Waitara Public School

Fire Engineering Engineering

Report

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TSA Management

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Date: 18 March 2019

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<table>
<thead>
<tr>
<th>REVISION</th>
<th>DATE</th>
<th>COMMENT</th>
<th>APPROVED BY</th>
</tr>
</thead>
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<tr>
<td>01</td>
<td>3/10/2018</td>
<td>Draft FER</td>
<td>BC</td>
</tr>
<tr>
<td>02</td>
<td>9/11/2018</td>
<td>Addition of Fire Hydrant coverage</td>
<td>BC</td>
</tr>
<tr>
<td>03</td>
<td>9/11/2018</td>
<td>Updates made per NBRs comments</td>
<td>BC</td>
</tr>
<tr>
<td>04</td>
<td>14/11/2018</td>
<td>Updated compartmentation</td>
<td>BC</td>
</tr>
<tr>
<td>05</td>
<td>18/03/2019</td>
<td>Updates made per MBC comments</td>
<td>EJ</td>
</tr>
</tbody>
</table>

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Victoria University of Technology, 2005
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Executive Summary

This document is a Fire Engineering Report (FER) for the proposed four storey primary school which is to include classrooms, library, administration area, multipurpose hall and associated facilities construction. As per the Building Code of Australia (BCA) 2016[1], the proposed development is classified as Class 5 (Administration areas) and Class 9b with a rise in storeys of 4 and an effective height of less than 12m. As such, the building is required to be of Type A construction.

![Figure 1 - Site Plan](image)

The proposed Performance Solutions for this development are listed in Table 1, with the applicable BCA Deemed-to-Satisfy (DtS) Provisions, relevant BCA Performance Requirements and the proposed methods of assessment.

All other items of fire and life safety which have not been identified in Table 1 are to be in accordance with the BCA DtS provisions. Any change in this information to suit future building works or re-organisation will require further analysis to confirm compliance with the regulations and the fire engineering assessment.

The fire safety strategy outlined in this report has been developed to provide a practical fire safety design for the scheme, taking into account the various design constraints incumbent on the design by virtue of its site, whilst ensuring a robust fire safety philosophy for both building occupants and the Fire Brigade.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description of Performance Solution</th>
<th>BCA Clauses</th>
<th>Performance Requirements</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location and coverage of Fire Hydrants</td>
<td>E1.3</td>
<td>EP1.3</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>2</td>
<td>Permit the removal of Fire Hose Reels</td>
<td>E1.4</td>
<td>EP1.1</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>3</td>
<td>Egress from non-required stairway</td>
<td>D1.12</td>
<td>DP5</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>4</td>
<td>Egress from the Plant Room is provided via single stair only with extended travel distances</td>
<td>D1.2, D1.4</td>
<td>DP4, DP5</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td></td>
<td>Permit the removal of fire rating of steel columns and ceiling on Level 4</td>
<td>C1.1</td>
<td>CP1</td>
<td>Absolute, Qualitative, Deterministic</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------------------------</td>
<td>------</td>
<td>-----</td>
<td>----------------------------------</td>
</tr>
</tbody>
</table>
1. Introduction

1.1 Scope

WGE has been engaged to develop a performance based fire safety strategy for the development located at 68 Edgeworth David Ave, Wahroonga NSW 2076. The fire safety objective of this strategy is limited to achieving compliance with the Performance Requirements of the Building Code of Australia (BCA 2016) [1]. Fundamentally the BCA aims to protect life safety, prevent fire spread to adjacent buildings, and facilitate Fire Brigade operations.

Our approach to Fire Engineering is in accordance with the International Fire Engineering Guidelines (IFEG) [2]. WGE adopt worldwide best practice and standards as outlined in Section 0.1.1 (of the IFEG), and using the document as general guidance on the analysis process without strictly following each individual sub-system as per Section 1.3 of the IFEG, which permits different approaches to demonstrate compliance. In this light guidance documentation such as the New Zealand Verification Method 2 [3] and C/AS2 – C/AS7 Acceptable Solutions for Buildings [4], British Standard PD 7974 Series [5], Society of Fire Protection Engineering Handbook of Fire Protection Engineering [6], CIBSE guide E [7] and the NFPA Series [8] are all referenced.

1.2 Design team and stakeholders

The relevant project stakeholders are listed in Table 2.

<table>
<thead>
<tr>
<th>Role</th>
<th>Organisation/Company</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client / Developer</td>
<td>NSW Department of Education</td>
<td></td>
</tr>
<tr>
<td>Project Manager</td>
<td>TSA Management</td>
<td>Rosie Majer</td>
</tr>
<tr>
<td>Architects</td>
<td>NBRS Architecture</td>
<td>David Heap</td>
</tr>
<tr>
<td>BCA Consultant</td>
<td>Metro Building Consultancy</td>
<td>Seb Howe</td>
</tr>
<tr>
<td>Fire Brigade Representative</td>
<td>FRNSW</td>
<td>TBC</td>
</tr>
</tbody>
</table>

1.3 Relevant documentation

The relevant documents and drawings reviewed and assessed as part of this report are listed in Table 3.

