Infrastructure NSW

Walsh Bay Arts Precinct

Fire Engineering Report for SSDA

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Job number 248853-00

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Executive Summary

Arup has been engaged by Infrastructure NSW (INSW) to develop the fire safety engineering design for the Walsh Bay Arts Precinct. The precinct works covers two separate buildings; Wharf 4/5 (excluding the Sydney Theatre Company) and Pier 2/3.

This report has been produced in response to the Secretary's Environmental Assessment Requirements (SEARs) Application Number SSD 7689 (No18 Fire Engineering Report) on behalf of Infrastructure NSW and ArtsNSW in support of the State Significant Development (SSD) Application.

1 Introduction

This report describes the fire safety strategy for the proposed refurbishment of Pier 2/3 and Wharf 4/5 at Walsh Bay for Infrastructure NSW. The fire strategy has been developed using a combination of performance based fire engineering and Deemed-to-Satisfy (DtS) Provisions as set out in the Building Code of Australia (BCA) 2016.

This fire strategy does not address the internal Sydney Theatre Company (STC) spaces specifically but does acknowledge where these works may have an impact on or be impacted by this tenancy of Wharf 4/5. Arup are providing fire safety engineering services on the STC fire strategy design and the two strategies will be developed to avoid any adverse impact on each other.

The purpose of this report is to outline the strategic concept fire safety strategy for support of the Stage 1 State Significant Development (SSD) application. It is intended to demonstrate how the design is capable of satisfying the Performance Requirements of the BCA and the measures to be provided as part of the design strategy.

Based on our review of the project documentation, it is considered that performance based fire engineering can be used to demonstrate compliance with the Performance Requirements of the BCA without major changes to the current building form.

The Performance Solutions will be documented with detailed supporting assessments in the Fire Engineering Report for the project Certification in subsequent design stages, in line with normal design and approvals process.

It is anticipated that other non-compliances with the Deemed to Satisfy Provisions of the BCA may be identified by the Certifier as the design is developed further, it is however considered that there are unlikely to be significant issues that would impact the overall fire strategy design approach.

2 Building characterisation

The Walsh Bay Arts Precinct involves the adaptive reuse of Pier 2/3 and partial refurbishment of Wharf 4/5. Pier 2/3 is the last remaining undeveloped wharf in Sydney. The precinct is to be activated for cultural, and creative purposes which will include event spaces and facilities for the Australian Chamber Orchestra (ACO), the Bell Shakespeare Company, The Australian Theatre for Young People (ATYP), Bangarra Dance Theatre, Sydney Dance Company and Philharmonia and Gondwana Choirs and The Song Company.

Pier 2/3 will consist of 4 floors (Ground, Mezzanine, Level 1 and Level 2).

Pier 2/3 is understood to be separated from Wharf 4/5 by a fire rated party wall located midway through the shore sheds.

The buildings are predominantly timber construction with exposed steel connections and steel beams. In some areas concrete topped floors are provided over the timber floors. The structural engineer (TTW) has investigated the inherent fire ratings and has concluded that the loadbearing elements (columns, beams and floors) will achieve an FRL of at least 1 hour.

The following key population numbers are understood to be included in the Pier 2/3 development:

- Ground floor function space – provisional number (based on 1350 function of 1300 + 50 staff)
- Level 1 function space 300 people
- Bell rehearsal spaces – 300 people (spread over both spaces)
- Australian Theatre for Young People (ATYP) Performance space – 200 people
- Australian Chamber Orchestra (ACO) Performance space – 300 people

Key areas are shown in the following figures:

Pier 2/3
Ground floor

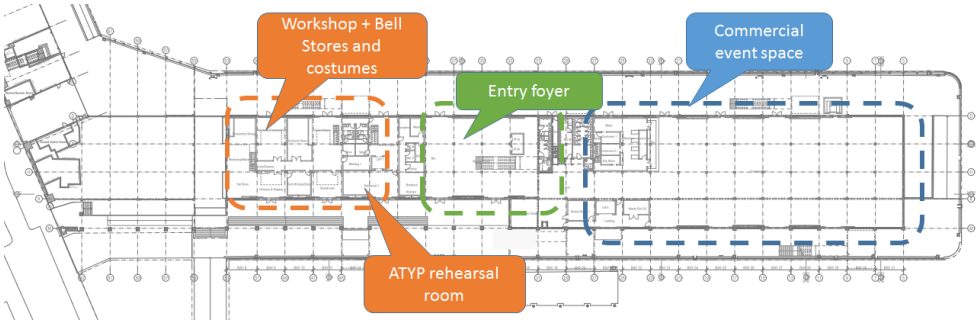


Figure 1: Pier 2/3 Ground floor

Pier 2/3
Mezzanine

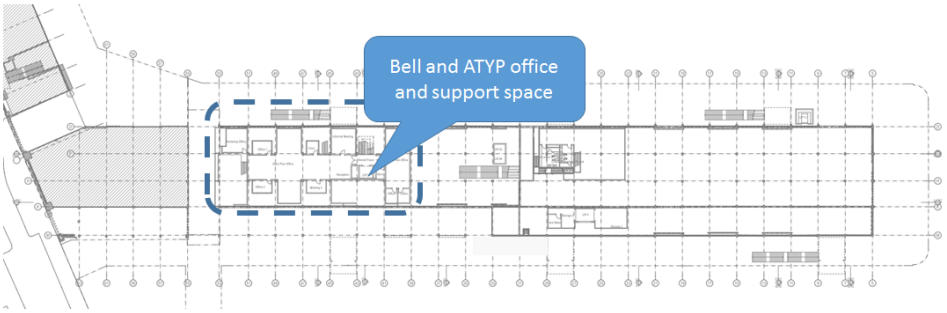


Figure 2: Pier 2/3 Mezzanine

Pier 2/3
Level 1

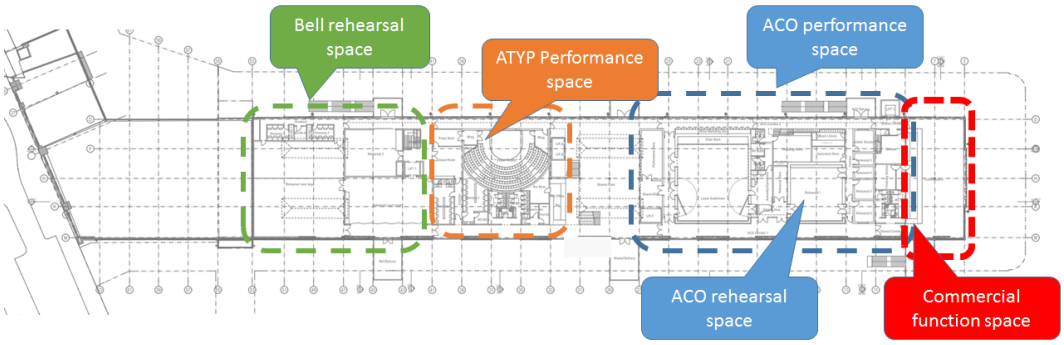


Figure 3: Pier 2/3 Level 1

Pier 2/3
Level 2

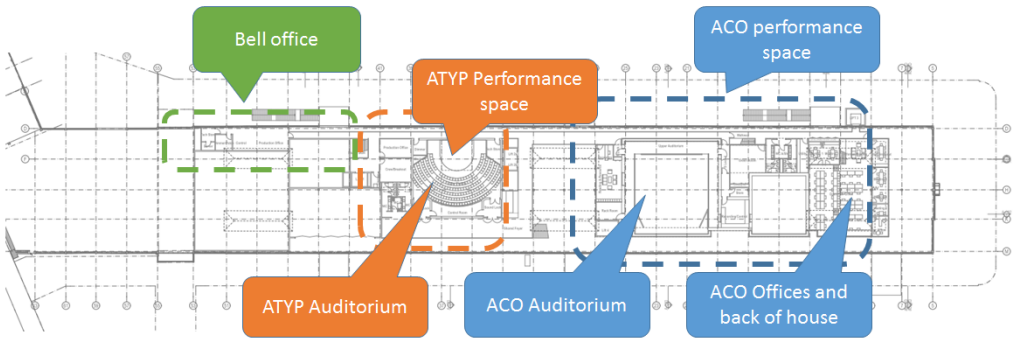


Figure 4: Pier 2/3 Level 2

Wharf 4/5

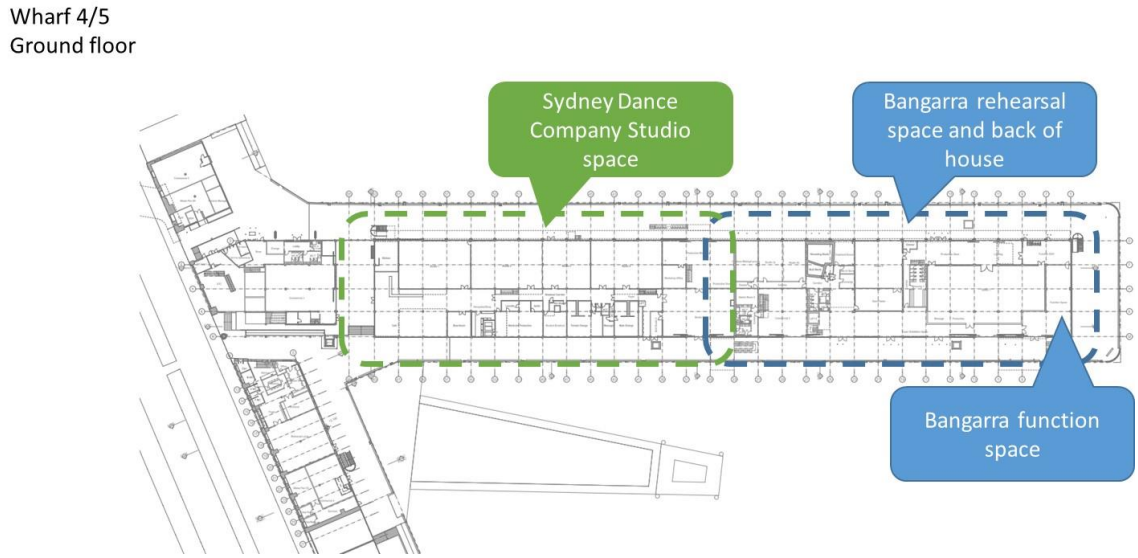


Figure 5: Wharf 4/5 - Ground floor

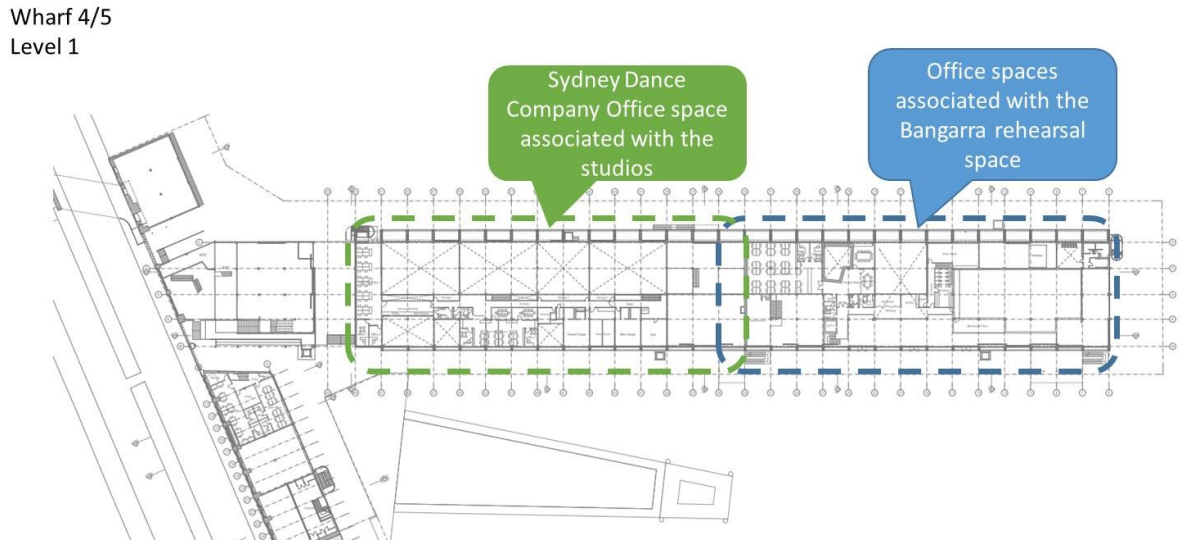


Figure 6: Wharf 4/5 Level 1

3 Proposed fire safety strategy

3.1 Design objectives

The fire safety strategy is to provide a design that gives a satisfactory level of occupant life safety and protection to other properties and can facilitate Fire and Rescue NSW (FRNSW) intervention, whilst meeting other project objectives, as described below. The building upgrade works are generally to be in accordance with the DtS Provisions of the BCA appropriate to the use of the building as a performance and cultural hub for Sydney, except as outlined in this report and in subsequent stages of the design.

There is an existing fire engineering report that relates to the shore shed and existing retail and commercial areas of Pier 2/3. The aim of this design is not to impact on this existing condition and maintain a level of appropriate fire separation so as not to impact on this existing strategy. Generally this requires a 60 minute fire rating.

The timber structure and proposed floor interconnections present a risk of fire and smoke spread through the building, thereby increasing the risk to occupants located both above the fire or remote from a fire. To address this, the general philosophy will be to minimise fire and smoke spread through the provision of sprinkler protection and compartmentation, in lieu of smoke exhaust due to the division of spaces which would make smoke exhaust impractical.

Compartmentation will be incorporated into the building while appreciating the historic nature of the building and architectural aspirations to leave much of the original structure as exposed as possible.

Detection and exits direct to the outside will help provide shorter evacuation times for the large occupant numbers in the buildings. Phased evacuation will be considered in conjunction with appropriate fire separation of levels and spaces to minimise required exit widths and crowding on the apron.

3.2 Structural fire resistance

Based on the DtS requirements of the BCA the building should have a Fire Resistance Level (FRL) of 120 mins. This is consistent across both Pier 2/3 and Wharf 4/5.

The building has an existing timber and steel structure that will be largely exposed. Therefore the DtS 120 min FRL is unachievable without significant upgrades to the building, which may be contrary to the architectural and heritage objectives, although essential for the new uses proposed for them. The structural engineer has confirmed that the loadbearing elements (columns, beams and floors) can achieve an FRL of at least 60 mins. Some steel members will require added protection in order to achieve this fire rating including steel “strong backs’ supporting floors.

The key requirement is to demonstrate that occupants have sufficient time to evacuate the building prior to structural failure, and that conditions are appropriate for safe brigade fire fighting operations.

3.3 Internal Compartmentation

3.3.1 General

The existing Pier 2/3 and Wharf 4/5 buildings are currently a single fire compartment. This causes a conflict with a number of aspects of the BCA DtS provisions particularly with regard to the maximum compartment size for a Class 9b assembly space.

The DtS provisions require a smoke exhaust system for a Class 9b compartment of over 2000m². The limitations of the existing building mean that this is difficult to achieve without detrimental impact on the historic fabric of the building. In addition, the division of spaces in the building mean that effective smoke exhaust would be difficult to achieve. Instead a compartmentation strategy is proposed that keeps the compartment sizes within the 2000m² limits, to minimise smoke and fire spread.

3.3.2 Pier 2/3

The proposed fire walls may have a number of penetrations, and this will generally be considered to be acceptable, with the aim of the strategy being to delay the spread of fire and smoke in the early stages of a fire allowing occupants more time to evacuate from the building.

