AEDGROUP
Innovation & expertise in building regulations

Fire Engineering Report

Melaleuca 1

Diggings Terrace,

Thredbo

DATE ► 27 March 2024

FIRE ENGINEERING REPORT No ►F2744 FER Rev 06

PREPARED FOR ► Hillam Architects

PREPARED BY ► AED Fire

FRNSW REFERENCE ► N/A

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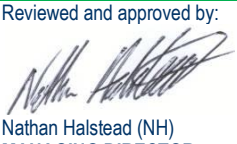

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REVISION STATUS				
REVISION	**DATE**	**STATUS**	**WRITTEN**	**CHECKED**
F2744 FER Rev 01	31 October 2019	Draft issued for client review	AP	LC/NH
F2744 FER Rev 02	07 November 2019	Final Report	AP	LC/NH
F2744 FER Rev 03	4 April 2022	Revised report. Addition of assessment of the undercroft separating wall	AP	LC
F2744 FER Rev 04	14 March 2024	Revised report, updating the design requirement of the intumescent paint to the penetrating timber element on one side of the wall, Occupant Warning System and sub-floor protection of the subject building's side only.	AP	LC/NH
F2744 FER Rev 05	21 March 2024	Revised report with the following: - Updated approved floor plans, - Change from Class 1a to Class 1b as advised by PCA, - Referencing MOD 1 of Development Application, - Addition of undercroft separating wall Building Code of Australia requirements to Executive Summary table.	AP	LC
F2744 FER Rev 06	27 March 2024	Report updated with clarifications as per the Client's comments including: - Basement storey fire wall, - Architect and builder details to Section 2.3.	AP	LC

COMMERCIAL IN CONFIDENCE

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1 Executive Summary

AED Fire has been commissioned by **Hillam Architects** to carry out a fire safety engineering analysis and assessment at Melaleuca 1 at Diggings Terrace, Thredbo NSW.

This report details the fire engineering briefing process and reporting phase to report on the findings of the fire engineering assessment undertaken to verify compliance with a number of Performance Requirements of the Building Code of Australia (BCA)[1]. This document covers the Fire Engineering Report (FER) process. The Performance Solutions have been formulated in accordance with the International Fire Engineering Guidelines[2].

This version of the document represents the FER process, which will be issued to the stakeholders for their review and approval.

The subject building is an existing building with proposed extension areas as shown in the plans under Section 3 of this report, with a Section S4.55 – MOD1 (Application number MOD 10108 (DA No. 9373 MOD 1)), dated 15 January 2021. The MOD1 included modifications to the approved development of the following:

- Extension of an existing deck and privacy screen on Level 2,
- Installation of external stairs to access the basement level,
- Installation of a roof structure to cover proposed external stairs,
- Retention of stone cladding and relocation of entry door to basement level, and
- Installation of metal cladding to screen basement undercroft area.

Following advice from the Principal Certifier, the building classification within this report has been updated from a Class 1a to a Class 1b. See Appendix C.

The Performance Based Assessment provides a Performance Solution, as defined by the Building Code of Australia to permit performance based variations to the Deemed-to-Satisfy (DTS) provisions of the Building Code of Australia. The report has assessed the building and proposes suitable solutions considered appropriate for proposed building design. The assessments verify that the relevant Building Code of Australia provisions have been addressed.

The Performance Solutions are proposed as follows:

PS#	PROPOSED PERFORMANCE SOLUTION	Building Code of Australia Deemed-to-Satisfy CLAUSE Determined in accordance with Building Code of Australia Clause A2.4(3)(a)	Building Code of Australia PERFORMANCE REQUIREMENT Determined in accordance with Building Code of Australia Clause		ASSESSMENT METHOD	*IFEG Sub-system (s) (SS)**
			A2.4(3)(b)	A2.4(3)(c)		
1	**Fire Rated Wall Separation Penetration** To address the timber roof and structural elements penetration through the fire rated separating wall of a Class 1b duplex building to the adjoining unit. The issues include: • The residential storeys contains timber elements that penetrates through the fire separating wall, • The separating wall does not continue down to the undercroft storey where the structural beam and columns are exposed, • The column and beams is situated over the allotment boundary and encroaches on the adjoining sublease area, • The beams of a single dwelling penetrates the wall into the undercroft void below the adjacent dwelling, • The separating wall does not commence at the footings or ground slab and is not a horizontal projection,	3.7.3.2	P2.3.1	N/A	Absolute, Qualitative and Deterministic in accordance with Building Code of Australia clause A2.2(2) (b)(ii) Other Verification Methods	SS-C SS-E SS-F

[1] Australian Building Codes Board. "Building Code of Australia 2019, Amendment 1"
[2] Australian Building Codes Board. "The International Fire Engineering Guidelines 2005"

PS#	PROPOSED PERFORMANCE SOLUTION	Building Code of Australia Deemed-to-Satisfy CLAUSE Determined in accordance with Building Code of Australia Clause A2.4(3)(a)	Building Code of Australia PERFORMANCE REQUIREMENT Determined in accordance with Building Code of Australia Clause		ASSESSMENT METHOD	*IFEG Sub-system (s) (SS)**
			A2.4(3)(b)	A2.4(3)(c)		
	• The floor over the undercroft is a timber flooring that is not permitted.					

Trial Design Requirements for Performance Solution 1 (PS1)

Residential Storey Separating Wall and Timber Element

1. The timber structure that penetrates through the separating wall identified from item 2 of AED Group's Clause 94 Significant Issues Report, report number: Project 9592 Rev A, dated 29 October 2019, shall be coated in intumescent paint for 400mm as measured from the site of timber penetration of the fire separating wall, in the subject building's side of the wall, shall be treated as follows:
    a. All surfaces be prepared as per CAP Coating Australia specification;
    b. Apply 1 coat of Zinsser 1.2.3 primer;
    c. Apply CAP508 intumescent paint to achieve a total Dry Film Thickness (DFT) of not less than 700 microns DFT (3 coats usually);
    d. Apply topcoat to match architectural colour and finish requirements (note that a moisture resistant topcoat must be prepared in areas of high moisture such as kitchens and bathrooms);
    e. Application, certification, CAPMark RFID tag all be as per CAP Coating Australia specification;
    f. The CAP508 intumescent paint shall be applied by a CAP Coating Australia recognised applicator; and
    g. Certification from CAP recognised applicators shall state that the system has applied to the thickness above and as per the Manufacturer's Specification and the fire engineered solution.

2. Enhanced smoke detection system shall be installed in accordance with AS1670.1-2018 to the subject dwelling, including:
    a. Smoke detectors shall be located within all rooms on the residential storeys, linked to an Occupant Warning System. Where the use of the room may cause spurious alarms, a suitable alternative as per AS 1670.1 may be installed, and
    b. The smoke detectors will have a maximum distance of 8m between them, and
    c. The floor void over the undercroft area shall be equipped with thermal detectors and located within 2m of the separating wall and provided with a fire-rated access panel for maintenance access and inspection that is tested to AS 1530.4 – 2014, and
    d. The occupiable undercroft area shall be equipped with thermal detectors spaced as above, and
    e. The detectors on all storeys within a single dwelling, including the thermal detectors within the void and the undercroft area, shall be interconnected.

3. The activation of the smoke or thermal detector shall operate a Building Occupant Warning System for the subject dwelling. The Building Occupant Warning System may include sounder bases for the smoke detectors.

Figure 1-1 Timber structure penetration of the fire rated separation wall crossing over to the adjoining neighbouring Melaleuca 2.

Figure 1-2 Timber structure penetrations of the fire rated separation wall.

Sub-Floor Design Requirements

4. This Performance Solution is based on the separating wall within the undercroft constructed as per Clause 3.7.3.2 of the Building Code of Australia, except the undercroft separating wall extends to the underside of the floor over the undercroft.

5. The underside of the floor over the undercroft shall be installed with:
    a. A tested fire-rated ceiling system to AS 1530.4 – 2014 for at least 60/60/60, and
    b. The fire-rated plasterboard shall be suitable for external weather use, and
    c. The junction of the fire-rated separating wall and fire-rated ceiling shall be sealed with fire-rated intumescent sealant, and
    d. The fire-rated ceiling shall extend down to the steel beam, and
    e. Services penetrations through the fire-rated ceiling shall be sealed with a tested system or approved system as per AS 1530.4 – 2014 to achieve a fire-resistance level of at least 60 minutes to maintain the fire-resistance level of the ceiling.

6. This Performance Solution is based on the basement undercroft area being provided with the following:
    a. A separating wall achieving a minimum fire-resistance level of 60 minutes as per the Building Code of Australia, and
    b. Services penetrations through the separating wall being protected as per AS 1530.4 – 2014 achieving the minimum fire-resistance level -/60/60, and
    c. The separating wall shall be formed with 60 minute fire-resistance level, from the ceiling to the floor slab.

7. The exposed steel beams to the floor over the undercroft, for the extent of the subject dwelling, shall be either:
    a. Protected from the undercroft area beneath by the proposed 60 minute fire rated ceiling above, or
    b. Shall be encased in three sided 60/-/- fire-resistance level plasterboard that is weatherproof and tested to AS 1530.4-2014. The junction between the steel beam and the fire-rated ceiling shall be sealed with a bead of fire-rated intumescent sealant, or
    c. Sprayed with vermiculite system tested to AS 1530.4 – 2014 to achieve a fire-resistance level of at least 60/-/- and suitable for external use to the exposed faces of the steel beam, or
    d. Be protected with intumescent paint suitable for steel exposed to weathering, tested to AS 1530.4-2014 to achieve a fire-resistance level of at least 60/-/-, to the exposed faces of the steel beam. The external intumescent paint shall be annually certified as per the internal intumescent paint system above.

8. The exposed column in the undercroft shall be protected with either:
    a. 4 sided 60/-/- fire-resistance level plasterboard that is weatherproof and tested to AS 1530.4-2014. The junction between the fire-rated protection of the column and the fire-rated ceiling shall be sealed with a bead of fire-rated intumescent sealant, or
    b. Sprayed with vermiculite system tested to AS 1530.4 – 2014 to achieve a fire-resistance level of at least 60/-/- and suitable for external use, or
    c. Be protected with intumescent paint suitable for steel exposed to weathering, tested to AS 1530.4-2014 to achieve a fire-resistance level of at least 60/-/-. The external intumescent paint shall be annually certified as per the internal intumescent paint system above.

Important Note Regarding the Trial Design

The trial design detailed in the above table shall be strictly complied with and any inability to comply with this design during the installation of the measures ***MUST*** be discussed with the fire engineer prior to installation. AED Fire will not provide fire engineering compliance statements on designs where the design has been modified without consultation with AED Fire. This consultation will allow the proposed design alterations to be assessed against the Performance Solution(s) and the report to be revised accordingly.

The trial design requirements do not replace the Building Code of Australia Deemed to Satisfy provisions. The trial design requirements are measures required to support the Performance Solutions assessed in the report. The trial design requirements are in addition to any Deemed to Satisfy provisions required to be provided to the building unless it is noted in the Performance Solution and trial design that a Deemed to Satisfy provision is being deleted or modified by the trial design. AED Fire are not responsible for determining compliance with the Building Code of Australia Deemed to Satisfy provisions - see relevant Building Code of Australia compliance report for the required Deemed to Satisfy provisions.

Where optional trial design requirements are provided, the full implementation of any of the options will achieve compliance with this report. The partial implementation or selective implementation of several options will not achieve compliance and should be discussed with the author.

1.1 Conclusion

It is concluded that, subject to the application of the requirements of the trial design and management in use procedures and based on the limitations and assumptions listed below, the trial design will meet and comply with the relevant performance requirements.

General Requirements of all Performance Solutions

1. **The Fire Safety Schedule** for the building should be updated to specifically reference the requirements of this Fire Engineering Report.
2. **Commissioning & Testing** - All fire safety measures are to be maintained and tested in accordance with AS 1851 and the Environmental Planning & Assessment Act 1979.

1.2 Assumptions and Limitations of the Final Trial Design

The following are known assumptions and limitations of the Trial design –

- None

1.3 Construction and Commissioning Requirements

The fire safety measures shall be designed, installed and commissioned in accordance with the relevant Australian Standards. Other requirements are presented in Appendix A of this report (Section 6.10 Construction and Commissioning Requirements)

1.4 Management and Use

The following management in use procedures are required by this report –

1. The intumescent paint coating on the timber structure must be reviewed annually and will be added as an item to the AFSS.

1.5 Maintenance Requirements

The fire safety measures required by this report shall be listed on the schedule of essential services for the building and shall be subject to maintenance and testing as required by the relevant part of AS1851.

2 Introduction

AED Fire has been commissioned by **Hillam Architects** to carry out a fire safety engineering analysis and assessment on Melaleuca 1 at Diggings Terrace, Thredbo NSW. This report will detail the proposed Performance Solutions for a number of deemed-to-satisfy non-compliances arising from the timber roof and structural element penetration through the fire separating wall in a duplex.

This report details the fire engineering briefing process and reporting phase to report on the findings of the fire engineering assessment undertaken to verify compliance with a number of Performance Requirements of the Building Code of Australia (BCA). This document covers the Fire Engineering Report (FER) process. The Performance Solutions have been formulated in accordance with the International Fire Engineering Guidelines[3].

