Defire
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Performance solution report

DesignInc Sydney

New Ultimo Pyrmont Public School

SY170214

Revision R1.4 | 25 October 2017

Amendment schedule

Version	Date	Information relating to report			
R1.0	29/09/2017	Reason for issue	Report issued to DesigInc Sydney, Lacoste + Stevenson and BCA Logic.		
			Prepared by	Reviewed by	Approved by
		Name	Genevieve Fick	Greg Leach	Greg Leach
		Signature			
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		Signature			
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		Signature			
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			Prepared by	Reviewed by	Approved by
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		Signature			

Executive summary

This report documents the findings of a fire safety engineering assessment undertaken to determine whether the proposed New Ultimo Pyrmont Public School complies with the relevant performance requirements of the National Construction Code 2016 Volume One – Building Code of Australia (BCA). Defire undertook the assessment in accordance with the International Fire Engineering Guidelines (IFEG) at the request of DesignInc Sydney.

The project is the redevelopment of the Ultimo Pyrmont Public School. The project involves the construction of a new five storey school building. The school site slopes from east to west and is bounded by Quarry Street to the north, Wattle Street to the west, Jones street to the east and neighbouring residential buildings to the south.

The design of the building includes areas that do not comply with the deemed-to-satisfy (DTS) provisions of the BCA. Table 1 describes the BCA requirements associated with the performance solutions.

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
1.	The maximum travel distance to a point of choice from the level 4 balcony area outside the community hall is up to 39m instead of 20m.	Clause D1.4	DP4	Complies with performance requirements A0.3(a)(i) and A0.3(b)	Verification method A0.5(b)(ii)
2.	The maximum travel distance between alternative exits on levels 1 and 2 is up to 61.5m instead of 60m.	Clause D1.5	DP4	Equivalent to DTS A0.3(a)(ii) and A0.3(b)	Comparison to DTS A0.5(d)

Table 1 BCA requirements associated with the performance solutions

The fire safety engineering assessment found that the design of the building achieves compliance with the relevant performance requirements of the BCA, subject to the following recommendations:

- This report and the fire safety measures listed in section 5 must be implemented into the design and identified on the fire safety schedule for the building. They must be maintained and certified in accordance with the Environmental Planning and Assessment Regulations 2000 and relevant Australian standards.
- If there are building alterations or additions, a change in use or changes to the fire safety system in the future, a reassessment will be needed to verify consistency with the assessment contained in this report.

Contents

1. Introduction

This report documents the findings of a fire safety engineering assessment undertaken to determine whether the proposed New Ultimo Pyrmont Public School complies with the relevant performance requirements of the National Construction Code 2016 Volume One – Building Code of Australia (BCA)[1]. Defire undertook the assessment in accordance with the International Fire Engineering Guidelines (IFEG)[2] at the request of DesignInc Sydney.

2. Fire engineering brief

The purpose of the fire engineering brief (FEB) is to consult with the relevant stakeholders to define the scope of the project and to agree on the objectives, fire safety measures, methods of analysis and acceptance criteria for the performance solutions. The IFEG states that the scope of the project and the method by which it will receive regulatory approval dictates the extent of the FEB process required.

The proposed performance solutions are considered to be minor departures from the deemed-to-satisfy (DTS) provisions of the BCA. A meeting was held on 17 August 2017 with the relevant stakeholders identified in Table 2 to discuss the project and potential performance solutions. The following key points were discussed:

- The project is a state significant development (SSD).
- The potential for partial sprinkler protection to the building was to be reviewed. Subsequent to the meeting, further review of the proposed design was undertaken and Defire confirmed that a performance solution to justify the installation of a partial sprinkler system within the building is not appropriate. A sprinkler system is to be installed throughout the building.
- The potential for extended travel distances to be assessed via performance solutions. Subsequent to the meeting, Defire confirmed that the following extended travel distances will be assessed:
  - The maximum travel distance to a point of choice from the level 4 balcony area outside the community hall is up to 39m instead of 25m.
  - The maximum travel distance between alternative exits on levels 1 and 2 is up to 61.5m instead of 60m.
- The initial BCA Assessment Report noted that the external walls will incorporate timber battens. The design has subsequently been revised so that timber battens are no longer utilised.
- The initial BCA Assessment Report noted that Stair 5 discharges to the ground floor at a level above the level of egress to a road or open space. The design has subsequently been revised to address this issue.

At the end of the discussion it was agreed that the proposed design and performance solutions were suitable for detailed analysis.

It is understood that a requirement of an SSD project is for Fire & Rescue NSW (FRNSW) to provide comments on any fire engineered solution. Due to the timing associated with the SSD DA submission, consultation with FRNSW has not yet been undertaken. Consultation with FRNSW is to be undertaken after the SSD DA submission is lodged.

The relevant stakeholders identified for this project are listed in Table 2.

[1] National Construction Code 2016, Volume One – Building Code of Australia, Australian Building Codes Board, Australia.
[2] International Fire Engineering Guidelines – Edition 2005, Australian Building Codes Board, Australia.

Name	Role	Organisation
Jacqueline Urford Sandeep Amin	Client	DesignInc Sydney
Belinda Dawes Thierry Lacoste	Architect	Lacoste + Stevenson
Sarita Ellison	BCA consultant	BCA Logic
Genevieve Fick	Fire safety engineer	Defire
Greg Leach	Accredited fire safety engineer C10 – BPB 2402	Defire

Table 2 Stakeholders

Defire report SY170214 R1.1 was prepared to incorporate revised drawings.

Defire report SY170214 R1.2 was prepared to incorporate revised drawings and reference updated drawing revisions.

Defire report SY170214 R1.3 was been prepared to reference updated drawing revisions and minor comments from DesignInc Sydney.

Defire report SY170214 R1.4 has been prepared to incorporate minor comments from DesignInc Sydney.

3. Description of the building and performance solutions

3.1 Building description

The project is the redevelopment of the Ultimo Pyrmont Public School. The project involves the construction of a new five storey school building. The school site slopes from east to west and is bounded by Quarry Street to the north, Wattle Street to the west, Jones street to the east and neighbouring residential buildings to the south. Refer to Figure 1.

The building incorporates voids between the library area on the ground floor, level 1 and level 2, and voids outside the homebase rooms on the ground floor – level 3.

It is noted that the shell space for a 40-space child care centre on level 4 of the building on Jones Street is part of a separate scope of works to the main school building.