<table>
<thead>
<tr>
<th>Document Name/Description</th>
<th>Organisation</th>
<th>Date</th>
<th>Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCA report</td>
<td>NBRS Architecture Compliance</td>
<td>14-09-18</td>
<td>1</td>
</tr>
<tr>
<td>Architectural drawings</td>
<td>NBRS Architecture</td>
<td>11-09-18</td>
<td>P1/P2/P3</td>
</tr>
</tbody>
</table>

1.4 Report application and assumptions

Please note all referenced documentation, standards and texts are done so in the following style “[ ]”. Appendix A 1.1, details the full references made mention of within this report.

It should be noted that the figures presented in the Performance Solutions provide an indicative supporting mark-up of the identified non-compliances. The figures are used for illustrative purposes only and should be read in conjunction with the drawings prepared by the architect or engineers for this project.

The following assumptions will be incorporated into the Fire Engineering Analysis:

- Only one fire will occur at a time within the development.
- All exit routes are maintained clear of obstructions.
- The analysis is limited to the assessment of single / accidental fires as intended by the BCA. The fire scenarios investigated within this document may be representative of intentional fires caused by an opportunistic arsonist; however multiple fires, severe acts of malice intent, terrorism, sabotage, or by wilful interference with fire and life safety systems are considered outside the scope of this assessment.
- No property protection requirements have been advised and therefore included within the design. Some property protection is inherent within the life safety measures required for the building however this is incidental.
- We have not been advised of any insurer’s requirements and therefore this has not been considered within the design.
- All essential services, equipment services and strategies will be maintained to the operational capacity to which they were designed, and will correctly function during a fire situation.
- All other components of the building not addressed within this document will be installed to the requirements of the Deemed-to-Satisfy provisions of the Building Code of Australia applicable at the time of design.
- The Fire Engineering Assessment carried out is specific to this project. The findings and outcomes of this document shall not be used outside the scope of this project.
2. **Building and Occupant Characteristics**

2.1 **Building characteristics**

2.1.1 **Building Location**

The premise is proposed to the existing site located on the corner of Edgeworth David Ave and Myra St, Wahroonga, NSW 2076 as shown in Figure 2.

![Figure 2: Building Location](image)

2.1.2 **Building classification**

The Building Classification has been tabulated in Table 4, based on the information provided in the BCA Assessment Section 1.6.

**Table 4: Building Characteristics and Classification**

<table>
<thead>
<tr>
<th>BCA Clause/Section</th>
<th>Description</th>
<th>Description of requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1.1</td>
<td>Effective height</td>
<td>&lt;12m</td>
</tr>
<tr>
<td>A3.2</td>
<td>Building occupancy &amp; BCA Classification</td>
<td>5, 9b</td>
</tr>
<tr>
<td>C1.1</td>
<td>Construction type</td>
<td>A</td>
</tr>
<tr>
<td>C1.2</td>
<td>Rise in Storeys</td>
<td>4</td>
</tr>
<tr>
<td>Table C2.2</td>
<td>Fire compartment floor area</td>
<td>7,000m²</td>
</tr>
</tbody>
</table>

2.1.3 **Building description, occupant loading and evacuation**

The subject building is a four storey building to be used as an educational facility, with an administration and office area located on Level 1. The building structure will include reinforced concrete floor slabs and concrete columns supporting a steel framed roof structure covered with metal roof sheeting. The external walls are to be a combination of light weight construction and glazing.
Table 5 details a functional description of the spaces on each level of the building along with an approximate total area.

**Table 5: Building Description**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description of Spaces, Function and Egress</th>
</tr>
</thead>
</table>
| Level 1 | Administration, Offices, Hall, Amenities  
Egress: Fire isolated stair or direct egress point located within a compliant distance to all areas. |
| Level 2 | Classrooms, OOSH, Canteen, Special Programs, Amenities  
Egress: Fire isolated stair located within a compliant distance to all areas. |
| Level 3 & 4 | Classrooms, Amenities  
Egress: Fire isolated stair located within a compliant distance to all areas. |
| Level 5 | Plantroom  
Egress: Fire isolated stair with travel distance up to 25m to a single exit. |

### 2.1.4 General compartmentation & egress strategy

**Figure 3 – Egress points L1**
Figure 4 – Egress points and fire isolated stairways L2

Figure 5 – Egress points and fire isolated stairways L3
The fire isolated stairways and egress routes are located as shown in Figure 3 to Figure 7.

2.2 Occupant characteristics

The characteristics of occupants and their corresponding interaction with the building environment, staff, queues and people around them is important when trying to understand the evacuation process. It is therefore necessary to consider the characteristics of the occupants that can be expected in the building when undertaking Fire Engineering Analysis, as highlighted in the IFEG [2].

The principal occupant characteristics for the building are listed in Table 6, using Table 2 of BS 9999 [7].