This version of the document represents the FER process, which will be issued to the stakeholders for their review and approval.

2.1 Scope and Basis of the Project

This report a performance based assessment of the Performance Solutions required to address the Deemed-to-Satisfy non-compliance issue identified by AED BCA Consultant in a Clause 94 Significant Issues Report at Melaleuca 1, Lot 774 Diggings Terrace, Thredbo NSW

This report addresses compliance with the Building Code of Australia 2019. The issues to be addressed are:

- Timber structure penetrations into fire rated separation wall in a Class 1b duplex, and
- The separating wall to the basement storey does not extend down as far as required by the Building Code of Australia, and
- The Basement storey ceiling over is of timber construction.

2.2 Reference Information and Documentation

This Fire Engineering Report is based on the following documentation:

- Building Code of Australia 2019 Amendment 1, Volume 2 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 2019 Amendment 1, Volume 1 published by the Australian Building Codes Board (ABCB)

The project documents depicted in the following have been reviewed in preparing this report.

[3] Australian Building Codes Board. "The International Fire Engineering Guidelines 2005"

Document	By	Description	Revision
MOD 10108 (DA No. 9373 MOD 1)	Department of Planning, Industry and Environment – Alpine Resorts Team	Modification of Development Consent – Section 4.55(1) of the EP&A Act 1979	15/01/2021
Sheet 18 of 19	N/A	Design Diagram - Proposed external stairway, balcony extension and amended privacy screen	20/11/2020 Rev 9
DA001/MOD 001	Dezignteam	Site Plans	27/05/2020
DA12	Archi Spectrum	Proposed Site and Roof Plan	30/08/2023 Issue B
DA002	Dezignteam	Basement Floor Plan	Dec 2017 Rev. 8
DA10	Archi Spectrum	Proposed Ground and First Floor plan	30/08/2023 Issue B
DA11	Archi Spectrum	Proposed Second and Third Floor plan	30/08/2023 Issue B
DA010/MOD010	Dezignteam	North, South and West Elevations	20/11/2020 Rev. 9.1
DA13	Archi Spectrum	Proposed North and South Elevations	30/08/2023 Issue B
DA14	Archi Spectrum	Proposed West Elevation	30/08/2023 Issue B
DA15	Archi Spectrum	Proposed East Elevation	30/08/2023 Issue B
DA16	Archi Spectrum	Proposed Section A-A	30/08/2023 Issue B
DA17	Archi Spectrum	Proposed Section B-B	30/08/2023 Issue B
DA18	Archi Spectrum	Proposed Section C-C and D-D	30/08/2023 Issue B
DA19	Archi Spectrum	Proposed Section E-E	30/08/2023 Issue B
DA No. 9373	NSW Government Department of Planning and Environment	Development Consent	Aug 2018
Project 9592	AED BCA Consultant	Clause 94 Significant Issues Report	Rev A 29 October 2019
Project 9592	AED BCA Consultant	Table of Photos and key points	05/01/2022
	AED BCA Consultant	Inspection photos and table of separating wall through undercroft	Dated 5 January 2022

2.3 Relevant Stakeholders

Organisation	Role
John Moran	Client
Martin Bednarczyk from Archispectrum	Principal Architect
Beechwood Constructions Pty Ltd	Builder
Fire and Rescue New South Wales	Emergency services advisory authority (not consulted)
AED Fire	Fire Engineering
AED	BCA consultant
J² Engineering Pty Ltd	Principal Certifier

Other Relevant Information for the FER Process

To provide a concise and easily understood document, certain information has been provided in Appendix A in lieu of being produced in the body of the report, this includes the following:

- Limitations of the report – See Section 6.1 - Limitations of the Report
- Assumptions of the report – See Section 6.2 - Assumptions of the Report

- Abbreviations – See Section 6.3 -Common Abbreviations Used in Fire Engineering
- Objectives – See Section 6.4 - Client Design and Building Regulatory Objectives
- Analysis methods – See Section 6.5 - Methods of Analysis
- Regulatory details of Performance Solutions – See Section 6.6 - Performance Solutions
- Sub-systems for the analysis – See Section 6.3 – Relevant IFEG Sub-Systems
- General acceptance criteria – See Section 6.8 - Acceptance Criteria and Factors of Safety for the Analysis
- Approaches and analysis methods for Performance Solutions – See Section 6.9 - Approaches and Methods of Analysis
- Requirements of construction and commissioning – See Section 6.10 - Construction and Commissioning Requirements

3 Fire Engineering Brief

The development of this report follows a consultative process with the design team and relevant stakeholders. This process included discussions however the issuance of an agreed Fire Engineering Brief was not considered necessary. The following sections detail the relevant sections that would form the basis of the Fire Engineering Brief.

The original report was issued prior to the implementation of Schedule 7 of the Building Code of Australia, where a Performance-Based Design Brief was required prior to the issuing of the Fire Engineering Report. This report is to update the previously accepted Performance Solution and therefore an updated Fire Engineering Report is provided.

For a Class 1b building, referral to FRNSW as a stakeholder is not required.

3.1 Principal Building Characteristics

The S4.55 Modification Application for DA 9373, advises the following –

'*The subject site is known as 'Melaleuca 1' and is a dwelling (chalet) attached to another dwelling, however located on its own allotment on Diggings Terrace, Thredbo Village. The property is legally described as Lot 774 DP 1119757.*

The building is attached to 'Melaleuca 2' and is located adjacent to Aspect Chalets.

The existing property is licensed to contain a maximum of four (4) beds for the purpose of tourist accommodation. The property is directly accessible from Diggings Terrace.'

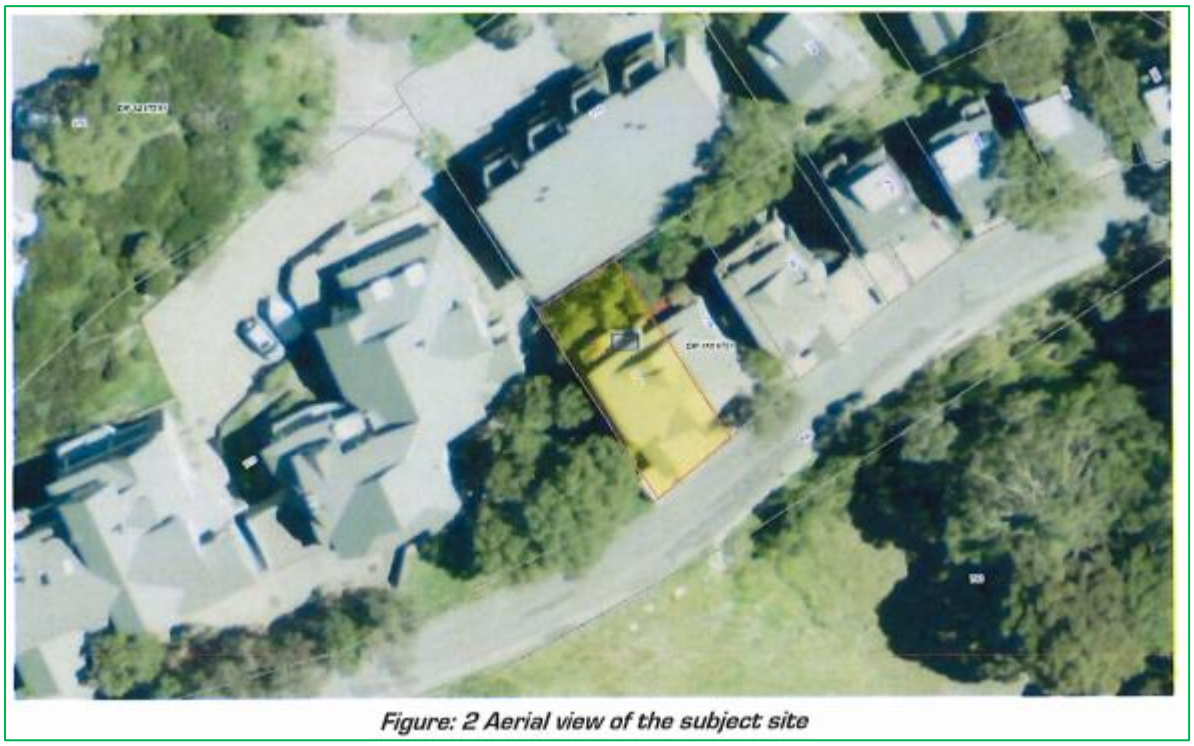


Figure: 2 Aerial view of the subject site

Figure 3-1 Aerial view of subject building – S4.55 Modification Application.

Figure 3-2- Front view of Diggings Terrace

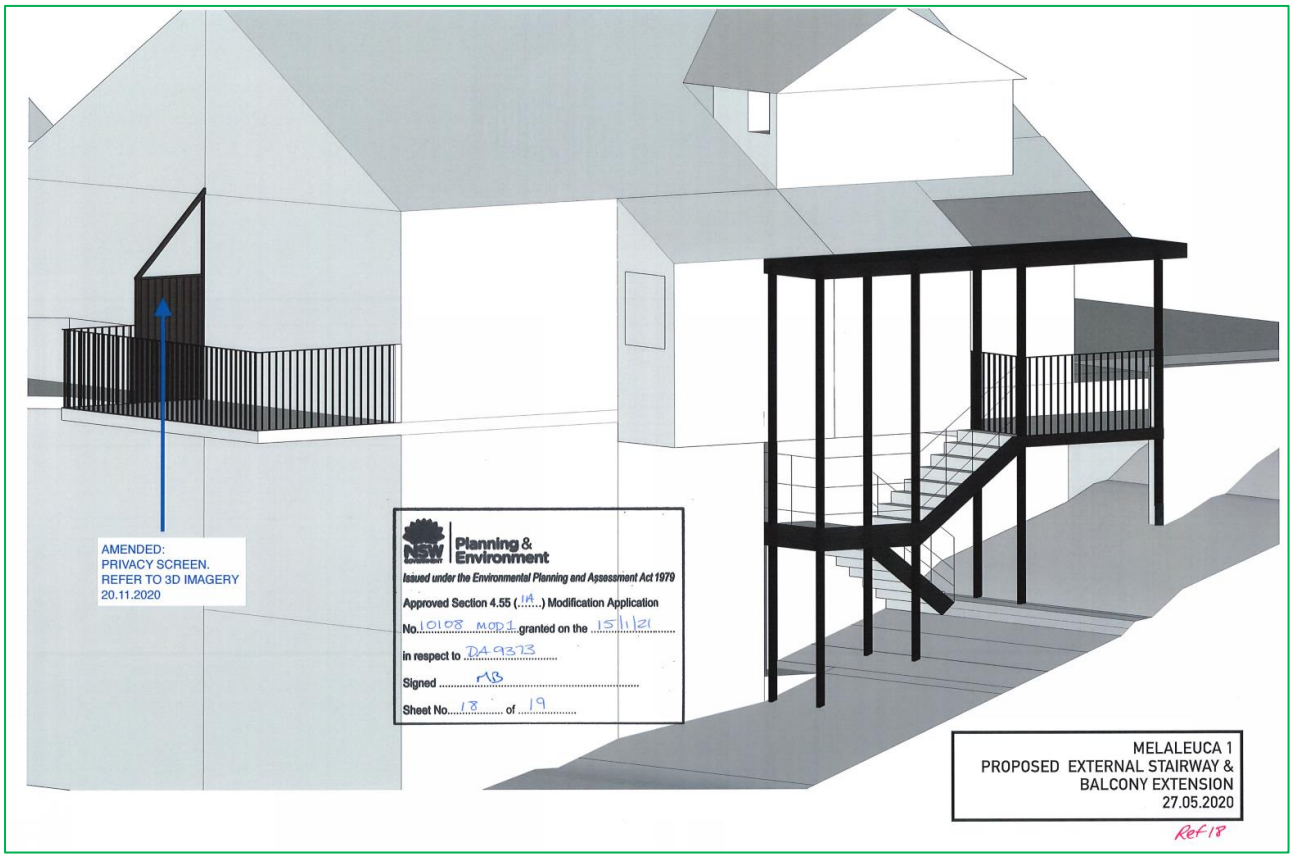


Figure 3-3 External view - privacy screen, proposed external stairway and balcony extension.