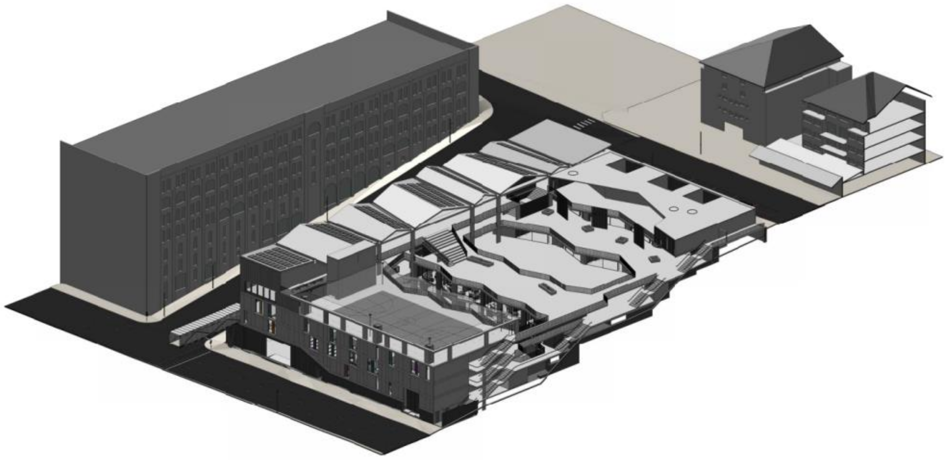


Figure 1 Ultimo Pyrmont Public School

Table 3[3] shows the main characteristics of the building for determining compliance with the BCA. Table 4 shows the proposed use and classification of the building or part in accordance with clause A3.2 of the BCA.

Characteristic	BCA provision	Description
Effective height	A1.1	Less than 25m
Type of construction required	C1.1	Type A
Rise in storeys	C1.2	Five
Levels contained	-	Five

Table 3 Main building characteristics

Part of building	Use	Classification (A3.2)
Ground floor	Carpark	Class 7a
Ground floor – level 4	Assembly building	Class 9b

Table 4 Use and classification

3.2 Preventive and protective measures

The building will be provided with the following major fire safety measures required by the DTS provisions of the BCA.

- Automatic sprinkler system
- Fire hydrant system
- Fire rated lightweight construction

[3] BCA Logic, 18 September 2017, BCA assessment report, 106876-BCA-r4.

- Emergency lighting
- Exit signs
- Fire dampers
- Fire doors
- Fire hose reel system (childcare and carpark only)
- Portable fire extinguishers
- Sound system and intercom systems for emergency purposes

A comprehensive list of fire safety measures is to be provided by the certifier as part of the building approval process. Additional fire safety measures required as part of the performance solution are listed in Section 5.

3.3 Occupant characteristics

The characteristics of the occupants expected to be in the building are listed in Table 5.

Characteristic	Description
Familiarity	Occupants are expected to primarily primary aged school students who will be familiar with the layout of the building and location of fire exits. It is noted that the students are primary school aged, and students in the younger years will require assistance in reaching the exit locations. Staff are also expected to be present who are familiar with the layout of the building and trained in emergency situations.
Awareness	Occupants are expected to be awake and alert to a potential emergency event such as a fire in the building.
Mobility	Occupants are assumed to have the same level of mobility as the general population. This may include a limited proportion of mobility impaired occupants. These occupants may require crutches, a wheelchair or similar to evacuate on their own or need assistance from other occupants.
Age	Occupants of all ages may be present within the building. The majority of the occupants are school children and school staff aged between 5-65 years of age.
Language	Although occupants may have English as their second language, they are expected to understand signs and verbal instructions in English enough to not adversely impact evacuation.
Occupant load	It is understood that the school is to accommodate 800 students and around 30 staff[4].

Table 5 Occupant characteristics

3.4 Performance solutions

The design of the building includes areas that do not comply with the DTS provisions of the BCA. We intend to use a performance solution to meet relevant performance requirements of the BCA. Table 6 shows the BCA requirements associated with the performance solutions.

No	Description of performance solutions	DTS provision	Performance requirements	Method of meeting performance requirements	Assessment method
1.	The maximum travel distance to a point of choice from the level 4 balcony area outside the community hall is up to 39m instead of 20m.	Clause D1.4	DP4	Complies with performance requirements A0.3(a)(i) and A0.3(b)	Verification method A0.5(b)(ii)
2.	The maximum travel distance between alternative exits on levels 1 and 2 is up to 61.5m instead of 60m.	Clause D1.5	DP4	Equivalent to DTS A0.3(a)(ii) and A0.3(b)	Comparison to DTS A0.5(d)

Table 6 BCA requirements associated with the performance solutions

[4] Email from Jacqueline Urford of DesignInc Sydney to Genevieve Fick of Defire dated 29 October 2017, SSD DA Test of Adequacy – Comments Register.

4. Scope, objective and assumptions

4.1 Scope and objective

- The scope of this report is limited to the performance solutions described in section 3.4.
- The objective of this report is to demonstrate compliance with the fire safety aspects of the performance requirements of the BCA. Matters such as property protection (other than protection of adjoining property), business interruption, public perception, environmental impacts and broader community issues – such as loss of a major employer and impact on tourism – have not been considered as they are outside the scope of the BCA.
- This report considers fires involving a single ignition point. Arson or destructive acts involving:
  - large amounts of accelerants which significantly change the expected burning behaviour of materials
  - multiple ignition sources
  - terrorism

  are not considered in the scope of this assessment.
- The scope of our works is limited to considering evacuation and fire safety issues for people with disabilities to the same degree as the DTS provisions of the BCA. Specifically, the evacuation from the building of people with disabilities under the provisions of the Disability Discrimination Act 1992 is excluded.
- If there are building alterations or additions, a change in use or changes to the fire safety systems in the future, a reassessment will be needed to verify consistency with the assessment in this report.
- The data, methodologies, calculations and conclusions documented in this report specifically relate to the building and must not be used for any other purpose.
- The documentation that forms the basis for this report is listed in Appendix A.
- This report has been prepared based on information provided by others. Defire has not verified the accuracy and/or completeness of this information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

4.2 Assumptions

- The design complies with the current DTS provisions of the BCA relating to fire safety except for the specific performance solutions described in section 3.4.
- All the fire safety systems are assumed to be designed, installed and operated in accordance with the appropriate Australian standards, other design codes, legislation and regulations relevant to the project unless specifically stated otherwise.
- For a satisfactory level of fire safety to be achieved, regular testing and maintenance of all fire safety systems and measures – including management-in-use systems – is essential and is assumed in the conclusion of this assessment.

5. Fire safety measures

The fire safety measures required as part of the performance solution are listed in the following sections:

5.1 General

1. The design must comply with the current DTS provisions of the BCA relating to fire safety unless specifically mentioned. This section does not provide a comprehensive list of fire safety measures required by the DTS provisions of the BCA. The fire safety measures listed here only relate to the performance solutions and must be read together with the DTS provisions.
2. This report and the requirements listed in this section must be implemented into the design and identified on the fire safety schedule for the building. They must be maintained and certified in accordance with the Environmental Planning and Assessment Regulations 2000 and relevant Australian standards.
3. We recommend periodic inspection, testing and maintenance of all fire safety measures be undertaken in accordance with the AS 1851-2012 series of standards.

