FIRE ENGINEERS

11 FARNELL STREET, CURL CURL

FIRE ENGINEERING REPORT

DEVELOPED IN ACCORDANCE WITH
THE PERFORMANCE REQUIREMENTS OF THE BCA

- PROTECTION OF OPENINGS

DATE: 13 SEPTEMBER 2018
REPORT NO: 0773 FEAS REV C – **FINAL**
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PREPARED BY: J² CONSULTING ENGINEERS | **FIRE SAFETY ENGINEERING**

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REVISION STATUS

REPORT NO.	REVISION	DATE	STATUS	WRITTEN	REVIEWED
0773	REV A	27/03/18	**DRAFT**	MB	JS
0773	REV B	02/05/18	**FINAL**	MB	JS
0773	REV C	13/09/18	**FINAL**	MB	JS

EXECUTIVE SUMMARY & RECOMMENDATIONS

J² Consulting Engineers have been commissioned to carry out a fire safety engineering analysis and assessment of the proposed three storey residential development located at 11 Farnell Street, Curl Curl NSW. It is proposed to undertake alterations and additions to the existing two storey residential dwelling to convert the building to a three storey building with two separate dwellings. These dwellings are to be located such that one dwelling is located atop and adjacent the other.

It has been identified that elements of the building design do not satisfy the Building Code of Australia's (BCA's) Deemed to Satisfy (DTS) provisions and this report has been developed to provide a solution that satisfies the relevant performance requirements.

This report provides a Fire Engineered Performance solution developed to permit the following deviations from the BCA prescriptive requirements. The Performance solutions proposed are as follows:

#	Performance solutions	BCA DTS Provision	BCA Performance Requirement	Assessment Methodology
1.	Develop a performance solution to permit openings within external walls to be located within 3m of a boundary fire source feature and not require protection in accordance with C3.4 of the BCA.	C3.2, C3.4	CP2	Qualitative and comparative assessment demonstrating compliance with the relevant performance requirements under A0.3(a)(i) via performance assessment under A0.5(d).

REQUIREMENTS OF PERFORMANCE SOLUTIONS

Considering the relevant provisions of the BCA, the Performance solution, subject to the provision of the following requirements, is considered to meet and comply with the Performance Requirement CP2.

1. Each SOU shall be provided with interlinked AS3786 thermal alarms which are configured such that when a device operates in one apartment, it operates within the other apartment thereby offering occupants of the adjacent apartment the same opportunities to evacuate the building. Notably, this should be provided in addition to the minimum AS3786 smoke alarms which are required to be provided to comply with BCA Spec. E2.2a Clause 3.
2. The bounding walls between the two SOUs shall have a FRL of 90/90/90 in accordance with the Spec C1.1 Table 3 of the BCA, as shown in the following figure.
3. Any doorways located within the bounding construction between the granny flat and the main unit shall be self-closing fire doors with a FRL of -/60/30 in accordance with the Spec C1.1 Table 3 of the BCA, as shown in the following figure.

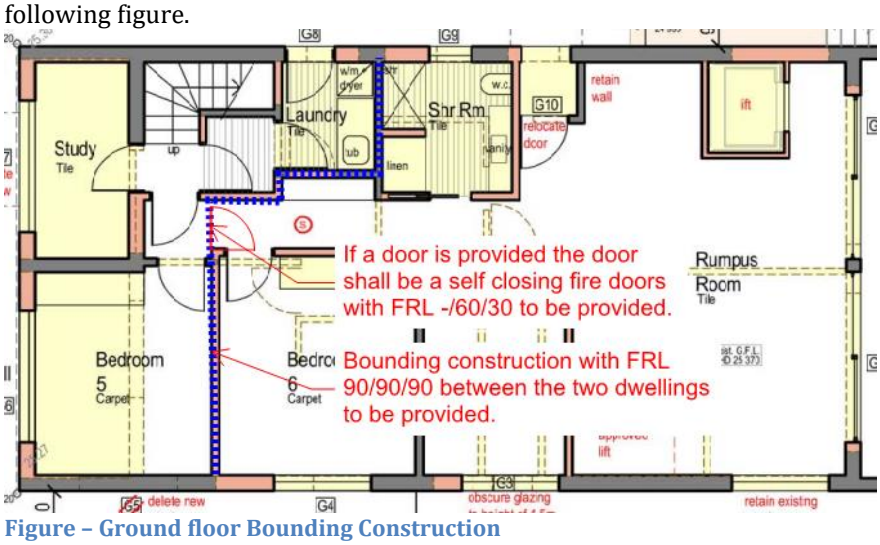


Figure – Ground floor Bounding Construction

Maintenance

1. The recommendations of this report must form part of the annual fire safety schedule for the building to ensure the recommendations of this report are complied with throughout the building operation.

The Performance solution has been developed using comparison and absolute with the Deemed-to-Satisfy Provisions and a qualitative assessment, and is considered to comply with BCA Performance Requirement CP2. The BCA recognises these Assessment Methods as acceptable methods for determining that the Performance solution satisfies the Performance Requirement in accordance with BCA Clauses A0.3(a)(i) and A0.5(d).

1.0 INTRODUCTION

J² Consulting Engineers have been commissioned to carry out a fire safety engineering analysis and assessment of the proposed three storey residential development located at 11 Farnell Street, Curl Curl NSW. It is proposed to undertake alterations and additions to the existing two storey residential dwelling to convert the building to a three storey building with two seperate dwellings. These dwellings are to be located such that one dwelling is located atop and adjacent the other.

It has been identified that elements of the building design do not satisfy the Building Code of Australia's (BCA's) Deemed to Satisfy (DTS) provisions and this report has been developed to provide a solution that satisfies the relevant performance requirements.

This report demonstrates that upon the adoption of suitable performance solutions, as detailed in the Executive Summary of the report, the relevant Performance Requirement of the Building Code of Australia (BCA) will be met.

1.1 Basis of the Report

This performance solution report is based on a desktop assessment of the following documentation:

- Building Code of Australia 2016, published by the Australian Building Codes Board (ABCB)
- International Fire Engineering Guidelines 2005, published by Australian Building Codes Board (ABCB)
- The Guide to the BCA 2016, published by the Australian Building Codes Board (ABCB)
- The following architectural drawings prepared by Howard K Smith & Associates Pty Ltd:

Drawing No.	Drawing Title	Date / Revision
1204 S96-04	Ground Floor Plan	09.11.2017 / B
1204 S96-05	First Floor Plan	18.01.2016 / A
1204 S96-04	Second Floor Plan	18.01.2016 / A

Preparation of the Assessment Report will be under the Performance Requirement of the BCA. The report will address the following deviations from the Deemed-to-Satisfy (DTS) provisions of the BCA:

- Develop a performance solution to permit openings within external walls to be located within 3m of a boundary fire source feature and not require protection in accordance with C3.4 of the BCA.

