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Australian Institute of Nanoscience

Concept Fire Engineering Report

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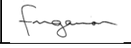
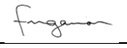
		Signature			
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Contents

1 Fire Safety Strategy

The concept fire strategy for the Australian Institute of Nanoscience (AIN) is set out below.

The strategy will meet the Performance Requirements of the Building Code of Australia relating to achieving an appropriate level of fire life safety for all building occupants.

The strategy aims to achieve this in a cost effective manner that has minimal impact on the architectural intent and functional requirements of the building.

In order to accomplish this it is likely that the fire strategy will include non-compliances from the Deemed to Satisfy (DtS) Provisions of the BCA.

Any such non-compliances will require being addressed as Alternative Solutions in order to demonstrate to the approving authority and any other relevant stakeholders that the Performance Requirements of the BCA are achieved.

The design is largely consistent with the previous reference design scheme, which was discussed with FRNSW at a concept meeting and broadly endorsed.

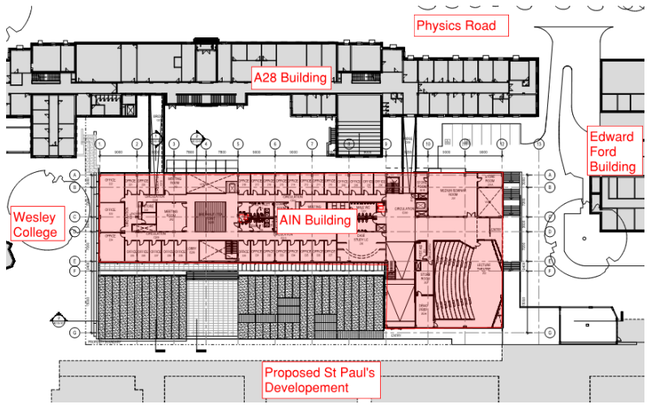

Figure 1: AIN site plan showing surrounding buildings

The building is split into two distinct areas, the west area which consists of laboratories, cleanroom, offices and research areas, and the east area which mainly consists of teaching areas, seminar rooms and lecture theatre. As noted in Figure 1 the building has multiple other buildings to all other sides.

1.1 Building Separation

From a fire strategy perspective the Nanoscience building is proposed to be a standalone building and that the level of fire safety to the existing A28 building is as a minimum not reduced in anyway. This requires that where the building is within 6m of the adjacent A28 Physics Building adequate fire separation is provided. This is likely to be achieved by a combination of methods including-

- Solid construction achieving 2 hours fire rating;
- Fire rated doors on hold open devices that release on fire trip;
- Wall wetting sprinkler system applied to glazed openings;
- Fire shutters.

The areas noted as being within 6m of the A28 building are highlighted in Figure 2 adjacent.

For the area 2 noted in Figure 2 it is proposed that in order to enable the majority of the façade of the AIN building to remain non fire rated that the required protection is provided by the solid façade of A28 that extends up to the Level 4 slab of AIN. The masonry walls of the existing A28 building façade have been checked by the structural engineer and they have determined that they achieve the required 2 hours fire rating (FRL 120/120/120). In addition any openings in the A28 building will require being appropriately fire stopped to maintain the required level of fire separation.

Further to this it has been identified that the areas above the eves of A28 (i.e. the sloping roof area) is currently non-fire rated. In order to maintain the required level of fire protection between the building the plant areas on Level 4 of the AIN building have been located so that they are not located within 6m horizontally of the existing A28 roof. The façade enclosing the northeast circulation stair and associated void are within 6m of the non-fire protected A28 roof and therefore this portion of façade will need to be protected (FRL -/60/60 or external wall wetting sprinklers). The details of this are noted in Figure 3.

Due to the link bridges being considered part of the AIN building these areas are within 6m of the A28 building. It is proposed that fire rated doors (FRL -/120/120) are provided where the link bridges connect to the A28 building. These doors can be on hold open devices that release on fire trip in either the AIN or A28 building.

While it is intended to provide fire separation and treat the existing A28 and new Nanoscience building as separate buildings there is a risk that as changes are being made to the existing A28 building, albeit minor, that the consent authority enforce legislation that allows them to request fire safety upgrades to this building. This is covered under Clause 94 of the EP&A Regulations. The level of fire safety upgrade requested by Council could range from minor upgrades through to partial or even complete conformance with the current BCA. It is recommended that this risk to the project is addressed as soon as possible with all stakeholders meeting to discuss the possible options for reducing the risk of this occurring.

