FIRE SAFETY STRATEGY

Sydney Flight Training Centre

28-30 Burrows Road St Peters

Report Number:

222056_FSS_03

Date:

05/10/2022

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REPORT DETAIL

Project:	Sydney Flight Training Centre
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Report Revision History

Rev	Date	Comment	Prepared By	Reviewed By
01	29/09/2022	Draft Issue	**Joshua Raines** *MEng Fire Safety* *BEng (Civil)* *MIEAust*	**Thomas O'Dwyer** *BE (Building)* *Grad Dip (Performance Based Building & Fire Codes)* *MIEAust* *BDC 0766*
02	29/09/2022	Final Issue *Captures Design Team Comments*		
03	05/10/2022	Final Issue *Updated Drawings Per Client Request*		

EXECUTIVE SUMMARY

Affinity Fire Engineering Pty Ltd has been engaged by Logos Development Management Pty Ltd to develop a preliminary Fire Safety Strategy for the proposed development located at 28-30 Burrows Road St Peters. The State Significant Development SSD-47601708 for Sydney Flight Training Centre consists of a large isolated building accommodating various aircraft cabin training rooms, flight simulators and ancillary office space.

This Fire Safety Strategy (FSS) outlines the fire engineering principles that will be utilised in ensuring that the prescriptive non-compliances with the Deemed-to-Satisfy (DTS) provisions of the Building Code of Australia 2019 Amendment 1 (BCA) [1], as noted herein, are resolved through a fire engineered Performance Solution in order to conform to the building regulations.

The complete fire engineered analysis will form the Fire Engineering Report, and will be completed in consultation with relevant stakeholders including the FRNSW and as such is not documented herein. This Fire Safety Strategy does however outline the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building and satisfy the Performance Requirements of the BCA.

CONTENTS

1 INTRODUCTION & SCOPE

1.1 Overview

This Fire Safety Strategy has been undertaken and nominates Performance Solutions for assessing compliance with the nominated Performance Requirements of the BCA [1] in accordance with the methodologies defined in the AFEG [3] and provide a workable and safe Fire Safety Strategy.

1.2 Fire Safety Objectives

The objective of the Fire Engineering Assessment is to develop a Fire Safety System, which satisfies the Performance Requirements of the NCC whilst maintaining an acceptable level of life safety, protection of adjacent property and adequate provisions for Fire Brigade intervention. At a community level, fire safety objectives are met if the relevant legislation and regulations achieve compliance. As stated in the NCC, *"Compliance with the NCC is achieved by satisfying the Performance Requirements"*. In addition to this, certain non-regulatory objectives exist as detailed below.

A full and compete Fire Engineering Process is to be completed prior to achieving a CC. This process shall include a PBDB in the form of an FEBQ (that shall be reviewed by all relevant stakeholders including the FRNSW) followed by a formal Fire Engineering Report. This process shall satisfy the SEARS fire and incident management requirement.

1.2.1 Fire Brigade Objectives

The overall philosophical Fire Brigade objectives throughout Australia are to protect life, property and the environment from fire, according to the Fire Brigade Intervention Model (FBIM) [13] as per the Fire Services State and Territory Acts and Regulations.

Over and above the requirements of the NCC, the Fire Brigade has functions with regard to property and environmental protection and considerations regarding occupational health and safety for its employees.

1.2.2 Building Regulatory Objectives

The following items are a summary of the fire and life safety objectives of the NCC:

- **Life safety of occupants -** the occupants must be able to leave the building (or remain in a safe refuge) without being subject to hazardous or untenable conditions. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of exposing building occupants to hazardous or untenable conditions in an event of a fire.

- **Life safety of fire fighters -** fire fighters must be given a reasonable time to rescue any remaining occupants before hazardous conditions or building collapse occurs. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would facilitate fire brigade intervention and minimise the risk of exposing fire fighters to hazardous or untenable conditions in an event of a fire.
- **Protection of adjoining buildings** - structures must not collapse onto adjacent property and fire spread by radiation should not occur. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of fire spreading from one building to another.

1.2.3 Non-Prescribed Objectives

Fire Engineering has an overarching benefit to many facets of the built environment where non-prescribed objectives can have an influence on the Fire Safety Strategy adopted. The client and stakeholders for the design have not requested any additional nonprescribed objectives are required to be met through the preparation of the FER.

1.3 Regulatory Framework of the Fire Engineering Assessment

1.3.1 National Construction Code Series - Building Code of Australia

One of the goals of the BCA [1] is the achievement and maintenance of acceptable standards of safety from fire for the benefit of the community. This goal extends no further than is necessary in the public interest and is considered to be cost effective and not needlessly onerous in its application.

Section A2.1 of the BCA [1] outlines how compliance with the Performance Requirements can be satisfied. These are as follows:

1. Performance Solution; or
2. Deemed-to-Satisfy Solution; or
3. Combination of (1) and (2).

Sections A2.2 of the BCA provides several different methods for determining that a Performance Solution complies with the Performance Requirements. These methods are summarised as follows:

1) A Performance Solution is achieved by demonstrating-
   - (a) Compliance with all relevant Performance Requirements; or
   - (b) The solution is at least equivalent to the Deemed-to-Satisfy Provisions.
2) A Performance Solution must be shown to comply with the relevant Performance Requirements through one or a combination of the following Assessment Methods:
   - (a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements.
   - (b) Verification Methods including the following:

(i) The Verifications Methods in the NCC

(ii) Other Verification Methods accepted by the appropriate authority that show compliance with the relevant Performance Requirements.

(c) Expert Judgment.

(d) Comparison with the Deemed-to-Satisfy Provisions.

3) Where a Performance Requirement is satisfied entirely by a Performance Solution, in order to comply with (1) the following method must be used to determine the Performance Requirement or Performance Requirements relevant to the Performance Solution:

(a) Identify the relevant Performance Requirements from the Section or Part to which the Performance Solution applies.

(b) Identify Performance Requirements from the other Section or Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.

4) Where a Performance Requirement is proposed to be satisfied with a Performance Solution, the following steps must be undertaken:

(a) Prepare a performance-based design brief in consultation with relevant stakeholders.

(b) Carry out analysis, using one or more of the Assessment Methods listed in (2), as proposed by the performance-based design brief.

(c) Evaluate results from (b) against the acceptance criteria in the performance-based design brief.

(d) Prepare the final report that includes-

(i) All Performance Requirements and/or Deemed-to-Satisfy Provisions identified through A2.2(3) or A2.4(3) as applicable: and

(ii) Identification of all Assessment Methods used; and

(iii) Details of steps (a) and (c); and

(iv) Confirmation that the Performance Requirement is met; and

(v) Details of conditions or limitations, if any exist, regarding the Performance Solution.

Section A2.3 of the BCA states that a solution that complies with the Deemed-to-Satisfy Provisions is deemed to have met the Performance Requirements. A Deemed-to-Satisfy Provision can be shown compliance with the Deemed-to-Satisfy Provisions through one or more of the following Assessment Methods:

(a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements.

(b) Expert Judgement.

As described in Section A2.4 a combination of Performance Solutions and Deemed-to-Satisfy Solutions may be used to satisfy the Performance Requirements. When using a combination of solutions, compliance can be shown through the following, as appropriate:

(a) Section A2.2 for assessment against the relevant Performance Requirements.

(b) Section A2.3 for assessment against the relevant Deemed-to-Satisfy Provisions.

Where a Performance Requirement is satisfied by a Performance Solution in combination with a Deemed-to-Satisfy Solution, in order to comply with (1), the following method must be used to determine the Performance Requirement or Performance Requirements relevant to the Performance Solution:

(a) Identify the relevant Deemed-to-Satisfy Provisions of each Section or Part that are to be the subject of the Performance Solution.

(b) Identify the Performance Requirements from the same Sections or Parts that are relevant to the identified Deemed-to-Satisfy Provisions.

(c) Identify Performance Requirements from other Sections or Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Deemed-to-Satisfy Provisions that are subject of the Performance Solution.

1.3.2 Australian Fire Engineering Guidelines (AFEG)

The AFEG [3] document has been developed for use in fire safety design and assessment of buildings and reflects Australia's best practice. The document is intended to provide guidance for fire engineers as they work to develop and assess strategies that provide acceptable levels of safety.

The document is particularly useful in providing guidance in the design and assessment of Performance Solution against the Performance Requirements of the BCA. The prescribed methodology set out in the AFEG shall be generally adopted as part of the fire engineering for the assessment of each individual deviation from the prescriptive provisions as identified by the Principal Certifier. With the design of each deviation developed with a holistic understanding of the impact of the requirements and deviations assessed on the overall risk of fire spread, and occupant and fire fighter life safety.

The AFEG is not adopted in whole as there are professionals employed in the building process that determine the level of compliance with the building code. Conformation of compliance with the applicable BCA is the role of the BCA consultant / Principal Certifier. Where not commented on within this report it is the expectation that the design complies with the BCA.

1.3.3 Stakeholders

The Performance Solution has been developed collaboratively with the relevant stakeholders as identified in the table below:

Table 1-1: Relevant Stakeholders

Role	Organisation	Contact
Developer	LOGOS Development Management Pty Ltd	Athlene Kyle Mark Linfoot
Architecture	PACE Architects	Patrick Pace
Planning	Urbis Pty Ltd	Erin Dethridge
Builder	FDC Construction	Joshua Basso William Picone
Civil Engineer	Costin Roe	Mark Wilson
BCA Consultant	Steve Watson & Partners	Joshua Hawke
Fire Safety Engineer	Affinity Fire Engineering	Thomas O'Dwyer Joshua Raines

It should be noted that at times some parties may have a vested interest in the outcome of the Fire Engineering assessment. such parties can include local fire brigades, insurers, Environmental Protection Authority (EPA), project control groups, end users and community representatives. Although not always a legislative requirement, the design team should give due consideration to their inclusion in the Fire Engineering process. Where not required by legislation it is the client's decision to involve such parties, especially local fire brigade, to ensure a transparent and adequate fire safety solution for all. Where we are not notified of the inclusion of such parties it is assumed the client / representative has given due consideration to the above.

1.4 Sources of Information

The following sources of information have been relied upon in the preparation of this document:

- BCA Compliance Report prepared by Steve Watson & Partners, Version 1.1 dated 05/10/2022
- Dangerous Goods Report prepared by RiskCon Engineering, dated 23/09/2022.
- Architectural plans prepared by PACE as noted in Figure 1-1.

CT000	COVERPAGE	04.10.22	19
CT100	SITE PLAN	20.09.22	16
CT101	GROUND FLOOR PLAN	30.09.22	18
CT102	LEVEL 1 & LEVEL 2 PLAN	04.10.22	19
CT200	SECTIONS - LONG	26.09.22	17
CT201	SECTION - SHORT	26.09.22	17
CT202	ELEVATION NORTH AND SOUTH	04.10.22	19
CT203	ELEVATION EAST & WEST	26.09.22	17
CT204	3D PERSPECTIVE - EAST CORNER	20.09.22	16
CT205	3D PERSPECTIVE - WEST CORNER	20.09.22	16
CT206	3D PERSPECTIVE - ALEXANDRA CANAL	20.09.22	16
CT207	3D AXONOMETRIC AERIAL VIEW	20.09.22	16
CT207-1	3D AXONOMETRIC AERIAL VIEW2	20.09.22	16
CT207-2	3D AXONOMETRIC AERIAL VIEW3	20.09.22	16
CT208	MATERIALS	20.09.22	16
CT209	3D PERSPECTIVES - BURROWS ROAD	20.09.22	16
CT210	SIGNAGE & WAYFINDING SITE PLAN	04.10.22	19
CT212	GFA PLANS	20.09.22	16

Figure 1-1: Architectural Drawing List

1.5 Limitations and assumptions

In this instance, this Fire Safety Strategy has been developed based on applicable limitations and assumptions for the development which are listed as follows:

- This advice is specifically limited to the project described in Section 2.
- This advice is based on the information provided by the team as listed in Section 1.4.
- Building and occupant characteristics are as per Section 2 and 3 of this document. Variations to these assumptions may affect the Fire Engineering Strategy and therefore they should be reviewed by Affinity Fire Engineering should they differ.
- As per any building design, DtS or otherwise, the report is limited to the fire hazards and fuel loads as prescribed in Section 5. In line with the methodology and overarching strategy with the BCA, this report does not provide guidance in respect of multiple fire ignitions or sabotage of fire safety systems.
- This does not provide guidance on the storage of Dangerous Goods, flammable liquids, explosive materials or high temperature production equipment. Where present expert advice from an accredited Dangerous Good Risk Consultant must be sort.
- The development complies with the DtS provisions of the NCC [1] with all aspects relating to fire and life safety unless otherwise specifically stated in this report. Where not specifically mentioned, the design is expected to meet the NCC DtS requirements of all relevant codes and legislation at the time of construction and / or at the time of issue of this report.

- The assessment is limited to the objectives of the NCC and does not consider property damage such as building and contents damage caused by fire, potential increased insurance liability and loss of business continuity.
- Malicious acts or arson with respect to fire ignition and safety systems are limited in nature and are outside the objectives of the NCC. Such acts can potentially overwhelm fire safety systems and therefore further strategies such as security, housekeeping and management procedures may better mitigate such risks.
- This report is prepared in good faith and with due care for information purposes only and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.
- This Fire Safety Strategy (FSS) is only applicable to the completed building. This report is not suitable, unless approved otherwise, to the building in a staged handover.
- Where parties nominated in Section 1.3.2 have not been consulted or legislatively are not required to be, this report does not take into account, nor warrant, that fire safety requirements specific to their needs have been complied with.
- Full and compete Fire Engineering Process is to be completed prior to achieving a CC. This process shall include a PBDB in the form of an FEBQ (that shall be reviewed by all relevant stakeholders including the FRNSW) followed by a formal Fire Engineering Report.

2 BUILDING CHARACTERISTICS

2.1 Overview

Building characteristics are assessed as part of the Fire Safety Strategy due the following:

1. The location can affect the time for fire brigade intervention and potential external fire exposure issues.
2. The structure will impact on the ability to resist a developing fire and support condition to allow occupants to escape the building and the fire brigade to undertake fire-fighting to the degree necessary.
3. The floor area determines the potential fire size and area required to be evacuated in the event of a fire.
4. BCA details such as Type of Construction, classification and height will dictate passive and active fire safety systems.

2.2 Site Location

The proposed development is to be located within the NSW suburb of St Peters, approximately 6.0km south of the Sydney CBD and local to the City of Sydney LGA. The subject site fronts Burrows Road to the north, the Alexandra Canal to the south and existing neighbouring developments to the east and west respectively. The site location relative to the local setting is presented in Figure 2-1.

Figure 2-1: Development Site Location Relative to Existing Local Setting (SixMaps 2022)

In regard to Fire and Rescue operations, the site influences the likely fire brigade intervention times, and given the close proximity to the nearest fire station is expected to facilitate a relatively convenient and expedient fire brigade response. Furthermore, being located in an inner suburb of a major city, the development is provided with the services and facilities expected in an urban setting. The likely two nearest fire brigade stations provided with permanent staff are Mascot and Alexandria fire stations approximately 2.1km and 2.4km from site respectively when considering actual driving conditions.

2.3 Building Description

The development will be a three-storey operational flight training centre, housing full motion flight simulators (simulators) for pilot training and emergency procedures training for pilots and cabin crew. The building layout incorporates these internal storeys as mezzanine type arrangement to open into the remaining building enclosure.

