MINERVA

29 March 2022

Attention: David Griffin

Integrated Projects Pty Ltd
david@integratedprojects.com

Project:	Project Francis, The Star, Sydney
Document Reference:	2191-DA-001
Revision	B

Development Application | Fire Engineering Letter of Support

The Star Casino, 80 Pyrmont Street, Pyrmont NSW

The Star – Former Part 3A Approval MP08_0098
Section 4.55(2) – Modification Application 18
Alterations and additions to the Multi Use Entertainment Facility

Dear David,

This letter has been prepared to support a Section 4.55(2) modification application, submitted to the Department of Environment and Planning, for alterations and additions to the Multi Use Entertainment Facility at the Star. This letter is to assist with demonstrating that although the design contains some non-compliances with the prescriptive requirements of the Building Code of Australia (BCA), we have assessed the design and are comfortable that these can be addressed through fire engineering analysis. This letter should be read in conjunction with the concept fire strategy report provided by Minerva Group (ref. 21191-FECR-001-B dated 8th March 2022).

The proposed works consist of redevelopment of the existing function centre space into two separate entertainment facilities which can operate separately and concurrently to provide the operator with maximum flexibility. The location of the existing MUEF is outlined in Figure 1, with the split between the two venues then shown in Figure 2.

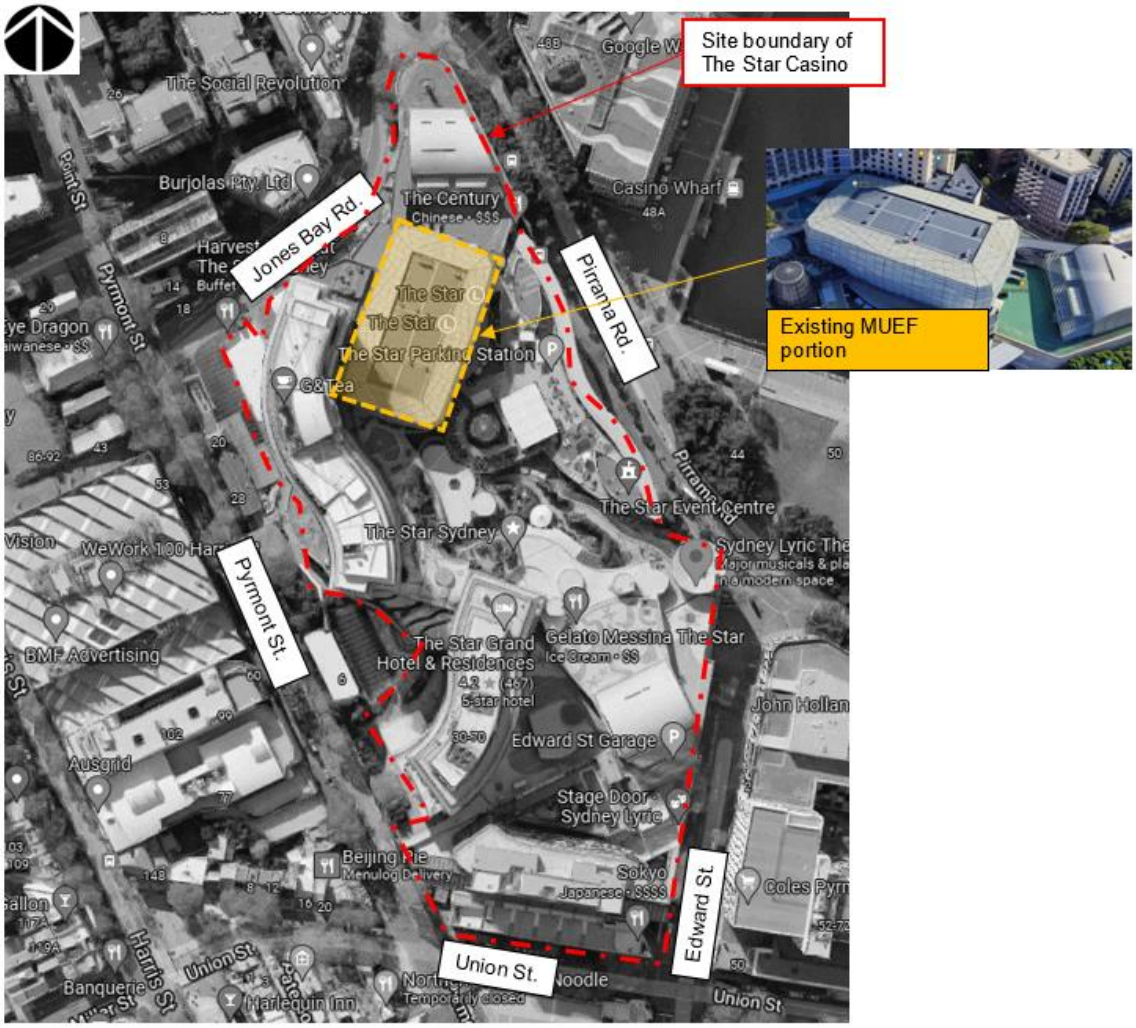

Figure 1 –Aerial Photo of Existing Star Casino Site – (Google Maps© 2021)

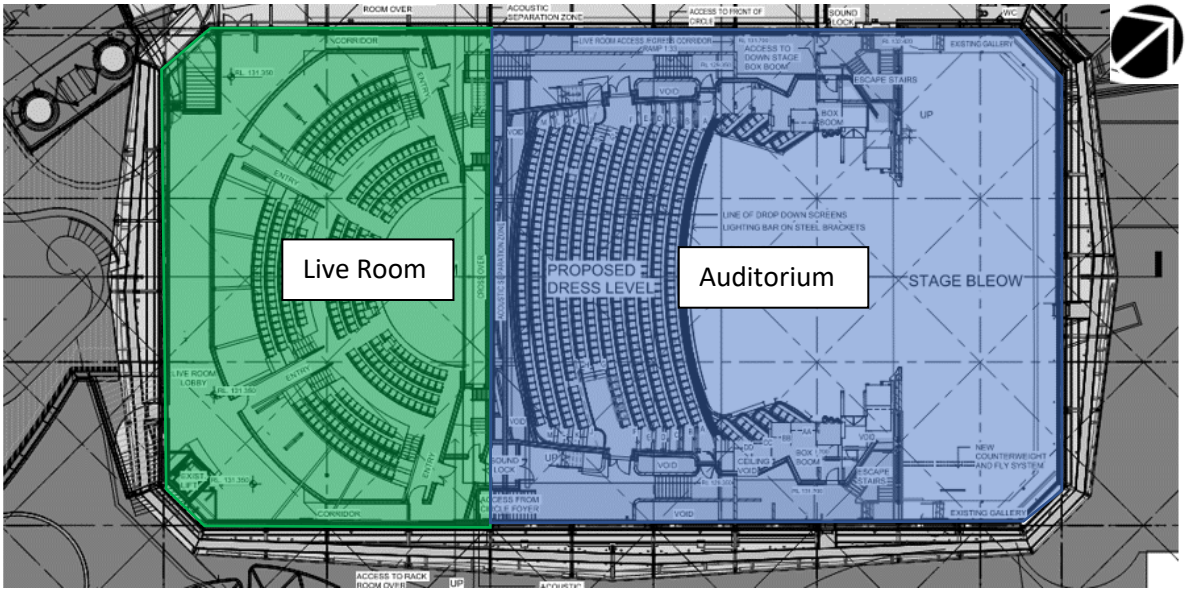

Figure 2 – Level 5 plan showing split between Auditorium and Live Room

Our design review has been based on the following documents:

- NCC Assessment Report produced by VPL Consulting (ref. V220002 dated 26th February 2022)
- Architectural drawings provided by Altis Architecture (dated 28th March 2022)

The fire safety design will generally satisfy the Performance Requirements of the Building Code of Australia by complying with the Deemed-to-Satisfy Provisions. There are some aspects of the design that will require the use of Performance-Based fire engineering to achieve compliance with the relevant Performance Requirements of the BCA. Subject to approval from the Principal Certifying Authority and relevant stakeholders during the design process, the proposed Performance Solutions outlined in Appendix A can meet the Performance Requirements of the BCA once further fire engineering analysis has taken place during later phases of the design process.

This document is for the purposes of supporting the proposed design for DA. It shall not be used for Construction Documentation and compliance with the Performance Requirements of the BCA will need to be verified through a formal fire engineering assessment by a *Certifier – Fire Safety* during later stages of the design process.

Should you have any queries, please do not hesitate to contact the undersigned.

Yours sincerely,

Dan Kirk, NSW Accredited Fire Engineer - BDC 2952

Technical Director

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Appendix A – BCA report extract

The following is an extract of the BCA report (rev. 2) confirming the fire engineering Performance Solutions which will be required on this project.

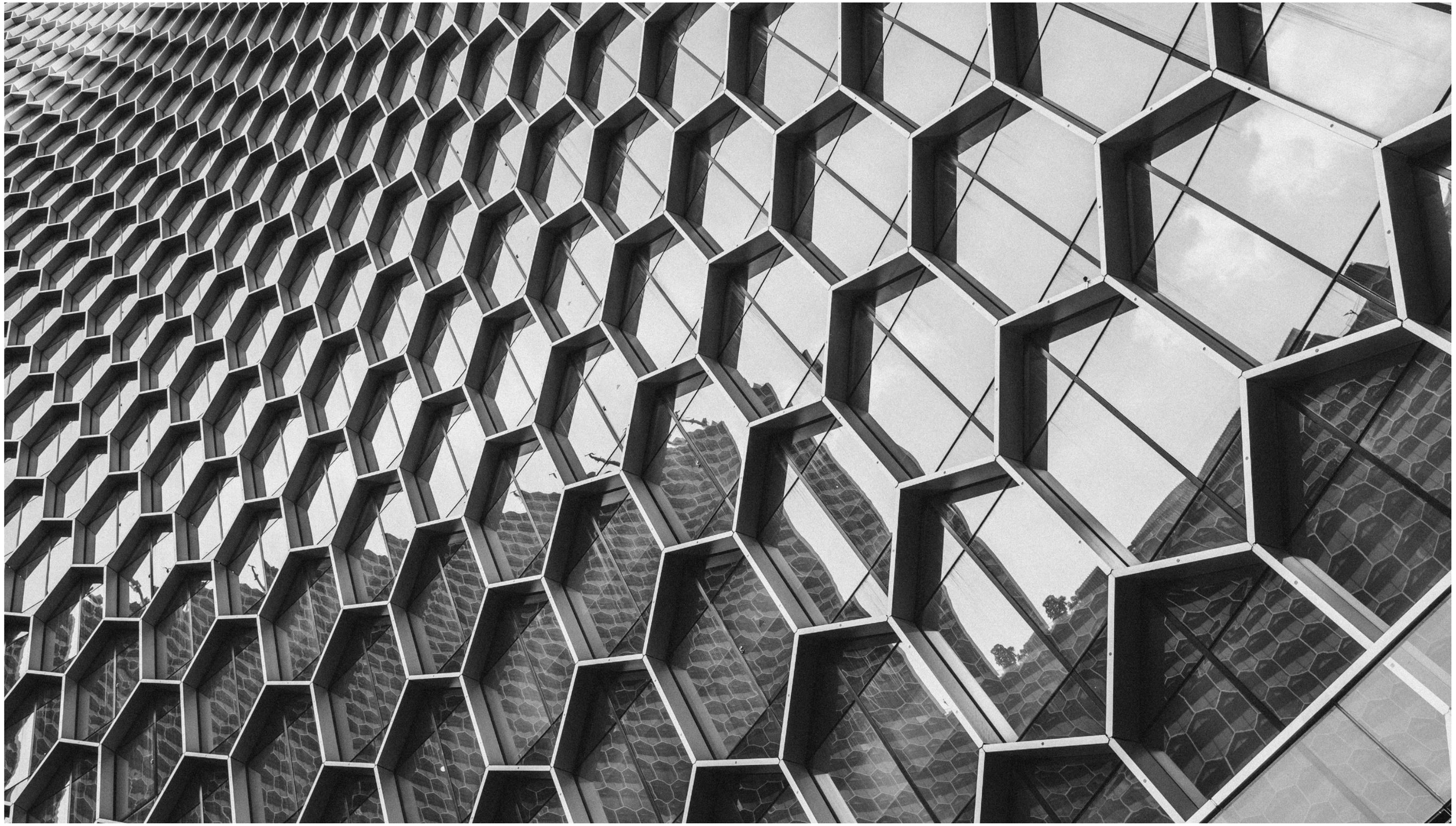
VPL CONSULTING

2.3 – Fire Safety Engineering Alternative Solutions

Prior to the issue of a construction certificate the following variations from deemed to satisfy provisions of the BCA provisions are to be addressed via an alternative solution:

(1) BCA Clause/Table 3 Specification C1.1 – To permit a reduction in FRLs to structural elements of the existing and new works
(2) BCA Clause/Table3 Specification C1.1 – to permit the floor construction to the seating area to both the auditorium and Live Room to not have a FRL
(3) BCA Clause C2.12 – To permit the emergency equipment contained with plant rooms not to be fire separated from the remainder of the building
(4) BCA Clause D1.2 (g) – To permit egress from the Entertainment Venue to discharge via another sole-occupancy unit
(5) BCA Clause D1.3 & NSW H101.15 – To permit the dressing room to Levels 4 and 5 to not be served by two (2) fire-isolated exits and not be separated by construction achieving a FRL of not less than 60/60/60
(6) BCA Clause D1.4 & D1.5 – To permit extended distance of travel to a point of choice between exits, the distance of travel to a required exit and the distance of travel between exits
(7) BCA Clause D1.6 – To permit a reduced egress width to serve the Entertainment Venue
(8) BCA Clause D1.9 – To permit non-fire-isolated stairways to not have a continuous path of travel to the storey that leads to a road or open space
(9) BCA Clause D2.11 – To permit horizontal exits to account for more than 50% of the required exits
(10)
(11) BCA Clause D2.2, D2.13 – To permit the use of escalators in a required egress path
(12) BCA Clause E1.4 – To permit the removal of hose reels to serve the whole of the Entrainment Venue
(13) BCA Clause E1.5 – To permit false floors (subfloor area) under the auditorium seating to not be protected by a sprinkler system
(14) BCA Table E2.2a – To dispense with smoke exhaust throughout the whole of the Entertainment Venue based on the building being considered as a large-isolated building
(15) BCA Clause E2.2 – To permit a rationalized smoke exhaust system to serve the Entertainment Venue
(16) BCA Clause E3.4 – To permit Dressing Rooms to Levels 4 & 5, plant room and store room to Level 6 not to be served by an emergency lift
(17) BCA Clause E4.5 & E4.7 – To permit the exit signs contained within the auditorium spaces to not be illuminated at all times
(18) BCA Clause NSW H101.2 – To permit the entertainment venue to not be fire separated from the remainder of the building

(19) BCA Clause NSW H101.5.3 & H101.10 – To permit the stage to the main auditorium to not be separated by a safety curtain
(20) BCA Clause NSW H101.7 (a) (iv)– To permit the structural steel supporting the stage tower not to be enclosed by concrete or masonry construction.
(21) BCA Clause NSW H101.7 (b) (i) – To permit the stage to the main auditorium to not be separated by a proscenium wall having a FRL of 120/120/120 and the proscenium opening not to be protected by a rigid safety curtain
(22) BCA Clause H101.11.1 – To permit seating in rows to contain 12 seats in lieu of 8 seats
(23) BCA Clause 101.11.5 – To permit seating in rows to contain 25 seats in lieu of 24 seats
(24) BCA Clause 101.12 – To permit the auditorium seating to deviate from Table NSW H101.12
(25) NSW H101.16 – To permit storerooms to not be separated by construction achieving a FRL of not less than 60/60/60



Project Francis, The Star

Fire Engineering Concept Report

Foundation Theatres

MINERVA

29 March 2022 | Revision C | 21191-FECR-001-C

DOCUMENT CONTROL

Project	Project Francis, The Star
Project Reference	21191-FECR-001-C
Client	Foundation Theatres

Rev	Date	Overview	Prepared	Reviewed	Approved
A	21 January 2022	Issued for design team comment	Dan Kirk	Eliot Reeves	DRAFT
B	8 March 2022	For DA submission	Dan Kirk	Eliot Reeves	Dan Kirk
C	29 March 2022	Revised to address final stakeholder comments	Dan Kirk	Eliot Reeves	Dan Kirk

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EXECUTIVE SUMMARY

Summary

This report has been prepared to support a Section 4.55(2) modification application, submitted to the Department of Environment and Planning, for alterations and additions to the Multi Use Entertainment Facility at the Star. The site is located on Level 3 – 6 of the existing development referred to as The Star, Sydney. The existing use of the site is as a large-scale function facility and for live music acts (Class 9b use) which will now be split into two separate areas to provide greater functionality for the operators.

This report outlines the fire safety strategy that will support the elements of the building design that will not comply with the Deemed-to-Satisfy Provisions of the Building Code of Australia for the following parts:

1. **Section C – Fire resistance**
    a. Part C1 – Fire resistance and stability
    b. Part C2 – Compartmentation and separation
    c. Part C3 – Protection of openings
2. **Section D – Access and egress**
    a. Part D1 – Provision for escape
    b. Part D2 – Construction of exits
3. **Section E – Services and equipment**
    a. Part E1 – Fire-fighting equipment
    b. Part E2 – Smoke hazard management
    c. Part E3 – Lift installations
    d. Part E4 – Visibility in an emergency, exits signs and warning systems
4. **Section H – Special use buildings**
    a. Part H1 – Class 9b buildings

This report shall not be used for Construction Documentation and compliance with the Performance Requirements of the BCA will need to be demonstrated through a formal fire engineering assessment by a Registered Certifier – Fire Safety in the subsequent Fire Engineering Brief and Fire Engineering Report as part of the formal building approvals process.

Table 1 provides a summary of the BCA DtS non-compliances that have been identified to date and are intended to be addressed as Performance Solutions during the later phases of design.

Table 1 – DtS non-compliances / Proposed Performance Solutions

PS #	BCA DtS Clause	Description of Non-Compliance
1.	Spec. C1.1 – Fire-resisting construction	Assess a reduction of FRLs within the Loading Dock to 120 minutes, in lieu of 240 minutes. *PS1 - This solution was included in the original AECOM FER, so will need to be reassessed within the Project Francis report to enable the original document to be superseded as it deals with existing site constraints.*
2.	Spec. C1.1 – Fire-resisting construction	Assess a number of roof trusses providing lateral stability to the walls of the MUEF as not being fire rated
		Assess the outriggers providing lateral stability to the external walls as not being fire rated
		Assess the main support columns as being enclosed by speedpanel (or similar) on either side, however from the outside, these columns will not achieve the required FRL as it is tested to a greater span *PS2 - The above three solutions were included in the original AECOM FER, hence it is intended to reassess these items to omit the need for providing additional fire protection to the existing structure.*
	NSW H101.7 (a) (vi) – Flying scenery	Assess the structural steel supporting the stage tower to not be enclosed by concrete or masonry construction *(subject to further review at next phase of design)*
3.	C2.12(a) – Separation of equipment	Assess the plant room at Level 04 (Grid G6-K) as containing emergency equipment which will be used in fire mode. To meet the DtS provisions the plant room should be enclosed in a 120-minute fire-isolated room. It is proposed to omit this based on: The essential MSSB being contained within a fire rated cupboard achieving 120 minutes fire resistance. The provision of a self-closing fire door having an FRL of not less than -/120/30 to the cupboard. The plant room will be separated from the reminder of the building with smoke proof construction between the plant room and the existing hotel. *PS3 – This solution was included in the original AECOM FER, so will need to be reassessed within the Project Francis report to enable the original document to be superseded as it deals with existing site constraints.*
4.	D1.2 – Number of exits required D1.9 – Travel by non-fire isolated stairways or ramps D2.2 – Fire isolated stairways and ramps D2.13 – Goings and risers	Assess the use of escalators as part of the egress strategy for the building along a required egress path
5.	D1.2(g) - Number of exits required	Assess the egress strategy for the development as utilising a pathway which takes occupants through a tenancy which is not controlled by the Theatre. *Note: a legal agreement will need to be formed between The Star and Foundation Theatres to enable this configuration to be formalised regarding access through into the current cold shell tenancy to the north of Sovereign Gaming.*

PS #	BCA DtS Clause	Description of Non-Compliance
6.	D1.3 – When fire isolated exits and ramps are required NSW H101.15 – Dressing rooms	Assess the provision of smoke compartmentation in lieu of fire compartmentation to the new dressing rooms area, which will not be provided with two (2) exits in accordance with NSW Clause H101.15(b)
7.	D1.4 – Exit travel distances D1.5 – Distance between alternative exits	Assess the following egress non-compliances within the proposed design: • Up to 30 m to a single exit / point of choice between two exits, in lieu of 20 m • Up to 60 m to the nearest of two or more available exits, in lieu of 40 m. • Up to 90 m between alternative exits, in lieu of 60 m.
	D1.6 – Dimensions of exits and paths of travel to exits	Assess parts of the scope of works area as having a reduced egress width (both Class 9b public assembly areas and ancillary plant spaces) – exact areas / reductions to be confirmed during later design stages. *PS4 - It is anticipated that travel distances and aggregate egress width will be non-compliant within the Auditorium and Live Music Venue. It has also been noted that egress width reductions are present within plant areas from the original AECOM report. Smoke and evacuation modelling will be used to quantify that an acceptable outcome can be achieved from the public areas, with plant areas being assessed qualitatively.*
	D2.11 – Fire isolated passageways	Assess the use of horizontal exits which account for more than 50% of the required exits
8.	D1.9 – Travel by non-fire isolated stairways or ramps	Assess the venue as not being served by continuous stairs that lead directly to a road or open space, including their use being for egress from the dressing room / storage areas, and the flytower serving the auditorium's stage *PS5 - This solution was included in the original AECOM FER, so will need to be reassessed within the Project Francis report to enable the original document to be superseded as it deals with existing site constraints, with additional areas now affected by it due to the revised design.*
9.	E1.4 – Fire hose reels	Assess the omission of hose reels within the venue (all areas). *PS6 - It is proposed to assess the omission of hose reels from all areas as the primary objective for occupants for public assembly buildings is to escape immediately, rather than attempt to attack the fire.*
10.	E1.5 – Sprinklers AS 2118.1 (2017) Spec. C1.1 Table 3	Assess the omission of sprinklers beneath the false floor areas beneath the Auditorium seating Assess the floor construction to the seating area to both the auditorium and Live Room to not have a FRL *PS7 – Assuming the area is kept sterile and any ignition sources within are suitably fire rated from the void space, it is intended to omit the need to install sprinklers within this area. Please note that this solution will be subject to Brigade acceptance as they have recently pushed back on this proposal on other projects.*

PS #	BCA DtS Clause	Description of Non-Compliance
11.	E2.2 – Smoke hazard management	Assess the use of rationalised smoke exhaust provisions within both venues in terms of the following: • smoke exhaust rates (112.5 m^3 in place at present which we intend to reuse) • smoke reservoir sizes (may be compliant as a result of the proposed MUEF split) • the omission of smoke exhaust to Back of House (BOH) spaces, despite the fact that the site is considered a Large Isolated Building (LIB) by definition *PS8 - We intend to utilise the existing smoke exhaust fans, where possible, and make amendments to the make-up air and smoke baffles / reservoirs to suit the configuration of the new space to ensure the design can be supported. Smoke and egress modelling will be used to quantify this outcome.*
12.	E3.4 – Emergency lifts	Assess the dressing rooms on Levels 4 & 5, and the plant room and storeroom on Level 6 as being served by an emergency lift which does not serve every level of the building *(subject to further review at next phase of design)*
13.	E4.5, E4.8 & Clause 6.7 of AS 2293.1	Assess the use of performance based illuminated exit signage (for the Auditorium space only) which shall not be illuminated at all times. *PS9 - It is assumed that the design team would prefer for exit signage to be switched off within the Auditorium during events. An auto-cutover system will be introduced to enable this to be facilitated.*
14.	H1.3, NSW H101.5.3, NSW H.101.10,	Assess the omission of proscenium curtains in the new Auditorium and the Live Music Venue. *PS10 - It is proposed to omit proscenium curtains in both areas through smoke and evacuation modelling which will demonstrate safe evacuation is possible without these in place.*
15.	NSW H101.2, NSW H101.12	Assess the entertainment venue to not be fire separated from the remainder of the building *(subject to further review at next phase of design)* Assess candy bars within the Auditorium and some storerooms as not being fire rated from the rest of the space by 60/60/60 FRL fire rated construction (subject to final design) *PS11 – The entertainment venue is already fire separated from the other portions of the building, other than a glazed wall in the reception area around the escalator void which will be justified through fire engineering assessment. It is also proposed for small candy bars and storerooms as being omitted from requiring fire rated construction around them based on the limited fuel load and ignition sources present in these small spaces. The areas this solution can be applied to will be subject to the final design.*
16.	NSW H101.11.1	Assess seating rows as containing up to 12 seats with an aisle on only one side, in lieu of 8 seats
	NSW H101.11.5	Assess seating rows containing up to 25 seats in aisles, in lieu of 24 seats
	NSW H101.12.6(b)	Assess the first exit door from the stage as being 11 rows back, in lieu of being between 5-7 rows back

PS #	BCA DtS Clause	Description of Non-Compliance
	NSW H101.12.3 & Table H101.12	Assess the main auditorium seating as deviating from Table H101.12, as follows: Having the actual depth of rows at 950 mm for continental rows, and 925 mm from aisles within the balcony, in lieu of 1000 mm and 975 mm Having the actual depth of rows at 1000 mm for continental rows, and 950 mm from aisles within the boxes (lower), in lieu of 1025 mm and 975 mm *PS12 - A number of seating non-compliances have been identified by the design team within the current Project Francis design. Smoke and evacuation modelling will be used to demonstrate safe evacuation is possible with the proposed seating configuration in place.*

Conclusion

It is the finding of this report that, subject to approval from the Principal Certifying Authority, Fire & Rescue NSW (FRNSW), and other relevant applicable stakeholders during the design process, the proposed Performance Solutions nominated in Table 1 related to the subject development can be demonstrated as meeting the relevant Performance Requirements of the BCA.

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1 INTRODUCTION

1.1 Report Purpose

This report has been prepared to support a Section 4.55(2) modification application, submitted to the Department of Environment and Planning, for alterations and additions to the Multi Use Entertainment Facility at the Star..

The purpose of this report is to outline the following:

- The scope of works and relevant project stakeholders
- The principal characteristics of the project and building occupants
- An overview of the building features that will not comply with the Deemed-to-Satisfy (DtS) Provisions of the BCA
- A summary of the Performance Solutions that may be adopted to support the design
- Any applicable assumptions, dependencies, or limitations

1.2 Project Scope

Minerva Group (NSW) Pty Ltd has been appointed by Foundation Theatres to assess the deviations from the BCA Deemed-to-Satisfy (DtS) Provisions which were summarised in Table 1. These are discussed in more detail in Section 5 of this report.

1.3 Relevant Project Stakeholders

The relevant project stakeholders are outlined in Table 2.

Table 2 – Relevant Project Stakeholders

Role	Organisation	Name
Client	Foundation Theatres	Paul Rigby
Project Manager	Integrated Projects	David Griffin
Architect	Altis Architecture	Derek Carroll
Principal Certifying Authority	McKenzie Group	Aaron Celarc
BCA Consultant	VPL Consulting	Vic Lilli
Certifier – Fire Safety	Minerva Group (NSW) Pty Ltd	Dan Kirk
Structural Engineer	TTW	Richard Milsted
Building Services Engineer	Webb Australia	Paul Moro

1.4 Fire Engineering Process

1.4.1 International Fire Engineering Guidelines (IFEG)

The IFEG outline the process by which Fire Engineering analysis is undertaken when assessing deviations from the DtS Provision of the BCA. This step-by-step process enables fire safety professionals to undertake a consistent approach such that the inputs for the Performance Solution are transparent and the outcomes can be understood by the community.

The methodology outlined in the IFEG will be adopted at each stage of the fire engineering process, as summarised below.

1.4.2 Fire Engineering Brief (FEB)

The objectives of the Fire Engineering Brief are to:

- Agree the design objectives of the project brief.
- Test a Trial Concept Design to meet the objectives of the project brief.
- Agree with stakeholders the assessment approach and acceptance criteria necessary to demonstrate compliance with the Performance Requirements.

The FEB will be developed at the next stage of works which is post-DA submission.

1.4.3 Fire Engineering Report (FER)

On acceptance of the Fire Engineering Brief, the objectives of the Fire Engineering Report are to:

- Undertake the engineering analysis to assess compliance with the Performance Requirements.
- Detail the outcomes of the engineering analysis in terms of the fire safety design and management requirements.
- Clearly document the Performance Solutions that satisfy the relevant BCA Performance Requirements

1.5 Existing Fire Engineering Reports

There are multiple existing FERs applicable to The Star as a whole. There is only one applicable to the existing entertainment facility though, as outlined below:

- AECOM FER ref. '20110913-60151681_MUEF_FER_rev_12a' | 12/12/2012 | Rev 12a

The above FER will be superseded as part of these works, with the new Minerva FER then being applicable to the redeveloped venue (including any ancillary areas elsewhere on site which are also covered in the above report).

2 BUILDING CHARACTERISTICS

2.1 Building location

The scope of works area (MUEF portion) spans Level 3 – 6 of 80 Pyrmont Street, Pyrmont (as illustrated in Figure 1). This forms part of the wider Star Casino development as outlined by the dashed red line in the same diagram.

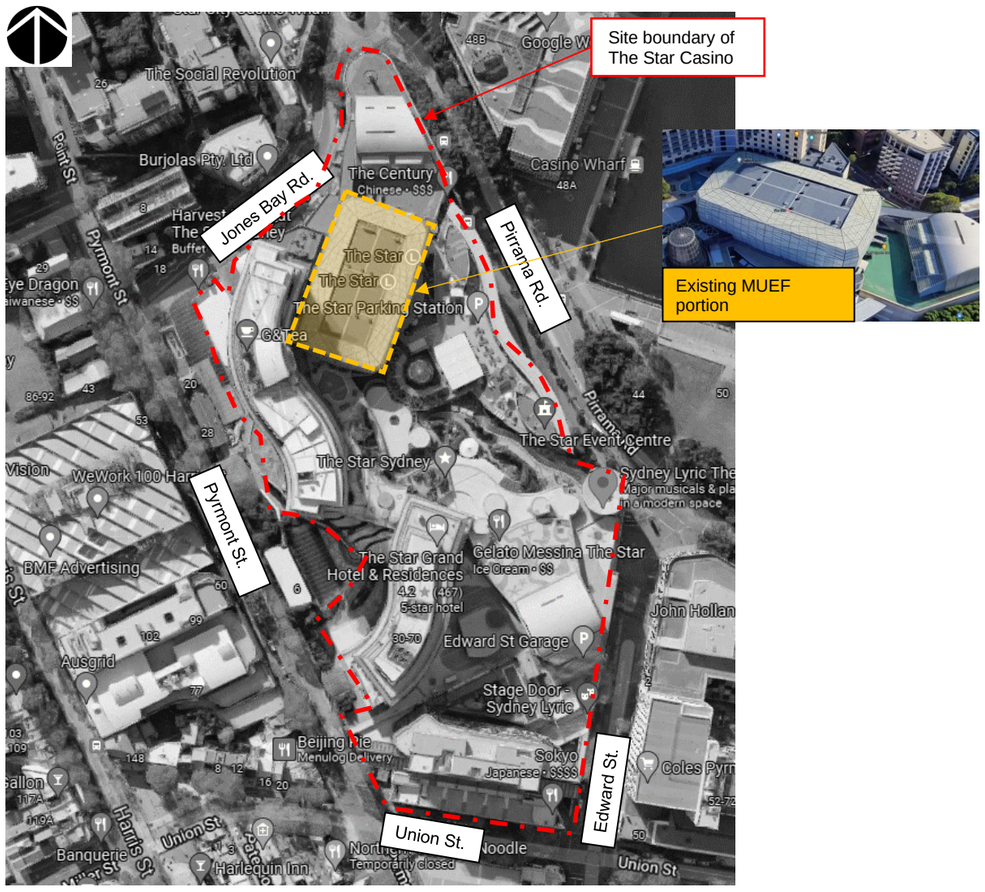


Figure 1 –Aerial Photo of Existing Star Casino Site – (Google Maps© 2021)

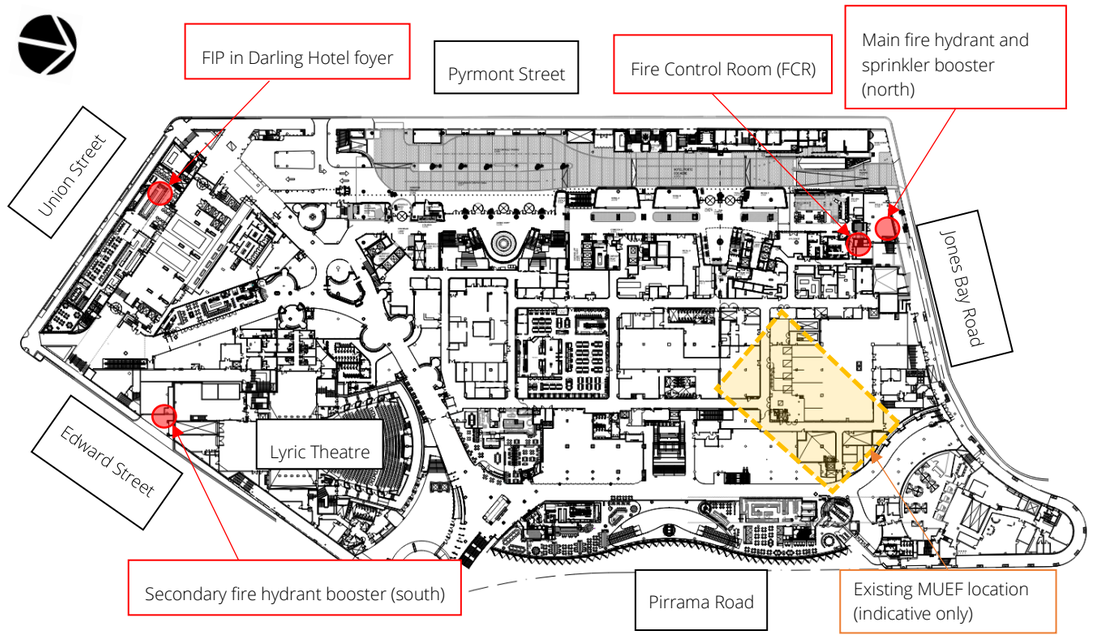


Figure 2 –Floor Plan of Existing Star Casino Site – (Google Maps© 2021)

2.2 Proposed building arrangement

Project Francis comprises of the redevelopment of the existing MUEF complex into a new dual-venue facility. These will consist of the main theatre auditorium which spans the stalls, dress circle, and gallery (Level 3 – 6), and the live music venue which spans only Level 5 and 6.

The diagrams on the following pages set out the current design for the floors referred to above. There is also a loading dock for the venue on Basement 2, but it is not considered that this will form a major part of the redevelopment scope so has been omitted in the following pages.