5.2 Access and egress

5.2.1 Provisions for escape

4. Travel distances within the building must comply with clauses D1.4 and D1.5 of the BCA with the following exceptions:
   a. The maximum travel distance to a point of choice on the level 4 balcony area outside the community hall is up to 39m instead of 20m. Refer to Figure 2.
   b. The maximum travel distance between alternative exits on levels 1 and 2 is up to 61.5m instead of 60m. Refer to Figure 7.

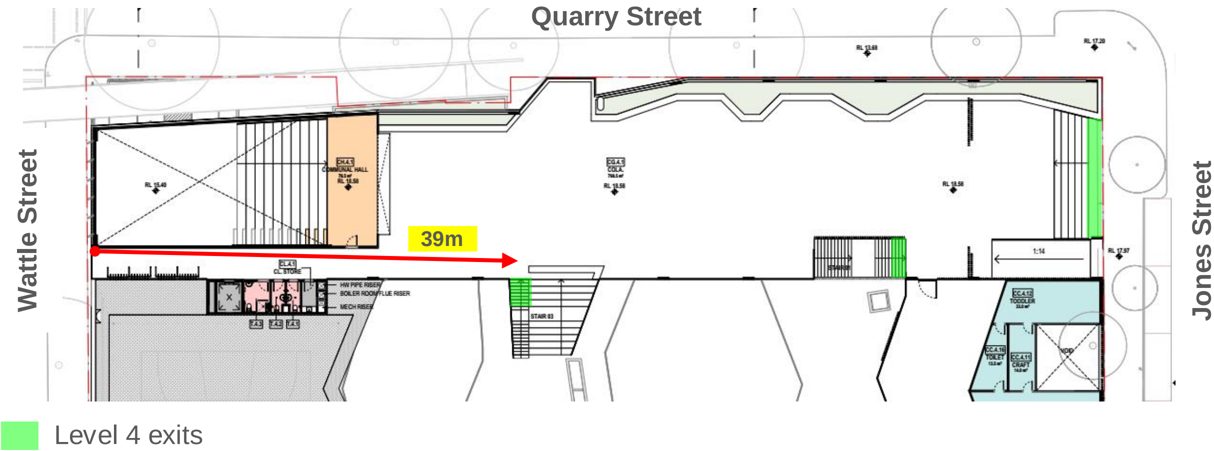
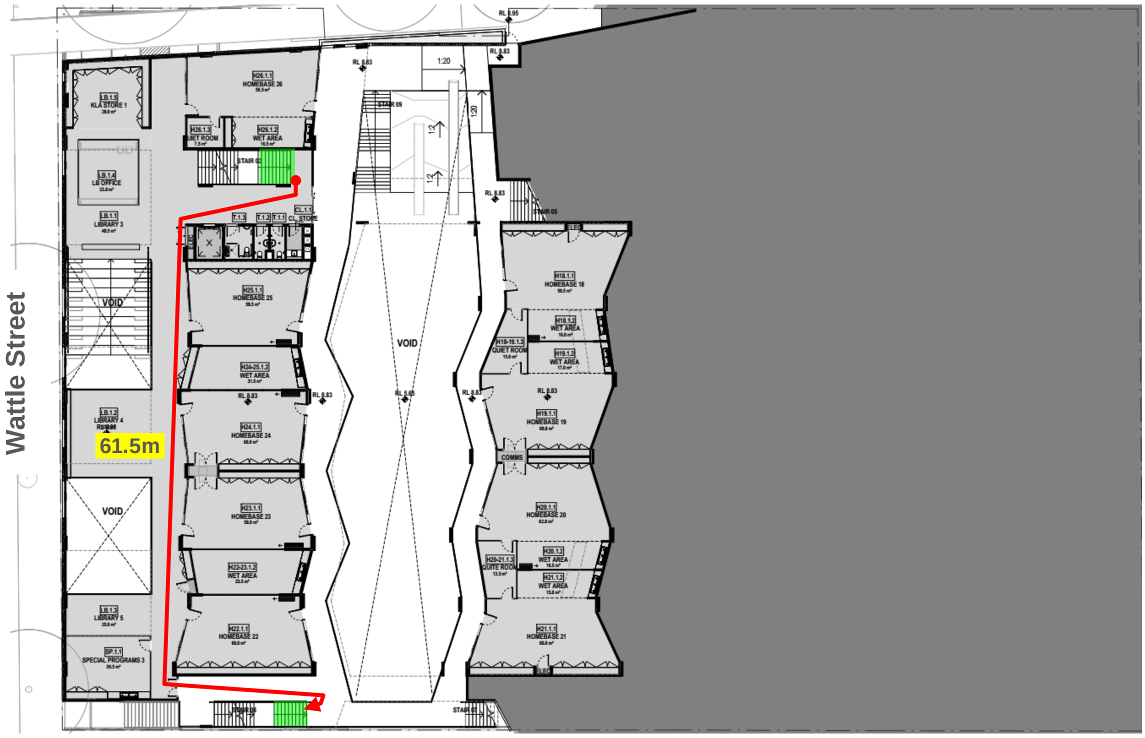


Figure 2 Extended travel distance to a point of choice – level 4



Level 4 exits

Figure 3 Extended travel distance between alternative exits – level 1 (indicative of level 2)

5.3 Services and equipment

5.3.1 Fire fighting equipment

5. A sprinkler system in accordance with the requirements of specification E1.5 of the BCA and AS 2118.1-1999 must be provided throughout the building.

5.3.2 Emergency lighting, exit signs and warning systems

6. An emergency lighting system must be installed throughout the building in accordance with clauses E4.2 and E4.4 of the BCA and AS 2293.1-2005.
7. Exit signs and directional signs must be installed throughout the building in accordance with clauses E4.5, E4.6 and E4.8 of the BCA and AS 2293.1-2005.
8. A sound system and intercom system for emergency purposes in accordance with clause E4.9 of the BCA and AS 1670.4:2015 with pre-recorded verbal evacuation message must be provided. The system must be audible throughout the building, including potential external areas where evacuation back into the building is required.

6. Safety in design

Our scope of works is to assess the level of fire safety and demonstrate the design achieves compliance with the relevant performance requirements of the BCA. A preliminary safety in design review was undertaken as part of our assessment. The review considered whether the recommended fire safety measures in section 5 could reasonably be expected to introduce unique or unusual hazards that would not otherwise be present in the construction, installation and/or maintenance of building. The fire safety measures in section 5 are performance specifications for other consultants to incorporate into their designs. The detailed designers retain discretion over where and how systems and structures are installed and are therefore responsible for the safety in design for the detailed design. It is important to note that the outcomes of our review are limited to issues that could reasonably be foreseen by a fire safety engineer within our limited scope and involvement in the project. It is likely that other parties involved in detailed design, installation and/or maintenance will identify additional issues.