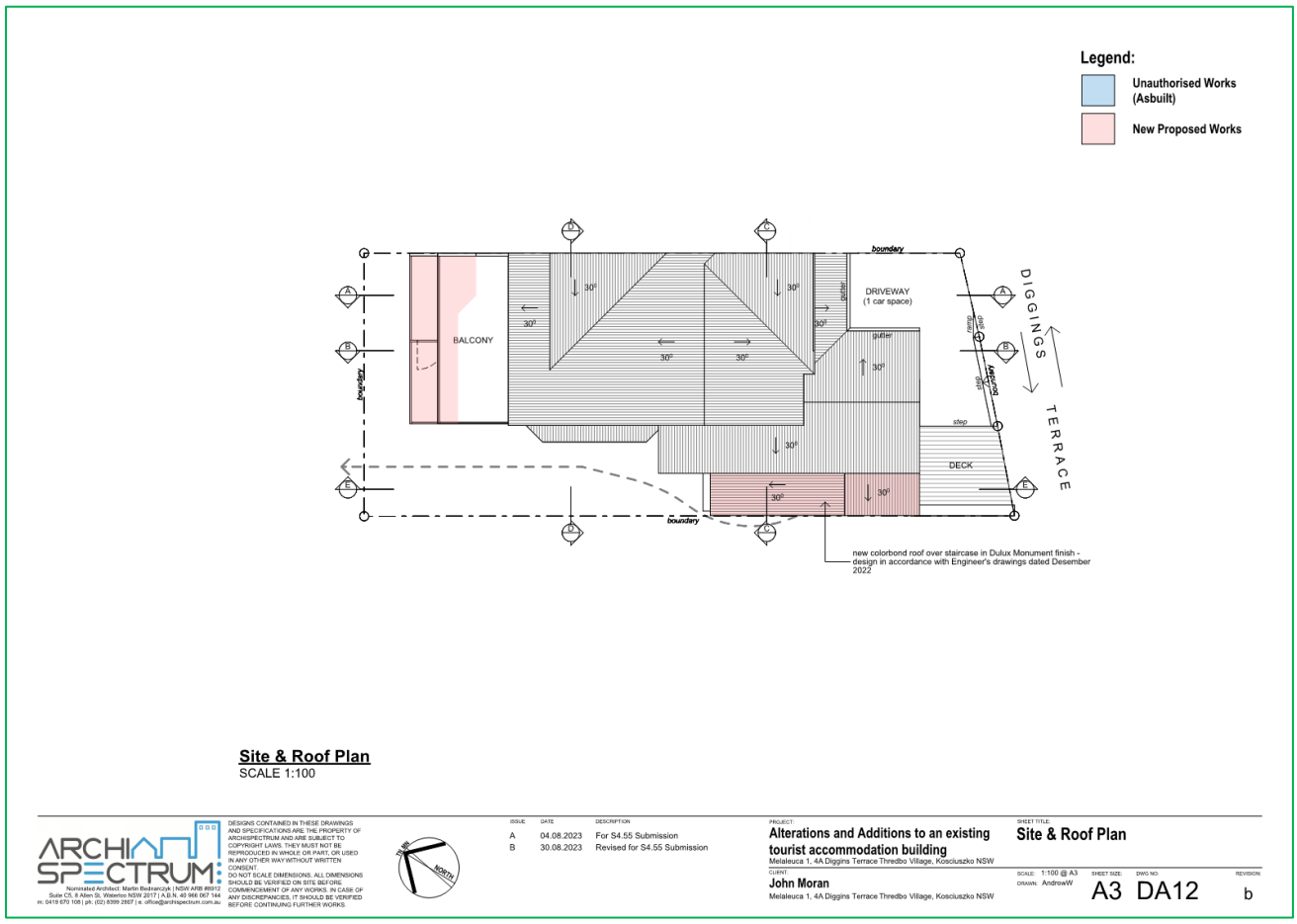


Figure 3-4- Site Plan of Diggings Terrace

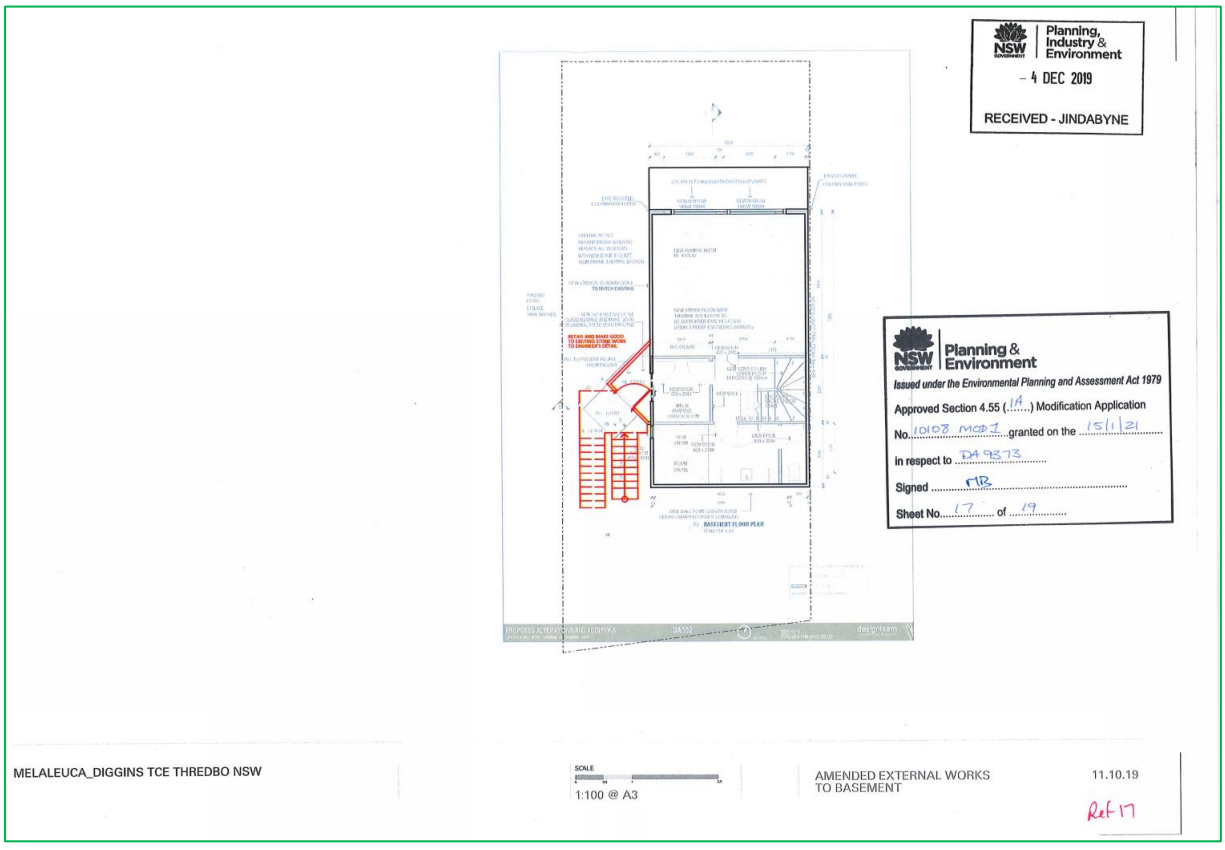


Figure 3-5- Basement plan of Diggings Terrace

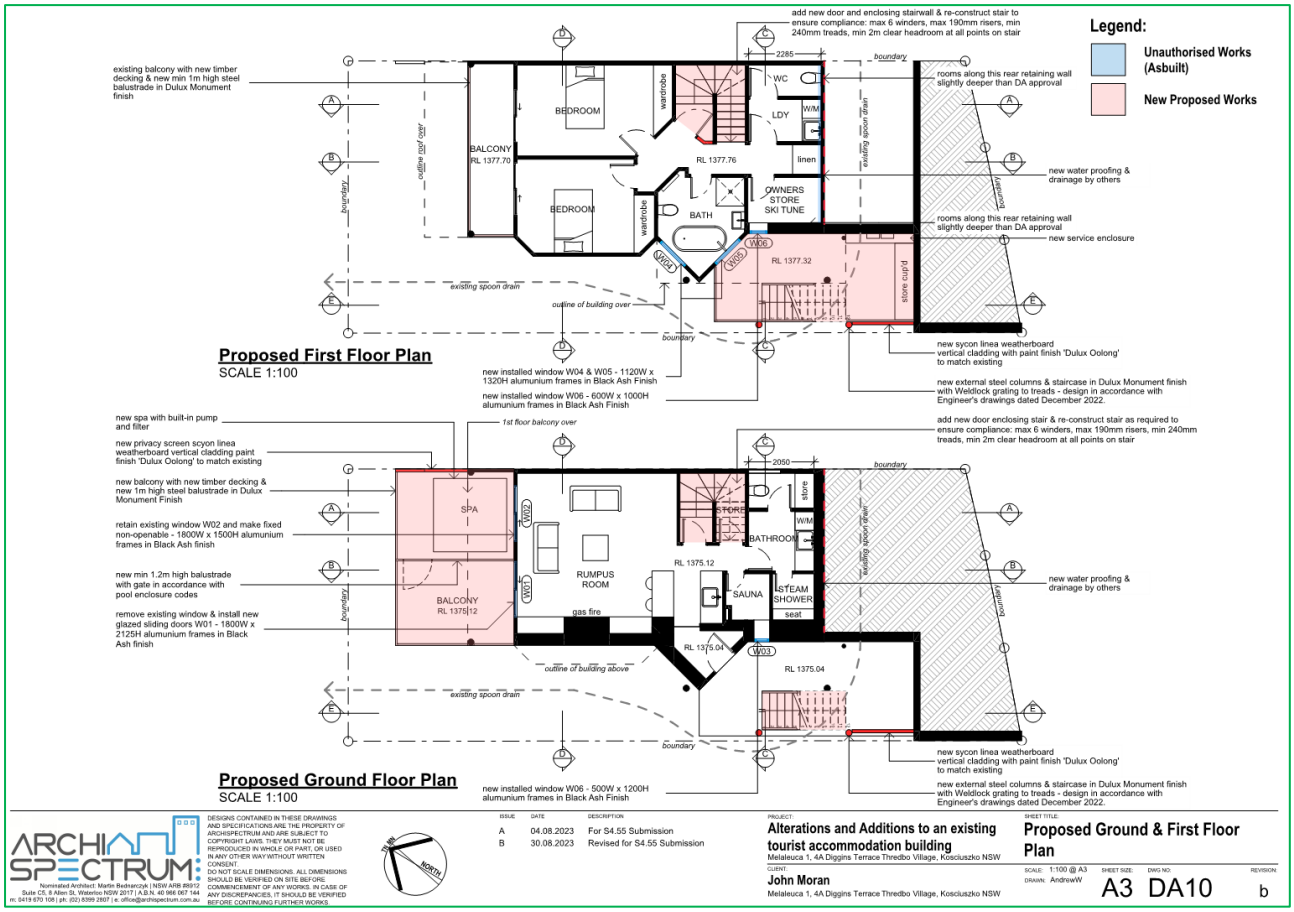


Figure 3-6 Ground Floor and First floor plans of Diggings Terrace.

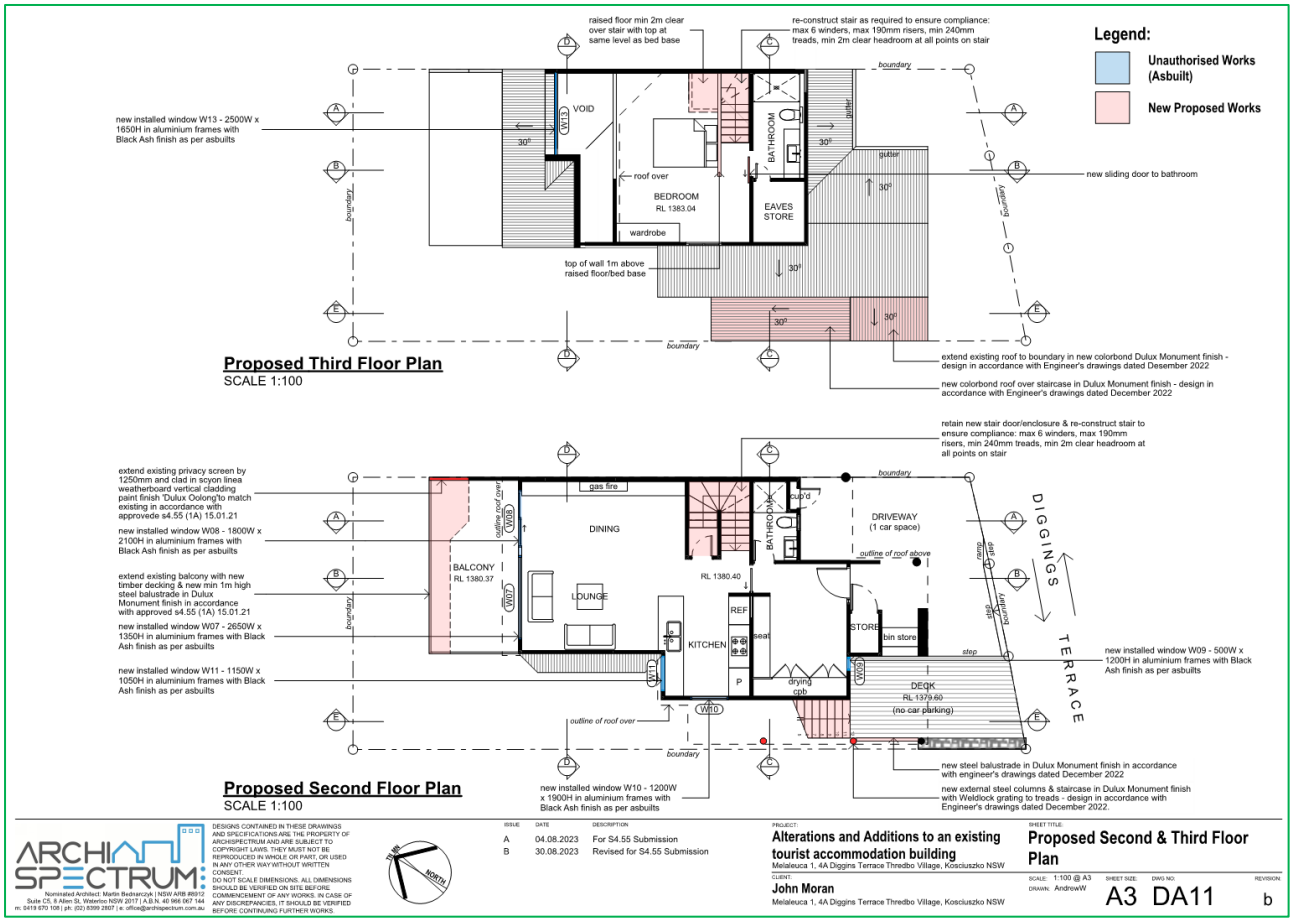


Figure 3-7 Second and Third floor plans of Diggings Terrace.