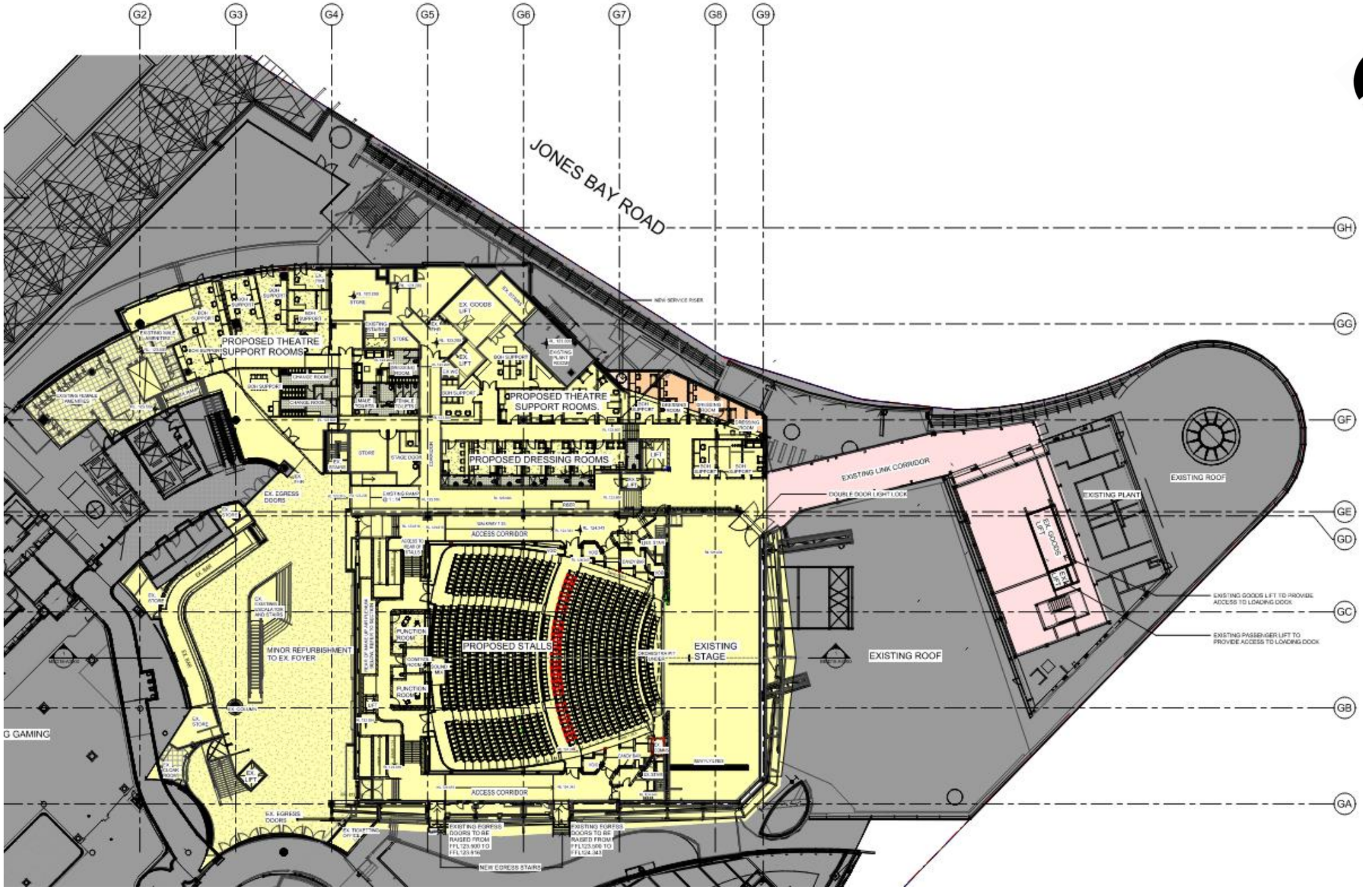


Figure 3 – Level 3 plan

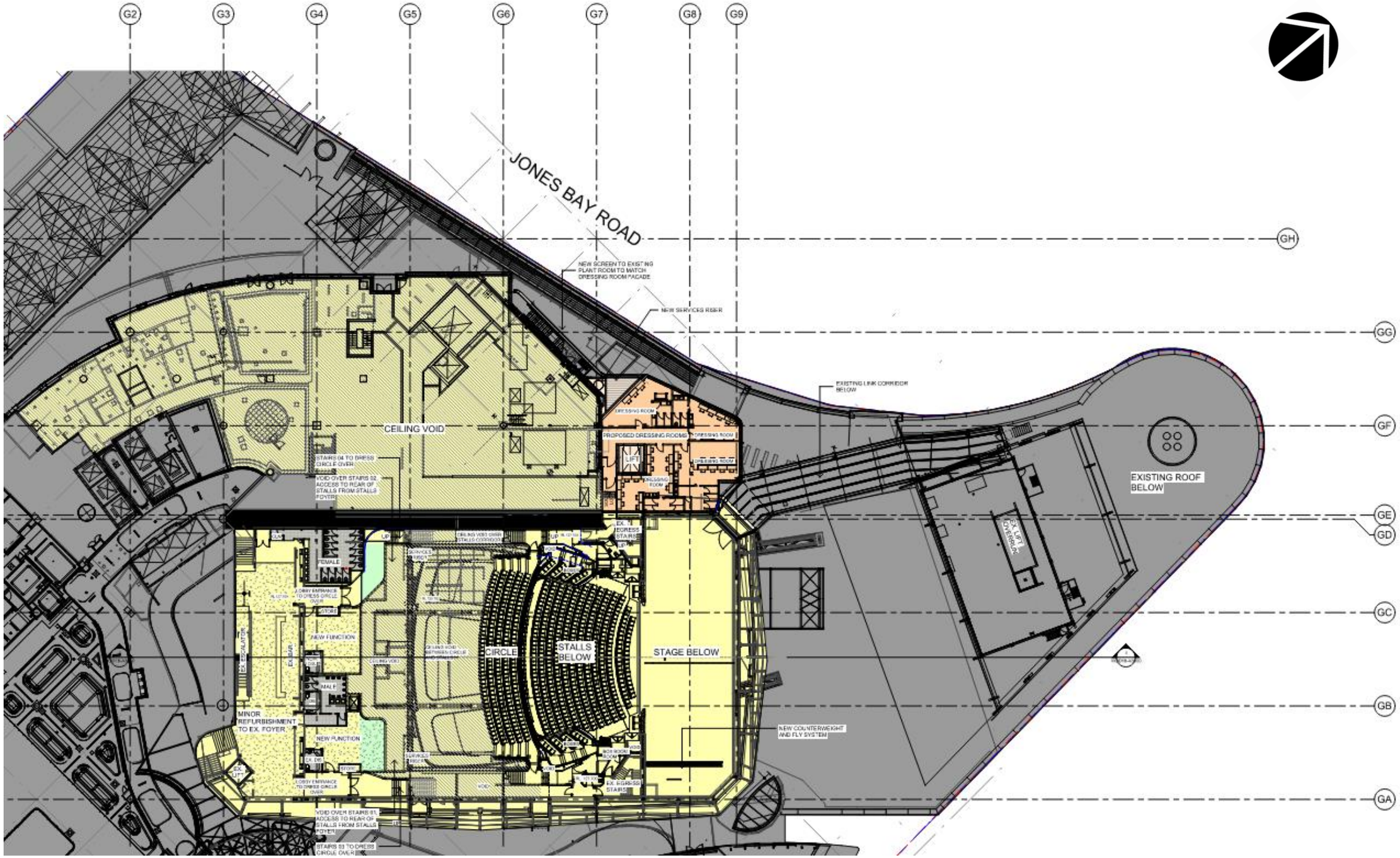


Figure 4 – Level 4 plan

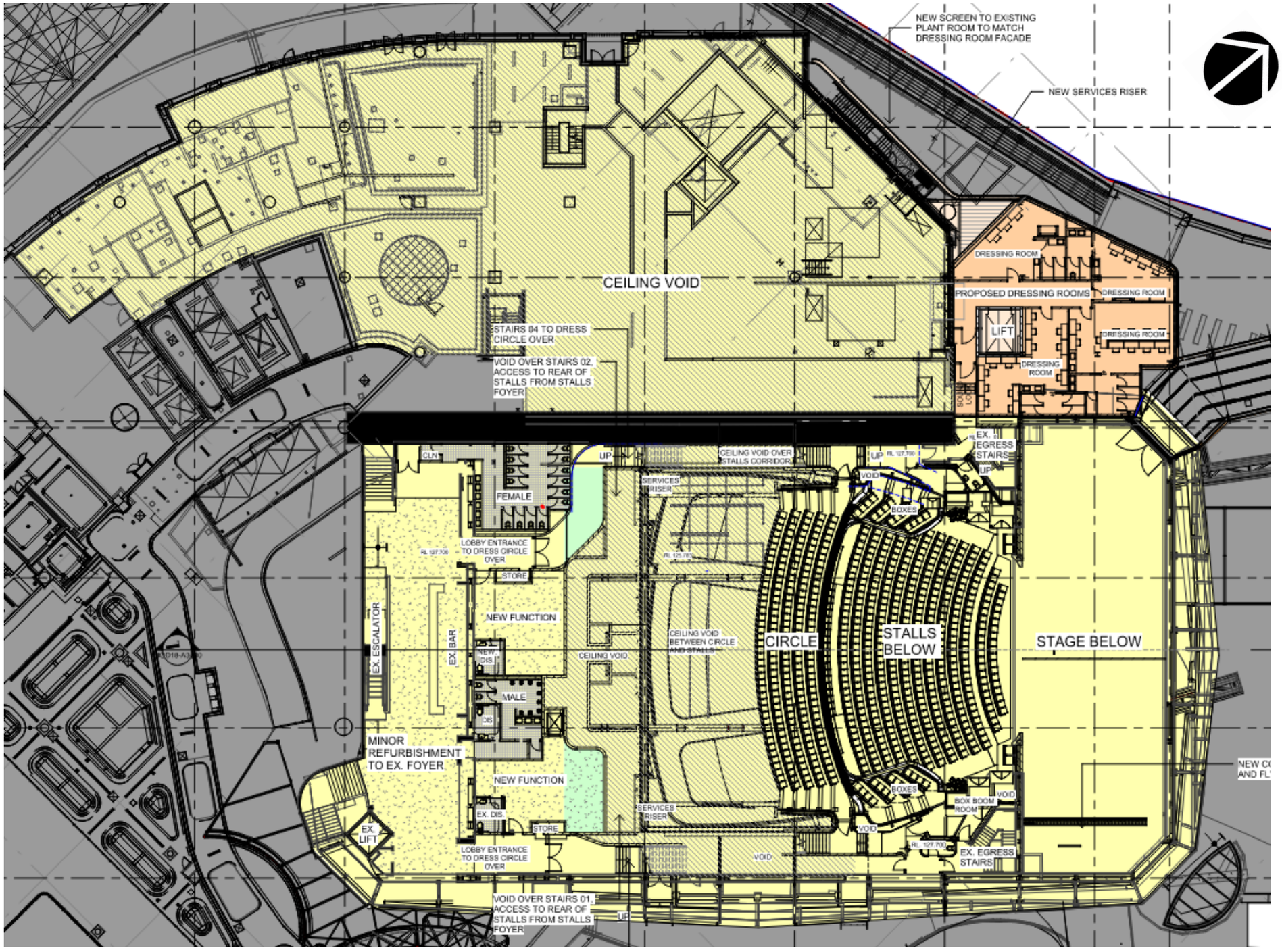


Figure 5 – Level 5 plan

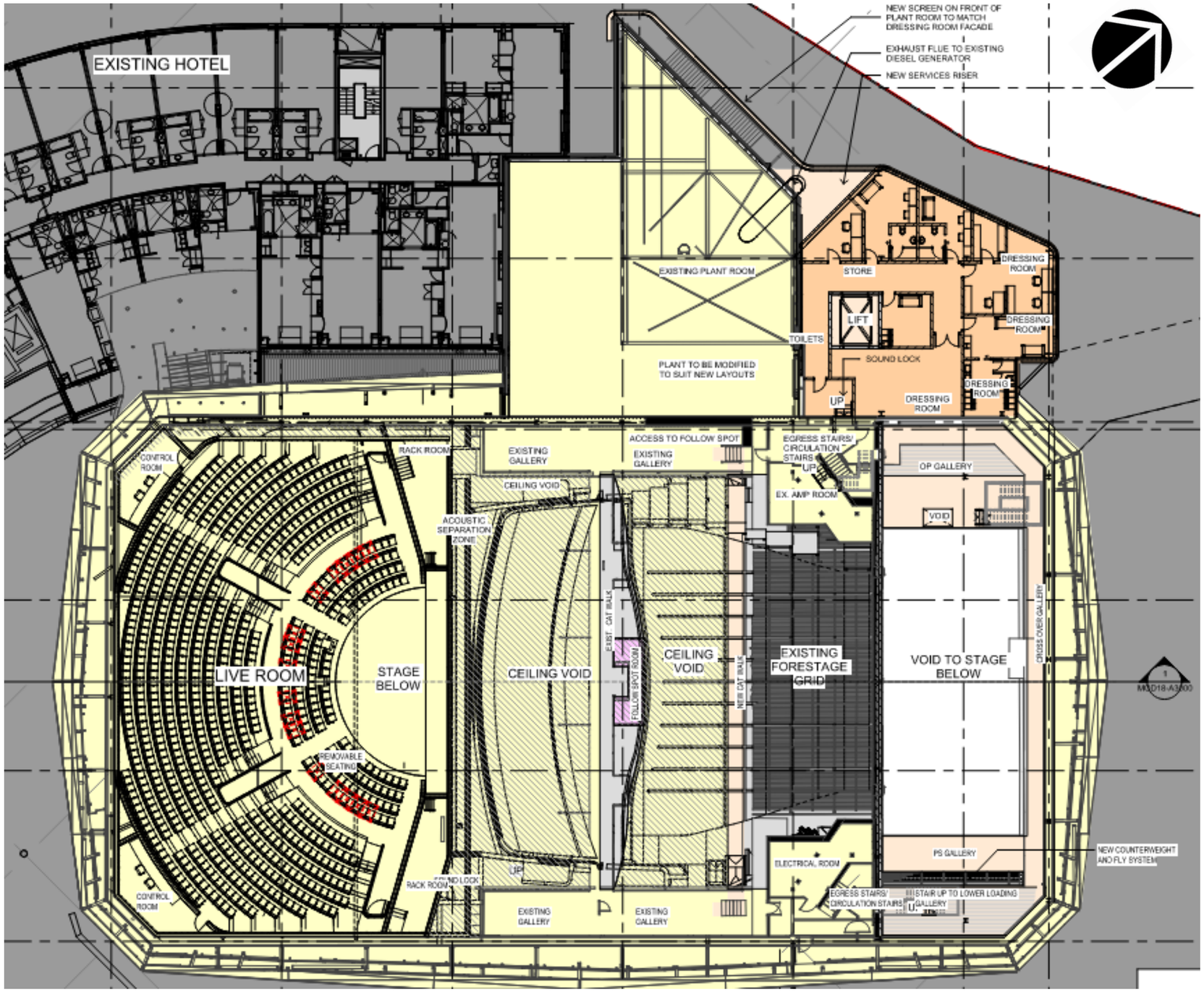


Figure 6 – Level 6 plan

2.3 BCA DtS Reference Criteria

The BCA DtS reference criteria is summarised in Table 3.

Table 3 – BCA DtS Reference Criteria

BCA Clause	Item	Description or Requirements
A6.0	Classification	Class 2 Residential Class 3 Hotel Class 6 Retail Class 7a Carpark Class 7b Storage Class 9b Theatre
C1.1	Construction Type	A
C1.2	Rise in Storeys	Star Casino – 14 above ground storeys, with 5 levels of basement
Schedule 3	Effective Height	> 50 m

2.4 Fire Hazards and Preventative and Protective Measures

Table 4 examines the fire hazard and mitigation measures that are in place.

Table 4 – Fire Hazards and Protective and Preventative Measures

Area	Fire Hazards	Mitigation Measures
Residential / Hotel	**Ignition Sources** – Electrical equipment – Heating and cooling equipment – Mechanical equipment – Office equipment e.g. printers – Kitchenette **Fuel Load** – Paper, chairs, tables – Storage cabinets – Electrical appliances – Cleaning chemicals	**Preventative Measures** – Staff and security – Housekeeping – Maintenance of equipment **Protective Measures** – Fire compartmentation – Fire hydrants – Automatic fire sprinklers – Automatic smoke detection – Portable fire extinguishers – Exit signage and emergency lighting
Retail	**Ignition Sources** – Electrical equipment – Heat and cooling equipment – Mechanical equipment – Cooking equipment **Fuel Load** – Chairs and tables – Electrical appliances – Cleaning chemicals – Stock	– EWIS system – Fire Hose Reels (where applicable) – Smoke Exhaust System – Stair Pressurisation
Carpark	**Ignition Sources** – Cars – Air handling equipment – Lighting **Fuel Load** – Cars – Storage	
Storage	**Ignition Sources** – Air handling equipment – Lighting **Fuel Load** – Storage	
Theatre	**Ignition Sources** – Electrical equipment – Heat and cooling equipment – Mechanical equipment – Stage equipment **Fuel Load** – Chairs – Stage props	

3 OCCUPANT CHARACTERISTICS

3.1 Building Occupants

3.1.1 Distribution

The following table summarises the information taken from BCA Table D1.13. Table 5 in relation to the floor space factors per person on the various occupancy types within this building. It should be noted that population numbers will be determined from seating numbers for all public (Class 6 and 9b) portions.

Table 5 – Building Occupancy Rates

Occupancy	Area per person (m^2)
Bar / foyer space	0 – Population is calculated on number of theatres patrons
Theatre / Live Music Venue patrons	1
Theatre dressing room (assumed to apply to back of stage areas)	4

Building occupancy numbers will be confirmed throughout the design process. We anticipate that a performance solution will be required to account for insufficient egress width, and this has been included in the preliminary Performance Solution list.

Below are the proposed occupancy rates per area / level. These population numbers assume that occupants within the foyer area each have an allocated seat hence the total population is driven by seat numbers. Staff and performer numbers are expected to be around 300 persons across all areas.

Table 6 – Building population

Part of Project	BCA Classification	Assumed Population (based on seating)
Theatre – Level 03 to 05	9b	1 600
Live Room – Level 05	9b	600
Live Room – Level 06	9b	400
Staff / performers	9b	300 (across whole venue)
TOTAL		**2 900**

3.1.2 Expected State, Attributes and Familiarity

In an emergency, the characteristics of occupants and their corresponding interaction with the building environment and people around them play an important role in their ability to escape in a timely manner. It is therefore necessary to consider the characteristics of the range of occupants that can be expected in the Lyric Theatre. The principal occupant characteristics are listed in Table 7 below.

Table 7 – Occupant Attributes

Occupancy Type	Distribution – age, gender & location	Familiarity with surroundings	State of awareness
Class 6 / 9b – general public	Theatre guests are considered to be representative of the general population with no specific or unusual distributions applicable in gender, age and physical or mental attributes.	Occupants are expected to be awake and unfamiliar with the building. However due to simple layout, numerous exits, clear signage, and assistance from the theatre staff, evacuation is expected to be expedited. Some guests may be under the influence of alcohol and hence not expected to be conscious of their surroundings.	Occupants who are awake and unfamiliar with the building. Occupants could potentially be intoxicated.
Class 6 / 9b – staff	Staff are expected to present at all times.	Based on the function and use of the building, staff are considered to have been trained on emergency procedures, emergency response, and evacuation, as well as being alert and awake at the time of any alarms. Staff response time to any fire scenarios is likely to be minimal based on these points, their familiarity of the area they work in and exit routes, and knowledge of the emergency response plan for the theatre.	Occupants who are awake and familiar with the building.

3.1.3 Personal Emergency Evacuation Plans (PEEPs)

It is expected that building occupants requiring special evacuation assistance will be provided with a dedicated evacuation plan that will be executed in the event of an emergency. It is the responsibility of the tenants to co-ordinate this process.

3.2 Location of Nearest Fire Stations

The nearest fire stations to The Star are shown in the table and figures below.

Table 8 – Nearest fire stations

Fire Station	Distance to site
Pyrmont Fire Station	750 m
Glebe Fire Station	2.5 km

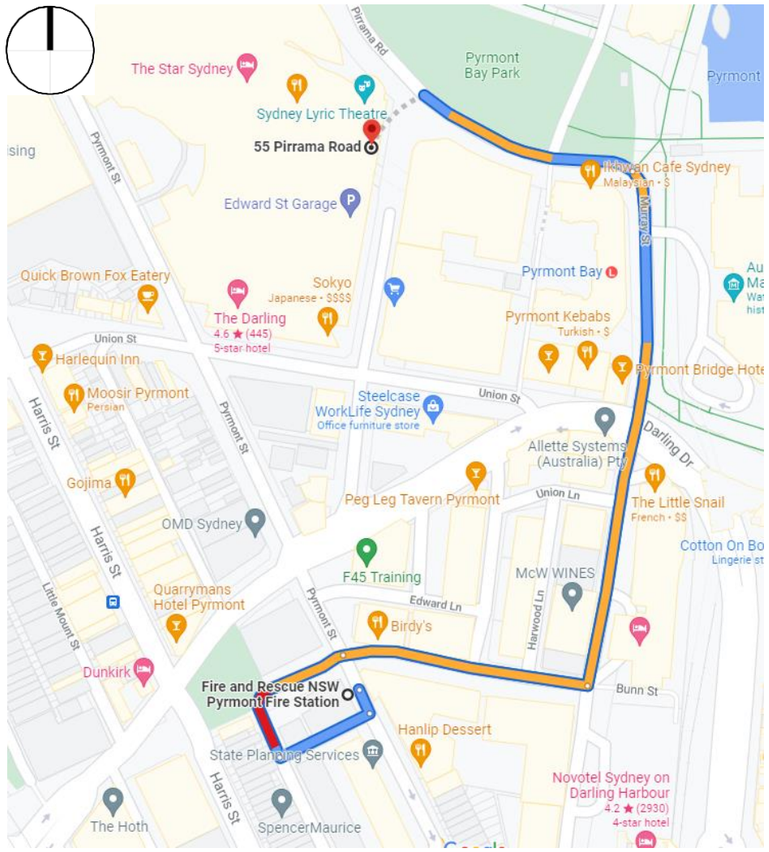


Figure 7 – Location of Nearest Fire Stations – Pyrmont

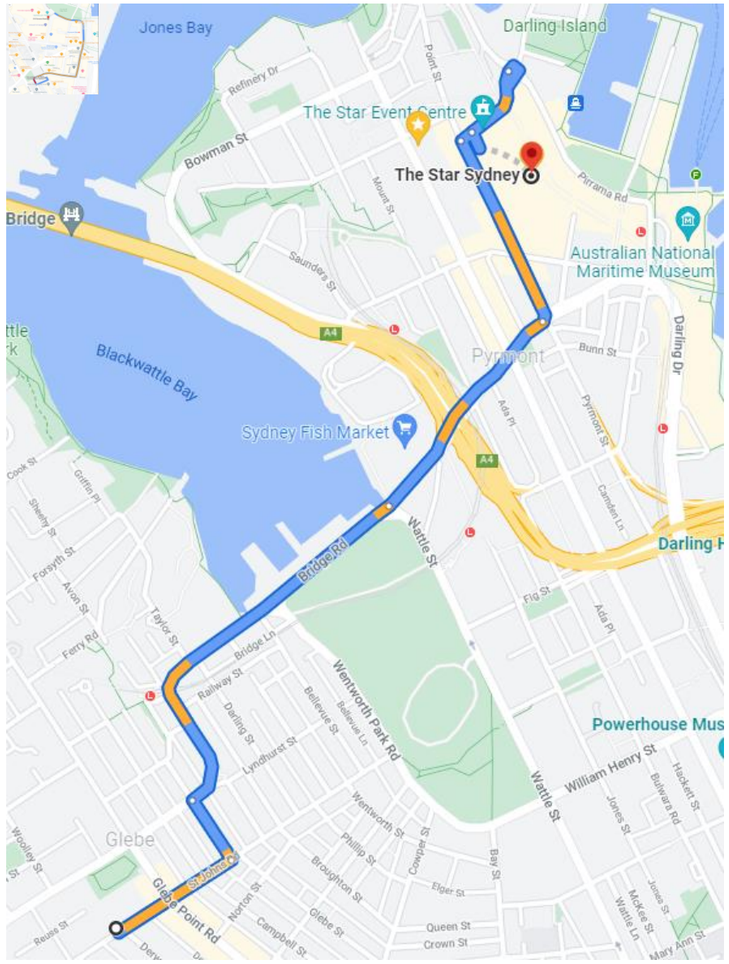


Figure 8 – Location of Nearest Fire Stations – Glebe

4 PRELIMINARY FIRE SAFETY DESIGN

4.1 General

This section presents the Fire Safety Design that must be implemented to demonstrate that the building meets the Performance Requirements of the BCA. The Fire Safety Design is a checklist that can be used as a reference to identify the necessary fire safety systems and other requirements that will be included in the building design.

4.2 Application of the DtS Provisions

Any building feature that is not referred to or affected by this report will comply with the 'Deemed-to-Satisfy' provisions of the BCA, relevant Australian Standards, National, State, and local legislation as applicable other than existing items not required to be upgraded. Any changes to the building design or layout during the design or construction process will be assessed against the report. All future modifications, changes or layouts to the building will be reassessed.

4.3 Section C – Fire Resistance

4.3.1 Part C1 – Fire resistance and stability

The building will be provided with Type A construction throughout, but with a number of deviations from the prescriptive requirements included within the design. The following extract from the original AECOM FER which is applicable to this space summarises those non-compliances (any figure or appendix references in the following text refers back to the original AECOM report):

a) The building elements associated with the MUEF must have a fire resistance level (FRL) in accordance with Table 3 of Specification C1.1 of the BCA for Type A construction, with the following exceptions:

i. Reduction of FRLs to 120 minutes from 180 minutes (Class 6 portions)

ii. Reduction of FRLs to 120 minutes from 240 minutes (Class 7b portions)

iii. Reduction of FRLs to 60 minutes from 120 minutes (Gallery seating)

iv. Roof trusses identified in item b) in Section 5.2 are not proposed to be fire rated

v. Outriggers identified in item c) in Section 5.2 are not proposed to be fire rated

vi. The main support columns identified in item d) in Section 5.2 are enclosed by speedwall on either side however from the outside, the speedwall will not achieve the fire rating due to the span.

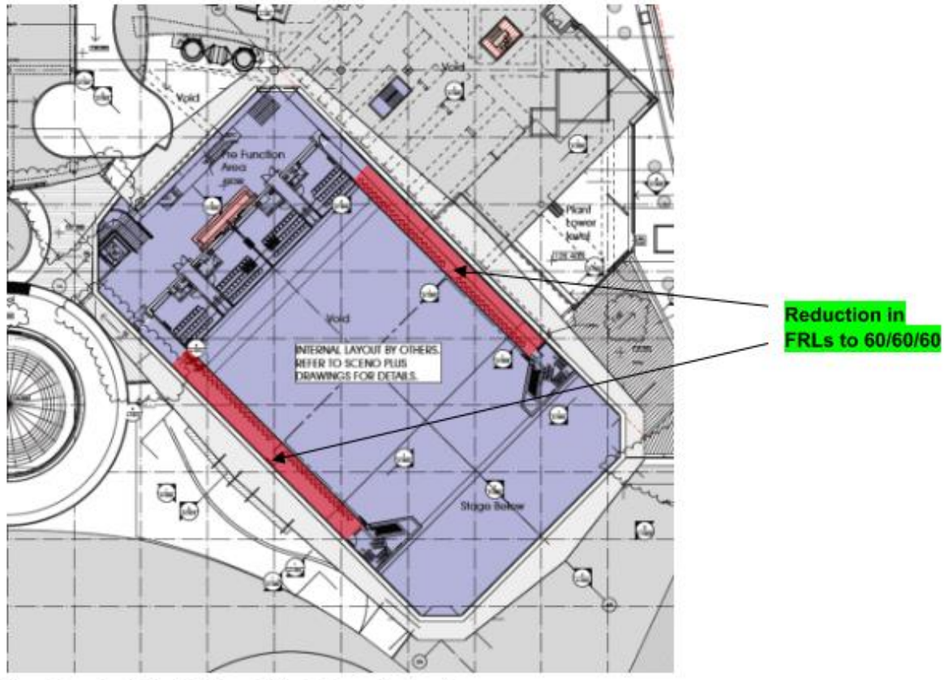


Figure 7 Reduction in FRLs – Gallery 1 (Mezzanine Level)

Figure 9 - Extract of Figure 7 from the existing AECOM FER

b) The roof truss within the MUEF nominated in Figure 9 and Appendix I are not required to be fire-rated in lieu of compliance with BCA Specification C1.1. The roof truss above the high balcony seating is required to be protected to achieve an FRL of not less than 120/-/-.

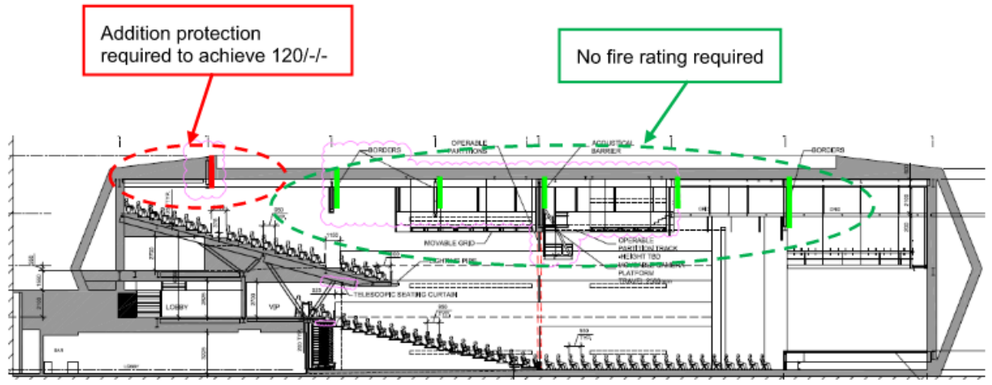


Figure 9 MUEF roof trusses

Figure 10 - Extract of Figure 9 from the existing AECOM FER

c) The outriggers providing lateral stability to the external walls are not proposed to be fire rated. The structural design is proposed to incorporate sufficient redundancy such that the failure of an outrigger will not result in collapse of the external walls of the MUEF. Refer to Appendix I. Note: TTW has confirmed there is only one outrigger within a 3.2 m zone.

d) The main support columns (except for the Truss 6 primary support columns) are enclosed by speedwall either side. From the inside, the speedwall achieves an FRL of -/120/120 due to restrictions in span. From the outside, the speedwall does not achieve the required fire rating. Due to the proposed span. Refer to Figure 10.

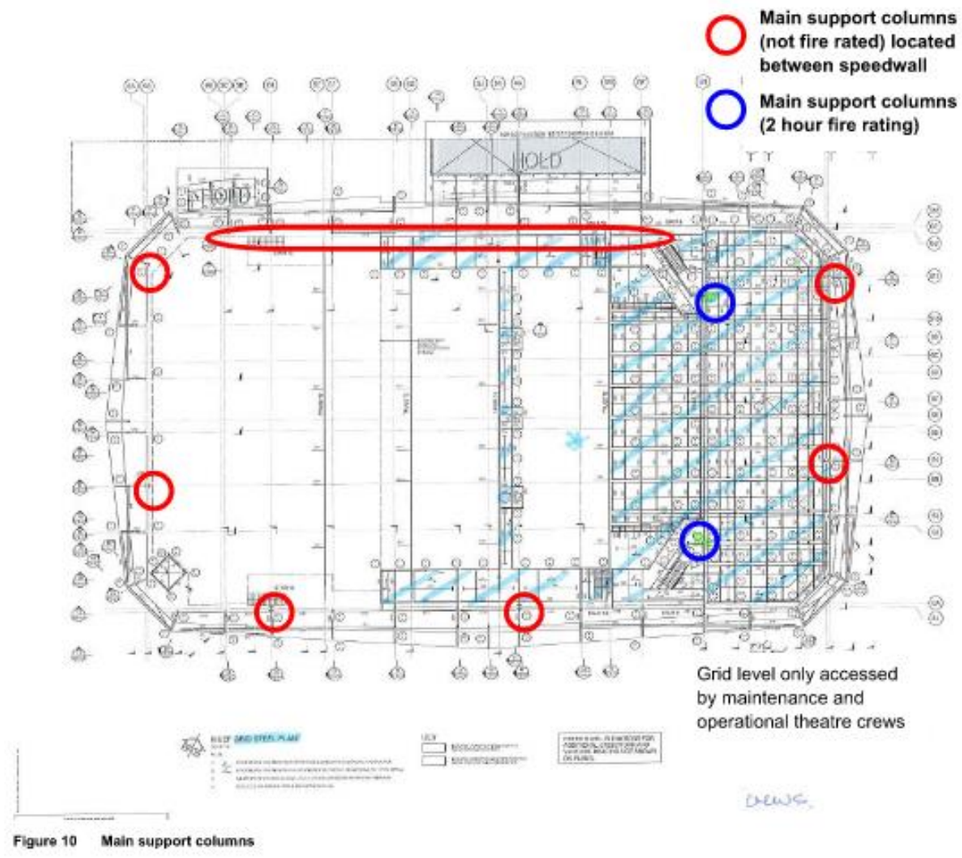


Figure 11 - Extract of Figure 10 from the existing AECOM FER

e) In relation to items b) and c), the project structural engineer has provided a design intent statement confirming structural failure is unlikely to occur to unprotected structure.

f) The pre-function areas on Levels 03, 04 and 05 must be fire separated from the theatre by construction with an FRL of not less than 60/60/60.

g) The loading dock must be separated from the remainder of Level B2 by construction with an FRL of not less than 120/120/120, as illustrated in Figure 61 (see Appendix L of AECOM FER).

h) Separation of the stage, backstage area and accessible under-stage area from the audience by a proscenium wall is not applicable as the MUEF is provided with a sprinkler system complying with BCA Specification E1.5.

i) The MUEF must be fire separated from the remainder of the casino by construction with an FRL of not less than 120/120/120. The lines of fire separation are outlined in Figure 62 to Figure 71. Openings in different fire compartments must be protected in accordance with BCA Clauses 3.3 and C3.4.

j) The upper level plant areas may form part of the MUEF theatre fire compartment provided that separation of equipment complies with BCA Clause C2.12. Specifically, smoke control exhaust fans located in the air stream which are constructed for high temperature operation in accordance with Specification E2.2b need not be separated."

Based upon the above, the following FRLs will generally by achieved in accordance with Type A construction and via Performance Solutions within the scope of works area, subject to further calculation and assessment during later stages of design.

Table 9 – Fire resistance levels

Classification	Fire resistance level (minutes)
Class 6 – Bar areas	120 in lieu of 180 (Performance Solution)
Class 7b – Storage / Loading Dock	120 in lieu of 240 (Performance Solution)
Class 8 – Substation	180 – service provider to be consulted for any specific or additional requirements
Class 9b – Theatre / Live music venue / Foyer	120 on the most part (DtS compliant), but with specific structural members provided within either a 60-minute FRL (gallery seating), or omitting from having an FRL completely (specific roof trusses, outriggers, and support columns)

The above items will be reassessed as part of these works to verify compliance with the Performance Requirements of the BCA.

4.3.1.1 Fire hazard properties

It is expected that lining materials, including the materials used for any seating, will be fully compliant with BCA Spec. C1.10 and AS 1530.3 (1999) for a theatre space, as per the following BCA extract.

Table 10 – BCA Spec. C1.10 material requirements for theatre seating

Material or assembly location	*Flammability Index*	*Spread-of-Flame Index*	*Smoke-Developed Index*
Class 9b buildings used as a theatre, public hall or the like: Any part of fixed seating in the audience area or auditorium.	N/A	0	5

This assumption forms a key part of the fire safety design for the inputs used for the fire and smoke modelling which is being undertaken.

4.3.2 Part C2 – Compartmentation and separation

4.3.2.1 Fire compartmentation

Fire compartmentation and separation shall generally be provided in accordance with Part C2 of the BCA. Floor area and volume limitations shall be observed which are as per the table below.

Table 11 – Floor area and volume limitations for Type A construction

Classification	Max floor area of fire compartment	Max volume of fire compartment
Class 6 – Bars / restaurant areas	5,000m^2	30,000m^2
Class 7b – Storage / Loading Dock		
Class 8 – Substation		
Class 9b – Theatre / Live music venue / Foyer	8,000m^2	48,000m^3

The fire compartmentation strategy for the building is provided in the table below.

Table 12 – Compartmentation strategy

Area	Compartmentation strategy
Loading Dock / Substation	The Loading Dock and Substation on the lower floors (B1 / B2) shall form a single fire compartment that observe the fire compartmentation levels for Type A construction (refer Table 11).
Bars / Theatre / Live music venue / Foyer	The existing foyer space will be fire separated from the main auditorium using the existing 60-minute fire wall which runs east-west between the two spaces. The floor of the live music venue will need to be fire rated to uphold this fire separation between foyer and event areas. This is for the purposes of creating a level of fire separation to enable occupants to move away from the fire affected area to align with the intended strategy. The existing MUEF venue is fire separated from the Sovereign Gaming space on this floor by 120-minute fire rated construction. Further review of the separation distances between the MUEF and the northern-east portion of Sovereign Gaming area is needed as the project progresses, as this appears to be ~5.6 m at present which would be deemed a non-compliance (refer Figure 12 for details).
Plant	Plant areas shall form a single fire compartment that observe the fire compartmentation levels for Type A construction (refer Table 11). The need for fire separation to such areas will be subject to the contents of the room(s) in relation to BCA Clauses C2.12 and C2.13.

We will assist in the development of fire compartmentation drawings to be provided as part of the detailed design, where needed.

4.3.2.2 Smoke compartmentation

The Auditorium and the Live Music Venue will form separate smoke zones as part of the proposed fire strategy (as shown in Figure 24 of Appendix C). The design of this smoke wall will be assessed in detail as the design progresses.

In addition to the above, it is also intended to smoke rate the existing non-fire isolated stairwells as part of these works, and to make the new dressing room areas on Level 4 and 5 smoke rated from any adjoining areas, in lieu of being fire rated. Refer to Appendix A for more details.