The building will be used for the purpose of flight training to enable pilots and cabin crews from Qantas and other airlines to undertake regular training and testing to meet regulatory requirements by simulating both aircraft and emergency procedural environments. The building accommodates flight simulators, emergency procedures facilities and ancillary spaces for classrooms and office space.

The ground level serves as the pedestrian and vehicle main entrance, with direct access from Burrows Road from the north to the building reception and perimeter vehicle access around the rear of the structure. The ground level incorporates various aircraft training rooms, staff lounges, and eight aircraft cockpit simulators distributed along the southern and western wall of the building. These simulators are mechanical and when operational move to simulate the pitch and yaw of a moving plane. Fire services infrastructure is located external of the building in the south-eastern corner of the site. Non-fire-isolated stairs are located on the northern and eastern building walls. Key features of the ground level are illustrated in Figure 2-2.

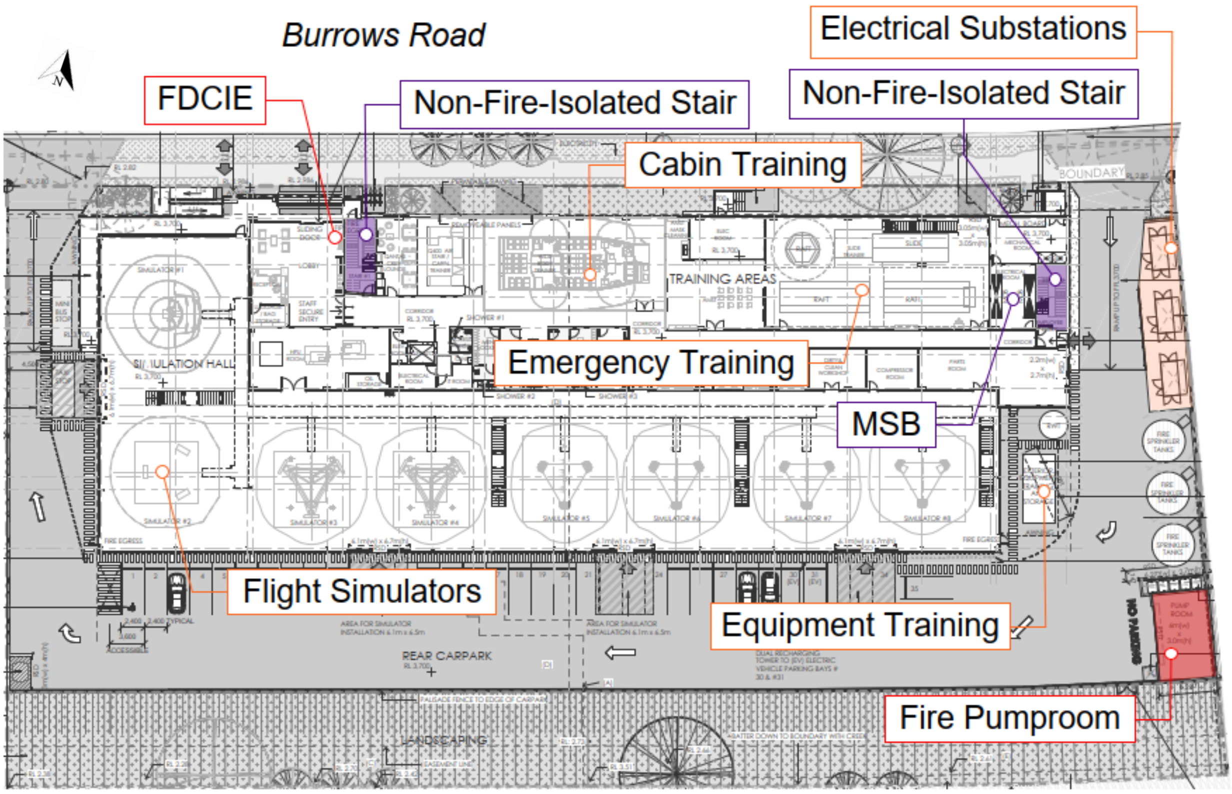


Figure 2-2: Ground Level Description

Level 1 serves multiple training rooms, offices, meeting rooms and computer rooms all opening into a centralised pedestrian throughfare corridor. The level 1 floorplate occupies part of the building footprint with the space above the flight simulators as a void up to the building ceiling. Access to the flight simulators is via the level 1 balcony which opens into the greater building enclosure, each of the flight simulators have a bridging gantry which extends out to the balcony. Key features of the level 1 are illustrated Figure 2-3.

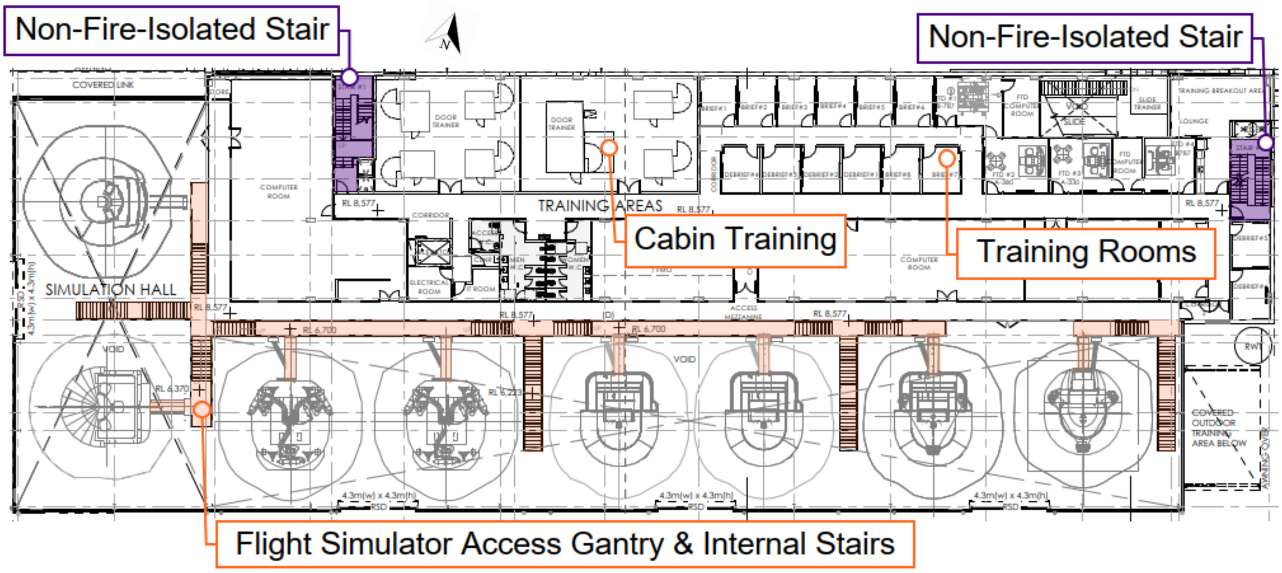


Figure 2-3: Level 1 Description

Level 2 is located directly above the level 1 mezzanine type floorplate and accommodates more classrooms, offices and amenities. Level 2 does not have balcony rather a traditional building enclosure from the adjacent void down to the ground level. Stairs are located at each end of the floorplate benefiting egress options from the floorplate. Key features of the level 2 are illustrated in Figure 2-4.

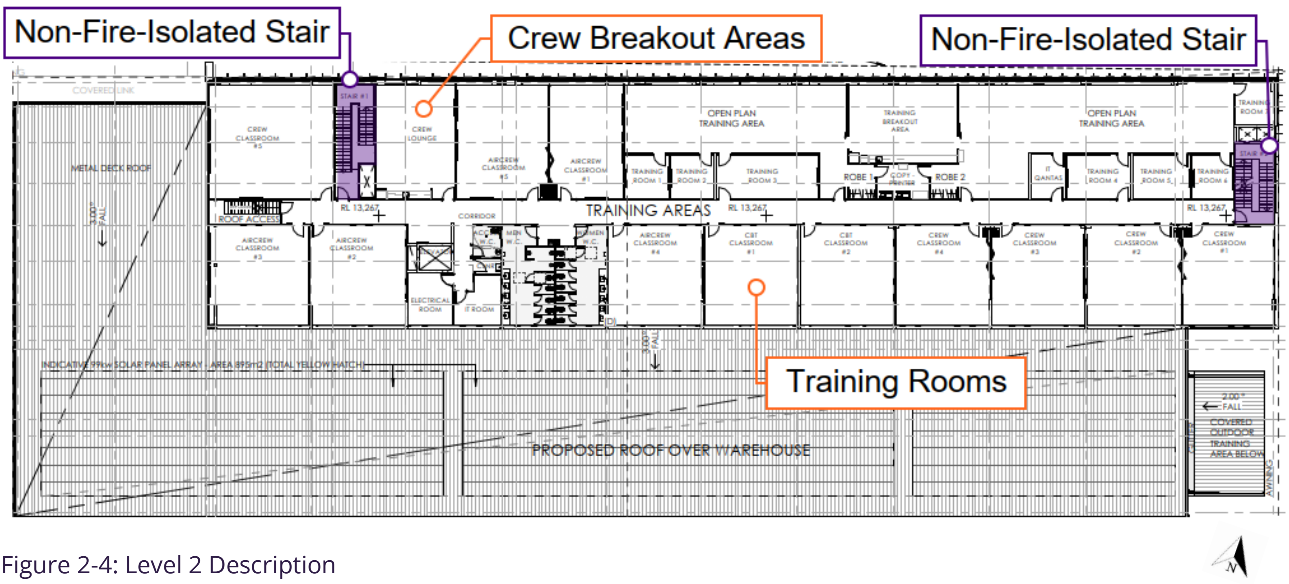


Figure 2-4: Level 2 Description

The levels of offices relative to the greater building are best illustrated in Figure 2-5 where the office and training rooms form roughly half the structure with the aircraft training simulators situated within a void to the south.

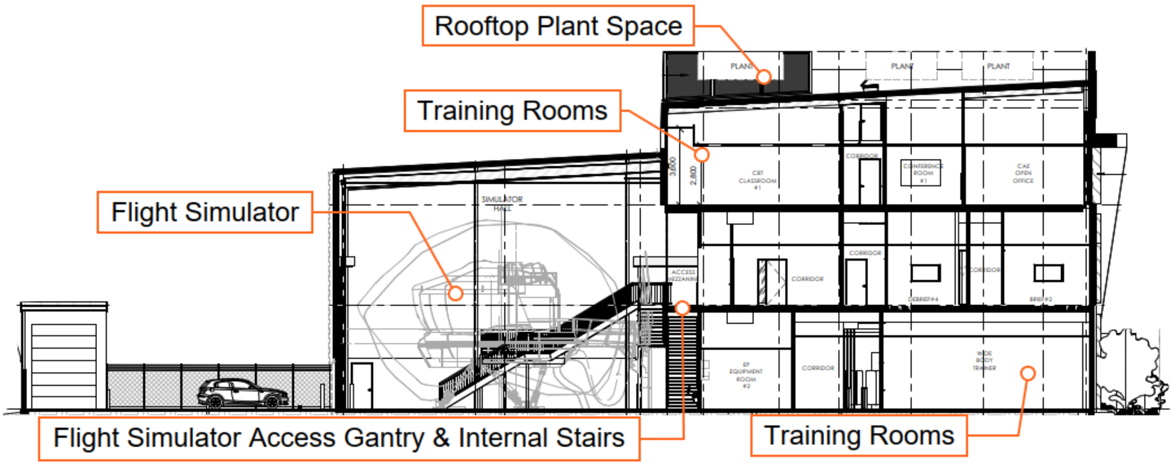


Figure 2-5: Building Section Indicating The Office Levels Relative To The Overall Structure

2.4 Building Structure

The Class 9b building is assessed to contain a rise-in-storey of 3 to necessitate Type A construction provisions and due the building exceeding the maximum compartment limitations under BCA Clause C2.2 is classified as a large-isolated building. All materials used in the construction will conform with the testing methodology outlined in the DTS provisions so to mitigate the spread of fire and smoke in turn minimising the fire related risks to occupants and firefighters.

2.5 Building Characteristic Assessment

The following table summarises the characteristics of the subject building, relevant to fire and life safety.

Table 2-1: Building Characteristics Assessment

CHARACTERISTIC	DESCRIPTION
BCA Classification	Class 9b (Assembly Area / Education Purposes)
Rise in Storeys	Three (3)
Type of Construction	Type A Construction (Large Isolated Building)
Building Floor Areas	Ground Level: 3,253m^2 Level 1: 1,629m^2 Level 2: 1,627m^2 Total: 6,510m^2

3 OCCUPANT CHARACTERISTICS

3.1 Overview

The occupant characteristics are assessed as part of the Fire Engineering Review due to the following:

1. Population numbers can dictate the time required to evacuate the building and the required life safety systems to be provided due to evacuation times.
2. Physical and mental attributes affects the occupants capacity to respond to various fire cues and react accordingly.
3. Familiarity of occupants can affect the time taken to evacuate the building and subsequent active/passive requirements.

3.2 Dominant Occupant Characteristics Assessment

Characteristic	Description
Population numbers	Generally, the occupant numbers in the building are expected to less than the occupant densities (m^2/person) listed in the NCC Table D1.13 for the various areas and the building layout. However for conservatism and allow flexibility in future tenant uses, all fire engineering shall conservatively adopt population numbers per the following densities from NCC Table D1.13: - 1 person peer $2m^2$ for a School – General Classroom. - A maximum 4 people per flight simulator.
Physical and mental attributes	**Staff** Staff in the building are expected to be awake and alert at all times. Staff are expected to have a level of understanding where they can recognise an emergency situation and have the ability to take and implement decisions independently. In addition, staff are expected to respond at all times, and to be unaffected by physical or sensory disabilities. Staff are not expected to be mentally impaired by drugs, alcohol, fatigue or other adverse conditions to degrees greater than in other business places. **Students / Training Crew** The key occupant group in this building shall be the students and respective training staff who shall be occupying the rooms and respective training facilities. All of this occupant group are expected to be able bodied and unaffected by physical or sensory disabilities. They are not expected to be mentally impaired by drugs, alcohol, fatigue or other adverse conditions predicted on the building use for aircraft crew training. This group however

Characteristic	Description
	may be focused on undertaking emergency simulations related to scenarios serving as part of their training and hence may display a possible delay in acknowledging a building fire emergency. Notwithstanding this occupant group is expected to be accompanied by building staff who can assist in fire emergencies. **Visitors** This occupant group is expected to be awake and alert. Visitors may also exhibit physical and mental disabilities to the degree and frequency of the general public. It should be noted that some visitors may consist of young children as well as elderly occupants and these occupant groups are expected to be accompanied by an adult. This occupant group is unlikely permitted within the greater extent of the structure. **Firefighters** This occupant group will be equipped with breathing apparatus and specialist equipment to prevent them from being adversely affected by fire hazards. They are expected to be trained in emergency response and be capable of undertaking fire suppression and coordination of evacuation of the building. **Maintenance personnel** This occupant group is expected to awake and alert at all times. Maintenance personnel are expected to be able-bodied individuals who are capable of making independent decisions and evacuate themselves.
Familiarity with the building	**Staff** Staff are expected to have a complete knowledge of the building layout and be able to coordinate evacuation of other occupant groups in an emergency. **Students / Training Crew** The students and training crew within the building are expected to have a reasonable familiarity with the building noting the prolonged access and occupation of the structure. Noting the building use for aircraft crew operations, all students and training crew entering the structure are expected to have undergone site specific evacuation protocols and this be aware of the available exits. **Visitors** Visitors may not have complete knowledge of evacuation routes in the subject building and are likely to choose to exit via the route they entered the building if not directed/guided by staff to the nearest exit.

