG Sub-Systems

The directly relevant IFEG sub-system (SS) for this analysis are:

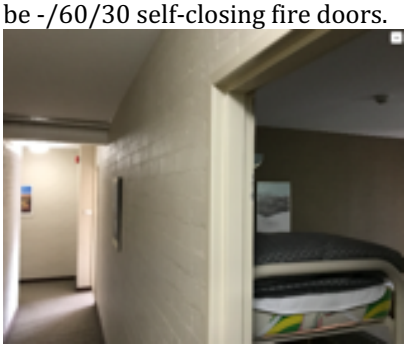
IFEG Sub-System	Description	Symbol
Sub-system C Fire Spread and Impact and Control	• Fire resistive barriers • Fire resistive structural elements • Fire resistive services • Exposure protection	
Sub-system D Fire Detection, Warning and Suppression	• Automatic detection equipment • Automatic warning equipment • Surveillance equipment • Automatic suppression equipment • Manual suppression equipment	
Sub-system E Occupant Evacuation and Control	• Evacuation plans • Egress signage • Egress routes (including fire isolated elements)	

3.0 BCA COMPLIANCE REVIEW

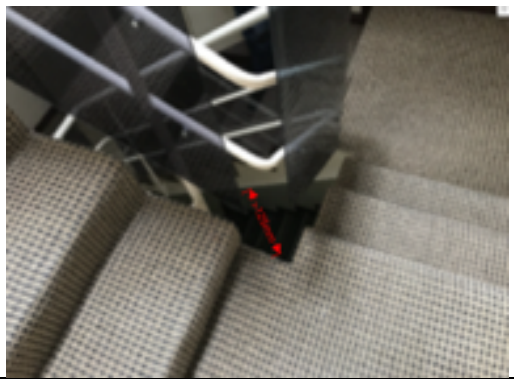
The following assessment against current BCA provisions has been undertaken with any non-compliances listed and the proposed strategy for upgrade noted.

Summary of Identified Issues of Non-Compliance to be Addressed

NO.	DTS CLAUSE	DESCRIPTION OF NON-COMPLIANCE	RECOMMENDATION
1.	C2.12	Separation of Equipment - Boiler Room access doors required to be self-closing and achieve FRL of --/120/30. 	Addressed via fire engineered solution 1 contained in this report
2.	C3.8	Openings in fire – isolated exits – door to stairs required to be self-closing -/60/30 fire doors. 	Addressed via fire engineered solution 1 contained in this report

NO.	DTS CLAUSE	DESCRIPTION OF NON-COMPLIANCE	RECOMMENDATION
3.	C3.11	SOU entry doors in Type A construction required to be -/60/30 self-closing fire doors.  Window to games room requires protection in accordance with C3.11(g) and C3.4 because in path of travel from an exit. 	Addressed via fire engineered solution 1 contained in this report.
4.	C3.13	Access panels to service shafts to achieve FRL -/60/30. 	The access panel is to be lined over the existing with 1/16 thick layer of fire rated plasterboard.
5.	C3.15	Laundry ventilation duct penetrating through walls and spanning corridor. 	The duct is to be wrapped with a fire rated wrap such as Promat Supawrap or boxed in with 1/16 thick fire rated plasterboard.

NO.	DTS CLAUSE	DESCRIPTION OF NON-COMPLIANCE	RECOMMENDATION
6.	Spec C1.1 Clause 3.6	Roof lights within adjacent SOUS are within 3m of each other. 	Addressed via fire engineered solution 1 contained in this report.
7.	Spec C1.1 Table 3	Walls bounding SOU's required to achieve FRL of 90/90/90 – existing masonry walls do not comply. 	Addressed via fire engineered solution 1 contained in this report.
8.	D1.2	Basement level does not have two compliant required exits.	Addressed via fire engineered solution 2 contained in this report.
9.	D1.3	The main internal stair is required to be fire isolated – does not comply because it does not discharge to open space and is not fitted with fire doors as noted above and contains combustible elements.	Addressed via fire engineered solution 2 contained in this report.
	D2.4	The main internal stair shaft contains rising and descending stair flights without suitable smoke separation	Addressed via fire engineered solution 2 contained in this report.
10.	D2.7	Exhaust duct discharging to exit path of travel from basement. 	Addressed via fire engineered solution 2 contained in this report.

NO.	DTS CLAUSE	DESCRIPTION OF NON-COMPLIANCE	RECOMMENDATION
11.	D2.13	Goings to front entry stairs exceed BCA requirements. Stair riser at front door not compliant and internal stairs require nonslip nosing's. 	Install nonslip nosing's to internal stairs and obtain a fire engineered solution to address other non-compliances.
12.	D2.16	Gaps in internal balustrade greater than 125mm. 	Reduce gaps in balustrades. External balustrade to have any gaps in excess of 125mm removed. Any climbable areas between 150mm and 760mm AFFL removed where fall height is greater than 4m from deck level.

NO.	DTS CLAUSE	DESCRIPTION OF NON-COMPLIANCE	RECOMMENDATION
13.	D2.17	Handrails required to basement egress stair, southern egress stair and western entry stairs.	Install handrails in accordance with D2.17

NO.	DTS CLAUSE	DESCRIPTION OF NON-COMPLIANCE	RECOMMENDATION
14.	D2.21	Lever handles to be installed in accordance with D2.21 to doors serving as required exits or in required exit path. 	Install compliant lever handle latches
17.	E1.5	The class 3 building has a rise in stories of four and as such is required to be fitted with a sprinkler system throughout.	Install sprinklers or obtain a fire engineered solution to address non-compliance.
18.	G1.2	Refrigerator chamber requires indictor lamp positioned outside the chamber which is illuminated when the interior light is switched on.	Install indicator lamp
19.	G4.3	External doors required to open inwards and display open inward signage.	Re swing doors and add required signage or obtain a fire engineered solution to address non-compliance.
20.	G4.6	Main entry door and basement egress discharge to areas that could entrap snow.	Obtain a fire engineered solution to address non-compliance.

4.0 PERFORMANCE SOLUTION 1 – FIRE RESISTANCE

It is proposed to develop a Performance Solution to permit the following non-compliances:

- To permit the doors serving the SOUs to be solid core doors and not -/60/30 fire doors.
- To permit the doors opening into the main stair shaft to be solid core doors and not -/60/30 fire doors.
- To permit the walls separating the SOUs/corridors to be 60/60/60 in lieu of 90/90/90 required for type A construction.
- To permit the walls separating the stair shaft to be 60/60/60 in lieu of 90/90/90 required for type A construction.
- To permit roof lights in SOUs to be located within 3m of each other.

4.1 Deemed-to-Satisfy Non-compliance

Pursuant to A2.2(1) of BCA the following DTS provisions have been identified as being subject to the Performance Solution:

Specification C1.1 Table 3 Type A Construction: FRL of Building Elements

Table 3 Spec C1.1	**Fire Resistance Level Type A**		**Comments**
Building Element	Class 2, 3 & 4 parts	Class 7b or 8	
EXTERNAL WALL (distance to fire source feature)			
For loadbearing parts-			
Less than 1.5m	90/90/90	NA	NA
1.5 to less than 3m	90/60/30	NA	NA
3m or more	90/60/30	NA	✓
For non-loadbearing parts -			
Less than 1.5m	-/90/90	NA	NA
1.5 to less than 3m	-/60/60	NA	NA
3m or more	-/-/-	NA	✓
EXTERNAL COLUMN (not incorporated in external wall)			
For loadbearing columns	90/-/-	NA	✓
For non-loadbearing column	-/-/-	NA	✓
COMMON WALLS & FIRE WALLS	90/90/90	NA	NA No fire walls
INTERNAL WALLS			
Fire resisting lift and stair shafts			
Load bearing	90/90/90	NA	X – likely 60/60/60 achieved
Non-loadbearing	-/90/90	NA	
Internal walls bounding public corridors and the like:			
Loadbearing	90/90/90	NA	X - Likely 60/60/60 achieved
Non-loadbearing	-/90/90	NA	
Between or bounding sole occupancy units			
Loadbearing	90/90/90	NA	X - Likely 60/60/60 achieved
Non-loadbearing	-/60/60	NA	
FLOORS	90/90/90	NA	Likely to comply ✓
ROOF	90/60/30	NA	✓ - Clause 3.5

4.2 Relevant Performance Requirements

Pursuant to A2.4(3)(b) of BCA the following Performance Requirements have been identified as being directly relevant to the DTS provisions identified above:

CP1 Structural stability during a fire

A building must have elements which will, to the degree necessary, maintain structural stability during a fire appropriate to-

(a) the function or use of the building; and
(b) the fire load; and
(c) the potential fire intensity; and
(d) the fire hazard; and
(e) the height of the building; and
(f) its proximity to other property; and
(g) any active fire safety systems installed in the building; and
(h) the size of any fire compartment; and
(i) fire brigade intervention; and
(j) other elements they support; and
(k) the evacuation time

CP2 Spread of fire

(a) A building must have elements which will, to the degree necessary, avoid the spread of fire—
  (i) to exits; and
  (ii) to sole-occupancy units and public corridors; and
  (iii) between buildings; and
  (iv) in a building.
(b) Avoidance of the spread of fire referred to in (a) must be appropriate to—
  (i) the function or use of the building; and
  (ii) the fire load; and
  (iii) the potential fire intensity; and
  (iv) the fire hazard; and
  (v) the number of storeys in the building; and
  (vi) its proximity to other property; and
  (vii) any active fire safety systems installed in the building; and
  (viii) the size of any fire compartment; and
  (ix) fire brigade intervention; and
  (x) other elements they support; and
  (xi) the evacuation time.