No unique or unusual hazards that would not otherwise be present in the construction, installation and/or maintenance of building have been identified in relation to the performance solution as a result of our preliminary safety in design review.

Note: Residual risks are to be considered and addressed by appropriate persons within the design, construction and maintenance teams who have duties under the health and safety legislation.

7. Performance solution 1 – Level 4 extended travel distance to a point of choice

7.1 Introduction

Clause D1.4(d) of the BCA states that in a class 9b assembly school building, no point on the floor must be more than 20m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40m.

The maximum travel distance to a point of choice from the level 4 balcony area outside the community hall is up to 39m instead of 20m. Refer to Figure 4.

This assessment was undertaken to demonstrate that the design complies with performance requirement DP4 of the BCA.

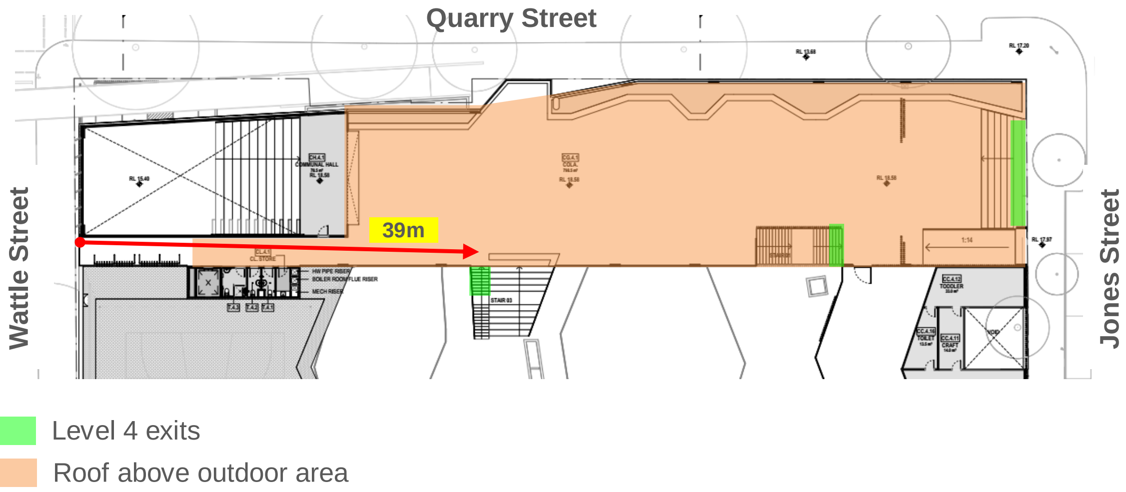


Figure 4 Extended travel distance to a point of choice – level 4

7.2 Intent of the BCA

The guide to the BCA[5] states that the intent of clause D1.4 is *'to maximise the safety of occupants by enabling them to be close enough to an exit to safely evacuate.'* The guide expands further that *'clause D1.4 travel distances are based on an assumption of what is considered 'reasonable' distances to be travelled by occupants in reaching an exit.'*

The guide further elaborates on the intent of the travel distance to a single exit or point of choice requirement where people are assumed to be alert and awake. *'Clause D1.4(c)(i) sets out the maximum travel distance in class 5-9 buildings. The distances specified allow people to evacuate in a reasonable time, assuming that they are not asleep. In case a fire blocks a path of travel, clause D1.4(c)(i) requires that alternative routes must be available within 20m of the starting point, unless it is possible to reach a single exit within 20m.'*

7.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the BCA are summarised in Table 7.

Assessment approach	
Method of meeting performance requirements of the BCA	Clauses A0.3(a)(i) and A0.3(b): Complying with the performance requirements
BCA assessment methodology	Clause A0.5(b)(ii): Other verification methods

[5] Guide to NCC Volume One 2016 – Building Code of Australia, Australian Building Codes Board, Australia.

Assessment approach	
Type of assessment	Qualitative absolute Deterministic
Fire safety sub-systems addressed	Sub-system B – Smoke development and spread and control Sub-system C – Fire spread and impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

Table 7 Performance solution approach and method of assessment

7.4 Acceptance criteria

The acceptance criterion for the assessment is that the design of the level 4 balcony area outside the community hall and the active fire safety systems installed facilities safe occupant evacuation.

7.5 Fire hazards

7.5.1 Hazard identification

Table 8 identifies potential fire hazards associated with the departures from the DTS provisions of the BCA.

Hazards	Preventative and protective measures
The path of travel to the point of choice from the level 4 balcony area outside the community hall is obstructed by fire.	• The path of travel to the point of choice is along the open balcony and through circulation space outside the community hall. • The balcony area is to be free from obstructions with the exception of bike racks. The area is associated with a low fire load. • The circulation space outside the community hall is free from obstructions and associated with a low fire load. • The path of travel to the point of choice requires occupants to pass by a lift and amenities. These areas are expected to contain minimal combustibles. • The covered outdoor learning area (COLA) is sprinkler protected.

Table 8 Hazards and preventative / protective measures related to the assessment

7.5.2 Occupant characteristics

Occupants on the level 4 balcony are expected to be school students, staff members or visiting family and friends of school students. Occupants are expected to be awake and alert to a potential emergency event such as a fire in the building. Some students may require assistance in reaching the exit locations.

7.5.3 Layout

The level 4 balcony area adjacent to the community hall facilities access to the bike racks at the western end of the balcony and the lift and amenities located on the southern side of the balcony – refer to Figure 6.

The path of travel from the level 4 balcony to a point of choice requires occupants to travel along the open balcony, along the balcony between the community hall and lift / amenities, and through a portion of the COLA – refer to Figure 6.

The primary fire hazard associated with the proposed design is that the path of travel to the nearest exit may be obstructed by a fire.

7.5.4 Fire load

The level 4 balcony area is to be free from obstructions with the exception of bike racks as illustrated in Figure 4. Therefore, the area is associated with a low fire load. The circulation space outside the community hall is also free from obstructions and associated with a low fire load.

The path of travel to the point of choice requires occupants to pass by a lift and amenities. These areas are expected to contain minimal combustibles.

7.5.5 Sprinklers

The building, including the COLA is to be provided with a sprinkler system in accordance with specification E1.5 of the BCA and AS 2118.1-1999. The successful activation of the sprinklers should have the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe evacuation time.
- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire becoming large – ie spreading beyond the area / room of origin or flashover occurring.