The individual performance spaces will be fire isolated in order to contain a fire to the compartment of origin. This compartmentation will make use of the more onerous acoustic requirements of these spaces. The compartmentation of the performance spaces will aim to provide different compartments through which to egress, reducing the risk of a fire outside of the performance space preventing occupants from egressing out of the performance space.

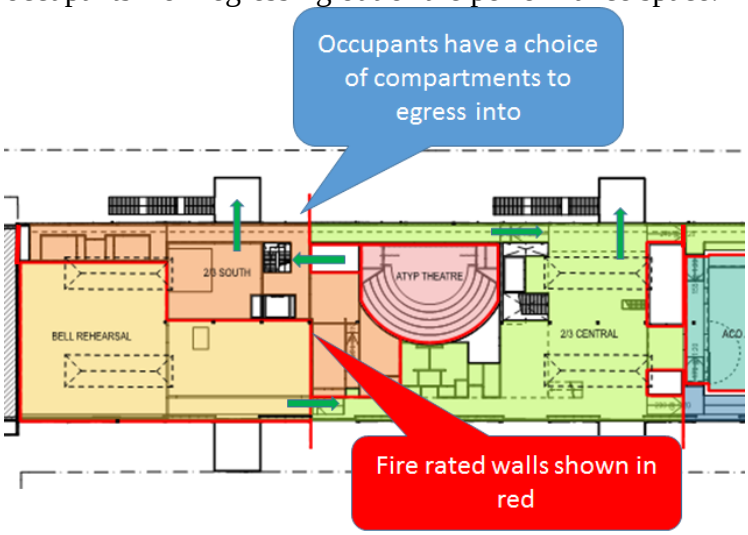


Figure 7: Egress options

The compartmentation required would only come into effect if the sprinklers were to fail which is considered unlikely. If they were to fail then the compartmentation would limit the fire to the area or compartment of fire origin.

The building has open stairs and lifts that effectively connect 4 storeys. This will need addressing via a Performance Solution. The general building design will be to move the fire effected compartment first as one. In that way the connected floors becomes less of an issue as occupants can move horizontally.

The proposed compartmentation strategy is outlined below in the following figures:

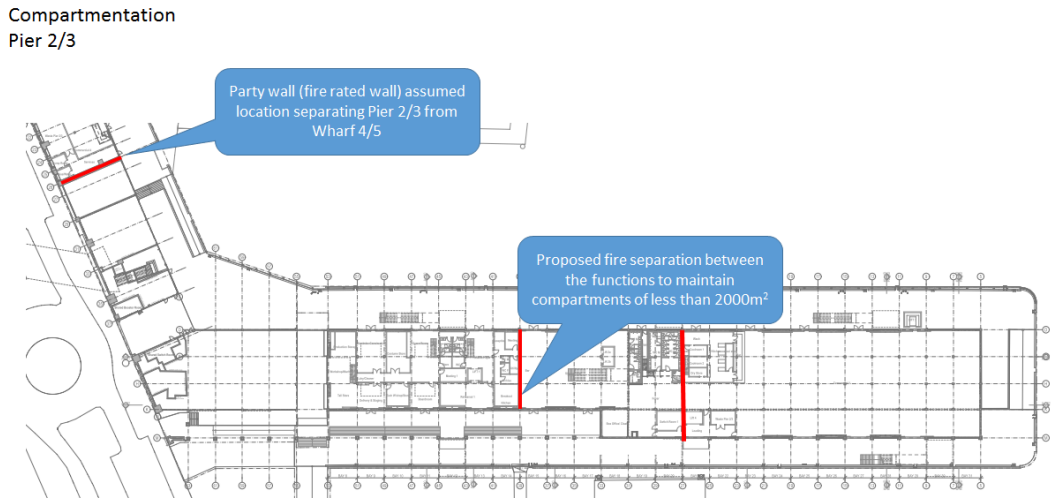


Figure 8: Ground Floor

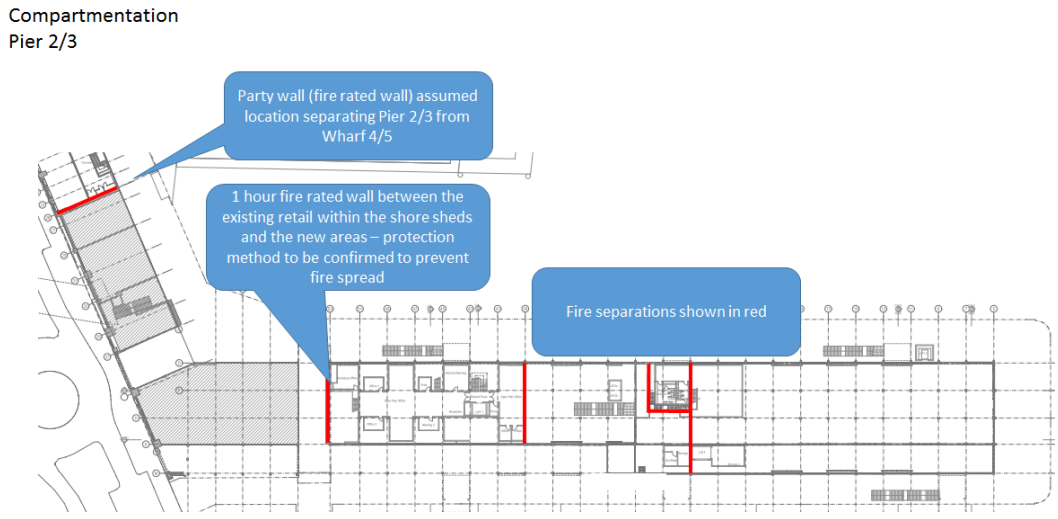


Figure 9: Mezzanine

The shaded areas are the existing shore sheds and part of an existing fire engineered solution for STC which will be maintained.