No other aspects or parts of the building will be assessed, and the remainder of the proposed development is assumed to comply with the relevant DTS provisions or the Performance Requirement of the BCA.

1.2 Purpose of the Report

This report has been prepared to address the deviations from the Deemed-to-Satisfy Provisions of the BCA (as tabled in the Executive Summary), and to provide a performance solution developed in accordance with the provisions of the BCA.

The purpose of this report is to demonstrate that the proposed development will satisfy Performance Requirement CP2 as the design is at least equivalent to the relevant Deemed-to-Satisfy provisions of the BCA and/or satisfies the Performance Requirement of the BCA.

1.3 Limitations of the Report

This report excludes any works not outlined above, however specifically excludes the following:

- Determining full compliance with the BCA, other than the matters identified in the executive summary of this report;
- Addressing any matters that are outside the scope or limitations of the BCA;

- Amendments to the performance solution Brief due to design changes or incapacity to comply with the Trial Designs;
- Consideration of any fire services operations (including hydraulic, electrical or other systems);
- Consideration of any structural elements or geotechnical matters relating to the building, including any structural or other assessment of the existing fire resistance levels of the building;
- This report does not provide concessions for any Performance solution or exemptions from the requirements of the BCA, other than that identified in the Executive Summary of this report;
- Determining compliance with the Disability Discrimination Act 1992 or Part D3 of the BCA;
- Reporting on hazardous materials, OH&S matters or site contamination;
- Any energy efficiency assessment; however, if necessary proposals can be obtained from suitably qualified and accredited assessors.

1.4 Assumptions of the Report

This report provides a performance solution for the Deemed-to-Satisfy deviation identified in the Executive Summary. The remainder of the building is assumed to comply with the Deemed-to-Satisfy Provisions of the BCA for the purposes of this report.

The report is provided on the basis that:

- The Performance solution only applies to property detailed in section 2.2.
- The Performance solution is applicable to the design documentation provided for assessment and as listed in Section 1.1. Any future alteration, enlargement or addition will require re-assessment to determine the application of this solution to those changes.
- The Building will generally comply with the Deemed-to-Satisfy Provisions of the BCA, except where modified specifically by this report.
- It is assumed that the building will be subject to ongoing annual maintenance and the fire safety measures required by this report and the BCA will be maintained to a standard not less than their installation standard.

2.0 FIRE ENGINEERING BRIEF

The development of this report follows a review of the BCA consultant's report and conversations with the project manager. Due to the nature of the proposed performance solution no FEB was undertaken as part of this project. Further details of the data relied upon in the FEB/FER process are detailed in Appendix A.

2.1 Relevant Stakeholders

Stakeholder/Role	Name
Architect	Howard K Smith & Associates Pty Ltd
Fire Engineers	J² Consulting Engineers – James Sunjaya / Marie Beerbaum

2.2 Building and Occupant Characteristics

General Building Characteristics

Building Characteristic	Description
Occupancy/Use Building Class/es: Type of construction: Rise in Storeys: Effective Height:	Residential dwelling/apartment Class 2 Type A 4 <12m
Location: General description of development:	11 Farnell Street, Curl Curl NSW. The works involve the refurbishment of an existing two storey class 1 dwelling to a three storey class 2 dwelling with proposed extensions at the rear, sides and an additional floor. The proposed building is to include a granny flat on the ground floor.

Occupant Characteristics

Occupant Characteristic	Description
Type and number	Occupants are considered to be of characteristics consistent with that of the general Australian population which a combination of occupants of differing cultural backgrounds, ages, etc.
Occupant state	Building occupants could be both awake and asleep. Occupants are expected to have a good level of familiarity with the building given the building would most likely be their place of residence. Visitors are considered to have a reasonable level of familiarity given the simple layout and relatively small footprint of the building.
Physical and mental attributes	It would be expected that occupants are capable for caring for themselves.
Assistance required/available	It will be likely that assistance will not be required as the occupants will become readily familiar with the location of the exits due to simple layout and the dwelling most likely their place of residence.
Training and Roles	Occupants are considered to have limited training or experience.
Hazards	Kitchen cooking areas. Electrical power and lighting equipment.

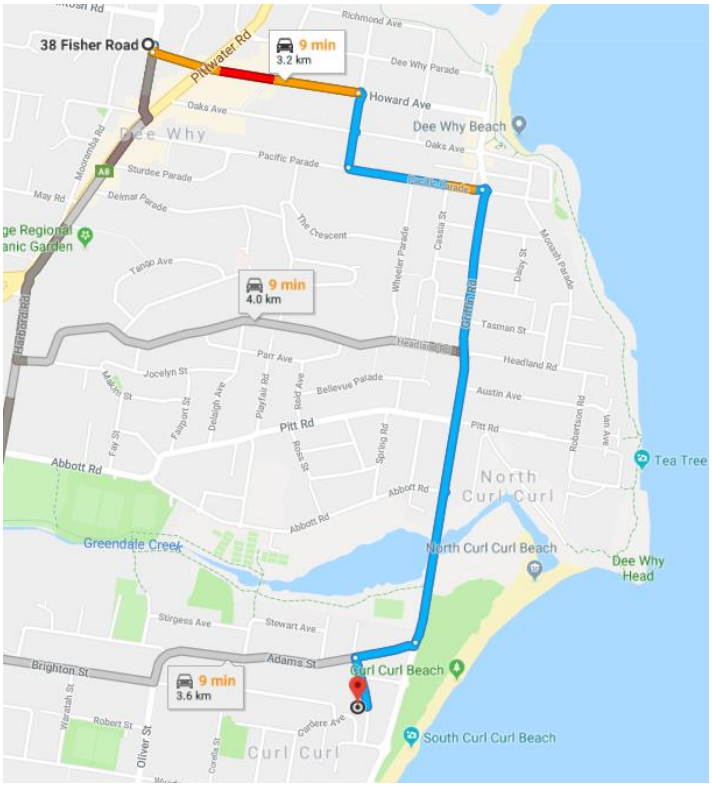
2.3 Hazards, Preventative and Protective Measures Available

The following hazards have been identified.