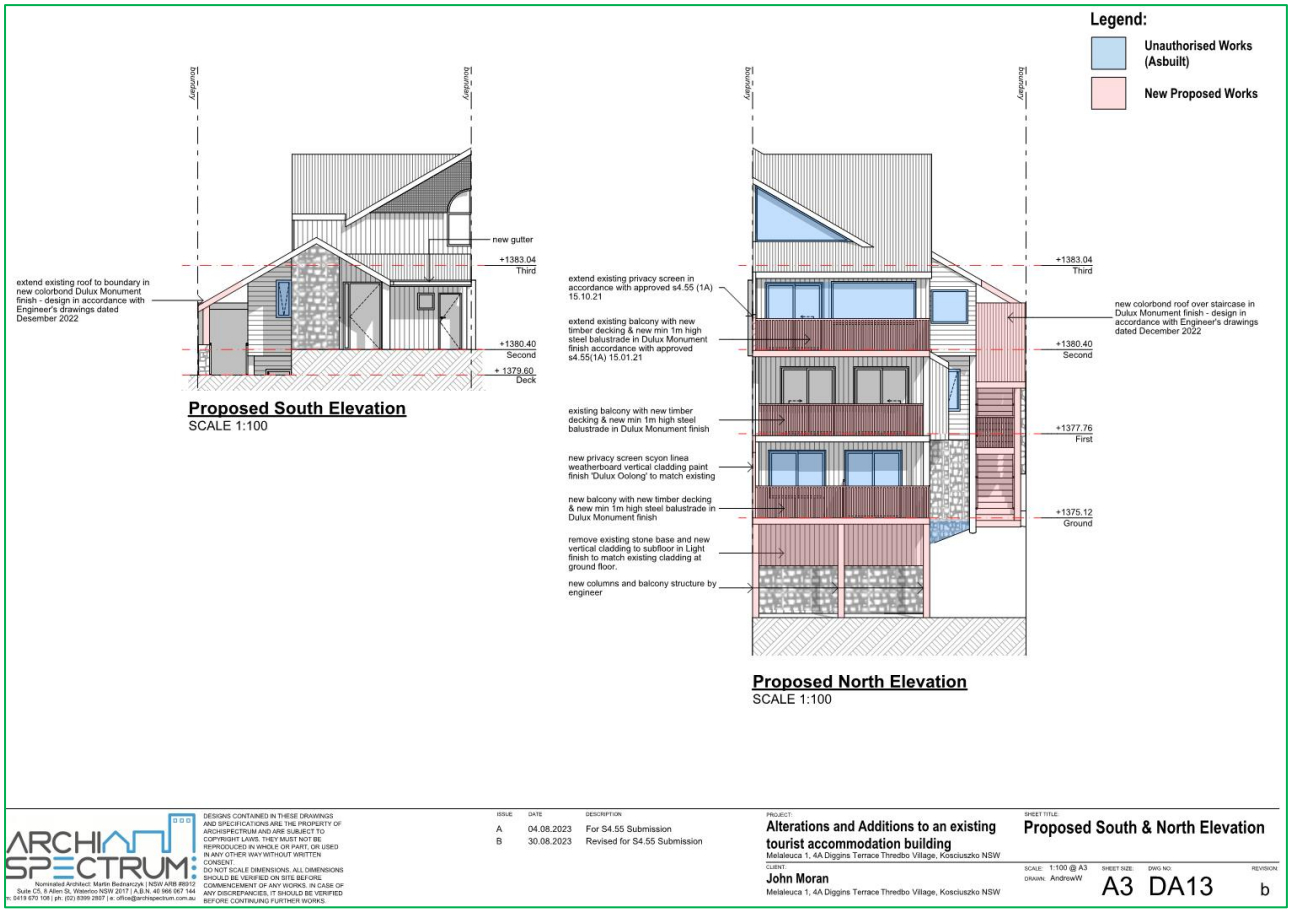


Figure 3-8 North and South elevations of Diggings Terrace.

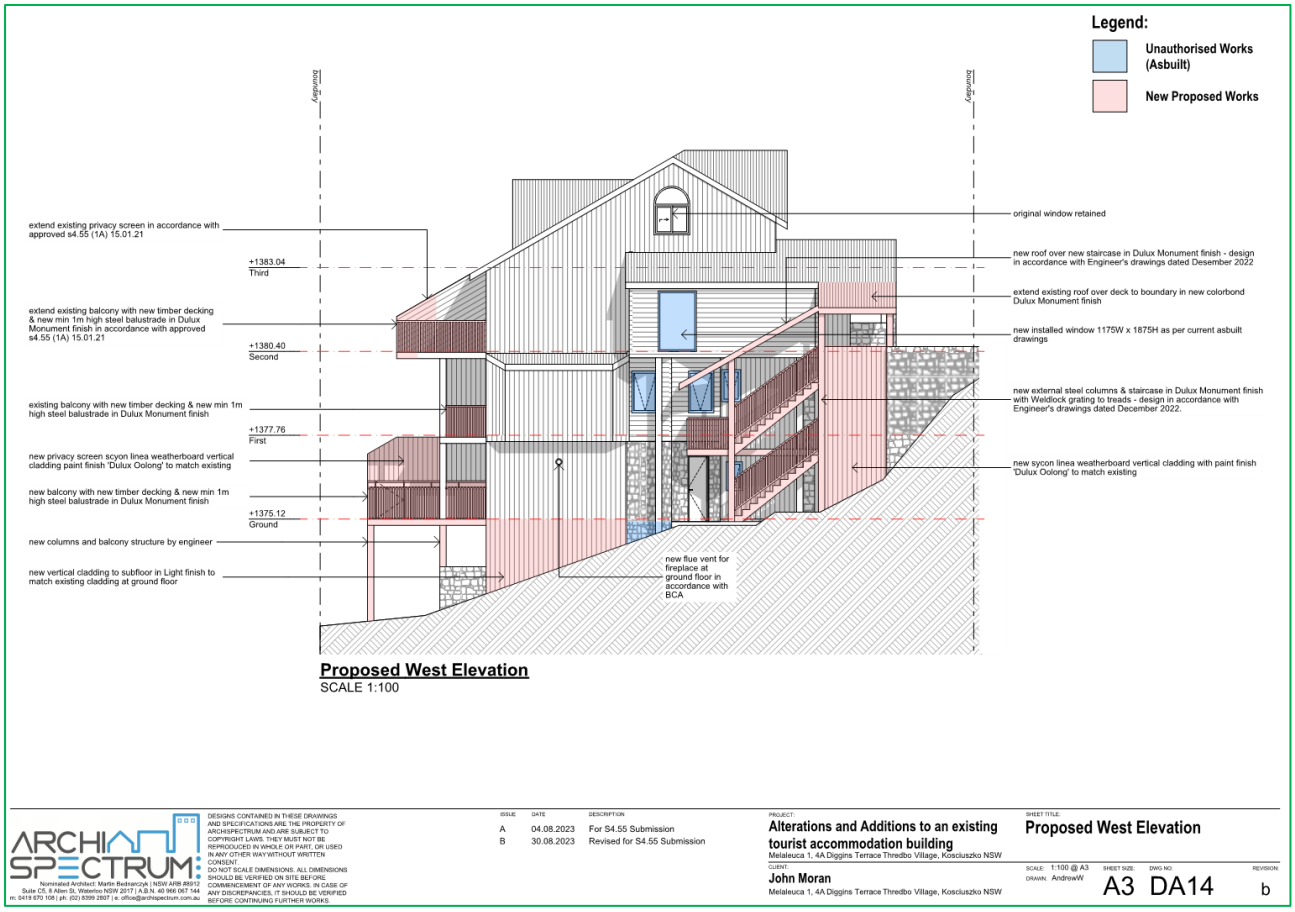


Figure 3-9 West elevation.

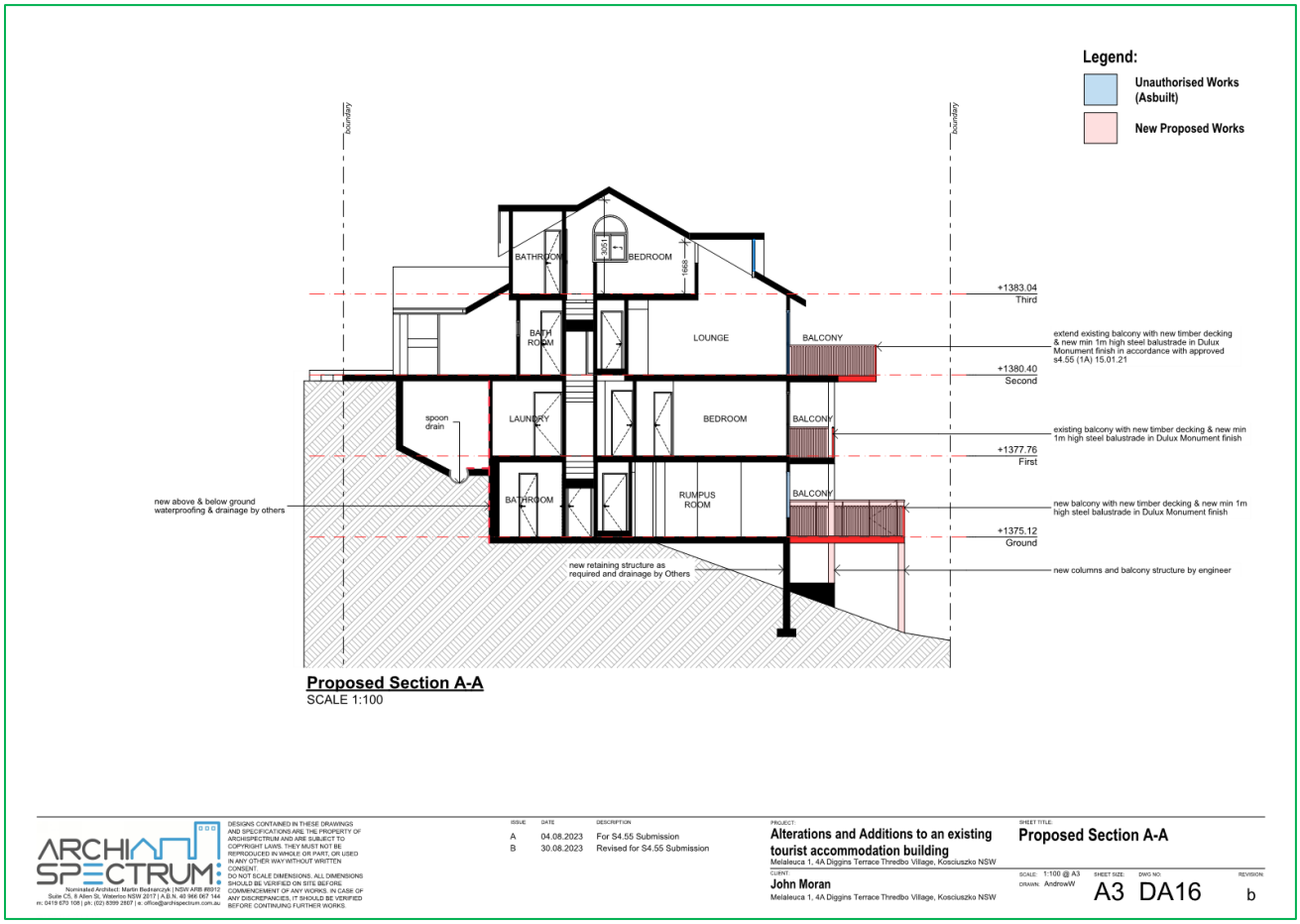


Figure 3-10 Section A-A.