It can generally be assumed that successful operation of the sprinkler system will have the following impact on compartment temperatures during a fire[6,7,8].

- The average temperatures outside the immediate area of operation of the sprinkler system will be below 100°C.
- The temperature in the localised area above the fire will be somewhat higher than the mean compartment temperature but is still unlikely to exceed 200°C.

Full scale tests have shown that standard sprinklers can be expected to maintain tenable conditions in relation to temperature and toxicity outside the room where the fire started.

Data collected in the US demonstrates that 'when sprinklers are present, the chances of dying in a fire are reduced by one-half to three-fourths, and the average property loss per fire is cut by one-half to two-thirds, compared to fires where sprinklers are not present'[9]. When fatalities do occur in sprinkler protected buildings, the victims tend to be in close proximity to the fire, intimate with ignition or incapable of self-preservation[10].

The CIBSE Guide E[11] notes the following potential concessions for buildings protected by sprinklers:

- Building compartment areas / volumes may be increased over that for a similar building without sprinklers.
- A structural element is liable to maintain its load-bearing capacity and a separating element will maintain both its integrity and its ability to resist the transfer of heat. The fire resistance levels may therefore be reduced if sprinklers are fitted.
- The distance required to travel to an exit can potentially be increased without reducing the level of safety to people.

Statistics on US experience with sprinklers show that 88% of fires are controlled by one or two heads when sprinklers were effective[12]. Data provided by Marryatt concludes that 92% of fires are controlled by 1-5 heads[13].

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[6] England JP, Young SA, Hui MC and Kurban N, 2000, Guide for the design of fire resistant barriers and structures, Warrington Fire Research Australia and Building Control Commission, Melbourne VIC.
[7] Technical Memoranda TM19:1995 – Relationships for smoke control calculations, CIBSE, London UK.
[8] Lougheed GD, 1997, Expected size of shielded fires in sprinklered office buildings, ASHRAE Transactions, vol 103, pt 1, pp 395-410.
[9] Rohr KD and Hall Jr JR , 2005, US experience with sprinklers and other fire extinguishing equipment, Fire Analysis and Research Division NFPA, Quincy MA.
[10] Fire protection handbook, 2008, 20th edn, NFPA, Quincy MA.
[11] CIBSE Guide E: Fire Engineering, 2010, 3rd edn, CIBSE, London, UK.
[12] Hall Jr JR, 2013, US experience with sprinklers and other fire extinguishing equipment, Fire Analysis and Research Division NFPA, Quincy MA.
[13] Marryatt HW, 1988, Fire: A century of automatic sprinkler protection in Australia and New Zealand 1886-1986, Australian Fire Protection Association, Melbourne VIC.

Sprinkler systems have been demonstrated to achieve high operational reliability through numerous statistical studies. Budnik estimated that the mean reliability of sprinkler systems was 93-96%, based on the analysis of 16 separate studies[14]. Reliability is likely to be even higher where sprinkler systems are correctly designed, commissioned and maintained.

7.6 Assessment

The path of travel from the level 4 balcony to a point of choice requires occupants to travel approximately 10m along the open balcony, 15m along the balcony between the community hall and lift / amenities, and a further 14m through the COLA – refer to Figure 5.

The initial 10m travel is along the open balcony bounded by the community hall and a balustrade to the south as illustrated in Figure 6. This portion of the balcony will be free from obstructions with the exception of bike racks, as such this area is associated with a low fire load. The 15m portion of the path of travel past the amenities is also through an area that is free from obstructions due to the use of the area for circulation only. The last 14m of travel to the point of choice is through the COLA which is open on the southern side above the balustrade illustrated in Figure 6. This portion of the COLA is expected to remain free from obstructions, as this area is required to remain clear so that occupants can access the lifts and amenities. Therefore, the entirety of the path of travel to the point of choice is associated with a low fire load.

In the unlikely event of a fire occurring along the path of travel to the point of choice, occupants are expected to receive intrinsic cues and evacuate prior to the path of travel to the exit becoming blocked. It is also noted that the layout of the area incorporating openings on the southern side of the path of travel would aid in smoke venting from the area in the event of a fire, mitigating the likelihood of smoke filling the area and blocking the path of travel to the point of choice.

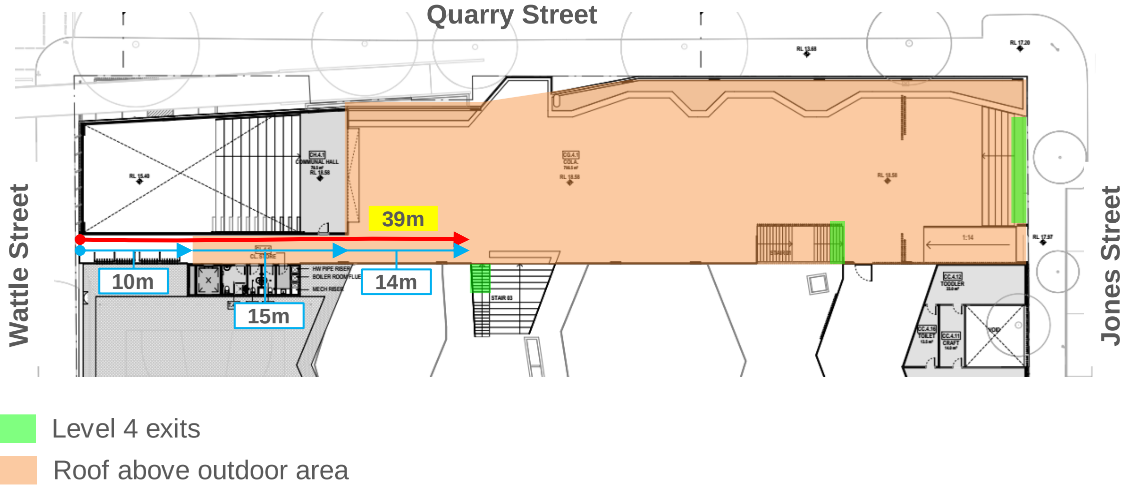


Figure 5 Extended travel distance to a point of choice – level 4

[14] Budnick EK, 2001, Automatic sprinkler system reliability, Fire Protection Engineering, Winter 2001, issue 9, pp 7-12.