Characteristic	Description
	Firefighters This occupant group is not expected to have any familiarity of the building layout, however are assumed to obtain the required information from the site block plans and tactical fire plans available prior to entering the building. Notwithstanding this, they will be equipped with breathing apparatus and specialist equipment to prevent them from being adversely affected by fire hazards. **Maintenance personnel** This occupant group is expected to have a reasonable familiarity with the building as they would have to undergo site specific induction prior to commencement of work on site.
Pre-movement time	Pre-movement times can vary and is highly dependent on a combination of a variety of factors [5] such as: - Familiarity with building - Commitment to activity being undertaken at the time of fire ignition - Mental capabilities (ability to assess risks and make appropriate decisions, alertness) - Physical capabilities - Group dynamics - Occupant relationships / social affiliations - Frequency of false alarms Documents such as PD7974-6:2004 [8] and CIBSE Guide E [11] provide guidance on estimating pre-movement times for various occupancies.
Travel speed	Travel speeds for individuals can vary depending on factors such as: - Age and sex, - Physical capabilities (ambulant, semi-ambulant, bed-ridden) - Occupant density / crowding - Perceived danger Based on a literature review of work carried out by Boyce et al. [14], Nelson and Mowrer [15], Pauls [15], Milinskii, Pelecheno [16], Pretechskii [17] and Shi et al. [18], the following travel speeds are adopted for an average horizontal travel speed: - 1.2m/s is assumed for an able-bodied adult where congestion is unlikely [11] such as in the ground level simulation hall floorplate; and - 1.0m/s is assumed for an able-bodied adult where congestion is likely [11] such as in the training areas; and

4 HAZARDS AND PROTECTIVE MEASURES

4.1 Overview

The fire hazard analysis forms the basis for the review of non-compliances within the buildings. In assessing expected and statistically validated hazards, preventative and protective measures are developed commensurate with those expected risks. The following section reviews applicable hazards and recommends possible measures to address those risks. Furthermore, hazards identified can form a justified basis for selected scenarios in fire engineering assessments.

4.2 Fire Hazards

4.2.1 General Activities

The public assembly building serves as a flight training centre for pilots and cabin crew training facility for their flight crew and pilots. The building accommodates multiple training rooms akin to classrooms for seated learning however also incorporates larger teaching rooms with airplane cabin mock up rooms for cabin training and emergency training. The greater part of the building accommodates eight full motion flight simulators which permit pilots to train and experience the quasi-realistic conditions of a plane in flight. External of the building and in a dedicated location, staff shall undertake basic fire extinguishment training.

4.2.2 Building Layout and Egress

Exits are provided around the building's perimeter at ground floor to allow for multiple alternative egress opportunities for those located within the facility. The level 1 and level 2 teaching rooms and ancillary rooms are distributed along a central corridor with fire-isolated stairs located at both ends to provide minimal distances to a point of choice and alternative egress routes.

Egress from the flight simulators is provided via retractable bridges to a level 1 mezzanine which serves as an internal balcony from the level 1 teaching rooms. This walkway is set down slightly lower to the level 1 floorplate and is accessible back into the common corridor through to a fire exit or, via open stairs down to the ground level floorplate below. Consideration of this bespoke evacuation is made in this fire engineering strategy.

4.3 Fuel Loads

Quantity of Materials

The training facility incorporates multiple training rooms and mock up cockpits thus best reflecting the fire fuel load of a typical office or education centre. In this regard the fire fuel loads are not likely to vary considerably over the life of the building. Uniquely to this facility are the eight flight simulator cabins which incorporate hydraulic and pneumatic machinery however these are not expected to increase the overall fire fuel load within the compound.

The IFEG [4] notes that an aircraft hanger and aircraft factory capture a mean fire fuel load density of 200MJ/m^2 which is noted to be reflective of the typically non-combustible building materials associated with aeroplane design and components. In comparison the IFEG [4] notes a school to capture a mean fire fuel load of 300MJ/m^2 and an office as 800MJ/m^2.

These fire fuel loads are unlikely to be densely incorporated into the building with a significant portion of the building accommodating a floor to ceiling void where the flight simulators are located.

4.4 Dangerous Goods

Dangerous goods are not expected to be stored on the site in significant quantities. It is however noted that all commercial buildings will contain a degree of flammable materials for maintenance purposes (i.e. liquid petroleum gas and flammable liquid.) and where DGs are stored, they shall be stored in accordance with the Regulatory requirements. Dangerous Goods consultant RiskCon Engineering have concluded that threshold quantities for the DGs to be stored and transported are not exceeded per report conclusion presented in Figure 4-1.

Riskcon engineering

5.0 Conclusion and Recommendations

5.1 Conclusions

A review of the quantities of DGs stored at the proposed facility and the associated vehicle movements was conducted and compared to the threshold quantities outlined in Chapter 3 of SEPP (Resilience and Hazards). The results of this analysis indicates the threshold quantities for the DGs to be stored and transported are not exceeded; hence, the Chapter 3 of SEPP-RH does not apply to the project. Futhermore, a reivew of the potential to cause offense was conducted which indicated the site operations would be unlikely to result in noise or odour to occur at levels which would cause offense.

As the facility is not classified as potentially hazardous or offensive, it is not necessary to prepare a Preliminary Hazard Analysis for the facilty as Chapter 3 of SEPP-RH does not apply.

5.2 Recommendations

No recommendations have been made as a result of the assessment.

Figure 4-1: RiskCon Engineering DG Report Excerpt

This Fire safety Strategy has been developed based on there being no Dangerous Goods stored on site other than those required for daily maintenance purposes. Any storage of Dangerous Goods will require review and assessment by a suitably qualified Risk Consultant to determine the associated hazards and required preventive measures to meet BCA Clause E1.10 and E2.3.

4.5 Insulated Sandwich Panels

Should any of the tenancies be adopted for future use as a temperature-controlled storage facility or, where future tenancy fit outs will contain temperature controlled areas with freezers and cool rooms and the like, these enclosures shall be constructed using Insulated Sandwich Panels (ISPs) that meet the following requirements to ensure a suitable degree of fire protection and life safety is incorporated into the design;

- All sandwich panels must be installed in accordance with the "Insulated Panel Council Australasia (IPCA) Code of Practice (CoP) - Version 4.3".
- The panels must be installed by an accredited installer as recognised by the Code of Practice prepared by IPCA (refer website: http://www.insulatedpanelcouncil.org/code-compliant-companies).
- Certification must be provided from the accredited installer prior to final occupation certificate being issued for the building.
- Signage and block plans will be required at each FDCIE to alert fire fighters to the;
    - Location of all sandwich panels installed.
    - Type of sandwich panels installed (commercial brand and core material).

4.6 Rooftop Solar Panels

Solar photovoltaic systems contribute to an increased probability of a fire event, primarily due to electrical risks [7]. Additionally, should the solar panels be subjected to a fire event, attending fire brigade can be exposed to hazardous toxins from the combustion of the panel materials.

Storage battery systems pose a significant risk to attending brigade with coming in to contact with the photovoltaic system. Drenching with hoses may disconnect or expose wiring to water in which create live current exposure to personnel or possibly additional fires through sparks or short circuits.

Where the design incorporates provisions for rooftop solar panels to offset the building's energy requirements, the following design measures shall be included to mitigate the risk to the attending fire fighters in the event of a fire as per FRNSW requirements.

- A minimum of an A3 sized block plan shall be provided at each FDCIE to alert the attending fire fighters of the presence of all key components inclusive, but not limited to, the following-
    - the location of the solar panels, inverters,
    - details of the operating voltage and current
    - the location of storage equipment and respective battery type
    - the location of the all-associated isolation switches, AC and DC isolators for the shut-off of generated electricity.
    - Notification of whether the solar panels are designed to be automatically isolated on fire trip, or alternatively whether manual isolation is required by attending fire fighters.
- The above signage is to be constructed of a weatherproof and fade resistant material.

4.7 Review of Relevant Fire Statistics

The following discussion is based on the fire statistics attached in APPENDIX A.

4.7.1 Public Assembly Building

Training facilities have an inherently low risk fire due to occupants being aware and generally focussed on a single area and at the discretion of emergency management plans. This is backed up by statistics which demonstrate that there are few fires reported in theatre areas as well as minimal deaths and injuries in comparison to other building types. Flynn [21] compiled the reported fires in public assembly buildings between 2000 and 2004 in the US. It was documented that on average, the fire brigade responded to 4,910 fires in public assembly properties which did not include eating or drinking establishments, religious buildings or funeral properties. An average of 1 civilian fatality and 52 civilian injuries were reported annually.

The leading causes of fires in these buildings are illustrated in Figure 4-2. Contained trash fires are shown to be the most common ignition, however the magnitude of these fires is generally small based on no civilian injuries occurring despite this cause representing 34% of public assembly fires. Cooking equipment is the next most common ignition cause followed by intentionally lit fires.

Omitted from these statistics are the civilian deaths. From the data presented by Flynn [21] the only civilian deaths in the 4 year period occurred due to intentionally lit fires in crawl or substructure spaces. It is presumed that these fatalities resulted from a single fire event and therefore show an unlikely skew in the statistics.

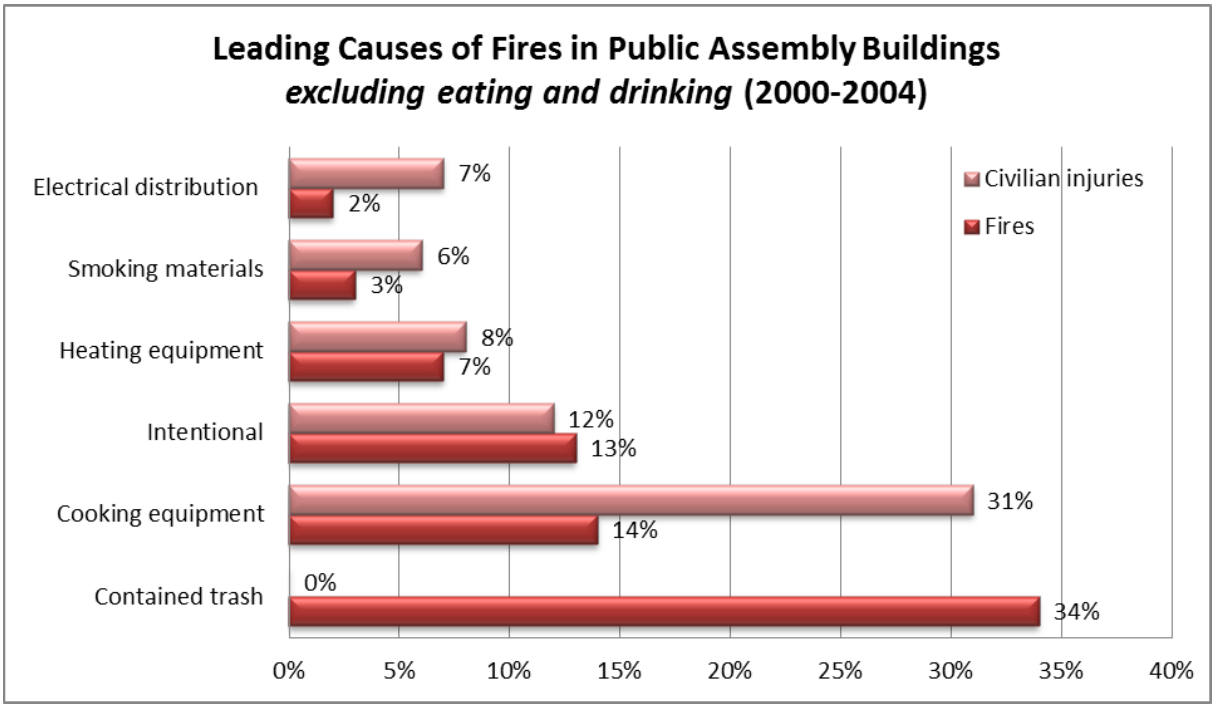


Figure 4-2: Leading Causes of Fires in Public Assembly Buildings [21]

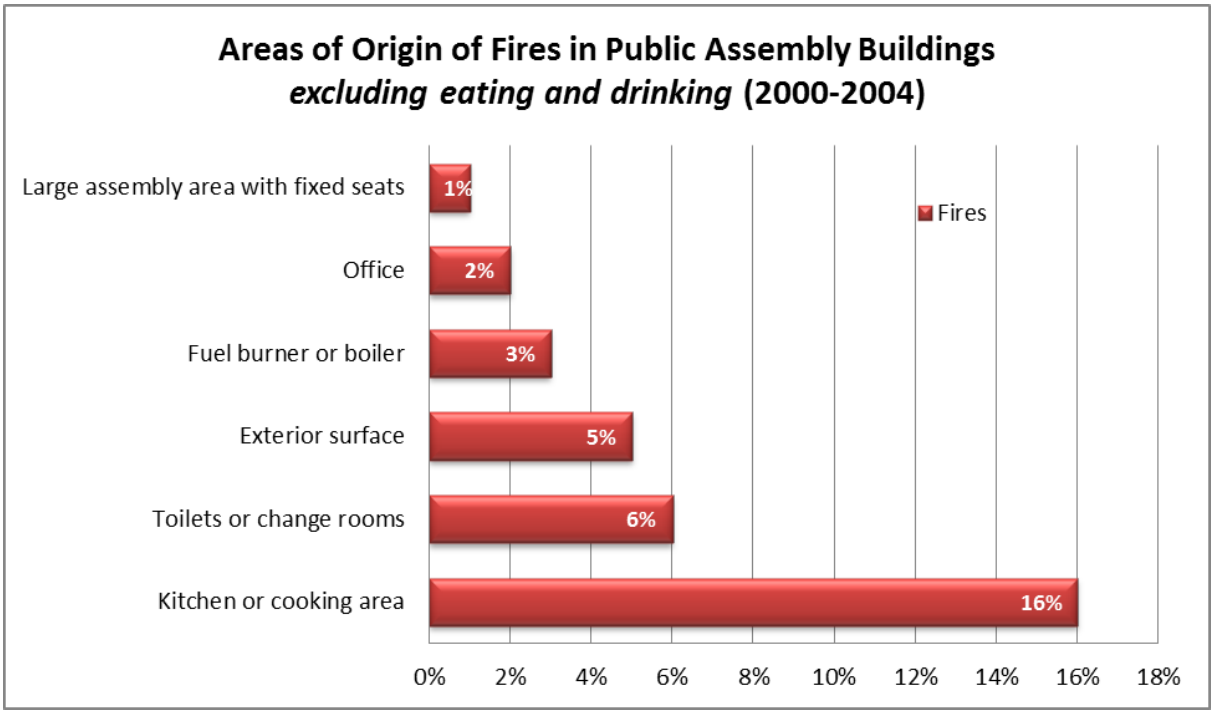
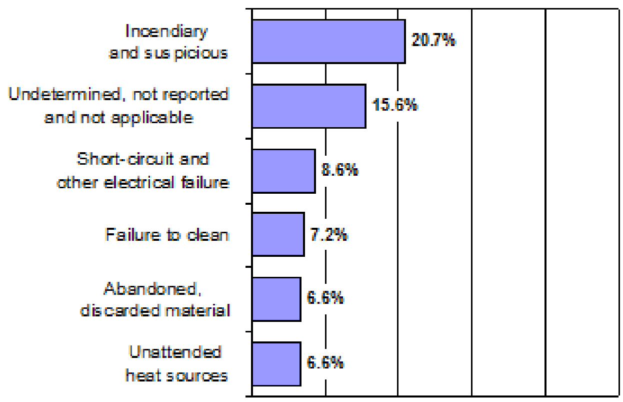


Figure 4-3: Leading Areas of Fire Origin in Public Assembly Buildings [21]

Furthermore, specific to NSW, statistics from 2006-2007 demonstrate that the cooking areas are the most likely location for a fire, backing-up the US statistics. A higher percentage of intentionally lit fires have been reported however, although this represents a much smaller sample size with only 347 fires occurring in the year.