CP4 Safe conditions for evacuation

To maintain tenable conditions during occupant evacuation, a material and an assembly must, to the degree necessary, resist the spread of fire and limit the generation of smoke and heat, and any toxic gases likely to be produced, appropriate to-

(a) the evacuation time; and
(b) the number, mobility and other characteristics of occupants; and
(c) the function or use of the building; and
(d) any active fire safety systems installed in the building.

4.3 Assessment Methodology

In order to address the provisions of the BCA, a qualitative, deterministic and absolute assessment will be undertaken to determine compliance with the relevant Performance Requirements CP1, CP2 and CP4. The assessment will discuss each of the proposed deviations in detail to determine whether or not the proposed trial design is capable of satisfying the relevant Performance Requirements CP1, CP2 and CP4.

4.4 Acceptance Criteria

It must be demonstrated that the proposed trial design reduces the potential for;

- fire spread within the building;
- the impact of a fire on the structure; and
- the impact of fire on the tenability of paths of travel to exits,

to a level considered acceptable to satisfy the relevant Performance Requirements CP1, CP2 and CP4.

4.5 Qualitative Assessment

Performance requirements CP1 and CP2 are generally related to ensuring that a building has appropriate elements, to the degree necessary, to restrict the spread of fire within the building and to prevent progressive collapse due to the failure of structural elements.

With respect to the use of the term "to the degree necessary" in Performance Requirements CP1 and CP2 the Guide to the BCA states the following:

CP1 and CP2 use the term "to the degree necessary". This word usage is designed to provide flexibility in the way this provision is implemented. The intended meaning of the term "to the degree necessary" in CP1 and other Performance Requirements, is explained in A1.7.

It means that the BCA recognises that different building elements require differing degrees of structural stability during a fire. The expression is intended to allow the appropriate authority to determine the degree of compliance necessary in each particular case.

Any decision made in this context can extend to not requiring an item to be installed or a particular level of performance to be achieved, if that is the appropriate action to be taken.

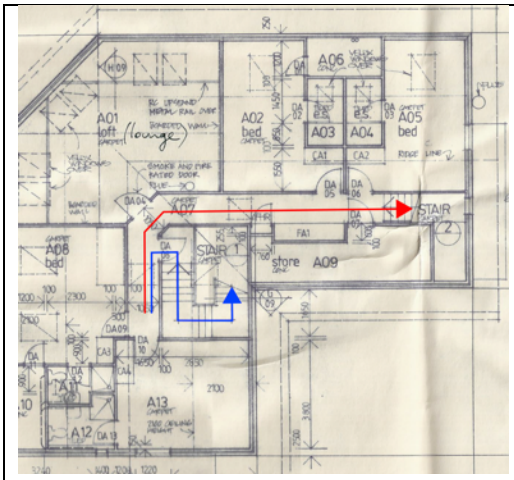
The structure of the building is masonry and concrete and hence is largely type A compliant. As opposed to a timber framed building, a fire within the building would not cause progress collapse of external and internal load bearing walls. Similarly the floors would not combust rapidly and collapse in dragging the external and internal walls down with it. This is the intent of Type A construction, that a building will maintain structural adequacy during a fire event such that it does not collapse before evacuation and brigade search and rescue can take place and such that it does not collapse onto the neighbouring buildings or attending firefighting personnel.

The fire resisting construction requirements of Type A construction are the same for a three storey class 3 ski lodge as they are for a 70 storey hotel in Sydney. Obviously the time taken to evacuate a 70 storey hotel would be considerably longer than for a three storey ski lodge and hence the concept of "to the degree necessary" can be applied. For example load bearing walls separating hotel rooms in the 70 storey building are required to resist the spread of fire for 90 minutes. This is a result of the potential fire load within a major hotel and the time taken to evacuate and carry out search and rescue operations. The time taken to evacuate from Attunga Lodge would be significantly less and the fire load contained in the small sole occupancy units (SOUs) is also considerably less. In other words, a smaller fire and less distance to open space can permit a reduction in fire resistance to the degree necessary.

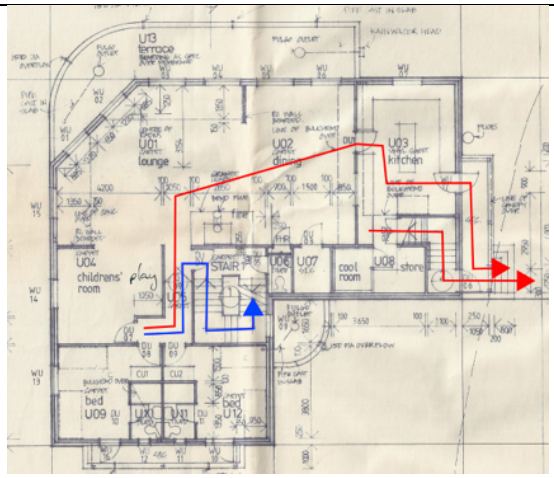
The walls separating the SOUs are single ski masonry. This typically achieves an FRL of 60/60/60 and may indeed even achieve 90/90/90 depending upon the load sustained and the height of the wall. Assuming a conservative assessment that 60/60/60 is achieved the walls achieve less than the DTS requirement for 90/90/90. Using the logic proposed above, can an FRL be considered sufficient or to the degree necessary in the existing lodge and therefore satisfy the relevant Performance Requirement in their current arrangement. Similarly can the doors to the SOUs be solid core doors in lieu of fire doors and can the fire stair be downgraded to an FRL of 60/60/60 and be similarly served by solid core doors in steel frames. The following is an assessment of this downgrade to determine compliance with the relevant Performance Requirements CP1 and CP2.

Attunga Ski Lodge is a four storey building but because it is constructed on a slope the lower ground floor level is below the level at which general access and egress to the building can occur. In fact the majority of the sole occupancy units are located one floor above the level at which access and egress occurs, at Jack Adams Path as shown in the below detail. The two lower ground floors have direct egress to open space or can enter the man fire stair to exit the building. The occupants of the upper level SOUs are not required to move down four floors to evacuate, instead they can be in open space by moving down one level.

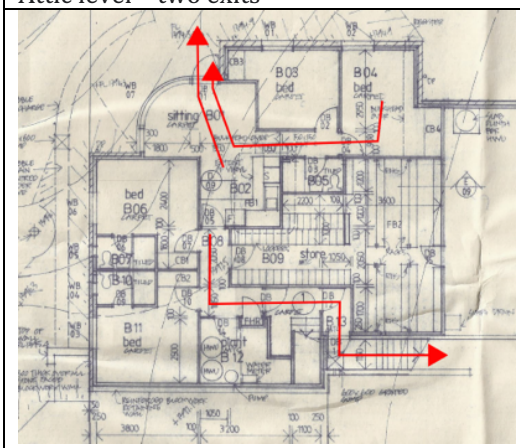
Figure 9 - whilst four storeys on one facade the building can be compared to a two storey building.



Attic level – two exits



Ground level – multiple exits



Basement level – two exits

Lower ground floor – two exits.

A two storey ski lodge with basement levels is required to be of type B or C construction. Each of which require the walls bounding SOUs and fire stairs to achieve an FRL. Furthermore type B and C construction require doors to SOUs to be solid core doors and not fire doors. This reduction is due to the likely reduced fire load in a smaller class 3 building and the reduced time taken to move down one level to reach open.

Egress from the upper levels can also be provided via stairs which are not fire separated from the level at which egress occurs. Occupants are potentially required to egress though a ground floor which is fire affected. Occupants of Attunga are provided with two egress options from the attic level, both of which provide egress to open space without the requirement to pass through a fire on the ground level. This will be further expanded upon in Performance Solution 2, but it is clear that the arrangement can be reasonably compared to egressing from a two storey ski lodge subject to Type B and C and hence the fire resistance levels provided via the single skin masonry walls serving the fire stair, the SOUs and the corridors is considered to provide an adequate level of protection against fire spread internally. Furthermore the solid core doors serving the SOUs with metal jambs will also provide sufficient protection via comparison to Type B and C.

It is also proposed as part of the strategy to provide smoke seals to the door jambs to restrict the spread of smoke from the SOU of fire origin to the corridors, exits and internal stair. Research undertaken by Lorient indicated that solid core doors provided with smoke seals are capable of reducing smoke spread by a factor of between 19 and 35 (Rakic). This effectively ensures that toxicity, temperature, and smoke concentration within the corridors is significantly reduced when compared to a DTS scenario.

Roof lights
Clause 3.6 of Spec C1.1 requires roof lights to be located not less than 3m from each other when they are serving separate SOU. The roof lights to the attic level SOUs are located within 3m of each other without protection. This issue relates more to asset protection in this case than fire safety of the occupants because it would require a fire in flashover to burn out the roof light and spread down into the adjacent roof light. It is reasonable to assume that given the building is fitted with a compliant smoke detection and alarm system, the neighbouring SOU occupants will be aware of the fire start and able to evacuate well before flashover develops. It is also assumed that the proposed sprinkler system will prevent flashover occurring and therefore fire spread between roof lights will not occur.

Sprinkler Protection
It also proposed to install a residential sprinkler system throughout all levels in accordance with AS2118.4-2012. The reliability (refer Appendix A) of sprinkler systems and ability to control and/or extinguish a fire in its early growth stage will offset against the potential for fire spread throughout the building associated with the non-compliant fire resistance levels to the external walls.

Fire & Rescue NSW have undertaken research into the suitability of the FPAA101D sprinkler system in residential type building with results focusing upon temperature and toxicity. The results of the fire tests indicated that the peak temperature achieved was 372°C, which is well below the lower temperature range, being 500°C, for flashover conditions to occur and that in most cases the operation of only two sprinkler heads was sufficient to prevent the fire event from spreading from the point of origin (F&R NSW, 2017). Considering the above, a fire event contained within the sprinkler protected part of the building would not achieve flashover and the fire event would be isolated to its origin or may be extinguished.