Table 6: Occupant Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers and administration staff</td>
<td>Permanent teachers, office staff and other maintenance staff</td>
<td>Awake and familiar</td>
</tr>
<tr>
<td>Students</td>
<td>Students who are attending the school</td>
<td>Awake and unfamiliar — reliant on teachers</td>
</tr>
<tr>
<td>Visitors</td>
<td>Parents and other family members</td>
<td>Awake and unfamiliar</td>
</tr>
</tbody>
</table>
3. **Fire Brigade Intervention**

3.1 **Location of local Fire Station and building access**

The site is located approximately 2.3km (as determined by Google Maps) from Hornsby Fire Station, Fire and Rescue NSW as depicted in Figure 8.

![Figure 8 – Hornsby Fire Station](image)

3.2 **Fire Brigade site access and equipment**

Fire Brigade access is provided direct via Myra Street with a secondary entry from Edgeworth David Ave. The hydrant booster assembly will be located adjacent to the main entry off Myra Street.
4. Fire Safety Measures

4.1 Suppression

- Southern windows of the home bases directly above the canteen on Levels 3 and 4 are to be provided with wall wetting sprinklers, if these have not been fire rated meeting an FRL of -/60/-.

4.2 Detection

- Smoke detection is to be provided in accordance with AS 1670.1 -2015 [15] throughout.
- The smoke detection system must shut off the mechanical air conditioning system upon detection.
4.3 **Alarm**
- A smoke alarm system is to be provided in accordance with AS 1670.2 with a Sound System and Intercommunications System for Emergency Purposes (SSISEP) in compliance with BCA Clause E4.9.

4.4 **Hydrant system**
- A hydrant system is to be provided in compliance with AS 2419.1-2005 and BCA Clause E1.3. Location of the Fire Hydrants has been addressed in Performance Solution 1 – Fire Hydrant Location.

4.5 **Fire hose reels**
- Fire hose reels are to be installed to the ground floor administration area, the hall, canteen and staff room, complying with AS2441-2005. All other areas have been exempt as shown in Performance Solution 2 – Fire Hose Reels.

4.6 **Portable extinguishers**
- Portable fire extinguishers are to be installed in accordance with AS2441-2001 and BCA Clause E1.6.

4.7 **Smoke hazard management**
- No smoke hazard management is required.

4.8 **Construction and compartmentation**
- Protection of openings against hazard is to be in accordance with BCA C3.4 inter alia AS2118.1-1999 Section 3.
- The eastern wall is to be fire rated to a minimum FRL 120/120/120. All openings in this wall are to be fire doors meeting an equivalent FRL.
- The proposed canteen service windows are to be fitted with Fire Shutters meeting an FRL of --/60/-- as outlined in the BCA report undertaken by NBRS Architecture Compliance.
- Where spandrels have been proposed around the perimeter of floors on Level 2, 3 and 4 these must meet an FRL of 60/60/60.
- Performance Store, Chair Store, PE Sports Store, Music Stores in the Hall and the Back of House room are to be separated to other areas of the building by FRL 60/60/60 construction.
- Store rooms or other enclosed spaces if included under stairs are to be fire rated enclosures FRL 60/60/60.
- The performance store room and stairway leading off the stage on Level 1 are separated from the stage meeting an FRL of 60/60/60.
4.9 Emergency lighting & exit signage

- Emergency lighting and exit signage to all common areas in accordance with BCA Clause E4.4 and AS 2293.1 [14] - 2005.
- Exit signage is required at the base of the amphitheatre stairs in accordance with AS 2293.1 – 2015, leading occupants to the two closest fire isolated stairways as outlined in Performance Solution 3.

4.10 Fire Brigade provisions

The following are the required fire engineering assessment provisions:

- Signage is to be provided at the entrance to the fire isolated stairways, notifying fire brigade personnel of the location of the hydrants prior to entering. The signage is to state “HYDRANTS LOCATED ON HALF LANDINGS”. Lettering is to be minimum 50mm in height and of a colour contrasting the background.
- Signage is to be provided at each internal hydrant and the FIP, noting the use of two hose lengths. The signage is to state “TWO HOSE LENGTHS ARE TO BE USED”. Lettering is to be minimum 50mm in height and of a colour contrasting the background.
- Signage is to be placed at the FIP stating “REDUCED FRL TO THE PLANT LEVEL AND ROOF OF LEVEL 4 – CARE IS TO BE TAKEN WHEN UNDERTAKING FIREFIGHTING ACTIVITIES IN THIS AREA”. The signage is to be at least 30mm high and of a colour contrasting the background.

4.11 Management in use

The following is the management in use requirements which need to be understood by the building owners and operators, and should be included as part of any management documentation and Annual Fire Safety Statement Certificate.

- A no smoking policy is to be implemented in all common property areas.
- General house-keeping must be undertaken to maintain the egress paths and exits clear in order to allow unimpeded travel.

4.12 Maintenance of essential services

Commissioning and integrated function testing of all fire safety and protection systems including interfaces to ensure proper function must be undertaken.