Public assembly - 347 building fires



Area of fire origin	
Kitchen, cooking area	33.7%
Lavatory, locker room, cloakroom	11.5%
Dining area, lunchroom, cafeteria	4.0%
Lobby, entrance way	3.7%
Hallway, corridor, mall	2.9%
Undetermined, not reported and not applicable	2.9%
Waste or rubbish area, container	2.9%
Average dollar loss per fire*	**$30,445**

Figure 4-4: Ignition Cause and Area of Origin in Public Assembly (NSW 06/07)

4.7.2 Offices

NFPA statistics published for the years 2007-2011 estimates an average of 3,340 structure fires in office properties per year. Fires in office properties accounted for less than one in every 100 (0.7%) reported structure fires from 2007-2011. These fires caused annual averages of 4 civilian deaths and 44 civilian injuries. One in every four fires was caused by cooking. Electrical distribution and lighting equipment was the second leading major cause. The percentage of fires, civilian injuries and deaths that occurred in 2007-2011 at different times of the day are presented in the figure below.

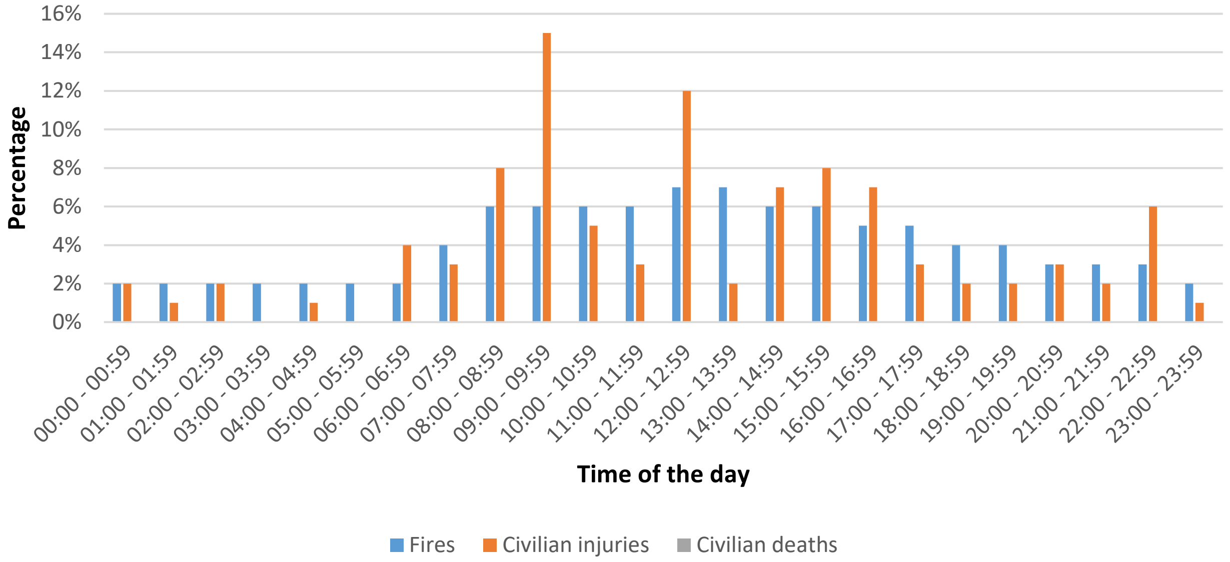


Figure 4-5: Percentage Of Fires, Civilian Injuries And Deaths At Different Times Of The Day (Offices)

The following graph that shows the ratio of injuries and deaths to total number of fires has been developed from the data presented in the previous figure. It can be noted that the number of fires during the day is almost four times as many as those during the night. The number of fires peak at midday and are the lowest in the night. This is likely due to the fact that office tenancies are generally unoccupied during the night.

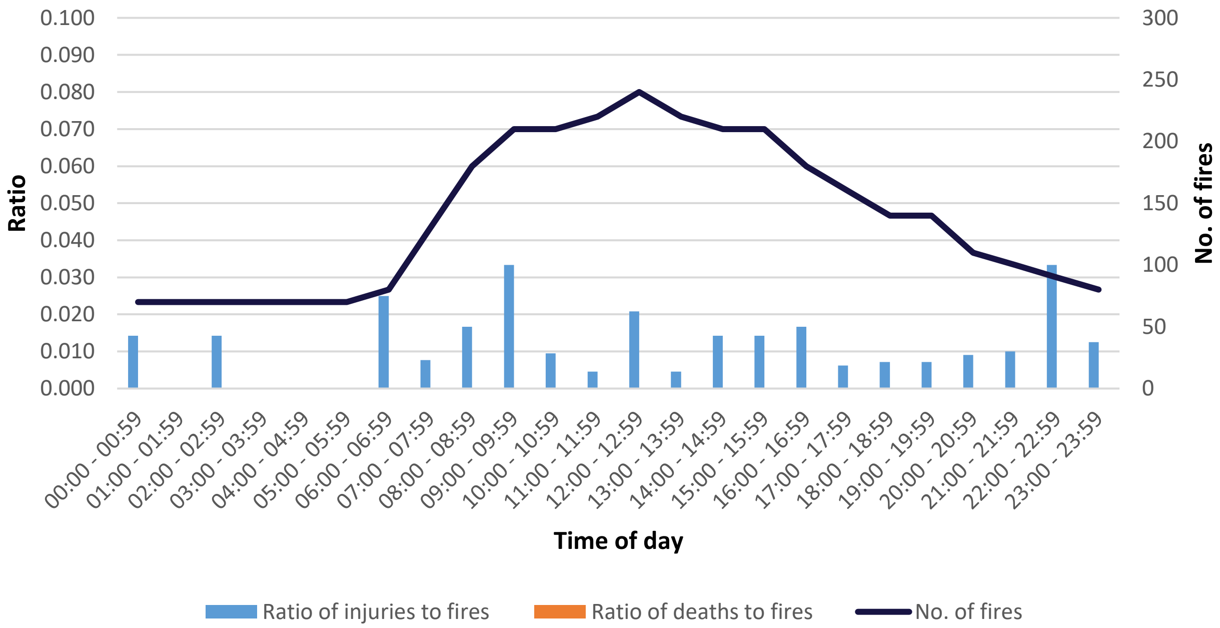


Figure 4-6: Number Of Fires, Ratio Of Injuries/Fires And Deaths/Fires For Different Times Of The Day (Offices)

The most common ignition sources in order of likelihood in office structure fires are:

- Cooking equipment (29%)
- Electrical distribution and lighting equipment (12%)
- Heating equipment (11%)
- Intentional (10%)
- Smoking materials (9%)

The most common fire origins in order of likelihood in office structure fires are:

- Kitchen or cooking area (22%)
- Unclassified outside area (4%)
- Lavatory, bathroom, locker room (4%)
- Lobby or entrance way (3%)
- Attic or ceiling/roof assembly or concealed space (2%)
- Duct for HVCA, cable, exhaust, heating or AC (2%)
- Machinery room or elevator machinery (2%)
- Unclassified storage area (2%)

5 BCA DTS NON-COMPLIANCE REVIEW

5.1 Overview

In this instance the BCA DTS non-compliances have been formulated based on a regulatory review undertaken by the project building surveyor and / or design team and through Affinity Fire Engineering experience of similar buildings of the size and nature as the subject development. Where not listed herein the building is required to achieve compliance with relevant DTS provisions and relevant codes, reports and Standards. The following table lists the proposed departures from the DTS provisions of the BCA for the development and the analysis methodology proposed for the Fire Engineering assessment.

5.2 BCA DTS Non-Compliance Assessment and Acceptance Criteria

Table 5-1: Summary of Performance Solutions

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA
Combustible Signage & Construction Elements
Relevant Regulatory Requirements BCA Clause C1.1 requires the building be constructed in accordance with Type A construction per BCA Specification C1.1. Table 3 of BCA Specification C1.1 requires a roof to be fire rated, however also affords a concession under Spec C1.1 Clause 3.5 that allows the FRL to be omitted if the roof covering is non-combustible and the building sprinkler protected throughout. BCA Clause C1.9 requires that a Type A construction building are to be provided non-combustible material for their building elements and their components, including the external walls and all their components incorporated in them such as façade, framing and insulation. BCA Clause C1.13 requires any sign attached to the external face of the external wall to be: - Non-combustible; or - Achieve a Group Number rating of 1 or 2 provided it does not extend beyond one storey, nor extend beyond one fire compartment. **Performance Requirement** The relevant performance requirement is CP2 **Non-Compliance To DTS Provisions** - The roof covering may incorporate polycarbonate translucent roof sheeting to allow natural light to pass down into the simulation hall floorplate. These roof lights are not non-combustible and therefore have been deemed non-compliant.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

- Signage shall be fitted to the external face of the external walls (e.g. Developer and Tenant signage). These signs shall be constructed of a polycarbonate material that has not been tested to achieve a Group 1 or 2 rating under AS5637.1:2015.
- Roller shutters providing access to the ground level simulation hall incorporate insulated panel door elements which do not achieve the AS1530.1:1994 requirements for combustibility.

Relevant IFEG Sub-Systems

ABCDEF

Approaches & Method of Analysis

The assessment shall be in accordance with BCA Clauses A2.2(1)(a) and A2.2(2)(b)(ii) as an absolute and qualitative evaluation of the roof elements and attachments to the non-combustible external wall. The assessment shall discuss that due to the limited available fire fuel load and otherwise non-combustible perimeter supporting structure, there is limited risk of fire spread.

Perimeter Vehicular Access

Relevant Regulatory Requirements

BCA Clause C2.4 requires vehicular access as a continuous means of passage for emergency vehicles in a forward direction around the entire building. Further to this, the roadway is required to have a width of no less than 6m, be located within 18m of the building and have nothing constructed on the pathway that obstructs passage.

Performance Requirement

The relevant Performance Requirement is CP9

Non-Compliance To DTS Provisions

- Vehicular perimeter access temporarily narrows to the measured values in lieu of the required 6.0m:
    - 4.5m along the western boundary between the site boundary and taxi and mini bus stops.
    - 3.5m between carparks located along the south-eastern building corner and the FRNSW appliance fire sprinkler staging area.

Relevant IFEG Sub-Systems

ABCDEF

Approaches & Method of Analysis

The assessment methodology will adhere to BCA Clause A2.2(1)(a) and A2.2(2)(b)(ii) in an absolute and qualitative approach. Performance Solution will demonstrate that the configuration of perimeter access combined with the fire safety systems installed within the building ensure that firefighting capabilities are able to be suitably maintained.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Travel Distance Egress Provisions

Relevant Regulatory Requirements

BCA Clause D1.4 states that in a Class 9b building the travel distance to the point of choice must not exceed 20m and to the nearest exit must not exceed 40m where more than one exit is available.

BCA Clause D1.5 states that the travel distance between alternative exits must not exceed 60m.

Performance Requirements

The relevant Performance Requirements are DP4 & EP2.2.

Non-compliance To DTS Provisions

Based on the expected location of exit doors, the following travel distances have been identified across the Ground level, level 1 and level 2 floorplates as exceeding the BCA Deemed-to-Satisfy limitations:

- Ground Level:
  - Up to 26m to a Point-of-Choice; and
  - Up to 50m to an exit in lieu of 40m; and
  - Up to 70m between alternative exits in lieu of 60m.
- Level 1 & Level 2:
  - Up to 25m to a Point-of-Choice; and
  - Up to 55m to an exit in lieu of 40m; and
  - Up to 80m between alternative exits in lieu of 60m.

Relevant IFEG Sub-Systems

ABCDEF

Approaches & Method of Analysis

The assessment methodology shall be undertaken in accordance with BCA Clauses A2.2(1)(b) and A2.2(2)(d) as a comparative and quantitative evaluation of the required safe egress time (RSET) of a reasonable person. The assessment shall demonstrate that through reducing the alarm time component of the RSET, this can suitably offset the additional time for an occupant to reach an exit in an equivalent or better time to a DTS compliant design.

Dimensions of Exits

Relevant Regulatory Requirements

BCA Clause D1.6 in a required exit or path of travel to an exit, the unobstructed width of each exit or path of travel to an exit, except for doorways, must be not less than 1m. The unobstructed width of a required exit must not diminish in the direction of travel to a road or open space, except where the width must increase to accommodate greater populations.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Performance Requirements

The relevant Performance Requirements are DP2, DP4 & DP6.

Non-Compliance To DTS Provisions

The gantries serving access from the Level 1 access mezzanine to all flight simulators narrow to less than the required 1m clear egress width. Similarly, those paths within the aircraft cabin training rooms and between SIM bays, the egress paths out shall not achieve the 1m clear width.

Relevant IFEG Sub-Systems

ABCDF

Approaches & Method of Analysis

The absolute and qualitative assessment shall be in accordance with BCA Clauses A2.2(1)(a) and A2.2(2)(b)(ii) to evaluate these gantries relative to Australia Standard 1657:2018 for fixed platforms, walkways, stairways and ladders relative to the occupant characteristics and building use. The assessment shall demonstrate that access along these gantries and through the aircraft cabins permit the occupant type to safely move through to an exit.

Fire Hydrant System Design

Relevant Regulatory Requirement:

BCA Clause E1.3 requires that a fire hydrant system be provided and installed in accordance with AS2419.1:2005 which in turn requires that:

- External hydrants located at the wall of the building must be provided with a radiant heat shield (90/90/90 FRL) a minimum 2m each side of the hydrant and 3m above the base of the hydrant.

Performance Requirement

The relevant Performance Requirement is EP1.3

Non-compliance with DTS provisions:

The following non-conformances have been identified and intended to be addressed through a Performance Based Solution:

- External fire hydrants shall be located within 10m of the external wall and shall not be provided with the AS2419.1:2005 required 90/90/90 FRL protecting walls.

Relevant IFEG Sub-Systems:

ABCDEF

Approaches and Method of Analysis:

The assessment will adhere to BCA Clause A2.2(1)(a) and A2.2(2)(b)(ii) and will be qualitative and absolute, with minor quantitative elements. The Performance Solution for external hydrant design

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

relies on the area's ability to maintain tenable conditions for fire fighters to connect to the hydrant point.

Fire Sprinkler Infrastructure Location

Relevant Regulatory Requirement:

BCA Clause E1.5 requires that fire sprinklers to be installed in accordance with AS2118.1:2017 which in turn requires under Clause 4.14.1 that the sprinkler booster and suction be located in accordance with AS2419.1:2005 requirements.

AS2419.1:2005 requires the booster assembly must be located as follows when remote from the building:

- At the boundary of the site; and
- Within sight of the main entrance of the building; and
- Adjacent to the principal vehicular access to the site; and
- Not less than 10m from the external wall of any building served.

Performance Requirement

The relevant Performance Requirement is EP1.4

Non-compliance with DTS Provisions

The following non-conformances have been identified in relation to the fire sprinkler booster assembly location:

- The fire sprinkler booster assembly is not:
    - On the site boundary; and
    - In sight of the main entrance; and
    - Adjacent to the principle vehicular access.