It is therefore considered that the deviations from the DtS provisions of the BCA have been adequately addressed to satisfy the relevant Performance Requirements CP1, CP2 and CP4.

4.6 Assessment against relevant Performance Requirement

The following is an assessment of the relevant Performance Requirement CP1, CP2 and CP4.

CP1 Structural Stability During a Fire & CP2 Spread of Fire	
(a) A building must have elements which will, to the degree necessary, avoid the spread of fire -	
(i) to exits; and	Occupants with each level of the building have access to at least 2 exits at all time. Should the additional measures proposed within the assessment be installed it is expected that at least 1 of these exits shall remain tenable for the period required for occupants to egress from the building.
(ii) to sole occupancy units and public corridors; and	The existing fire-resistant construction to SOUs and public corridors is sufficient to prevent the spread of fire between these areas given it will provide 60 minutes.
(iii) between buildings; and	Given the distance between adjoining properties fire spread between buildings shall not occur.
(iv) in a building.	The installation of either the FPAA101D sprinkler system and the inherent fire resistance levels of the bounding walls shall ensure that a fire cannot readily spread throughout the subject building.
(b) Avoidance of the spread of fire referred to in (a) must be appropriate to the following and a building must have elements which will, to the degree necessary, maintain structural stability during a fire appropriate to-	
(i) the function and use of the building; and	The subject building is deemed to be a typical Class 3 ski lodge building.
(ii) the fire load; and	The fire load contained within the subject building is considered to be typical of a Class 3 ski lodge building.
(iii) the potential fire intensity; and	The fire intensity within the subject building is considered to not differ from a typical Class 3 ski lodge building.
(iv) the fire hazard; and	The expected fire hazard within the subject building does not differ from a typical Class 3 ski lodge building.
(v) the number of storeys in the building; and	The subject building has a rise in storeys of 3 with a minimum of 2 exits available from each storey.
(vi) its proximity to other property; and	The subject building is located 21m from the nearest building resulting in fire spread being unlikely to occur.
(vii) any active fire safety systems installed in the building; and	The buildings fire safety systems will comply with the DTS provisions. Installation of the AS 1670.1 monitored smoke detection system and the proposed 101D sprinkler system is DTS compliant with BCA 2019+1.
(viii) the size of the fire compartment; and	The fire compartment size does not differ from a DTS arrangement.
(ix) fire brigade intervention; and	The provision of a smoke detection system with detectors spaced in accordance with AS1670.1 throughout all areas ensure early notification to occupants and the ability of the installed sprinkler system ensures occupants time to safely evacuate and the fire to be suppressed / controlled until the local fire brigade arrives. The system is monitored via a fire alarm communication link ensuring an early response to a fire start. All levels of the building shall be in reach of a F&R NSW aerial appliance.
(x) other elements they support; and	The masonry construction will provide adequate structural adequacy in a fire event equal to Type B and where the sprinkler system activates it will not fail.
(xi) the evacuation time.	The proposed sprinkler system install throughout the build will assist in suppressing any fire flashover area ensuring structural adequacy of the building enabling safe evacuation of all occupants. Further this, the

CP1 Structural Stability During a Fire & CP2 Spread of Fire	
	proposed upgrade with a full AS1670.1 smoke detection system throughout will ensure all occupants of the building are notified simultaneously in the event of a fire alarm.

CP4 Safe Conditions for Evacuation	
To maintain tenable conditions during occupant evacuation, a material and an assembly must, to the degree necessary, resist the spread of fire and limit the generation of smoke and heat, and any toxic gases likely to be produced, appropriate to—	
(a) the evacuation time; and	The proposed additional fire safety measures shall ensure that a fire event shall not spread beyond the storey of origin for the period occupants take to egress from the building.
(b) the number, mobility and other characteristics of occupants; and	It is expected that occupants within the building will generally be able to care for themselves. Should assistance be required it is likely that fellow occupants shall render assistance and any available staff shall direct occupants. The use as a 26 bed club lodge assumes occupants will be familiar with the exit pertain to their SOU. Any guests are expected to be either accompanied or will follow exit and evacuation signage as appropriate.
(c) the function or use of the building; and	The subject building is considered to be typical of a Class3 ski lodge building.
(d) any active fire safety systems installed in the building.	The buildings fire safety systems will comply with the DTS provisions. Installation of the AS 1670.1 monitored smoke detection system and the proposed 101D sprinkler system is DTS compliant with BCA 2019+1.

4.7 Assessment Conclusion

The above assessment demonstrates qualitative analysis that the trial design proposed satisfies the relevant performance requirements CP1, CP2 and CP4 subject to the additional fire safety measures proposed below:

1. The installation of a FPAA 101D compliant sprinkler system throughout the building.
2. The three sides of the door jambs serving the sole occupancy units are to be provided with medium temperature smoke seals capable of restricting smoke up to 200^{o}C for thirty minutes.

5.0 PERFORMANCE SOLUTION 2 – ACCESS AND EGRESS

It is proposed to develop a Performance Solution to permit the following non-compliances:

- Permit a fire stair to serve four levels of a building but not discharge directly to open space and past unprotected openings. The fire resisting non-compliances associated with the stair have been addressed in Performance Solution One.
- Permit and rising and descending stair to be contained in the same shaft.
- Permit a basement level to be served by a single exit.
- Permit a reduced path of travel to an exit.
- Permit stairs to have non-compliant rise and run dimensions.

5.1 Deemed-to-Satisfy Non-compliance

Pursuant to A2.2(3) of BCA the following DTS provisions have been identified as being subject to the Performance Solution:

D1.2 Number of Exits Required
Class 2-9 Building

(c) Basements — In addition to any horizontal exit, not less than 2 exits must be provided from any storey if egress from that storey involves a vertical rise within the building of more than 1.5 m, unless—

(i) the floor area of the storey is not more than 50 m^2; and
(ii) the distance of travel from any point on the floor to a single exit is not more than 20 m

D1.3 When fire-isolated stairways and ramps are required

(a) Class 2 and 3 buildings – Every stairway or ramp serving as a required exit must be fire-isolated unless it connects, passes through or passes by not more than-

(i) 3 consecutive storeys in a Class 2 building; or
(ii) 2 consecutive storeys in a Class 3 building,
And one extra storey of any classification may be included if-
(iii) It is only for accommodation of motor vehicles of for other ancillary purposes; or
(iv) The building has a sprinkler system (other than a FPAA101D system) complying with Specification E1.5 installed throughout;
(v) The required exit does not provide access to or egress for, and is separated from, the extra storey by construction having-
(A) An FRL of -/60/60, if non-loadbearing; and
(B) An FRL of 90/90/90, if loadbearing; and
(C) No opening that could permit the passage of fire or smoke.

D1.6 Dimensions of exits and paths of travels to exits

In a required exit or path of travel to an exit-

(a) The unobstructed height throughout must be not less than 2m, except the unobstructed height of any doorway may be reduced to not less than 1980mm; and
(b) The unobstructed width of each exit or path of travel to an exit, except doorways, must be not less than-
(i) 1m; or
(ii) 1.8m in a passageway, corridor or ramp normally used for the transportation of patients in beds within a treatment area or ward area: and
(iii) In a public corridor in a Class 9c aged care building, notwithstanding (c) and (d)-
(A) 1.5m; and
(B) 1.8m for the full width of the doorway, providing access into a sole-occupancy unit or communal bathroom;

D1.7 Travel via fire-isolated exits
Guide

(a) A doorway from a room must not open directly into a stairway, passageway or ramp that is required

to be fire-isolated unless it is from—

(i) a public corridor, public lobby or the like; or

(ii) a sole-occupancy unit occupying all of a storey; or

(iii) a sanitary compartment, airlock or the like.

(b) Each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway—

(i) to a road or open space; or

(ii) to a point—

(A) in a storey or space, within the confines of the building, that is used only for pedestrian movement, car parking or the like and is open for at least 2/3 of its perimeter; and

(B) from which an unimpeded path of travel, not further than 20 m, is available to a road or open space; or

(iii) into a covered area that—

(A) adjoins a road or open space; and

(B) is open for at least 1/3 of its perimeter; and

(C) has an unobstructed clear height throughout, including the perimeter openings, of not less than 3 m; and

(D) provides an unimpeded path of travel from the point of discharge to the road or open space of not more than 6 m.

D2.14 Separation of rising and descending stairs

If a stairway serving as an exit is required to be fire-isolated—

(a) there must be no direct connection between—

(i) a flight rising from a storey below the lowest level of access to a road or open space; and

(ii) a flight descending from a storey above that level; and

(b) any construction that separates or is common to the rising and descending flights must be—

(i) non-combustible; and

(ii) smoke proof in accordance with Clause 2 of Specification C2.5.

D2.13 Goings and risers

(a) A stairway must have—

(i) not more than 18 and not less than 2 risers in each flight; and

(ii) going (G), riser (R) and quantity (2R + G) in accordance with Table D2.13, except as permitted by (b) and (c); and

(iii) constant goings and risers throughout each flight, except as permitted by (b) and (c), and the dimensions of goings (G) and risers (R) in accordance with (a)(ii) are considered constant if the variation between—

(A) adjacent risers, or between adjacent goings, is no greater than 5 mm; and

(B) the largest and smallest riser within a flight, or the largest and smallest going within a flight, does not exceed 10 mm; and

(iv) risers which do not have any openings that would allow a 125 mm sphere to pass through between the treads; and

(v) treads which have—

(A) a surface with a slip-resistance classification not less than that listed in Table D2.14 when tested in accordance with AS 4586; or

(B) a nosing strip with a slip-resistance classification not less than that listed in Table D2.14 when tested in accordance with AS 4586; and

(vi) treads of solid construction (not mesh or other perforated material) if the stairway is more than 10 m high or connects more than 3 storeys; and

(vii) in a Class 9b building, not more than 36 risers in consecutive flights without a change in direction of at least 30°; and

(viii) in the case of a required stairway, no winders in lieu of a landing.