The proposed Fire Engineering Strategy for the building imposes the following requirements on the eventual Building Managers:

- Maintain all active Fire Safety Systems in accordance with the relevant section of AS 1851.
- Evacuation diagrams in accordance with AS 3745 to be provided. The standard emergency evacuation plans are to detail an accessibility specific emergency evacuation.
- Where services are modified as part of a Performance Solution, these must be included in the maintenance and annual certification.
- Regular evacuation drills to be conducted annually (minimum) within the building.

4.13 Safety in Design

The Fire Engineering Analysis is conducted on the basis that any ramifications for “Safety in Design” will be covered by the risk management reporting of the relevant consultants/disciplines responsible for detailed documentation of works recommended by these disciplines including, but not limited to, the Architect and the relevant building services consultants. We will not produce a separate, standalone Risk Management Report for this discipline. We note that the OH&S legislation places particular obligations on the developers and owners of property with respect to the management of OH&S issues arising from the construction, use, maintenance and demolition of plant and buildings.
5. Performance Solutions

5.1 Methodology

Satisfying the Performance Requirements of the BCA through Fire Engineering Performance Solutions can be undertaken using a variety of methods, as detailed in Table 8. Where Performance Solutions are undertaken using Verification Methods, documents such as IFEG [2] and BS 7974-D0 [4] have been used to define the appropriate type of analysis, i.e. Absolute – Qualitative – Deterministic.

Table 7: BCA Clauses – A0.2 Meeting the Performance Requirements and A0.5 Assessment Methodology

<table>
<thead>
<tr>
<th>Clause A0.3</th>
<th>Clause A0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Performance Solution must -</td>
<td>The following Assessment Methods, or any combination of them, can be used to determine that a Performance Solution or a Deemed-to-Satisfy Solution complies with the Performance Requirements, as appropriate:</td>
</tr>
<tr>
<td>(a) Comply with the Performance Solution</td>
<td>(a) Evidence to support that the use of a material, form of construction or design meets a Performance Requirement or a Deemed-to-Satisfy Provision as described in A2.2.</td>
</tr>
<tr>
<td>i. Comply with the Performance Requirements; or</td>
<td>(b) Verification Methods such as—</td>
</tr>
<tr>
<td>ii. Be at least equivalent to the Deemed-to-Satisfy Provisions</td>
<td>i. the Verification Methods in the NCC; or</td>
</tr>
<tr>
<td>And be assessed according to one or more of the Assessment Methods</td>
<td>ii. such other Verification Methods as the appropriate authority accepts for determining compliance with the Performance Requirements.</td>
</tr>
<tr>
<td>(b) A Performance Solution will only comply with the NCC when the Assessment Methods used satisfactorily demonstrate compliance with the Performance Requirements</td>
<td>(c) Expert Judgement.</td>
</tr>
<tr>
<td></td>
<td>(d) Comparison with the Deemed-to-Satisfy Provisions</td>
</tr>
</tbody>
</table>

5.2 List of Performance Solutions

The following table shows the identified non-compliances with the BCA-2016 DtS provisions, which are addressed as Fire Engineered Performance Solutions within this report:

Table 8: Summary of Performance Solutions

<table>
<thead>
<tr>
<th>No.</th>
<th>Description of Performance Solution</th>
<th>BCA Clauses</th>
<th>Performance Requirements</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location and coverage of Fire Hydrants</td>
<td>E1.3</td>
<td>EP1.3</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>2</td>
<td>Permit the removal of Fire Hose Reels</td>
<td>E1.4</td>
<td>EP1.1</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>3</td>
<td>Egress from non-required stairway</td>
<td>D1.12</td>
<td>DP5</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>4</td>
<td>Egress from the Plant Room is provided via single stair only with extended travel distances</td>
<td>D1.2, D1.4</td>
<td>DP4, DP5</td>
<td>Comparative, Qualitative, Deterministic</td>
</tr>
<tr>
<td>5</td>
<td>Permit the removal of fire rating of steel columns and ceiling on Level 4</td>
<td>C1.1</td>
<td>CP1</td>
<td>Absolute, Qualitative, Deterministic</td>
</tr>
</tbody>
</table>
5.3 Performance Solution 1 – Fire Hydrant Location

5.3.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

<table>
<thead>
<tr>
<th>Table 9: Summary of Performance Solution 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>DtS Clause</td>
</tr>
<tr>
<td>A0.2 - BCA Approach</td>
</tr>
<tr>
<td>A0.3 – Approach Methodology</td>
</tr>
<tr>
<td>Fire hazards</td>
</tr>
<tr>
<td>Acceptance Criteria</td>
</tr>
<tr>
<td>Description of Alternative Solution</td>
</tr>
</tbody>
</table>

5.3.2 Comparative / Qualitative Analysis

BCA Clause E1.3 sets the requirements for provision of fire hydrants and their corresponding locations. Clause E1.3(b)(ii) states that where internal fire hydrants are to be provided they must serve only the storey in which they are located.

The BCA performance requirement EP1.3 states that the intent of the BCA is to provide adequate water, under sufficient pressure and flow, to allow the fire brigade to fight fires.