Relevant IFEG Sub-Systems:

ABCDEF

Approaches and Method of Analysis:

The assessment will incorporate an absolute and qualitative approach in adherence to BCA Clause A2.2(1)(a) and A2.2(2)(b)(ii) where the analysis is an absolute and qualitative evaluation demonstrating that the location of the fire sprinkler booster enables fire brigade operations. The assessment rationalises that with the inclusion of fire brigade infographic block plans and being located along the perimeter vehicle path, the location of the fire infrastructure can be promptly located and utilised.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Fire Sprinkler Coverage

Relevant Regulatory Requirements

BCA Clause E1.5 and subsequently BCA Specification E1.5 illustrate the provisions and design requirements for the inclusion of automatic sprinkler systems.

The BCA references AS2118.1:2017 for the design requirements and performance of the automatic sprinkler system. In turn this Australian Standard provides the requirements on the coverage of the sprinkler system and, the conditions of where sprinklers may be omitted.

Performance Requirements

The relevant Performance Requirement are CP2 & EP1.4

Non-Compliance To DTS Provisions

Automatic fire sprinkler coverage shall not be provided to the following locations:

- The exterior equipment training and storage area, situated in the south-eastern corner of the building, is covered by an awning which is physically attached to the main structure.
- Within the eight aircraft cockpit flight simulators located on the ground level simulation hall.
- Fire sprinkler coverage shall be shielded beneath the eight aircraft flight simulators.
- Within the ground level "wide body training" aircraft cabin and Level 1 door trainer areas.
- Within ground level MDB / Electrical Room.
- Within the Level 1 computer rooms.

Relevant IFEG Sub-Systems

ABCDEF

Approaches and Method of Analysis

The assessment shall be undertaken in accordance with BCA Clauses A2.2(1)(a) and A2.2(b)(ii) in an absolute and qualitative evaluation of fire sprinkler omission to the specific part of the building. The assessment shall evaluate the proximity of the adjacent parts of the building to demonstrate that due to the activities and passive fire protection, fire spread shall be unlikely to occur.

Rationalised Automatic Smoke Exhaust System

Relevant Regulatory Requirements

BCA Clause E2.2 and BCA Table E2.2b Specific Provisions require that other Class 9b assembly buildings (excluding schools) having a fire compartment floor area more than 2,000m^2 be provided with an automatic smoke exhaust system complying with BCA Specification E2.2b or, automatic smoke-and-heat vents complying with BCA Specification E2.2c.

Performance Requirement

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

The relevant Performance Requirement is EP2.2

Non-Compliance To DTS Provisions

The engineering strategy rationalises the performance and fan locations for the facility whereby:

- No automatic smoke exhaust system be provided to the ground level, level 1 or level 2 internal training areas.
- The automatic smoke exhaust system provided to the simulation hall shall be in accordance with BCA provisions and AS1668.1:2015 with the following exceptions:
    - A smoke extraction rate of one simulation hall volumetric air change per hour in lieu of the extraction rates detailed defined by in BCA Specification E2.2b.

Relevant IFEG Sub-Systems

ABCDEF

Approaches and Method of Analysis

The absolute and qualitative assessment shall be in accordance with BCA Clauses A2.2(1)(a) and A2.2(b)(ii) which demonstrates that through the use of the building, the occupant characteristics and supporting comparison other building types which do not necessitate smoke hazard management, the provided bespoke automatic smoke exhaust system achieves the performance requirements.

6 PROPOSED FIRE SAFETY STRATEGY

The fire safety strategy outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the fire safety strategy is required to adequately address the specific fire and life safety hazards identified for the proposed development, and as such have been generally derived from the preventative and protective measures outlined within the BCA, and fire engineering literature and research.

The specified fire safety strategy will undergo analysis as part of a Fire Engineering Report to ascertain whether the relevant Performance Requirements of the BCA are satisfied. The information herein is therefore pending completion of the fire engineering analysis and as such is possible to change and or modification through the detailed design phase of the project.

6.1 Passive Fire Construction

6.1.1 Fire Resisting Construction

The building structure including floors, walls, columns and shafts shall be constructed in accordance with the requirements of BCA Clause C1.1, Specification C1.1 for Type A Construction. As part of the Performance Solution to address the rationalised automatic fire sprinkler coverage (see Section 6.3.5) the following passive fire resistant construction is required:

- The external wall supporting the external awning must be fire rated to achieve a 120/120/120 FRL for a minimum of 3m above the awning.
- The external awning must be constructed of entirely non-combustible materials.
- The adjacent rainwater tank must be constructed of non-combustible materials.
- The Level 1 south facing window (overlooking the awning) must be non-operable and constructed with minimum 6mm thick toughened glazing, fitted with non-combustible frames.

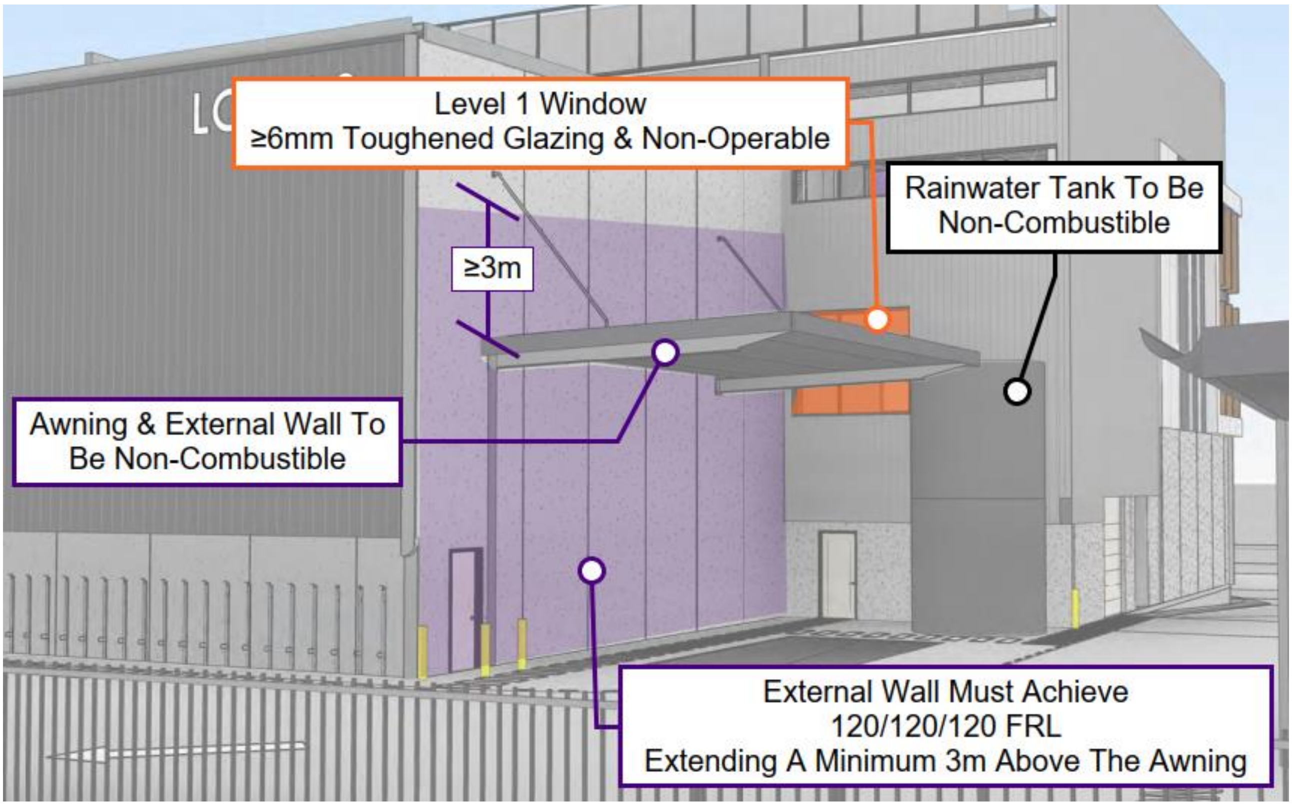


Figure 6-1: South-Eastern Building Corner Awning Passive Fire Resistant Measures

6.1.2 Separation of Equipment

Rooms containing equipment listed below must be fire separated from the remainder of the building by construction in accordance with Specification C1.1 or 120/120/120 FRL construction, whichever is greater, with any door opening into that room consisting of a --/120/30 FRL self-closing fire door.

- Lift motors and lift control panels (unless the lift installation does not have a machine-room); or
- Emergency generators used to sustain emergency equipment operating in emergency mode; or
- Central smoke control plant (other than smoke exhaust systems designed for high temperature operation); or
- Boilers; or
- A battery system installed in the building that have a total voltage of 12 volts or more and a storage capacity of 200kWh or more.

Electricity supply systems inclusive of electricity substations located within a building and main switchboard located within the building which sustains emergency equipment operating in the emergency mode (i.e. the smoke exhaust fan switchboard) must meet the requirements of BCA Clause C2.13. This includes the requirements of being separated from any other part of the building by construction having:

- An FRL of not less than 120/120/120: and
- Any doorway in that construction protected with a self-closing fire door having an FRL of not less than --/120/30.

The fire engineering strategy requires that the ground level MDB / Electrical Room and the Level 1 computer rooms are fire separated from the remainder of the building achieving a 120/120/120 FRL where these areas accommodate battery storage facilities and are not provided automatic fire sprinklers (see Section 6.3.5).

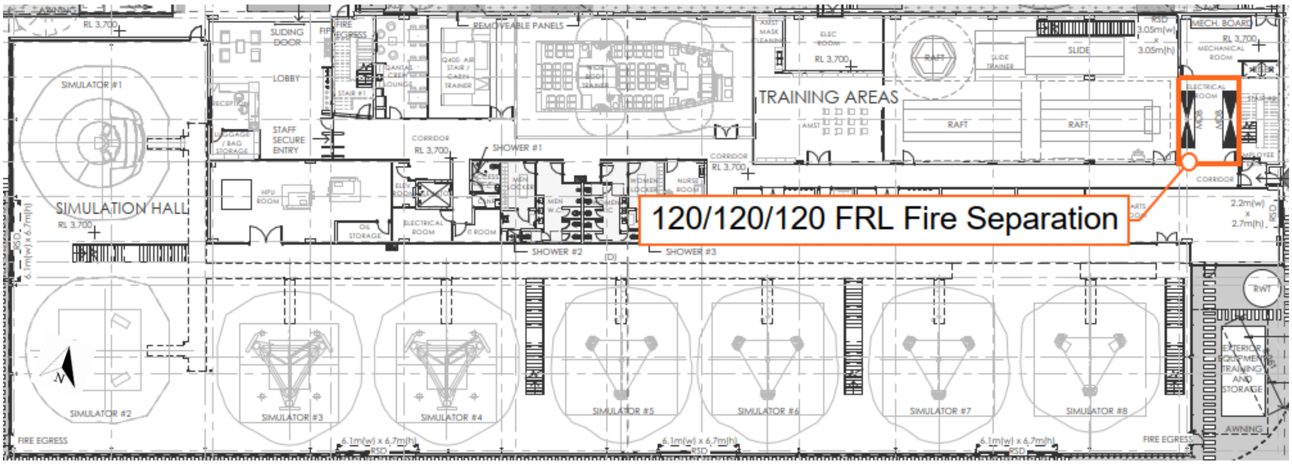


Figure 6-2: Ground Level MDB Room Fire Separation

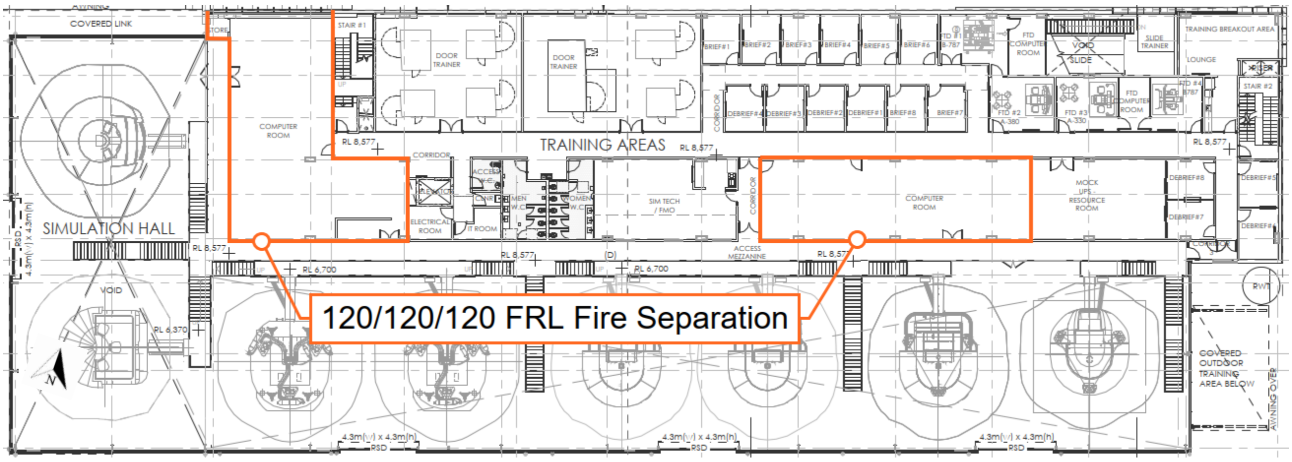


Figure 6-3: Level 1 Computer Room Fire Separation

All doors opening into these level 1 computer rooms must be AS1905.1:2015 fire doors achieving a --/120/30 FRL and may be fitted within appropriate vision panels. Furthermore, all window openings incorporate into the firewalls are to be provided with automatically descending AS1905.2:2005 fire shutters/curtains which achieve a --/120/120 FRL.

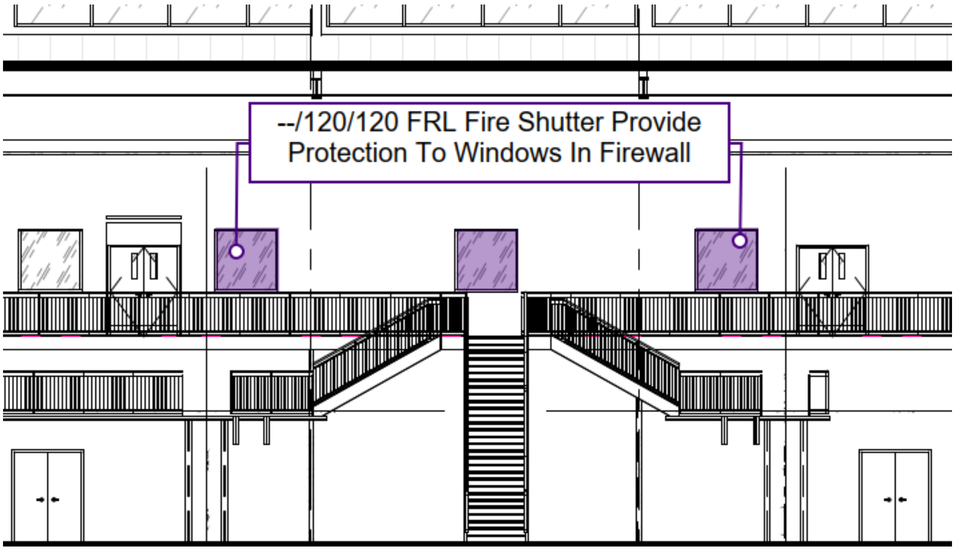


Figure 6-4: Elevation Example Of Internal Firewall Walls Fitted With Fire Shutters

6.1.3 Service Penetrations

All service penetrations are to be sealed in accordance with BCA Clause C3.15 and BCA Specification C3.15 to ensure that the fire and smoke resisting performance of the element through which it passes is maintained.