Hazard	Details/Precaution
General Layout and Design	No hazards have been identified with this design.
Activities	Information is not available to suggest that activities outside those normally undertaken in a similar building will be undertaken.
Cooking - NSWFB statistical data indicates that these fires make up 33% of all reported residential fires. (NSWFB 2001/2002)	Smoke alarm system within the SOU will notify occupants to respond to fire outbreaks if unattended. If the outbreak develops beyond that controllable occupants are required to evacuate.
Occupants smoking in Sole Occupancy Units (SOU's). NSWFB statistical data indicates that fires in sleeping areas make up 44% of all reported residential fires. These predominantly include smoking in bed and combustibles placed upon or near heaters. (NSWFB 2001/2002)	Smoke alarms would notify occupants to respond to smoking fire outbreaks if unattended. If the outbreak develops beyond that controllable occupants are required to evacuate.
Electrical power and lighting equipment.	<u>SOU habitable space</u> Smoke alarms would notify occupants to respond to electrical fires. If the outbreak develops beyond that controllable occupants are required to evacuate. <u>Concealed spaces</u> The roof void hazard is limited to down lights and electrical wiring as an ignition source which makes up a very small percentage of the number fire starts according the NSWFB statistical data, hence the roof void hazard is considered low.
Multiple arson attack, malicious acts, and acts of terrorism.	The resulting impact of fires from these hazards has not been addressed in this report.

The hazards that are present in the building have been removed or reduced by six sub-systems of preventative and protective measures.

Sub-System	Present in Building/Requirements
A Fire initiation, development and control	Fire loads or heat release rates are not proposed to be in excess of the original class 1 dwelling as the proposed extensions are minor, and it is therefore proposed to consider fire development will not be abnormally fast.
B Smoke development, spread and control	Smoke development and spread will not be inconsistent with that of the original residential class 1 building. FRL of 30/30/30 between SOU's will mitigate against smoke spread between the two SOUs.
C Fire spread, impact and control	Fire separation in accordance with clause C2.9 between the SOU's areas will ensure that fire is contained to the unit of origin for this period.
D Fire detection, warning and suppression	An AS3786 compliant smoke alarm system will notify occupants to a fire outbreak. An interlinked smoke alarms are to be provided in both SOUs configured such that when a device operates in one apartment, it operates within the other apartment.
E Occupant evacuation and control	A single exit from the granny flat is provided to the northern side of the site. The granny flat is provided independent egress on the ground floor to the street and does not require to egress via the main unit to reach open space. The main unit is

Sub-System	Present in Building/Requirements
	provided with direct access to open space at the western side of the building on the first floor.
F Fire services intervention	The building is served by a permanent fire brigade at Manly within 4.5km and Dee Why within 3.2 km of the site and therefore fire services intervention is likely to occur within a time period equal or better than the majority of the Metropolitan Sydney area.  **Distance from the Dee Why fire station to the proposed site courtesy of Google Maps.**

*International Fire Engineering Guidelines 2005 (IFEG)
Sub-system A – Fire Initiation and Development and Control
Sub-system B – Smoke Development and Spread and Control
Sub-system C – Fire Spread and Impact and Control
Sub-system D – Fire Detection, Warning and Suppression
Sub-system E – Occupant Evacuation and Control
Sub-system F – Fire Services Intervention

2.4 Directly relevant IFEG Sub-Systems

The directly relevant IFEG sub-system (SS) for this analysis are:

IFEG Sub-System	Description	Symbol
Sub-system C Fire Spread and Impact and Control	• Separation of fuel • Separation of buildings • Fire resistive barriers • Fire resistive structural elements • Exposure protection	

3.0 PERFORMANCE SOLUTION 1 – PROTECTION OF OPENINGS

A performance solution has been developed to address the proposed deviation from the DTS provisions of C3.2 and C3.4 relating to allowing openings within a wall required to achieve a fire resistance level to remain unprotected without the provision of window wetting fire sprinklers (as required to satisfy clause C3.4). The solution proposes to consider the building holistically and determine whether or not the boundary setbacks applicable for a class 1 building are more appropriate given the nature of the building use.

3.1 Deemed-to-Satisfy Provisions

BCA DTS Clause C3.2 requires that an opening in an external wall that is required to have an FRL not be located within 3m of a fire source feature and if located less than 3m from a fire source feature or boundary, are to be protected in accordance with BCA DTS Clause C3.4. The DTS clause is as follows:

C3.2 Protection of openings in external walls

Openings in an external wall that is required to have an FRL must—

(a) if the distance between the opening and the fire-source feature to which it is exposed is less than—

(i) 3 m from a side or rear boundary of the allotment; or

(ii) 6 m from the far boundary of a road, river, lake or the like adjoining the allotment, if not located in a storey at or near ground level; or

(iii) 6 m from another building on the allotment that is not Class 10,

be protected in accordance with C3.4 and if wall-wetting sprinklers are used, they are located externally

C3.4 Acceptable methods of protection

(a) Where protection is required, doorways, windows and other openings must be protected as follows:

(i) Doorways—

(A) internal or external wall-wetting sprinklers as appropriate used with doors that are self-closing or automatic closing; or

(B) –/60/30 fire doors that are self-closing or automatic closing.

(ii) Windows—

(A) internal or external wall-wetting sprinklers as appropriate used with windows that are automatic closing or permanently fixed in the closed position; or

(B) –/60/– fire windows that are automatic closing or permanently fixed in the closed position; or

(C) –/60/– automatic closing fire shutters.

(iii) Other openings—

(A) excluding voids — internal or external wall-wetting sprinklers, as appropriate; or

(B) construction having an FRL not less than –/60/–.

(b) Fire doors, fire windows and fire shutters must comply with Specification C3.4

The Guide to the BCA states that the intent of Clause C3.2 is:

To require any opening in external walls to be protected, only where the wall is required to have an FRL, to prevent the spread of fire from the boundary of an adjoining allotment, or one building to another building on the same allotment.

This approach is used to determine whether the performance solution complies with the Performance Requirements, as permitted by BCA Clause A0.5(d).

For a building of Type A construction, in accordance with Specification C1.1 Table 3 a wall within 3m of a fire source feature is required to be provided with an FRL.

3.2 Deemed-to-Satisfy Deviation

In accordance with C3.2(a)(i) and C3.4(a)(ii) window openings within an external wall required to achieve a fire resistance level must be protected with window wetting sprinklers and be fixed closed/automatic closing or achieve a

fire rating through other means. In this instance, it is proposed to permit window openings within 3m of the allotment boundaries to remain unprotected. This arrangement can be seen in the figures below.