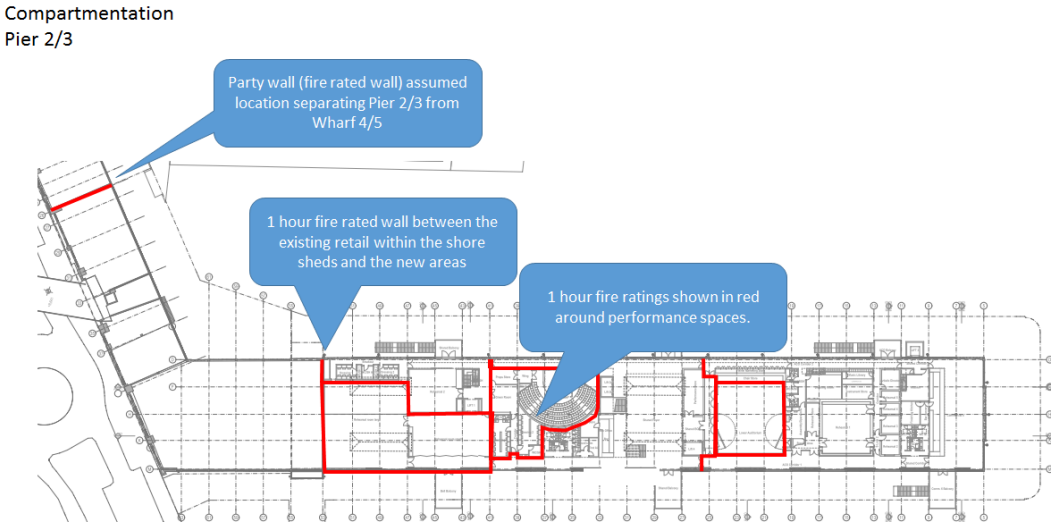


Figure 10: Level 1

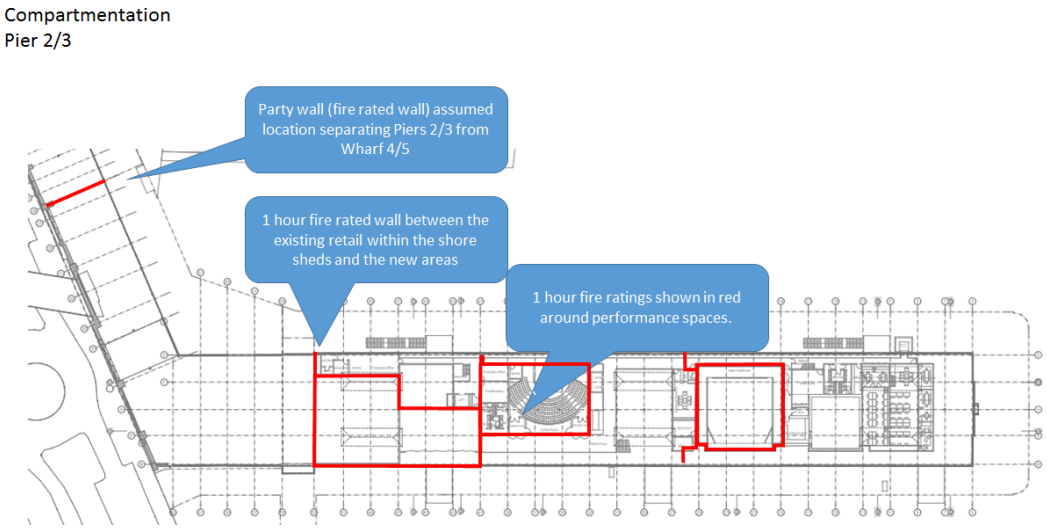


Figure 11: Level 2

3.3.3 Wharf 4/5

The works on Pier 4/5 do not incorporate the whole Wharf and sheds. The Sydney Theatre Company is to remain and works referred to in this SSDA are only proposed on the ground and mezzanine floors.

The principle of Pier 2/3 will be applied to Wharf 4/5 to compartmentalise the building in to areas less than 2000m². The STC internal works will follow a similar approach, which will include the separating fire and smoke rated floor between Level 1 and STC above.

In SDC, the Workshop and Studio 5 will be a separate fire compartment to reduce the Class 9B portion of the compartment to 2,000 m². ‘Commercial 5’ is also a separate compartment.

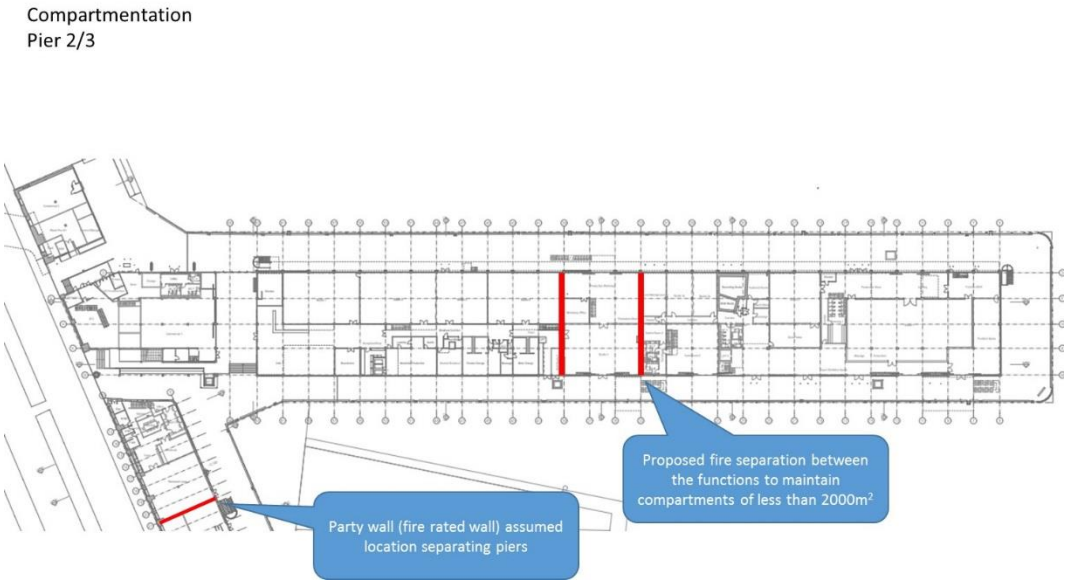


Figure 12: Wharf 4/5 Ground Floor

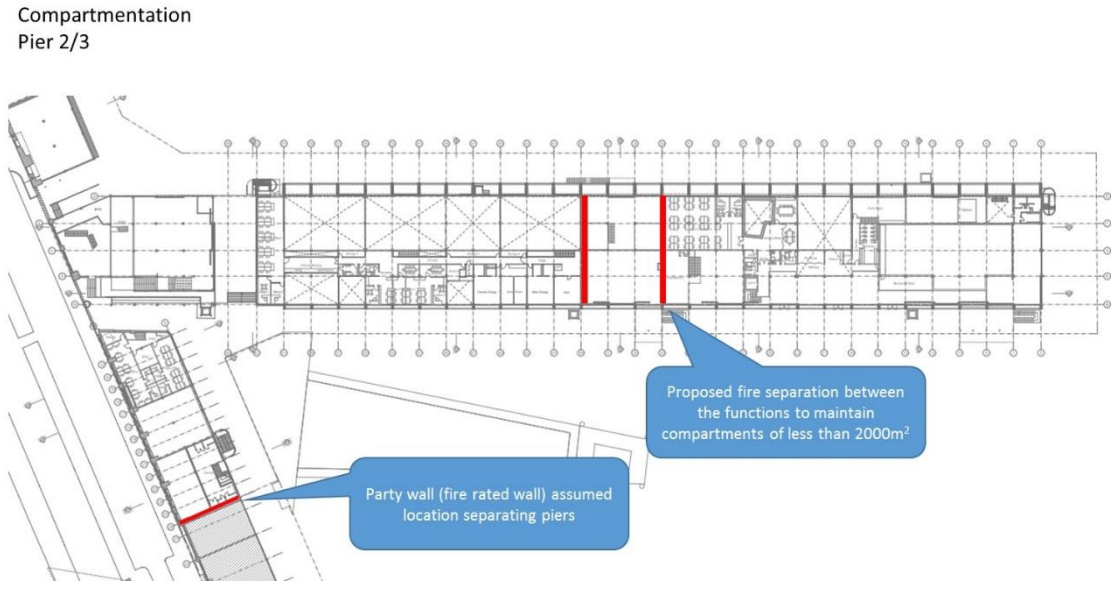


Figure 13: Wharf 4/5 Level 1

3.4 Egress

3.4.1 General

The buildings are to have a staged evacuation regime in order to support the reduced exit widths within the building, the delay between areas of the building will be defined as the design progresses but generally it would be between 4-6minutes between evacuation zones. This may also be beneficial t limit queuing, particularly due to the large populations from the function area in Pier 2/3 on Level 1. This will be worked through in more detail in subsequent stages of the project.

The building is provided with a number of external fire isolated stairs and direct access to the outside on ground floor.

For the purposes of performance design with regard to travel distances the egress is considered to be complete once on the apron. However, the overall egress to Hickson Road and the apron “holding capacity” for all evacuating occupants will also need to be assessed.

Protection of window openings and walls facing the external stairs within 6m will be assessed in detail in subsequent stages to determine the required protection to enable safe egress of occupants but the intent at this stage is to leave the stairs unprotected, equivalent to required non fire isolated stairs supplemented with horizontal evacuation and sprinkler protection. This may include a combination of fire rated walls and wall wetting sprinklers where calculations show excess received radiation.

Additionally it is noted that there will be areas on the apron susceptible to queuing and which may require design solutions to limit the risk of falling into the water.. This is described in more detail in Appendix A1.

3.4.2 Pier 2/3

Based on the population number within the building, Pier 2/3 is to be provided with 12.5m of exit width on the advice of the building certifier. This is less than required by the DtS provisions of the BCA and will be addressed via a Performance Solution

The proposed design includes:

- Use of external stairs from the upper levels
- Use of open internal stairs through no more than 3 levels (noting the open stairs connect all levels, only 3 storeys are required to be used by the evacuating occupants due to the combination of horizontal evacuation, external stairs and fire protection to the mezzanine level).