6.1.4 Finishes and Linings

Where practicable, internal finishes, internal linings and internal materials used throughout the building should be non-combustible to reduce the spread of fire and the generation of toxic smoke products.

All wall, floor and ceiling, and roof and ceiling assemblies must be tested and rated for their fire hazard properties in accordance with the prescriptive requirements of BCA Clause C1.10 and Specification C1.10.

6.1.5 Non-Combustible Materials

As part of the requirements for Type A Construction, roof covering, lift pits and external walls including their components and any attachments (both internal and external), are to be non-combustible and/or compliant with BCA Clause C1.9 and C1.14 with the following exceptions;

- The roof covering may incorporate polycarbonate translucent roof sheeting to allow natural light to pass down into the simulation hall floorplate. These roof lights are not non-combustible and therefore have been deemed non-compliant.
- Signage shall be fitted to the external face of the external walls (e.g. Developer and Tenant signage). These signs shall be constructed of a polycarbonate material that has not been tested to achieve a Group 1 or 2 rating under AS5637.1:2015.
- Roller shutters providing access to the ground level simulation hall incorporate insulated panel door elements which do not achieve the AS1530.1:1994 requirements for combustibility.

As part of the above Performance Solution, the following fire safety measures shall be incorporated into the building design:

- The translucent roof sheeting must consist of a polycarbonate material.
- The total quantity of translucent roof sheeting must not exceed 20% of the total roof covering.
- The translucent roof sheet locations must be coordinated with the fire sprinkler design to ensure there are no roof sheets located directly above a sprinkler heads.

6.1.6 Rooftop Solar Panels

The following measures shall be provided due to the inclusion of the solar panels installed on the roof of the building;

- A minimum of an A3 sized block plan shall be provided at the Main-FDCIE to alert the attending fire fighters of the presence of all key components inclusive, but not limited to the location of the solar panels, inverters, operating voltage and current, location of storage equipment and respective battery type.
- The location of all associated isolation switches, AC and DC isolators for the shut-off of generated electricity shall be displayed at the Main-FDCIE with brief instructions of the safe process to subdue the hazard.
- Notification shall also be provided detailing whether the solar panels are programmed to automatically shutdown on fire trip, or whether manual isolation is required by attending fire fighters.

Where the battery storage devices for the solar array are of lithium-Ion design, the batteries shall be contained within a dedicated enclosure incorporating the following minimum fire safety measures;

- The room shall be separated from other areas of the building by a minimum 120/120/120 FRL. Doors within a fire rated wall to be a fire door achieving a --/120/30 FRL per AS1905.1:2015.
- The enclosure shall have direct access to outside.
- The room shall be protected with an automatic fire sprinkler system in accordance with AS2118.1:2017.
- An external fire hydrant, located no closer than 10m from the room, shall be located outside to provide coverage of the enclosure.

6.1.7 Insulated Sandwich Panels

Where future tenancy fit outs contain temperature-controlled areas with Freezers, Cool Rooms or the like, and Insulated Sandwich Panels (ISP) are incorporated in the design. The ISP shall consist of material that meet the following requirements to ensure a suitable degree of fire mitigation.

- All sandwich panels must be installed in accordance with the “Insulated Panel Council Australasia (IPCA) Code of Practice (CoP) - Version 4.3”.
- The panels must be installed by an accredited installer as recognised by the Code of Practice prepared by IPCA (refer website: http://www.insulatedpanelcouncil.org/code-compliant-companies).
- Certification must be provided from the accredited installer prior to final occupation certificate being issued for the building.
- All future works, modifications or repairs must be completed using ISP with the same core and material type (i.e. the panel must not be substituted with a product having an EPS or PUR core).
- Signage and block plans will be required around the site adjacent to each sprinkler and hydrant block plan to alert fire fighters to the following:
    - Location of all sandwich panels installed.

- Type of sandwich panels installed (commercial brand and core material).

6.2 Egress Provisions

6.2.1 Alarm & Evacuation Strategy

Activation of any sprinkler head, smoke detection device or manual call point shall initiate the building occupant warning alarm tones throughout the building.

Dedicated fire wardens shall ensure that all patrons, any visitors, maintenance contractors and staff are promptly evacuated if a fire is identified anywhere in the building.

6.2.2 Egress Provisions

With exception of the following items being addressed through a fire engineered Performance Solution, travel distances to a point of choice or single exit to be not more than 20m, the distance to the nearest of two or more alternative exits must not exceed 40m and the distance between alternative exits must be no closer than 9m and no further apart than 60m.

The fire engineering assessment shall address travel distances that have been identified as being non-compliant in the following listed locations. See also the most onerous egress distances in Figure 6-5 and Figure 6-6.

- Ground Level:
    - Up to 26m to a Point-of-Choice; and
    - Up to 50m to an exit in lieu of 40m; and
    - Up to 70m between alternative exits in lieu of 60m.
- Level 1 & Level 2:
    - Up to 25m to a Point-of-Choice; and
    - Up to 55m to an exit in lieu of 40m; and
    - Up to 80m between alternative exits in lieu of 60m.

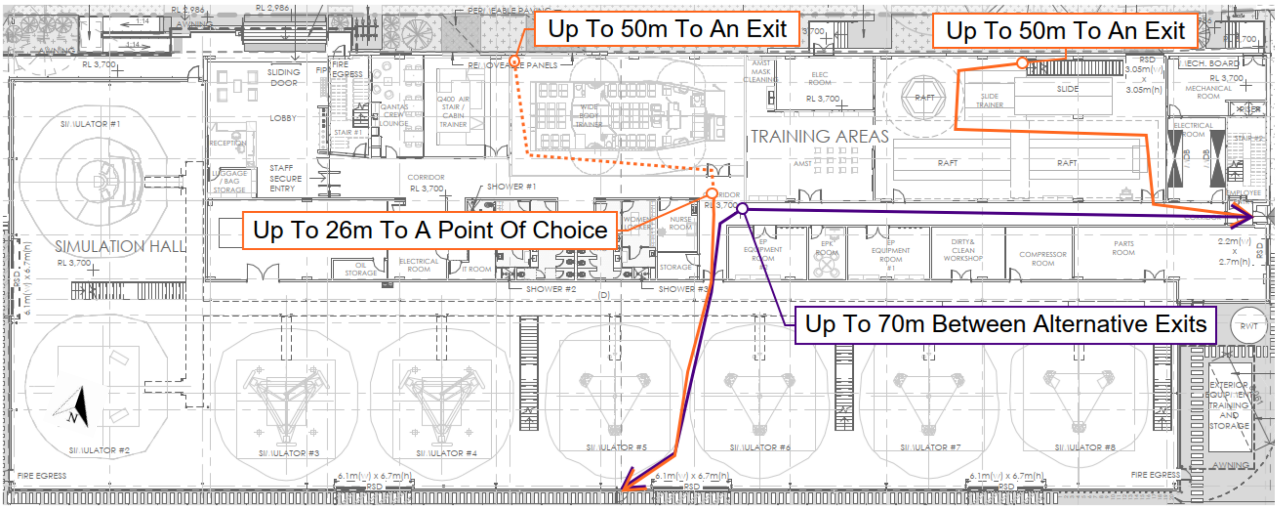


Figure 6-5: Ground Level Travel Distances

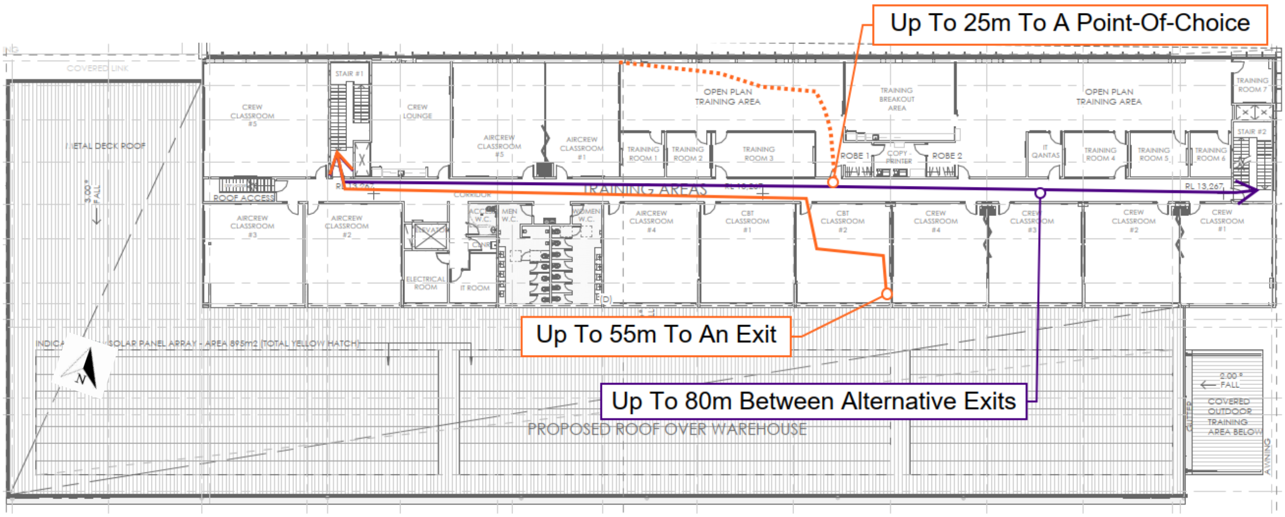


Figure 6-6: Level 1 & Level 2 Travel Distances (Level 2 Shown)

Design Note: *Additional exit and egress doors may be required and/or modification to accommodate future fit outs or layouts and ensure the travel distance limitation defined by Fire & Rescue NSW, "no point in a fire compartment is to be more than 100m from a hydrant external to that compartment". This shall be determined through detailed design phase of the project.*

6.2.3 Construction of Exits

The building accommodates multiple stairs for egress whereby those serving evacuation from Level 1 and Level 2 may be designed as non-fire-isolated stairs. This is predicated on BCA Clause D1.3 concessions for a building having a rise-in-storey of three and being fire sprinkler protected with an AS2118.1:2017 system.

All stairs and walkways must achieve the dimensional requirements of BCA Clause D1.6 and as part of the performance solution, the following exceptions are permitted:

- The gantries serving access from the Level 1 access mezzanine to all flight simulators narrow to less than the required 1m clear egress width. Similarly, those paths within the aircraft cabin training rooms and between SIM bays, the egress paths out shall not achieve the 1m clear width.

6.2.4 Door Hardware, Operation and Mechanisms

All doors serving as required exits shall have hardware, door swings, latch operations and signage in accordance with the prescriptive requirements of BCA Clauses D2.19, D2.20, D2.21 and D2.23.

6.2.5 Signage and Lighting

Exit and emergency lighting is to be provided throughout the building in accordance with the prescriptive DTS provisions of BCA Clause E4.2, E4.4, E4.5, E4.6, E4.8 and AS2293.1:2018.

- Exit signs are to be pictograph 'running man' signs as per the prescriptive requirements of AS2293.1:2018.
- All exit and directional exits signs are to be power operated illuminated signs.

6.3 Active Fire Protection Systems

6.3.1 Fire Control & Indicating Equipment

The site shall be served by the Main Fire Detection Control & Indicating Equipment (FDCIE) located within a dedicated Fire Control Centre designed and installed in accordance with BCA Specification E1.8 and the requirements of AS1670.1:2018.

The Fire Control Centre will be a dedicated area within the office main entry lobby. The FDCIE shall be designed with the following capabilities.

- Have the ability to enable, disable & reset zones / alarms throughout its respective building.
- The site ASE shall be located at this FDCIE.
- Contain the smoke hazard management controls / FFCP for the building.

6.3.2 Fire Brigade Alarm Signalling Equipment

An automatic link shall be provided directly to an approved monitoring centre on activation of the fire sprinkler and smoke detection systems installed in the building.

- The ASE unit shall ensure compliance with the DtS Provisions and AS1670.3:2018.
- The fire brigade turnout address shall be Burrows Road at the office entry lobby.

6.3.3 Building Alarm and Communication System

A Building Occupant Warning System (BOWS) shall be provided throughout each building. The system shall be in accordance with the prescriptive requirements of Specification E1.5 and Clause 6 of Specification E2.2a and AS1670.1:2018.

Activation of any fire sprinkler head, smoke detector or manual call point shall initiate the Building Occupant Warning System.

6.3.4 Automatic Smoke Detection System

An automatic smoke detection is required to be installed as part of the DtS required smoke exhaust system necessary in a large isolated building. This smoke detection system must be installed in accordance with Clause 6 of BCA Specification E2.2a and AS1670.1:2018, however as part of the Performance Solution the following design shall take precedence:

Training Areas

- The training areas shall be provided with an automatic smoke detection system spaced in accordance with AS1670.1:2018 Section 5. Detectors shall be located in each room on a grid layout not more than 10m apart and not more than 5m from any wall or bulkhead.
    - Point type AS1670.1:2018 smoke detectors must be installed within all mock aircraft enclosures (Ground Level wide body trainer, door trainers, etc.).
- The system shall be designed to activate the building's smoke hazard management systems, the building occupant warning system, the ASE signal to brigade any ancillary trips such as door latch release and/or mechanical shutdown.

Simulation Hall

- Simulation hall areas shall be provided with roof level automatic smoke detection spaced in accordance with AS1670.1:2018 Section 7.
- The eight flight simulators shall be fitted with Aspirating Smoke Detection (ASD) internally.
- The system shall be designed to activate the building's smoke hazard management systems, the building occupant warning system, the ASE signal to brigade any ancillary trips such as door latch release and/or mechanical shutdown.

6.3.5 Automatic Fire Sprinkler System

A fire sprinkler system shall be provided throughout each building in accordance with the prescriptive requirements of BCA Specification E1.5 and AS2118.1:2017 with the conditional exception of the following:

The fire sprinkler booster assembly location shall not be:

- located at the boundary of the site; and
- located within sight of each building's main entrance; and
- located adjacent to the principal vehicular access to the site.

Automatic fire sprinkler coverage shall not be provided to the following locations:

- The exterior equipment training and storage area, situated in the south-eastern corner of the building, is covered by an awning which is physically attached to the main structure.
- Within the eight aircraft cockpit flight simulators located on the ground level simulation hall.
- Fire sprinkler coverage shall be shielded beneath the eight aircraft flight simulators.
- Within the ground level "wide body training" aircraft cabin and level 1 door trainer areas.
- Within ground level MDB / Electrical Room.
- Within the Level 1 computer rooms.