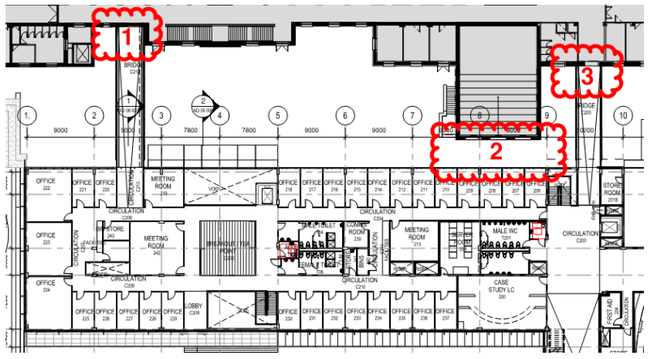

Figure 2: Areas requiring fire protection between AIN and A28

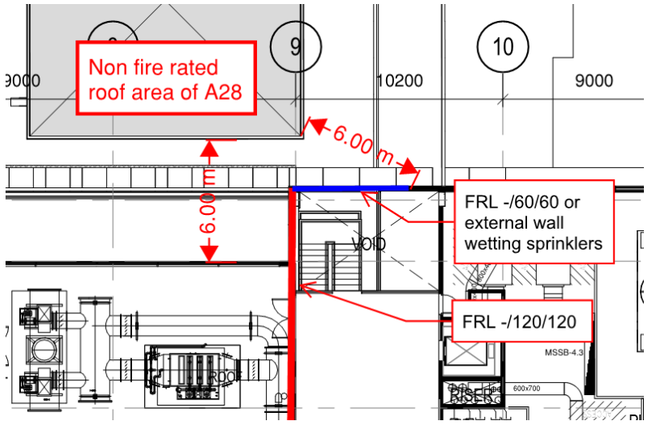

Figure 3: Fire separation between AIN and A28 at Level 4 (area 2)

1.2 FRLs and Compartmentation

Due to the building having a rise in storeys of 4, Type A construction is required. It is proposed that the structural fire resistance level (FRL) for the building is 2hrs throughout, this includes rationalising the requirement for Class 8 (laboratory) from 4hrs to 2hrs FRL. This rationalisation of FRL will be based on fuel load density comparisons and/or fire severity calculations.

The building includes multiple classifications, including:

- Class 5 (office);
- Class 8 (laboratory);
- Class 9b (assembly area – teaching spaces).

It is proposed that the DtS fire compartment area and volume limits noted in the BCA are observed. This removes the potential for the building to be classified as a large isolated building, which has more onerous DtS fire safety requirements including 100% perimeter access for fire service vehicles.

The limits noted in the BCA for compartment sizes vary between the building classifications and are determined on the perceived fire load and risk associated. Where a single compartment includes multiple classifications the limit on the compartment area and volume can be calculated on a pro-rata basis. Using this method of assessment it is considered that the following fire compartments meet the limits noted in the BCA Compliance Report -

<u>West Compartment, includes;</u>
Offices, laboratories and associated plant spaces, café area, Learning Studio, cleanroom and associated plenum and meeting rooms. The compartment spans Level 01 – Level 03 due to the voids and open stairs that penetrate the floor slabs in multiple locations.

<u>East Compartment, includes;</u> Entrance Foyer's at Level 1 and 2, Lecture Theatre, Student Commons area, Third Year Teaching Laboratory, Medium and Large Seminar Room, Type C laboratories (located at east section of Level 1) and the atrium space. The compartment spans Level 01 – Level 04 due to the presence of open voids and stairs connecting all building levels.

Each of the compartments should be fire separated from the adjacent areas by construction achieving the FRLs set out by the DtS Provisions (except where these are proposed to be reduced). In general this will be an FRL -/120/120.

Where the West and East Compartments meet in the area highlighted in Figure 5 and Figure 6, the facades will either require being fire rated (FRL -60/60) so that no openings are within 4m of each other or alternatively wall wetting sprinklers could be provided internally or externally in order to protect the risk of fire spread between the compartments.

It may be the case that additional rooms identified as having a high fire risk or relating to the operation of life safety equipment will require being enclosed in fire rated construction. These will be identified in the subsequent design stages.