The subject building is proposed to have fire hydrants located on the half landings of the fire isolated stairs throughout, allowing each hydrant to serve more than one level, and to serve more than the level in which they are located. Entrance to all three fire isolated stairways is via external space as shown in Figure 11 and Figure 12. The current fire hydrant system that is proposed has also been found to not provide adequate coverage to Levels 2, 3 & 4.

It is proposed to provide signage to note the location of the hydrants on half landings and the use of two conjoined hose lengths to achieve full coverage to the floor plan. Signage in relation to the hydrant location is to be provided at the external entrance to each fire isolated stair, informing fire-fighting personnel that the hydrants are located on half landings. Signage in relation to the hydrant coverage is to be provided at the FIP and each internal hydrant noting that two conjoined hose lengths are to be used. Further details of this signage is included in section 5.3.3.

The proposal of locating the hydrant in the half landing means that the hose must be ran up or down the stairs to reach the fire location and that the hydrants will not be located on each level, creating a technical non-compliance with Clause 3.2.3 of AS2419.1-2005. As the stairs are fire isolated personnel that may be passing by the fire hose will be in a place of intermittent safety, and as such will not need to be rushing past this area. Furthermore, the BCA does not make mention of a fire hose running past stairs that may be used to connect two points throughout a single level, such as those shown in Figure 11. It is deemed that the hose running from the mid-landing to the floor of interest does not pose a greater risk than that of a stairway passing through two points on the same level.
The non-compliant fire hydrant coverage through the use of a single hose can be seen in Figure 13 to Figure 15. By providing signage at each hydrant and the FIP, fire brigade personnel are expected to be notified about the use of two hose length before the setup of the hose from the hydrant. As such it is not expected that inadequate coverage will be found in any areas throughout the subject building during firefighting activities.
5.3.3 **Robustness or Safety Factor**

- Signage is to be provided at the entrance to the fire isolated stairways, notifying fire brigade personnel of the location of the hydrants prior to entering. The signage is to state “HYDRANTS LOCATED ON HALF LANDINGS”. Lettering is to be minimum 50mm in height and of a colour contrasting the background.
- Signage is to be provided at each internal hydrant and the FIP, noting the use of two hose lengths. The signage is to state “TWO HOSE LENGTHS ARE TO BE USED”. Lettering is to be minimum 50mm in height and of a colour contrasting the background.

5.3.4 **Fire Brigade Intervention**

The location of the fire hydrants is to provide the fire brigade with adequate equipment to undertake fire-fighting activities. If fire brigade personnel decide to retreat they are able to follow the fire hose back to the fire isolated stair in which it is connected.

5.3.5 **Conclusion**

Based on the qualitative assessment undertaken, it has been shown that locating the hydrants on half landings in the fire isolated stairs does not increase risk to firefighting personnel over DTS design. As such, Performance Requirement EP1.3 is said to have been met.
### 5.4 Performance Solution 2 – Fire Hose Reels

#### 5.4.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

<table>
<thead>
<tr>
<th>Description</th>
<th>Fire hose reels are proposed not to be provided in the requiring areas on Level 2 to Level 4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DtS Clause</td>
<td>E1.4</td>
</tr>
<tr>
<td>Performance Requirements</td>
<td>EP1.1</td>
</tr>
<tr>
<td>IFEG Sub-systems</td>
<td>A – C – E</td>
</tr>
<tr>
<td>A0.2 - BCA Approach</td>
<td>Deemed-to-Satisfy Solution</td>
</tr>
<tr>
<td>A0.3 – Approach Methodology</td>
<td>Comply with the Performance Requirements</td>
</tr>
<tr>
<td>Analysis Methodology</td>
<td>A0.5 (d) – Comparison with the DtS provisions.</td>
</tr>
<tr>
<td>Comparative- Qualitative- Deterministic</td>
<td></td>
</tr>
<tr>
<td>Fire hazards</td>
<td>Fire within non-classroom areas of the subject building.</td>
</tr>
<tr>
<td>Acceptance Criteria</td>
<td>Occupant egress will not be restricted by the exclusion of the fire hose reels</td>
</tr>
<tr>
<td>Description of Alternative Solution</td>
<td>The approach used in this solution will be qualitative in nature and will use a deterministic absolute approach.</td>
</tr>
</tbody>
</table>

#### 5.4.2 Comparative / Qualitative Analysis

BCA Clause E1.4 sets the requirements for provision of firehose reels and their corresponding locations. Clause E1.4(a) states that fire hose reels are not required in classrooms and associated corridors in a primary or secondary school, but must be provided to serve any other fire compartment with a floor area greater than 500m² in accordance with section (b) of the same clause.

The BCA performance requirement EP1.1 states the intent of the BCA is to allow occupants to fight a fire which may be in its infancy stages. It is also noted that the BCA Guide states that compliance with E1.4 is not compulsory if alternative means can be found to satisfy the appropriate authority that the Performance Requirements will be achieved.

The areas on Levels 3 and 4 have a typical layout with a fire compartment area of 675m². It is proposed to include fire hose reel coverage only to the areas on Level 1 and the OOSHC area on the eastern side of Level 2. In the event of a fire the primary intent for students is to evacuate the building safely, for this reason students are assumed not to undertake fire-fighting activities. Providing students with access to a fire hose reel may give them a false sense of security and lead to them being more likely to stay in a place of danger.