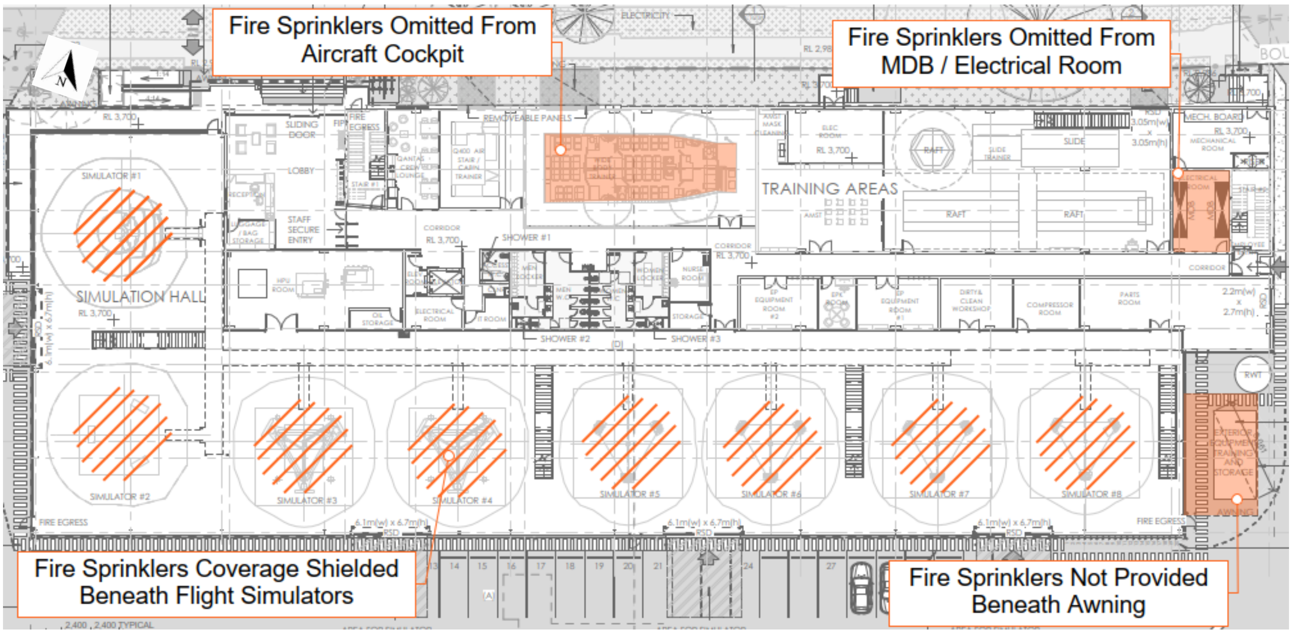


Figure 6-7: Ground Level Areas Without Fire Sprinkler Coverage

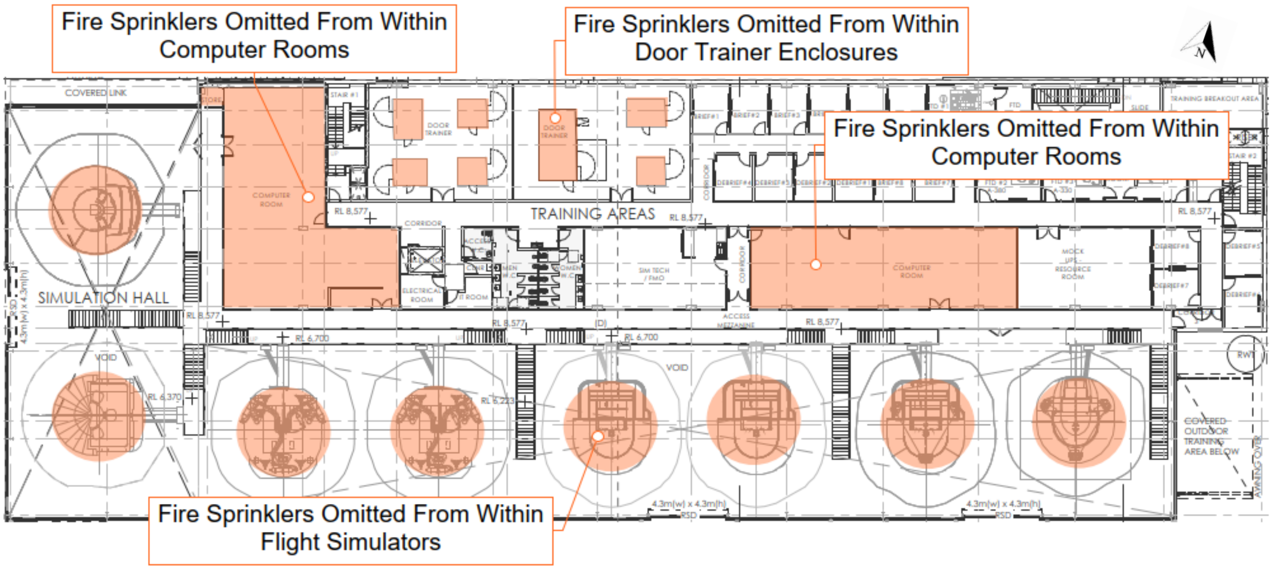


Figure 6-8: Level 1 Areas Without Fire Sprinkler Coverage

As part of the fire sprinkler system design, the following must be incorporated:

- The fire sprinkler booster assembly must ensure adequate staging area for pumping appliances as per FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"* available at https://www.fire.nsw.gov.au/ and AS2118.1:2017. This must not restrict vehicular access around the site.
- The onsite sprinkler pumps, water storage tanks and associated infrastructure must ensure compliance with DTS provisions and AS2118.1:2017.
- The sprinkler block plans must be provided at each FDCIE.

The general arrangement of the fire sprinkler infrastructure for the site is illustrated in Figure 6-9.

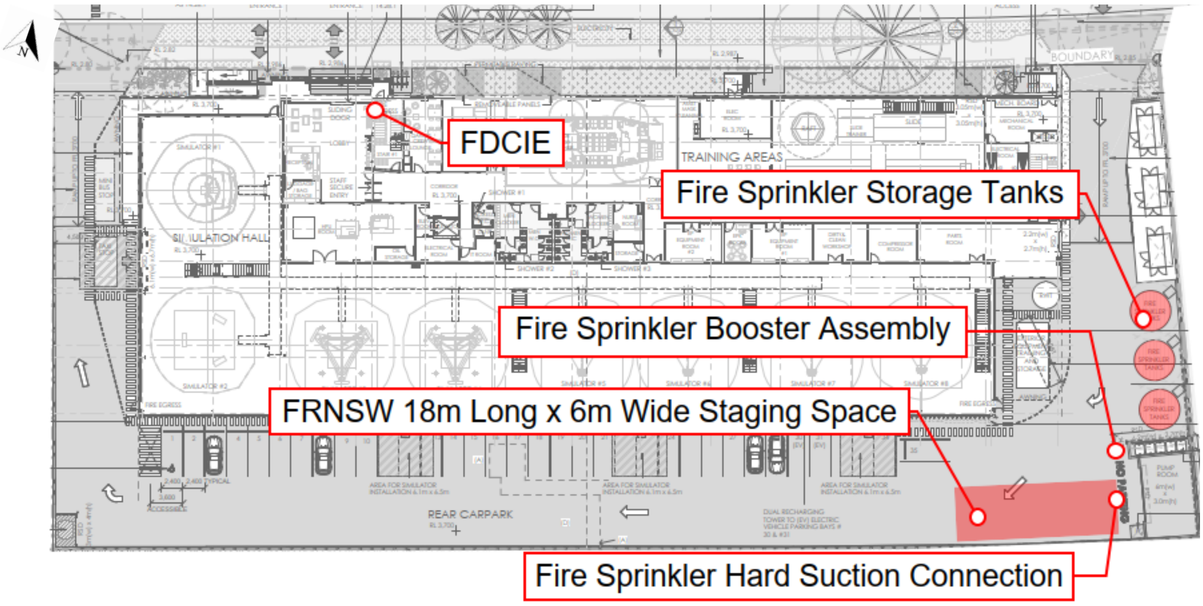


Figure 6-9: Fire Sprinkler Infrastructure & Main FDCIE Location

Fire & Rescue NSW Hardstand Requirement

As detailed in FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"*, any hardstand serving a suction-connection outlet is to have a working space which extends a minimum 18m from the point of connection to allow a semi-rigid suction hose to be connected to the rear of the fire appliance. This is demonstrated in Figure 6-10.

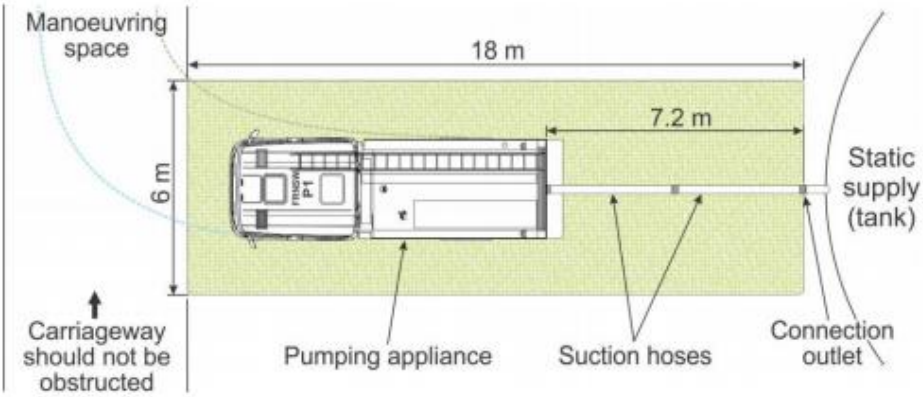


Figure 14 Hardstand area serving a suction-connection outlet

Figure 6-10: FRNSW Access For Fire Brigade Vehicles & Firefighters Excerpt (State Govt NSW 2019)

The preliminary fire engineering assumes that the fire sprinkler suction point is located inward facing to the hardstand and hence necessitate an appliance to back up against it. The orientation of the suction point may be adjusted so long as the design reflects the FRNSW requirements for as detailed in FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"*. Connection orientations are as per excerpt from the aforementioned FRNSW document per Figure 6-11.

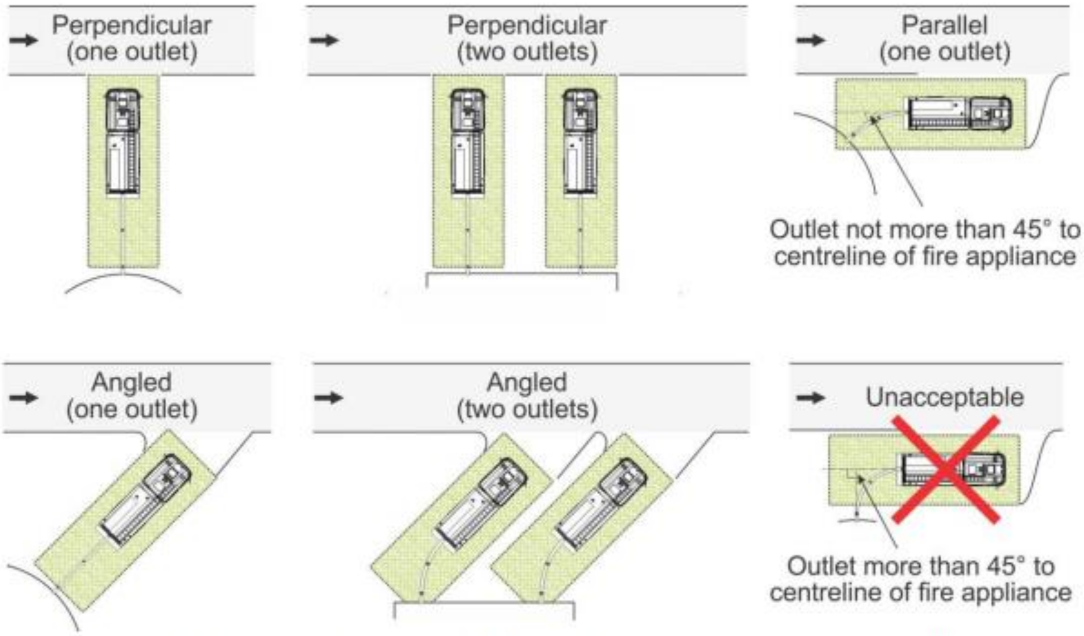


Figure 15 Example of orientation of hardstand area for suction-connection outlets

Figure 6-11: FRNSW Access For Fire Brigade Vehicles & Firefighters Excerpt (State Govt NSW 2019)

Notwithstanding, a detailed design of the fire sprinkler suction connection point and booster assembly respectively must be undertaken by the fire sprinkler design consultant to meet the desired requirements. Note that a minimum 6m clear width must be maintained past any appliance staging area to meet the requirements of BCA Clause C2.4 unless otherwise permitted by the fire engineering strategy.

6.3.6 Automatic Smoke Hazard Management Systems

An automatic smoke exhaust system shall be provided to the building in accordance with prescriptive DtS provisions of BCA Specification E2.2b and AS1668.1:2015 with the following exceptions addressed through a fire engineered Performance Solution:

Training Rooms

- No automatic smoke exhaust system be provided to the ground level, level 1 or level 2 internal training areas, only the simulation hall.

Simulation Hall

- The automatic smoke exhaust system provided to the simulation hall shall be in accordance with BCA provisions and AS1668.1:2015 with the following exceptions:
    - A smoke extraction rate of one simulation hall volumetric air change per hour in lieu of the extraction rates detailed defined by in BCA Specification E2.2b.

As part of the fire engineered Performance Solution for Smoke Hazard Management, the following must be provided:

- The automatic smoke exhaust system must be designed in accordance with BCA Specification E2.2b and AS1668.1:2015 unless otherwise notes as part of this fire engineering strategy.
- A mechanical block plan shall be provided at the Main FDCIE and incorporate:
    - Signs alerting the Fire Brigade to the operation of the smoke exhaust system.
    - A schematic of the system detailing fan extraction rates, and make-up air locations and free area requirements.
    - Reference the Fire Engineering Report.
    - Make notification that no smoke exhaust is provided to the office, carparking and breezeway areas.
- Automatic smoke exhaust system must be connected to the site's essential power source.

6.4 Occupant Fire Fighting Facilities

6.4.1 Fire Hose Reel

Fire hose reels are to be provided throughout each building in accordance with the prescriptive DTS provisions of BCA Clause E1.4 and AS2441:2005.

6.4.2 Portable Fire Fighting Equipment

Portable fire extinguishers are to be provided throughout each building in accordance with Table E1.6 of the BCA.

The type of extinguisher should be selected in accordance with the prescriptive DTS provisions with consideration for the guidelines detailed in AS2444:2001.

General office areas	Dry Powder (ABE type)	2.5Kg
Computer/server rooms	CO_2	3.5 Kg
Plant rooms	Dry Powder (ABE)	2.5 Kg
Designated exits	Dry Powder (ABE)	4.5 Kg
Adjacent each fire hose reel cabinet	Dry Powder (ABE)	4.5 Kg

6.5 Fire Brigade Intervention

6.5.1 Fire Hydrant System

A fire hydrant system shall be provided throughout the building in accordance with the prescriptive requirements of Clause E1.3 and AS2419.1:2005 with the following exceptions which shall be addressed through a fire engineered Performance Solution:

- The required 90/90/90 FRL protecting wall behind each external hydrant is to be omitted through the Performance Solution with the design relying on the sprinkler system installed throughout the building.

As part of the Performance Solution and typical Fire & Rescue NSW requirements, the system shall incorporate the following measures:

- The system shall incorporate a ring main and associated isolated valves as required for a large isolated building. Isolation valves shall be numbered with those corresponding numbers indicated on the hydrant block plan.
- All connection points must be fitted with Storz hose couplings which comply with Clause 7.1 and 8.5.11 of AS2419.1:2005, as well as comply with FRNSW Technical Information D15/45534 for *"FRNSW compatible Storz hose connections"*. Further information is available from FRNSW available at www.fire.nsw.gov.au.
- Per the request of FRNSW, as far as possible the hydrant system should consist of external hydrant points, with internal hydrants only provided to where there are shortfalls in coverage from external hydrants.
    - Where internal hydrants are required;
        - They must be designed to allow progressive movement through the building such that an internal hydrant is within 50m of an external hydrant and 25m of an internal hydrant.
        - A localised block plan must also be provided at every hydrant pictorially and numerically illustrating the location of the next available additional hydrant. These localised block plans should be of a size appropriate to their notice and location and be of all-weather fade resistant construction.
- The hydrant system is to be connected to a pressurised town mains water supply to ensure a continuous and inexhaustible water supply for firefighting.
    - Where on site tanks are required, the tank must have a refill functionality linked direct from the pressurised town main supply.
- *See additional requirements above relative to solar panel batteries.*

6.5.2 Vehicular Perimeter Access

Emergency vehicular perimeter access pathway shall be provided around each building. This shall be designed and constructed in all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Clause C2.4 and FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"* (available from www.fire.nsw.gov.au) with the following exceptions conditionally permitted:

- Vehicular perimeter access temporarily narrows to the measured values in lieu of the required 6.0m:
  - 4.5m along the western boundary between the site boundary and taxi and mini bus stops.
  - 3.5m between carparks located along the south-eastern building corner and the FRNSW appliance fire sprinkler staging area.