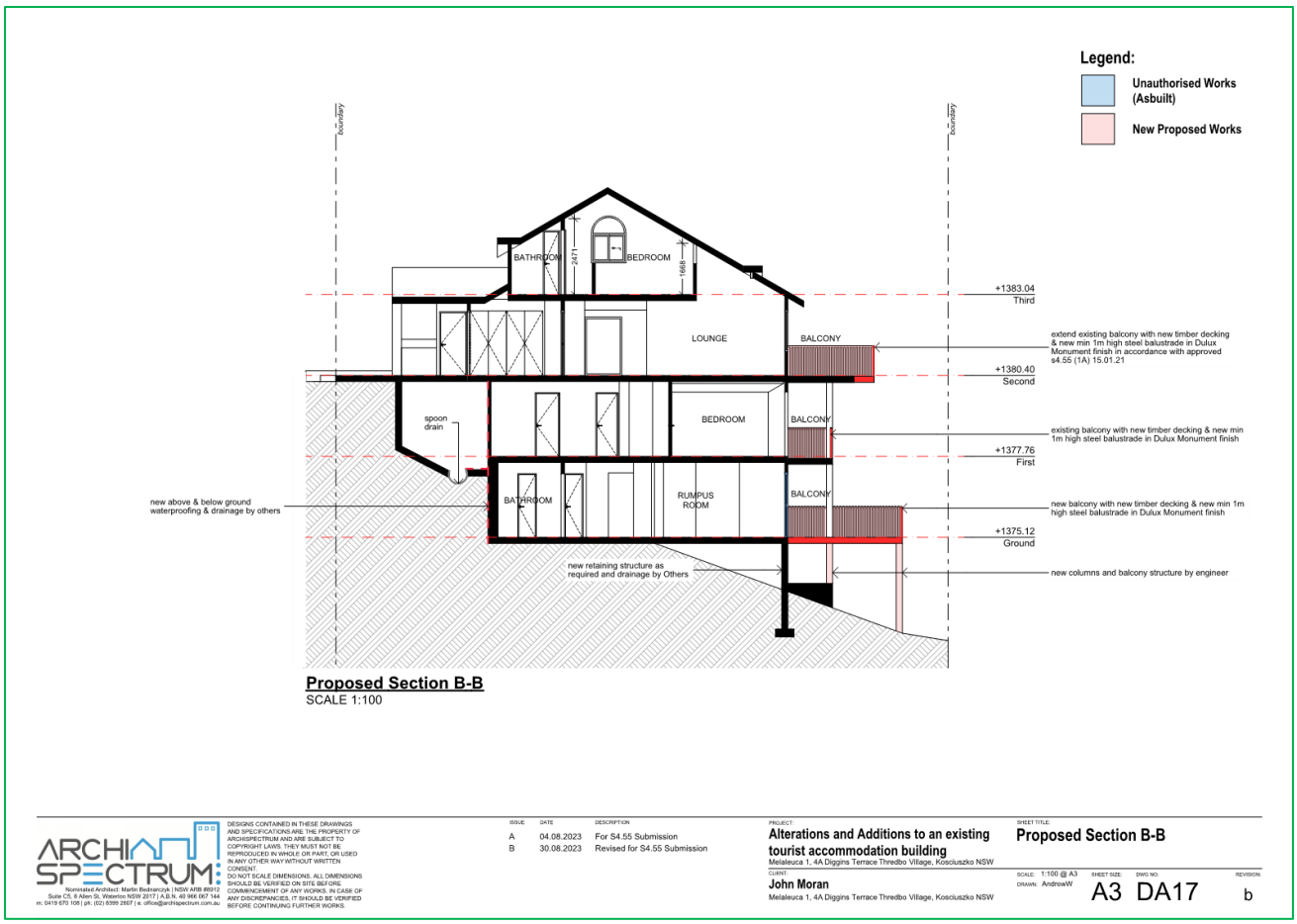


Figure 3-11 Section B-B.

The following table contains Building Code of Australia assessment based on AED Fire's interpretation. This is for the purposes of the Fire Engineering assessment and does not constitute a Building Code of Australia assessment.

Building Characteristic	Description
Occupancy/Use	
Building Class:	Class 1b required
If more than one class:	N/A
Type / use of premises:	Duplex – residential
Type of construction:	N/A
Effective Height:	Less than 12m
Location	
General:	
Proximity to other buildings:	Joined to Melaleuca 2. Melaleuca 3 appears within 3m of Melaleuca 2.
Distance to two nearest fire stations:	850m – Thredbo fire station
Emergency services access:	Front door entrance on Level 1
Location of Fire Indicator Panel:	TBC
Location hydrant & sprinkler boosters:	N/A
Building Layout and Structure	
General layout:	See plans above
Rise in Storeys:	4
Levels Contained:	4
Total Floor Area:	197.3m^2
Largest Fire Compartment Area:	Level 2: 60.2m^2
Ground Floor Area:	56.5 m^2
Unusual features:	N/A
Access and Egress	
Access paths:	Occupants may enter through the front door onto level 2. Stair access to all storeys in the building.
Egress paths:	Front entrance exiting level 2 to the driveway. Side exit proposed for basement on the west elevation.
Airflow and Ventilation	
Hidden voids:	N/A
Openings, shafts, ducts and atriums:	N/A
Ventilation, HVAC, air handling:	N/A

3.2 Dominant Occupant Characteristics

Occupant Characteristic	Description
Type and number	The building provides temporary accommodation for occupants. Occupancy numbers are variable throughout the day although it is noted there is a maximum of 4 sleeping residents permitted. All occupants may be of any age or gender.
Occupant state	Residential occupants may be asleep or awake. Occupants may or may not be intoxicated. The occupants of the subject area of the building will be familiar with the location of the front door exit upon entry.
Physical and mental attributes	The majority of occupants are considered to be mobile and ambulatory, however mobility impaired persons may reside in the building. Mobility impaired persons are unlikely to enter the subject area of the building.
Assistance required/available	Assistance is considered not to be required during an evacuation as the occupants will generally be familiar with the egress paths, upon entering the building that is limited to a single dwelling.
Training and Roles	As this is a residential building the occupants will not be trained in evacuation procedures.
Activity at the onset of fire	The residential occupants may be awake, asleep during a fire incident, eating watching television or any other activity to be expected in a residential building. The presence of smoke alarms would ensure that the occupants in the area of a fire incident are likely to be awake.
Building familiarity	Occupants are considered to be familiar with the building and the location of exits.
Design Occupant Group	Residents of the building.

3.3 Hazards and Preventative and Protective Measures Available

The following hazards have been identified after design review and stakeholder input.

Hazard	Details
General Layout and Design	Fire rated separation wall contains timber structure penetrations.
Activities	Fires originating from people smoking. Electrical faults in domestic appliances. Cooking fires.
Ignition Sources	Electrical hazards. Cooking and kitchen risks. Heater appliances and electrical faults.
Fuel Sources/Fire Load	It is assumed that the buildings will have a typical fire load of a building used for residential, which would be made up of primarily domestic appliances, upholstered furnishings, timber furniture, office furniture, books, magazines, bedding and general domestic storage.

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	Bounding construction as per Volume 2 of the Building Code of Australia for Class 1b buildings.
B Smoke development, spread and control	Bounding construction as per Volume 2 of the Building Code of Australia for Class 1b buildings.
C Fire spread, impact and control	Bounding construction as per Volume 2 of the Building Code of Australia for Class 1b buildings.
D Fire detection, warning and suppression	FIP system as per image from site inspection.
E Occupant evacuation and control	Occupants are considered to be untrained in evacuation procedures as this is a tourist dwelling block and no evacuation plan is necessary.
F Fire services intervention	FIP system

**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

3.4 Annual Fire Safety Schedule

The fire safety schedule for the building shall be amended so that the trial designs for the Performance Solution addressed in this fire engineering report are incorporated into the annual fire safety schedule and that the fire engineering report is to be referenced in the annual fire safety schedule.

3.5 Assessment of Performance Solutions

The areas of non-compliance, the directly and indirectly relevant performance requirements, assessment methods and Performance Solutions for each non-compliance issue in this project are summarised in the table presented in the Executive Summary of this report, along with the design requirements for each Performance Solution. The assessment of the Performance Solutions are provided in the following chapters, which includes the full assessment of the Performance Solution for suitability for the building design and discussion of the compliance of the solution with the relevant Performance Requirements of the BCA.

Summaries are provided in Appendix A for the general methodologies detailed in the relevant standards and codes and acceptance criteria for the Performance Solution process. The specific methodologies, approaches have been used to formulate and assess the Performance Solutions are provided in the individual Performance Solution sections to follow.

4 Performance Solution PS1 Fire Rated Wall Separation Penetration

Building Code of Australia Non-Compliance – Clause 3.7.3.2

A Performance Solution has been developed to address departures from the Building Code of Australia Deemed to Satisfy Clause 3.7.3.2.

The proposed additions to the tourist accommodation building Melaleuca 1 causes timber structures to penetrate the fire rated separating wall on the residential storeys.

Figure 4-1 Timber penetration into the fire rated separation wall.

There are extension works proposed to the undercroft, and the issues that arises from this include the following as identified in the email from the Certifier in Appendix B and AED's Photo table dated 05/01/2022:

- The floor structure of the two adjacent dwellings that is common to the separating wall, does not continue down to the undercroft storey where the structural beam and columns are exposed,
- The column and beams is situated over the allotment boundary and encroaches on the adjoining sublease area,
- The beams of a single dwelling penetrates the wall into the undercroft void below the adjacent dwelling,
- The separating wall does not commence at the footings,
- The horizontal projection is not protected with a construction containing fire-resistance level of 30 minutes beneath both dwellings,
- The floor over the undercroft is a timber flooring that is not permitted.

Figure 4-2 Undercroft separating wall non-continuous and exposed beams and columns over the allotment boundary.

Figure 4-3 Beam penetrates through to adjacent dwelling's undercroft void.

4.1 Assessment Methodology

The issue will be addressed as per the methodology in the table below –

Type of assessment	Building Code of Australia Deemed to Satisfy Clause in accordance with A2.4(3)(a)	Assessment Method in accordance with A2.2(2)	Performance Requirements in accordance with A2.4(3)(b)&(c)	IFEG Sub-systems
Absolute Qualitative Deterministic	3.7.3.2	(b)(ii) Other Verification Methods	P2.3.1	SS-C Fire Spread and Impact and Control SS-E Occupant Evacuation and Control SS-F Fire Services Intervention

4.2 Acceptance Criteria

The acceptance criteria for the assessment is the proposed fire safety measures shall prevent spread of fire from the adjoining accommodation to Melaleuca 1.

4.3 Fire Scenarios

The following design fire scenarios are considered –

Design Scenario[4]	Performance Requirement	Outcome required	Method or solution
Fire Scenario 1 A fire blocks evacuation route (BE) A fire via from the adjacent dwelling may spread via the timber elements through the fire-rated wall. Fire may spread through the subject dwelling and block an exit.	P2.3.1	Demonstrate that the level of safety is at least equivalent to the deemed to satisfy provisions	Demonstration that a viable evacuation route (or multiple evacuation routes where necessary) has been provided for building occupants.
Fire Scenario 2 A fire in a concealed space (CS) The flooring over the undercroft is a timber floor where the separating wall does not extend down to the footings or ground slab. A fire within the concealed void space may burn unnoticed for a period of time and spread to the adjacent dwelling via the combustible flooring.	P2.3.1	Demonstrate that the fire spread via concealed spaces will not endanger occupants; and Demonstrate that the level of safety is at least equivalent to the deemed to satisfy provisions	Solutions might include providing separating construction of fire suppression or automatic detection complying with a specified Standard.
Fire Scenario 3 Horizontal fire spread (HS) The non-compliant separating wall does not provide a fire-rated barrier between the two adjacent Class 1 dwellings as the wall does not extend down to the ground slab or footings.	P2.3.1	Demonstrate that the risk of fire spread between buildings is not greater than buildings complying with the Deemed to Satisfy provisions	A qualitative assessment shall be provided to demonstrate the risk of fire spread is reduced.
Fire Scenario 4 Structural Stability and other properties (SS). The structural beam extends to the adjacent dwelling's void. The beam and column are located over the allotment boundary and are externally exposed.	P2.3.1	Demonstrate that the building does not present an unacceptable risk to other property due to collapse or barrier failure resulting from a fire; and Demonstrate that the level of safety is at least equivalent to the Deemed to Satisfy provisions.	Undertake analysis of structure and fire safety systems

[4] Building Code of Australia Schedule 7 1.4 Design Scenarios: NCC Performance Requirements

4.4 Qualitative Assessment

The Building Code of Australia deemed to satisfy provisions require the fire rated separating wall between two compartments to be constructed with no penetrations throughout the wall. The relevant deemed to satisfy clause is 3.7.3.2 and the relevant parts are shown below in bold and italics –

3.7.3.2 Separating walls

(a) A separating wall between Class 1 buildings, or a wall that separates a Class 1 building from a Class 10a building which is not associated with the Class 1 building must—

(i) have either—

(A) an FRL of not less than 60/60/60; or

(B) be of masonry construction not less than 90 mm thick; and

(ii) commence at the footings or ground slab (see Figure 3.7.3.1), except for horizontal projections to which 3.7.3.5 applies (see Figure 3.7.3.4); *and*

(iii) extend—

(A) if the building has a non-combustible roof covering, to the underside of the roof covering (see Figure 3.7.3.1 and Figure 3.7.3.2); or

(B) if the building has a combustible roof covering, to not less than 450 mm above the roof covering (see Figure 3.7.3.1); and

(iv) comply with (b) to (e) and 3.7.3.3 as applicable.

(b) A separating wall of lightweight construction must be tested in accordance with Specification C1.8 of the NCC Volume One.

(c) A separating wall complying with (a)(iii)(A)—

(i) must not be crossed by timber or other combustible building elements except for roof battens with dimensions of 75 x 50 mm or less, or roof sarking; and

(ii) *must have any gap between the top of the wall and the underside of the roof covering packed with mineral fibre or other suitable fire-resisting material…**'***

'3.7.3.5 Horizontal projections

(a) Where a horizontal projection forms part of a separating wall complying with 3.7.3.2, any horizontal projection within 1.8 m on each side of the separating wall (see Figure 3.7.3.4) must—

(i) be a floor/ceiling or floor/soffit system incorporating a ceiling or soffit which has a resistance to the incipient spread of fire to the space above itself of not less than 60 minutes; or

(ii) have an FRL not less than 30/30/30 when tested from the underside*; or*

(iii) have a fire-protective covering on the underside of the floor, including beams incorporated in it, if the floor is combustible or of metal.