5.2 Relevant Performance Requirements

Pursuant to A2.4(3)(b) of BCA the following Performance Requirements have been identified as being directly relevant to the DTS provisions identified above:

DP2 Safe movement to and within a building
So that people can move safely to and within a building, it must have—
(a) walking surfaces with safe gradients; and
(b) any doors installed to avoid the risk of occupants—
(i) having their egress impeded; or
(ii) being trapped in the building; and
(c) any stairways and ramps with—
(i) slip-resistant walking surfaces on—
(A) ramps; and
(B) stairway treads or near the edge of the nosing; and
(ii) suitable handrails where necessary to assist and provide stability to people using the stairway or ramp; and
(iii) suitable landings to avoid undue fatigue; and
(iv) landings where a door opens from or onto the stairway or ramp so that the door does not create an obstruction; and
(v) in the case of a stairway, suitable safe passage in relation to the nature, volume and frequency of likely usage

DP4 Exits
Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to—
(a) the travel distance; and
(b) the number, mobility and other characteristics of occupants; and
(c) the function or use of the building; and
(d) the height of the building; and
(e) whether the exit is from above or below ground level.

DP5 Fire-isolated exits
To protect evacuating occupants from a fire in the building exits must be fire-isolated, to the degree necessary, appropriate to—
(a) the number of storeys connected by the exits; and
(b) the fire safety system installed in the building; and
(c) the function or use of the building; and
(d) the number of storeys passed through by the exits; and
(e) fire brigade intervention.

DP6 Paths of travel to exits
So that occupants can safely evacuate the building, paths of travel to exits must have dimensions appropriate to—
(a) the number, mobility and other characteristics of occupants; and
(b) the function or use of the building

5.3 Assessment Methodology

In order to address the provisions of the BCA, a qualitative, deterministic and absolute assessment will be undertaken to determine compliance with the relevant Performance Requirements DP2, DP4, DP5 and DP6. The assessment will discuss each of the proposed deviations in detail to determine whether or not the proposed trial design is capable of satisfying the relevant Performance Requirements DP2, DP4, DP5 and DP6.

5.4 Acceptance Criteria

It must be demonstrated that the proposed trial design is better than or at least equivalent to the DtS compliant building in that;

- occupants seeking to egress from the building are able to reach the discharge point without passing through or past untenable conditions within an exit or path of travel to an exit;
- the reduced exit width is sufficient to facilitate egress for the occupant type and density within the building; and
- use of stairs will not be detrimentally impacted.

Should the above be demonstrated it is considered that the proposed Trial Designs shall satisfy the relevant Performance Requirements DP2, DP4, DP5 and DP6.

5.5 Qualitative Assessment

Performance Requirements DP2, DP4, DP5 and DP6 are generally related to ensuring that a building has appropriate elements to ensure that occupants within the building can move in conditions which are deemed safe whether that be in day-to-day tasks or egressing from the building during an emergency.

Non-fire Isolated Stairway
The subject building consists of a four-storey ski lodge containing Class 3 residential areas. The building contains one fire isolated stairway which whilst not possessing the required fire resistance levels as set down in Table 3 of Spec C1.1 (addressed via PS1) provides a level of protection or isolation from the residential portions of the building. The. Main issues with the stair are:

- It does not discharge to open space. It discharges within the building on the lower ground floor level,
- It contains rising and descending flights, i.e. it acts as an exit for egress from the basement level by ascending to the lower ground level to discharge and to serve the attic level and ground floor level by descending flights to this level.

D1.3 of the BCA specifies that every stairway serving as a required exit must be fire-isolated unless it connects 2 consecutive storeys in a Class 3 building and one extra storey of any classification may be included if it is only for the accommodation of motor vehicles or for other ancillary purposes associated with the accommodation of motor vehicles; or the building is served by a sprinkler system, other than a FPAA101D system, complying with Specification E1.5 installed throughout.

The existing arrangement does not satisfy the requirements of D1.3 of the BCA in that it connects four levels. The above Performance Solutions indicate the incorporation of a FPAA101D sprinkler system which D1.3 specifically notes as being insufficient to allow the concession to apply. The Performance Solution shall justify the use of the FPAA101D system to the degree necessary to allow the concession granted by D1.3 to be applicable.

The intention of D1.3 is *to indicate when fire-isolated stairways and ramps are required to enable safe egress in case of a fire*. The omission of fire-isolated exits impact upon the ability of the building occupants to evacuate safely passed the fire affected storey, the attending fire brigade to carry out operations such as search and rescue and firefighting, and the distance occupants must travel in a fire affected area before they are able to access a “safe place” or discharge from the exit to open space. Considering this, the separation of the occupants and fire brigade from the fire affected part of the building is paramount to ensuring a satisfactory degree of occupant life safety.

The current arrangement requires a person to move through the change room area, then the entry foyer before exiting under the overhang the building to open space. This does not comply with D1.7 which requires a fire stair to discharge into an area not affected by fire from within the building. If a fire is burning on the lower ground floor it may not be possible to pass through the change room and foyer areas to evacuate.

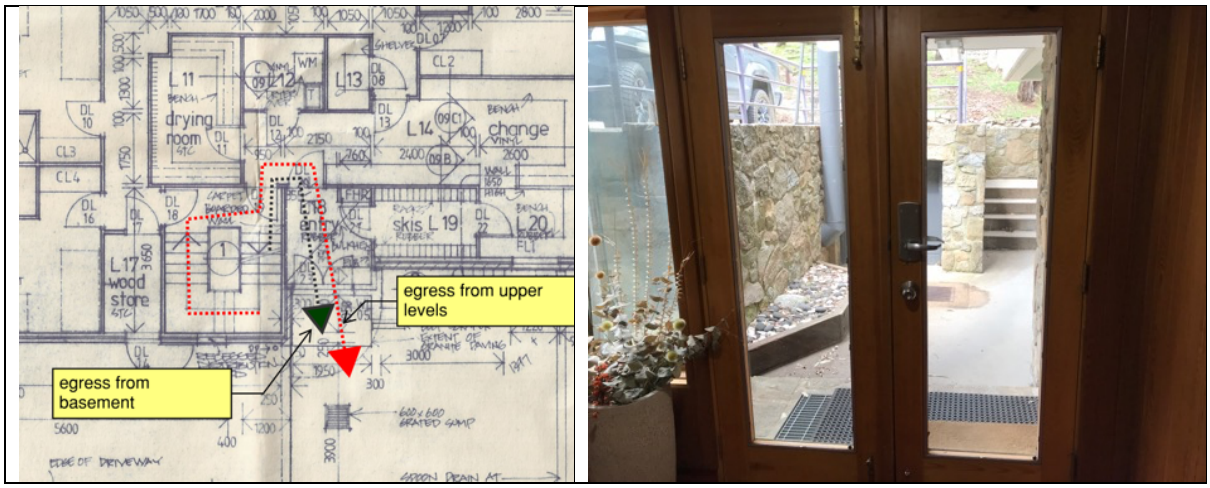


Figure 10 - egress at lower ground floor level requires a person to move through change/entry areas.

The stair does however provide an alternative exit via the basement level whereby a person could descend to the basement level and discharge to open space via the external stair. The trial design proposes the installation of a vision panel to the door between the stair and change room to enable a person ascending the fir stair to view conditions in the change room before entering and where not safe, continue down to the alternative exit on the basement level. The trail design will also require a sign at this door to provide instruction regarding the alternative exit. Alternative exits are also available from the upper two levels should a person decide to move back up the stair to egress the building.

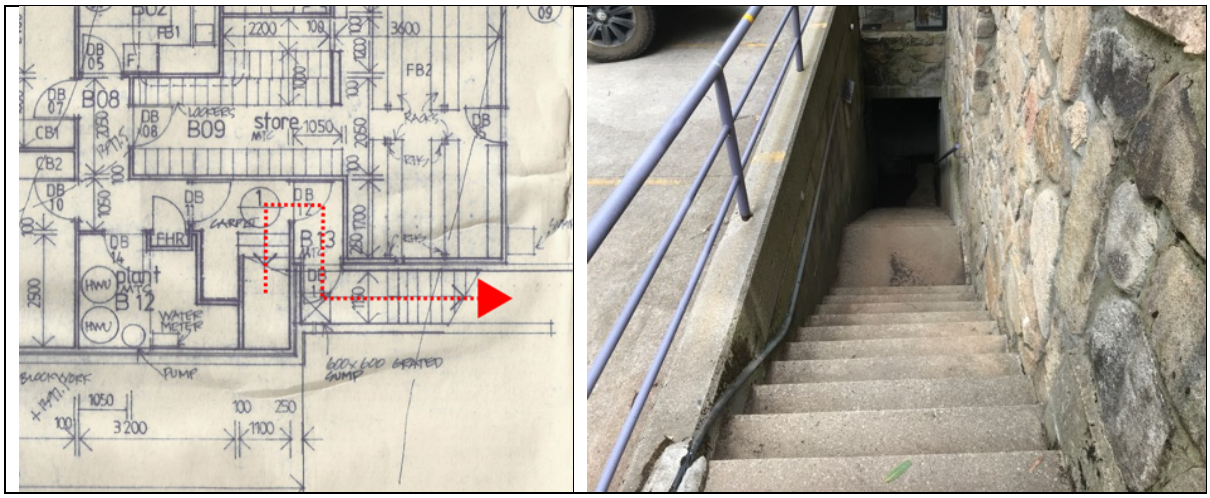


Figure 11 - egress from basement level directly to external stair provides an alternative exit option.