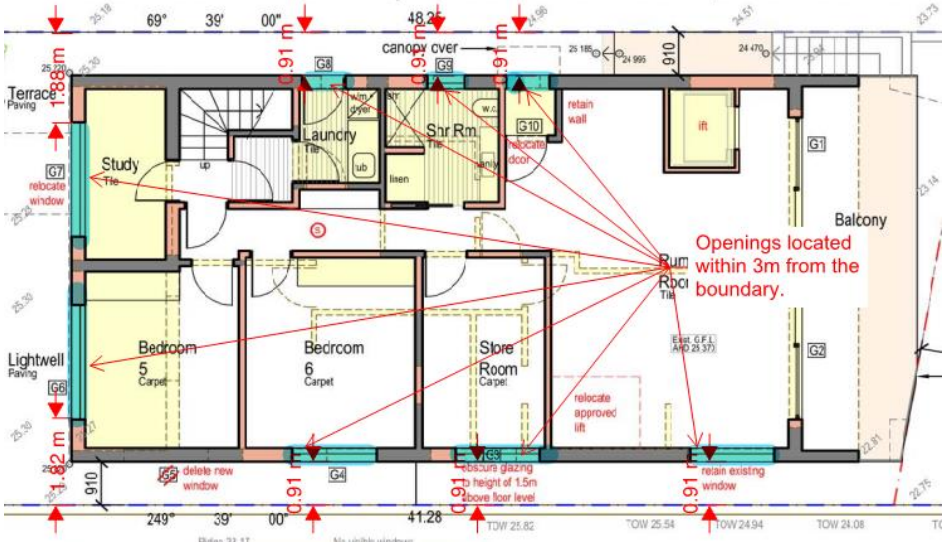


Figure 1 – Ground floor openings located within 3m of the allotment boundaries.

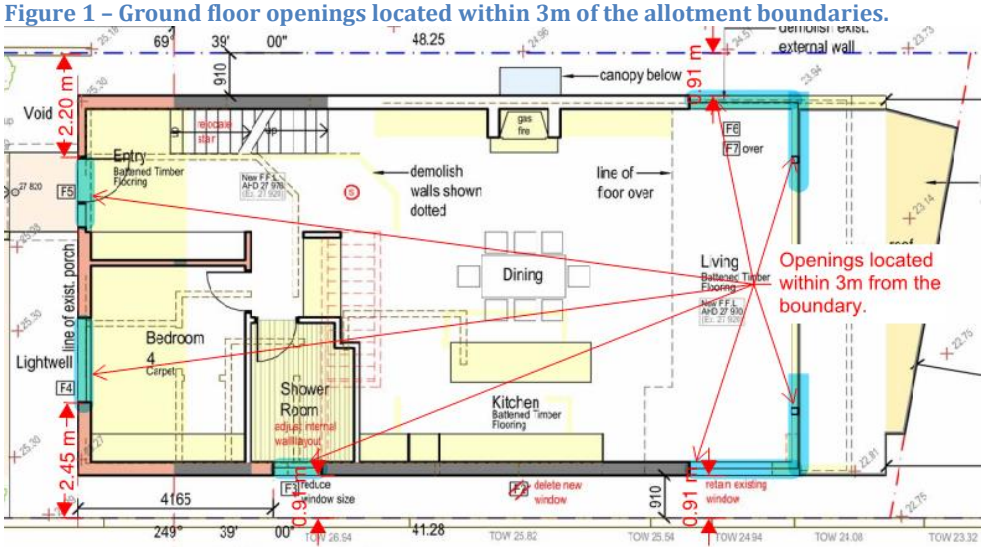


Figure 2 – First floor openings located within 3m of the allotment boundaries.

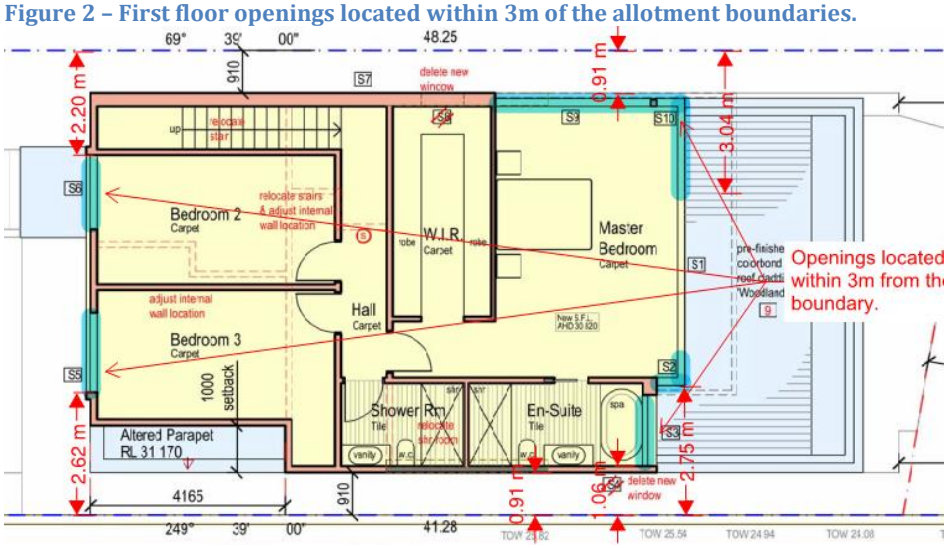


Figure 3 – Second floor openings located within 3m of the allotment boundaries.

The existing openings contained within the existing facade, are located at approximately 910mm from the northern and southern side allotment boundaries and subsequently require protection. It is proposed that these windows remain without the provision of any protection.

3.3 Relevant Performance Requirement

Pursuant to A0.7(b) of BCA the following performance requirements have been identified as being directly relevant to the DTS provisions identified above:

CP2

(a) A building must have elements which will, to the degree necessary, avoid the spread of fire—

(i) to exits; and
(ii) to sole-occupancy units and public corridors; and
(iii) between buildings; and
(iv) in a building.

(b) Avoidance of the spread of fire referred to in (a) must be appropriate to—

(i) the function or use of the building; and
(ii) the fire load; and
(iii) the potential fire intensity; and
(iv) the fire hazard; and
(v) the number of storeys in the building; and
(vi) its proximity to other property; and
(vii) any active fire safety systems installed in the building; and
(viii) the size of any fire compartment; and
(ix) fire brigade intervention; and
(x) other elements they support; and
(xi) the evacuation time.

3.4 Assessment Methodology

In order to address the provisions of the BCA, a performance based approach will be adopted to demonstrate compliance of the Performance Solution with the BCA. The proposed Performance Solution will review the proposed solution using qualitative and comparative assessment against the requirements of CP2.

3.5 Acceptance Criteria

It must be accepted that the building does not promote fire spread to or from the boundary in excess of the existing class 1a building. The current building is considered to satisfy the requirements of BCA Volume 2 (as applicable to class 1a buildings) in terms of boundary setback. If the proposed performance solution is capable of demonstrating the proposed building does not substantially differ from that the original three-storey class 1a residence, the boundary setbacks required for a class 1a building will be considered to be satisfactory therefore achieving compliance with the relevant provisions of the BCA.

3.6 Qualitative Assessment

Whilst the BCA considers the building to be a class 2 building with a rise in storeys of three, the building was originally designed and constructed as a class 1a residential building and therefore the building has elements which are more similar to that of a class 1a building, including the associated setbacks. Whilst the building is proposed to be used as two separate residential accommodations, the general arrangement of the building is not considered to be dissimilar to a class 1a building as some of the applicable windows are all located within the existing part of the building which is currently configured as a class 1a building with the addition of windows to the areas which are proposed to be extended.