Figures 2 to 5 below show the proposed fire compartment lines.

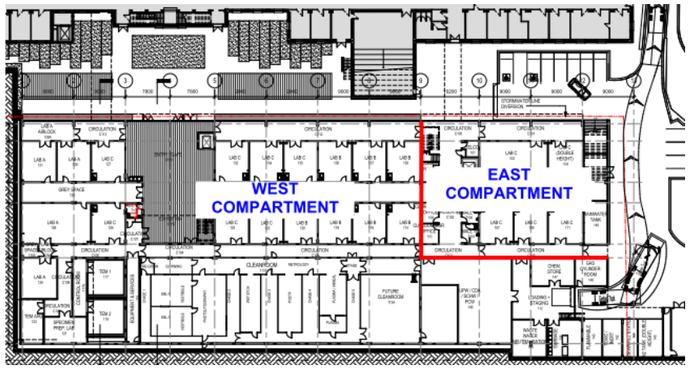

Figure 4: Fire compartmentation at Level 1 (North at top)

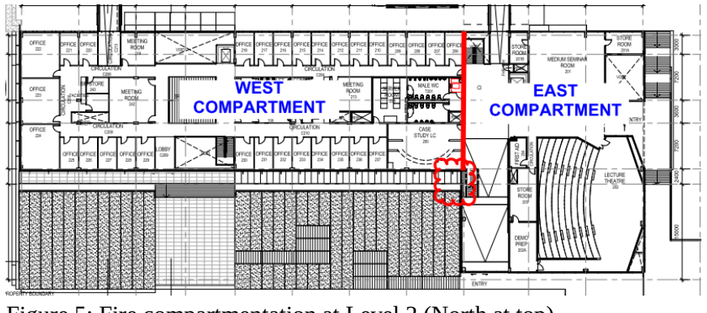

Figure 5: Fire compartmentation at Level 2 (North at top)

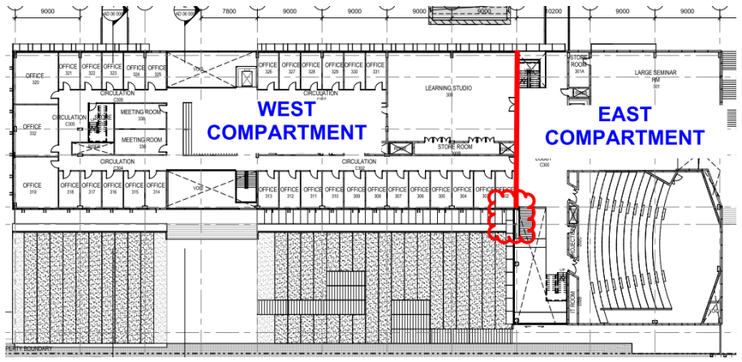

Figure 6: Fire compartmentation at Level 3 (North at top)

As noted in Figure 7 the rooftop areas above the West Compartment form a separate fire compartment.

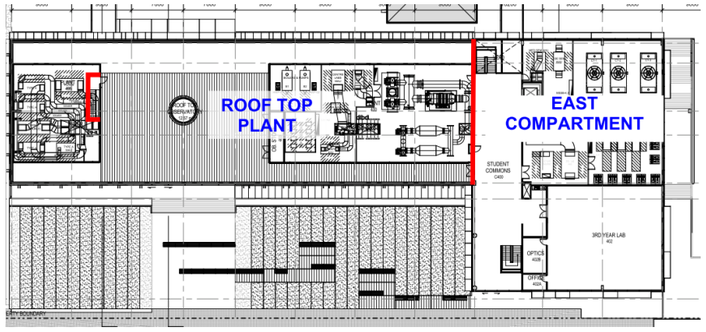

Figure 7: Fire compartmentation at Level 4 (North at top)

1.3 Egress Provisions

It is proposed that a simultaneous evacuation of the building is used, whereby on fire trip all occupants are instructed to evacuate. This strategy reduces the need for occupants to remain within the building for prolonged periods of time during a fire and therefore reduces the need for additional systems designed to restrict the movement of fire and smoke.

There is no reliance on exits into or from the adjacent A28 Physics building and the design of the new building does not impede egress of A28 occupants.