The concrete floors separating levels within the building will restrict fire spread between levels in the building and the sprinkler system proposed shall further prevent fire spread making it possible to move to a level where the fire start has not occurred to egress the building.

The stair which rises up from the basement is potentially subject to the affects a flashover fire on the lower ground floor level via the window to the ski tuning room. It is therefore proposed to add drencher protection to the window to this and ensure it is fixed closed or fixed glass.

In support of this, D1.7 permits windows within 6m of a path of travel from the discharge of a fire isolated stair to open space to remain where protected with a drencher internally installed in accordance with C3.4.

Rising and descending stair

Whilst the stair does contain rising and descending flights to discharge at the lower ground level, an option exists for occupants of the basement level to move through the base of the fire stair and egress via the side stair. This is the preferred method of egress exit signs are to indicate this. The manner in which access to

this exit is achieved is to enter the base of the fire stair and then exit to the rising external stair. This may cause smoke to enter the stair at the basement level making the stair conditions untenable. Where smoke enters the stair on the basement level it will rise up and potentially render the stair untenable where the door is kept open .This typically occurs where a fire stair serves a basement carpark and the brigade us the stair to access the carpark to fight the fire. The hoses will keep the door to the fire stair open allowing smoke spread into the stair.

In this case access to the basement level is possible through the managers unit which has direct egress to open space. Hoses can be taken into the basement level through this unit and therefore they will not hold open the door to the stair. The door to the stair is also to be provide with smoke seals and to further prevent smoke ingress to the stair. The doors to the stair on each level are also to be provided with vision panels to allow occupants to see conditions in the stair shaft prior to entering. Where not safe an option from each level exists to exit via an alternative exit.

The same approach applies to the discharge from the basement past an exhaust duct griller. Where the products of combustion are emitted from the grille and entering the external stair, it will be obvious to the user and allow them to re-enter the fire stair to move up the building and discharge from another level.

Path of Travel Widths
With respect to egress widths The Guide to the BCA states the intent of D1.6 is to *'require exits and paths of travel to an exit to have dimensions to allow all occupants to evacuate within a reasonable time'.*

Clause D1.6(f)(iii) allows the typical exit or path of travel width of 1000mm to be reduced by 250mm to 750mm at doorways. This measurement is considered to provide an exit width that will allow up to 100 occupants within a building to evacuate in a reasonable time, as referred to in the *Guide to the BCA*.

Due to the required installation of a handrail to one side of the stairway rising up from the basement the width of egress is reduced throughout the flight of stairs. If we liken this reduced width on the stairway and egress path to a doorway then by comparison, we can consider the concession afforded by D1.6(f)(iii) allowing the width of the area to be reduced by 250mm to 750mm which is less than the proposed width of 900mm above.

In support of the above, anthropometric data from Fairweather Et Al (Fairweather) based on British and American adult men 19-65 years of age and shows that the 95th Percentile of the studied population did not exceed a shoulder breadth of 510mm and 515mm respectively (Fairweather 1977). According to the study, the 95th percentile of adult British and American women did not exceed a hip breadth of 435mm and 440mm respectively, noting that hip breadth is considered the limiting factor in women.

Research conducted by A. Damon (Damon) indicates that a reasonable design minimum egress width for public corridors is 530mm; this is adequate for all but the largest 1% of the population. The restricted area exceeds this amount and it is therefore considered that the egress width provided only marginally restricts egress in localised areas of the building which will have limited effect on the overall ability of occupants to safely evacuate the building (Damon 1971).

Human behaviour in fire emergencies (NFPA 2003) states that the major axis across the shoulders of a body ellipse used to develop egress systems is 609mm. Another consideration is the sway width of shoulders when walking or evacuating a building in an emergency. Based on NFPA's anthropometric data as shown in the below detail, the sway width for adult male shoulders ranges from 510 to 760mm (NFPA 2012).

The reduced clear width of 900mm is therefore considered sufficient to accommodate this movement.

Via the above assessment the subject reduced width on the stairway of 900mm is considered to be sufficient to facilitate evacuation of the occupants likely to be located in these areas. On this basis, the performance solution is considered to comply with DP2, DP4 and DP6 subject to the assessment contained below.

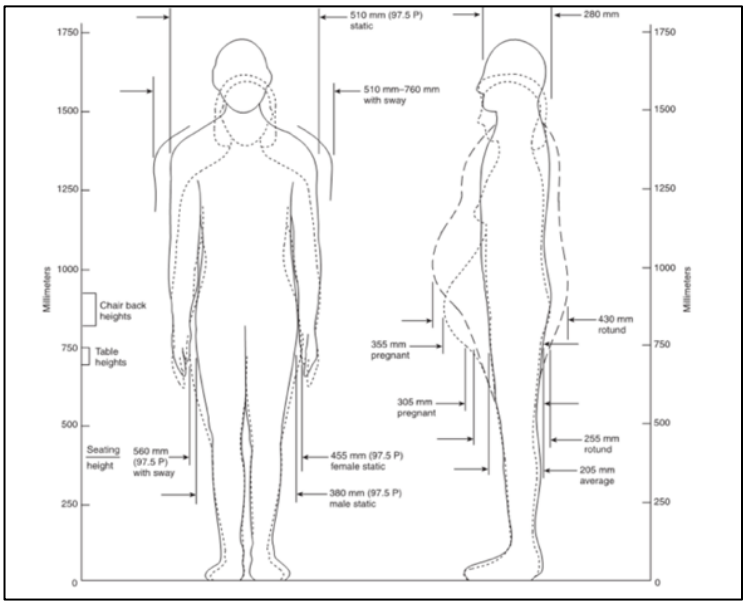


Figure 12 - Anthropometric data for adults, males and females, some dimensions apply to maximum range at the 97.5 percentile.

Stair rise run dimensions

It was noted that the external concrete stair shown below has going dimensions which exceed those specified in D2.13 at 470mm. Whilst in excess of the 355mm permitted these wide stairs are not considered to be a hazard to persons using them due to the short flight. Typically, wide stairs are difficult to use, especially for short people because they may need to take a second short step on the tread rather than one step per tread. A tall person on the other hand may have no difficulty extending their gait to climb or descend the stair with one step per tread.

Given the flight has only four risers, the fact that children and short persons will need to shuffle step on the treads is not considered to be a hazard or cause undue fatigue, especially given the arrangement has been this way since the construction of the building.

The trial design requires the installation of contrast strips to the stair treads to enable users to clear identify the riser location and therefore make a clear judgement of the need to shuffle step or not according to their gait. A handrail to one side of the stair is also required.

It is therefore considered that the deviations from the DtS provisions of the BCA have been adequately addressed to satisfy the relevant Performance Requirements DP2, DP4, DP5 and DP6.

On the basis of the above, it is not considered that the proposed treads shall not impact upon the safe movement of occupants within the subject building. On the basis, of the above analysis it is considered that compliance with DP2, DP4, DP5 and DP6 is achieved subject to the assessment contained below.

5.6 Assessment against relevant Performance Requirement

The following is an assessment of the relevant Performance Requirements DP2, DP4, DP5 and DP6.

DP2 Safe movement to and within a building	
So that people can move safely to and within a building, it must have—	
(a) walking surfaces with safe gradients; and	Not applicable to this performance solution.
(b) any doors installed to avoid the risk of occupants— *(i) having their egress impeded; or*	Not applicable to this performance solution.

(ii) being trapped in the building; and	
(c) any stairways and ramps with— *(i) slip-resistant walking surfaces on—* *(A) ramps; and* *(B) stairway treads or near the edge of the nosing; and* *(ii) suitable handrails where necessary to assist and provide stability to people using the stairway or ramp; and* *(iii) suitable landings to avoid undue fatigue; and* *(iv) landings where a door opens from or onto the stairway or ramp so that the door does not create an obstruction; and* *(v) in the case of a stairway, suitable safe passage in relation to the nature, volume and frequency of likely usage.*	Due to the inclusion of winders in the stair, it is proposed to provide textured contrast strips and signage to offset the increased risk of occupant tripping or falling. Signage shall be installed in a prominent position as to be visible occupants seeking to use the stair.

DP4 Exits	
Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to—	
(a) the travel distance, and	Not applicable to this performance solution.
(b) the number, mobility and other characteristics of occupants; and	Occupants of the Class 3 ski lodge are expected to be consistent with the national average. Occupants are expected to be capable of caring for themselves, however, should assistance be required staff and occupants would render assistance.
(c) the function or use of the building; and	The building is used as a Class 3 ski lodge type building. The function and use are considered to be typical of a Class 3 provided with a full time onsite manager.
(d) the height of the building; and	The height of the building is less than 12m therefore, a Fire and Rescue aerial appliance shall be able to reach all storeys of the building.
(e) whether the exit is from above or below ground level.	Exits from the building are provided at each of the four storeys and whilst a basement level exist direct egress to and from the level is possible via through the managers unit.

DP5 Fire isolated exits	
To protect evacuating occupants from a fire in the building exits must be fire-isolated, to the degree necessary, appropriate to—	
(a) the number of storeys connected by the exits; and	The subject stairs connect all four storeys of the building however, as per the assessment above the installation of the FPAA101D sprinkler system and the existing fire resistance construction throughout the building shall ensure occupants can egress in tenable conditions.