4.3.2.3 Separation of equipment

Separation of all equipment will generally comply with DtS Clause C2.12, excluding the Mechanical Services Switch Board (MSSB) on Level 04 which will be assessed as part of a Performance Solution (PS3).

4.3.3 Part C3 – Protection of openings

4.3.3.1 General

The protection of openings between fire compartments and in external walls shall generally comply with this part of the BCA. Pending further review there appear to be no external walls located within 3 m of the boundary and thus protection of external glazing is not currently required. There appears to be a 5.6 m separation distance between the MUEF and the north-east end of the Sovereign Gaming space, as outlined in the diagram below. It is likely that this will need to be assessed as part of these works (subject to further input from the BCA consultant).

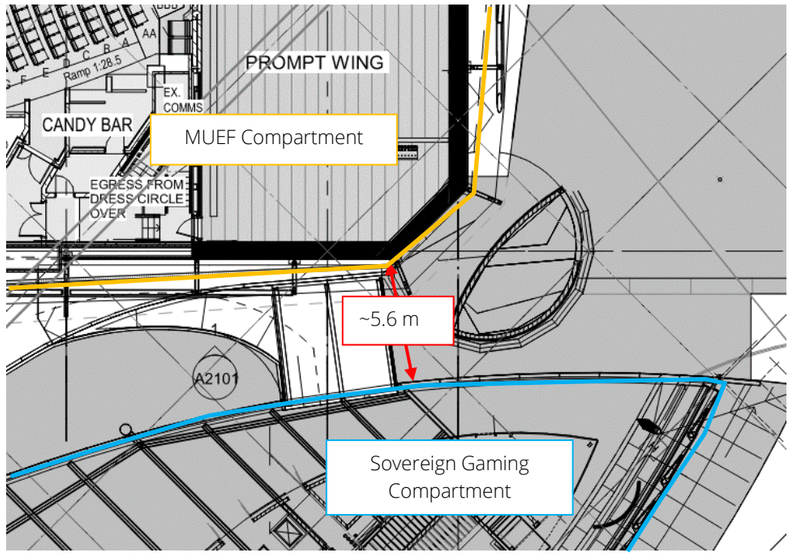


Figure 12 – Separation distances between MUEF and Sovereign Gaming (north whale tail)

There is also a glazed wall around the escalators to the Sovereign Gaming lift lobby which is currently unprotected. This will be justified either through qualitative assessment demonstrating that glazing failure is unlikely, or through drencher protection being provided to this glass. The location of this wall is provided in Figure 13.

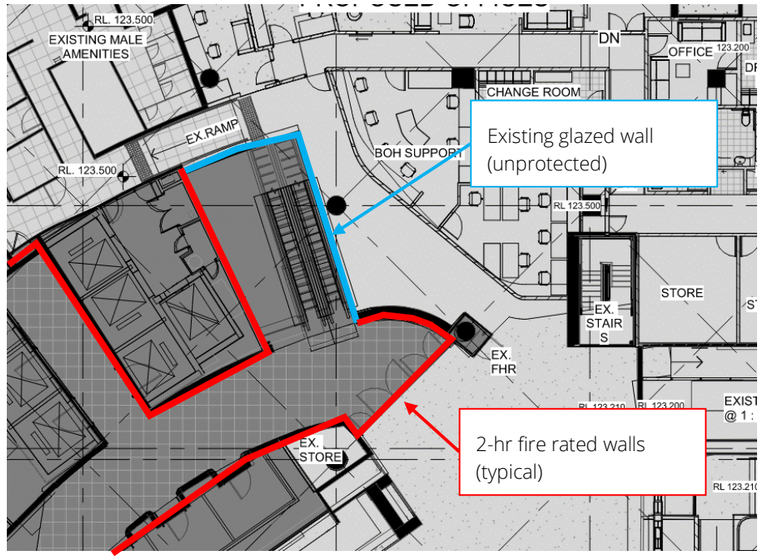


Figure 13 – Unprotected glazed wall between casino and venue (Level 3)

4.4 Section D – Egress

4.4.1 Part D1 – Provision for escape

4.4.1.1 Egress strategy

The existing MUEF is subdivided into two separate fire compartments – the foyer / pre-function space to the south, and the main entertainment venue to the north. It is intended to retain a similar configuration in the new design, but with additional smoke compartmentation being provided between the theatre and the live music venues to split the existing compartment into two separate smoke zones (refer Figure 24 of Appendix C).

Once occupants escape from the zone of fire origin (theatre, live music venue, or foyer space), they are then deemed to be remote from the fire event and provided some level of safety by the smoke or fire compartmentation which separates these spaces.

A number of non-compliances are present within the existing MUEF space which will be reassessed as part of the new works and incorporated within the new FER. These have been summarised in the following sub-headings. For further details on the egress configuration for the venue, refer to Appendix B of this report.

4.4.1.2 Exit travel distances / distance between alternative exits.

In general, the following extended travel distances will be supported within the base-building design:

- Up to 30 m to a single exit / point of choice between two exits, in lieu of 20 m
- Up to 60 m to the nearest of two or more available exits, in lieu of 40 m.
- Up to 90 m between alternative exits, in lieu of 60 m.

The above distances will be validated once a BCA report is made available for the current design.

4.4.1.3 Dimensions of exits and paths of travel to exits

Given the high population numbers within the two venues, it is not feasible to have prescriptive compliant exit dimensions within either venue. It is proposed to validate exit dimensions through performance-based assessment during later phases of design. Exact dimensions to be confirmed as design develops.

4.4.1.4 Travel by non-fire isolated stairways or ramps

Two existing internal stairs which serve Level 4, 5 and 6 as primary exit routes discharge into internal space on Level 3, which is a non-compliance under BCA Clause D1.9 This existing non-compliance will be assessed as a Performance Solution (refer PS5). A diagram showing this configuration is provided in Figure 14.

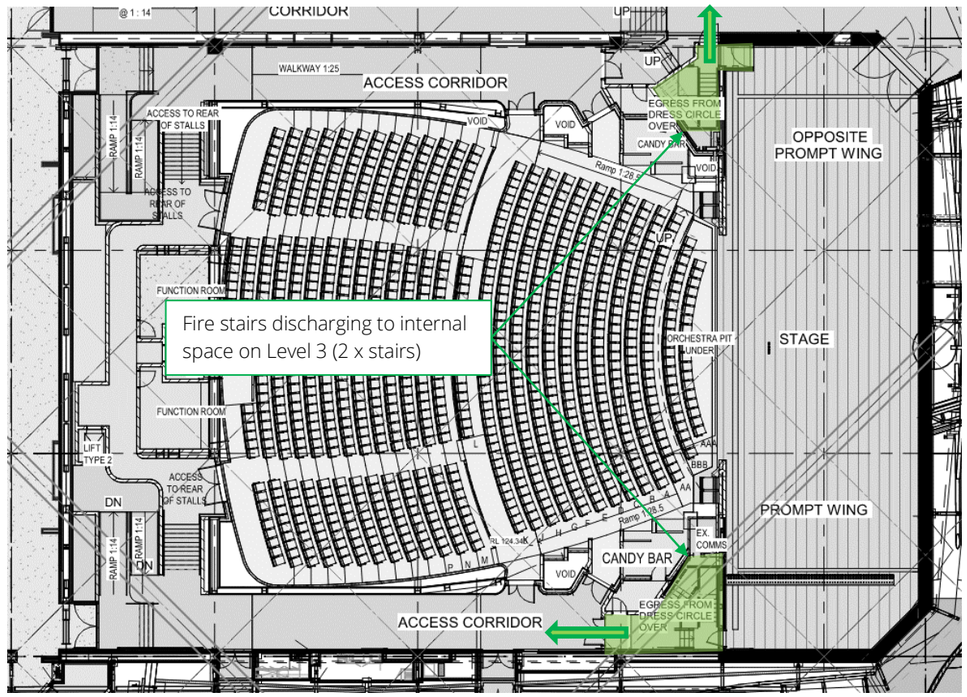


Figure 14 – Existing non-fire rated stairs from Level 4 – 6

In addition to the non-fire isolated exits discussed above, it is also intended to utilise escalators as a means of escape from the venue. These will continue operation in fire mode in the direction they were running in prior to the alarm condition and will be wired to the site's essential services supply which has generator backup for surety of operation.

4.4.1.5 Travel through adjacent tenancies

Part of the evacuation strategy be for occupants who pass through the eastern exits from the main auditorium during a fire event will be for them having to pass through the current cold shell tenancy within the Sovereign Gaming VIP space. This is a technical non-compliance under the BCA but will be addressed through a legal framework being agreed between Foundation Theatres and The Star to ensure this pathway is available during any event in the venue. This is essentially the same strategy that in place at present, but both venues are owned by a single operator (The Star) at this time which means this non-compliance has not been triggered to date.

4.5 Section E – Services and equipment

4.5.1 Part E1 – Fire-fighting equipment

4.5.1.1 Fire hydrants

The building is provided with a hydrant system that is generally compliant with AS 2419.1-2005. It is proposed to modify the hydrant system to comply with AS2419.1-2005 within the scope of works (subject to further input from the hydraulic engineer).

4.5.1.2 Fire hose reels

Fire hose reels are proposed to be omitted from the scope of works area. This is in keeping with the strategy which has been used on the Main Gaming Floor (MGF) of the casino portions, where occupant evacuation is deemed paramount and hose reels would be more likely to form a hinderance for evacuation than a benefit to life safety. Instead, additional fire extinguishers will be provided as an initial first-aid firefighting resource as a Performance Solution within this space.

4.5.1.3 Fire sprinklers

Fire sprinklers will be provided throughout the scope of works area in accordance with BCA Clause E1.5 – Sprinklers, AS2118.1-2017.

The sprinkler system shall feature the following performance solution:

- Assess the omission of sprinklers beneath the false floor areas beneath the Auditorium seating

The false floor area beneath the Auditorium seating will be maintained as devoid of any fuel load at all times through specific management in use requirements which will be documented in the FER. Any ignition sources present in the space (such as electrical junction boxes) shall be contained within fire rated boxes to alleviate the risk of these igniting the flooring material. The floor will also be of plywood construction rather than fire rated construction, which will be assessed within the same solution

The above solution is subject to Fire & Rescue NSW (FRNSW) review and concurrence as we have received objections to similar solutions with them in the past. If this were to occur, it may be a requirement to sheet the underside of the false floor with a non-combustible finish as part of works, or else sprinkler protection may need to be brought back into the design for this area.

4.5.1.4 Fire control centre

The site contains an existing fire control room which is accessible off Jones Bay Road. This is generally understood to comply with BCA Clause E1.8 and Specification E1.8 and is considered acceptable for Brigade operations.

4.5.2 Part E2 – Smoke hazard management

4.5.2.1 Automatic smoke detection

Automatic smoke detection shall be provided throughout the Project Francis space in accordance with BCA E2.2 – Smoke hazard management and AS1670.1-2018. Smoke detection will be on reduced spacing (10 m grid) to facilitate extended travel distances within the development.

Where smoke detectors are proposed to be replaced with another device to avoid spurious alarms, agreement with the Fire Engineer will be required prior to verify that this is not detrimental to the intended fire strategy.

4.5.2.2 Smoke exhaust

The Project Francis space will be provided with performance-based smoke exhaust provisions. These will be based on the existing MUEF infrastructure, but with modifications made to enable them to serve the two main performance areas.

The existing smoke exhaust infrastructure within the MUEF consists of four exhaust vents in the vertical plane at high level along the western wall which exhaust between 9.5 m³/s and 15 m³/s each. Three of these exhaust points draw from the main public assembly space, with the fourth one (north end) being used to exhaust from the stage area. There are then eight (8) x 7.5 m³/s smoke exhaust fans mounted in the ceiling of the MUEF which draw smoke out directly to atmosphere via the roof.

Smoke baffles are used to subdivide the volume into smaller smoke reservoirs to increase the effectiveness of the exhaust system. However, given the venue is being subdivided into two separate zones (venues), it is likely that these reservoirs will be consolidated to some extent in the final design.

The new smoke exhaust design will reconfigure these smoke exhaust points to enable the following (refer Appendix C for diagrams relating to this information):

- Stage: 15 m³/s exhaust across one exhaust point (as per existing)
- Auditorium: 58 m³/s exhaust across 6 x exhaust points (two on the walls, four in the roof)
- Live Music Venue: 39.5 m³/s exhaust across 5 x exhaust points (one on the wall, four in the roof)

As the project progresses, we will review whether the above rates can be rationalised to assist with how make-up air can be brought into each space. From the initial modelling results obtained to date (as found in Appendix D), it would appear that the rates defined above will need to be utilised in full as part of the design, but it may be feasible for these to be modified if some changes are made to the ceiling design on the Grand Circle level.

The existing make-up air strategy is for fresh air to be provided into the MUEF via two mechanical fans at low level from beneath the stage. The doors around the perimeter of the space all automatically open in fire mode which provides sufficient air flow for the exhaust fans to run at full capacity.

With the two new venues potentially having performances in place on the stage, it is not suitable for auto-opening doorways to be used in the new design as their operation too loud during a performance. It is therefore intended to explore ways of utilising under-seat supply air paths and/or operable louvres in the inner face of the walls of the theatre / live music venue to enable fresh air to flow to the space from the outer circulation corridors. These options are to be reviewed in more detail with the mechanical engineer as the design develops.

It is intended to omit smoke exhaust from the back of house areas based on additional smoke / fire compartmentation provisions between these and the public assembly space which will contain the majority of the population within this venue. This non-compliance will also need to address the fact that The Star is considered a Large Isolated Building (LIB), so omission of smoke exhaust from any portions is considered a non-compliance.

Although the smoke exhaust system serving this venue will not be prescriptively compliant with the BCA or AS 1668.1-2015, the exhaust rates, smoke reservoir sizes, and any other such non-compliances will be assessed and validated through an overarching smoke control provisions Performance Solution as part of the fire engineering process.

The smoke hazard management strategy has been outlined in further detail in Appendix C for clarity.

4.5.3 Part E3 – Lift installations

Lift installations shall largely comply with Part E3 of the BCA (the existing lifts within the Astral Hotel lift core are understood to achieve compliance as emergency lifts already – TBC by the vertical transportation engineer during initial concept phase).

Emergency lift provisions serving the dressing rooms (Level 4 & 5) and the storeroom (Level 6) in the north-west corner of the venue will be served by an emergency lift that does provide access to all floors of the building, given it will only span between Level 3 and 6. The Performance Solution will demonstrate that this configuration is satisfactory for emergency services personnel to both access these floors and enable them to take occupants on stretchers, should this be needed. The shaft of this lift will be made fire rated, with power being supplied by the generator-backed essential services supply, and fire service controls being provided for Brigade operation.

4.5.4 Part E4 – Visibility in an emergency, exit signs and warning systems

4.5.4.1 Emergency lighting and exit signage

Emergency lighting and exit signage shall be provided in accordance with the relevant sections of BCA Part E4 and AS 2293.1- 2018. A Performance Solution will be provided which permits exit signage to be switched off during performances. Additional measures will be implemented for signage to automatically switch back on in the event of a fire alarm condition. A switch will also be provided to the lighting control room for this to also occur manually for any other emergency event, with specific management procedures to be documented within the FER for clarity.

4.5.4.2 Emergency Warning and Intercom System (EWIS)

An EWIS system complying with BCA Clause E4.9 and AS 1670.4 – 2018 shall be provided throughout the scope of works area. The system will feature a cascade sequence that will expedite occupant evacuation. The sequence will be determined in the next phases of the design.

4.6 Section H – Special use buildings

4.6.1 Part H1 – Class 9b buildings

It is noted that a number of Part H1 clauses will not be complied with as part of these works. The following items are intended to be addressed as Performance Solutions.

Table 13 – Section H non-compliances to be assessed within FER

Clause reference	Overview of non-compliances to be assessed
H1.3, NSW H101.5.3, NSW H.101.10,	Assess the omission of proscenium curtains in the new Auditorium and the Live Music Venue.
NSW H101.2, NSW H101.12	Assess candy bars within the Auditorium and some storerooms as not being fire rated from the rest of the space by 60/60/60 FRL fire rated construction (subject to final design)
NSW H101.11.1	Assess seating rows as containing up to 12 seats with an aisle on only one side, in lieu of 8 seats
NSW H101.11.5	Assess seating rows containing up to 25 seats in aisles, in lieu of 24 seats
NSW H101.12.6(b)	Assess the first exit door from the stage as being 11 rows back, in lieu of being between 5-7 rows back
NSW H101.12.3 & Table H101.12	Assess the main auditorium seating as deviating from Table H101.12, as follows: Having the actual depth of rows at 950 mm for continental rows, and 925 mm from aisles within the balcony, in lieu of 1000 mm and 975 mm Having the actual depth of rows at 1000 mm for continental rows, and 950 mm from aisles within the boxes (lower), in lieu of 1025 mm and 975 mm

5 SUMMARY OF PERFORMANCE SOLUTIONS

5.1 General

This section presents a summary of the proposed Performance Solutions that must be implemented to demonstrate that the building can meet the Performance Requirements of the BCA.

5.2 Proposed Performance Solution

The table below outlines the proposed Performance Solutions, the proposed fire engineering analysis, and the design outcomes which will need to be incorporated into the building design in order to demonstrate compliance with the BCA. Subject to approval from the Principal Certifying Authority and relevant applicable stakeholders during the design process, the proposed Performance Solutions nominated in the table below related to the development can be demonstrated to meet the relevant Performance Requirements of the BCA.

Compliance with the Performance Requirements of the BCA will need to be conducted through a formal fire engineering assessment by a Registered Certifier – Fire Safety in the subsequent Fire Engineering Brief and Fire Engineering Report as part of the formal fire strategy approvals process. Fire Brigade consultation will be required to comply with BCA Part A2.2(4) and Clause 144 of the Environmental Planning & Assessment Regulations.

Table 14 – Overview of proposed Performance Solutions and intended fire engineering strategies

PS #	BCA DtS Clause	Description of Non-Compliance	Performance Requirements	Basis of Performance Solution
1.	Spec. C1.1 – Fire-resisting construction	Assess a reduction of FRLs within the Loading Dock to 120 minutes, in lieu of 240 minutes. *PS1 - This solution was included in the original AECOM FER, so will need to be reassessed within the Project Francis report to enable the original document to be superseded as it deals with existing site constraints.*	CP1 – Structural stability during fire CP2 – Spread of fire CP8 – Fire protection of openings and penetrations	Equivalent fire severity and other fire engineering calculations will be undertaken to demonstrate that sufficient ventilation is provided to limit the severity of a fire with respect to full compartment burnout. Conservative fire loads will be selected to demonstrate the rationalised FRLs are suitable and comply with the performance requirements.
2.	Spec. C1.1 – Fire-resisting construction	Assess a number of roof trusses providing lateral stability to the walls of the MUEF as not being fire rated Assess the outriggers providing lateral stability to the external walls as not being fire rated Assess the main support columns as being enclosed by speedpanel (or similar) on either side, however from the outside, these columns will not achieve the required FRL as it is tested to a greater span *PS2 - The above three solutions were included in the original AECOM FER, hence it is intended to reassess these items to omit the need for providing additional fire protection to the existing structure.*	CP1 – Structural stability during fire	Qualitative analysis, alongside technical input from the structural engineer, to demonstrate that the oversizing of the structural steel will provide such members with an equivalent fire rating to what is needed, or that sufficient fire protection has been provided to the area which could potentially be exposed to direct flame impingement at the base. The omission of fire ratings will then be demonstrated as having a negligible effect on the steel's ability to withstand a fire event for the required period of time.
	NSW H101.7 (a) (vi) – Flying scenery	Assess the structural steel supporting the stage tower to not be enclosed by concrete or masonry construction *(subject to further review at next phase of desi*gn)		
3.	C2.12(a) – Separation of equipment	Assess the plant room at Level 04 (Grid G6-K) as containing emergency equipment which will be used in fire mode. To meet the DtS provisions the plant room should be enclosed in a 120-minute fire-isolated room. It is proposed to omit this based on: - The essential MSSB being contained within a fire rated cupboard achieving 120 minutes fire resistance. - The provision of a self-closing fire door having an FRL of not less than -/120/30 to the cupboard. - The plant room will be separated from the reminder of the building with smoke proof construction between the plant room and the existing hotel. *PS3 – This solution was included in the original AECOM FER, so will need to be reassessed within the Project Francis report to enable the original document to be superseded as it deals with existing site constraints.*	CP2 – Spread of fire	Although the plant room in question will not be fire rated from the rest of the building, smaller fire rated enclosures will be provided which will provide an equivalent level of fire resistance to the emergency equipment contained. The risk of equipment failure as a result of fire will be mitigated through this methodology.

PS #	BCA DtS Clause	Description of Non-Compliance	Performance Requirements	Basis of Performance Solution
4.	D1.2 – Number of exits required D1.9 – Travel by non-fire isolated stairways or ramps D2.2 – Fire isolated stairways and ramps D2.13 – Goings and risers	Assess the use of escalators as part of the egress strategy for the building along a required egress path	DP2 – Safe movement to and within a building DP4 – Exits DP6 – Paths of travel to exits EP2.2 – Safe evacuation routes	The use of escalators as part of the evacuation strategy for underground stations and large public buildings is internationally accepted by NFPA 130, London Underground, and BS 9999. Given occupants will already have familiarity of the location and configuration of these escalators since they likely used them to enter the venue, it is intended to enable them to be used for evacuation purposes too for the purposes of expediting evacuation from the venue. To enable this, they will be connected to the site's essential services power supply (which includes generator backup capabilities) and will be programmed to continue operation in fire mode in the direction they were running in pre-alarm.
5.	D1.2(g) - Number of exits required	Assess the egress strategy for the development as utilising a pathway which takes occupants through a tenancy which is not controlled by the Theatre *Note: a legal agreement will need to be formed between The Star and Foundation Theatres to enable this configuration to be formalised as part of works regarding access through into the current cold shell tenancy to the north of Sovereign Gaming.*	DP2 – Safe movement to and within a building DP4 – Exits EP2.2 – Safe evacuation routes	The existing entertainment facility is owned and controlled by The Star, as is the Sovereign Gaming VIP gaming area adjacent. The egress strategy for the venue utilises a pathway back through the VIP gaming space to reach a final exit point from the eastern side of the auditorium. It is intended for a legal agreement to be put in place to enable this same strategy to be retained even though the two areas will now be controlled by separate parties.
6.	D1.3 – When fire isolated exits and ramps are required NSW H101.15 – Dressing rooms	Assess the provision of smoke compartmentation in lieu of fire compartmentation to the new dressing rooms area, which will not be provided with two (2) exits in accordance with NSW Clause H101.15(b)	DP2 – Safe movement to and within a building DP4 – Exits EP2.2 – Safe evacuation routes	The dressing rooms will be smoke separated from any adjoining parts of the building. With sprinkler protection in place throughout, this is expected to provide ample time for evacuation of such areas, even if those occupants were to be sleeping at that time. It will also be demonstrated that while there is only one exit into the stair from the dressing room areas on Level 4 and 5, alarm conditions will be expedited through additional detection provisions to gain them additional time to escape this area prior to the onset of untenable conditions. The non-fire isolated stair is also intended to be made smoke rated as part of these works to limit the impact of smoke during the early phases of the fire.
7.	D1.4 – Exit travel distances D1.5 – Distance between alternative exits	Assess the following egress non-compliances within the proposed design: - Up to 30 m to a single exit / point of choice between two exits, in lieu of 20 m - Up to 60 m to the nearest of two or more available exits, in lieu of 40 m. - Up to 90 m between alternative exits, in lieu of 60 m.	DP4 – Exits EP2.2 – Safe evacuation routes	Reduced spacing smoke detection will be provided throughout the building to expedite alarm times within the space. Smoke and evacuation modelling will then be used to demonstrate that occupants can escape while tenable conditions are still present, with sufficient safety factors applies as per standard fire engineering practice.
	D1.6 – Dimensions of exits and paths of travel to exits	Assess parts of the scope of works area as having a reduced egress width (both Class 9b public assembly areas and ancillary plant spaces) – exact areas / reductions to be confirmed during later design stages. *PS4 - It is anticipated that travel distances and aggregate egress width will be non-compliant within the Auditorium and Live Music Venue. It has also been noted that egress width reductions are present within plant areas from the original AECOM report. Smoke and evacuation modelling will be used to quantify that an acceptable outcome can be achieved from the public areas, with plant areas being assessed qualitatively.*	DP4 – Exits DP6 – Paths of travel to exits EP2.2 – Safe evacuation routes	
	D2.11 – Fire isolated passageways	Assess the use of horizontal exits which account for more than 50% of the required exits		It will be demonstrated that through additional compartmentation between the performance areas and other portions of the venue, the large proportion of exits being horizontal exits will actually improve life safety within the space rather than being detrimental to it. This is considered a technical non-compliance as a result.

PS #	BCA DtS Clause	Description of Non-Compliance	Performance Requirements	Basis of Performance Solution
8.	D1.9 – Travel by non-fire isolated stairways or ramps	Assess the venue as not being served by continuous stairs that lead directly to a road or open space, including their use being for egress from the dressing room / storage areas, and the flytower serving the auditorium's stage *PS5 - This solution was included in the original AECOM FER, so will need to be reassessed within the Project Francis report to enable the original document to be superseded as it deals with existing site constraints.*	DP4 – Exits DP5 – Fire-isolated exits	Considerable smoke control and evacuation modelling will be undertaken as part of these works. The results of these models will be used to demonstrate that although the stairs in question will discharge within the facility rather than to outside, the conditions presented to those occupants at discharge will remain tenable so are deemed suitable to pass through. The stairs shall be made smoke rated as part of these works to enable them to be maintained as tenable for extended periods during the evacuation phase.
9.	E1.4 – Fire hose reels	Assess the omission of hose reels within the venue (all areas). *PS6 - It is proposed to assess the omission of hose reels from all areas as the primary objective for occupants for public assembly buildings is to escape immediately, rather than attempt to attack the fire.*	EP1.1 – Fire hose reels	Additional fire extinguishers shall be provided across the venue to enable first aid fire attack to be undertaken by occupants, should this need to take place. Such equipment is deemed far more suitable for the general public in such buildings, as hose reels pose a trip hazard when large quantities of occupants need to pass through a space.
10.	E1.5 – Sprinklers AS 2118.1 (2017)	Assess the omission of sprinklers beneath the false floor areas beneath the Auditorium seating	EP1.4 – Sprinklers	The false floor area beneath the Auditorium seating will be maintained as devoid of any fuel load at all times through specific management in use requirements which will be documented in the FER. Any ignition sources present in the space (such as electrical junction boxes) shall be contained within fire rated boxes to alleviate the risk of these igniting the flooring material. By eliminating ignition sources and restricting the seating materials above the floor, the risk of a fire occurring beneath or burning through from above is sufficiently reduced. It may be a requirement to sheet the underside of the false floor with a non-combustible finish as part of works, subject to Brigade feedback during the FEBQ phase of works.
	Spec. C1.1 - Fire-resisting construction	Assess the floor construction to the seating area to both the auditorium and Live Room to not have a FRL *PS8 – Assuming the area is kept sterile and any ignition sources within are suitably fire rated from the void space, it is intended to omit the need to install sprinklers within this area and utilise a plywood sheet to construct the false floor, which will not have an FRL. Please note that this solution will be subject to Brigade acceptance as they have recently pushed back on this proposal on other projects.*	CP1 – Structural stability during fire	
11.	E2.2 – Smoke hazard management	Assess the use of rationalised smoke exhaust provisions within both venues in terms of the following: - smoke exhaust rates (112.5 m^3 in place at present which we intend to reuse) - smoke reservoir sizes (may be compliant as a result of the proposed MUEF split) - the omission of smoke exhaust to Back of House (BOH) spaces, despite the site being a Large Isolated Building (LIB) by definition *PS8 - We intend to utilise the existing smoke exhaust fans, where possible, and make amendments to the make-up air and smoke baffles / reservoirs to suit the configuration of the new space to ensure the design can be supported. Smoke and egress modelling will be used to quantify this outcome.*	EP2.2 - Safe evacuation routes	Considerable smoke control and evacuation modelling will be undertaken as part of these works. The results of these models will be used to demonstrate that the smoke control provisions proposed will enable tenability to be maintained for a period of time which is sufficient for occupants to escape safely. A safety factor of 1.5 will be applied to any base case scenarios, with a number of sensitivity and redundancy scenarios also included to validate the design in full.
12.	E3.4 – Emergency lifts	Assess the dressing rooms on Levels 4 & 5, and the plant room and storeroom on Level 6 as being served by an emergency lift which does not serve every level of the building *(subject to further review at next phase of design)*	CP9 – Fire brigade access EP3.1 – Stretcher facilities EP3.2 – Emergency lifts	The new lift serving these back of house areas (consisting of dressing rooms on Level 4 and 5, and a storeroom on Level 6) to be constructed in a fire rated shaft which has dimensions suitable for a stretcher, and provided with essential services power and fire service controls. With these measures in place, this will enable emergency services personnel to both access and manoeuvre injured occupants from these areas to the main emergency lift which can be accessed on Levels 3 and 5.
13.	E4.5, E4.8 & Clause 6.7 of AS 2293.1	Assess the use of performance based illuminated exit signage (for the Auditorium space only) which shall not be illuminated at all times. *PS9 - It is assumed that the design team would prefer for exit signage to be switched off within the Auditorium during events. An auto-cutover system will be introduced to enable this to be facilitated.*	EP4.1 – Visibility in an emergency EP4.2 – Identification of exits	The Performance Solution will utilise an automated system which will switch the exit lighting back on without human intervention during performances should a fire alarm condition occur. A switch will also be provided to the lighting control room for this to also occur manually for any other emergency event, with specific management procedures to be documented within the FER for clarity.

PS #	BCA DtS Clause	Description of Non-Compliance	Performance Requirements	Basis of Performance Solution
14.	H1.3, NSW H101.5.3, NSW H.101.10,	Assess the omission of proscenium curtains in the new Auditorium and the Live Music Venue. *PS10 - It is proposed to omit proscenium curtains in both areas through smoke and evacuation modelling which will demonstrate safe evacuation is possible without these in place.*	EP2.2 - Safe evacuation routes	Smoke and evacuation modelling will be carried out for a number of scenarios within this space. It is intended for specific fire scenarios to be included for the two stage areas to demonstrate that even a very large fire on one of the stages will be unable to overwhelm the smoke control systems within each space.
15.	NSW H101.2, NSW H101.12	Assess the entertainment venue to not be fire separated from the remainder of the building *(subject to further review at next phase of design)* Assess candy bars within the Auditorium and some storerooms as not being fire rated from the rest of the space by 60/60/60 FRL fire rated construction *(subject to final design)* *PS11 – The entertainment venue is already fire separated from the other portions of the building, other than a glazed wall in the reception area around the escalator void which will be justified through fire engineering assessment. It is also proposed for small candy bars and storerooms as being omitted from requiring fire rated construction around them based on the limited fuel load and ignition sources present in these small spaces. The areas this solution can be applied to will be subject to the final design.*	CP2 – Spread of fire	A qualitative assessment will show that sufficient measures are in place to prevent this glass wall from failing during a fire, and to demonstrate that the limited fuel load, ignition sources, and floor area of such candy bars poses very little fire risk to the wider theatre space. The provision of sprinkler coverage throughout these areas will also assist in controlling any fires within the early phase. Fuel load limitations will be implemented around the glass wall to prevent direct flame impingement, with the risk of fire occurrence on the casino side of this glass negligible as this opens directly out to an escalator void which contains no fuel load.
16.	NSW H101.11.1	Assess seating rows as containing up to 12 seats with an aisle on only one side, in lieu of 8 seats	DP4 – Exits DP6 – Paths of travel to exits	Considerable smoke control and evacuation modelling will be undertaken as part of these works. The results of these models will be used to demonstrate that although some of the aisle and seating configurations do not prescriptively comply with Code, tenability within the space will be maintained for a period of time which is sufficient for occupants to escape safely.
	NSW H101.11.5	Assess seating rows containing up to 25 seats in aisles, in lieu of 24 seats		
	NSW H101.12.6(b)	Assess the first exit door from the stage as being 11 rows back, in lieu of being between 5-7 rows back		
	NSW H101.12.3 & Table H101.12	Assess the main auditorium seating as deviating from Table H101.12, as follows: - Having the actual depth of rows at 950 mm for continental rows, and 925 mm from aisles within the balcony, in lieu of 1000 mm and 975 mm - Having the actual depth of rows at 1000 mm for continental rows, and 950 mm from aisles within the boxes (lower), in lieu of 1025 mm and 975 mm *PS12 - A number of seating non-compliances have been identified by the design team within the current Project Francis design. Smoke and evacuation modelling will be used to demonstrate safe evacuation is possible with the proposed seating configuration in place.*		

6 CONCLUSION

This report has been prepared to support a Section 4.55(2) modification application, submitted to the Department of Environment and Planning, for alterations and additions to the Multi Use Entertainment Facility at the Star.

The design will include a number of building features that do not strictly comply with the BCA DtS Provisions and as such a Performance Solution will be implemented to ensure compliance with the BCA Performance Requirements.

Subject to approval from the Principal Certifying Authority and relevant stakeholders during the design process, the proposed Performance Solutions outlined in Appendix A can meet the Performance Requirements of the BCA once further fire engineering analysis has taken place during later phases of the design process.

This document shall not be used for Construction Documentation and compliance with the Performance Requirements of the BCA will need to be conducted through a formal fire engineering assessment by a Registered Certifier – Fire Safety in the subsequent Fire Engineering Brief and Fire Engineering Report as part of the formal fire strategy approvals process.

7 LIABILITY AND LIMITATIONS

7.1 Liability

This Fire Engineering Concept Report is applicable to Project Francis spanning Level 3 – 6 at The Star, Sydney. It should be recognised that this report does not provide a guarantee that a fire will not occur with potential to cause casualties or damage.

Minerva Group (NSW) Pty Ltd cannot be held liable for any loss or damage resulting from any defect of the building or its services or equipment or for any non-compliance of the building or its services or equipment with any legislative or operational requirement, whether or not such defect or non-compliance is referred to or reported upon in this report, unless such defect or non-compliance should have been apparent to a competent engineer undertaking the assessment of the type undertaken for the purpose of preparation of this report.

The fire safety assessment and recommendations has been based on the building architectural layouts and the information detailed Section 8 – Reference Information. Any change in this information to suit future building works or re-organisation will require further analysis to confirm compliance with the regulations and our reports.

7.2 Limitations

This report does not provide guidance in respect of areas, which are used for bulk storage, processing of flammable liquids, explosive materials, multiple fire ignitions or sabotage of existing fire safety systems.

Minerva Group (NSW) Pty Ltd has compiled this report based on the information listed in Section 8 – Reference Information. Note that this report is based upon information provided by the client – some of which may not have been verified.

Potential incendiary risks are limited in the scope of engineering design. Conventional building design can only provide limited protection against malicious attack; for example, large scale incendiary and multiple ignition sources can potentially overwhelm some fire safety systems.

Strategies such as security, housekeeping and other management procedures may be more effective than additional fire protection measures in addressing arson events.