The vehicular perimeter path for emergency vehicles is as indicated in Figure 6-12 where the purple line represents compliant portions and orange indicating the sections reduced to less than 6m clear width.

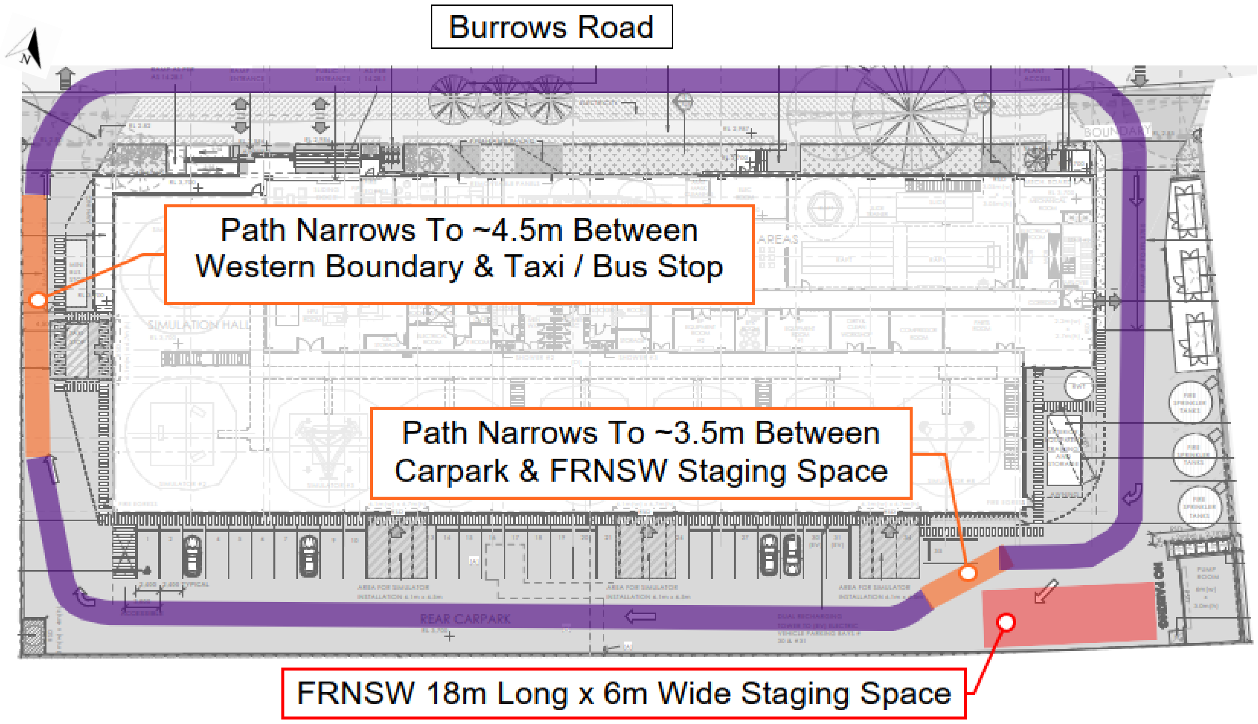


Figure 6-12: Vehicular Perimeter Path Around the Site with Non-Compliant Portions Highlighted

To facilitate the perimeter access non-conformances the following measures shall be provided as part of the Performance Solution:

- Sweep paths along the perimeter access path must be confirmed by traffic engineer to facilitate the turning circle of FRNSW general fire appliance and specialist fire appliances as detailed in FRNSW Fire Safety Guideline "*Access for fire brigade vehicles and firefighters*".
- Security gates positioned across the vehicular access pathway must have an unobstructed width no less than 6.0m and be;
  - Manually openable gates: are to be locked with a loose chain and padlock unlockable by fire brigade 003 keys; and

    - Mechanically driven gates: must be provided with a manual override that is accessible to attending fire brigade personnel with block plans indicating the manual overridable gates inclusive with pictorial step-by-step instructions at each FDCIE.
- Roadway gradients shall not hinder vehicle response and must be suitable for heavy vehicles in accordance with Australian Standards and FRNSW Fire Safety Guideline *"Access for fire brigade vehicles and firefighters"*.
- The fire appliance access road and surface are all weather and are capable of supporting the maximum appliance weights expected during fire conditions. The roadway should be designed to withstand a uniformly distributed load over the entire area as per the Fire and Rescue requirements. This would provide the necessary stability for fire-fighting appliances (pumping), and if necessary, the use of a heavier fire-fighting (aerial) appliances.
- The SEARS fire and incident management requirement for FRNSW vehicle access shall be demonstrated to achieve FRNSW Fire Safety Guideline, Access for fire brigade vehicle and firefighters (v05.01) and hence the NCC performance requirement CP9.

6.6 Building Management Procedures

The ongoing management of the building is as important in maintaining a high level of life safety as the provisions recommended during the design phase of the building.

6.6.1 Maintenance of Fire Safety Equipment

The fire detection systems, fire sprinkler systems, emergency warning systems, fire hydrants, hose reels, portable fire extinguishers, emergency lighting and any other fire safety equipment shall be tested and maintained in accordance with Australian Standard AS1851 or other relevant testing regulatory.

6.6.2 No Smoking Policy

A no-smoking policy shall be implemented and enforced through all internal areas of the building.

6.6.3 Fire Safety Manual

A fire safety manual shall be developed for the site to provide an overview of all fire safety procedures and systems within the building. The manual should also record false alarms, outcomes from fire drills and provide details of the ongoing maintenance and inspection procedures. The manuals should be reviewed annually and a lessons learned exercise undertaken. Any conclusions drawn from this exercise should be implemented into the fire safety procedures.

6.6.4 Emergency Management Plan

An Emergency Management Plan (EMP) must be developed in accordance with AS3745:2010. The EMP must;

- Developed by an emergency planning committee (EPC).
- Implement emergency control organisation (ECO) procedures for the building.
- Specifically address the types of emergencies that may arise from the industry and/or activities associated with the business operations.

- Ongoing training, education and execution of the emergency management procedures to be regularly conducted with all building occupants.
- An evacuation plan should be developed for the site in accordance with AS3745:2010 and standard fire orders should be displayed throughout the building.

6.6.5 Dangerous Goods

Should future use of the facility incorporate the use and/or storage of dangerous goods outside the purpose of frequent maintenance purposes, the site will require review and assessment by a suitably qualified Risk Consultant to determine the associated hazards and required preventative measures to meet BCA Clause E1.10 and E2.3. The fire engineering strategy shall be required to meet the following requirements:

- Storage of dangerous or hazardous goods on this site will require re-assessment of the fire engineering analysis by a registered Certifier - Fire Safety.
- Where the storage quantity trigger requirements for a fire safety study, the above re-assessment of fire engineering analysis must also be submitted to Fire and Rescue NSW for the key stakeholder's review and support.

6.6.6 Hot Works Policy

A hot works policy should be put in place and rigorously enforced to ensure that all hot works, including grinding and welding, are managed to avoid the accidental ignition of fires.

6.6.7 Fire Drills and General Fire Safety Training

All fire wardens are to be trained in first-aid firefighting and emergency response. All staff shall be inducted with a fire safety brief including the actions necessary on the activation of the building emergency warning system and the location of all emergency egress paths and fire exits. In addition periodic fire drills should be undertaken and any lessons learned included in future fire safety procedures.

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APPENDIX A FIRE STATISTICS

PROBABILITY OF FIRE STARTS

The probability of a fire start in a range of building uses, based on UK data, can be established using the data presented in Table 7-1 [9]; the applicable occupancy type is highlighted.

Table 7-1: Overall probability of fire starts for various occupancies, UK data

Occupancy	Probability Of Fire Starts (% Per Year)
Industrial	4.4
Storage	1.3
Offices	0.6
Assembly entertainment	12.0
Assembly non-residential	2.0
Hospitals	30.0
Schools	4.0
Dwellings	0.3

PROBABILITY OF CIVILIAN INJURY AND FATALITY

The probability of injuries and deaths for various occupancy types based on UK data [9] is presented in the following table.

Table 7-2: Probability of occupant injury and fatality by occupancy type, UK data averages for the years 1995 and 1997-1999

Type Of Occupancy	No Of Fires	Probability Of Occupant Injury Per Fire Event (%)	Probability Of Occupant Death Per Fire Event (%)
Further education	535	3.18	0.00
Schools	1669	3.06	0.00
Licensed premises	3317	7.90	0.08
Public recreational buildings	2581	1.86	0.05
Shops	5671	5.01	0.06
Hotels	1021	11.36	0.24
Hostels	1338	4.48	0.04
Hospitals	3063	3.69	0.11
Care homes	1616	8.04	0.28
Offices	1988	11.02	0.02
Factories	5299	5.40	0.08

APPENDIX B FIRE BEHAVIOUR

FIRE GROWTH RATE

As the fire increases in size, the rate of fire growth accelerates. The growth rate of a fire can result in various hazards for occupants due to the following:

- Protective and preventative measures may not be adequate
- Occupants may have insufficient time to evacuate
- Occupants may perceive a reduced threat from slow growing fires

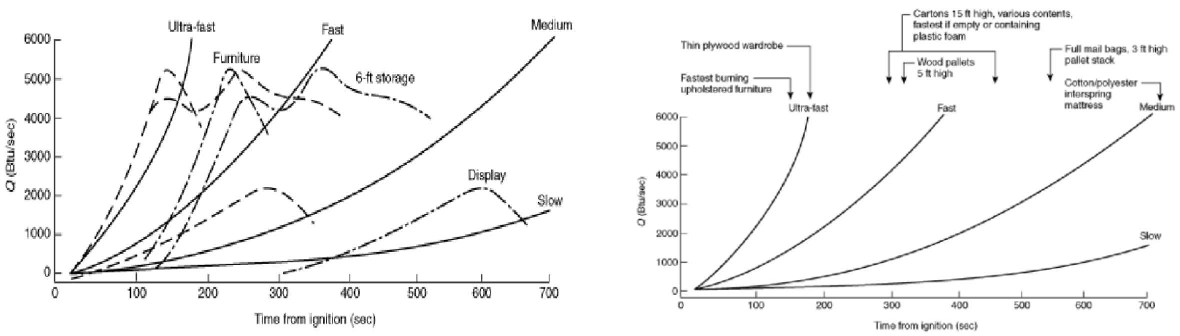
The rate of fire growth is generally expressed in terms of an energy release rate. The most commonly used relationship is what is commonly referred to as a quadratic t-squared fire. In such a fire, the rate of heat release is given by the expression:

$$Q = \left(\frac{t}{k}\right)^2$$

Where; t is time from ignition of the fire (seconds) and k is the growth time (seconds) for the fire to reach a heat output of 1.055 MW.

The continued growth of a fire defined by the above equation relies on both a sufficient source of fuel and air and assumes that flashover has not been reached. The rate of fire growth can be estimated from the results of a number of fire tests that have been performed on various fuel commodities.

National Fire Protection Association Standard NFPA 92B, provides information on the relevance of t-squared approximation to real fire as depicted in Figure 7-1.



(a) t-squared fire, rates of energy release (b) Relation of t-squared fires to some fire tests

Figure 7-1: NFPA 92B design fires and heat release rates

A slow fire growth is not considered to be the most challenging in terms of fire and life safety or fire brigade intervention. The continued growth of a fire defined by the above equation relies on both a sufficient source of fuel and air and assumes that flashover has not been reached. The rate of fire growth can be estimated from data published in CIBSE Guide E [11] and BS9999:2008 are listed below:

- Assembly hall seating : Medium-Fast
- Dwelling : Medium
- Office : Medium
- Hotel bedroom : Medium
- Hotel reception : Medium
- Meeting room : Medium
- Picture Gallery : Slow
- Reception area : Slow
- Restaurant/Canteen : Medium
- Shop : Fast
- Teaching laboratories : Fast
- Warehouse : Medium/Fast/Ultra-fast
- Waiting Room : Slow

From the above list, it can be concluded that the likely fire scenarios in the building may be approximated by the standard Ultra-fast time-squared fire growth rate curve.

APPENDIX C FIRE LOADS

The fire load within a room or compartment will influence the duration and severity of a fire and resultant hazard to occupants. The effective fire load for the building has been estimated by consideration of the typical spaces within the building. Fire load data published in Chapter 3.4 of the International Fire Engineering Guidelines [4] is derived from Switzerland, however is also applicable to buildings in Australia of similar use. The following fire loads have been extracted from the IFEG and are considered applicable to the subject building:

Table 8-9: Fuel Load Densities for Different Occupancies

TYPE OF OCCUPANCY	AVERAGE FIRE LOAD
Nursery School	300 MJ/m²
Carpark Areas	200-400 MJ/m²
Machinery Manufacturing / Mechanical Workshop	200 MJ/m²
Storeroom (workshop storerooms etc.)	1200 MJ/m²
Forwarding facility dealing in: beverages, food, furniture, glassware, plastic products, printed goods, textiles, varnish/polish.	Range from; 200 MJ/m² - 1700 MJ/m²
Office, Business	800MJ/m²
Office, Manufacturing	400MJ/m²
Storage of paper	1000 MJ/m²/m

The IFEG has published further fire load densities for broad occupancy groupings (extracted from CIB 1983) as provided in the table below. The CIB compilation emphasises that at least the 95% fractile should be selected for design purposes.

Table 8-10: Fuel Load Densities for Different Occupancy Groups

Densities in Mega-Joules per square metre				
Occupancy	**Mean**	**Percent Fractile**		
	(MJ/m²)	**80**	**90**	**95**
Dwelling	780	870	920	970
Hospital	230	350	440	520

Densities in Mega-Joules per square metre				
Occupancy	Mean	Percent Fractile		
	(MJ/m²)	80	90	95
Hospital storage	2000	3000	3700	4400
Hotel bedroom	310	400	460	510
Offices	420	570	670	760
Shops	600	900	1100	1300
Manufacturing	300	470	590	720
Manufacturing and storage <150kg/m²	1180	1800	2240	2690
Schools	285	360	410	450

Soot Yield

The materials that make up the fuel load will determine the soot yield of a fire. The fire soot yield should be assessed with respect to hazard due to the following:

- Soot yield can affect visibility for occupants trying to escape a fire
- Soot yield can be directly related to other products of combustion which may cause untenable conditions.

The NFPA Fire Protection Handbook provides test values of soot yield for some common plastics which vary from 0.012 to 0.23kg/kg [33]. Data for polyurethane is provided in the SFPE handbook which quotes a range between 0.104-0.227kg/kg [32]. As the quantity of fuel in any particular building is expected to be of mixed type, taking the upper value in the range of plastics is considered overly conservative in representing the entire fuel load. The soot yield, quoted by various sources, for wood is 0.015kg/kg which confirms that utilising 0.1kg/kg is a conservative average for fire modelling in pre-flashover conditions where a mixture of plastic and cellulosic fuel is expected.