DP5 Fire isolated exits	
(b) the fire safety system installed in the building; and	The building shall be provisioned with DtS required fire safety systems. A non-required FPAA101D sprinkler system shall be installed to the upper two residential storeys inclusive of stairways.
(c) the function or use of the building; and	The building is used as a Class 3 ski lodge type building with an associated storage Class 7b part. The function and use are considered to be typical of a Class 3 ski lodge where occupants are likely to be familiar with the building where they are club members.
(d) the number of storeys passed through by the exits; and	The height of the building is less than 12m therefore, a Fire and Rescue aerial appliance shall be able to reach all storeys of the building.
(e) fire brigade intervention.	Given the good means of egress from the subject building it is expected that fire brigade interventions would be assisted.

DP6 Paths of travel to exits	
So occupants can safely evacuate the building, paths of travel to exits must have dimensions appropriate to-	
(a) the number, mobility and other characteristics of occupants; and	Occupants of the Class 3 ski lodge are expected to be consistent with the national average. Occupants are expected to be capable of caring for themselves, however, should assistance be required staff and occupants would render assistance.
(b) the function or use of the building; and	The building is used as a Class 3 ski lodge type building. The function and use are considered to be typical of a Class 3 building.

5.7 Assessment Conclusion

The above assessment demonstrates qualitative analysis that the trial design proposed satisfies the relevant Performance Requirements DP2, DP4, DP5 and DP6 subject to the following measures:

1. An FPAA101D sprinkler system shall be installed throughout the building.
2. The doors to the fire stair are to be replaced with -/60/30 fire doors fitted with 200x300 vision panels. The doors may be installed into the existing steel jambs. The doors and jambs are not required to be tagged as fire doors. The doors are required to be fitted with door closers and medium temperature smoke seals, the three sides of the door jambs, which are capable of restricting smoke at a temperature of 200°C for thirty minutes.
3. To ensure occupants are aware of the alternative exit located to the basement level it is proposed to install signage stating, "SHOULD CONDITIONS BE UNSAFE, USE EXIT IN BASEMENT" on the lower ground floor level. Signage shall be installed to the stair side of the door either on the door under the vision panel or on the wall adjacent to the vision panel.
4. The installation of textured contrast strips to the treads of all stairs within and external to the building being not less than 50mm in width and in a colour which contrasts to the stair surface.
5. The installation of handrails to one side of the external stairs.