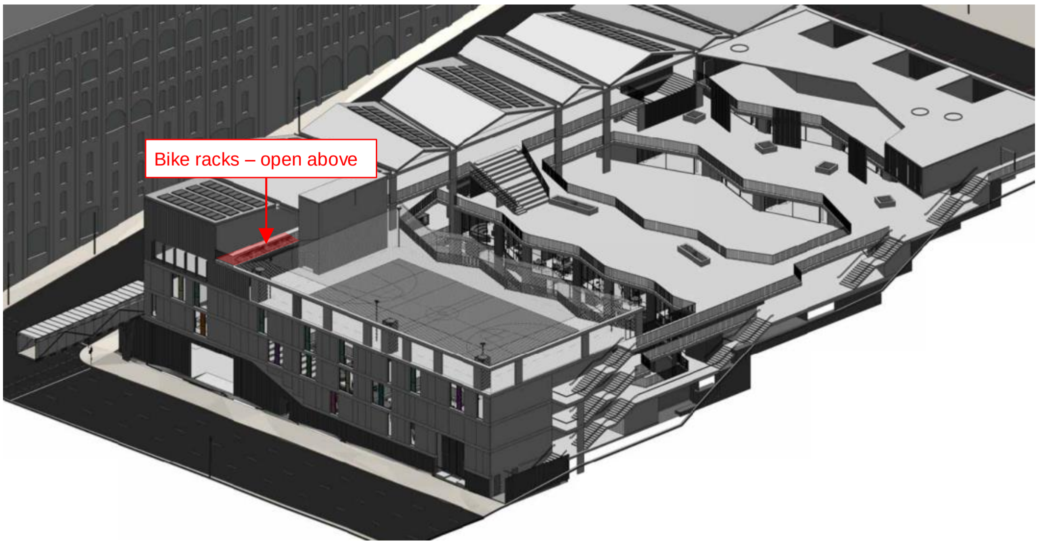


Figure 6 Path of travel along level 4 balcony

The proposed 39m to the point of choice from the level 4 balcony is 19m further than a design complying with clause D1.4 of the BCA. The time required for occupants to evacuate the fire affected area and travel an addition 19m to reach a point of choice is a small part of the overall evacuation time from the building. The evacuation time from a generic location within the level 4 balcony area can be estimated on the following basis:

- Queuing time within the area is expected to be limited and is conservatively ignored for the purposes of this assessment.
- Assuming a population density within the area of less than 1.0 person/m^2, the average travel speed equates to approximately 1.0m/s[15, 16, 17].

The additional 19m travel distance equates to approximately 19 seconds increase in the time for occupants to reach the point of choice compared to a DTS complying design. The additional 19 seconds is considered to be readily offset by the simple layout whereby occupants proceed along the open balcony to the point of choice, the low fire load associated with the area and design of the area including openings on the southern side of the balcony above the balustrade.

The sprinkler system complying with AS 2118.1-1999 provides an additional level of redundancy, reducing the likelihood of a fire within the COLA area becoming large and reducing the cue time in the event of a fire.

Based on the above, the design is considered adequate for facilitating safe occupant evacuation from the level 4 balcony area adjacent to the community hall despite the extended travel distance.

7.7 Conclusion

The assessment demonstrates that the design of the level 4 balcony area outside the community hall and the active fire safety systems installed facilities safe occupant evacuation. The proposed design of the building is therefore considered to comply with performance requirement DP4 of the BCA, subject to compliance with the fire safety measures given in section 5.

[15] Predtechenskii VM, Milinskii AI, 1978, Planning for Foot Traffic Flow in Buildings (translated from Russian), Stroizdat Publishers, Moscow, 1978. English translation published for the National Bureau of Standards and the National Science Foundation, Amerind Publishing Co., New Delhi, India.
[16] Fruin JJ, 1971, Pedestrian Planning Design, Metropolitan Association of Urban Designers and Environmental Planners Inc., New York, USA.
[17] Pauls JL, 1980, Effective Width Model for Evacuation Flow in Buildings, in Proceedings, Engineering Applications Workshop, Society of Fire Protection Engineers, Boston.

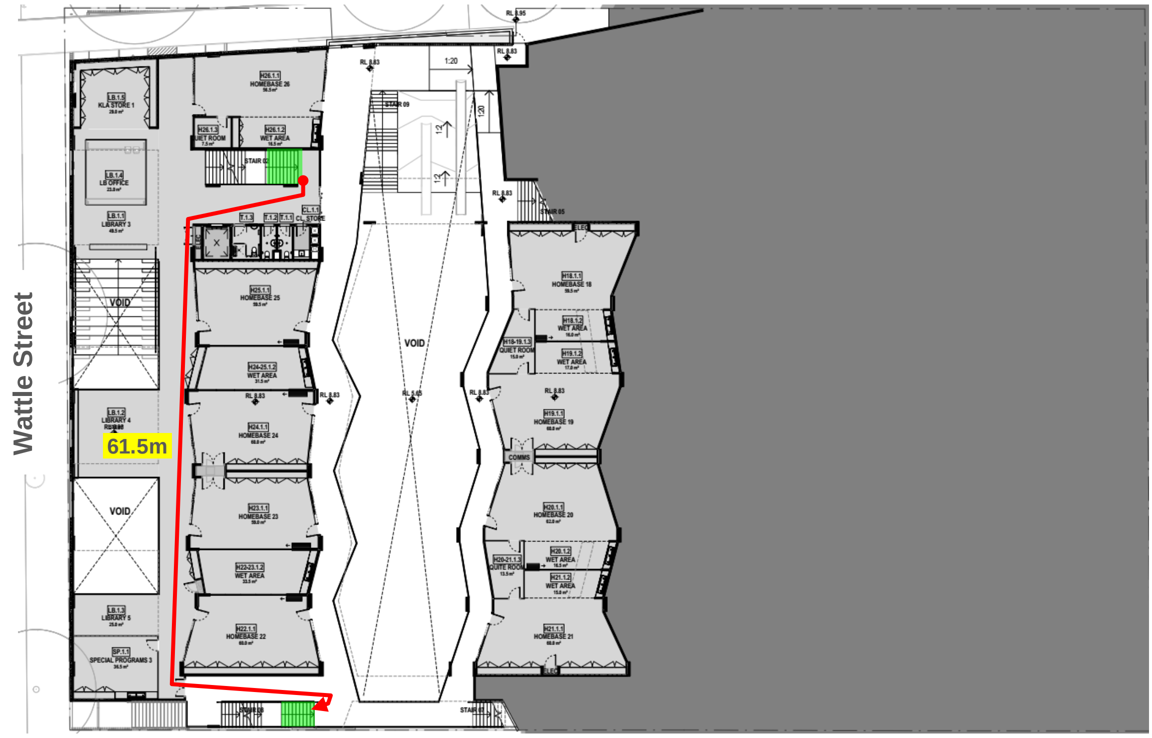
8. Performance solution 2 – Extended travel distance between alternative exits on levels 1 and 2

8.1 Introduction

Clause D1.5 of the BCA states that exits that are requires as alternative means of egress must be not more than 60m apart.

The maximum travel distance between alternative exits on levels 1 and 2 is up to 61.5m instead of 60m. Refer to Figure 7.