8 REFERENCE INFORMATION

8.1 Regulatory Framework

The following New South Wales Legislation is applicable to the project:

- NSW Environmental Planning & Assessment Act 1979 and subsequent amendments
- NSW Environmental Planning & Assessment Regulation 2000 and subsequent amendments

8.2 References

The following reference material is applicable to this report:

[1] Volume One of the Building Code of Australia (BCA) 2019 Amendment 1, Australian Building Codes Board, 2020

[2] Guide to the BCA 2019 Amendment 1, Australian Building Codes Board, 2020

[3] Chartered Institute of Building Services Engineers (CIBSE) Guide E – Fire Engineering

[4] International Fire Engineering Guidelines, 2005

8.3 Design Information

The engineering analysis document in this report is based upon the following information:

[5] Architectural drawings provided by Altis Architecture (dated 28th March 2022)

APPENDIX A – FIRE / SMOKE COMPARTMENTATION STRATEGY

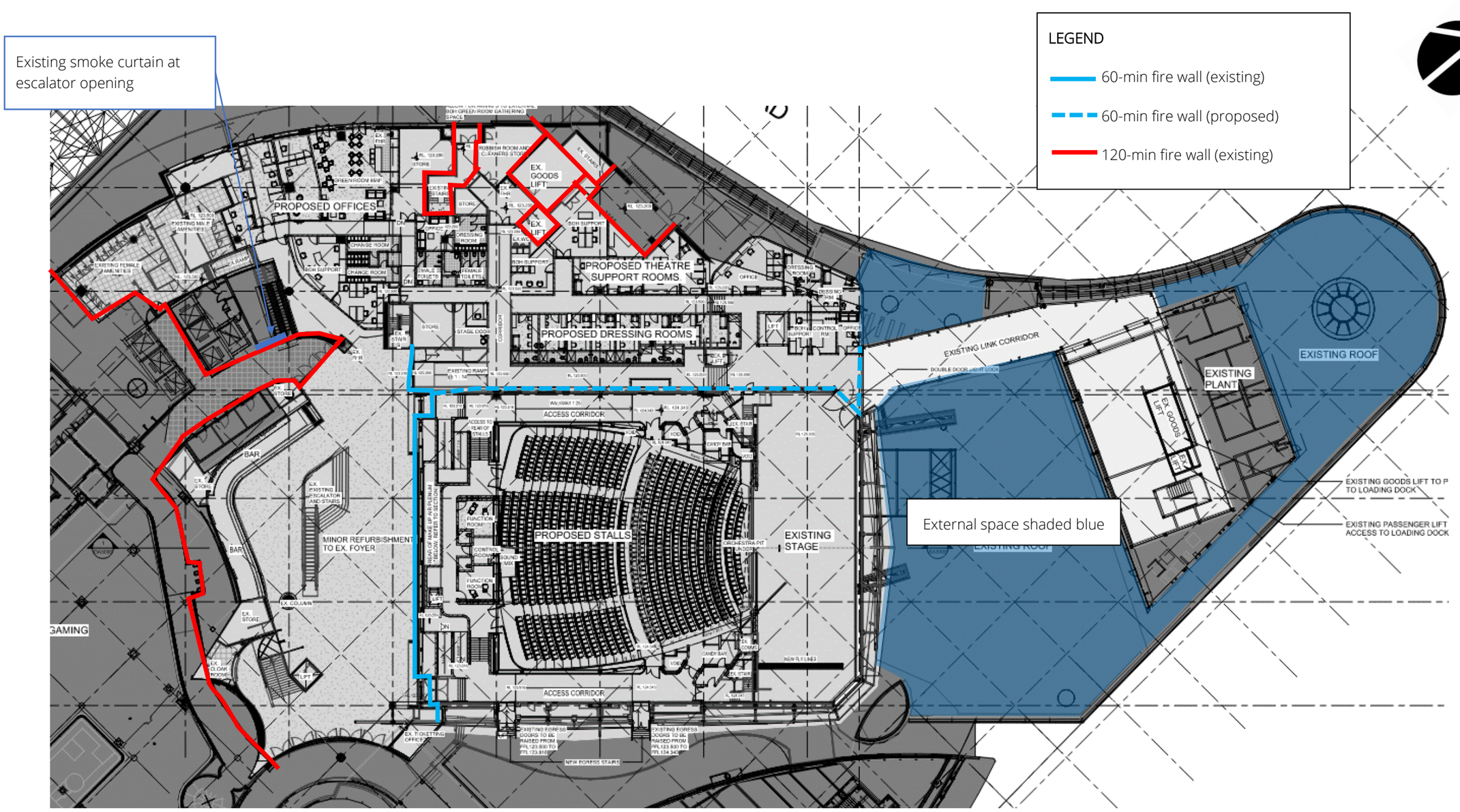


Figure 15 – Level 3 fire compartmentation plan (preliminary only)

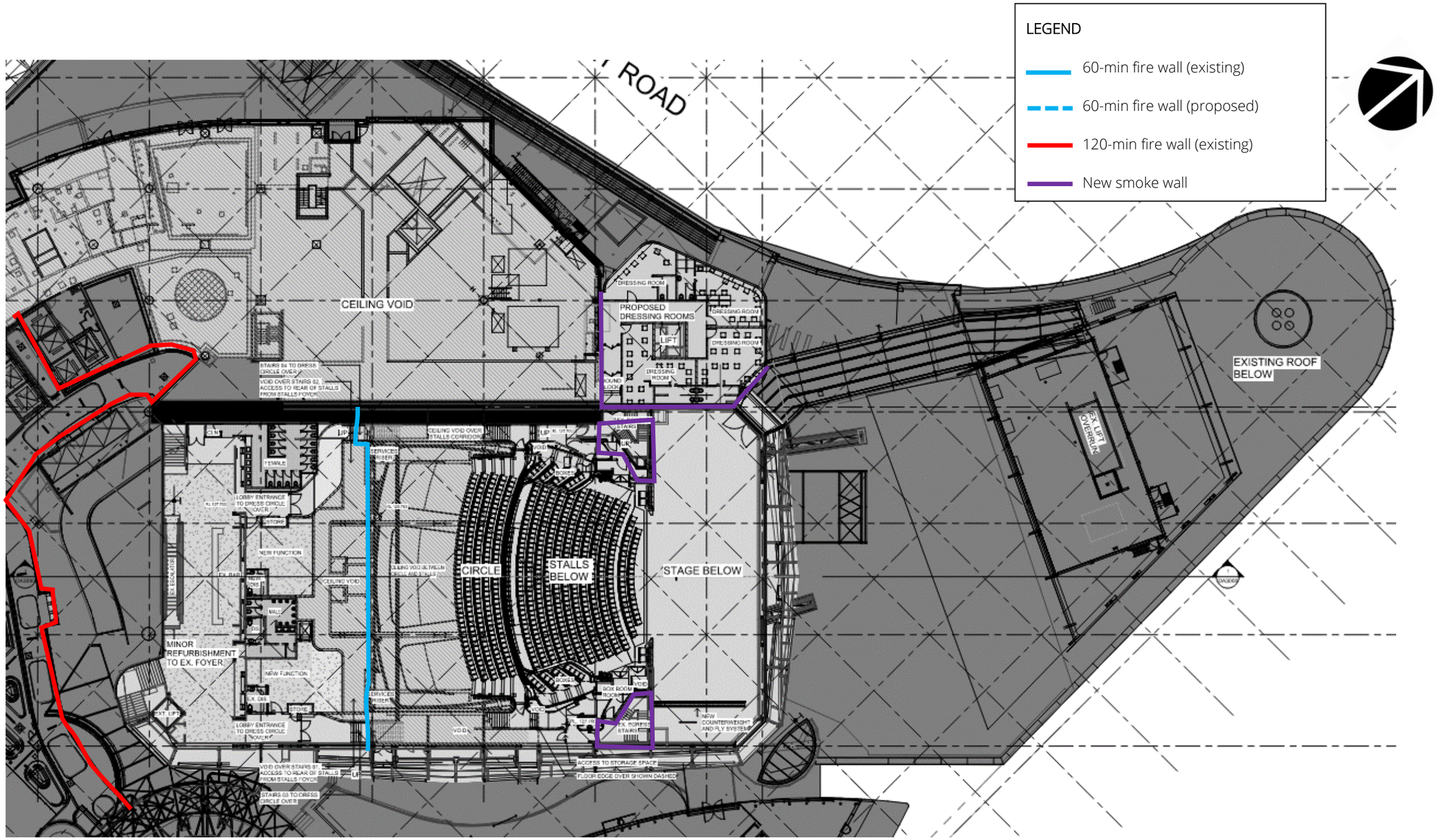


Figure 16 – Level 4 fire compartmentation plan (preliminary only)

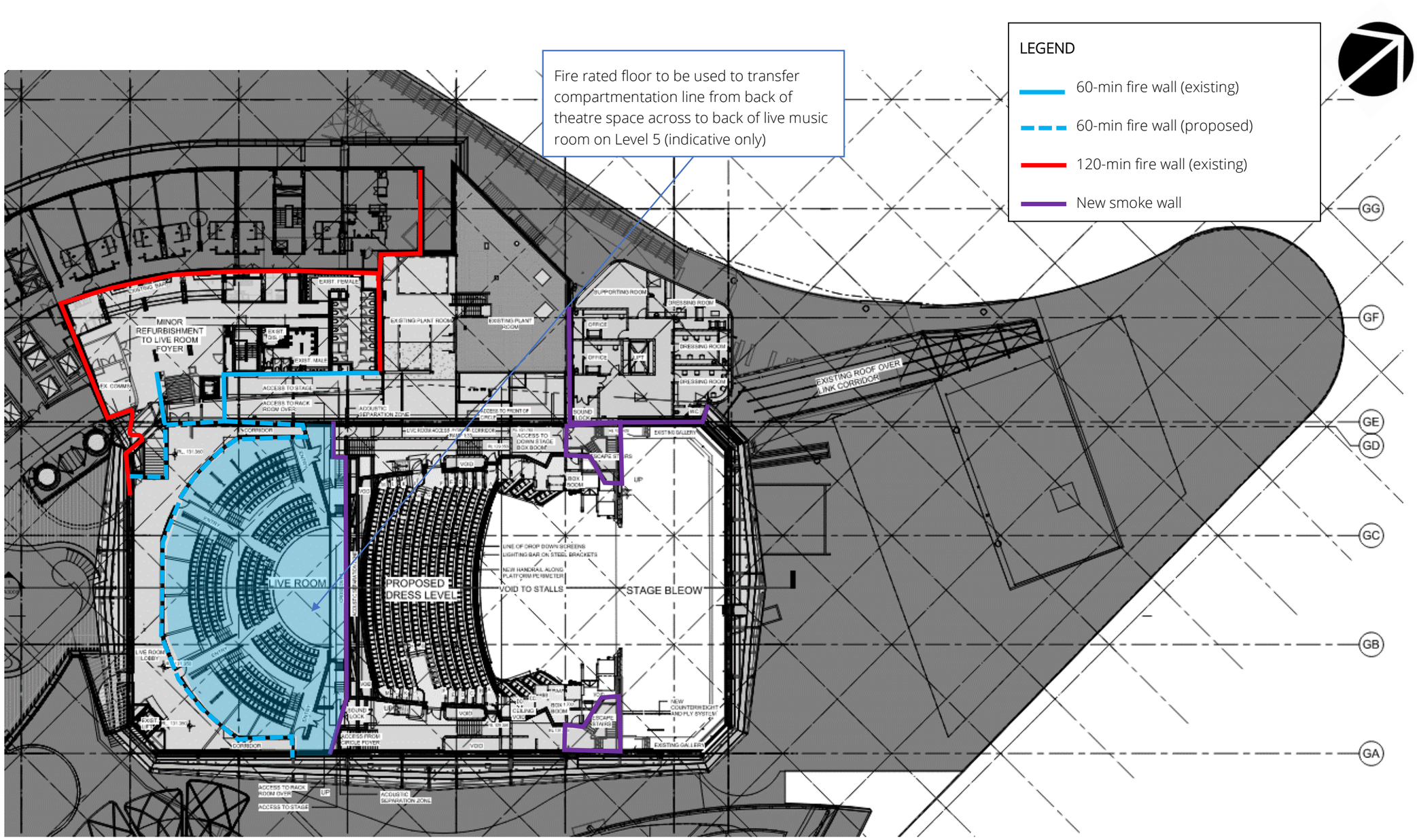


Figure 17 – Level 5 fire compartmentation plan (preliminary only)

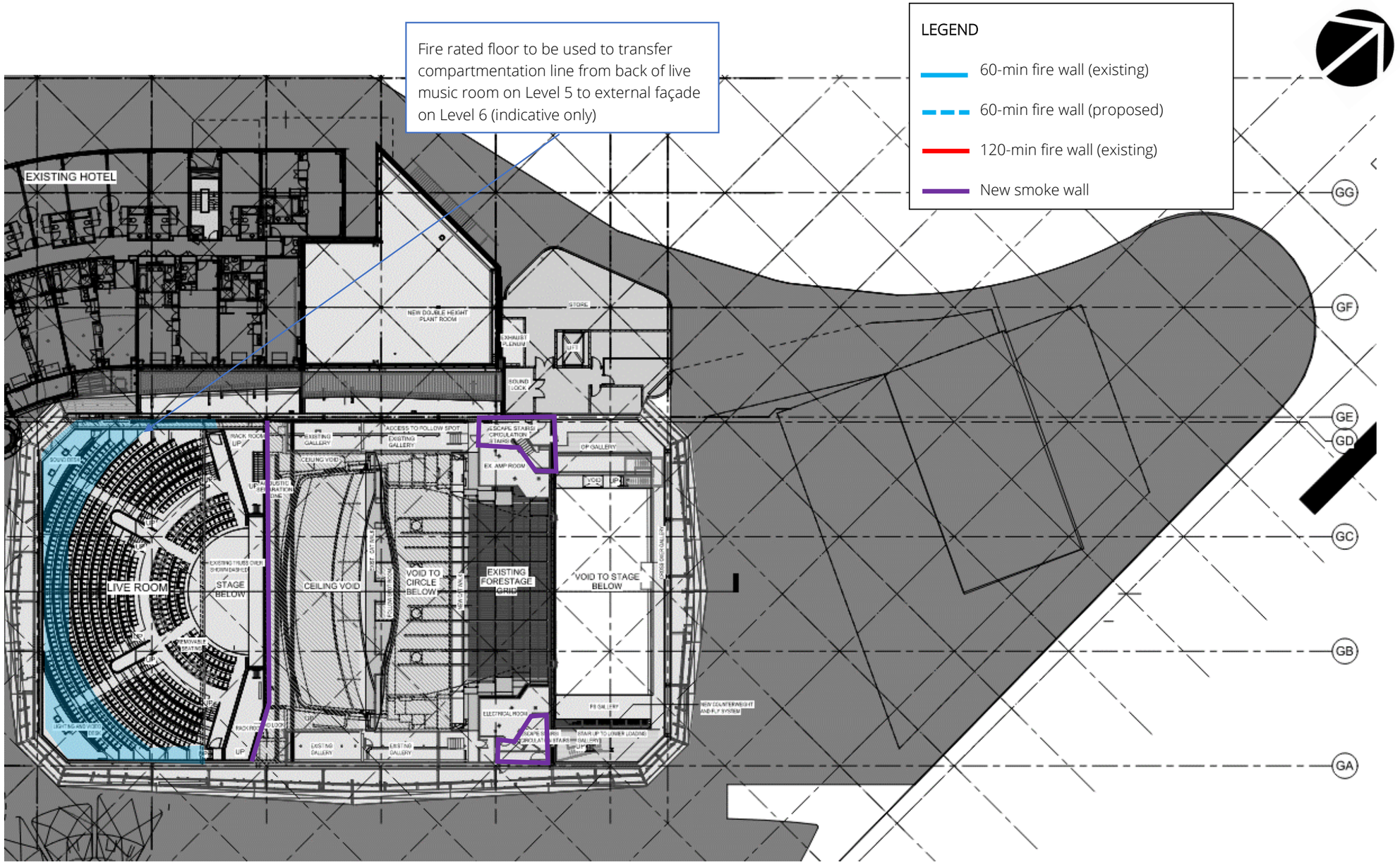


Figure 18 – Level 6 fire compartmentation plan (preliminary only)

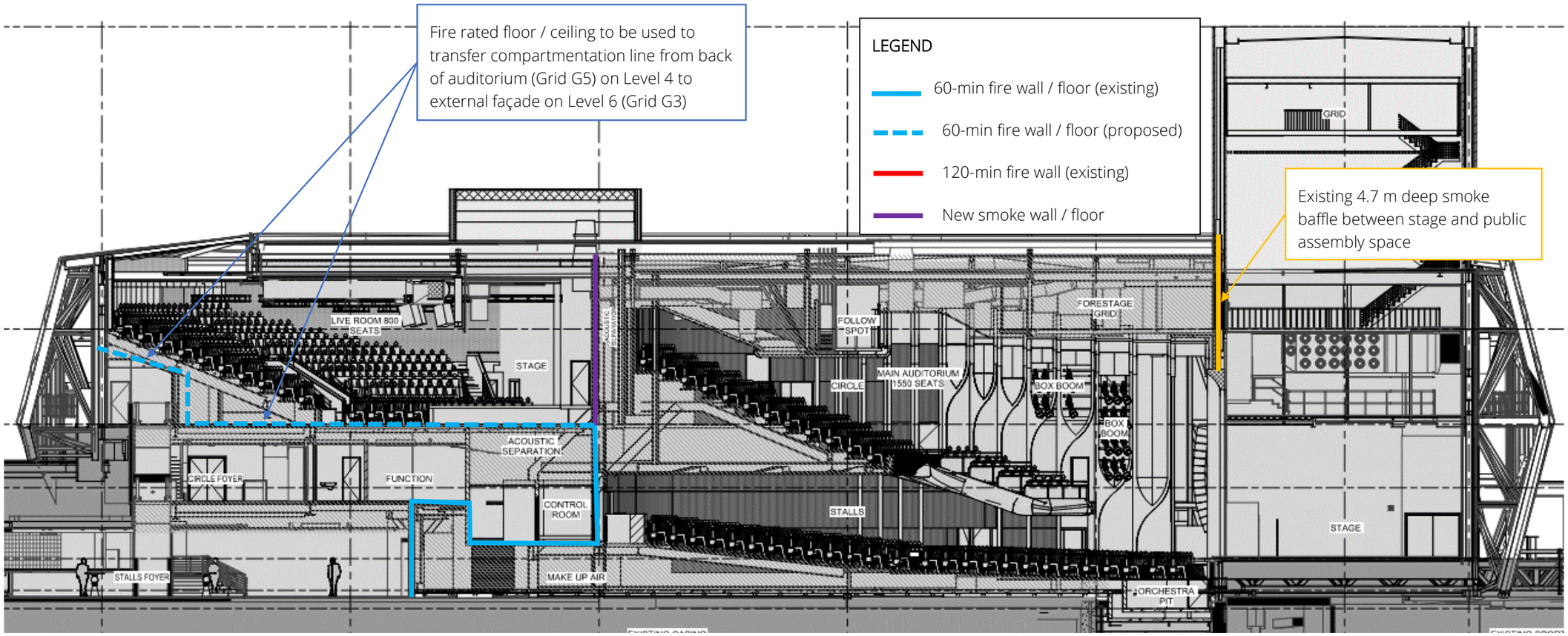


Figure 19 – North-south section showing fire and smoke separation between function spaces and event areas

APPENDIX B – EGRESS STRATEGY

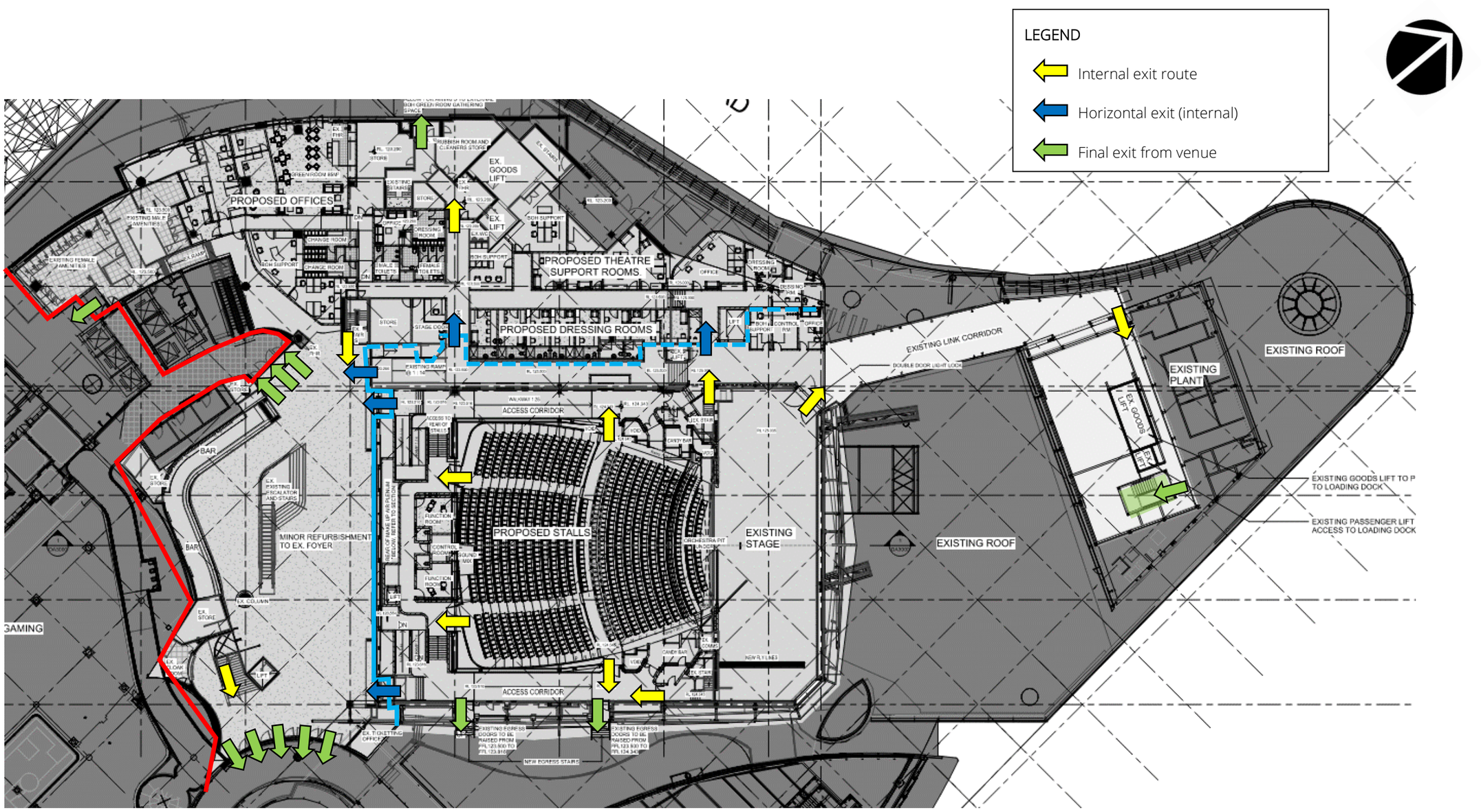


Figure 20 – Level 3 egress diagram (indicative only)

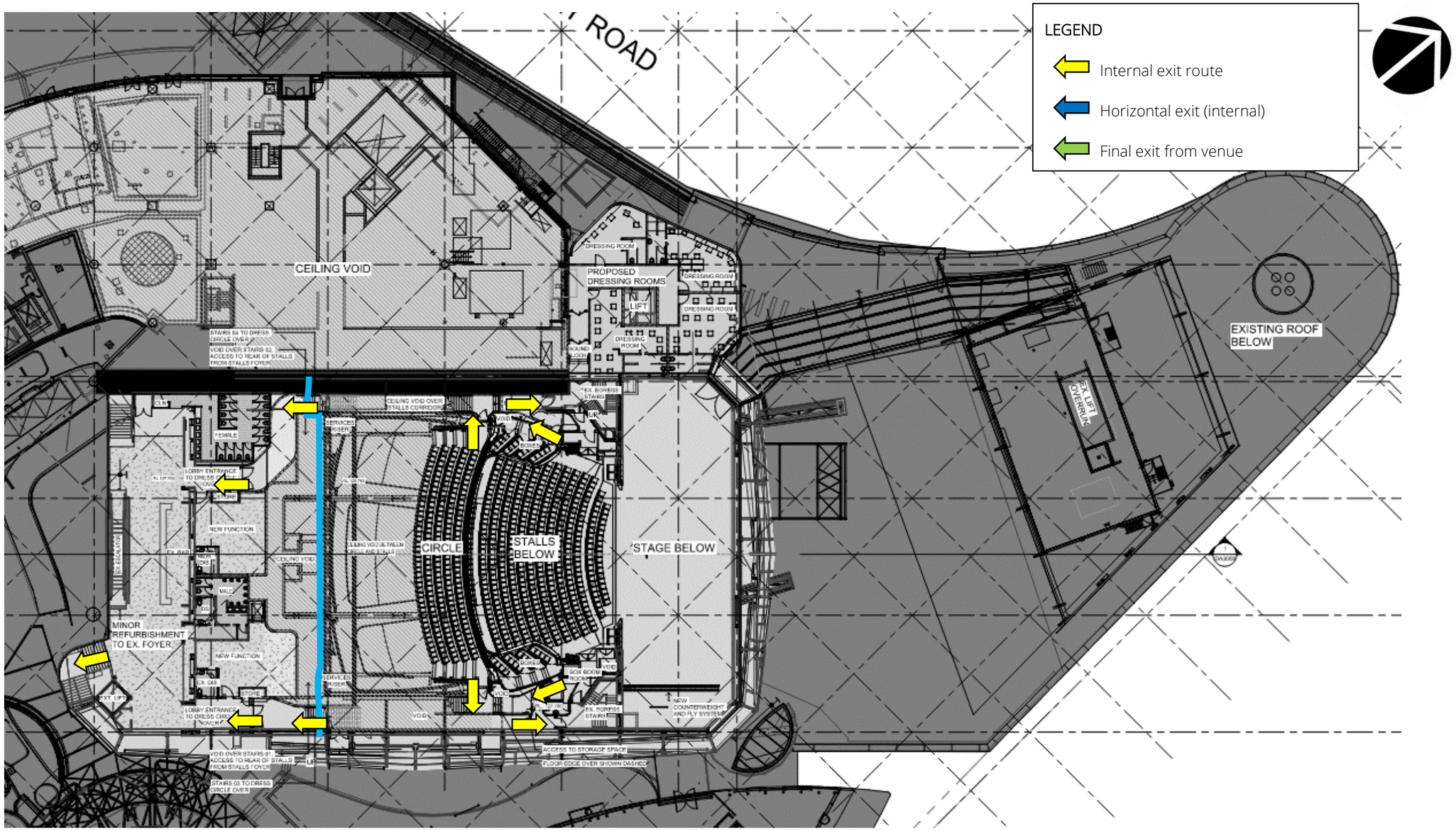


Figure 21 – Level 4 egress diagram (indicative only)

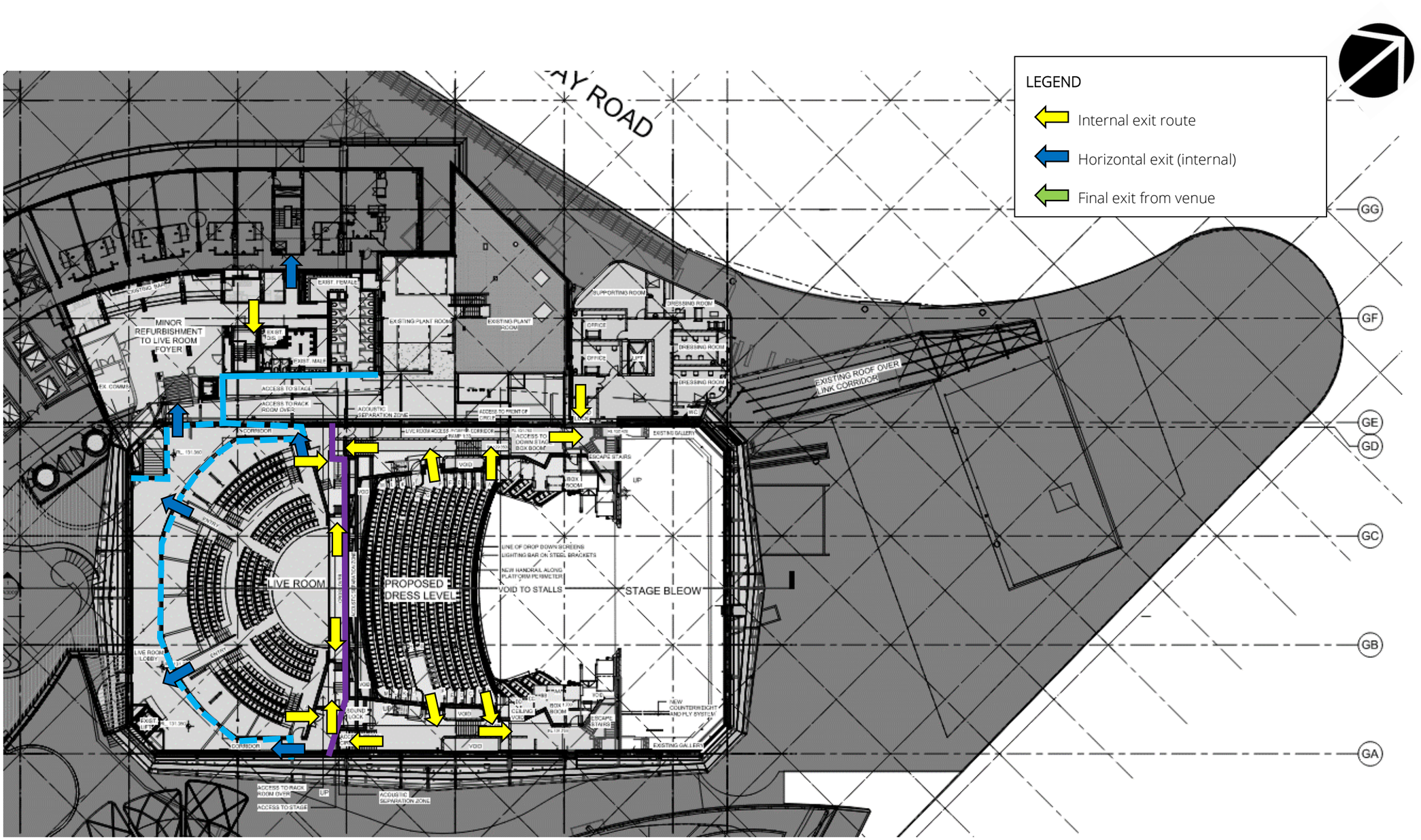


Figure 22 – Level 5 egress diagram (indicative only)

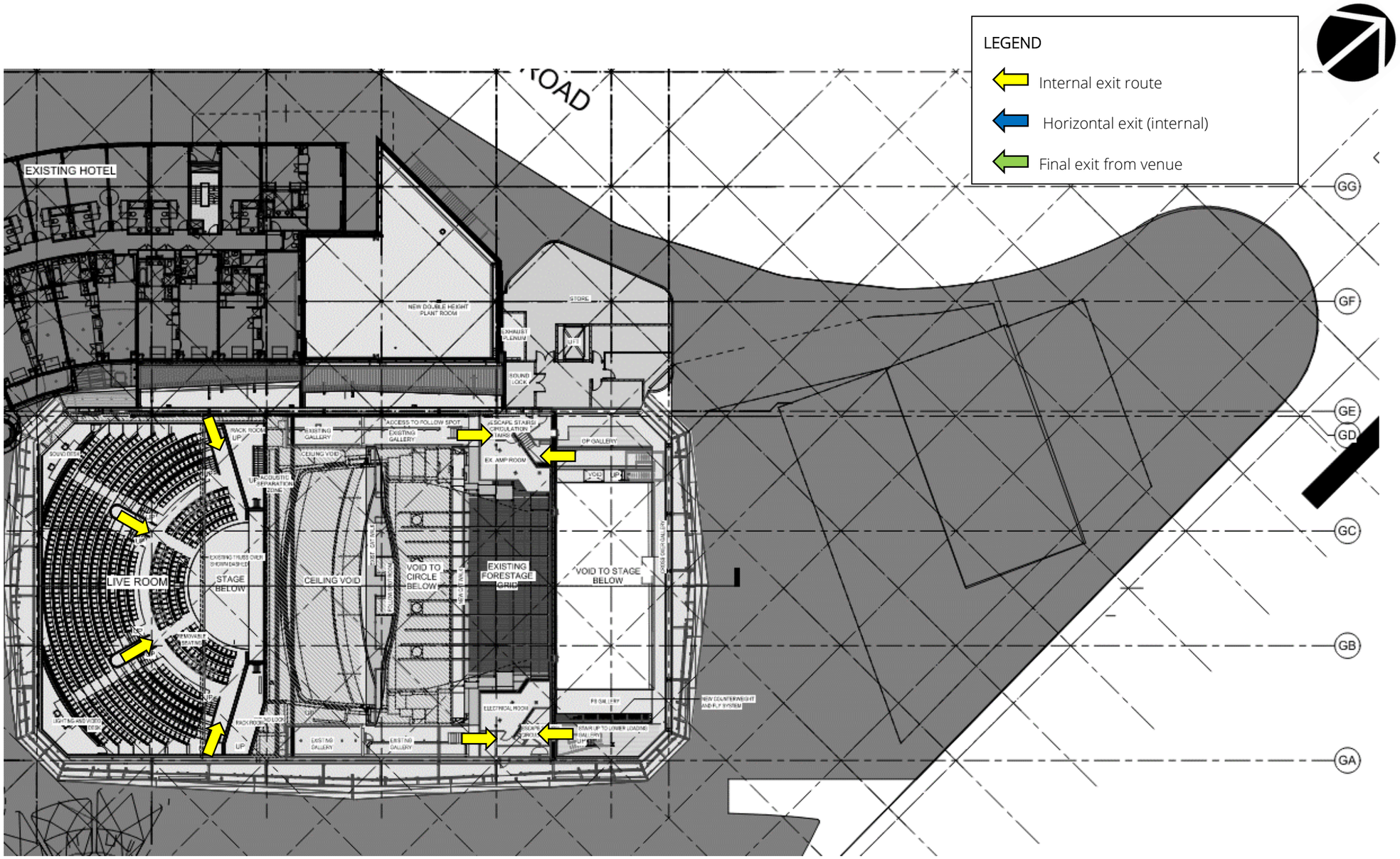


Figure 23 – Level 6 egress diagram (indicative only)

APPENDIX C – SMOKE HAZARD MANAGEMENT STRATEGY

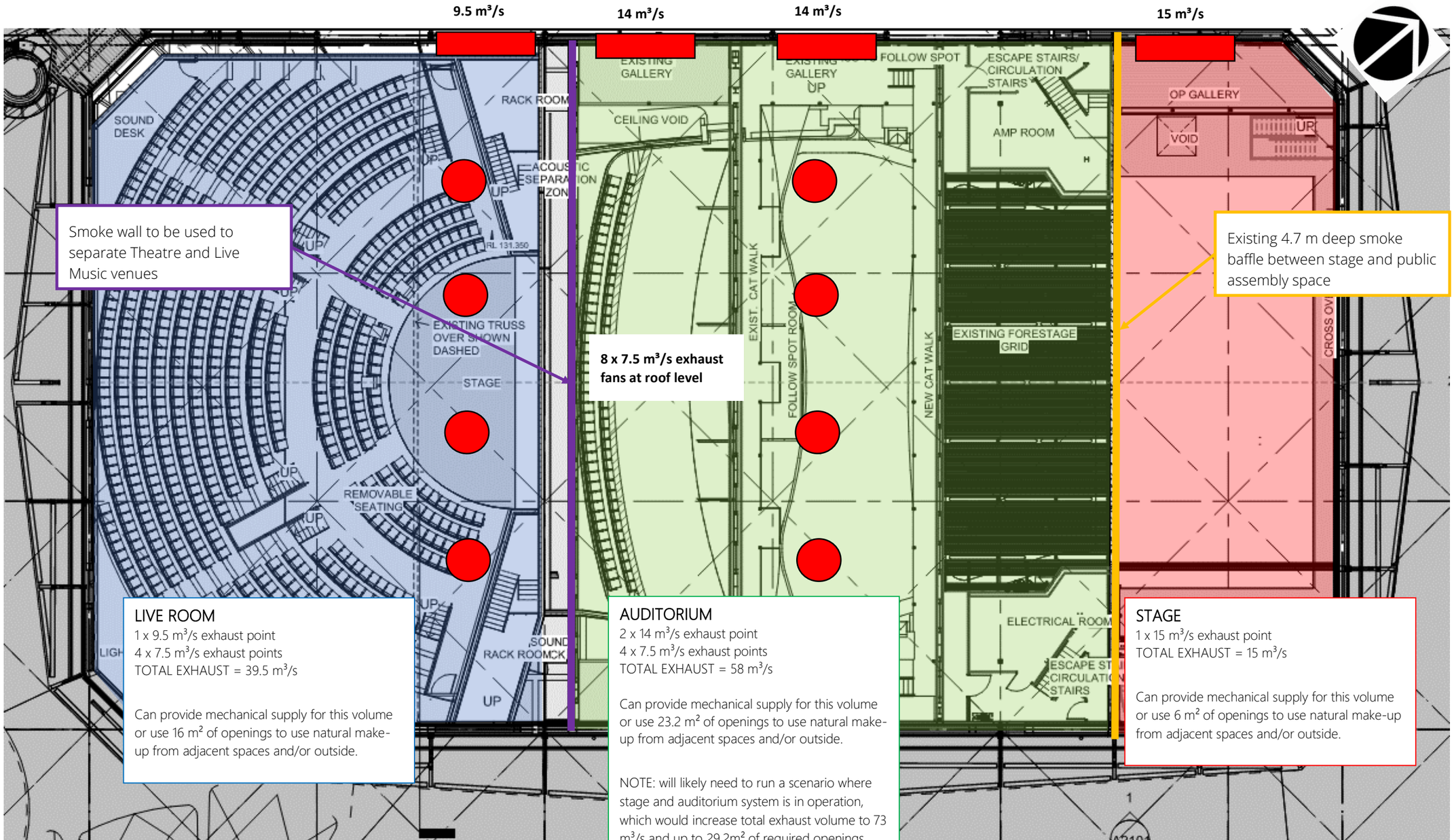


Figure 24 – Level 6 mechanical exhaust diagram (indicative only)

APPENDIX D – PRELIMINARY CFD ANALYSIS

Introduction

The CFD modelling programme used in this assessment was Fire Dynamics Simulator 6 (FDS 6.7.5) and was used to simulate the fire scenarios summarised below in Table 16. An evacuation analysis was also undertaken using the software package Pathfinder to calculate the time it takes for occupants to egress from the theatre to a space outside of this. Two scenarios have been modelled for the main auditorium space, and one scenario for the live room.