When analysing occupant characteristics in a fire scenario students are assumed to be awake and unfamiliar. Staff members in these areas have a duty of care to ensure that students are guided to safety in an emergency. For this reason, in a fire scenario staff are expected to direct students throughout the duration of egress.

Level 3 and Level 4 contain the only areas which both exceed fire compartment size of 500m², and are proposed not to be provided with hose reels. This area typical for both floors is shown in Figure 16. Whilst this area is technically not a classroom it should be noted that the area is used as a general learning area for students, more specifically library and maker space. Any staff members who are located throughout this area are assumed to have a similar duty of care as those teachers and are to guide students to safety during an evacuation event. As such, any staff who may have chosen to undertake fire-fighting activities in the early stages, have not been denied the opportunity.
Level 1 of the subject building contains a mixture of office space, store rooms, an assembly hall and circulation space and has a floor area greater than 500m², as such is required to be fitted with fire hose reels. As the subject site is only used as a school it is assumed that the assembly hall will be occupied for either a student assembly or a parent information session. In these two scenarios the majority of occupants will be either reliant on teachers, or unfamiliar with the site and as such will require assistance from staff during evacuation. A further portion of the floor area on Level 1 is used as storage and circulation and as such does not have a significant impact on the occupant population. It is shown in Figure 17 that the floor area which incorporates office and other staff space has a total area of 410m². This floor area is less than that of a DtS Design. As such it can be said that the removal of fire hose reels from Level 1 will not create a risk larger than that of a compliant design.

5.4.3 Robustness or Safety Factor

The areas on Level 1, Level 3 and Level 4 are to be provided with portable fire extinguishers in compliance with AS2444-2001 and BCA Clause E1.6. Furthermore, the subject areas are provided with three fire isolated stairways throughout the floorplan on each level. If a fire is to outbreak and block one of the provided stairways occupants are provided with alternate egress routes.

5.4.4 Fire Brigade Intervention

Fire brigade intervention is not affected as it is shown that evacuation will not be restricted to any less than that of a BCA DtS equivalent design.
5.4.5 Conclusion

Based on the qualitative assessment undertaken, it has been demonstrated that occupants are adequately provided with either the equipment necessary to attempt to extinguish the fire in its early stages, or safely egress from the subject building to a point of safety. As such EP1.1 is considered to be met.
5.5 Performance Solution 3 – Non Required Stairway

5.5.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

<table>
<thead>
<tr>
<th>Description</th>
<th>A non-required stair connecting Level 3 and Level 4 where neither floor has access direct to the ground.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DtS Clause</td>
<td>D1.12</td>
</tr>
<tr>
<td>Performance Requirements</td>
<td>DP5</td>
</tr>
<tr>
<td>IFEG Sub-systems</td>
<td>B – C – E – F</td>
</tr>
<tr>
<td>Approach</td>
<td>Deemed-to-Satisfy Solution</td>
</tr>
<tr>
<td>Analysis Methodology</td>
<td>0.5 - BCA Assessment Method Adamant with the DtS provisions.</td>
</tr>
<tr>
<td>Fire hazards</td>
<td>Fire located in the storage area beneath the non-required stair</td>
</tr>
<tr>
<td>Acceptance Criteria</td>
<td>Occupant evacuation will not be impacted by a fire located in the storage area beneath the stairway.</td>
</tr>
<tr>
<td>Description of Alternative Solution</td>
<td>The approach used in this solution will be qualitative in nature and will use a deterministic absolute approach.</td>
</tr>
</tbody>
</table>

5.5.2 Comparative / Qualitative Analysis

BCA Clause D1.12 is intended to limit the spread of fire and smoke through unprotected openings, which in this case is in the form of a stairway. The subject building has a non-required stair way in the central area of the floor plan connecting Level 3 and Level 4 only, in which neither of those floors has direct egress to a road or open space. The area is proposed to be used as an Amphitheatre with a combination of tiered seating and a stairway. The main use of this stairway is to provide occupants access to the tiered seating.

The BCA DtS Provisions permit the use of a non-required stairway to connect two storeys, if one of those storeys is situated at a level where there is direct egress to a road or open space. The subject building provides access to three fire isolated stairways which will provide occupants with a place of intermittent safety. Occupants will be able to travel through these fire isolated stairways and safely egress to open space on the northern boundary of the building.

It is proposed to provide the building with emergency signage in accordance with AS 2293.1 [14] -2005 at the base of the non-required stairway, directing passing occupants to fire isolated exits being Stair 2 and Stair 3. Occupants exiting the non-required stair will have a choice of the two egress paths measuring 15m and 25m as shown in Figure 18. If the corridor in which the both paths require to travel down is blocked by fire or smoke, occupants will be able to travel back up the non-required stair and egress through Stair 3 from Level 4 which is located 15m from the top of the stairway as shown in Figure 19. It is expected that occupants who chose to travel via the non-required stair will not have a greater
risk of exposure to the onset untenable conditions than a compliant DtS design of Level 3 egressing direct to open space.