As noted in Figure 8 - Figure 11 it is proposed that where possible egress from the West and East Compartments allows occupants to exit direct to outside without needing to pass through an adjacent area. This should assist with maintaining lines of security between the distinct building areas.

East Compartment

It is proposed that the majority of occupants in the East Compartment on Level 01 - 04 egress the building via the main entrances that serve this area. These include-

- Entrance to the north at Level 01; and
- Entrance to the south at Level 02
- Entrance to the east at Level 02

Alternative exits are provided from Level 03 and 04 via the northeast and southeast open circulation stairs (required non fire isolated stairs), which in turn provide access to the final exits noted above. Further, if additional egress capacity is required to accommodate increased occupants numbers horizontal exits may be provided into the adjacent West fire compartment at Level 03 and 04 through the secure line that separates these areas in normal operations. White break glass points would need to be provided to alert security staff that these doors had been activated via non authorized personnel.

Additional egress is available at Level 1 via the corridor leading direct to outside on the east façade of the building adjacent to the rainwater tank room.

West Compartment

As per the East compartment egress from the West compartment is provided via the main entrances to this compartment. These include-

- Entrance to the north at Level 01; and
- Entrance to the south at Level 02

From these exits occupants can move east away from the building on the route leading between the A28 Building and Wesley College; or west towards the pedestrian ramp between A28 and the Edward Ford building that leads to Physics Road.

Access to the exits is via the open circulation stair that connects all three levels of this compartment. Alternative horizontal exits are provided at all levels into the adjacent East fire compartment.

Egress from the Rooftop Observatory on Level 4 and services plant rooms is provided via the stair that discharges into the East compartment at Level 3 (adjacent top Gridline 2). From here occupants can proceed to the exits provided to this level. An alternative exit route is available from the rooftop area directly into the East compartment.

Summary

Based on the strategy noted above the maximum travel distances to an exit are within the DtS limits for distance to an exit, where alternative exit routes are available (i.e. 80m to the nearest exit where egress is available direct to outside). Travel distances to a point of choice are extended up to 29m (compared to 20m for DtS) and distance to the nearest exit is extended to up to 55m (compared to 40m for DtS).

It is considered acceptable that non fire isolated stairs are used as exit routes from all levels of the building due to the following reasons:

- Sub divisions of the building into separate fire compartments;
- Provision of a sprinkler suppression system;
- Alternative exit routes available from all areas;
- Overall travel distances to a final exit via a required non fire isolated stair meeting the DtS requirements (80m overall distance).