The fire scenarios studied as part of this initial work have been detailed in Table 16 below. It should be noted that both of these fire scenarios are considered base case, meaning a safety factor of 1.5 needs to be applied to the results. The peak fire size has also assumed that the materials which the theatre seating is made of will be fully compliant with BCA Spec. C1.10 and AS 1530.3 (1999) for a theatre space, as per the following BCA extract.

Table 15 – BCA Spec. C1.10 material requirements for theatre seating

Material or assembly location	***Flammability Index***	***Spread-of-Flame Index***	***Smoke-Developed Index***
Class 9b buildings used as a theatre, public hall or the like: Any part of fixed seating in the audience area or auditorium.	N/A	0	5

The preliminary results comparing the Available Safe Egress Time (ASET) from the CFD models with the Required Safe Egress Time (RSET) from the evacuation models are illustrated by the snapshots provided in Table 18.

Table 16 – Summary of Design Fire Scenarios - Auditorium

Fire Scenario	Fire Location	T^2 Growth Rate (kW/s^2)	Peak Heat Release Rate (kW)	Description
1	Stalls	Medium	1000	A fire is located in the centre of the back portion of the seat stalls within the theatre and located at Z = 0 (approximately RL 125.5) and is 0.5 m high. Maximum fire is not based on sprinkler activation and grows to 1 MW based on limited combustibility of theatre seating (BCA Spec. C1.10 compliance for Class 9b theatre seating).
2	Dress Circle	Medium	1000	Fire is located in the centre of the dress circle seats within the theatre and located at Z = 7 (approximately RL 132) and is 0.5 m high. Maximum fire is not based on sprinkler activation and grows to 1 MW based on limited combustibility of theatre seating (BCA Spec. C1.10 compliance for Class 9b theatre seating).

Table 17 – Summary of Design Fire Scenarios - Live Room

Fire Scenario	Fire Location	T^2 Growth Rate (kW/s^2)	Peak Heat Release Rate (kW)	Description
1	Top back row of the seating area	Medium	1000	A fire is located in the centre of the back portion of the seating area within the live room and located at Z = 13.6 m (approximately RL 125.5) and is 0.6 m high. Maximum fire is not based on sprinkler activation and grows to 1 MW based on limited combustibility of theatre seating (BCA Spec. C1.10 compliance for Class 9b theatre seating).

Scenario #1

Table 18 –Preliminary CFD and Pathfinder Results for Fire Scenario 1

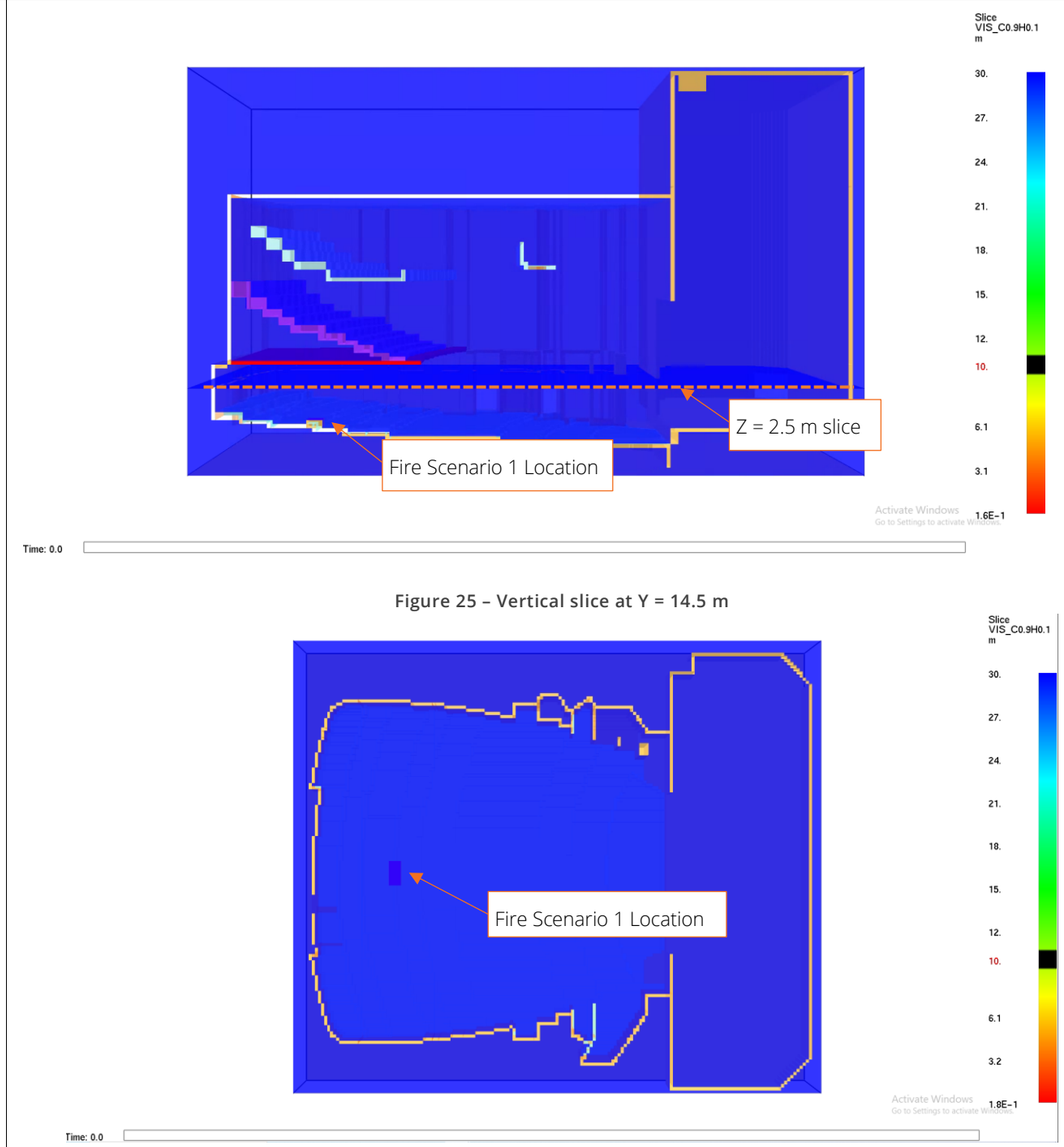
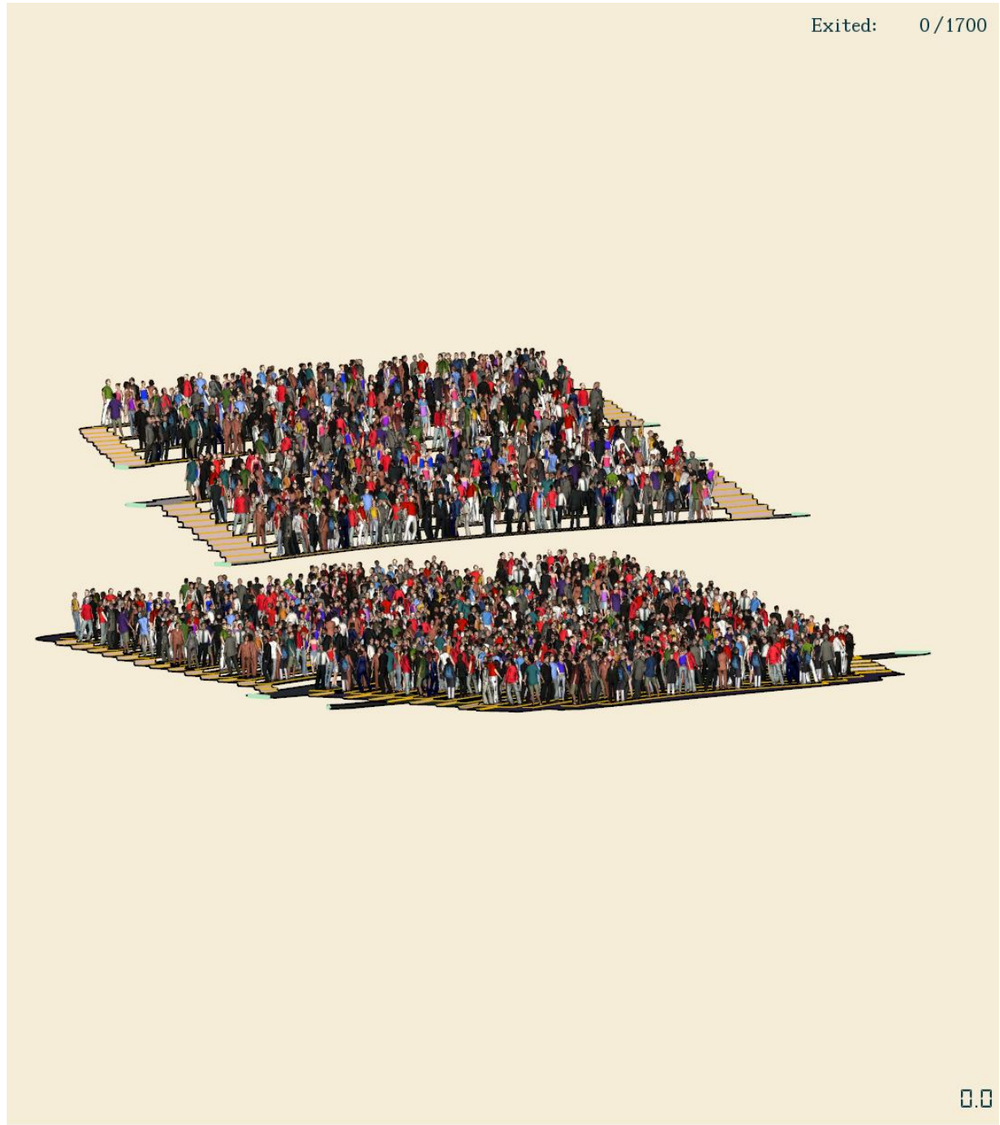
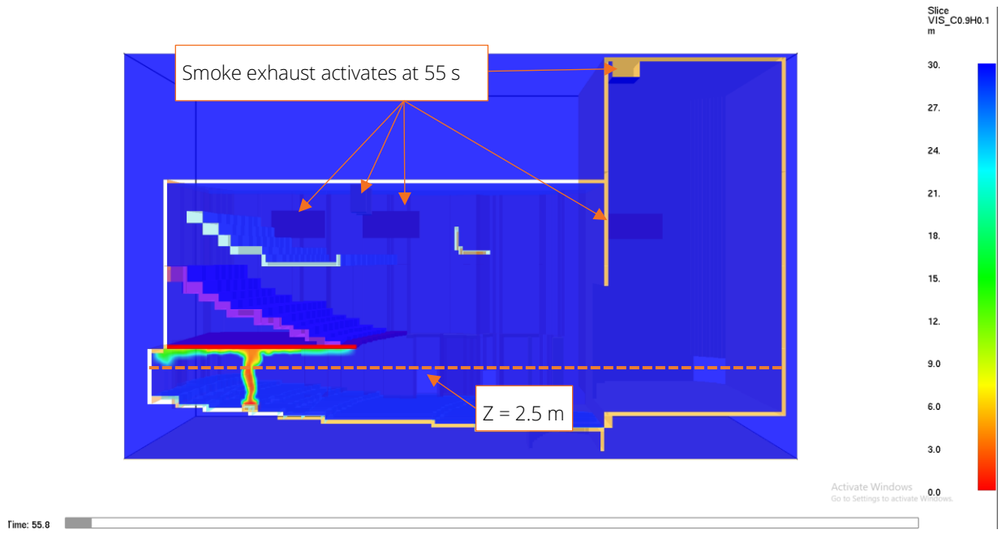
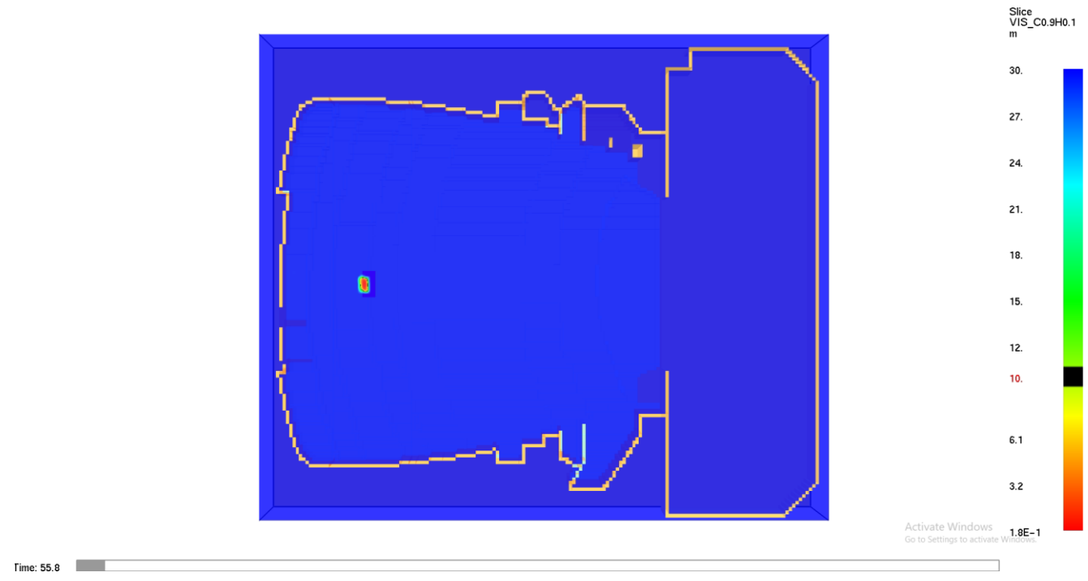
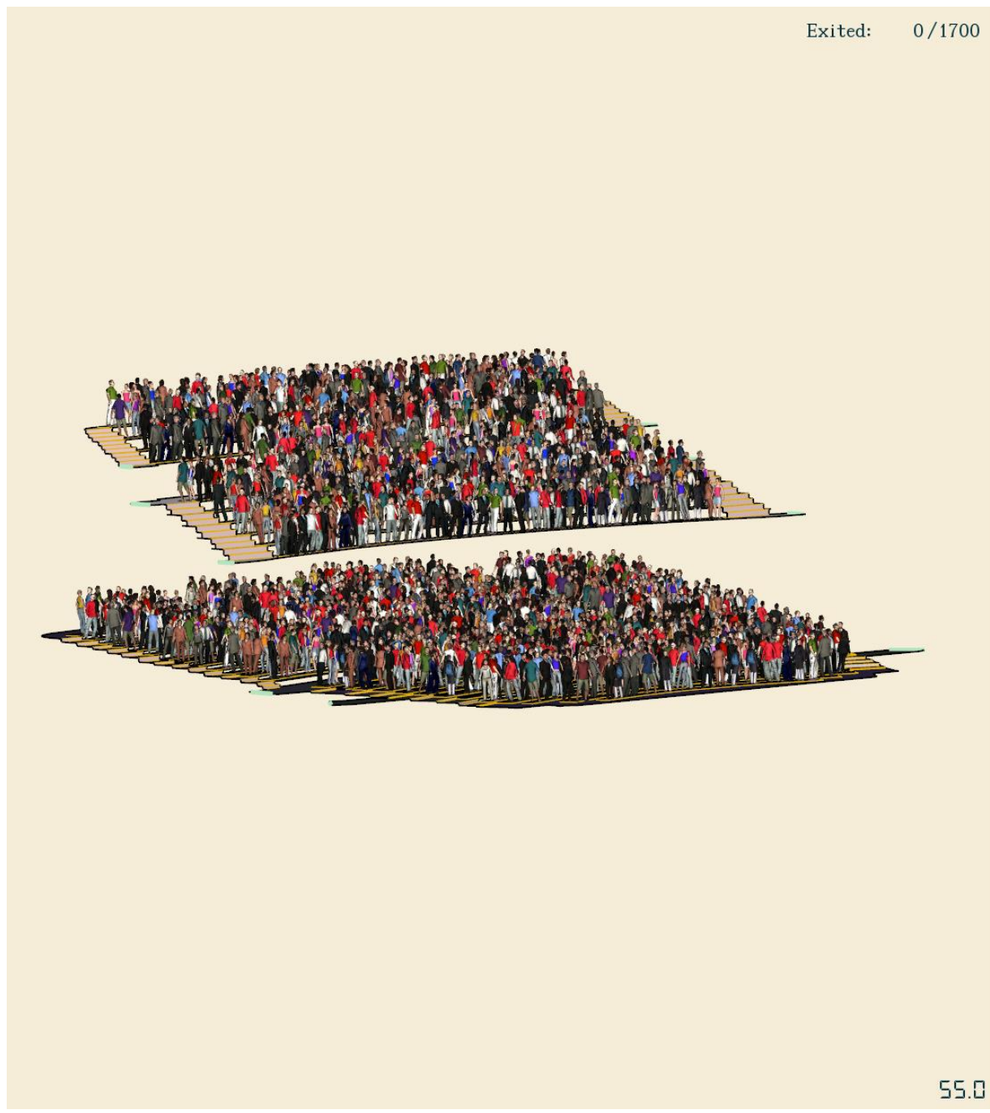
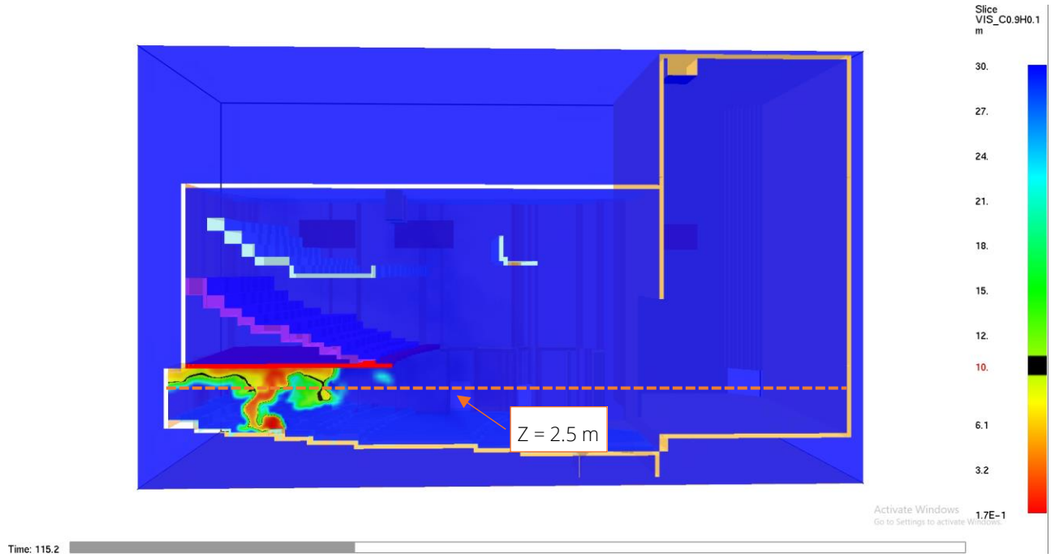
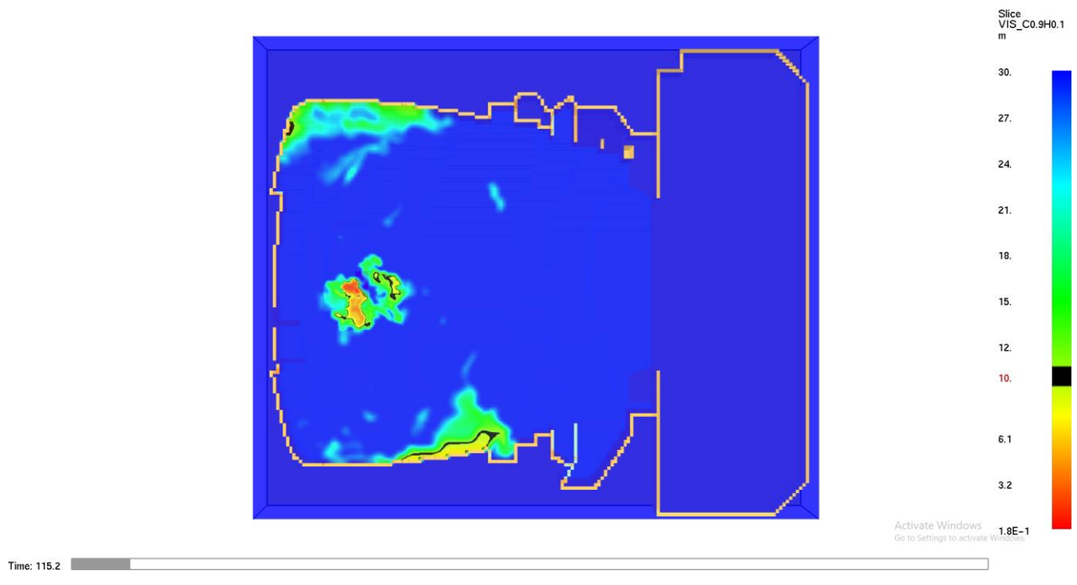
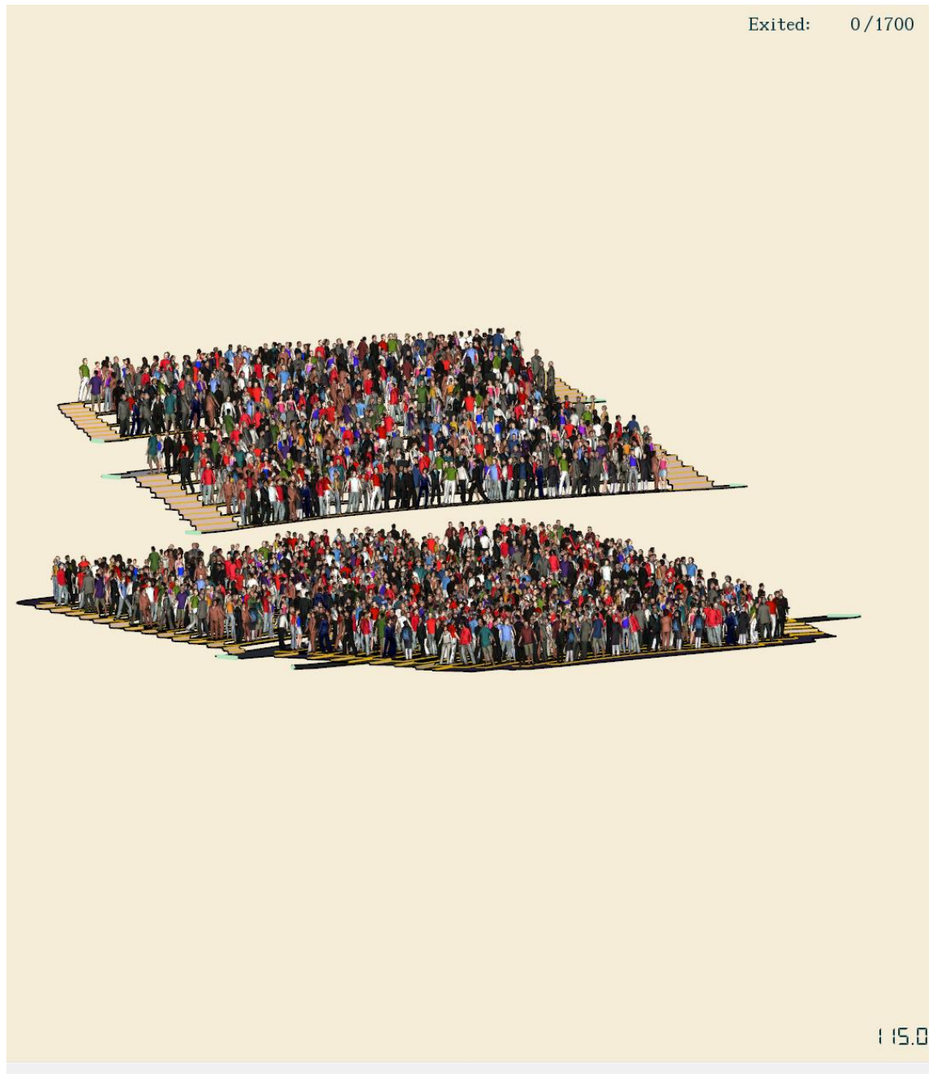
Fire Scenario 1 (Stalls)		
Time (s)	CFD Results	Pathfinder Results
0 s		

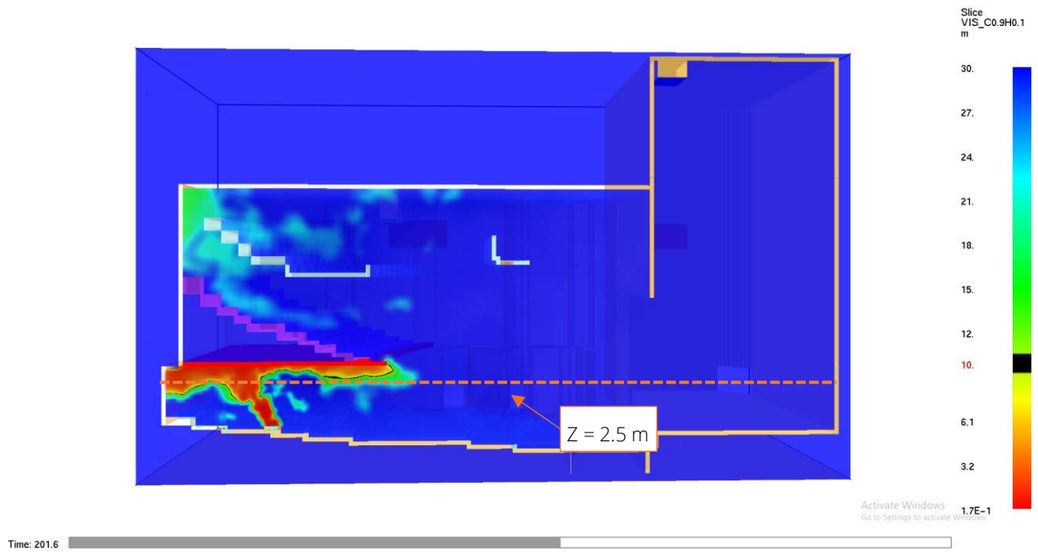
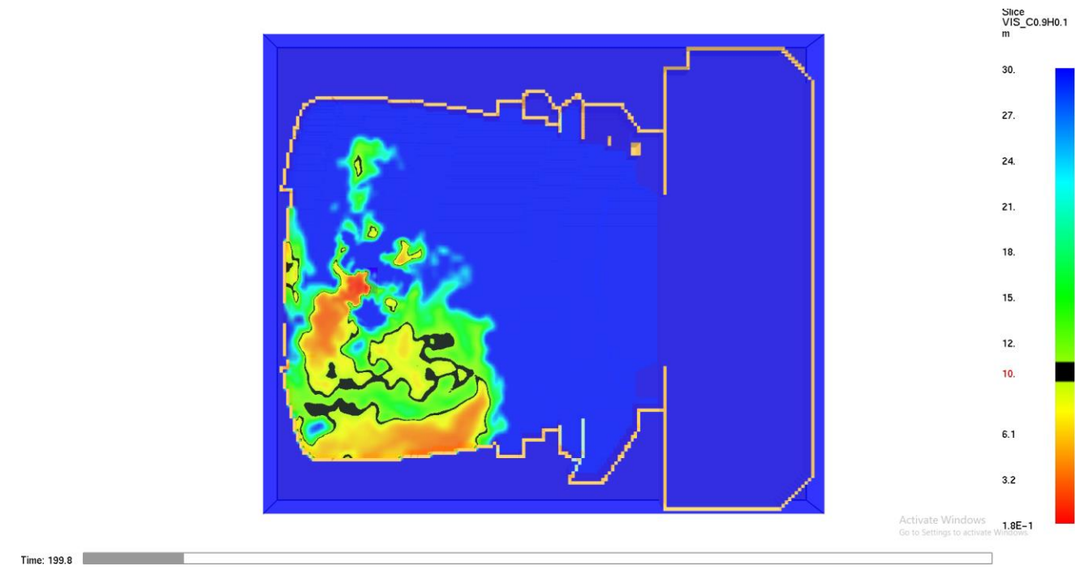
Figure 25 – Vertical slice at Y = 14.5 m

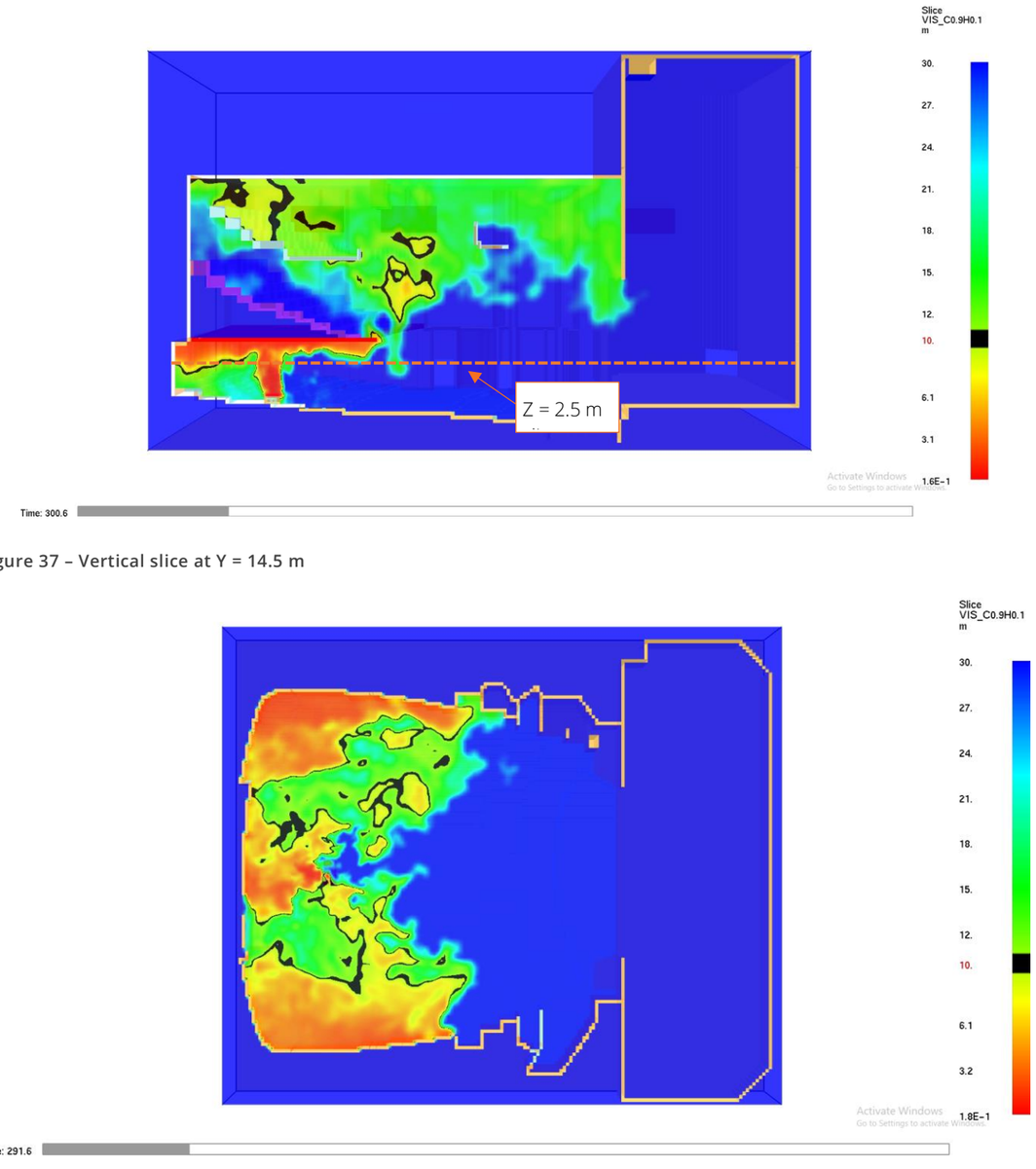
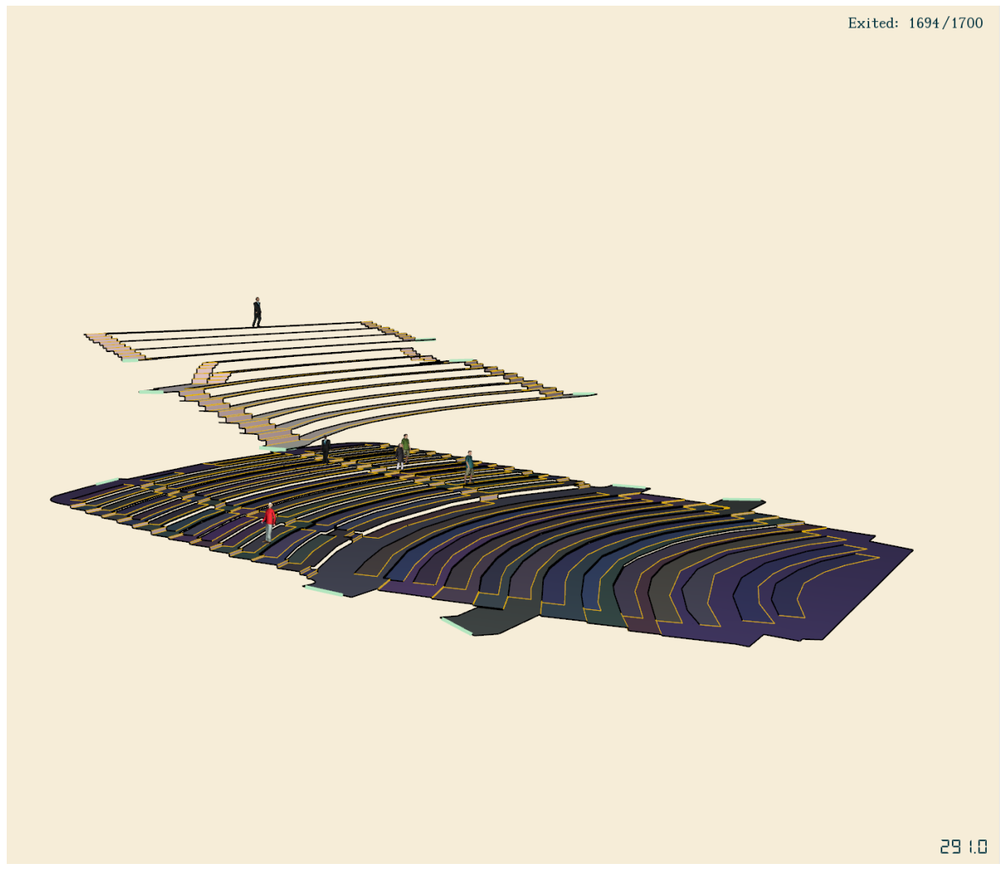
Figure 26 – Horizontal slice at Z = 2.5 m