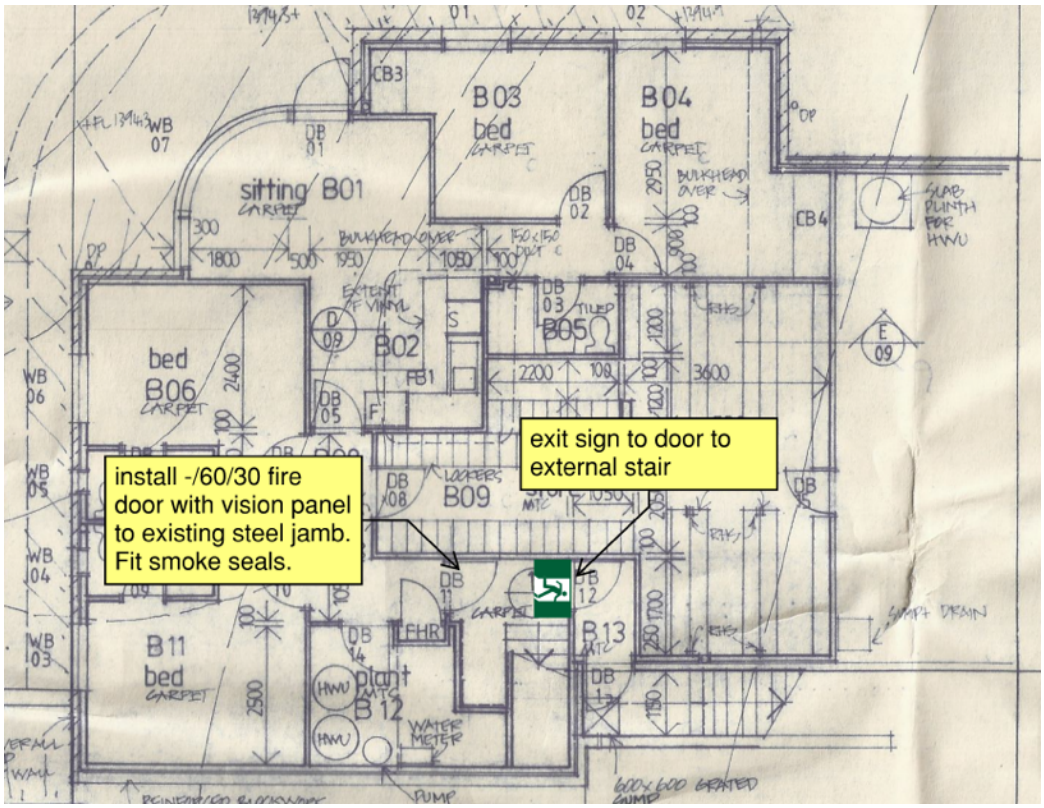


Figure 13 – Trial design requirements basement level

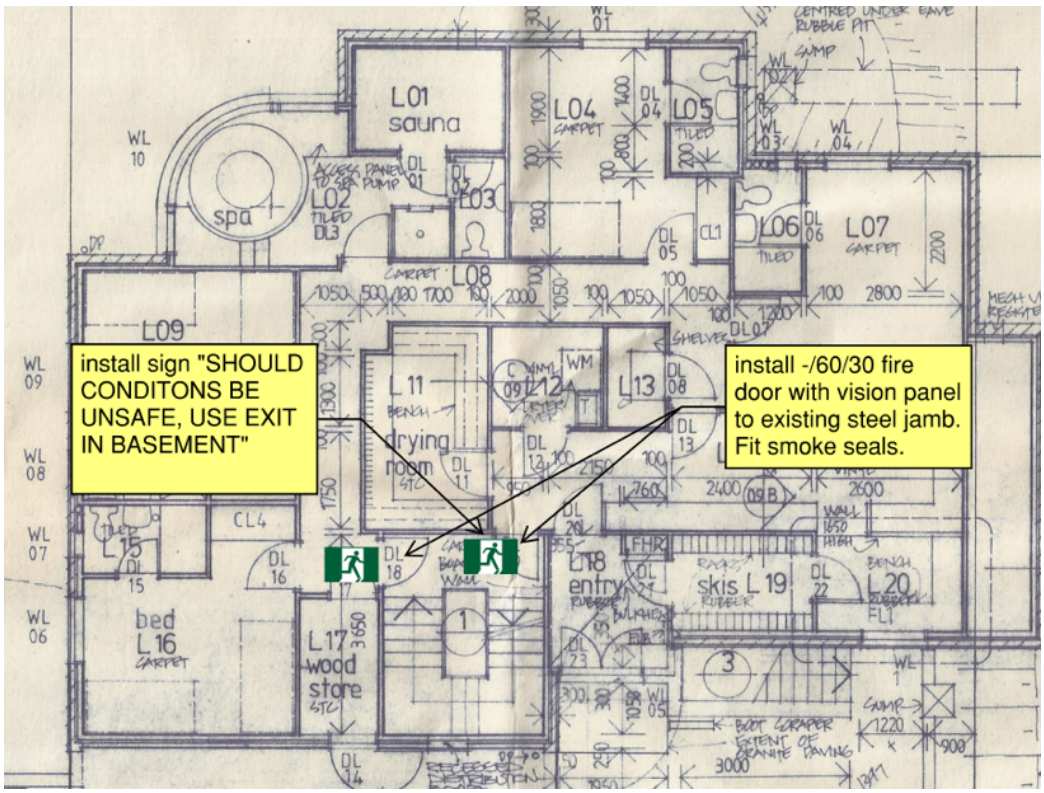


Figure 14 – Trial design requirements lower ground floor level

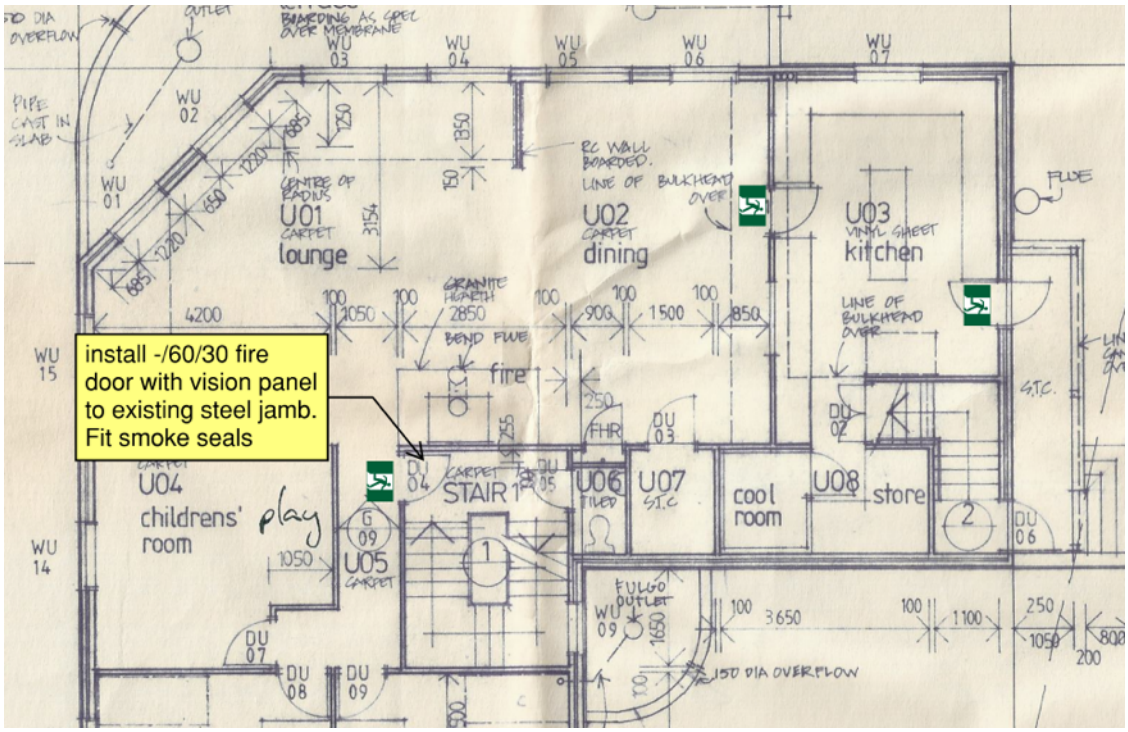


Figure 15 - trial design requirements ground floor

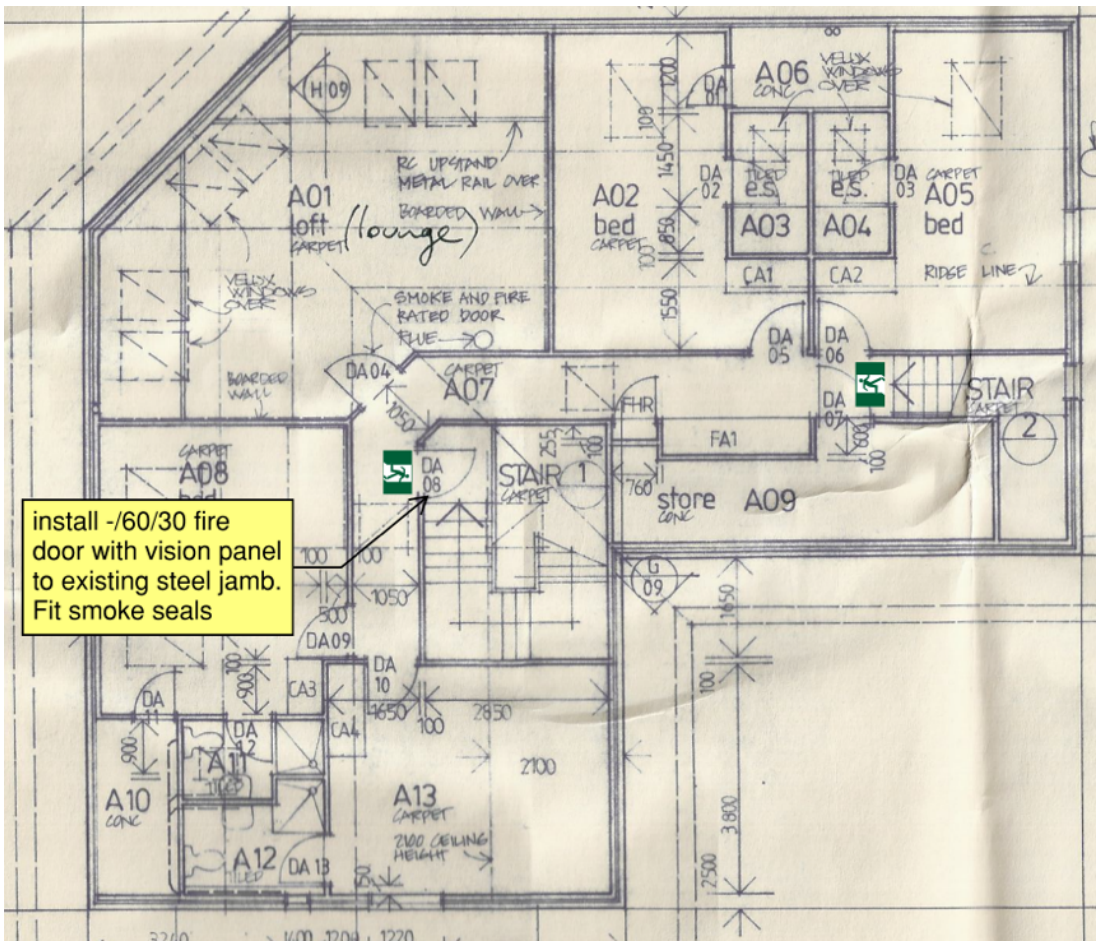


Figure 16 - trial design requirements attic level

6.0 INSPECTION, MAINTENANCE & COMMISSIONING

6.1 Good housekeeping

The ongoing management of the building should ensure good housekeeping procedures. The following matters should be considered by building management:

- Ensure exits and paths of travel to exits remain unobstructed (in particular stairways).
- Avoid storage of materials in unoccupied areas.
- Limit storage of flammable/combustible materials to designated and approved areas.
- Prevent chocking open fire/smoke doors.
- Prevent storage of materials that could hinder access to firefighting equipment.

6.2 Installation & commissioning

All fire safety measures are to be commissioned and tested prior to occupation of the building. The fire services contractor must provide certification of the installation and commissioning of the fire services required by this report and attached Annual Fire Safety Statement.

6.3 Building management & maintenance

The management of the building must be aware of the upgrade strategies applicable to the building, as well as the required measures for maintenance.

Management measures must be in place to ensure satisfactory maintenance, testing and inspection of all fire safety measures.

7.0 CONCLUSIONS

7.1 Conclusion

The Performance Solutions proposed as part of this Fire Safety Upgrade Master Plan Report have been developed using the techniques outlined within BCA Clauses A2.2(1)(a) and A2.2(2)(b)(ii), and demonstrate compliance with the relevant performance requirements CP1, CP2, CP4, DP2, DP4, DP5 and DP6 and through adoption of the trial design which deviates from the prescriptive DTS provisions of the BCA.

Accordingly, based on the above, it is considered that the directly related Performance Requirements CP1, CP2, CP4, DP2, DP4, DP5 and DP6 have been met, provided the Performance Solution requirements listed above are implemented.

7.2 Specification of the Final Trial Design

Considering the relevant provisions of the BCA, the Performance Solution, subject to the provision of the following requirements, is considered to meet and comply with the Performance Requirement CP1, CP2, CP4, DP2, DP4, DP5 and DP6.

The Performance Solution has been developed using absolute assessments utilising qualitative techniques and is considered to comply with BCA Performance Requirement CP1, CP2, CP4, DP2, DP4, DP5 and DP6. The BCA recognises these Assessment Methods as acceptable methods for determining that the Performance Solution satisfies the Performance Requirement in accordance with BCA Clauses A2.2(1)(a) and A2.2(2)(b)(ii).

7.3 Maintenance Requirements

The recommendations of this report must form part of the fire safety certificate for the building to ensure the recommendations of this report are complied with throughout the building operation.

7.4 Proposed Programme for Upgrade Measures

Based upon items contained within this report, the measures detailed in the table in the Executive Summary of this report form the Performance Solution.

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MFSE, B.Eng. (Elec.), B.Med.Sci.
BPB Accredited Fire Engineer Grade C10
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TAS Registered Building Practitioner (Fire Safety, Building Services)
Registered Professional Engineer Queensland
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AIBS Nationally Accredited Level 1 Building Surveyor
BPB Grade A1 Accredited Certifier and PCA
Fire Safety Engineer

8.0 REFERENCES

1. Australian Building Codes Board (2005), “International Fire Engineering Guidelines”, Australia.

2. Australian Building Codes Board (2015), “The Building Code of Australia”, Australia.

3. Australian Building Codes Board (2015), “The Guide to the Building Code of Australia”, Australia.

4. White, R. H., Charring Rates of Different Wood Species (Ph.D. thesis), Univ. Wisconsin, Madison (1988).

5. The Institution of Engineers, 1989

6. Australian Building Codes Board AS 3959-2009 Construction of buildings in bushfire prone areas

APPENDIX A - SPRINKLERS AS AN ALTERNATIVE TO PASSIVE PROTECTION

Sprinklers are subject to failures, but so are passive systems. In general, however, statistical data shows that sprinklers are more effective in reducing fire spread than passive fire protection system i.e. fire rated construction.

"Effectiveness of Fire Safety Components and Systems", I R Thomas [6] details nine to thirteen years of data from 1983 from the USA National Fire Incident Reporting System (NFIRS) database for a range of occupancies. These studies indicate:

- that the proposal is to install a sprinkler system instead of the fire rated construction to the level required by the BCA DTS provisions,
- that sprinklers give at least twice the reduction in fire spread than that required by the BCA.
- that the number of fire fighter and civilian casualties and estimated property losses for offices and retail show that sprinklers are more effective than the fire rated construction resulting in lower fire fighter injuries, fire fighter fatalities, civilian injuries, civilian fatalities and property loss except in one case, the civilian injuries in retail.

Sprinkler System Reliability

Data for reliability has also been compiled by Johansson [8] from a range of sources. Probabilities for a combination of the sprinkler system to activate and thereafter control or extinguish the fire were recorded. This data is summarised in the Table below.

Table 1. Reliability data for sprinkler systems (Johansson)

Source	Time Period	Reliability (%)
Industrial Risk Insurers	1975-1992 full sprinkler protection	98
NFPA	1925-1969	96.2
Department of Energy (DOE)	1952-1980	98.2
Australian and New Zealand data	1886-1968	99.8
Australian and New Zealand data	1968-1977	99.3
England (fire and loss statistics)	1965-1969	91.8
England (fire and loss statistics)	1966-1972	78.2

Similar data was also presented in a study by Edward and as summarised in Table 2 below for general occupancies.