Figure 18: Egress from non-required stair Level 3

Figure 19: Egress from non-required stair Level 4

5.5.3 Robustness or Safety Factor

The building is fitted with a smoke detection and alarm system throughout in accordance with AS 1670.1 and AS 3786. Exit signage is to be provided directing occupants from the non-required stairway on Level 3 to the available fire-isolated stairways.

5.5.4 Fire Brigade Intervention

In the case of a fire in the area nearby the Amphitheatre the fire brigade will have access to the point of interest by the fire isolated stairs on both sides of the area on Level 3 and Level 4. This provides fire brigade personnel 4 access points to the fire only a short distance from a location of relative safety.
5.5.5 Conclusion

Based on the qualitative assessment undertaken, it has been demonstrated that occupants are adequately provided with the ability to safely egress from the subject building to a point of safety. As such DP5 is considered to be met.
5.6 Performance Solution 4 – Non Compliant Egress

5.6.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

Table 12: Summary of Performance Solution 4

<table>
<thead>
<tr>
<th>Description</th>
<th>DtS Clause</th>
<th>Performance Requirements</th>
<th>IFEG Sub-systems</th>
<th>A – B – E</th>
</tr>
</thead>
<tbody>
<tr>
<td>The roof level is only provided with one egress point</td>
<td>D1.2, D1.4</td>
<td>DP4, DP5</td>
<td></td>
<td>A – B – E</td>
</tr>
<tr>
<td>Deemed-to-Satisfy Solution</td>
<td></td>
<td>A0.5 (d) – Comparison with the DtS provisions.</td>
<td></td>
<td>Comparative-Qualitative-Deterministic</td>
</tr>
<tr>
<td>Comply with the Performance Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire hazards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire located in the plant area on the roof level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupant evacuation will not be impacted by a fire located on the roof level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The approach used in this solution will be qualitative in nature and will use a deterministic absolute approach.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.6.2 Comparative / Qualitative Analysis

BCA Clause D1.2 and D1.4 set out the requirements for the number of exits which are to be provided and the occupant travel distances to those exits. Clause D1.2 states that a Class 9 building must be provided with no less than 2 exits from each storey. Clause D1.4 states that no point on the floor area is to exceed a maximum travel distance of 20m to an exit or point of choice between two exits. The plant area on the roof level is provided with only one exit point with a travel distance of up to 25m as shown in Figure 20.

![Figure 20: Egress from roof level to fire isolated stair](image)

The BCA Guide outlines that the purpose of controlling the number of required exits is to maximise the opportunity for people to have egress from the building. This is more specific to areas which may be difficult to egress from.

The plant area is to have access restricted to staff who are expected to be trained staff or contractors who should be familiar with the layout of the floor area and the egress point. The floor area has been calculated at 185m², of which an area of 80m² is proposed to be taken up by mechanical equipment, as shown in Figure 21. Applying a load factor of 30m² per person as outlined in BCA Table D1.13, it is expected that occupancy in this area will be 4 people at any one time. The low occupancy numbers mean that queuing times will not affect evacuation from this level. As such it can be said that the total egress time is less than a compliant design where a much higher occupancy causes queuing time before occupants pass through the egress point.
It is expected that if maintenance staff or contractors are located in the plant area it is because they are undertaking work on the mechanical equipment in this area and hence if a fire were to outbreak at this time it is most likely to be caused by the work that is being undertaken and hence in the immediate area that is being worked on. As such, occupants will be able to locate the fire in its early stages and egress before the fire grows to a size which may impede on their evacuation path.

The egress route from the plant area is via a fire isolated stairway and the building is to be fitted with an automatic smoke detection and alarm system. As such, a fire located throughout other areas in the subject building is not expected to impact egress from the roof level.

5.6.3 Robustness or Safety Factor

The building is to be fitted with an automatic smoke detection and alarm system in accordance with 1670.1-2105.

5.6.4 Fire Brigade Intervention

Fire brigade intervention is not affected as it is shown that evacuation will not be compromised.

5.6.5 Conclusion

Based on the qualitative assessment undertaken, it has been demonstrated that occupants are adequately provided with the means necessary to safely egress from the subject area to a point of safety. As such DP4 and DP5 are considered to be met.
5.7 Performance Solution 5 – Non Fire Rated Construction to Structural Elements

5.7.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

<table>
<thead>
<tr>
<th>Description</th>
<th>Columns on Level 4 and the roof is proposed not to be fire rated. Columns on Level 4 supporting the roof and the ceiling under the roof is not proposed to be fire rated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DtS Clause</td>
<td>Spec C1.1</td>
</tr>
<tr>
<td>A0.2 - BCA Approach</td>
<td>Deemed-to-Satisfy Solution</td>
</tr>
<tr>
<td>A0.3 – Approach Methodology</td>
<td>Comply with the Performance Requirements</td>
</tr>
<tr>
<td>Description of Alternative Solution</td>
<td>The approach used in this solution will be qualitative in nature and will use a deterministic absolute approach.</td>
</tr>
<tr>
<td>Acceptance Criteria</td>
<td>Collapse of structural columns or roof elements will not create a spread of fire to other compartments.</td>
</tr>
</tbody>
</table>

5.7.2 Comparative / Qualitative Analysis

Specification C1.1 of the BCA contains the requirements for fire-resisting construction of building elements. Performance requirement CP1 outlines that the structural stability must be appropriate to a number of factors all of which will differ from building to building. The BCA uses terms as “to the degree necessary” to provide flexibility for the designers of the building to determine the degree of compliance necessary.