Class 1 dwellings (houses and townhouses) are required to be setback from the boundary by 900mm. A class 2 apartment building requires a far greater setback of 1.5m for buildings of Type C construction, or 3m for buildings of Type B or Type A construction. The reason behind the increased setback is likely due to the difference in occupancy density, ignition sources and fuel load between the different classes of buildings.

As the proposed works involve a minor increase in the building floor area beyond that of the original class 1a building, it is considered that the fuel load may be increased. It is noted however that the proposed additions are fire separated from the original building via bounding construction and therefore it is not considered that the marginal increase in fire load has provided any increase on the ability for fire to spread towards the adjacent boundary. On this basis, it is proposed to compare the proposed building arrangement against the original class 1a building which has been designed and constructed in a manner similar to that applicable to a current class 1a residential building. It is proposed to review the proposed building against the current building arrangement to determine whether or not the subject building presents an overall increase or decrease in the likelihood of fire spread.

In this instance, it is proposed to compare the two buildings as follows:

Scenario 1 – Existing Building

- The existing building has a rise in storeys of three contained within a single dwelling providing a total of six bedrooms (assumed).
- The occupancy density is likely to be no more than twelve throughout the building at most times.
- The proposed building will have a total of one residence provided with AS3786 smoke alarms in the areas containing sleeping quarters.
- The required setback from the boundary is 900mm however the current setbacks from glazed openings are 910mm.

Scenario 2 – Proposed Trial Design

- The proposed building has a rise in storeys of three.
- The occupant density is likely to be no more than twelve, two per bedroom.
- The proposed building will have a total of two Sole Occupancy Units separated by bounding construction achieved through the floor/ceiling and bounding walls.
- The proposed building will have a total of two residences
- Each residence will be provided with AS3786 smoke alarms.
- The two residences will have interlinked smoke alarms with the below/adjacent residence.
- The proposed setback from the boundary is 910mm.

The comparison between the two buildings and comparison is provided below.

Building Characteristic	Scenario 1	Scenario 2	Net Position
Building Classification	Class 1a	Class 2 residential dwelling.	**Equivalent**
Rise in Storeys	3	3	**Equivalent**
No. of SOUs	1	2	**Negative** The fire hazard is increased based on the additional kitchen provided within the building.
Number of Bedrooms	3-6 for a large dwelling	6	**Positive** The total number of bedrooms is reduced thereby reducing the number of mattresses, fire sources and occupants sleeping.
Total Occupants	12	12	**Equivalent** Given the low number of occupants overnight means that occupants can evacuate sooner.
Floor Area of the Largest	325m^2	250m^2 Main Unit 75m^2 Granny Flat	**Positive**

Building Characteristic	Scenario 1	Scenario 2	Net Position
Fire Compartment			The building is provided with fire compartmentation by the bounding construction between the apartments (granny flat to the main residence).
Average Fuel Load Density	Density 970MJ/m^2 as outlined in IFEG for 95% fractile for dwellings (IFEG 2005)	Class 2 part - Density 970MJ/m^2 as outlined in IFEG for 95% fractile for dwellings (IFEG 2005)	**Equivalent**
Fire Hydrant System	Street fire hydrant coverage provided	Street fire hydrant coverage provided	**Equivalent**
Fire Extinguishers	Not required.	Required within building.	**Positive** Occupants can choose to extinguish any fires at the incipient stages if deemed possible or appropriate.
Smoke Alarms and Detectors	AS3786 alarms required in storeys containing bedrooms.	AS3786 smoke alarms required in storeys containing bedrooms. The smoke alarms provided within the two dwellings are to be interlinked.	**Positive** Thermal alarms provided in each dwelling will be interlinked so if heat from a fire is detected all the alarms simultaneously activate to warn all occupants within the building.
Fire Resistance Level of External Wall	No FRL required as the setback from the boundary is in excess of 900mm.	No FRL provided. The external walls to be provided with a FRL of 90/ 90/ 90 in accordance with the BCA.	**At Least Equivalent**
Distance Between Unprotected Openings and the Boundary	900mm required.	910mm proposed.	**At Least Equivalent** The external windows do not require protection if at least 900mm from the side allotment boundary, but windows are currently located at 910mm from the boundary and therefore do not require protection as a class 1a building.

As is evident, the comparative analysis undertaken above indicates that whilst the building now contains two class 2 SOUs the building has elements which mean that the potential for fire spread towards the boundary based on the fire intensity is reduced or at least equivalent to a class 1a residence.

In addition, as bounding construction is required to be provided between the granny flat and the main unit the wall segregating the two dwelling shall have an FRL of 90/90/90 and any doorways located between the granny flat and main unit shall be a self-closing fire door with FRL of -/60/30 in accordance with the Spec C1.1 Table 3 of the BCA. The required level of bounding construction is shown is the figure below.

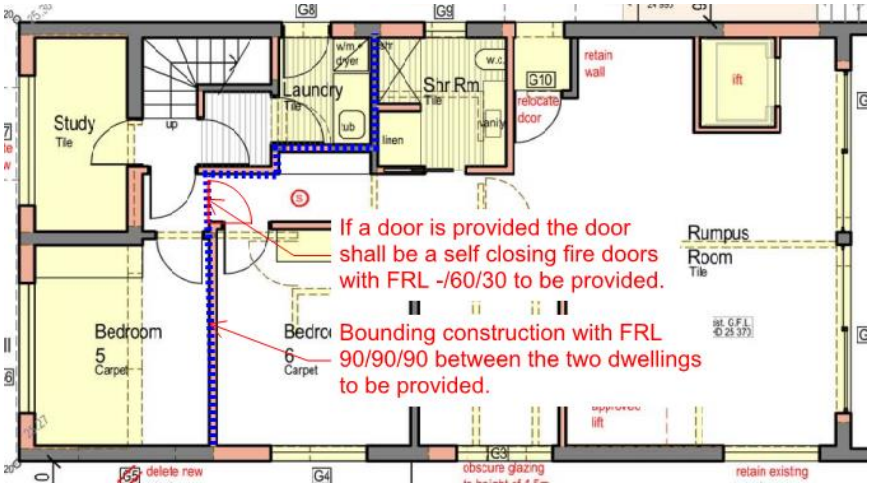


Figure 4 – Ground floor Bounding Construction

On this basis, the building is not considered to present an increased level of risk of fire spread towards the boundary despite the proposed changes to the building and it is therefore considered that application of the boundary setbacks for a Class 1 building are more appropriate in this instance. Notably the impact of a fire from a neighbouring building is not considered to differ for either scenario as this is irrespective of the receiving building's classification.

On this basis the provision of unprotected windows currently located at 910mm from the side allotment boundaries is considered to comply with the requirements of CP2 in this instance, subject to the assessment contained below.