Table 2 – Reliability data for sprinkler systems (Edward and Budnick)

Reference and Publication Year	Reliability (%)
Building Research Est., 1973	92.1
Miler, 1974	95.8
Miler, 1974	94.8
Powers, 1979	96.2
Richardson, 1985	96
Finucane et al, 1987	96.9-97.9
Maryat, 1988	99.5

Statistical analysis of sprinkler protection records in Australia and New Zealand between 1886 and 1986 has been undertaken by Marryatt [1].

With regards to health-care buildings (comprising hospitals), the statistics indicate that 100% of 157 fires were controlled by the successful operation of the installed sprinkler systems. The statistics indicate:

- 84 % of fires were controlled by the activation of 1 sprinkler head;
- 97 % of fires were controlled by the activation of 2 sprinkler heads;
- 100% of fires were controlled by the activation of 3 sprinkler heads;

A 100% record of fire control is idealistic, and is probably a consequence of the number of fires that have been recorded in the analysis.

However, in as represented by the above statistics sprinklers have an excellent record for controlling fires when they are installed and maintained properly, such that they activate successfully and perform as designed in a fire incident.

It is worth noting that the terminology "sprinkler controlled fire" does not mean that the fire has been extinguished. Rather, it means that the fire growth rate and spread has been controlled by the sprinkler activation. This acknowledges the fact that objects in the room may protect the seat of fire, such that the water discharge by the sprinkler system is unable to make direct contact with the combustible fuel surface(these are referred to as shield fires). Such a situation may occur with a fire beneath a table or behind furniture.

Marryatt (1) provides one of the most widely referenced studies of sprinkler system reliability on a 100 year study of fires in automatic sprinkler protected buildings in Australia and New Zealand. The statistical data shows that for a total of 9,022 recorded fires in 231 occupancies types, the following key facts was reported:

- Sprinklers controlled 99.46% of all fires reported
- Five or fewer sprinklers controlled over 90% of reported fires.
- In institutional and residential occupancies, there were three fire deaths in the 100-year period. In these cases, the deceased was "intimate with the source of ignition."

It is also worth mentioning that in all of the 9,022 recorded fires, standard sprinkler heads were used. The NFPA Handbook (2) has summarised statistics from 2,860 fire incidents where fire sprinklers were provided (refer 6-10A). Of these fire incidents, 74% of them were controlled by the action of 6 or less sprinkler heads and only 6 fires occurred where it activated more than 26 sprinkler heads.
The Fire Engineering Safety Guidelines (3) suggests the failure rate for new sprinkler heads to operate correctly has been estimated at 3.1% (reliability = 96.9%) and for old sprinklers at 5.1% (reliability = 94.9%).

Powers (4) provides the sprinkler reliability of success to be 98.8% for high-rise office buildings only in New York City, other than office buildings is 98.4% and for low-rise buildings is 95.8%.
For further information on the reliability of automatic sprinkler systems, Koffell (5) has produced a paper regarding sprinkler reliability based on NFPA data. The paper analyses 273,400 actual fires occurred between 1989-1999 where sprinklers were present. In 83.6% of fires sprinklers operated, it is noted that in a number of the remaining cases the fire was too small to operate the sprinklers.

The following are possible reasons why there may not be water at the sprinkler head:

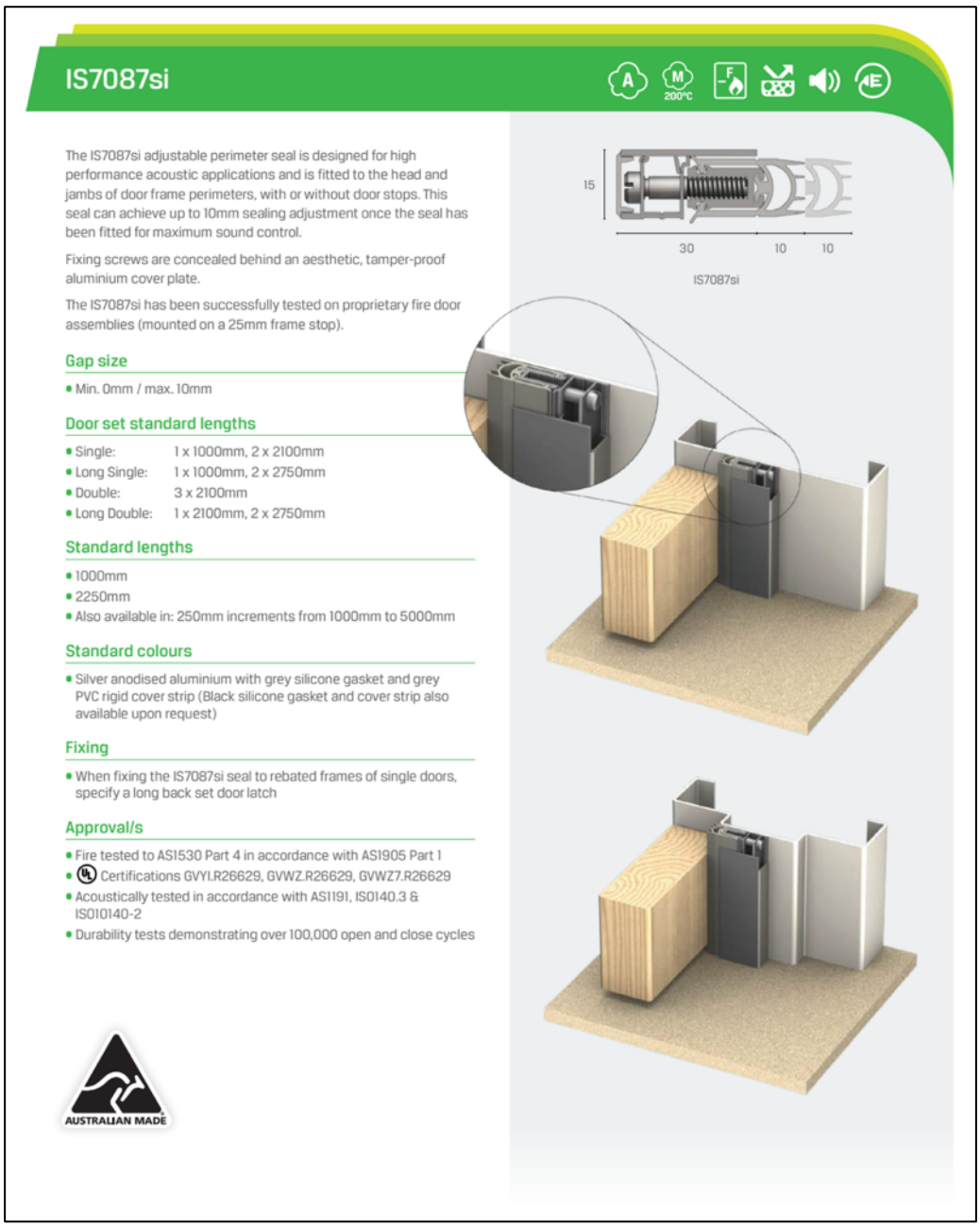
- No water to the building due to mains breakdown or total isolation
- Blockages within pipe work such that a sprinkler branch is isolated. Provided the system is adequately commissioned and subsequent tenancy work undertaken by qualified and competent fitters it is considered that the likelihood of this occurrence is extremely small. The use of end-of-line testing could further provide a check on this matter.
- Sprinkler head operates but debris introduced into pipe work blocks this isolated sprinkler head. Again, this is considered to be extremely unlikely especially if proper commissioning and

maintenance has taken place. Additionally the chance of two adjacent heads being blocked in this manner, will be close to zero.

- System has been unintentionally or intentionally isolated at stop valve.
- Part or all of the sprinkler system is isolated for tenancy upgrades. It is this last factor that has the biggest influence on reliability. Minimising the area isolated and the period of isolation would be important management issues.
- The above discussion illustrates that sprinklers are very effective in mitigating fires as supported by the statistical data listed above and that the probability of a sprinkler system failure is considered low.

According to the Fire Safety Engineering Guidelines [3] it can be assumed that the probability for a sprinkler system to activate is 95% for a flaming non flashover fire and 99% for a flashover fire. The probability of sprinkler control after sprinkler activation is estimated to be 99%.

APPENDIX B – SMOKE SEAL SPECIFICATION



IS7087si

The IS7087si adjustable perimeter seal is designed for high performance acoustic applications and is fitted to the head and jambs of door frame perimeters, with or without door stops. This seal can achieve up to 10mm sealing adjustment once the seal has been fitted for maximum sound control.

Fixing screws are concealed behind an aesthetic, tamper-proof aluminium cover plate.

The IS7087si has been successfully tested on proprietary fire door assemblies (mounted on a 25mm frame stop).

Gap size

- Min. 0mm / max. 10mm

Door set standard lengths

- Single: 1 x 1000mm, 2 x 2100mm
- Long Single: 1 x 1000mm, 2 x 2750mm
- Double: 3 x 2100mm
- Long Double: 1 x 2100mm, 2 x 2750mm

Standard lengths

- 1000mm
- 2250mm
- Also available in: 250mm increments from 1000mm to 5000mm

Standard colours

- Silver anodised aluminium with grey silicone gasket and grey PVC rigid cover strip (Black silicone gasket and cover strip also available upon request)

Fixing

- When fixing the IS7087si seal to rebated frames of single doors, specify a long back set door latch

Approval/s

- Fire tested to AS1530 Part 4 in accordance with AS1905 Part 1
- Certifications GVYI.R26629, GVWZ.R26629, GVWZ7.R26629
- Acoustically tested in accordance with AS1191, IS0140.3 & IS010140-2
- Durability tests demonstrating over 100,000 open and close cycles

AUSTRALIAN MADE