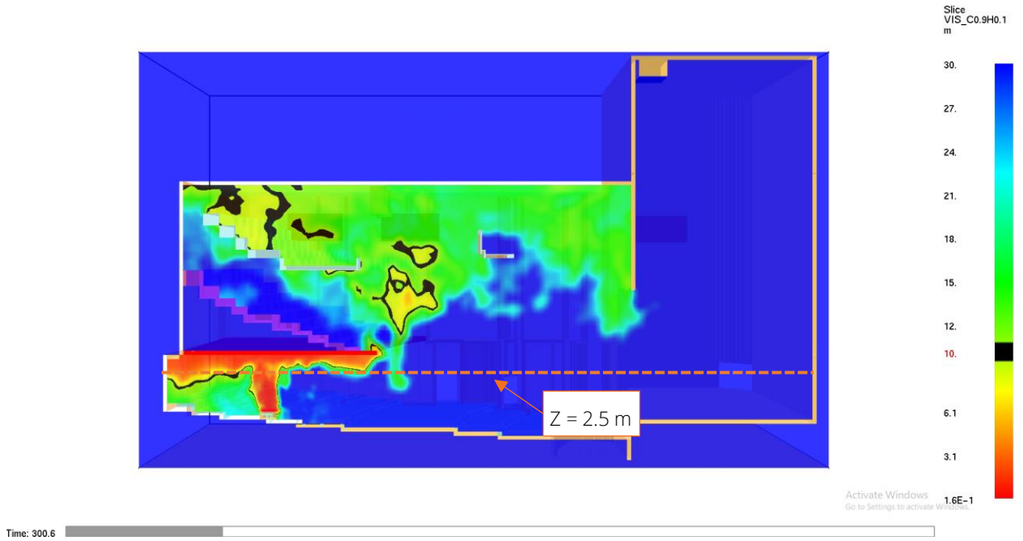
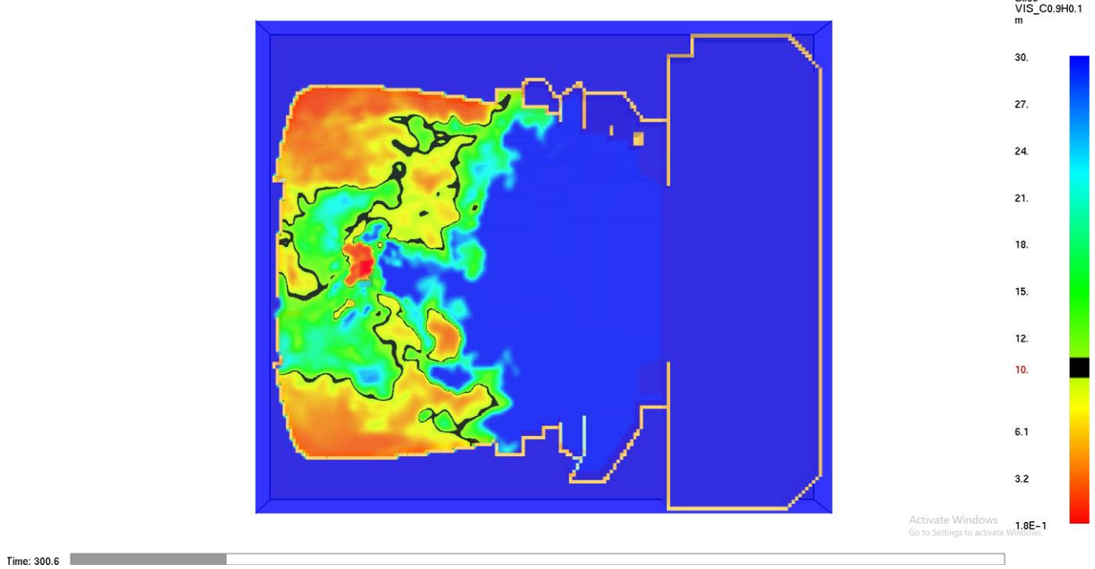
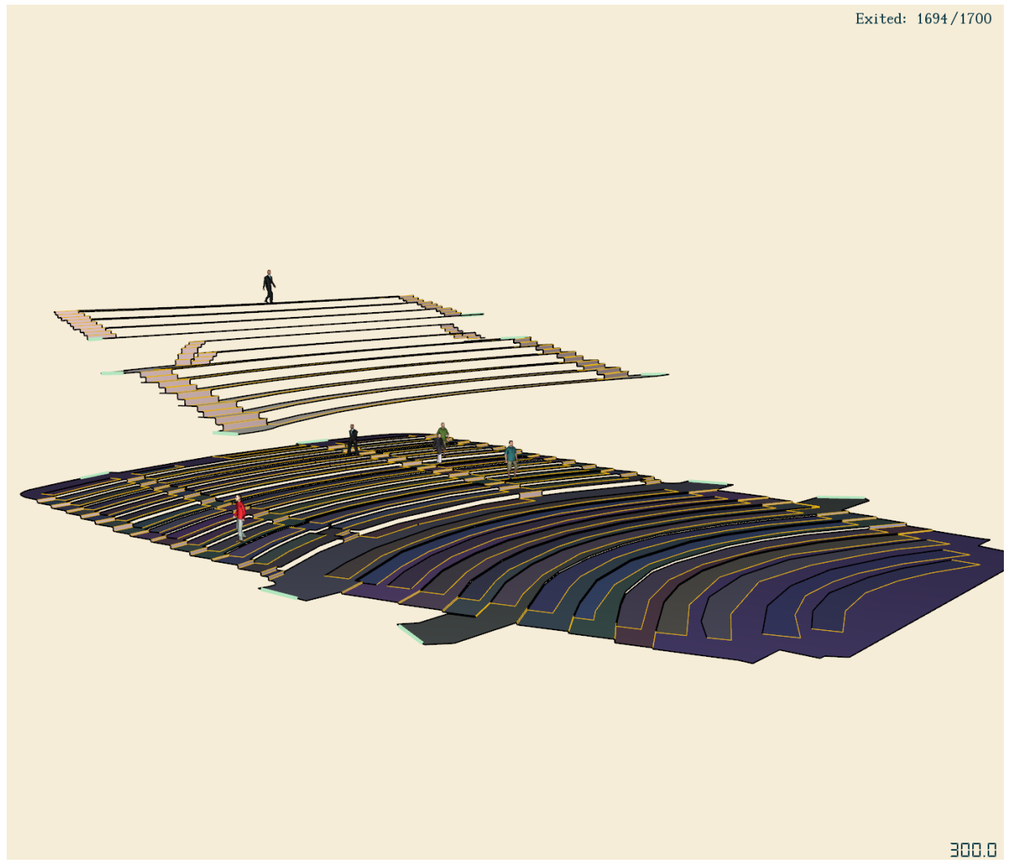
Figure 27 – Pathfinder results at 0 s

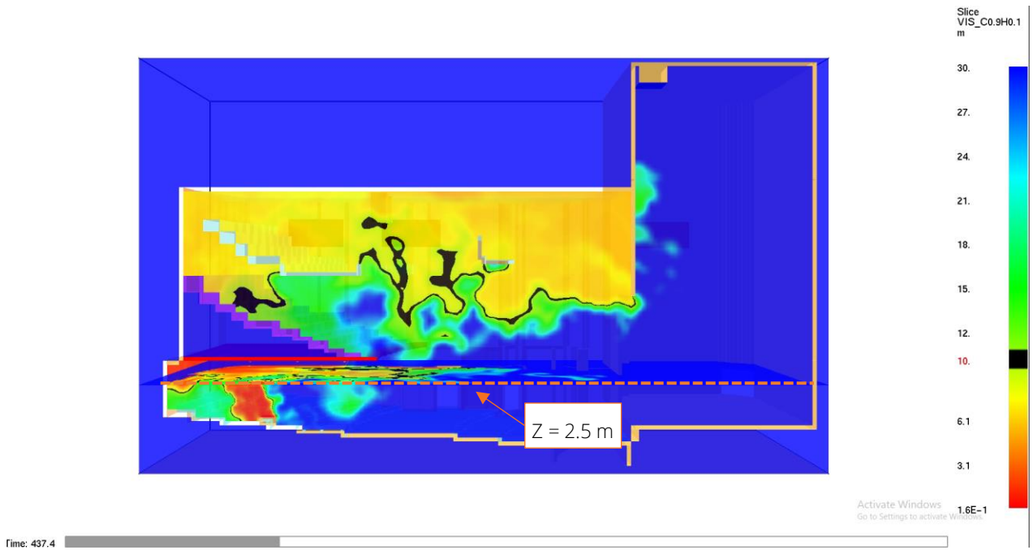
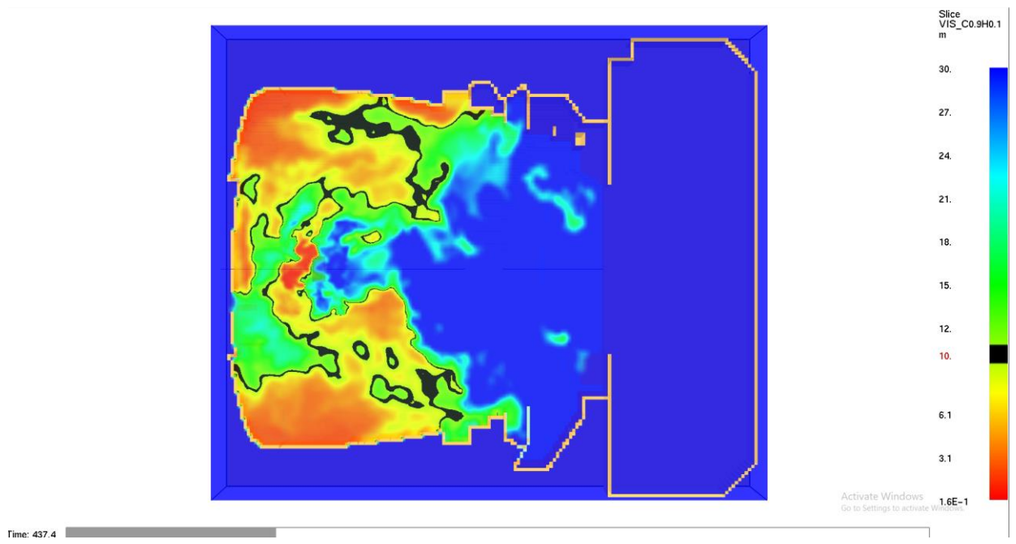
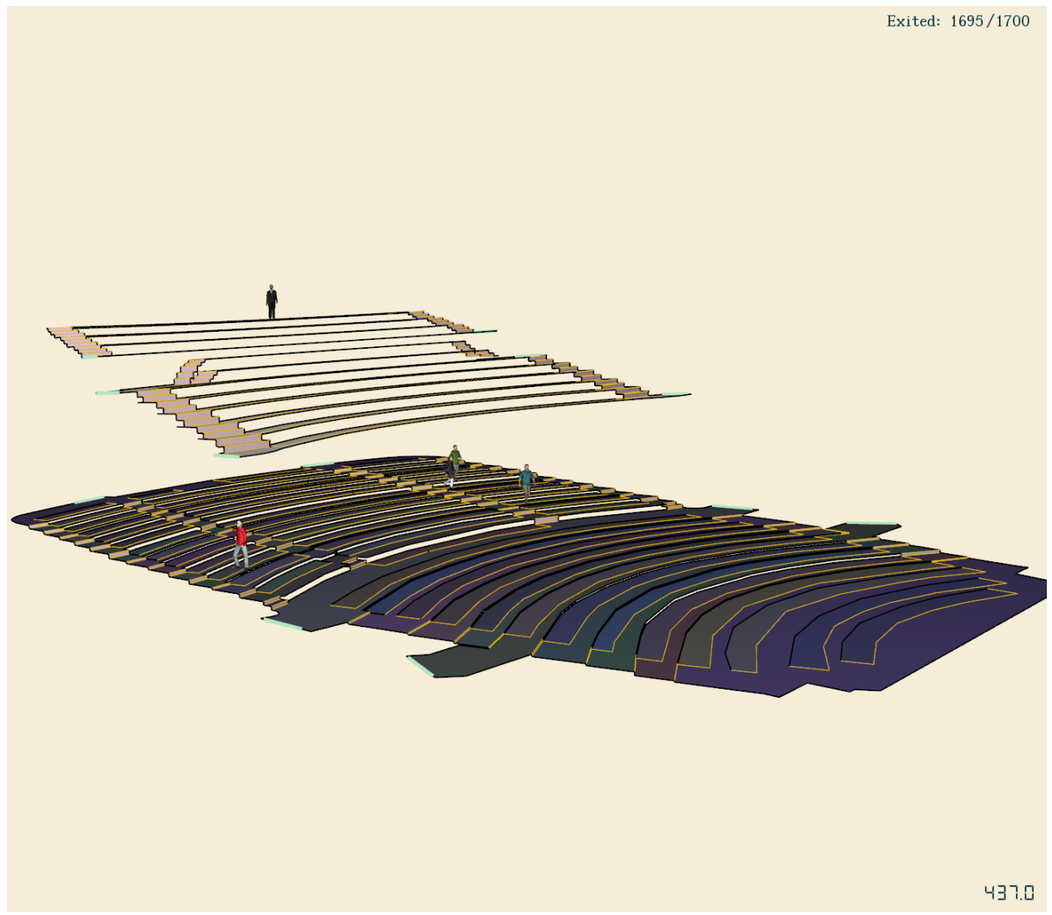
Fire Scenario 1 (Stalls)		
55 s	 **Figure 28 – Vertical slice at Y = 14.5 m**  **Figure 29 – Horizontal slice at Z = 2.5 m** • Smoke detector and smoke exhaust activates at 55 s	 **Figure 30 – Pathfinder results at 55 s** • Smoke alarm activates at 55 s to notify occupants of a fire

Fire Scenario 1 (Stalls)		
115 s	 Figure 31 – Vertical slice at Y = 14.5 m  Figure 32 – Horizontal slice at Z = 2.5 m	 Figure 33 – Pathfinder results at 115 s • A 60 s pre-movement time is applied after the activation of smoke detectors at 55 s • Occupants start evacuating at 115 s

Fire Scenario 1 (Stalls)		
200 s	 **Figure 34 – Vertical slice at Y = 14.5 m**  **Figure 35 – Horizontal slice at Z = 2.5 m** • Tenability is starting to degrade at back of theatre area on Stalls level, but still acceptable for evacuation purposes.	 **Figure 36 – Pathfinder results at 200 s** • 1284 /1700 occupants evacuated by this time step • 5 m visibility still available in south-east corner of space where occupants are queuing to escape. Future models will likely direct occupants to evacuate away from fire location to provide more true to life results.

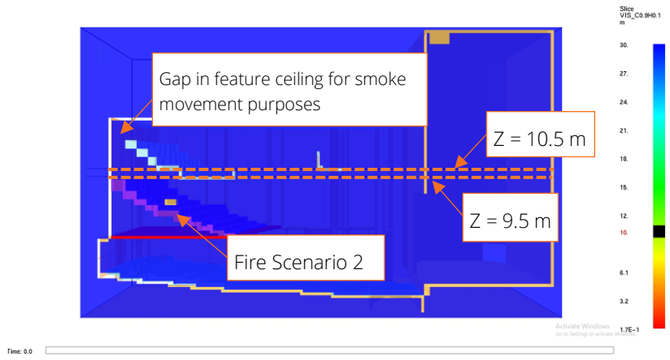
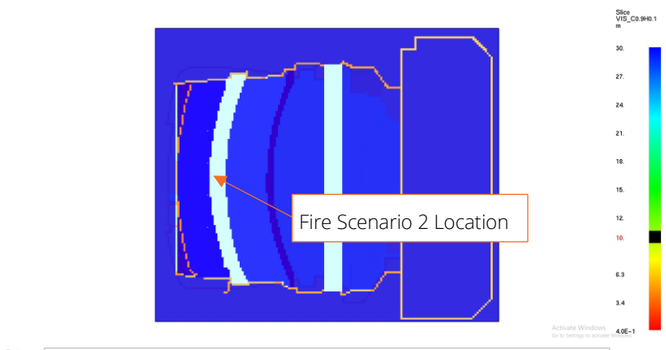
Fire Scenario 1 (Stalls)		
291 s	 **Figure 37 – Vertical slice at Y = 14.5 m** **Figure 38 – Horizontal slice at Z = 2.5 m** • Tenability is starting to degrade on the east and west sides of the theatre area on Stalls level, but still largely acceptable for evacuation purposes.	 **Figure 39 – Pathfinder results at 291 s** • 1694 / 1700 occupants evacuated • Six (6) occupants are stuck and can't evacuate (spurious error within evacuation model which needs to be resolved). This shall be resolved in the FEBQ/FER stage • RSET shall be taken at 291 s for the preliminary stage

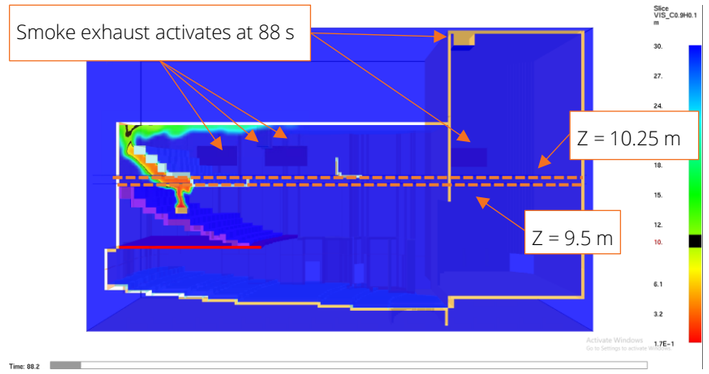
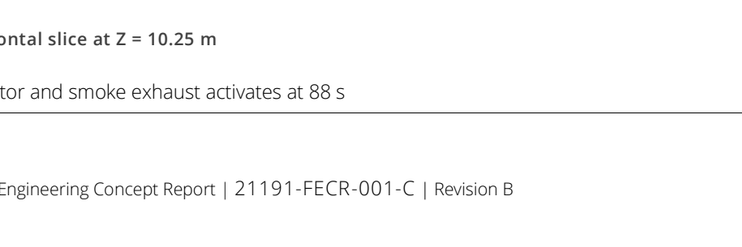
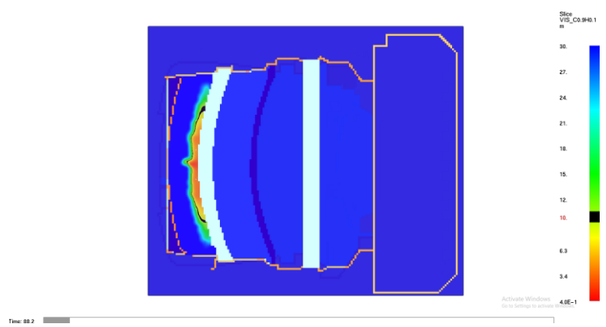
Fire Scenario 1 (Stalls)		
300 s	 **Figure 40 – Vertical slice at Y = 14.5 m**  **Figure 41 – Horizontal slice at Z = 2.5 m**	 **Figure 42 – Pathfinder results at 300 s** • 1694 / 1700 occupants evacuated • Five (5) occupants are stuck and can't evacuate. This shall be resolved in the FEBQ/FER stage.

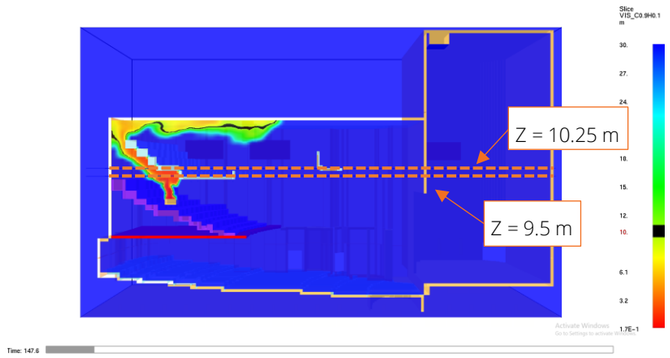
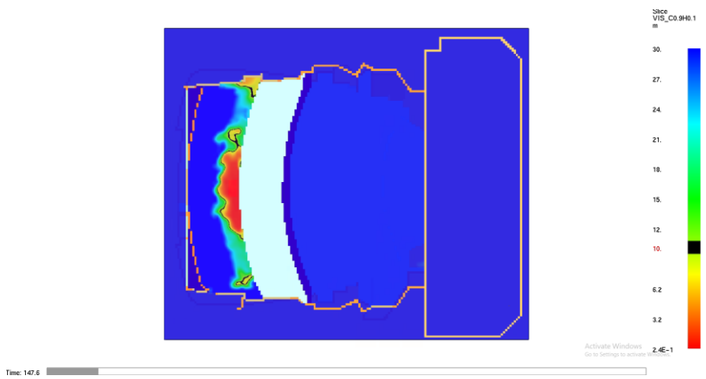
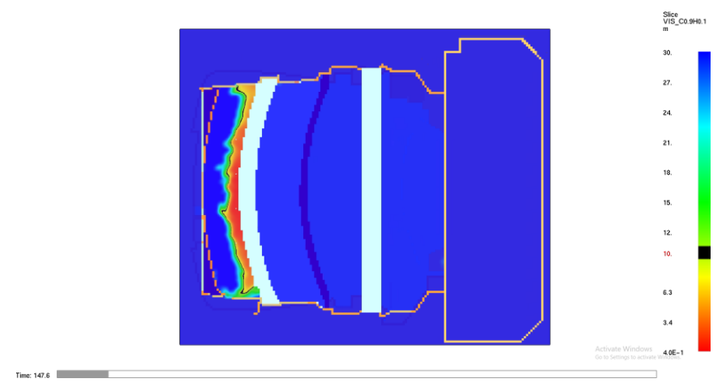
Fire Scenario 1 (Stalls)		
437 s	 **Figure 43 – Vertical slice at Y = 14.5 m**  **Figure 44 – Horizontal slice at Z = 2.5 m** • Slices are taken at 437 s for Available Safe Egress Time (ASET) to account for the Required Safe Egress Time (RSET) x 1.5 safety factor • Tenability is largely equivalent to the 300 second time step; hence steady state has been reached and conditions can now be maintained indefinitely at this level.	 **Figure 45 – Pathfinder results at 437 s** • 1695 / 1700 occupants evacuated • Five (5) occupants are stuck and can't evacuate. This shall be resolved in the FEBQ/FER stage

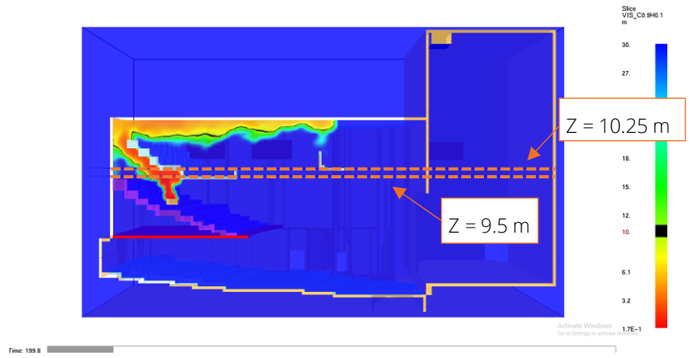
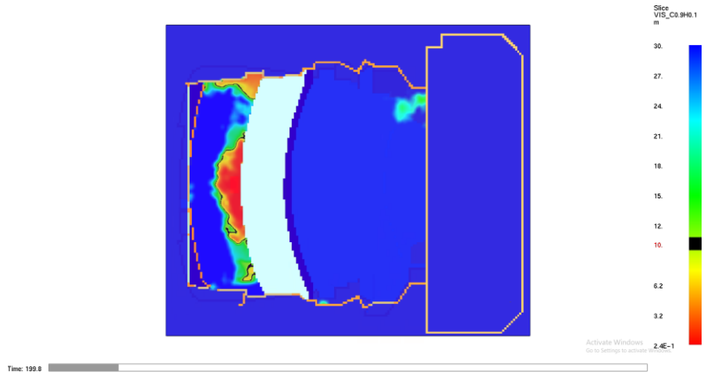
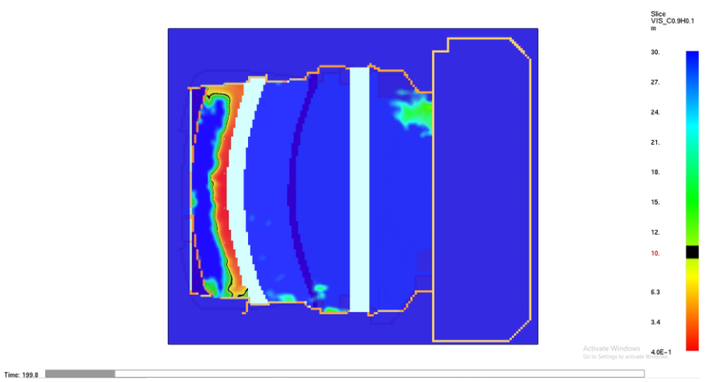
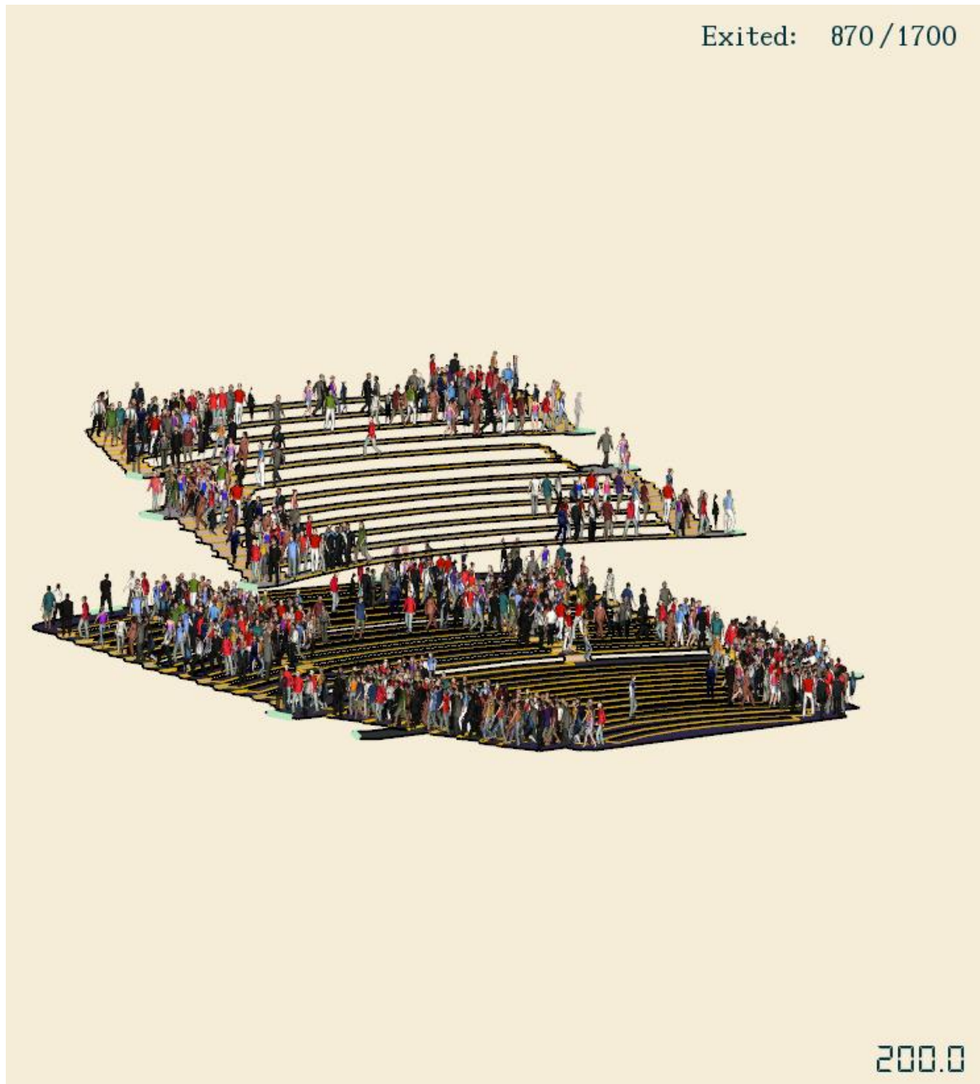
Scenario #2

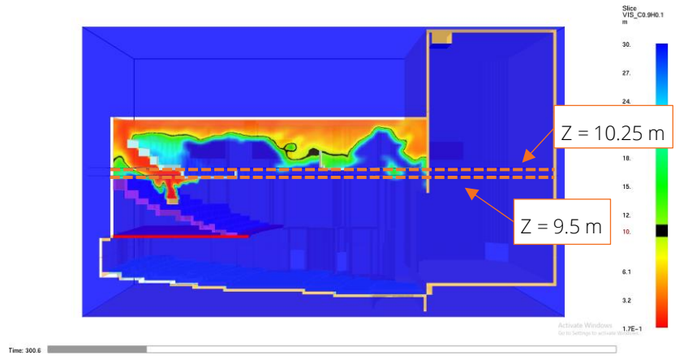
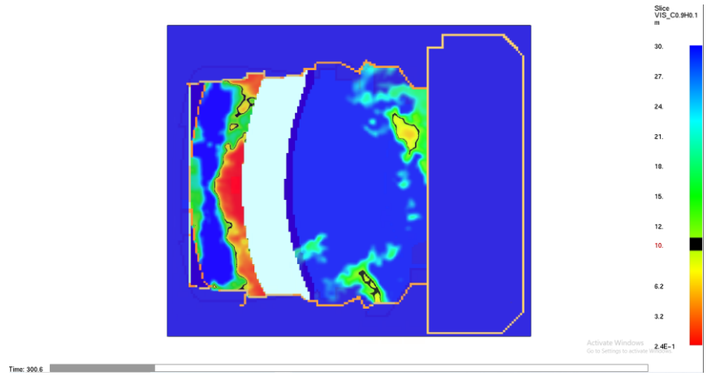
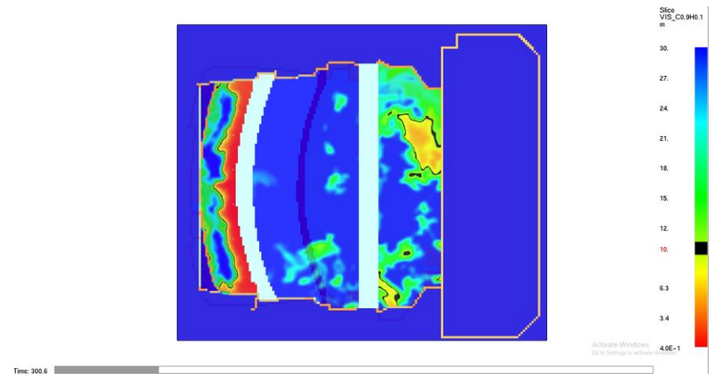
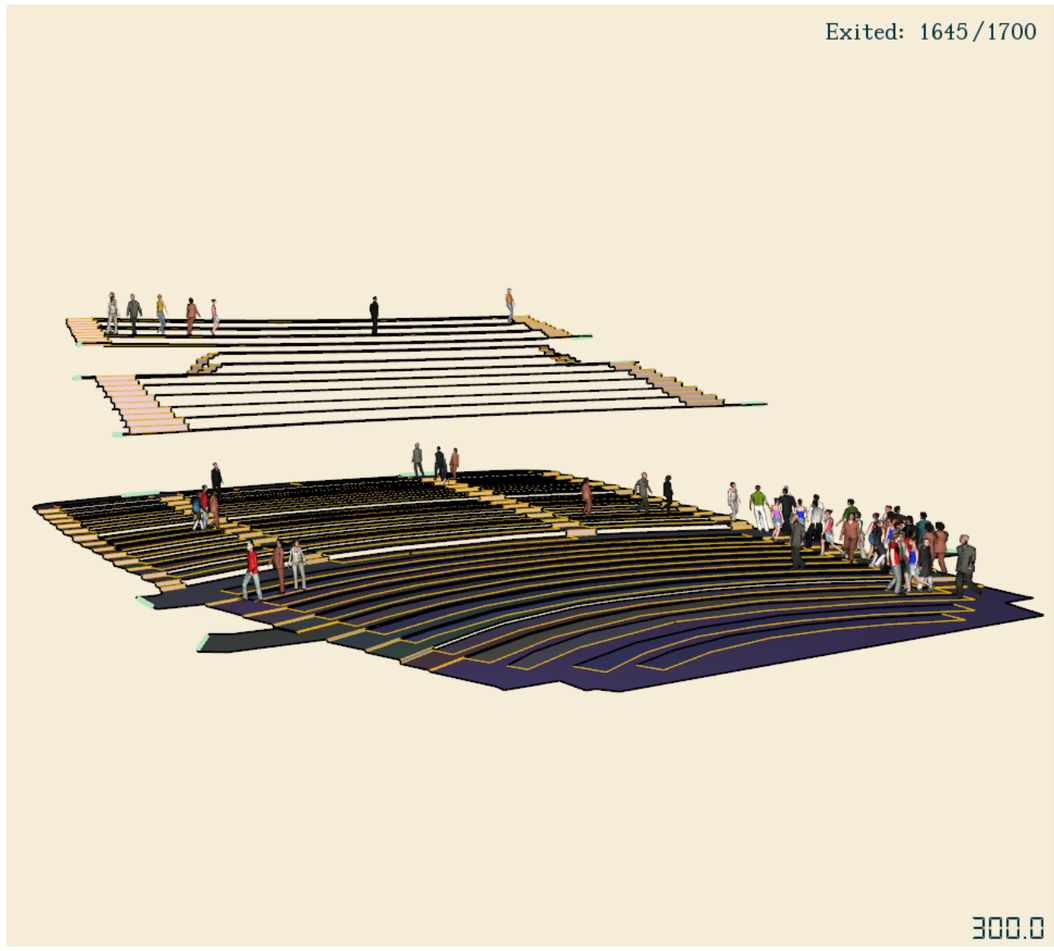
Table 19 –Preliminary CFD and Pathfinder Results for Fire Scenario 2

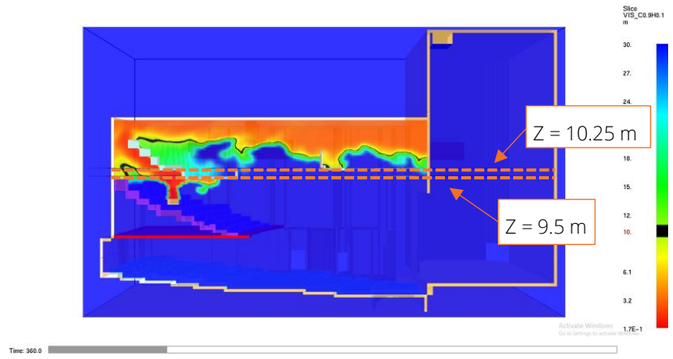
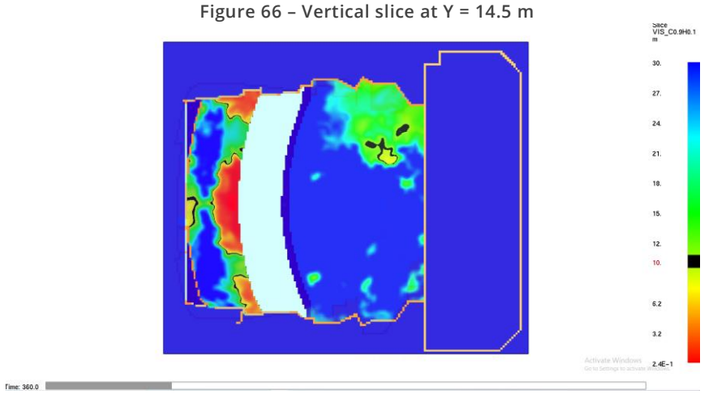
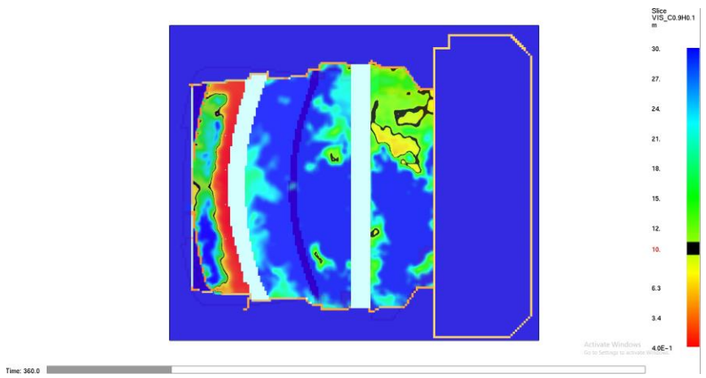
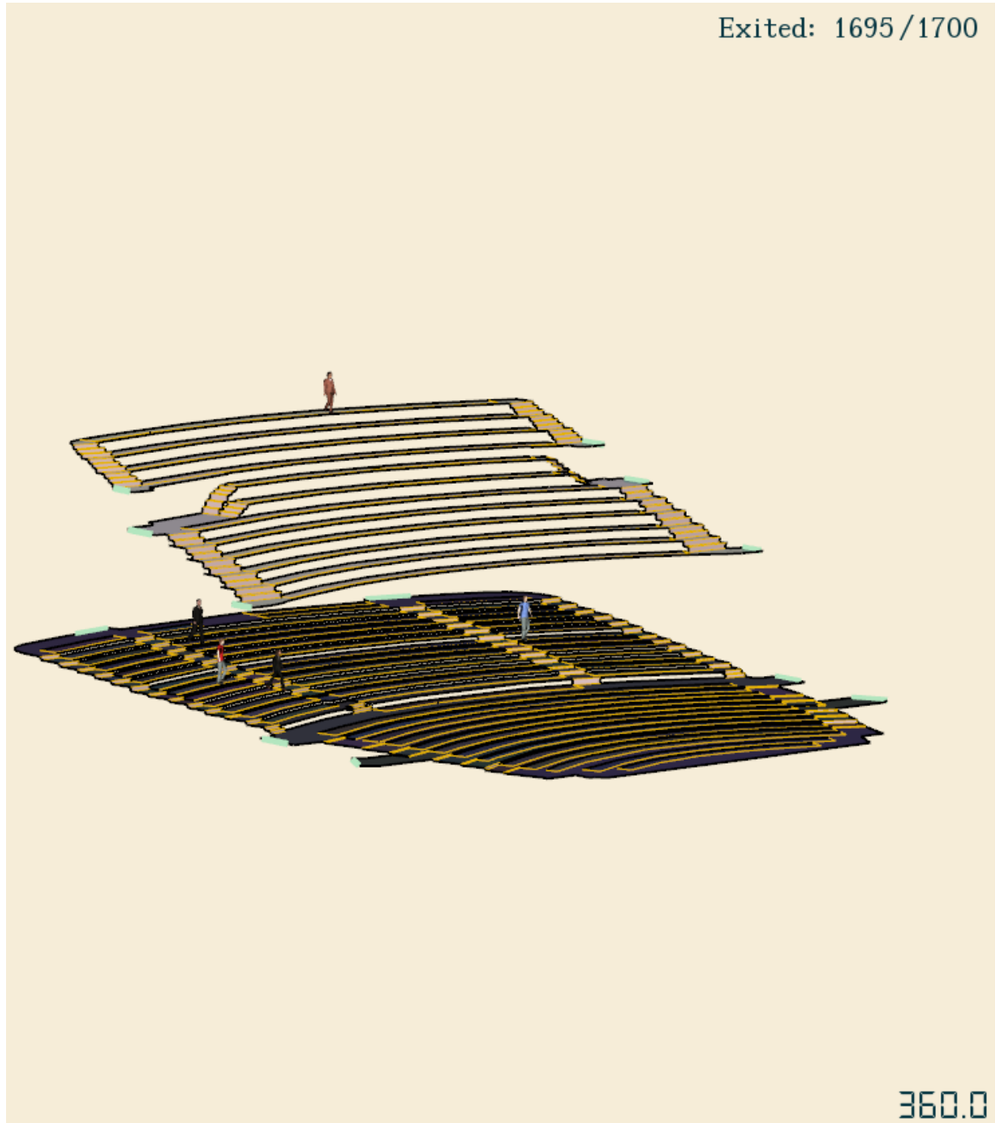
Fire Scenario 2 (Dress Circle)		
Time (s)	CFD Results	Pathfinder Results
0 s	 **Figure 46 – Vertical slice at Y = 14.5 m**  **Figure 47 – Horizontal slice at Z = 9.5 m**  **Figure 48 – Horizontal slice at Z = 10.25 m**	 **Figure 49 – Pathfinder results at 0 s**

Fire Scenario 2 (Dress Circle)		
	• Note that a gap has been left within the sloping ceiling at the back (south) end of the room to enable smoke to vent to the exhaust system above	
88 s		
	Figure 50 – Vertical slice at Y = 14.5 m	**Figure 53 – Pathfinder results at 88 s**
		• Smoke alarm activates at 88 s to notify occupants of a fire
	Figure 51 – Horizontal slice at Z = 9.5 m	
	• Additional smoke exhaust points might be required above corners of the dress circle. Details shall be confirmed as the design develops.	
		