3.7 Assessment against relevant Performance Requirement

The following table summarises the proposed qualitative assessment against the relevant performance requirement CP2.

CP2	
(a) A building must have elements which will, to the degree necessary, avoid the spread of fire-	
(i) to exits; and	Not applicable to this performance solution
(ii) to sole-occupancy units and public corridors; and	Not applicable to this performance solution
(iii) between buildings; and	The existing/new openings which face onto the northern and southern allotment boundaries are located at 910mm from the boundary and are considered compliant with the building in its current arrangement as a class 1a building. As demonstrated that the proposed building, has elements which decrease the risk of fire spread when compared to the original class 1 building and on this basis it is considered that the original 900mm applicable for class 1 buildings is considered an appropriate setback it is proposed that the existing windows remain in place without any further treatment.
(iv) in a building	Not applicable to this alternative solution.
(b) Avoidance of the spread of fire referred to in (a) must be appropriate to-	
(i) the function or use of the building; and	The building is considered to be a three-storey apartment building. The SOU provided on the ground level is provided with its own independent egress to open space. The building is considered to have elements which are more consistent with that of the original class 1a building which was originally constructed.
(ii) the fire load; and	The fire load in each compartment is considered to be reduced given the provision of fire rating between the SOUs when compared to the original class 1a building.
(iii) the potential fire intensity; and	The fire intensity expected, defined by the floor area, fuel load and ventilation to be consistent and equivalent to the original class 1a building.

CP2	
(iv) the fire hazard; and	Fire hazards are mainly confined to the kitchen area of each dwelling and is generally consistent with that expected of a residential building. The fire hazard is considered to be comparable to a similar occupancy.
(v) the number of storeys in the building; and	The rise in storeys of the building is three.
(vi) its proximity to other property; and	The building openings are separated by approximately 910mm from the allotment boundary which is considered appropriate for the existing class 1a building. The discussion above demonstrates that the risk of fire spread is reduced or at least equivalent for the proposed building despite the reclassification as a class 2 building and on this basis, it is considered that the existing setbacks are appropriate.
(vii) any active fire safety systems installed in the building; and	The building will be provided with a smoke alarms and thermal alarms to alert occupants in the event of a fire.
(viii) the size of any fire compartment; and	The fire compartment size does not exceed the DTS requirements.
(ix) fire brigade intervention; and	The nearest fire brigade in Dee Why is a fulltime station and within close proximity to the site.
(x) other elements they support; and	Not applicable to this performance solution
(xi) the evacuation time.	Not applicable to this performance solution

3.8 Assessment Conclusion

Based on the above discussion and analysis, it is considered that the proposed arrangement provides a decrease risk or at least equivalent risk of fire spread when compared to the original class 1a building and on this basis, it is considered that the original 900mm applicable for class 1a buildings is considered an appropriate setback for the proposed development. On this basis, it is proposed that the existing and proposed windows remain without any further treatment.

On this basis, it is considered that the relevant performance requirements CP2 are satisfied subject to the following requirement:

1. Each SOU shall be provided with interlinked AS3786 thermal alarms which are configured such that when a device operates in one apartment, it operates within the other apartment thereby offering occupants of the adjacent apartment the same opportunities to evacuate the building. Notably, this should be provided in addition to the minimum AS3786 smoke alarms which are required to be provided to comply with BCA Spec. E2.2a Clause 3.
2. The bounding walls between the two SOUs shall have a FRL of 90/90/90 in accordance with the Spec C1.1 Table 3 of the BCA, as shown in the following figure.
3. Any doorways located within the bounding construction between the granny flat and the main unit shall be self-closing fire doors with a FRL of -/60/30 in accordance with the Spec C1.1 Table 3 of the BCA, as shown in the following figure.

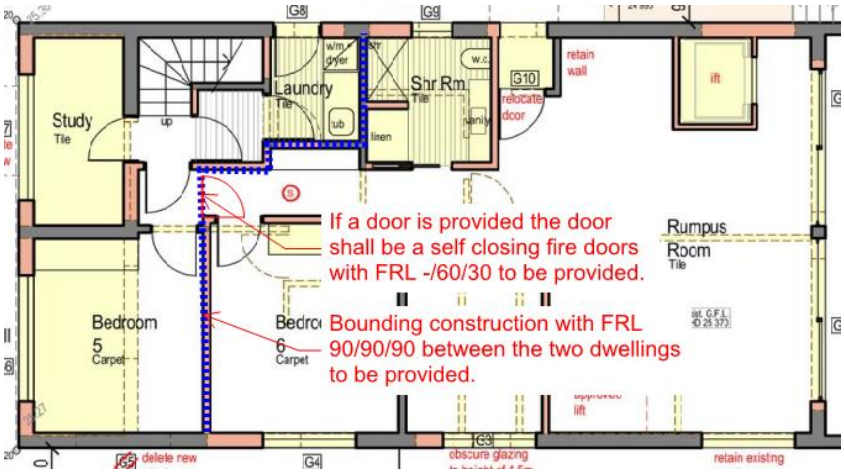


Figure 5 – Ground floor Bounding Construction

4.0 CONCLUSIONS

4.1 Conclusion

The Performance solutions have been developed using qualitative assessment with the Deemed-to-Satisfy Provisions and is considered to comply with BCA Performance Requirement CP2. The BCA recognises these Assessment Methods as acceptable methods for determining that the Performance solutions satisfy the Performance Requirements in accordance with BCA Clauses A0.3(a)(i)) and A0.5(d).

Accordingly, based on the above, it is considered that the directly related Performance Requirement CP2 have been met, provided the Performance solutions requirements listed in the executive summary are implemented.

4.2 Specification of the Final Trial Design

Considering the relevant provisions of the BCA and the above assessment, the Performance solution, subject to the provision of the Trial Design requirements, is considered to meet and comply with the Performance Requirement CP2. The Trial Design requirements detailed in each solution and in the Executive Summary become the Performance solutions.

4.3 Maintenance Requirements

The recommendations of this report must form part of the annual fire safety schedule for the building to ensure the recommendations of this report are complied with throughout the building operation.

4.4 Requirements of the Performance solution

The discussions undertaken have demonstrated compliance with the relevant performance requirements via the proposed design and installation of offset measures. The offset measures required as part of this Performance solution are listed in the Executive Summary and must be fully implemented in order for compliance to be achieved.

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5.0 REFERENCES

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- Australian Building Codes Board, “The Building Code of Australia”, Edition 2016, May 2016, Australia.
- Australian Building Codes Board, “The Guide to the Building Code of Australia”, Edition 2016, May 2016, Australia.
- IFEG (2005). International Fire Engineering Guidelines 2005, ABCB.