This assessment was undertaken to demonstrate that the design complies with performance requirement DP4 of the BCA.



Level 4 exits

Figure 7 Extended travel distance between alternative exits – level 1 (indicative of level 2)

8.2 Intent of the BCA

The guide to the BCA states that the intent of clause D1.5 is '*to require that if an exit is inaccessible, access to any required alternative exit must be available within a reasonable distance*'. The guide states that '*where a building requires multiple exits, the exits maximise the choices of a person evacuating, in case one exit becomes blocked*'.

The guide further elaborates on the intent of the maximum travel distance between alternative exits requirement – '*the maximum distance between alternative exits minimises the need to travel too far to reach an exit*.'

8.3 Methodology

The approach and method of assessment used to determine whether the performance solution meets the performance requirements of the BCA are summarised in Table 7.

Assessment approach	
Method of meeting performance requirements of the BCA	Clauses A0.3(a)(ii) and A0.3(b): Demonstrating equivalence to the DTS provisions
BCA assessment methodology	Clause A0.5(d): Comparison to the DTS provisions
Type of assessment	Qualitative comparative Deterministic
Fire safety sub-systems addressed	Sub-system B – Smoke development and spread and control Sub-system C – Fire spread and impact and control Sub-system D – Fire detection, warning and suppression Sub-system E – Occupant evacuation and control

Table 9 Performance solution approach and method of assessment

8.4 Acceptance criteria

The acceptance criterion for this assessment is that the open layout of the circulation areas and provision of a sprinkler system facilitates safe occupant evacuation equivalent to a design complying with the DTS provisions of the BCA.

8.5 Fire hazards

8.5.1 Hazard identification

Table 8 identifies potential fire hazards associated with the departures from the DTS provisions of the BCA.

Hazards	Preventative and protective measures
The path of travel between alterative exits on levels 1 or 2 is obstructed by fire.	• The building is sprinkler protected. • The western portion of levels 1 and 2 is of a relatively open layout, consisting of open library spaces and classrooms opening to a common circulation corridor.

Table 10 Hazards and preventative / protective measures related to the assessment

8.5.2 General occupancy characterisers

The majority of occupants within the building are children who may not be familiar with the location of exits and may require assistance in reaching the exit locations. A number of trained staff are expected to be present who are familiar with the layout of the building and locations of exits.

8.5.3 Layout

The western portion of levels 1 and 2 where the increased travel distances occur are served by two stairways as indicated in Figure 7. The primary fire hazard associated with the proposed design is that the path of travel between these alternative exits may be obstructed by a fire.

The western portion of levels 1 and 2 is of a relatively open layout consisting of open library spaces, and classrooms opening to a common circulation corridor.

8.5.4 Fire load

Data provided in the IFEG[18] specifies a mean fire load density for schools of 285MJ/m^2 with a 95% fractile value of 450MJ/m^2.

[18] International fire engineering guidelines – edition 2005: Australian Building Codes Board 2005.

8.5.5 Sprinklers

The building is to be provided with a sprinkler system in accordance with Clause E1.5 of the BCA and AS 2118.1-1999. The reliability of a sprinkler system, together with the impact that a sprinkler system will have on fire spread and fire intensity has been discussed in section 7.5.5.

8.6 Fire scenarios

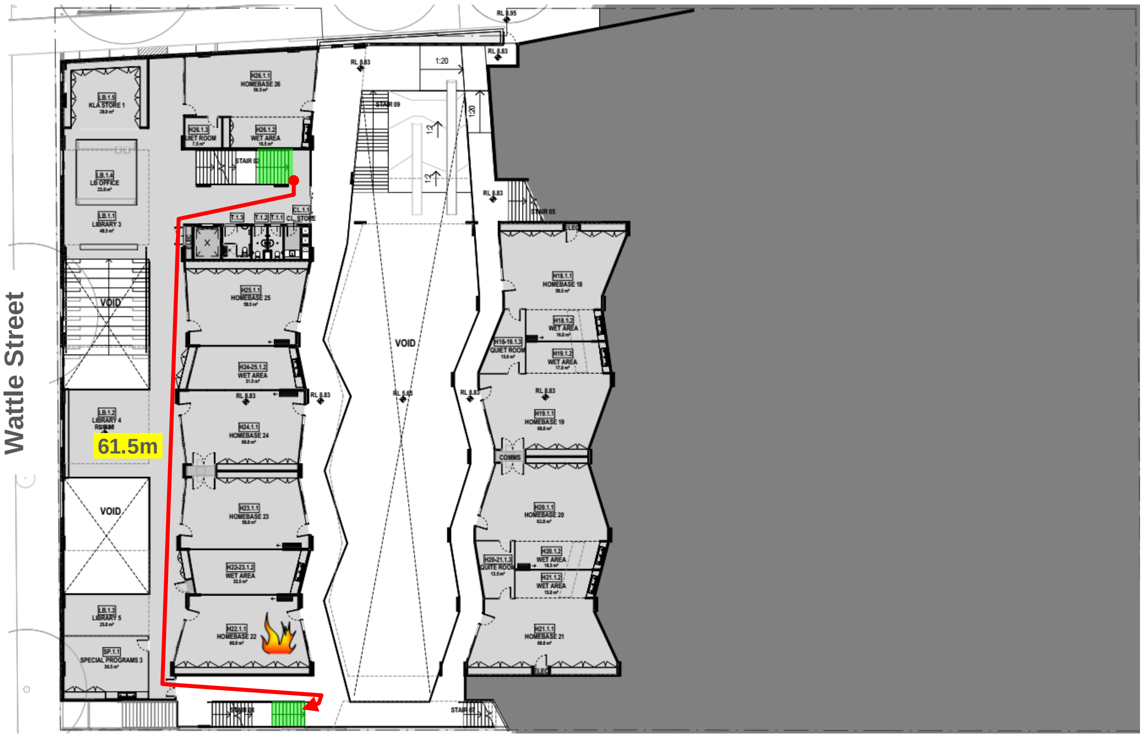
The selection of appropriate fire scenarios must take into consideration the:

- likelihood of occurrence
- potential consequences
- impact on the issues being assessed.

The following fire scenario has been identified for assessment:

1. A fire within homebase 22 obstructing the path of travel to the closest exit – refer to Figure 8. It is assumed that the western door to the homebase is closed, requiring occupants to travel further before recognising that the closest exit is blocked.

The western portions of levels 1 and 2 where the increased travel distances occur have a similar layout, as such this fire scenario is applicable to both levels 1 and 2.