This is based on the fire separation between the uses, the sprinkler protection, and the automatic smoke detection.

Travel distances are largely compliant with the DtS provision of the BCA although there are some areas where there are slight extended travel distances which will be addressed as a Performance Solution.

Final occupant numbers and aggregate exit width will be reviewed as the design progresses.

The following figures note the potential egress available to the occupants within Pier 2/3 and Wharf 4/5.

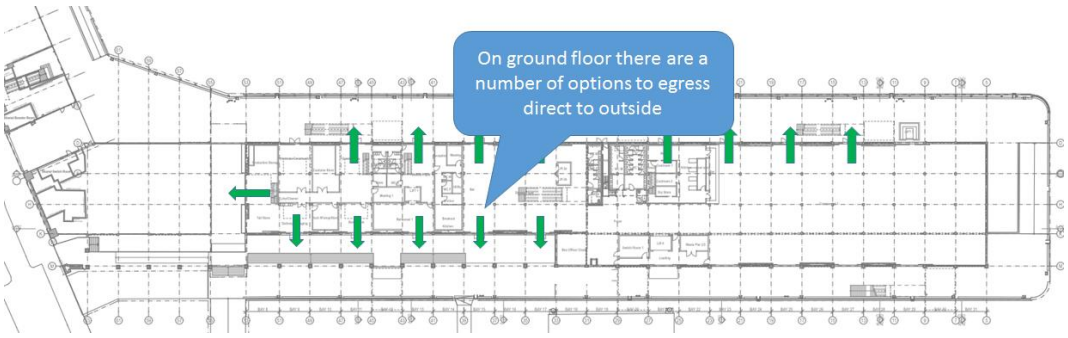


Figure 14: Pier 2/3 Ground Floor exits

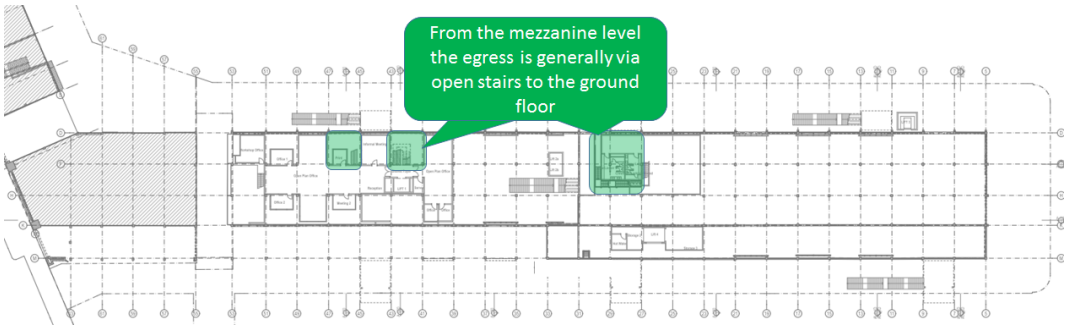


Figure 15: Pier 2/3 Mezzanine level egress

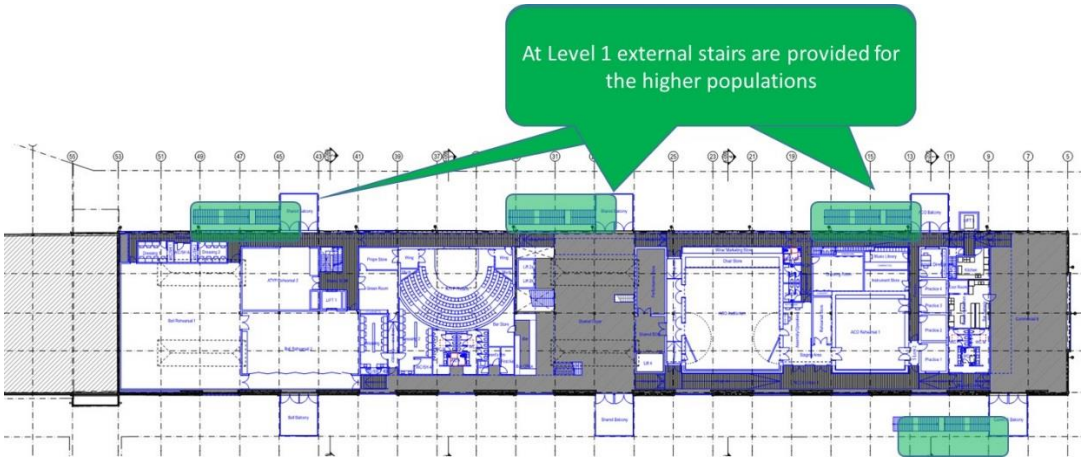


Figure 16: Pier 2/3 Level 1 egress

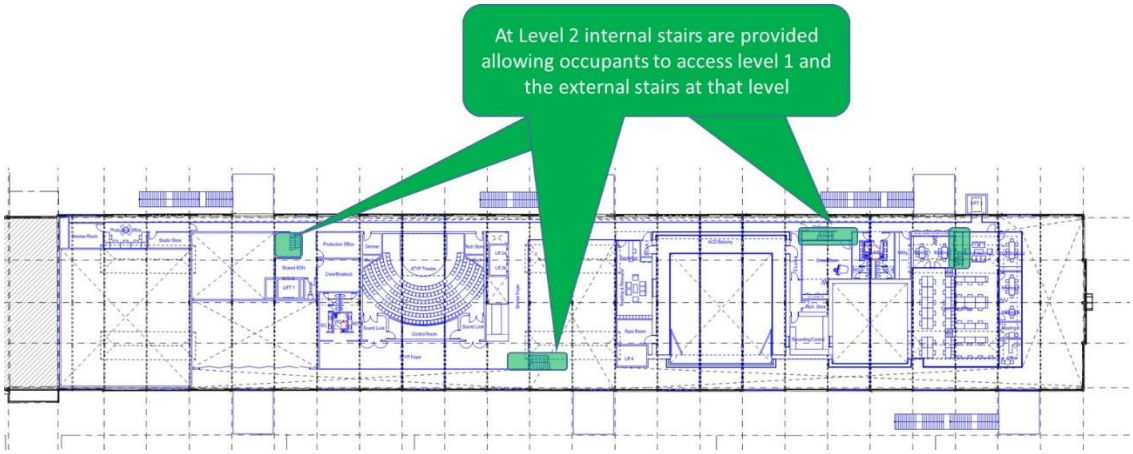


Figure 17: Pier 2/3 Level 2 egress

3.4.3 Wharf 4/5

Wharf 4/5 is largely existing and makes use of direct egress at ground level or internal open stairs at Level 1.