Appendix A – Data Relied upon in the FER Process

Common Abbreviations Used in Fire Engineering

Abbreviation/Term	Meaning
AFAC	Fire and Emergency Service Authorities Council
AS	Performance solution
ASB	Performance solution Brief - identical to FEB. ASB will not be used other than to relate this term to the Fire Engineering Brief.
ASR	Performance solution Report - identical to FEB. ASR will not be used other than to relate this term to the Fire Engineering Report.
BCA	Building Code of Australia.
CFD	Computational Fluid Dynamics – Used to describe the fire modelling for a building
Comparative	A methodology used for a fire engineering analysis that uses a comparison with the deemed to satisfy provisions of the BCA. This methodology shows that the performance solution is equivalent to the DTS provisions of the BCA and is often referred to as the equivalence approach.
DTS	Deemed-To-Satisfy - Representing the deemed to satisfy provisions set out in the BCA.
Equivalence	The equivalence approach is a fire engineering approach using a comparison to the DTS provisions of the BCA.
FEB	Fire Engineering Brief - identical to ASB. FEB is used throughout the report.
FER	Fire Engineering Report - identical to ASR. FER is used throughout the report.
FDS	Fire Dynamics Simulator – The software program used to perform fire modelling on buildings
FRL	Fire Resistance Level
FRNSW	Fire and Rescue New South Wales
IFEG	International Fire Engineering Guidelines
NFPA	National Fire Protection Authority
SAMFS	South Australian Metropolitan Fire Service
SFPA	Society of Fire Protection Engineers.

Client Design and Building Regulatory Objectives

The client design objectives are to address the issues of deemed-to-satisfy non-compliance with the production of a performance solution that meets the related Performance Requirement.
One of the purposes of this Fire Engineering Report is to provide the stakeholders with a document for consideration and to add further input with regards to the specific objectives.
The structure of the BCA is depicted in the following figure and is a hierarchal document with objectives, functional statements and Performance Requirement.

The primary objectives of the BCA are to protect the life safety of occupants by allowing them to exit the building without being exposed to hazardous or untenable conditions, the protection of adjacent buildings from collapse or fire spread and protection of the life safety of fire fighters by giving reasonable time for the emergency personnel to perform their duties.

The Performance Requirement are the only section of the BCA to which a design must comply, with objectives and functional statements given as guidance to explain the intent of the Performance Requirement. Satisfying the Performance Requirement can be achieved through one of three ways:

a) Complying with Deemed-To-Satisfy (DTS) provisions of the BCA
b) Formulating a performance solution which complies with the Performance Requirement
c) Combination of a) and b)

For this particular project the means of compliance to the BCA will be shown by complying to a/b/c above.
BCA clause A0.9 provides the following assessment methods to determine that a building solution complies with the BCA Performance Requirement:

a) Evidence to support that the use of a material, form of construction or design meets a Performance Requirement or a Deemed-to-Satisfy Provision
b) Verification Methods such as—
    i) The verification methods in the BCA; or
    ii) Such other verification methods as the appropriate authority accepts for determining compliance with the Performance Requirement
c) Comparison with the Deemed-to-Satisfy Provisions
d) Expert Judgement

The assessment methods that will be adopted for this project are in accordance with A0.9 above and the specific methods are detailed in the performance solution sections.

Methods of Analysis

The methods of analysis used in the development of performance solutions are detailed in BCA Clause A0.9, and include

A0.9(b)(i) *Verification Methods, such as the Verification methods in the BCA*

A0.9(b)(ii) *Verification Methods, other than those in the BCA that the appropriate authority accepts for compliance with the Performance Requirement*

A0.9(c) *Comparison to the* deemed-to-satisfy provisions of the BCA

A0.9(d) *Expert judgement*

In order to satisfy BCA Clause A0.5 - Meeting the Performance Requirement

(b) *formulating a performance solution which -*
(i) *complies with the Performance Requirement; or*
(ii) *is shown to be at least equivalent to the Deemed-to-Satisfy Provisions;*

The specific assessment methods used for the analysis are detailed in performance solution section for each issue.

Relevant IFEG Sub-Systems

The relevant IFEG sub-systems (SS) for this analysis are:

IFEG Sub-System	Description	Symbol
Sub-system A Fire Initiation and Development and Control	Limitation of ignition sources Limitation of nature and quantity of fuel Arrangement and configuration of fuel Separation of ignition sources and fuel Management of combustibles including housekeeping measures Electrical safety equipment Regular plant maintenance Adherence to procedures for 'hot work' (e.g. welding)	

IFEG Sub-System	Description	Symbol
Sub-system B Smoke Development and Spread and Control	Smoke barriers Natural smoke venting Mechanical smoke management	
Sub-system C Fire Spread and Impact and Control	Separation of fuel Separation of buildings Fire resistive barriers Fire resistive structural elements Fire resistive air-handling ducts Fire resistive dampers Exposure protection	
Sub-system D Fire Detection, Warning and Suppression	Automatic and manual detection equipment Automatic and manual warning equipment Surveillance equipment Automatic suppression equipment Manual suppression equipment	
Sub-system E Occupant Evacuation and Control	Evacuation plans Occupant training Emergency communications Egress signage Egress routes (including fire isolated elements)	
Sub-system F Fire Services Intervention	Type of fire services available (full-time/permanent or volunteer). Characteristics of fire services capability and resources Fire service access to the site and to the building Water supplies and infrastructure	

Acceptance Criteria and Factors of Safety for the Analysis

Qualitative Assessments

The acceptance criteria for qualitative assessments are the equivalence to a deemed to satisfy solution (preferred) or the collective agreement of the stakeholders. The IFEG allows both qualitative and quantitative approaches and states that -
"the methods chosen will be appropriate to the approach used".
The IFEG states -
"In the minority of cases, qualitative analysis may be agreed during the FEB process to be sufficient for the consideration of a single non-compliance issue. The basis (logic) on which this approach is used should be documented with appropriate references. A "Delphi" approach may also be appropriate in certain circumstances, where a group of suitably qualified expert professionals reach consensus agreement regarding the suitability of a particular solution."
The IFEG further states -
"Both comparative and absolute approaches may be adopted in the analysis strategy. The methods chosen will be appropriate to the approach used.

Comparative approach:

Typically, the fire safety provided by one element, or a sub-system, or the complete fire safety system, is compared to the level of fire safety that would be achieved in an identical building in which that element, sub-system or system is designed in compliance with the deemed-to-satisfy or prescriptive provisions identified in Section 1.2.8. If the analysis is carried out on such a comparative basis, it will involve the same assumptions, models, calculations and input data for the proposed trial design and the deemed-to-satisfy or prescriptive design.

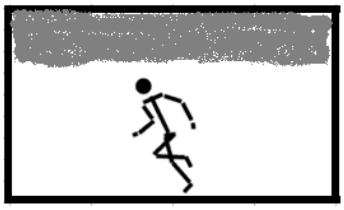
A comparative approach aims to determine whether the performance solution is equivalent to (or better than) the deemed-to-satisfy or prescriptive design. The comparative approach is often referred to as an "equivalence" approach."