	Figure 52 – Horizontal slice at Z = 10.25 m	
	• Smoke detector and smoke exhaust activates at 88 s	

Fire Scenario 2 (Dress Circle)		
148 s	 **Figure 54 – Vertical slice at Y = 14.5 m**  **Figure 55 – Horizontal slice at Z = 9.5 m**  **Figure 56 – Horizontal slice at Z = 10.25 m** • Tenability maintained throughout at this time step.	 **Figure 57 – Pathfinder results at 148 s** • A 60 s pre-movement time is applied after the activation of smoke detectors at 88 s • Occupants start evacuating at 148 s

Fire Scenario 2 (Dress Circle)		
200 s	 **Figure 58 – Vertical slice at Y = 14.5 m**  **Figure 59 – Horizontal slice at Z = 9.5 m**  **Figure 60 – Horizontal slice at Z = 10.25 m** • Tenability maintained throughout at this time step.	 **Figure 61 – Pathfinder results at 200 s** • 870 /1700 occupants evacuated

Fire Scenario 2 (Dress Circle)		
300 s	 **Figure 62 – Vertical slice at Y = 14.5 m**  **Figure 63 – Horizontal slice at Z = 9.5 m**  **Figure 64 – Horizontal slice at Z = 10.25 m** • Tenability starting to degrade at rear of space (approximately 15 m visibility at this point).	 **Figure 65 – Pathfinder results at 300 s** • 1645 /1700 occupants evacuated

Fire Scenario 2 (Dress Circle)		
360 s	 **Figure 66 – Vertical slice at Y = 14.5 m**  **Figure 67 – Horizontal slice at Z = 9.5 m**  **Figure 68 – Horizontal slice at Z = 10.25 m**	 **Figure 69 – Pathfinder results at 360 s** • 1695 /1700 occupants evacuated • Five (5) occupants are stuck and can't evacuate. This shall be resolved in the FEBQ/FER stage • RSET shall be taken at 360 s for the preliminary stage

Fire Scenario 2 (Dress Circle)

540 s

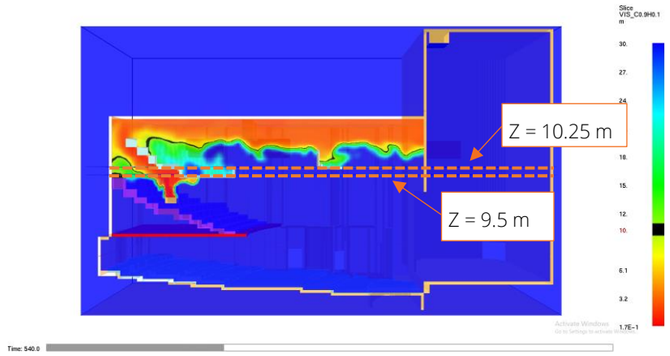


Figure 70 – Vertical slice at Y = 14.5 m

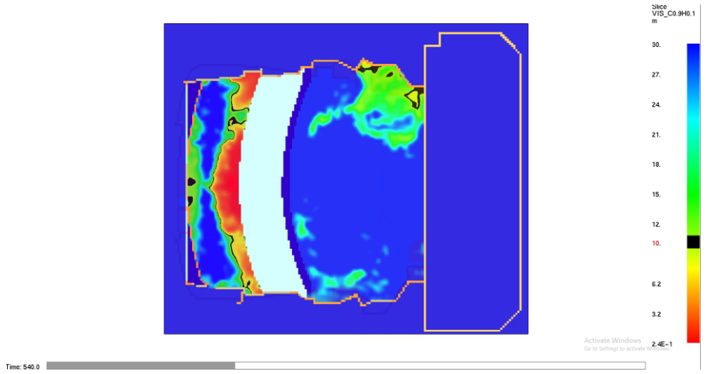


Figure 71 – Horizontal slice at Z = 9.5 m

- Slices are taken at 540 s for Available Safe Egress Time (ASET) to account for the Required Safe Egress Time (RSET) x 1.5 safety factor

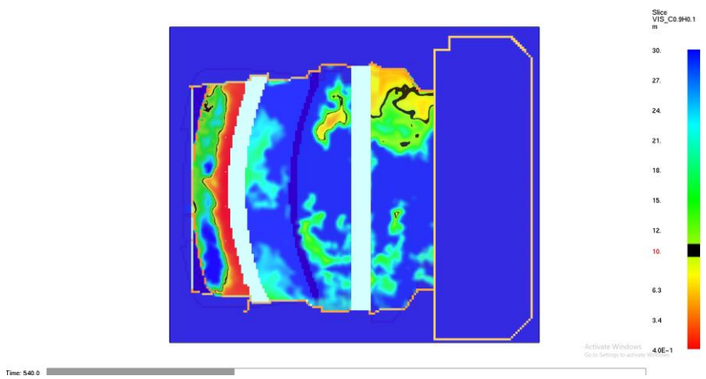


Figure 72 – Horizontal slice at Z = 10.25 m

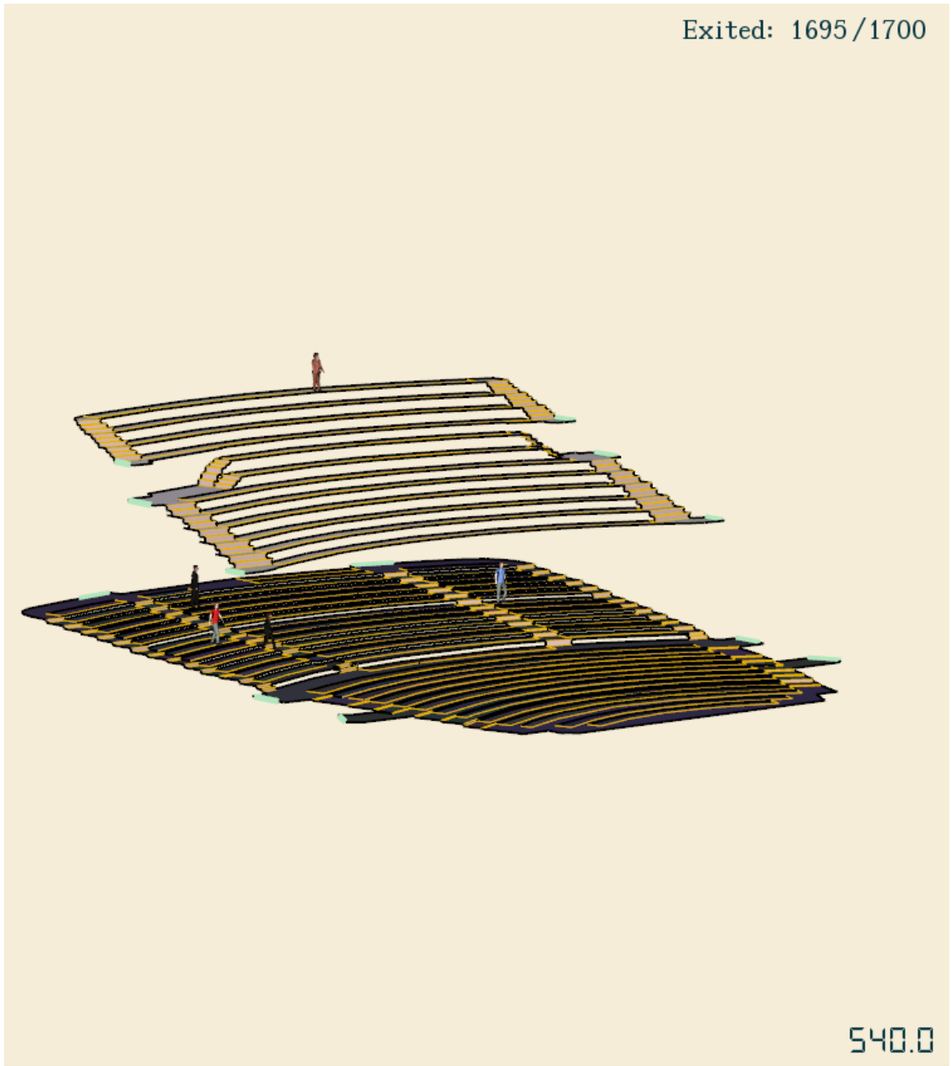


Figure 73 – Pathfinder results at 540 s

- 1695 / 1700 occupants evacuated
- Five (5) occupants are stuck – this shall be resolved in the FEBQ/ FER stage

Scenario #3

Table 20 –Preliminary CFD and Pathfinder Results for Fire Scenario 1 (Live Room)

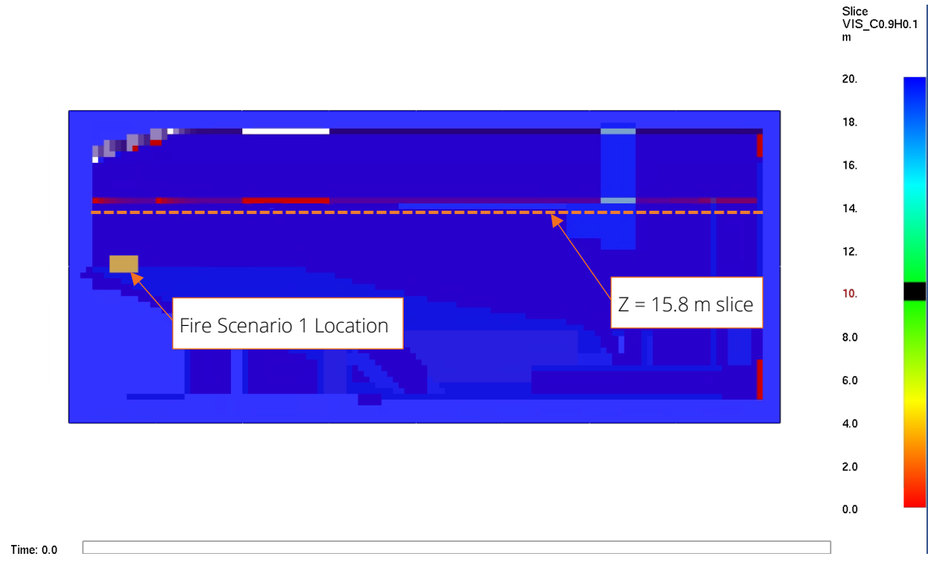
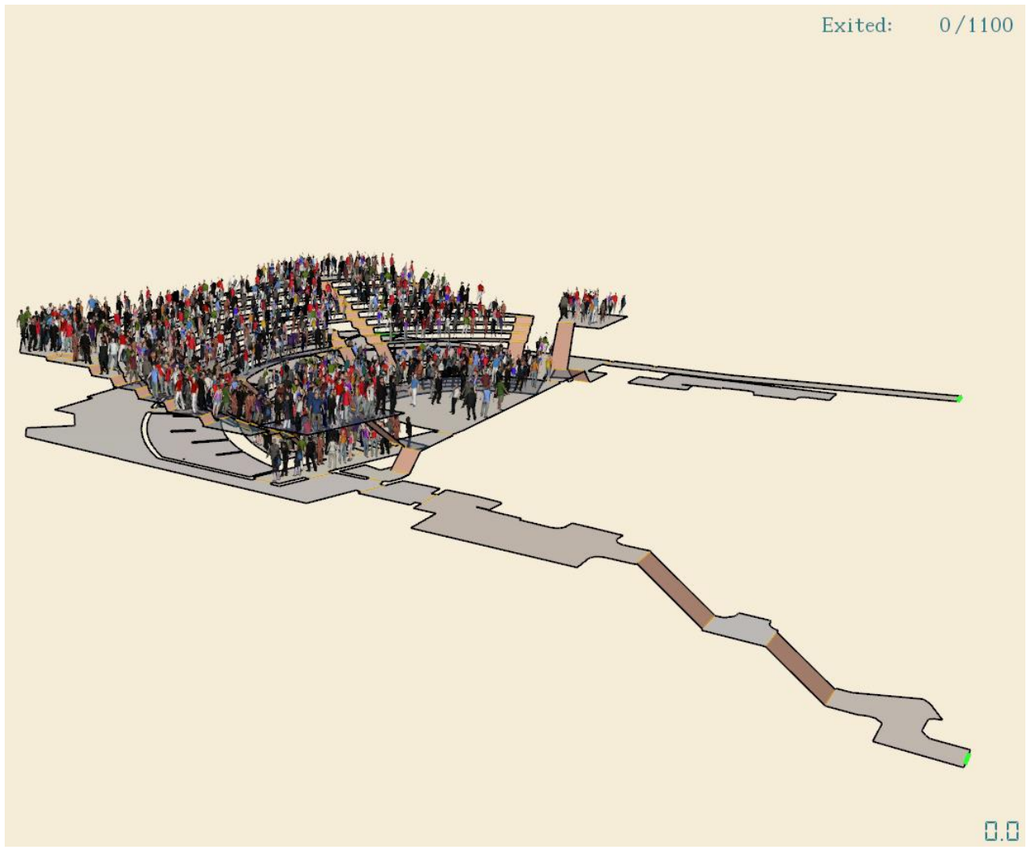
Fire Scenario 1 (Live Room)		
Time (s)	CFD Results	Pathfinder Results
0 s		

Figure 74 – Vertical slice at Y = 18.6 m

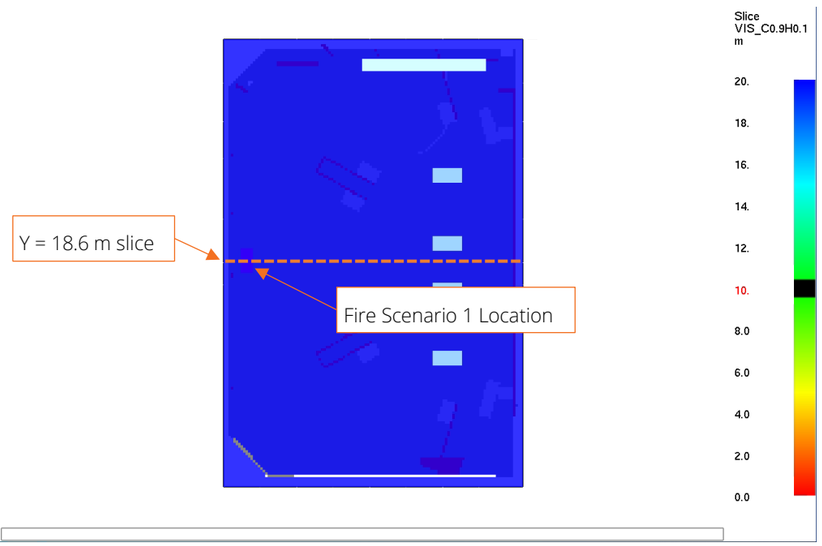


Figure 75 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

Figure 76 – Pathfinder results at 0 s

Fire Scenario 1 (Live Room)	
48 s	

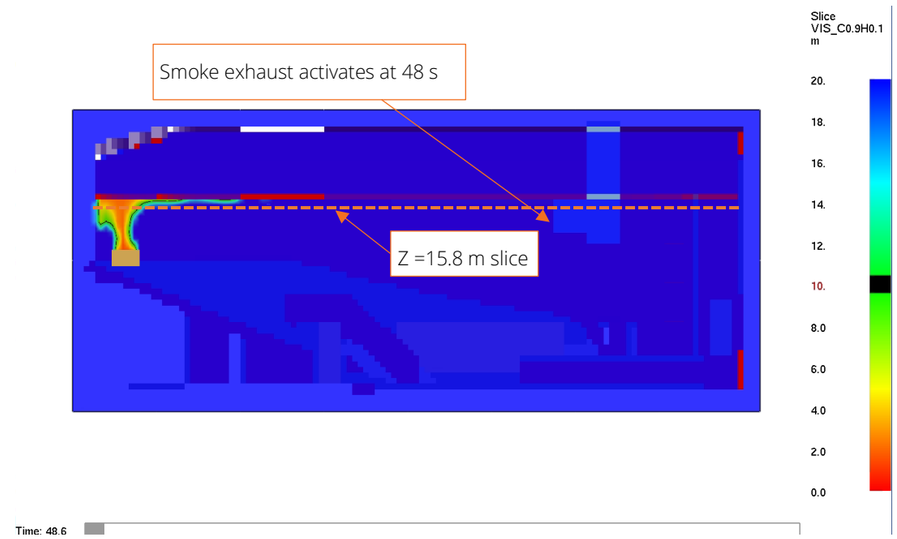


Figure 77 – Vertical slice at Y = 18.6m

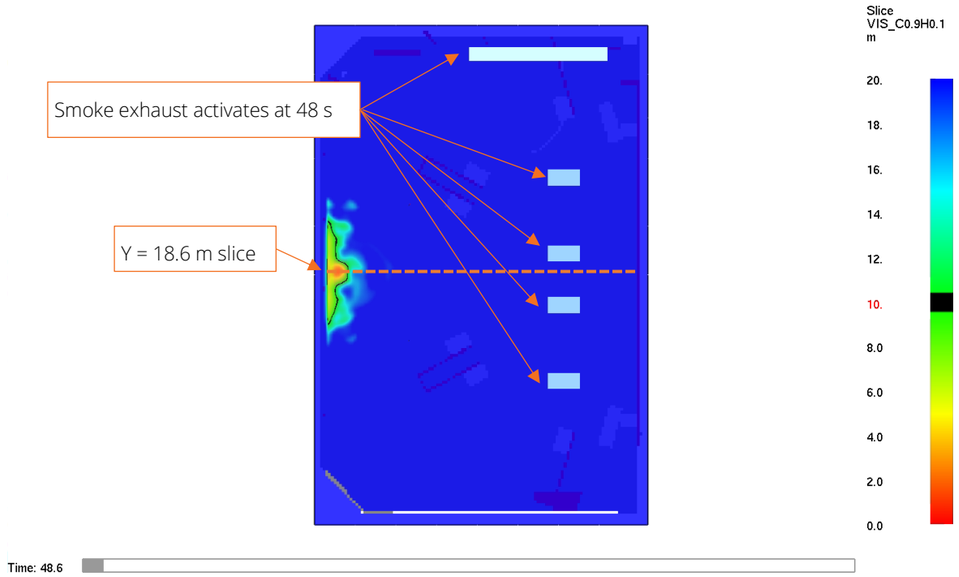


Figure 78 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

- Smoke detector and smoke exhaust activates at 48 s

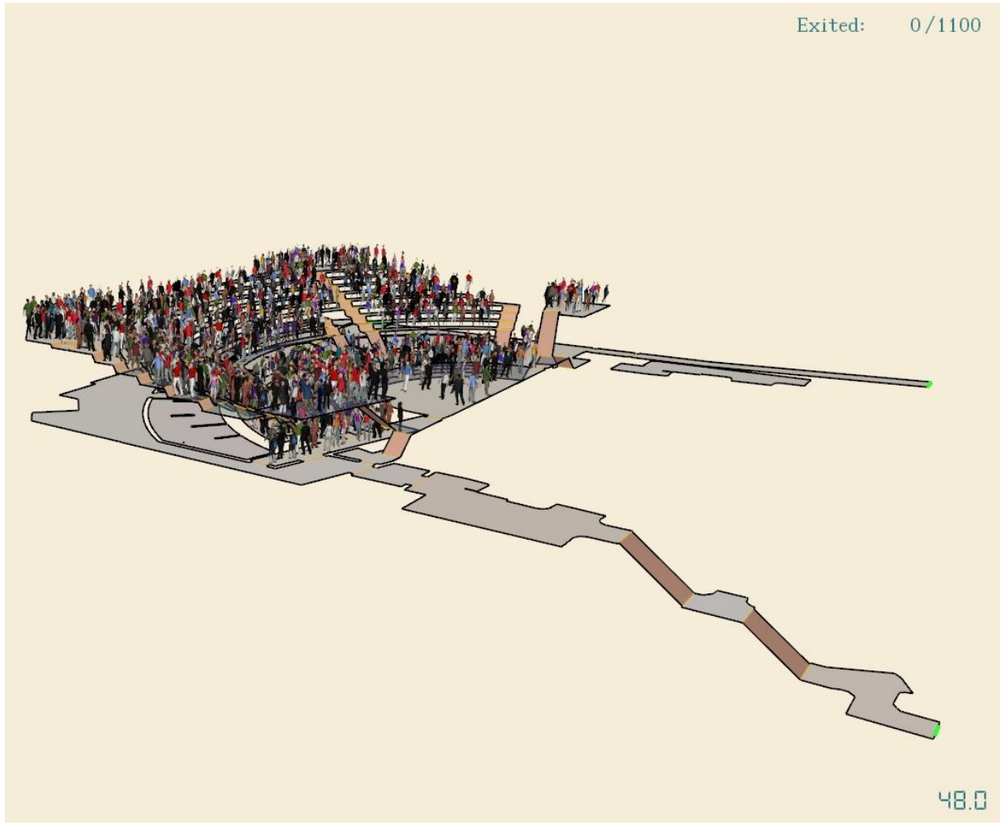


Figure 79 – Pathfinder results at 48 s

- Smoke alarm activates at 48 s to notify occupants of a fire. This is considered a conservative assumption as occupants would be expected to start evacuating through visual and olfactory clues much sooner than this if a fire were to occur in such proximity to their location.

Fire Scenario 1 (Live Room)

108 s

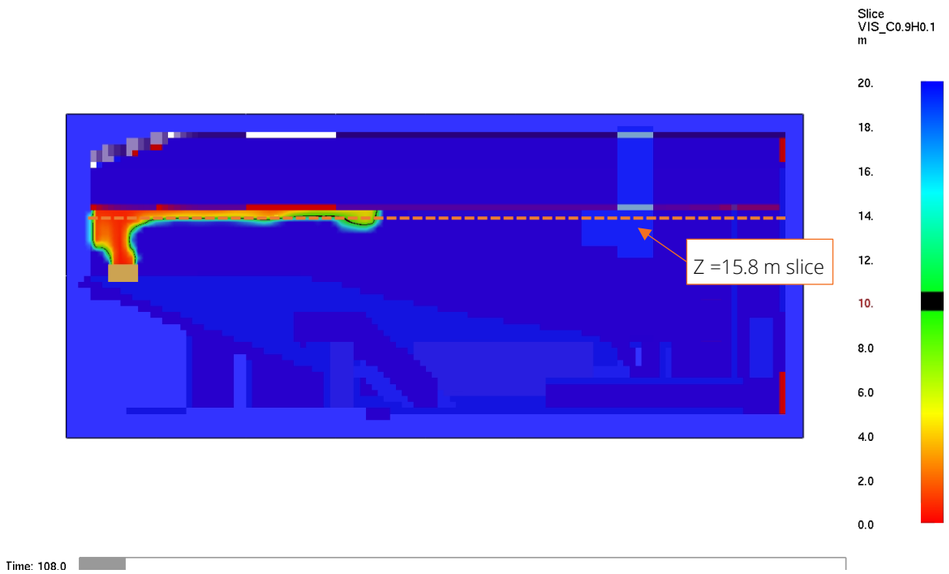


Figure 80 – Vertical slice at Y = 18.6 m

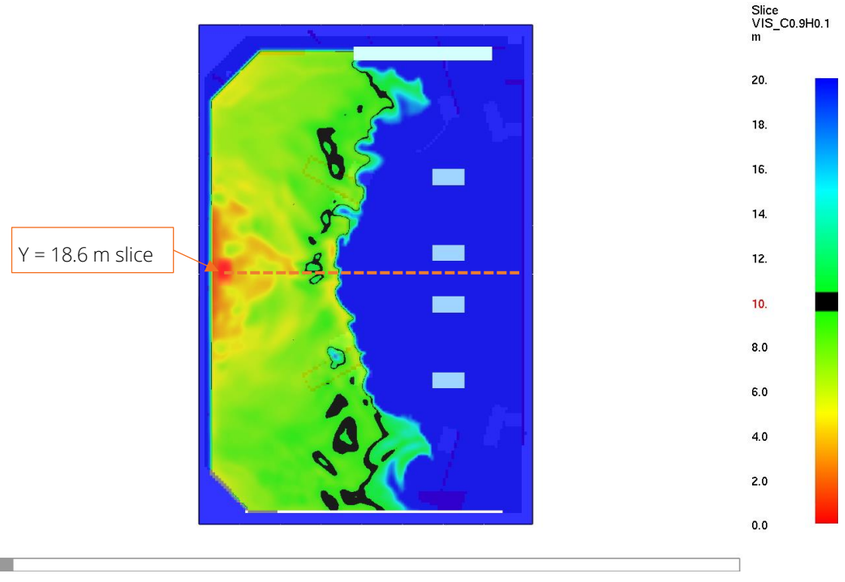


Figure 81 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

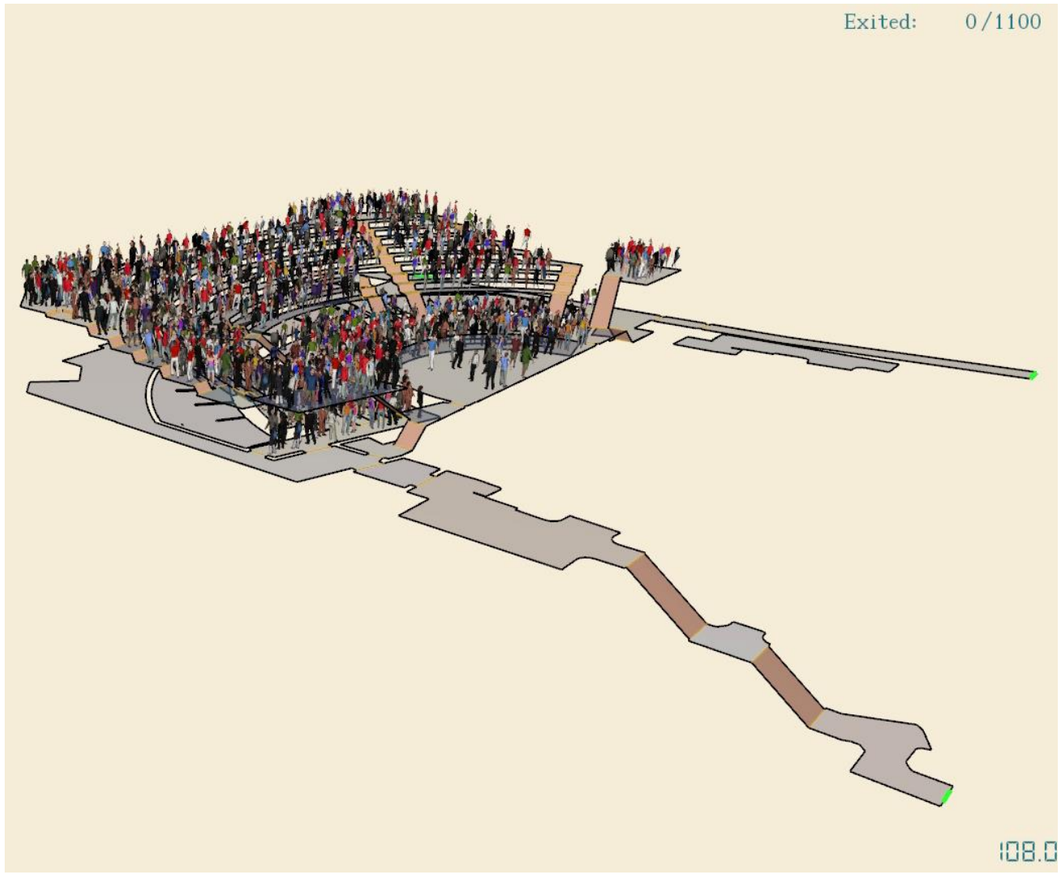
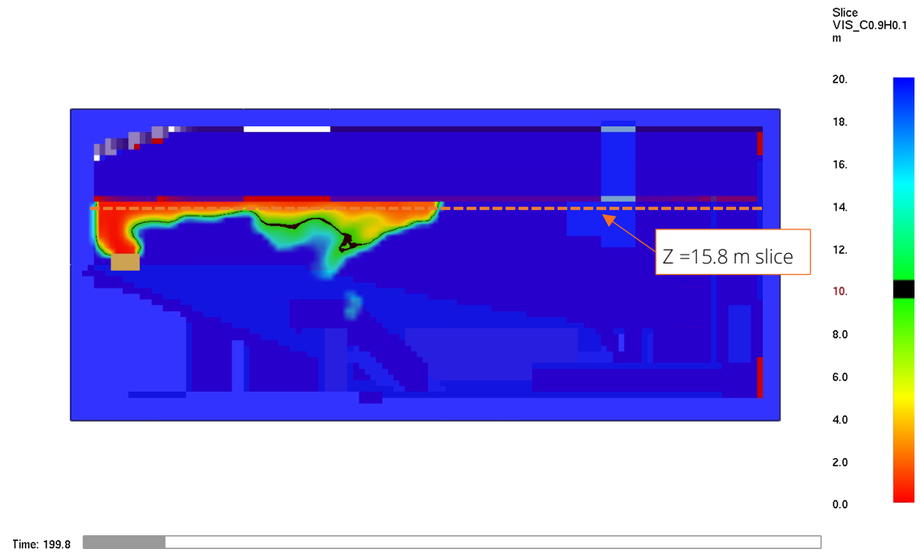
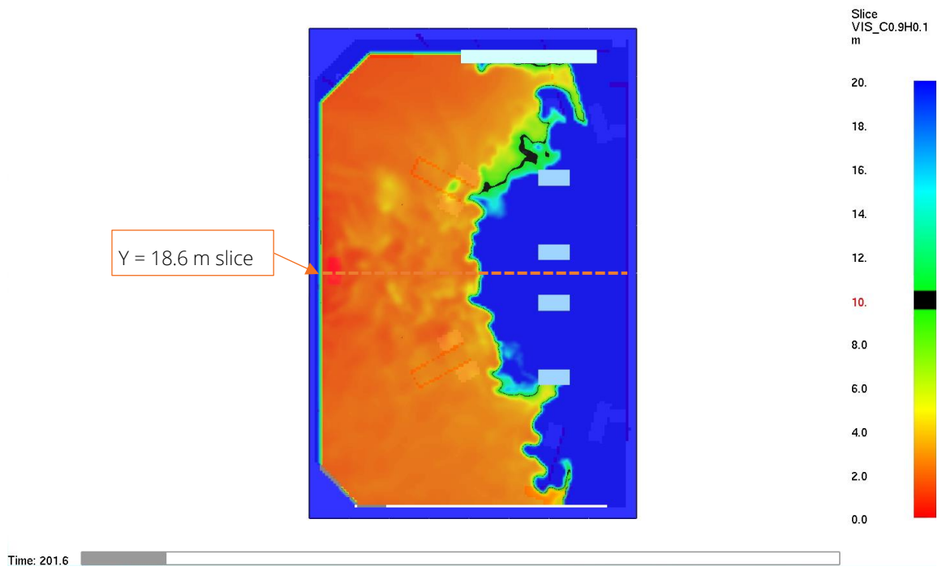
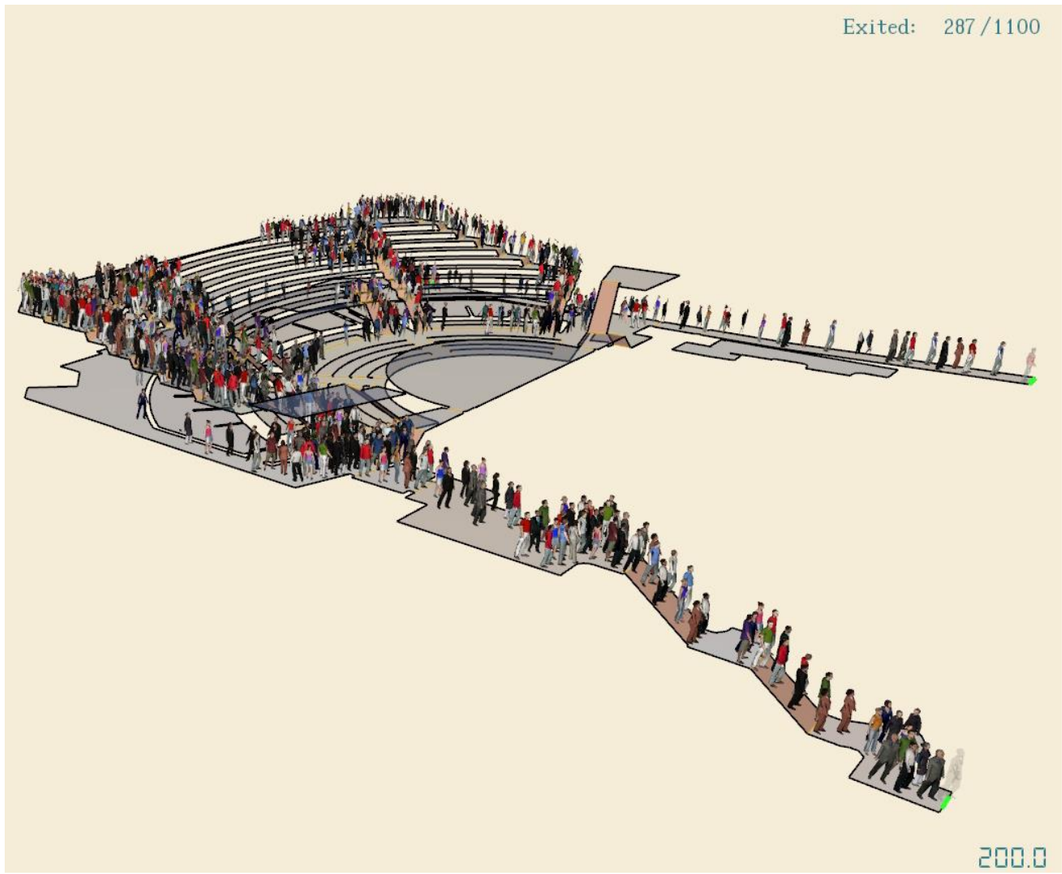
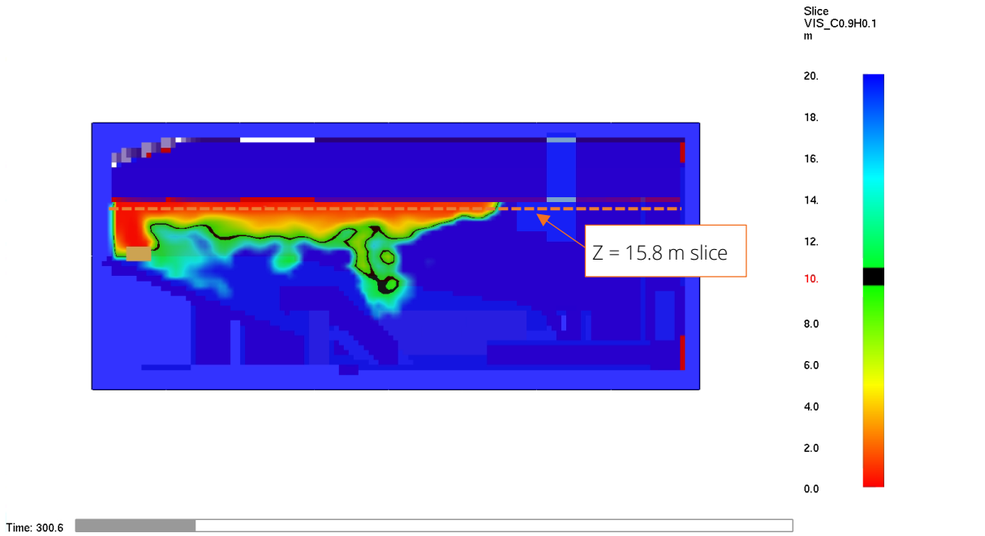
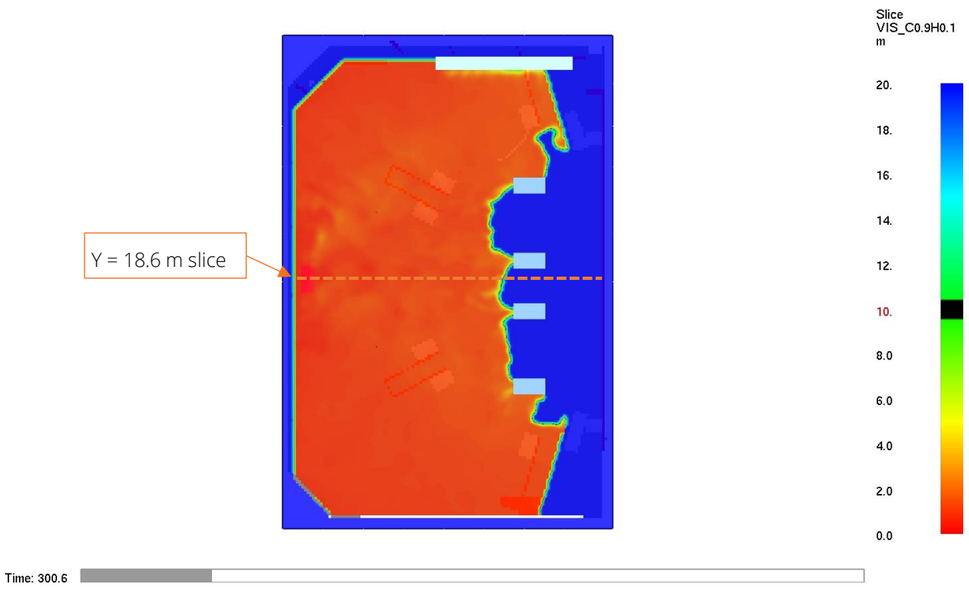
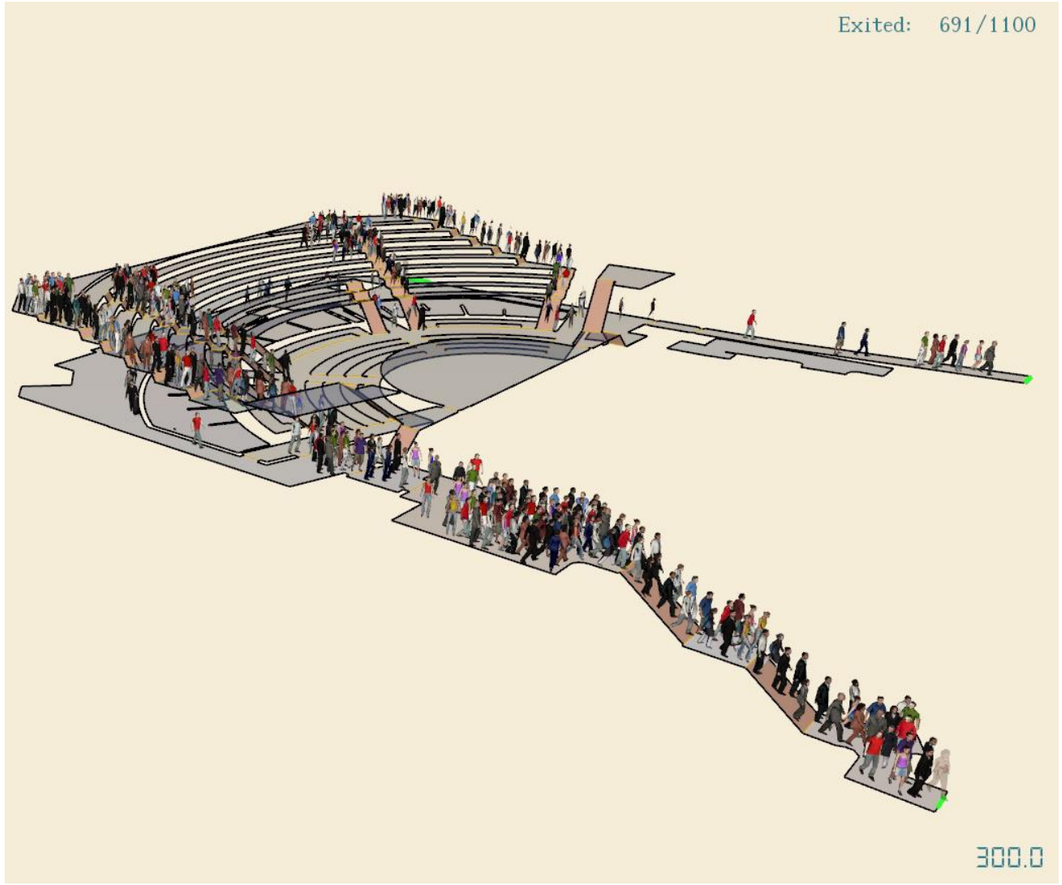