The subject building has a rise in storeys of 4 and is to be of Class A construction which requires the floor of each level to meet an FRL of 120/120/120 and all structural elements to meet a minimum structural fire resistance of 120 minutes. It is proposed that the columns and ceiling elements throughout Level 4 to be of non-combustible materials and be designed as such that if they are to fail in a fire scenario they will collapse inwards on the floor plate of the subject building. If this occurs the collapse of Level 4 is not expected to have an impact on the remainder of the building as it is protected by the Level 4 floor slab meeting the requirements outlined above. Furthermore, by the construction collapsing in on itself the risk of fire spread to neighboring buildings is reduced.

The risk of occupants being inside the building when it collapses is dependent on occupant movement time and the available fuel sources inside the building. The building is fitted with a smoke detection and alarm system notifying occupants of a fire hazard whilst the fire is in its early stages. Once occupants are notified of the fire, they are provided with egress routes through three fire isolated stairs and one external stair. The subject area is a combination of classrooms, washrooms, staffrooms and a library space. The largest fuel source on this level is expected to be the library area which only takes up an area of 40m² over a fire compartment which has been specified as 1900m² in the BCA Report. Furthermore, the columns and ceiling elements are to be of non-combustible materials and as such will not add to the fuel load limiting the size of the fire and meaning that failure will not occur from ignition of these elements but only through the elements reaching a temperature where their structural integrity is compromised.

In the unlikely scenario that the roof does collapse this will compromise the plant area above. The plant area is to have access restricted to staff who are expected to be trained staff or contractors who should be familiar with the layout of the floor area and the egress point. The floor area has been calculated at 250m², of which an area of 80m² is proposed to be taken up by mechanical equipment, as shown in Figure 22. Applying a load factor of 30m² per person as outlined in BCA Table D1.13, it is expected that occupancy in this area will not exceed 6 people at any one time. The low occupancy numbers mean that queuing times will not affect evacuation from this level. It is expected that once smoke is detected by the smoke detection and alarm system provided, occupants in this area will have adequate time to travel to the fire isolated stairs where they will be in a place of intermittent safety long before the structural collapse is risked. To inform fire brigade of the additional risk of roof collapse signage is to be placed at the FIP stating “REDUCED FRL TO THE PLANT LEVEL AND ROOF OF LEVEL 4 – CARE IS TO BE TAKEN WHEN UNDERTAKING FIREFIGHTING ACTIVITIES IN THIS AREA”. The signage is to be at least 30mm high and of a colour contrasting the background. The provision of this signage
will provide fire brigade with the information that they may be exposed to an additional risk of elements collapsing above them when attending a fire on Level 4 or the Mechanical plant space. Fire brigade will be able to travel to the level of concern through the protection of the fire isolated stairs and assess the situation. If brigade personnel do not deem the level safe to undertake firefighting activities the brigade may choose to retreat.

Figure 22: Proposed layout, roof level plant area

5.7.3 Robustness or Safety Factor
The subject building is to be provided with a smoke detection and alarm system in accordance with AS 1670.1 -2015. The columns and ceiling in the subject area are to be constructed of non-combustible material.

5.7.4 Fire Brigade Intervention
Signage is proposed to be provided at the FIP, notifying Fire Brigade of the reduced FRLs. Fire brigade intervention is considered to be facilitated if the assessment shows that occupants have facilitated safe egress from the subject area.

5.7.5 Conclusion
It has been demonstrated through the performance solution above that permission of fire ratings to be removed from the outlined building elements will not increase the risk of fire spread to other fire compartments or impede on the egress of occupants. As such, Performance Requirement CP1 is said to have been met.
# Appendix 1  Referenced Information

## A 1.1  Reference Documentation

> **Table 14: Summary of referenced documentation**

<table>
<thead>
<tr>
<th>#</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The hazard associated with removing smoke exhaust. Removal of mechanical smoke exhaust potentially result in compromised egress routes before all the occupants could safely egress.</td>
</tr>
<tr>
<td>8</td>
<td>NFPA 92B</td>
</tr>
<tr>
<td>11</td>
<td>AS 1668.1 (20xx)</td>
</tr>
<tr>
<td>12</td>
<td>AS 4100 (20xx)</td>
</tr>
<tr>
<td>13</td>
<td>AS 2218.1</td>
</tr>
<tr>
<td>14</td>
<td>AS 2293.1</td>
</tr>
<tr>
<td>15</td>
<td>AS 1670.1</td>
</tr>
</tbody>
</table>