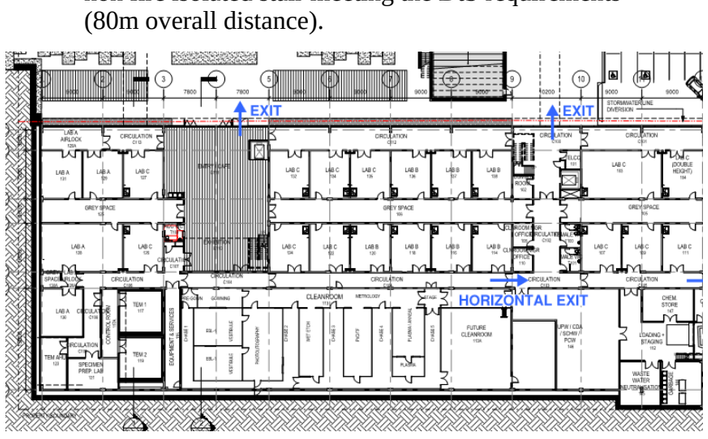

Figure 8: Egress provisions from Level 1

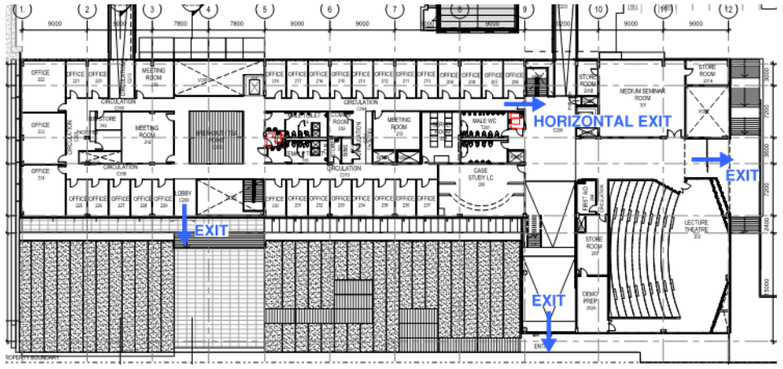

Figure 9: Egress provisions from Level 2

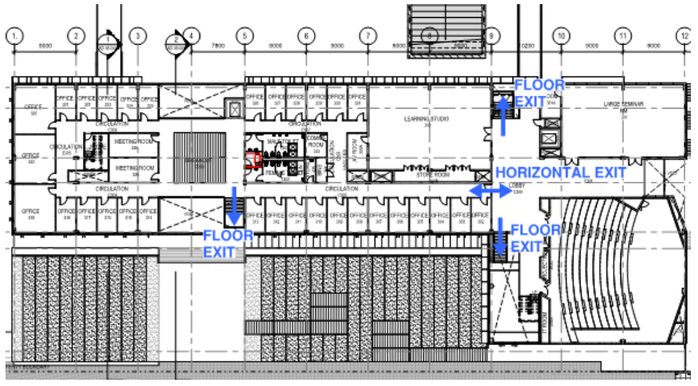

Figure 10: Egress provisions from Level 3

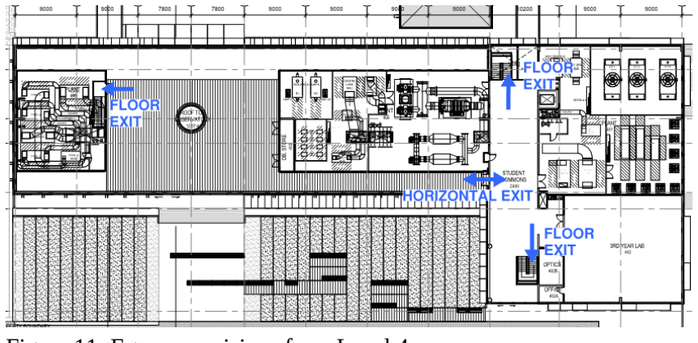

Figure 11: Egress provisions from Level 4

1.4 Fire Brigade Access

The constrained nature of the sites means that vehicle access is available on the eastern façade from Physics Road and western façade of the building via a road that provides access to the adjacent Wesley College car park. However as the Wesley College vehicle access is provided via an adjacent site it cannot be relied upon for future building access.

Vehicle access to the fire hydrant booster assembly will therefore need to be provided from Physics Road. Through discussion with Fire and Rescue NSW on the reference design scheme they confirmed that their preference was for the booster assembly to be located on Physics Road, therefore removing the need for a fire truck to drive into the confined vehicle parking and loading dock area between AIN and the adjacent Edward Ford building.

It is recommended that the FIP is located in a position close to the fire brigade access point. This is likely to be the Level 1 entrance from the car park or Level 2 east entrance.

The building is not provided with fire isolated stairs, therefore the hydrant outlets will require being positioned close (within 4m) to the required non fire isolated stairs. Additional on floor hydrants may be required in order to achieve full compliant hydrant coverage. FRNSW stated a preference that on floor hydrants are located on the path of travel to their likely main entrance and located within the compartment served.

An external hydrant outlet will be located on the path of travel to the building from the hydrant booster assembly so that coverage of the internal hydrants located within the entrances can be achieved.

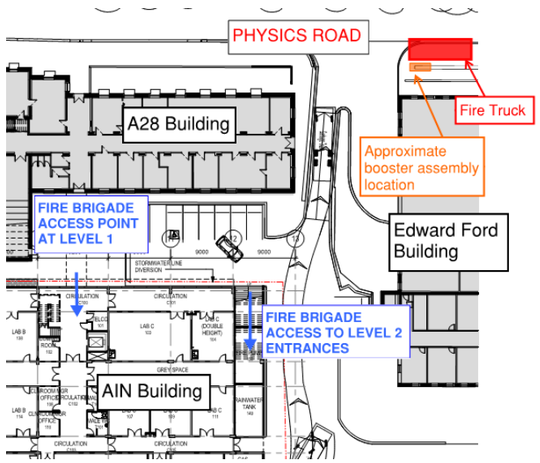

Figure 12: Fire brigade access to east side of building

1.5 Fire Safety Measures

To enable the fire strategy noted above the following fire safety measures are proposed:

- Automatic detection and alarm system in accordance with AS1668.1:1998 for the West compartment i.e. smoke detectors in common circulation areas and corridors. The exception to this is that detection in the ceiling voids is not required if sprinklers are provided through this area.
  - The rooms at Level 1 that are accessed directly from the West Compartment are to be provided with detection as per the requirements of AS1670.1:2004.
- Automatic detection and alarm system in accordance with AS1670.1:2004 throughout the East Compartment (detection in all occupied spaces):
  - Heat detectors in any areas where conditions may increase the potential for false alarms from smoke detectors such as laboratories.
- Sound systems and intercom systems for emergency purposes (SSISEP) to AS1670.4:2004, with the exception:
  - WIP phones are removed from the design due to simultaneous evacuation regime.
  - Subject to discussion with the University manual call points may be removed from the East Compartment in order to limit the potential for malicious activation of these devices in publically accessible areas.
  - Reducing the speech intelligibility requirements will be investigated in areas where compliant coverage is very hard to achieve due to the acoustic characteristics of the space
- Automatic sprinkler suppression system in accordance with AS2118.1:1999:
  - OH3 system as per University requirements;
  - Grade 3 water supply required.
- Hose reels to be provided throughout to BCA Clause E1.4 and AS 2441:2005.
- Hydrants to be provided throughout to BCA Clause E1.3 and AS 2419.1:2005.
- Fire extinguishers to be provided in accordance with BCA E1.6 (AS 2444:2001), particularly where a water based fire fighting medium is inappropriate.
- Emergency lighting and exit signage are to comply with BCA Part E4 and AS/NZS 2293.1.

1.6 Fire Safety Measures Omitted

The items listed below would normally be required under the DtS Provisions for a building of this type.

However, these items are considered unnecessary for an adequate level of safety to be achieved in this building.

Therefore, the following items are proposed to be omitted from the design:

- Atrium smoke control system in the East Compartment;
- Zone smoke control system;
- Fire isolated stairs;
- Stair pressurisation system.

1.7 Further Work

The following are the key fire safety issues that require further development as the project moves into the next design phase:

- Addressing and minimising potential impacts that the new building could have on the fire safety standard of the existing A28 Physics building, so that a full upgrade of the existing A28 building is not required. This includes fire separation of the buildings, addressing the risk associated with the non-fire rated roof of the existing A28 building, maintaining adequate egress paths and maintaining adequate fire brigade access;
- Resolving the compartmentation and addressing the risk of smoke spread through four open floor levels;
- Input from the University in relation to any increased property protection requirements for high value or critical assets.

The proposed fire safety strategy will need to be discussed with the Principal Certifying Authority (once appointed) and Fire and Rescue NSW prior to CC documentation.

The next deliverable would be a Fire Engineering Brief report developed for submission to the approving authorities and project stakeholders.

1.8 DtS Non-Compliant Items

Steve Watson and Partners has provided a BCA Compliance report (dated 19/12/12) that notes a number of non-compliance items with the design relating to the DtS Provisions of the BCA 2012. A brief description of why it is considered the performance requirements of the BCA can be achieved through alternative design solutions is included in the table below. This information does not form the alternative solution and this will be included within the subsequent Fire Engineering Brief (FEB) and Fire Engineering Assessment (FEA) documents.