Figure 82 – Pathfinder results at 108 s

- A 60 s pre-movement time is applied after the activation of smoke detectors at 48 s. Again, this is a highly conservative assumption, as occupants would be expected to start evacuation as soon as they identified the fire.
- Occupants start evacuating at 108 s

Fire Scenario 1 (Live Room)		
200 s	 **Figure 83 – Vertical slice at Y = 18.6 m**  **Figure 84 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)**	 **Figure 85 – Pathfinder results at 200 s** • 287 /1100 occupants evacuated by this time step. • As can be seen, visibility at the uppermost levels of the seating has degraded to around 3 m by this point.

Fire Scenario 1 (Live Room)		
300 s	 **Figure 86 – Vertical slice at Y = 18.6 m**  **Figure 87 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)** • Tenability remains stable due to the smoke exhaust and is still acceptable for evacuation purposes.	 **Figure 88 – Pathfinder results at 300 s** • 691 / 1100 occupants evacuated • Last occupants on back rows start to move down the stairs. • Visibility on the back 2-3 rows has reduced to around 0 – 2 m by this point, meaning tenability has been lost prior to evacuation. Refer to conclusion notes in relation to this point.

397 s

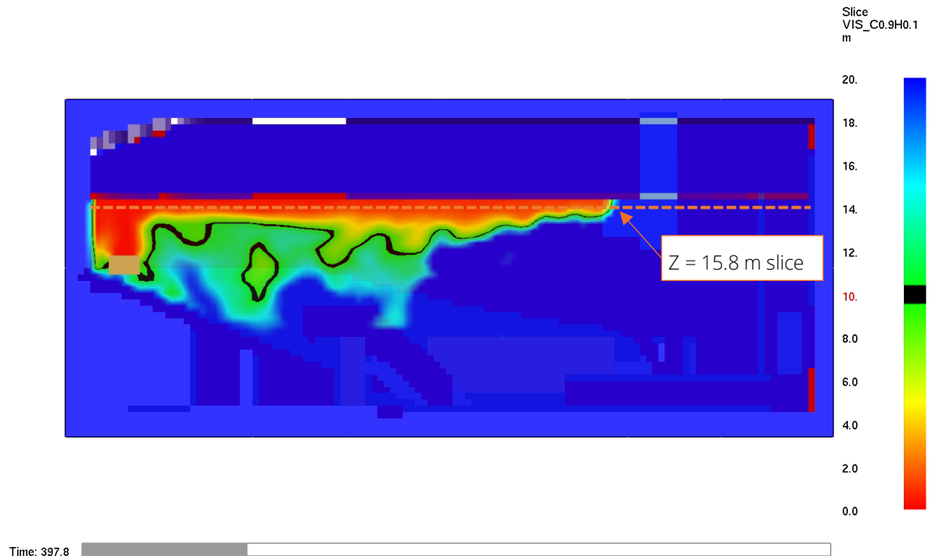


Figure 89 – Vertical slice at Y = 18.6 m

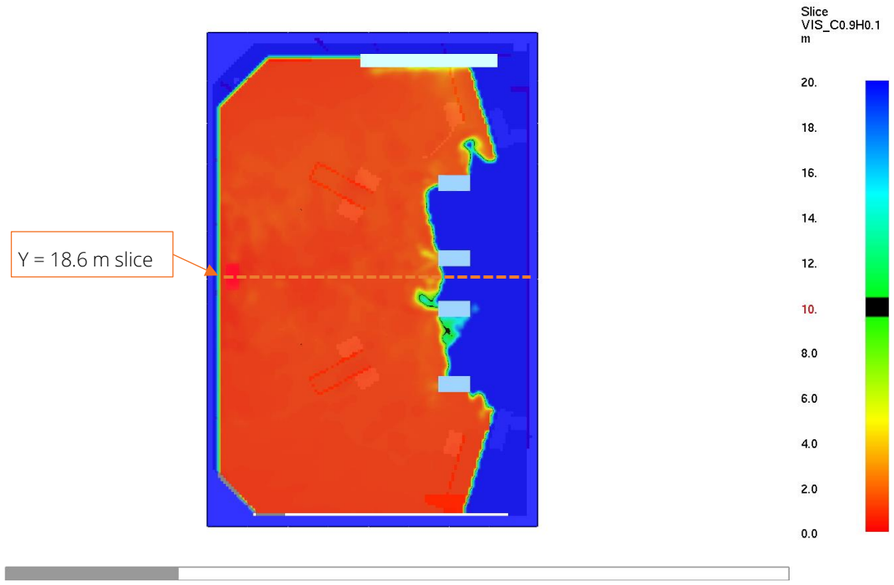


Figure 90 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

- Tenability remains stable due to the smoke exhaust and is still acceptable for evacuation purposes.

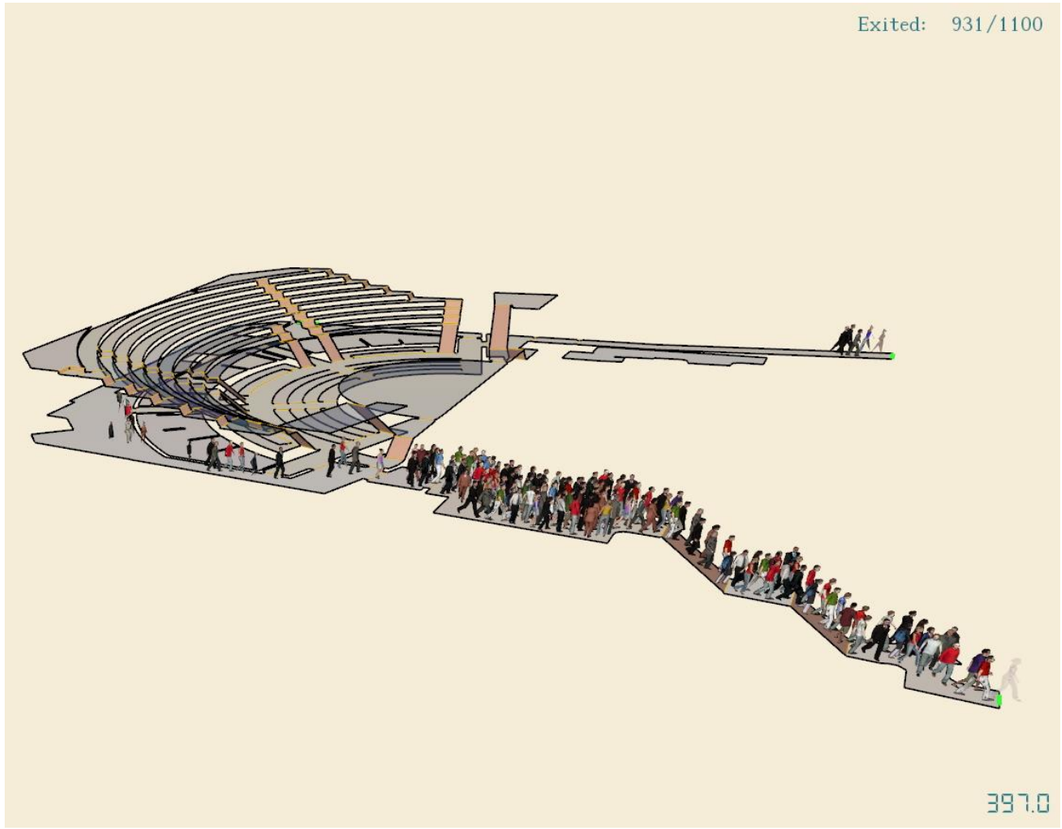


Figure 91 – Pathfinder results at 397 s

- 931 / 1100 occupants evacuated
- Occupants have exited the live room and have reached a relatively safe space, either through a smoke wall to the exit stairs, or to the corridor which takes them back to the entry foyer.

Fire Scenario 1 (Live Room)

425 s

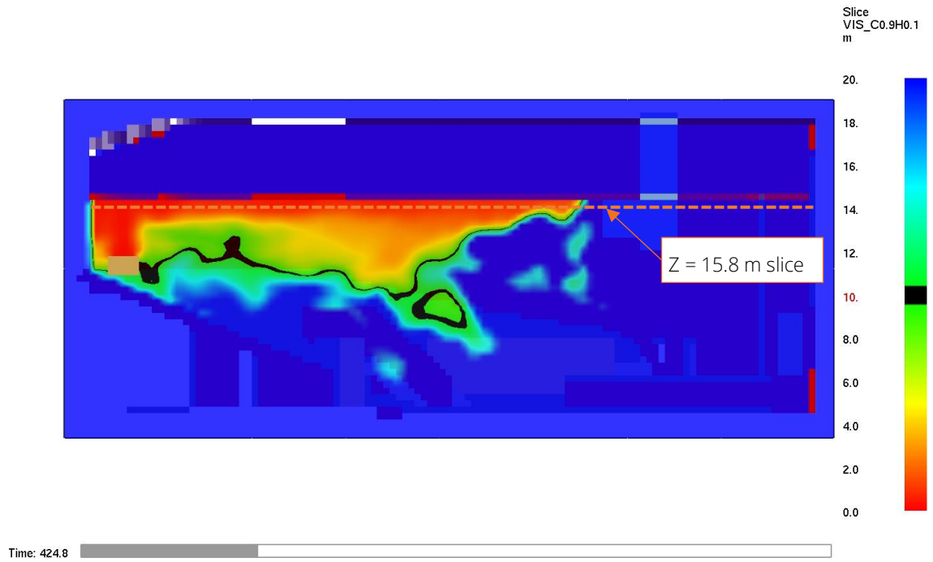


Figure 92 – Vertical slice at Y = 18.6 m

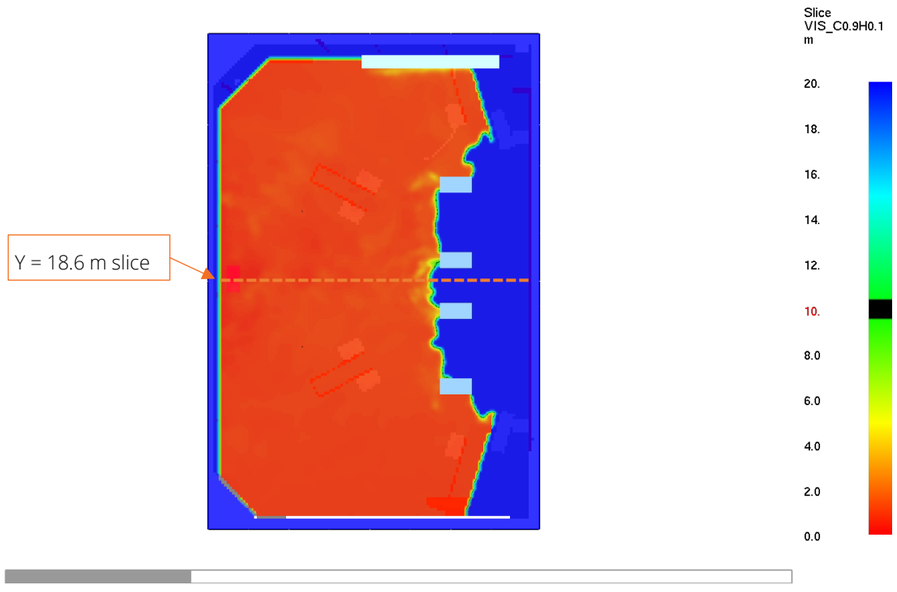


Figure 93 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

- Tenability slices are taken at 425 s when all occupants have evacuated from the live room fire compartment.

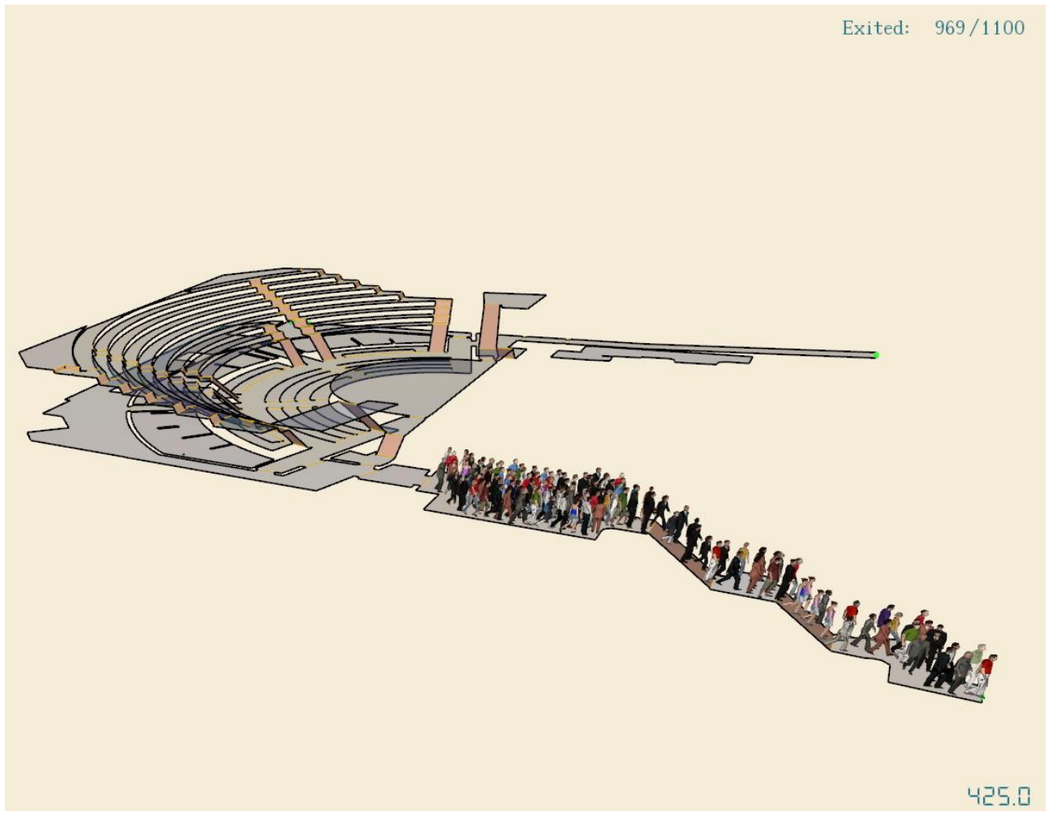


Figure 94 – Pathfinder results at 425 s

- 969 / 1110 occupants evacuated
- All occupants have evacuated from the live room fire compartment into a safe space

540 s

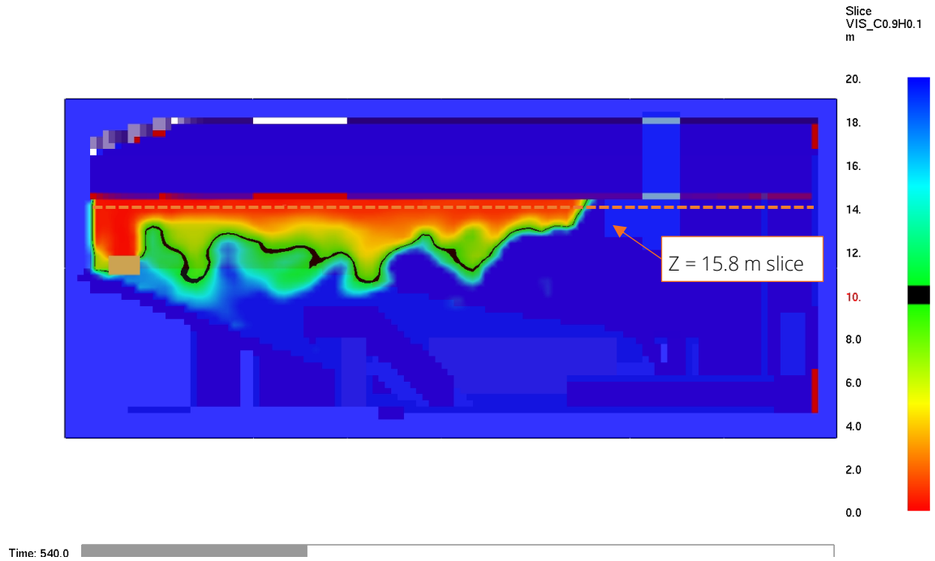


Figure 95 – Vertical slice at Y = 18.6 m

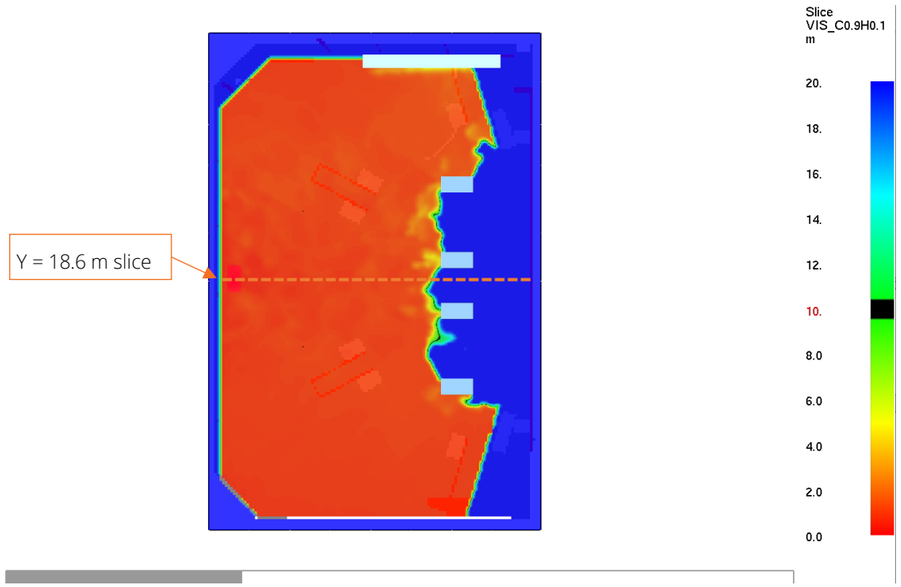


Figure 96 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

- Slices are taken at 540 s when all occupants have reached the final exit.
- Tenability is largely equivalent to the 425 second time step; hence steady state has been reached and conditions can now be maintained indefinitely at this level.

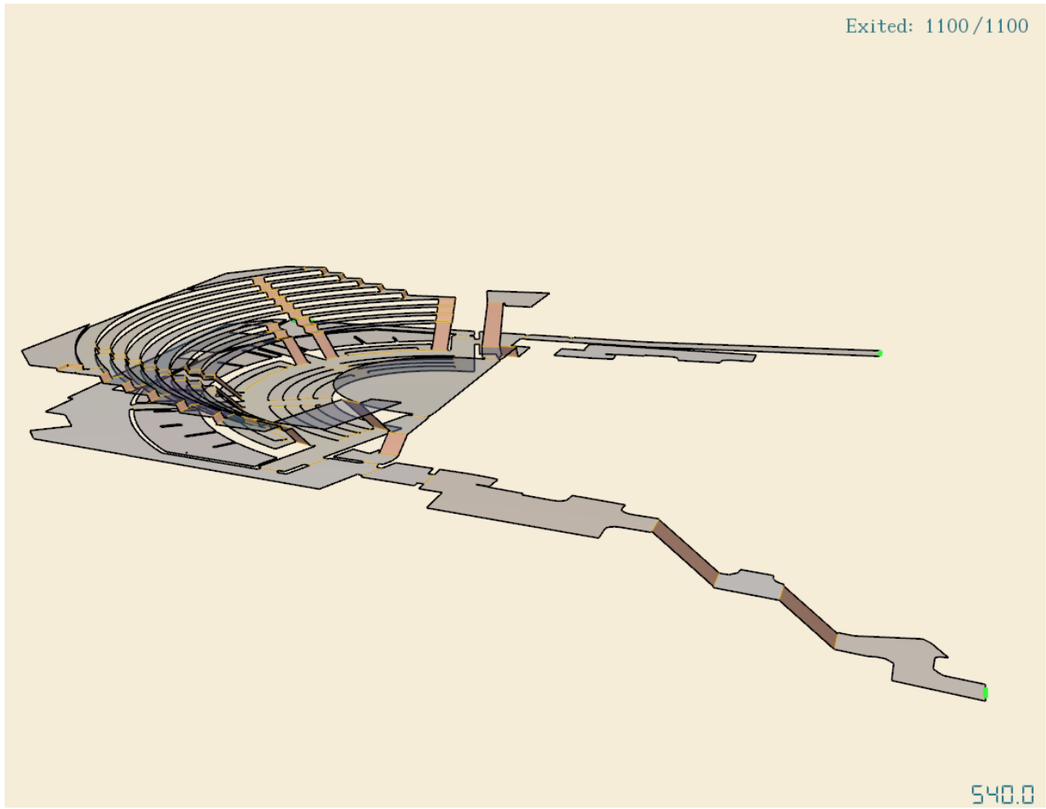


Figure 97 – Pathfinder results at 540 s

- 1100 / 1100 occupants evacuated
- All occupants have evacuated

Fire Scenario 1 (Live Room)

638 s

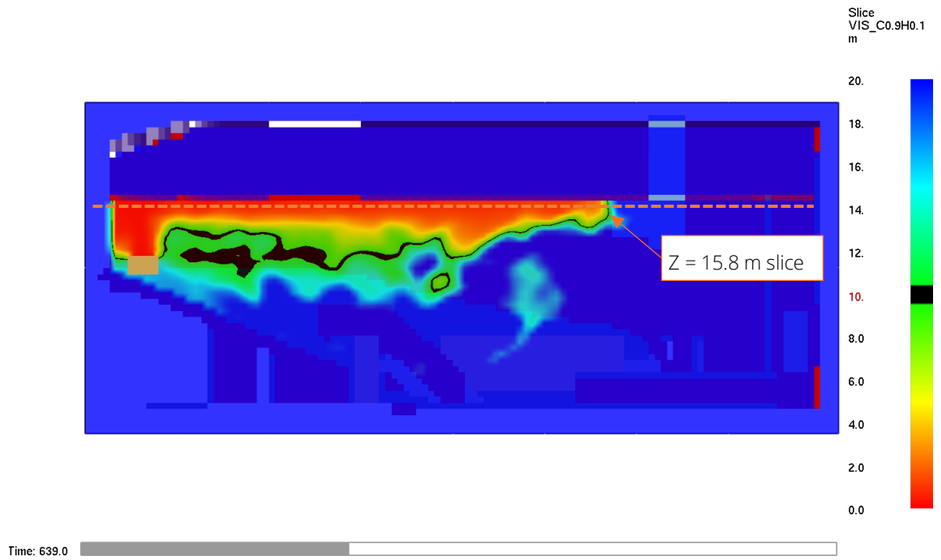


Figure 98 – Vertical slice at Y = 18.6 m

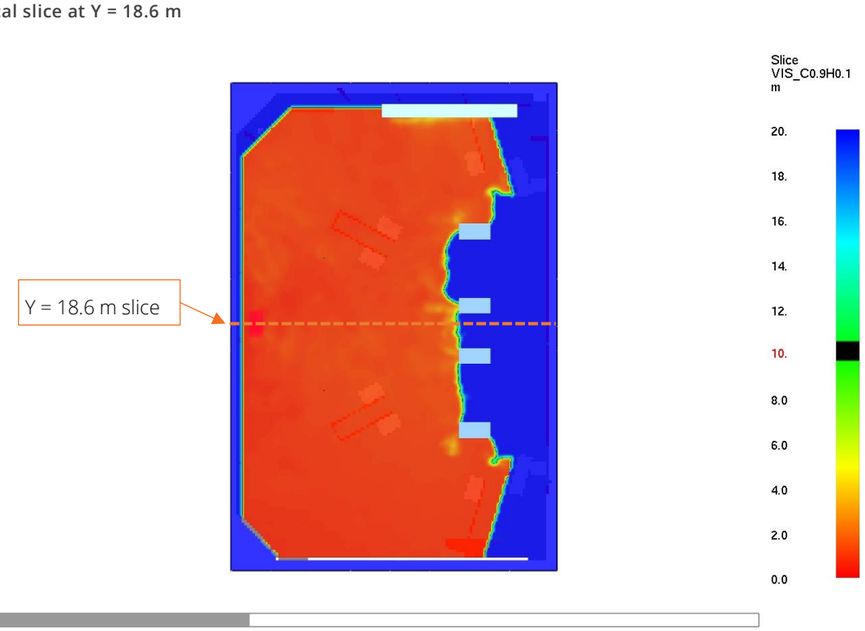


Figure 99 – Horizontal slice at Z = 15.8 m (1.6m slice above the fire)

- Slices are taken at 638 s for Available Safe Egress Time (ASET) to account for the Required Safe Egress Time (RSET) x 1.5 safety factor
- Tenability is largely equivalent to the 425 and 540 second time step; hence steady state has been reached and conditions can now be maintained indefinitely at this level.

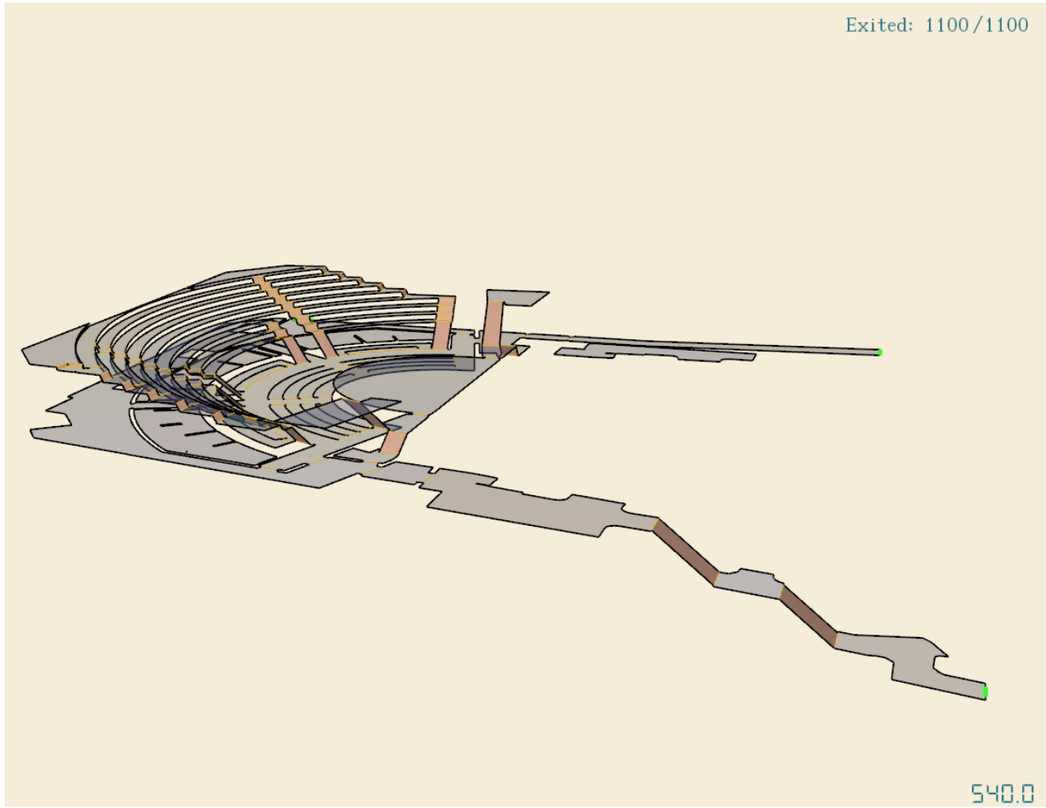


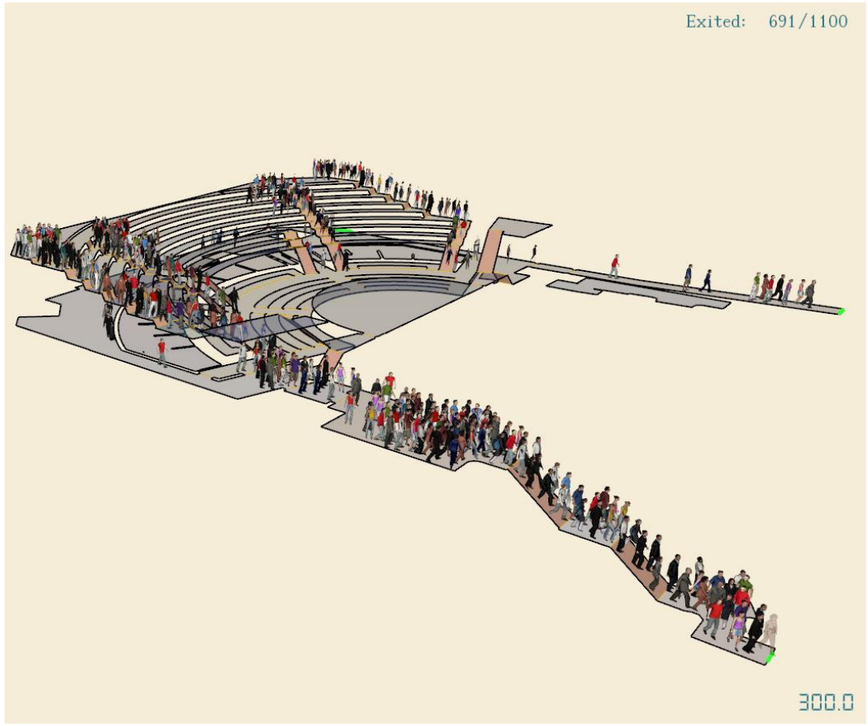
Figure 100 – Pathfinder results at 540 s

- 1100 / 1110 occupants evacuated
- All occupants have reached the final exit and evacuated

Conclusion

Auditorium

Based on the preliminary results obtained here for the auditorium, it is viewed that the currently proposed theatre design and smoke exhaust provisions (volumes and exhaust locations) will be able to be justified through fire engineering analysis. There are concerns that conditions on the back row(s) of the dress circle may become untenable depending on the fire's location and final ceiling design, but further analysis beyond what is included in this concept report has firmed up that area-specific exhaust being applied to this location can enable extended tenability in this space. This will be detailed further during the next phase of design.



Live Room

Tenability is not demonstrated as acceptable on the back rows of the live room from the results obtained here. It is clear that the existing smoke exhaust provisions to this room (which have been reused for this analysis) are not suitable in their current configuration as the back rows of the area drop below the acceptable visibility limits during our preliminary analysis. It is intended to provide ducted (slot) smoke exhaust along the back row of the venue to extend tenable conditions in the next phase of design.

It should also be noted that the evacuation times within this assessment included a 108 second detection and pre-movement time. Given the location of the fire is within the seating area, it would be expected that occupants would start moving almost immediately if they considered themselves at risk from a fire in close proximity. With ~108 seconds removed from the smoke modelling results, it can be seen that visibility is around 3-4 m when the last occupants move down off the back row (as demonstrated as the following two snapshots).

The design for the live room has changed considerably since this initial test analysis was conducted, hence we are comfortable that with dedicated supply air coming from the back of the room, tenability can be maintained on the back rows for much longer periods than is shown in this report. This will be documented further at the next phase of design.