(b) The part of the separating wall that projects outwards horizontally must—

(i) extend to the underside of the floor/ceiling or floor/soffit system complying with (a); and

(ii) not be crossed by timber or other combustible building elements except for framing members with dimensions of 75 x 50 mm or less, or sarking; and

(iii) have any gap between the bottom of the wall and the underside of the floor/ceiling or floor/soffit system packed with mineral fibre or other suitable fire-resisting material.

(c) Where a floor subject to (a)(ii) depends on direct vertical or lateral support from another part to maintain its FRL, that supporting part must have an FRL of not less than 30/-/-.

(d) Where a service passes through a floor referred to in (a), the penetration must not reduce the fire performance of the floor or covering.'

4.5 Assessment

In the event of a fire within the subject dwelling, fire may spread to the adjacent dwelling via the unprotected timber beams that penetrates through the separating wall on the residential storeys, or via the non-compliant separating wall construction of the basement storey.

4.5.1 Residential Storeys

Intumescent Paint

Intumescent paint as proposed by the Clause 94 Significant Issues Report, will be applied to the timber structure at a length of 400mm from the fire separating wall within the subject building. Clause 3.7.3.2(a)(i)(A) requires the fire separating wall to have an FRL of 60/60/60. As the timber structure crosses this fire separating wall, the timber structure should require an FRL of 60/-/-, maintaining 60 minutes of structural adequacy in order to prevent fire spread.

The results[5] of a fire-resistance test on a horizontal separating element of timber construction with the fibrous plaster was painted on the exposed face with CAP508 intumescent paint to a thickness of 700 μm Dry Film Thickness (DFT) when tested to AS 1530.4-2005, show that the specimen was able to achieve an FRL of 90/90/90 and the average and maximum temperature on the unexposed surface of the fibrous plaster ceiling after 60 minutes (referenced to the furnace ignition time of the test) are 124°C and 143°C respectively.

The recorded average and maximum temperatures after 60 minutes are below the firepoint temperature of the wood which is assumed to be 350ºC[6] and below the critical temperature of the structural steel of 538ºC[7] which is often used as a bench mark for determining the failure of the structural member exposed to fire which ensures the yield strength is not reduced to less than 50% of ambient value[8]. The measured temperatures are also below the maximum temperature of 250°C at which failure in relation to incipient spread of fire deemed to have occurred according to AS 1530.4-2014[9].

Further, the test[5] shows that the intumescent paint remained in place until it was observed that small section of paint has fallen off the ceiling after 59 minutes and large section of paint have fallen off the eastern side of the ceiling after 62 minutes. This implies that the timber members would be shielded from direct exposure to fire-conditions for up to 60 minutes, hence the integrity of the timber members are maintained.

In a fire scenario where timber is heated above 280°C, it will decompose or undergo pyrolysis into combustible gases, tar, and charcoal. The gases flame vigorously at temperatures above 280°C, but the charcoal requires temperatures of about 500°C for it to be consumed. As the char builds up it tends to protect the unburnt timber from rapid pyrolysis. The burnt timber (char) acts as a thermal insulator, and as a result, the timber a short distance from the char edge is unaffected by the fire.[10] This phenomenon allows timbers to have a form of fire resistance, especially for timbers with thicker depths.

Where the fire compartment temperature exceeds 500^{0}C, the unprotected timber shall burn away meanwhile, the intutmescent coating would have expanded and created a barrier to prevent fire spread to the timber for the length of approximately 400mm as measured from the separating wall. Accordingly, the timber elements when treated with CAP508 intumescent paint according to the method outlined in the Executive Summary would be able to achieve 60 minutes of fire-resistance level.

Smoke Detectors

The Clause 94 Significant Issues Report identifies the smoke alarm system is installed in accordance with the BCA Volume 2, clause 3.7.5.3 and AS1670.1-1995 for the existing construction. Due to the presence of timber penetrations, additional fire safety features are proposed to ensure evacuation of occupants is achieved before the building reaches untenable conditions. The existing smoke detection system upgrade as per recommended item 3 report, should be installed at a reduced spacing and shall be in each room in order to provide occupants with earlier fire alarm activation time and sufficient time to evacuate.

The design for the smoke detection system in the new construction space is based on the AS1670.1-2018 smoke detection system.

An $RSET_{Trial\ Design}$ Vs $RSET_{BCA\ DTS}$ can show that the subject scenario is equal or better than DTS.

Required Safe Egress Time is constructed of three parts:

- Detection Time;
- Pre-movement time;
- Travel time

Assuming that the pre-movement time is the same for both scenarios the difference is between the detection time and movement times:

[5] Fire-resistance test on a horizontal separating element, report number FSH 1343, 16 March 2009, CSIRO.
[6] Yudong LI and Drysdale Dougal, Measurement of Ignition Temperature of Wood, International Association of Fire Safety Science, pp. 380-385.
[7] Kodur V. K. R. and Harmathy T. Z., Properties of Building Materials, SFPE Handbook of Fire Protection Engineering, Society of Fire Protection Engineers, 5th Edition, 2016, Volume I, Chapter 9, Table 9.2, pp. 294.
[8] Kodur V. K. R. and Harmathy T. Z., Properties of Building Materials, SFPE Handbook of Fire Protection Engineering, Society of Fire Protection Engineers, 5th Edition, 2016, Volume I, Chapter 9, pp. 293.
[9] Standards Australia, 2014, Methods for fire tests on building materials, components and structures Part 4: Fire-resistance tests for elements of construction, AS 1530.4-2014.
[10] White, R. H., 2002, "Analytical Method for Determining Fire Resistance of Timber Members", Chapter 4-11, The SFPE Handbook of Fire Protection Engineering, 3rd Edition, DiNenno, P. J., ed., Society of Fire Protection Engineers.

The design occupant group for the travel distance assessments will be based on residents in the building. The SPFE handbook[11] suggests a travel speed of 1.2m/s for horizontal travel in population densities of 0.5 persons/m^2, which would be applicable to the dwelling as it is licensed to house a maximum of 4 sleeping individuals, with a total floor area of 218.4m^2.

The travel times can now be determined for each design. Where the travel distances to an exit are as follows (note travel times have been rounded up to the nearest second):

Exit Travel distance

The calculated egress distance from the furthest point in the building on level 1 to the new basement exit as seen in Figure 3-4- Site Plan of Diggings Terrace is 21m. As there are no distance requirements by the BCA for a class 1 building, the calculated movement time will be the same for both the trial design and reference design.

Trial design and Reference design (21m to an exit)

T_e =21m / 1.2 m/s

T_e = ***18 Seconds***

The data for smoke detector activation time	
The height of dwelling	2.64m
design fire	t-squared medium growth fire
Spacing of the detectors	Standard BCA dts design only requires detectors in the circulation space at 10m between detectors and 5m off walls. Subject Design: 8m maximum spacing between detectors. Maximum radial distance from fire to detector is 5.66m.
RTI detector	10 $m^{0.5}s^{0.5}$ lowest setting
Ambient Temperature	25^{o}C
Activation temperature of sprinklers	Detector Activation Temperature: 40oC (often used as a worst case for smoke detector activation, i.e. at least 13oC above ambient)

For the subject building design, the smoke detector will be located within each room of the residential storeys and upon activation shall sound the Occupant Warning System of the building.

The activation time of the smoke detector will be calculated using the sprinkler module of the fire engineering software 'Firewind'. Firewind was originally produced by the Victor Shestopal[12] under the name 'Firecalc'. 'Firecalc' was a dos based program. The current version has been developed by Victor Shestopal and has been ported to the MS Windows operating system.

[11] SFPE handbook Chapter 3.14 fig 3-14.4 speed in corridor, ramp, aisle doorway 1.2m/s for densities of 0.5 persons / m^2

[12] Shestopal V.O. Computer modeling of heat radiation from several emitters with applications. International Journal on Engineering Performance-Based Fire Codes, V. 4, No. 4, 112-118 (2002)Shestopal V.O. Computer modelling of heat radiation from several emitters with applications. International Journal on Engineering Performance-Based Fire Codes, V. 4, No. 4, 112-118 (2002).

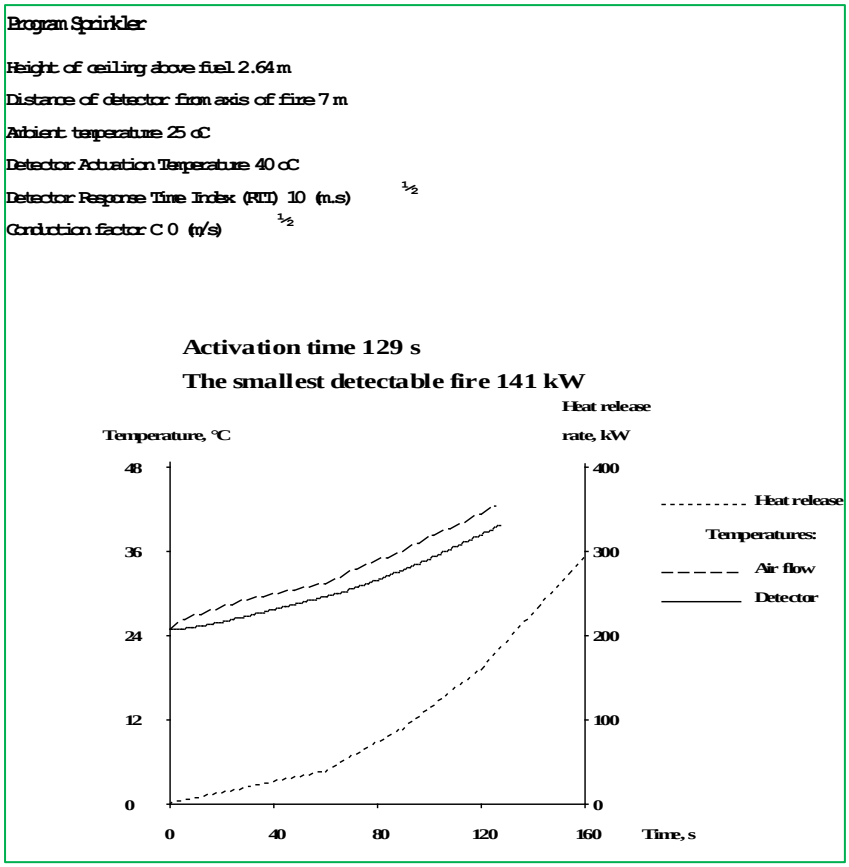


Figure 4-4 Deemed-to-satisfy output of smoke detector.

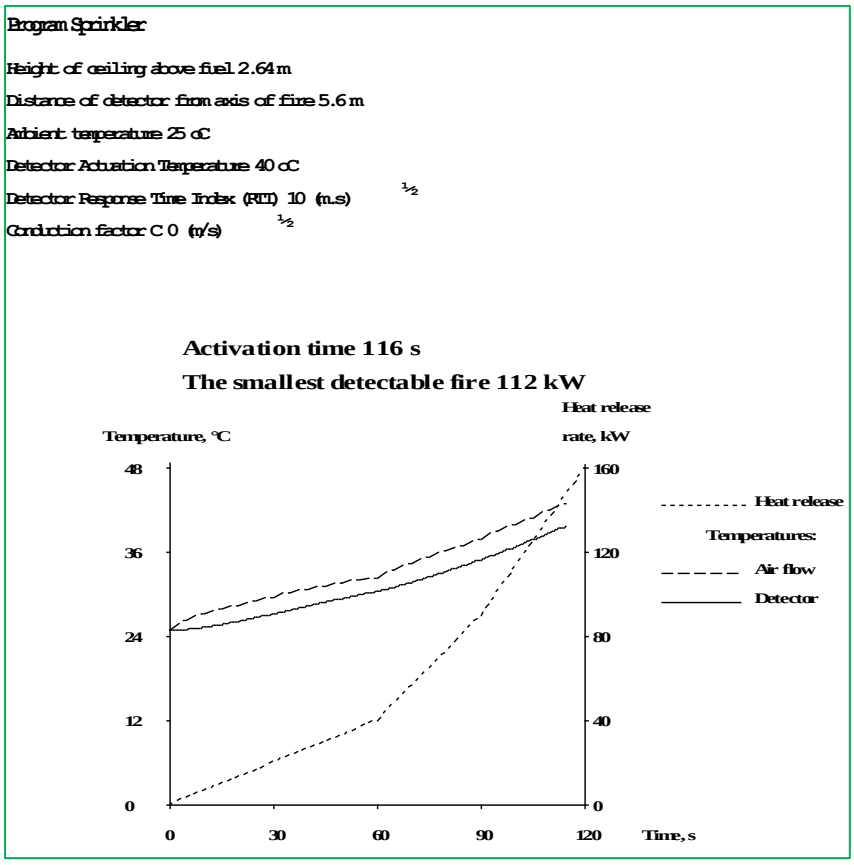


Figure 4-5 Reference design smoke detector output.

The outputs of the Firewind calculation are presented in the table below.