Level 4 exits

Figure 8 Fire scenario 1 – level 1 (indicative of level 2)

8.7 Assessment

8.7.1 Sprinklers

As previously stated in section 7.5.5, the building is to be provided with a sprinkler system in accordance with specification E1.5 of the BCA and AS 2118.1-1999. The successful activation of the sprinklers should have the following benefits:

- A reduction in the rate of burning and quantity of smoke produced, subsequently increasing the available safe evacuation time.

- A reduced fire intensity and duration, which in turn reduces the severity of fire exposure to structural and fire separating elements.
- A reduction in the chances of a fire becoming large – ie spreading beyond the area / room of origin or flashover occurring.

Sprinkler systems have been demonstrated to achieve high operational reliability through numerous statistical studies. Budnik estimated that the mean reliability of sprinkler systems was 93-96%, based on the analysis of 16 separate studies[19]. Reliability is likely to be even higher where sprinkler systems are correctly designed, commissioned and maintained.

The presence of a reliable sprinkler system means that the probability of a fire spreading beyond the area of origin and not being controlled by the sprinklers is low.

8.7.2 Evacuation

The worst credible fire scenario in terms of the impact on occupant travel distances is considered to be a fire which directly obstructs one of the two alternative exits available to occupants within the western portion of levels 1 and 2.

Fire scenario 1 – Fire within homebase 22 on level 1

As illustrated in Figure 9, a fire within homebase 22 on level 1 may obstruct the path of travel to the closest exit on level 1. Assuming that the western door to homebase 22 is closed, and occupants initially travel along the circulation corridor and through the doorway indicated in Figure 9 before being able to identify that a fire is blocking the nearest exit, occupants would then be required to travel back along the circulation corridor to the alternative exit – refer to Figure 9. The total travel distance in this instance would be 80m. A DTS compliant design would theoretically allow up to 40m travel towards an exit and a further 60m between alternative exits resulting in a total travel distance of 100m. As such, in the event of a fire blocking the nearest exit on level 1, the total travel distance is less than that theoretically allowed in a DTS compliant design.

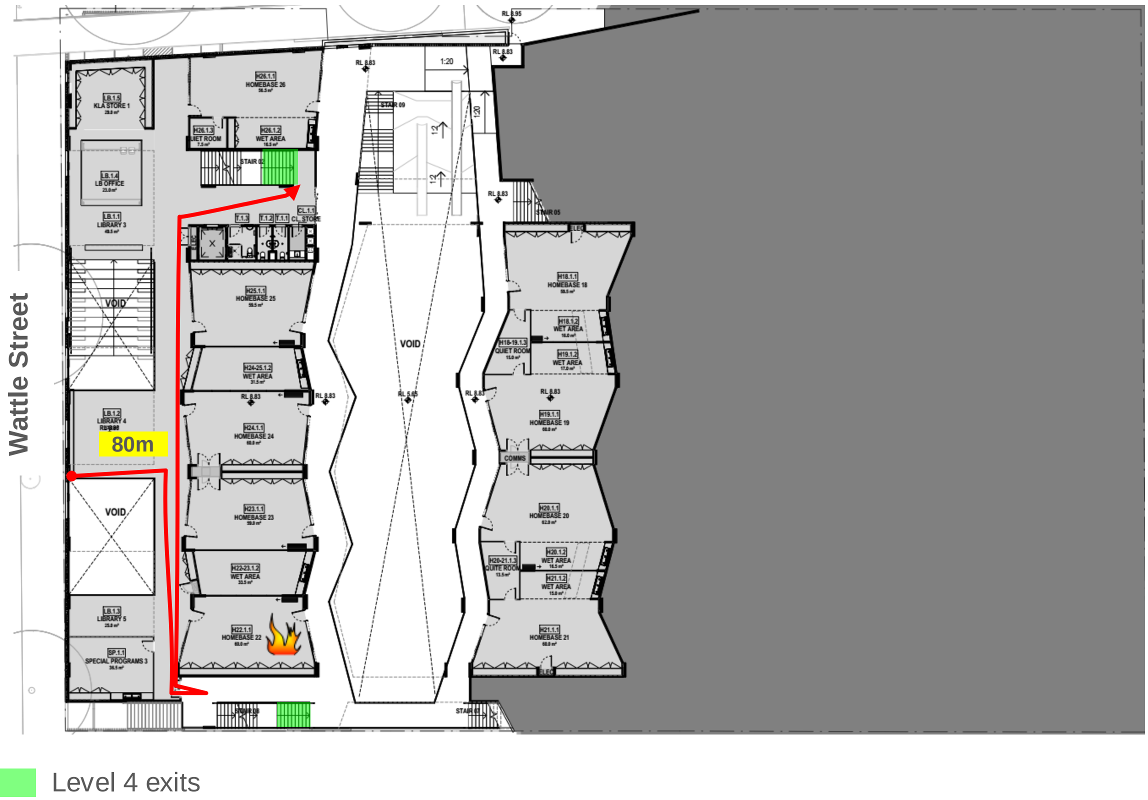


Figure 9 Fire scenario 1 – likely worst case travel distance by occupants in the event that an exit is blocked

[19] Budnick EK, 2001, Automatic sprinkler system reliability, Fire Protection Engineering, Winter 2001, issue 9, pp 7-12.

8.8 Conclusion

The assessment demonstrates that the open layout of the circulation areas and provision of a sprinkler system facilitates safe occupant evacuation equivalent to a design complying with the DTS provisions of the BCA. The proposed design of the building is therefore considered to comply with performance requirement DP4 of the BCA, subject to compliance with the fire safety measures given in section 5.

Appendix A Drawings and information

Drawing title	Dwg no	Date	Drawn
Ground – lower playground	DA-2300 rev Q	20/10/2017	Lacoste + Stevenson
Level 01 – Library	DA-2301 rev Q	20/10/2017	
Level 02 – Middle playground	DA-2302 rev Q	20/10/2017	
Level 03 – Upper playground	DA-2303 rev Q	20/10/2017	
Level 04 – COLA	DA-2304 rev Q	20/10/2017	
Roof level	DA-2305 rev Q	20/10/2017	
North elevation	DA-3001 rev J	20/10/2017	
East elevation	DA-3002 rev J	20/10/2017	
South elevation	DA-3003 rev D	20/10/2017	
West elevation	DA-3004 rev D	20/10/2017	
Building sections	DA-4001 rev J	20/10/2017	
Building sections	DA-4002 rev J	20/10/2017	
Perspective – Axonometric NW	DA-9002 rev B	20/10/2017	
Perspective – Axonometric SW	DA-9003 rev B	20/10/2017	
Perspective – Axonometric NE	DA-9004 rev B	20/10/2017	
Perspective – Axonometric SE	DA-9005 rev B	20/10/2017	

Other information	Ref no	Date	Prepared by
BCA Assessment Report	106876-BCA-r4	18/09/2017	BCA Logic