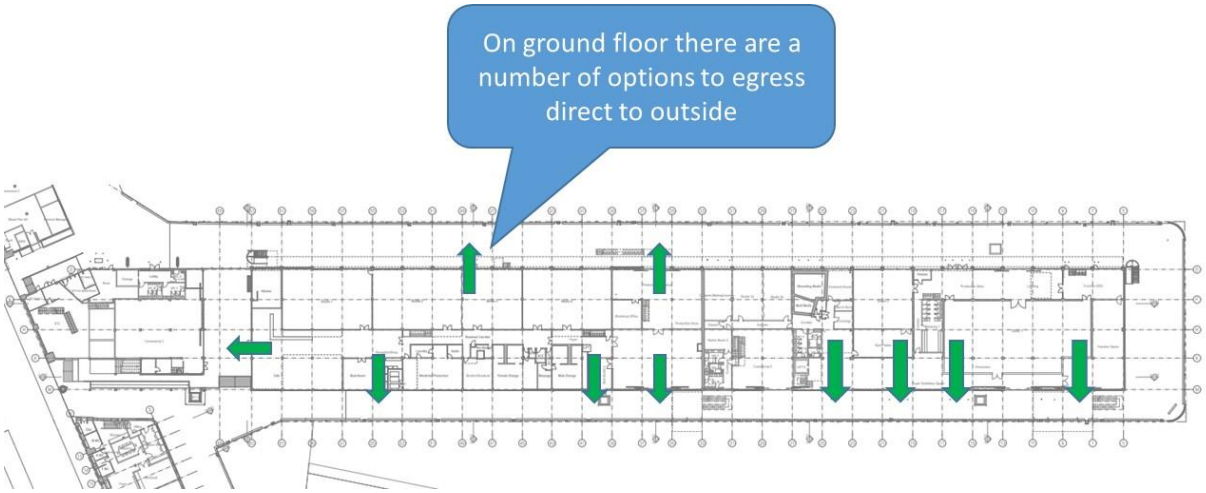


Figure 18: Wharf 4/5 Ground Floor egress

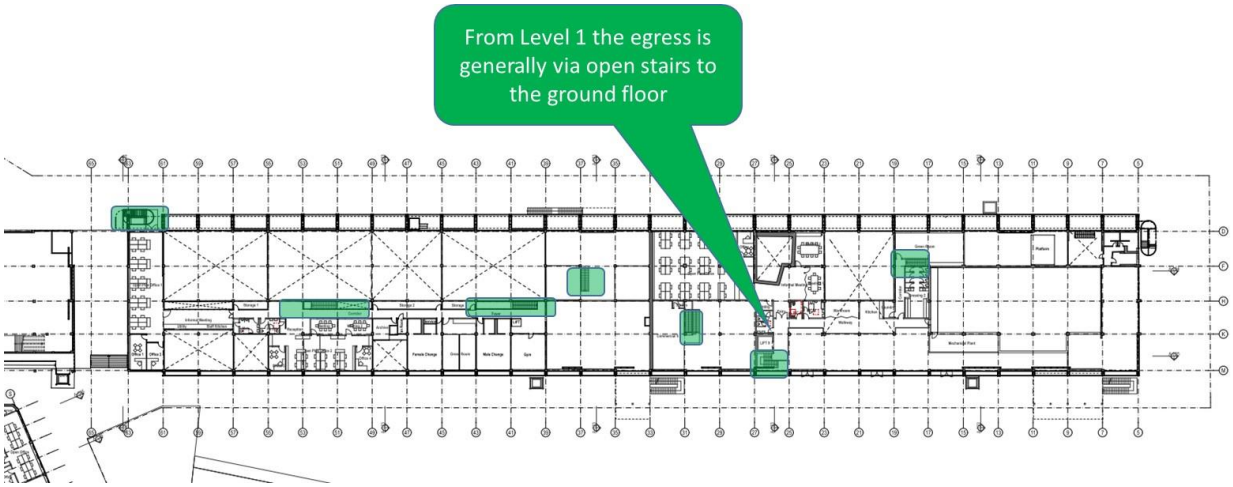


Figure 19: Wharf 4/5 Level 1 egress

3.5 Fire detection and alarm

3.5.1 Detection – Pier 2/3 and Wharf 4/5

Early detection of fire is essential for these buildings. Therefore, smoke detection is to be provided in accordance with AS1670.1 – 2015 throughout on a 10 m grid.

Security measures restricting access to areas of the building will need to release on fire alarm if they are located on escape routes.

3.5.2 Alarm – Pier 2/3 and Wharf 4/5

A Sound System Intercommunication System for Emergency Purposes (SSISEP) is to be installed to AS1670.4 and detection of smoke, activation of sprinklers or activation of a manual call point must immediately alert the building occupants.

It is proposed that a double knock style of system is incorporated where two smoke detectors (or one smoke detector and one manual call point) would evacuate the building or the activation of the sprinkler systems. This is to minimise false alarms or the unnecessary evacuation of the spaces.

The evacuation of the floors in each pier and shore sheds will be staged as noted in Section 3.4.1 above. The Piers will be split into evacuation zones that include multiple floors. The zones will be as per the diagrams below:

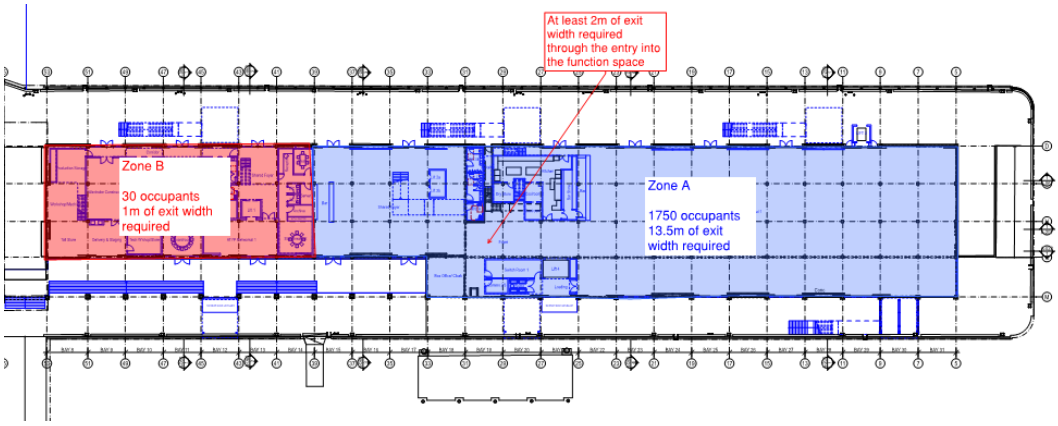


Figure 20: Pier 2/3 Level Ground Floor

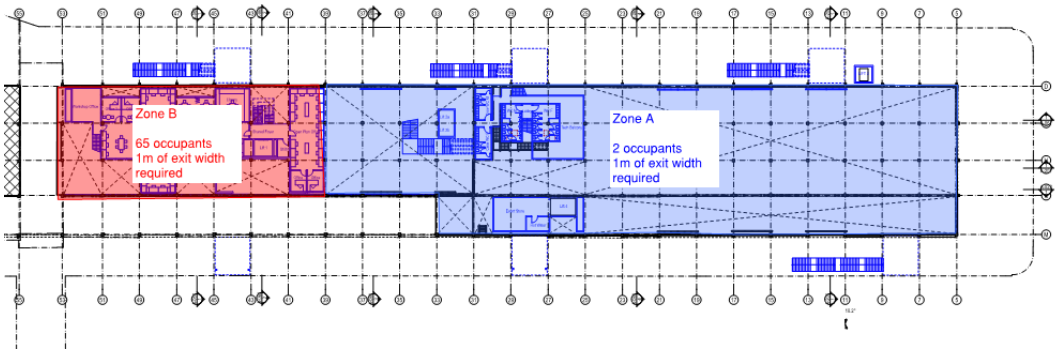


Figure 21: Pier 2/3 Level mezzanine

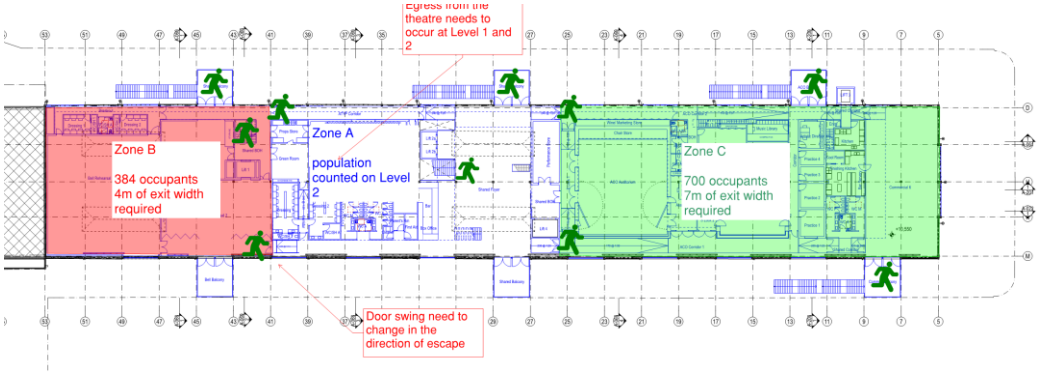


Figure 22: Pier 2/3 Level 1

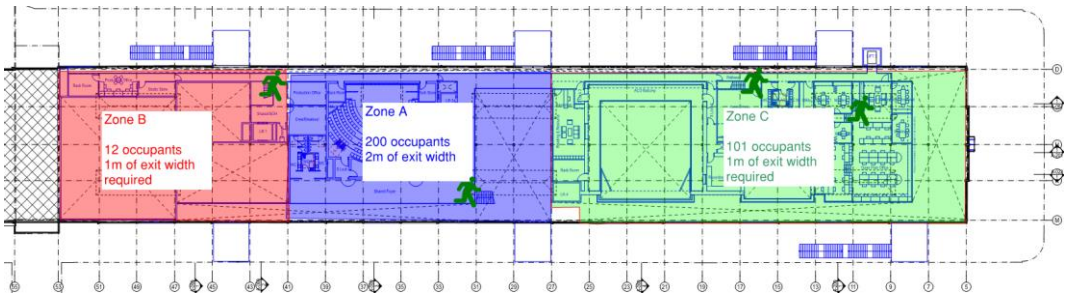


Figure 23: Pier 2/3 Level 2

Each coloured area will evacuate as one and also be able to move horizontally through the building to non effected areas. The staging between areas will be only approximately 4-6minutes and will be clarified as the design progresses.

Each pier is considered a separate building and provided with independent FIP and alarm systems, hence the fire alarm does not need to cascade between the two buildings automatically.

3.6 Hose reels

Hose reels are required throughout the building. At this design stage, it is assumed compliant fire hose reels will be installed in the buildings.

3.7 Sprinkler Suppression

Automatic sprinklers will be provided in accordance with BCA Clause E1.5 and AS2118.1-1999. Wharf 4/5 is also to be upgraded throughout.

To help justify the reduced fire rating of the elements it is proposed to install fast response, exposed heads. These would also be expected to keep the fire size to less than in a DtS designed space with standard response heads.

Fast response heads would be required for both piers and shore sheds.

3.8 Smoke Exhaust

Arup consider that active smoke exhaust is not required for Pier 2/3 due to the proposed compartmentation strategy and use of the performance spaces and auditoria. Arup acknowledge that the BCA would expect a smoke control system above a stage where it is over 50m².

Arup consider this an onerous requirement and prescribed more for theatre spaces where stage scenery is present. The auditoria (for the ACO, for example) has no fly tower or large sets and are mainly used for orchestral pieces. As such the requirements for such a system is reduced. The spaces will have automatic fire suppression with fast response heads as a mitigating measure. In addition the performance boxes are individually fire rated enclosures as the impact on occupants outside would be reduced.

Arup understand that the ATYP stage is less than 50m² and would not require smoke exhaust.

The ongoing obligation to manage the use of the auditorium to restrict scenery is outlined in Appendix B1. If such conditions are considered overly onerous on the operation, a performance based smoke exhaust system can be provided. Alternatively, should scenery be required in the future, it is recommended that a fire engineer reviews and reassesses the design such that an acceptable level of safety is maintained. This would need agreement by the proposed users of the space.

3.9 Fire Brigade Access

Arup assume that FRNSW would not drive a truck onto the piers or aprons. A water based fire tender is understood to be used by the fire brigade if the fire is not located close to Hickson Road.

The FIP's are to be located at the Hickson Road end of each pier.

3.10 Hydrants

The hydrant system for Pier 2/3 will be upgraded to meet current code. Currently external hydrants are provided and the necessity for the provision of internal hydrants will be investigated. At this stage it is assumed that internal hydrants would be required in Pier 2/3 to get compliant coverage.

The existing hydrant system on Wharf 4/5 is understood to also require full upgrade due to the amount of work to be undertaken in this development but there locations are considered adequate. The levels being refurbished are all covered by the external hydrants provided.

A Performance Solution will also be required to justify external hydrants within 10m of the building.

The upgrade will at least require double heads and Storz couplings provided to the current hydrant outlets.

4 Conclusion

Based on Arup's review of the project documentation, it is considered that performance based fire engineering can be used to demonstrate compliance with the Performance Requirements of the BCA without major changes to the current building form.

The Performance Solutions will be documented with detailed supporting assessments in the Fire Engineering Report for the project Certification in subsequent design stages, in line with normal design and approvals process.

It is anticipated that other non-compliances with the Deemed to Satisfy Provisions of the BCA may be identified by the Certifier as the design is developed further, it is however considered that there are unlikely to be significant issues that would impact the overall fire strategy concept approach.

5 Referenced Information

The proposed design is based on the architectural drawings by Tonkin Zulaikha Greer Architects (TZG), dated 07/10/2016.

This report is based on preliminary BCA advice and the BCA report undertaken by Blackett Maguire and Goldsmith dated October 2016 as well as ongoing advice from Jake Hofner and Brian Maguire.

The past fire engineering report relating to the Shore Sheds was titled "T.M Management Services Pty Ltd, Walsh Bay Shore Studios 2 and 3, Fire Safety Assessment Report August 2003.

Appendix A

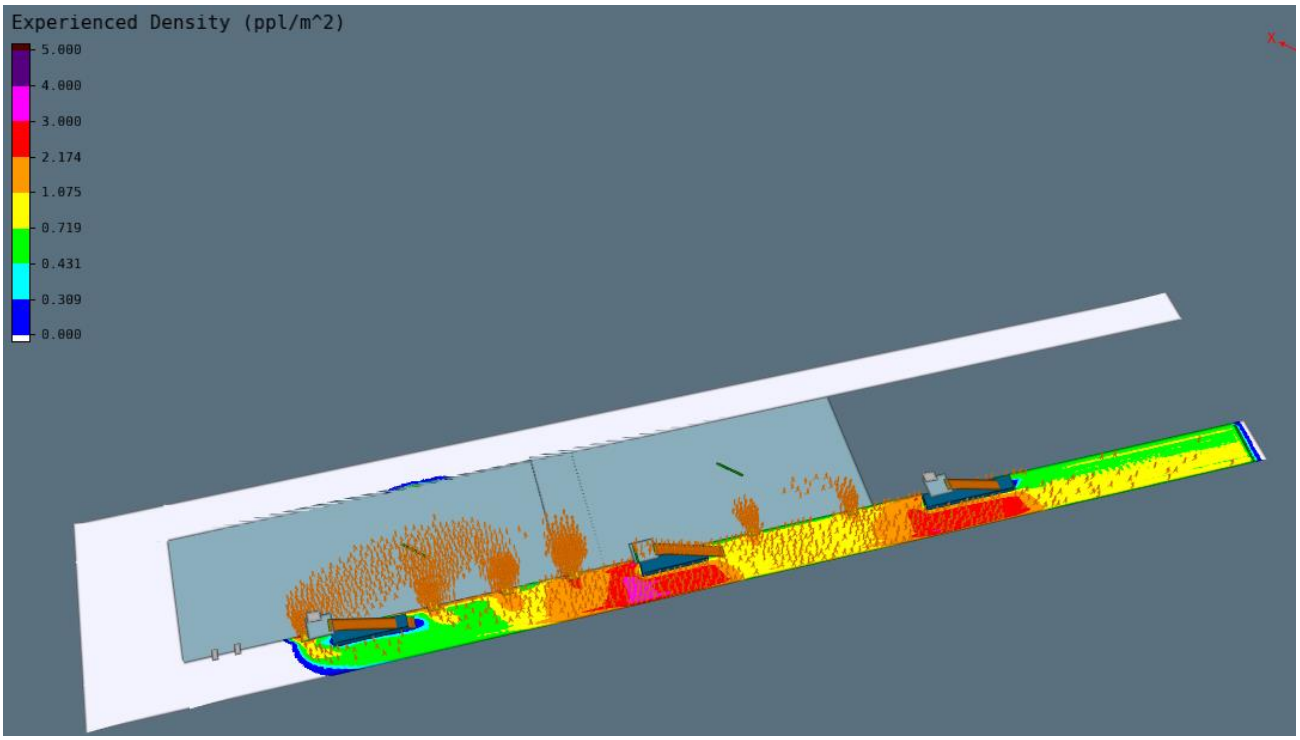
Apron

A1 Apron Crowding

The following areas of Pier 2/3 (highlighted Orange, Red and Pink) have been identified as an area potentially requiring further design considerations to help prevent falls or the build-up of crowds where significant queuing may be possible. This is based on phased evacuation of largest population (excluding the populations that may move east).