Secenario	Egress time (s)	Smoke Detector Activation Time (s)	Total Exit Time (s)
DTS	18	129	147
Reference	18	116	134

Therefore, the comparison of the deemed-to-satisfy design and the reference design, shows a difference of 13s where occupants are provided with an earlier warning time than the deemed-to-satisfy design. With the 60 minutes of fire resistance level from the intumescent paint and the earlier activation time of the smoke detector reference design, occupants are provided with additional time to evacuate from the onset of the burning timber structure.

4.5.2 Undercroft Separating Wall

The undercroft of the subject dwelling shall be constructed for occupant use.

The report by AE&D in Appendix B, advises a separating wall to the basement storey shall be formed of blockwork, achieving the required fire-resistance level. The photos show the basement storey fire wall is to be constructed of both blockwork and a fire-rated stud wall. This shall delay fire spread to the adjacent dwelling from within the undercroft area.

Where the structural beams and columns that penetrates through the adjacent dwelling's void, exposed over the boundary to the external fire source, failure of the undercroft beams and columns may result in failure of the upper storeys during occupant evacuation. Additionally, the ceiling void of the undercroft area is constructed of timber that does not achieve the required fire-resistance level.

4.5.2.1 Proposed Fire Safety Measures to Undercroft

To allow occupants to evacuate prior to failure of the flooring, several fire safety measures are proposed. These include:

- The underside of the ceiling to the undercroft area shall be a fire-rated ceiling achieving a fire-resistance level of at least 30 minutes and suitable for external weathering conditions, and
- A fire-rated wall achieving the minimum 60 minute fire-resistance level, that extends from the beam at the ceiling to the ground floor, and
- The floor void shall be installed with thermal detectors as per AS 1670.1-2018, within 2m of the separating wall, and
- The activation of the thermal detector shall sound the Occupant Warning System.

Meanwhile, the smoke detectors of the residential storeys shall be interlinked on all storeys including the floor void thermal detectors. Occupants asleep at the time of a fire, shall be made aware within the early stages of the fire timeline for a fire originating within the undercroft area that is remote and visually obstructed from occupants in the residential storeys above.

The structural elements remain exposed either to the undercroft area or of the external fire source, due to their location on the boundary.

The structural beam and columns are proposed to be protected with an AS 1530.4-2014 tested system achieving a fire-resistance level of at least 60 minutes of either:

- 3-sided and 4-sided construction for the exposed faces of the steel beam and 4-sided construction for the steel column with weatherproof fire-rated plasterboard, or
- Vermiculite spray to the exposed surfaces, or
- Intumescent paint suitable for steel exposed to weathering.

The proposed protection methods above apply to the exposed faces of the steel beam and columns where the beams and columns is not protected within the proposed fire-rated ceiling and remains exposed.

The proposed fire-rated ceiling in addition to the fire-rated separating wall shall prevent fire spread to both the adjacent dwelling's undercroft area and timber flooring above. The fire-rated elements shall essentially provide a barrier to fire spread within the undercroft accessible area as well as via the ceiling void that contains timber elements.

Where intumescent paint is used, in the event of exposure to a sufficiently large fire, the paint shall expand and create a barrier which shall prevent fire spread to the internal steel member for the period of fire-rating. The intumescent paint where used, shall require annual inspection, to ensure the paint remains intact to prevent gaps in the intumescent coating.

The enhanced detection system within the floor void shall alert occupants within the residential storeys to a fire occurring within the undercroft area. The passive protection to the flooring and structural beam and column shall delay fire spread and failure of the structural elements during an evacuation.

In the event of a fire to the residential storeys, there shall be a delay to fire reaching the basement storey due to the buoyant nature of the hot gases from the fire that shall travel upwards. Additionally, the proposed fire-rated protection of the basement ceiling and structural elements shall delay time until fire spreads to the residential storeys, where activation of the fire alarm shall alert occupants of the residential portion of the building to a fire who may be unaware of the need to evacuate.

4.6 Conclusion

The following design fire scenarios have been considered –

Design Scenario[13]	Performance Requirement	Outcome required	Method or solution
Fire Scenario 1 A fire blocks evacuation route (BE) A fire via from the adjacent dwelling may spread via the timber elements through the fire-rated wall. Fire may spread through the subject dwelling and block an exit.	P2.3.1	Demonstrate that the level of safety is at least equivalent to the deemed to satisfy provisions	The undercroft area is a normally unoccupied area. The risk of fire spread to the residential storeys shall be delayed by the proposed fire-rated ceiling and wall. Occupants asleep and obstructed from view of the fire, shall be provided with a warning of a fire within the early stages of the timeline by the proposed interconnection of smoke/thermal detectors within each storey.
Fire Scenario 2 A fire in a concealed space (CS) The flooring over the undercroft is a timber floor where the separating wall does not extend down to the footings or ground slab. A fire within the concealed void space may burn unnoticed for a period of time and spread to the adjacent dwelling via the combustible flooring.	P2.3.1	Demonstrate that the fire spread via concealed spaces will not endanger occupants; and Demonstrate that the level of safety is at least equivalent to the deemed to satisfy provisions	The concealed space, containing timber flooring where there is not vertical separating between dwellings, shall be equipped with a smoke detector system, to alert occupants in the residential storeys above to a fire. Interconnection of thermal and smoke detectors shall alert occupants to a fire that is obstructed from view, within the early stages of the fire timeline.
Fire Scenario 3 Horizontal fire spread (HS) The non-compliant separating wall does not provide a fire-rated barrier between the two adjacent Class 1 dwellings as the wall does not extend down to the ground slab or footings.	P2.3.1	Demonstrate that the risk of fire spread between buildings is not greater than buildings complying with the Deemed to Satisfy provisions	The undercroft area of both dwellings shall be installed with a fire-rated ceiling to the underside. The fire wall between the two dwellings within the undercroft level, as well as the proposed fire-rated ceiling shall provide for a barrier to the subfloor of the subject dwelling to the adjacent dwelling.
Fire Scenario 4 Structural Stability and other properties (SS). The structural beam extends to the adjacent dwelling's void. The beam and column are located over the allotment boundary and are externally exposed.	P2.3.1	Demonstrate that the building does not present an unacceptable risk to other property due to collapse or barrier failure resulting from a fire; and Demonstrate that the level of safety is at least equivalent to the Deemed to Satisfy provisions.	The exposed structural beams and columns are proposed to be equipped with a tested fire-rated protection system. The proposed fire-rating of at least 60 minutes to these structural shall prevent fire spread to and failure of the building elements for at least 60 minutes. This is greater than the time required for occupant evacuation from the residential storeys.

4.7 Compliance with Performance Requirements P2.3.1

The Performance Solution Demonstrates compliance witch the relevant Performance Requirements P2.3.1

P2.3.1	
(a)	*A Class 1 building must be protected from the spread of fire from—*
(i)	*another building other than an associated Class 10 building; and*
(ii)	*the allotment boundary, other than a boundary adjoining a road or public space.*
(b)	*A Class 10a building must not significantly increase the risk of fire spread between Class 2 to 9 buildings.*

4.8 Conclusion

Subject to the application of the design requirements outlined in the Executive Summary of this report the Performance Solution is deemed to have meet and complied with the relevant performance requirements.

All other essential services required to meet the deemed to satisfy provisions of the Building Code of Australia for this class of building shall be installed, tested, commissioned and maintained in accordance with the Building Code of Australia and the relevant Australian Standards.

[13] Building Code of Australia Schedule 7 1.4 Design Scenarios: NCC Performance Requirements

5 Conclusions

It is concluded that, subject to the application of the requirements of the trial design based on the limitations and assumptions listed below, the Performance Solutions will meet and comply with the relevant performance requirements.

5.1 Final Design and Other Requirements

The final design requirements that support the Performance Solutions are presented in the table in the Executive Summary of this report. Along with the assumptions and limitations of the solutions and the construction and commissioning, management and use and maintenance issues that are a relevant to the Performance Solutions.

6 Appendix A – Data Relied upon in the FER Process

6.1 Limitations of the Report

This report is strictly limited to the preparation of a Performance Solution(s) for the address listed in the Executive Summary of this report and excludes any works not outlined above and 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;
- This report is based on interpretations and assumptions in common practice at the time of the report and future changes in interpretations and assumptions cannot be retrospectively applied to this analysis and recommendations without re-assessment.
- Amendments to the Performance Solution Brief due to design changes or incapacity to comply with the Trial Designs;
- Issuing of any Part 4A certificates pursuant to the Environmental Planning and Assessment Act 1979. This report is not a Part 4A compliance certificate under the Environmental Planning & Assessment Act 1979 or Regulation 2000;
- 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;
- Heritage Issues;
- Any energy efficiency assessment; however if necessary proposals can be obtained from suitably qualified and accredited assessors.
- Reimbursement of losses caused by business interruption.
- Protection of Property (other than directly adjoining property)
- Fires caused by arson (other than as a potential source of fire initiation) or terrorist attacks.
- Multiple ignition sources for fire initiation.
- Operational checks of the fire safety equipment unless specified in this report.

6.2 Assumptions of the Report

This report provides a Performance Solution for the Deemed-to-Satisfy non-compliance 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 purpose of this report.

The report is provided on the basis that:

- The Performance Solution only applies to property detailed in section 2.1.
- The Performance Solution is applicable to the design documentation provided for assessment and as listed in Section 2.2. Any future alteration, enlargement or addition will require re-assessment to determine the application of this solution to those changes.
- The Buildings will generally comply with the Deemed-to-Satisfy Provisions of the BCA, except where modified specifically by this report.
- It is assumed that the buildings 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.

6.3 Common Abbreviations Used in Fire Engineering

Abbreviation/Term	Meaning
AFAC	Fire and Emergency Service Authorities Council
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.

Abbreviation/Term	Meaning
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
FRNSW	Fire and Rescue New South Wales
IFEG	International Fire Engineering Guidelines
NFPA	National Fire Protection Authority
SFPA	Society of Fire Protection Engineers.

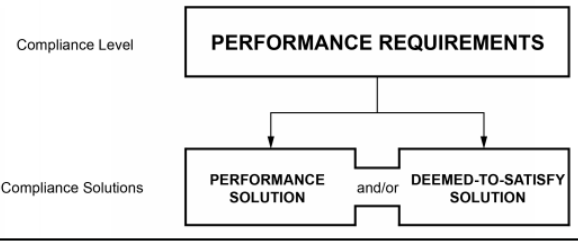
6.4 Client Design and Building Regulatory Objectives

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 requirements.

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 requirements.

Figure A0.2
NCC COMPLIANCE STRUCTURE



Note:
1. The term *Performance Solution* was formerly known as *Alternative Solution*.
2. The terms *Performance Solution* and *Deemed-to-Satisfy Solution* were formerly used under the term *Building Solution*.

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 requirements 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 requirements. Satisfying the performance requirements can be achieved through one of three ways:

(a) Performance Solution; or

(b) Deemed-to-Satisfy Solution; or

(c) Combination of (a) and (b).

6.5 Methods of Analysis

The methods of analysis used in the development of Performance Solutions are detailed in BCA Clause A0.5, and include

A0.5 Assessment Methods

A0.5(b)(i) *Verification Methods, such as the Verification methods in the BCA*

A0.5(b)(ii) *Verification Methods, other than those in the BCA that the appropriate authority accepts for compliance with the performance requirements*

A0.5(c) *Expert judgement*

A0.5(d) *Comparison to the deemed-to-satisfy provisions of the BCA*

In order to satisfy BCA Clause A0.3

A0.3 - Performance Solutions

(a) A Performance Solution must -

(i) comply with the Performance Requirements; or

(ii) be at least equivalent to the Deemed-to-Satisfy Provisions;

And be assessed according to one or more of the Assessment Methods

The specific assessment methods used for the analysis are detailed in Performance Solution section for each issue.

6.6 Performance Solutions

Clause A0.7 of the BCA 2016 stipulates that:

A0.7 Relevant Performance Requirements

In order to comply with the provisions of A1.5 (to comply with Section A and the NCC Performance Requirements) the following method must be used to determine the Performance Requirement or Performance Requirements relevant to the Performance Solution:

(a) Where a Performance Requirement is satisfied entirely by a Performance Solution:

(i) Identify the relevant Performance Requirement from the Section or Part to which the Performance Solution applies.

(ii) Identify Performance Requirements from other Sections or Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.

(b) Where a Performance Requirement is satisfied by a Performance Solution in combination with a Deemed-to-Satisfy Solution:

(i) Identify the relevant Deemed-to-Satisfy Provisions of each Section or Part that is to be the subject of the Performance Solution.

(ii) Identify the Performance Requirements from the same Sections or Parts that are relevant to the identified Deemed-to-Satisfy Provisions.

(iii) Identify Performance Requirements from other Sections or Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Deemed-to-Satisfy Provisions that are the subject of the Performance Solution.

The Performance Solution(s) will be prepared in accordance with Clause A0.7 of the BCA 2016.

A1.5 Compliance with all Performance Requirements

Subject to A1.6, Class 2–9 buildings must be so designed and constructed that they comply with the relevant provisions of Section A and the Performance Requirements of this Volume.

6.7 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)	
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	

IFEG Sub-System	Description	Symbol
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	

6.8 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.