DtS Section (extracted from Steve Watson and Partners report)	Issue (extracted from Steve Watson and Partners report)	Description of proposed Alternative Solution or revision to the design to implemented.
Section C	The building is proposed to be constructed generally in 2 hour fire rated construction which does not comply with Specification C1.1 for a Class 8 Type A building.	Class 8 (laboratory buildings) would require 4 hours fire rated construction under the DtS Provisions. This is not considered necessary as it can be demonstrated that laboratories like AIN generally have a lower fuel load than office buildings (Class 5) and therefore a fire will burn out quicker than a comparable office fire. This method of justification has been used on multiple laboratory projects.
Section C	Openings in the external wall of the building are located within 6m of another building on the same allotment.	The structural engineer has checked and determined that the external walls of the existing A28 building that will be within 6m of the AIN project achieve a fire resistance of 2 hours. It is therefore proposed to use the existing building fire protection and appropriately fire stop any openings within the walls of A28 in order to maintain fire separation between the buildings, thus reducing the extent of the AIN façade that needs to be protected. This is considered to achieve the Performance Requirements of the BCA in limiting the potential for fire spread between building.
Section D	The exit travel distances do not comply with Clause D1.4 and D1.5 of the BCA. On level 1 the distance to a point of choice is approximately 29m, total travel is approximately 55m and the distance between alternative exits is approximately 80m. On level 2 the distance to a point of choice is approximately 24m and the distance between alternative exits is approximately 66m. On level 3 the distance to a point of choice is approximately 26m and the distance between alternative exits is approximately 77m. The distance to a point of choice from the 3rd Year Lab is approximately 26m. On level 4 the distance to a point of choice from the central plantroom is approximately 32m without any plant in the room. Level 3 requires 4m of egress width for the calculated population in accordance with Clause D1.6 of the BCA but only 3.5m is provided.	The areas where extended travel distances are located are within the West fire compartment. This fire compartment is three storeys only and therefore if it formed a standalone building under the DtS Provisions it would not require a detection system. It is therefore considered that the provision of a smoke detection system in the common areas (circulation corridors and breakout areas) will significantly reduce the time taken to alert occupants of a fire in lieu of relying on a sprinkler head to break and operate the alarm system. A secondary means of escape is to be provided from within the plantroom to the roof area thus making the design compliant. The use of the BCA calculated population figures may be overly conservative and therefore the University should provide input as to the likely maximum population using the Large Seminar Room and Auditorium. If the exit capacity is still below the DtS Provisions then the door leading into the West compartment could be used as a horizontal exit and therefore compliant egress capacity would be achieved.

Section D	The stair providing access to the roof area from the West compartment and the stair accessed from the Level 4 Student Commons area discharge on Level 3 which does not provide direct egress to the road or opens space. Clause D1.9 of the BCA requires a non-fire isolated stairway to discharge to a level at which direct egress is provided to a road or open space.	The stair noted serves as an egress path from the Level 4 roof area (including the Roof Top Observatory and Plantrooms). An alternative means of escape route is available from this area into the Level 4 area of the East compartment. As these alternative egress routes are within separate fire compartments in the event that one route is compromised occupants can move to the alternative means of escape path and proceed to a final exit in a separate fire compartment to that affected. Further in order to reduce the potential for occupants to move to one exit and then have to return due to that route being compromised by fire or smoke, a system for alerting occupants if a detector has activated in the compartment in which they are about to enter will be investigated.
Section E	As the building has open stairs and an atrium connecting 4 storeys, the building is required to be sprinkler protected in accordance with Specification E1.5 of the BCA.	Due to the sloping nature of the site occupants can egress direct to outside at Level 1 and 2. Therefore occupants are never more than 2 storeys above an exit. This is considered similar to a DtS design whereby a three storey compartment with no fire stair is considered acceptable if the building is sprinkler protected. Further the overall travel distances to an exit are within the DtS limits for this compartment i.e. 80m to the nearest exit leading direct to outside.
Section G	The atrium well does not have a width throughout that is able to contain a cylinder having a horizontal diameter of not less than 6m. The atrium is not separated by bounding walls in accordance with Clauses G3.3 and G3.4 of the BCA. As the building contains an atrium connecting 4 storeys the provisions of Part G3 are applicable.	The atrium provisions in the BCA are not proposed for the AIN building due to the following reasons- The atrium smoke control system is designed to limit the spread of smoke in order to maintain tenable conditions in which occupants can evacuate. It is considered that due to the simultaneous evacuation strategy and overall travel distances to an exit being within the DtS limits that it can be demonstrated that occupants can evacuate the building in conditions equivalent to that considered acceptable under a DtS design. Further the 4 storey East Compartment is relatively small in size and is well below the compartment size limits noted in the DtS Provisions. Due to this the fire affected compartment in which the fire brigade may need to carry out operations is no more onerous in terms of area than a compliant design. Under the DtS Provisions of section G3 of the BCA the building would require a detection system in accordance with AS1670.1. However it is proposed that the three storey (i.e. non atrium) West compartment has detection to AS1668.1 spacing only. Due to the provision of an automatic sprinkler system, if the West Compartment formed a three storey standalone building it would not require an automatic smoke detection system and would rely on activation of sprinklers in order to alert occupants of a fire. It is therefore considered that the provision of detection to the common areas of the West Compartment (circulation areas upon which the individual rooms are accessed from) is considered to provide an appropriate level of detection.