Such solutions may include but not be limited to balustrading; increasing fire ratings of floors and phasing evacuation; or adding exits at ground floor east or even reducing population capacity.

Images taken below are taken from preliminary modelling carried out for the purpose of defining pinch points only at this stage:



Appendix B

Management of Stages

B1 Management requirements for Stages

B1.1 Introduction

This memo has been prepared for Infrastructure NSW and Arts NSW by Arup to clarify the expected limitations of performance space in order to support the omission of smoke control within the Australian Chamber Orchestra (ACO) auditoria at Walsh Bay, Sydney. Under the Deemed to Satisfy (DtS) provisions of the BCA a smoke exhaust system would be required. Arup believe this would be an onerous services requirements based on the limited use of the stage.

B1.2 Auditoria – Requirements and limitations

B1.2.1 Deemed to Satisfy code requirements

The BCA requires that Performance Requirements are satisfied as a minimum. This is achieved through either Deemed to Satisfy (DtS) provisions or Alternative Performance Solutions.

The DtS Provisions have specific NSW requirements for theatres and auditoriums. The requirement is that if a stage in an assembly building (e.g. theatrical) has a floor area greater than 50 m^2 but less than 150 m^2, an automatic smoke exhaust system or a roof mounted automatic smoke-and-heat vents must be provided over the stage.

Arup understands that the ACO auditoria stage is expected to have a floor area greater than 50 m^2 (100m^2 approx.) thus based on the above, the DtS code provisions would require an automatic smoke control system. The ATYP stage is less than 50m^2 and therefore does not require smoke exhaust.

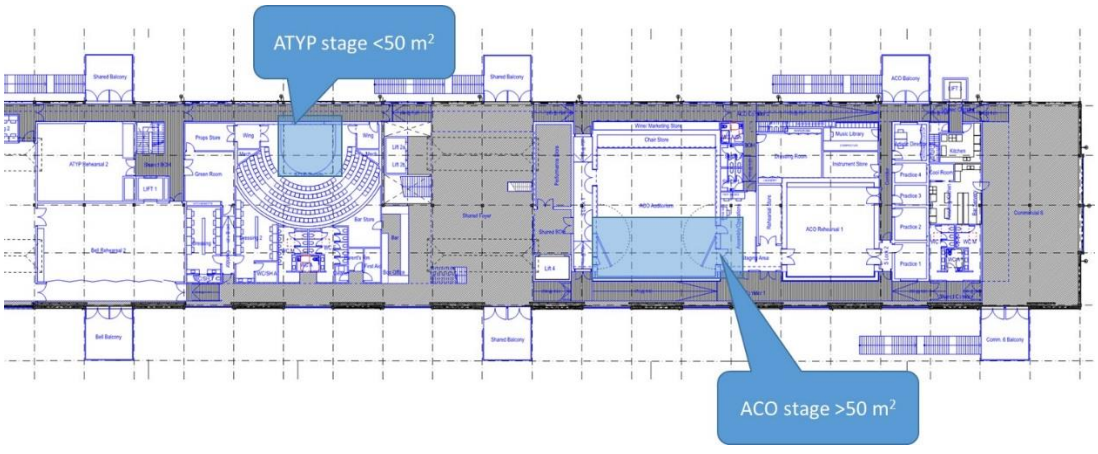


Figure 24: Level 1 floor plan showing the two stages and their stage sizes relatively.

However, the design team are proposing to adopt an Alternative Performance Solution to meet the Performance Requirements of the BCA, which would demonstrate that smoke exhaust is not required in the ACO theatre auditorium to achieve an acceptable level of safety. This is discussed further in the following sections.

B1.2.2 Limitations of the proposed design

The design team consider that active smoke exhaust is not required for this building due to the proposed compartmentation strategy and use of the performance space/ auditoria.

Arup's interpretation of the BCA's smoke control requirement is that it is a way to address the increased stage floor area potentially having complex and larger sceneries and ignition sources (like the setup in

Figure 25), which could contribute significantly to fire growth and the overall size of the fire on the stage leading to large quantities of smoke that could affect the occupant's ability to evacuate safely.

Figure 25: A high fuel load scenery setup. Obtained from Google Images.

Rather the expectation is that the performances at the ACO auditoria to be of orchestral, ballet, modern dance, presentations, musical performances and the like with limited sceneries (see Figure 26 for examples). Items from the above theatrical performances could include musical instruments, speakers, lecterns and such.

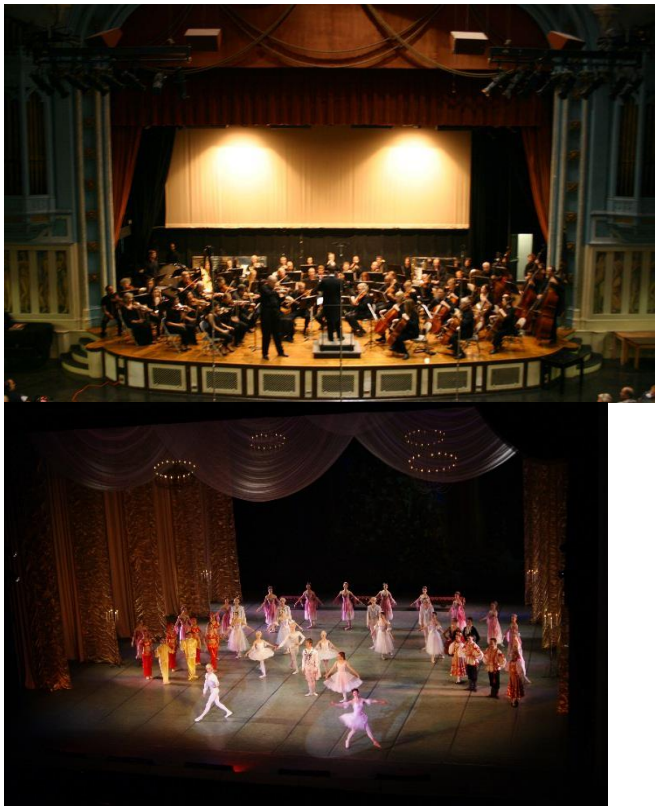


Figure 26: Examples of the expected on stage items. Obtained from Google Images from information only.

In such an arrangement, the auditoria would have no fly tower or large sets and used for orchestral performances. As such the requirements for an onerous exhaust system is considered to be reduced. Instead the spaces will have a fast response automatic fire suppression (sprinklers) as a mitigating measure to control the fire size and smoke production. In addition the performance boxes are to be individually fire rated enclosures as the impact on occupants outside would be reduced.

B1.3 Conclusion

Based on the use of the ACO auditoria and the proposed compartmentation and egress strategy, Arup consider it appropriate to omit the requirement of a smoke exhaust system over the stage.

The limitation imposed by deletion of a smoke control system is not strictly quantified and Arup do not ask for such defined restrictions. However, the strategy will require management to control such usage of the performance areas and should scenery be required in the future, it is recommended that a fire engineer reviews and reassesses the design such that an acceptable level of safety is maintained.