Quantitative Assessments

The following acceptance criteria are proposed for the assessment of the performance solutions compliance with the Performance Requirement of the BCA.

The acceptance criteria will be to demonstrate that fire safety is not adversely affected and that the occupants may safely evacuate the building and/or the fire will not spread to adjacent property and/or will allow fire fighters to safely perform their duties.

Heat Radiation - The limiting condition for radiation is assumed to be in the range 1.57 to 6.3kW/m2. The tolerance time for radiation at this level is 6 minutes.



$T < 1.57kW/m^2$ to $6.3kW/m^2$

Fire Brigade Intervention:

In considering the role of the fire brigade in attacking a fire, it is important to estimate the time at which the brigade will be effective in limiting the spread of the fire and reducing the heat output of the fire in the enclosure of fire origin. However this response time is variable and is a function of the time at which the alarm is received at the fire station, the travel time to the building, the setting-up time once the fire brigade has arrived and the time to impact the fire.

While the fire brigade will be available to assist evacuation through search and rescue of occupants, this action is not relied upon for occupant evacuation. The fire safety assessment is therefore conservative in this regard.

The conditions that define the tenability criteria for fire brigade personnel will be considered if the occupants cannot be shown to have sufficient available egress time prior to onset of untenable conditions. In certain instances the fire brigade intervention times will be required to be determined and tenability for the fire fighters assessed i.e. deletion of sprinklers from a carpark. The time for the fire brigade to arrive and commence fire fighting operations will be determined using the Fire Brigade Intervention Model or literature data on the fire brigade response time to fires.

Summary of Tenability Failure Criteria:

Condition	Criteria
Convective heat	Temperature > 60°C when smoke layer is below tenability height.
Radiant heat exposure	2.5kW/m² at head height or smoke layer temperature exceeds 200°C when above tenability height of 2.1m.
Visibility	10m when smoke layer is below tenability height of 2.1m for large rooms or 5m for small rooms.
Toxicity	OD > 0.1m–1 (10dB/m) when smoke layer is below tenability height of 2.1m, but not accessed if visibly acceptable.

The following table is an overview of the tenability's as accepted by the Fire and Emergency Service Authorities Council (AFAC)[1].

	Routine Condition	Hazardous Condition	Extreme Condition	Critical Condition
Maximum Time, min	25	10	1	<1
Maximum Temperature, °C	100	120	160	235
Maximum Radiation, kW/m²	1	3	4 - 4.5	>10

[1] Weng Poh 'Tenability in building fires: Limits and design criteria'. Fire Australia, 2010, No. 3,. pp 24-26

Approaches and Methods of Analysis

Approach

Fire engineering design can involve the use of a number of approaches including:

- Comparative or Absolute
- Qualitative or Quantitative
- Deterministic or Probabilistic

The IFEG gives descriptions of each type of approach, where it can be noted that a deterministic or probabilistic approach can only be applied to a quantitative analysis. The differences between a comparative and absolute approach and typical examples of acceptance criteria are depicted in the following table (reproduced from UK Fire Engineering Guidelines PD7974-0).

Comparative vs. Absolute Approach

	Fire Safety Objectives	
Analysis Method	**Deterministic**	**Probabilistic**
Comparative	Time available for escape is at least equal to that in an equivalent code compliant building	Level of risk of life equivalent to a code compliant building
Absolute	The time available for escape exceeds the time to untenable conditions	Expected number of casualties per year

A definition of each type of approach is outlined in the following table, which has been adopted from the IFEG. The type of approach adopted will depend on the type of compliance issue in question and subsequent methods of analysis will be prepared.

Analysis Approaches

Approach	Definition
Comparative	A comparative approach aims to determine whether the performance solution is equivalent to (or better than) the deemed-to-satisfy or prescriptive design. The comparative approach is often referred to as an "equivalence" approach.
Absolute	In an absolute approach, results of the analysis are matched directly against the Performance Requirement of the BCA, using agreed acceptance criteria.
Qualitative	A qualitative analysis may be agreed during the FEB process to be sufficient for the consideration of minor stand-alone compliance issues. The basis (logic) on which this approach is used should be documented with appropriate references.
Quantitative	The complexity of the compliance issues will often require a quantitative approach. This entails the use of one or more of the many analysis methods available The quantitative methods will often be supported by additional qualitative arguments.
Deterministic	Deterministic analyses are based on physical relationships derived from scientific theories and empirical results. Characteristically, for a given set of initial boundary conditions, a deterministic methodology will always produce the same outcome. They do not, however, indicate the probability of that outcome being realized.
Probabilistic	Probabilistic approaches use a variety of risk based methodologies. These methods generally assign reliabilities to the performance of the various fire protection measures and assign frequencies of occurrence of events. They may analyse and combine several different scenarios as part of a complete fire engineering evaluation of a building design. This use of multiple scenarios and their combination through probabilistic techniques is the key feature of some of the methods.

Construction and Commissioning Requirements

The fire safety measures shall be designed, installed and commissioned in accordance with the relevant Australian Standards.

- The management of the building must be aware of the Performance solution contained within the building, as well as the required measures for maintenance.
- The Building Management System, must incorporate maintenance measures to ensure satisfactory maintenance, testing and inspection of all fire safety measures.

All fire safety measures are to be commissioned and tested prior to occupation of the building. The fire services contractor must provide certification of the installation and commissioning of the fire services required by this report, including but not limited to:

- Fire Hydrant Systems
- Smoke detection
- Fire doors and acoustic seals
- Exit signage & emergency lighting
- Appropriate door hardware and door swing

The fire safety measures within the building must be maintained to ensure correct operation at all times that the building is occupied. All fire fighting equipment should be tagged when tested/inspected and log books kept up-to-date for all smoke detection, warning systems and sprinkler systems (where installed).

A Form 3 fire safety certificate must be submitted to the local council each year indicating satisfactory performance of the fire safety measures contained within the building.

The correct operation and maintenance of the buildings fire safety measures is critical in affording an adequate level of fire safety. Other issues identified in the FEB/R that will need to be incorporated into the management in use of the facility include:

- No smoking policy is to be implemented in all public areas.
- Commissioning and integrated function testing of all fire safety and protection systems including interfaces to ensure proper function.
- All essential services are to be maintained and tested in accordance with BCA and Australian Standard AS1851.
- Ensure exits and paths of travel to exits remain unobstructed (in particular stairways).
- Avoid storage of materials in unoccupied areas.
- Limit storage of flammable/combustible materials to designated and approved areas.
- Prevent chocking open fire/smoke doors.
- Prevent storage of materials that could hinder access to fire fighting equipment.