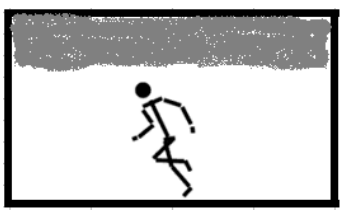
A comparative approach aims to determine whether the Performance Solution is equivalent to (or better than) the deemed-to-satisfy or prescriptive design. The comparative approach is often referred to as an "equivalence" approach."

Quantitative Assessments

The following acceptance criteria are proposed for the assessment of the Performance Solutions compliance with the performance requirements 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/m^2. The tolerance time for radiation at this level is 6 minutes.



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

Heat Convention - Direct exposure to hot gases will cause breathing difficulties, which may inhibit occupant escape. The International Fire Engineering Guidelines suggest that a hot layer temperature of 100^{o}C, when the hot layer is below 2.1m above the floor level, is

reasonable for most buildings however commonly a temperature of 80°C is used as a tenability criteria, the National Fire Protection Authority (NFPA) recommend a temperature range of 49°C to 60°C.

Direct exposure to hot gases will cause breathing difficulties, which may inhibit occupant escape. From the Fire Engineering Guidelines, the limiting hot layer temperature of 100°C when the hot layer is below 2.1m above the floor level is reasonable for most buildings.

However, for particularly susceptible occupants such as disabled occupants where escape times maybe longer, the Fire Engineering Guidelines advises that consideration should be given to using a maximum limit of 60°C as the tenability criteria for convective heat.

The Fire Engineering Guidelines recommend the following limiting conditions for tenability for heat

Temperature/humidity conditions	Tolerance times
< 60°C	> 30 minutes
60°C, < 1% H_2O	12 minutes
180°C, < 1% H_2O	1 minute

Fire engineering assessments are commonly based on a convected heat exposure of 60°C. For this assessment this has been taken as an upper limit exposure.

T < 60°C

Acceptance criteria are also further discussed in the assessment of each Performance Solution.

Toxicity:

The toxicity of combustion products varies widely according to the properties of the fuel. However, the International Fire Engineering Guidelines suggests that limiting conditions for all toxic products (asphyxiants and irritants) are unlikely to be exceeded for up to 30 minutes if the smoke optical density does not exceed 0.1m^{-1} (i.e. equivalent visibility distance of 10m).

Visibility:

Dense smoke may obscure exit paths, slowing or preventing escape. The International Fire Engineering Guidelines suggests that if a smoke optical density of less than 0.1m^{-1} or 10m visibility were maintained in the occupied zone, then visibility would be considered satisfactory for large enclosures. The smoke optical density can be doubled for a small room e.g. 5m or 0.2m^{-1}.

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/m^2 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)[14].

	Routine Condition	Hazardous Condition	Extreme Condition	Critical Condition
Maximum Time, min	25	10	1	<1
Maximum Temperature, ^{o}C	100	120	160	235
Maximum Radiation, kW/m^2	1	3	4 - 4.5	>10

6.9 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 requirements 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 analyze 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.

6.10 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 the following systems (where applicable for the subject building):

- Fire Hydrants Systems
- Smoke detection and BOWS

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

- Stair pressurisation
- Fire doors with smoke seals and a log of all required fire/smoke sealed doors.
- 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).

An annual fire safety certificate must be submitted to the local consent authority and the NSW Fire Brigade each year indicating satisfactory performance of the fire safety measures contained within the building. The annual fire safety statement should be displayed in a prominent place within the building (i.e. the main entry foyer).

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 FER 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.

7 Appendix B – Undercroft Separating Wall

From: Nick Wilson <nick.wilson@jsquared.com.au>
Sent: Wednesday, 23 March 2022 6:02 PM
To: Nathan Halstead <nathan@aedconsulting.com.au>; James Alexander <james.alexander@jsquared.com.au>
Subject: Melaleuca 1 - thredbo

Nathan / James

Melaleuca is chasing a detail for the separating wall for the new additions which I cannot see how it can be achieved DtS. We discussed some possibilities as per below as I believe it is required to be a separating wall? The existing floor structure of the 2 dwellings is common that is the separating wall does not continue down to the existing structural beam as seen in photos 1 and 2 below

Half the columns and the beam (photo 1 and 2) will remain exposed as it sits over the boundary line therefore protecting them from the external is difficult without works over the boundary allotment.

Beams in photo 3 and 4 will penetrate the external wall into subfloor void below the adjacent dwelling as - the rear of the block wall is on the boundary at present. photo 3 you can again see the joists and floor space to the adjacent dwelling.

Photo 5 shows extent of extension on ground level – the will be a roof as part of the above is the carpark and not sealed form the weather. There is plumbing and structural steel penetrating this proposed wall as well.

Happy to discuss further if my assessment is incorrect or if solution is required then can we prepare a fee proposal for the client.

1

2

3

Figure 7-1 Principal Certifier non-compliance.

8 Appendix C – Building Classification

From: James Alexander <james.alexander@jsquared.com.au>
Date: Tuesday, 3 March 2020 at 11:35 am
To: Nathan Halstead <nathan@aedconsulting.com.au>
Cc: John Moran <jmoran.wa@gmail.com>
Subject: Re: Fire Safety Reforms

Nathan/John,

The Dept considers your building a class 1b and as such have forced me to classify it that way due to legal advice they have received that a class 1a cannot exist in the KNP and therefore you are subject the new AFSS rules.

Regards,

James Alexander
Director

FIRE ENGINEERS

Adelaide Office: PO Box 146, Magill SA 5072
Sydney Office: PO Box 320 Harbord NSW 2096
Jindabyne Office: PO box 169 Jindabyne NSW 2627

9 Appendix D – Approved Section 4.55 MOD 1 Plans

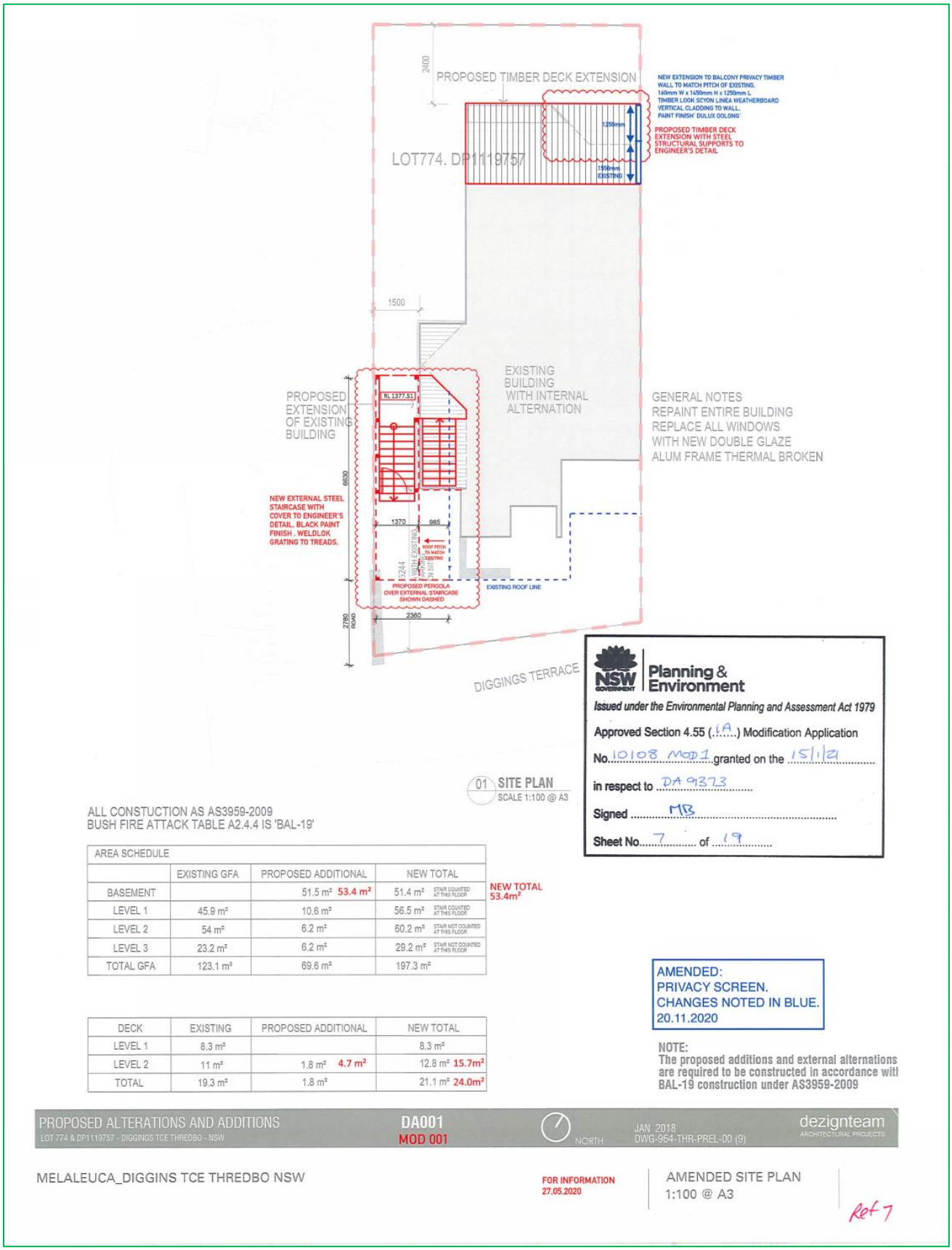


Figure 9-1 MOD 1 amended site plan.

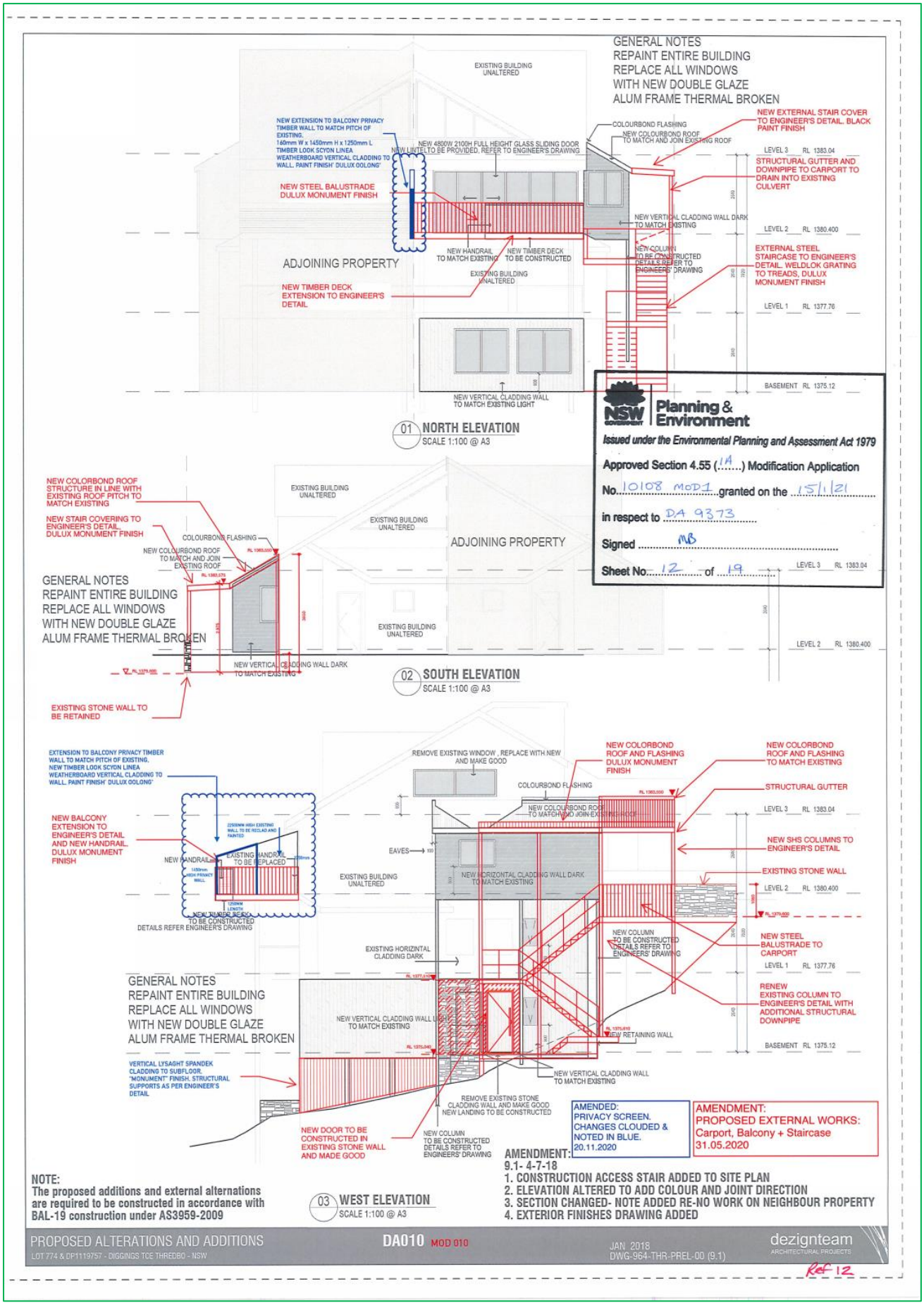


Figure 9-2 MOD 1 Amended elevation plans.

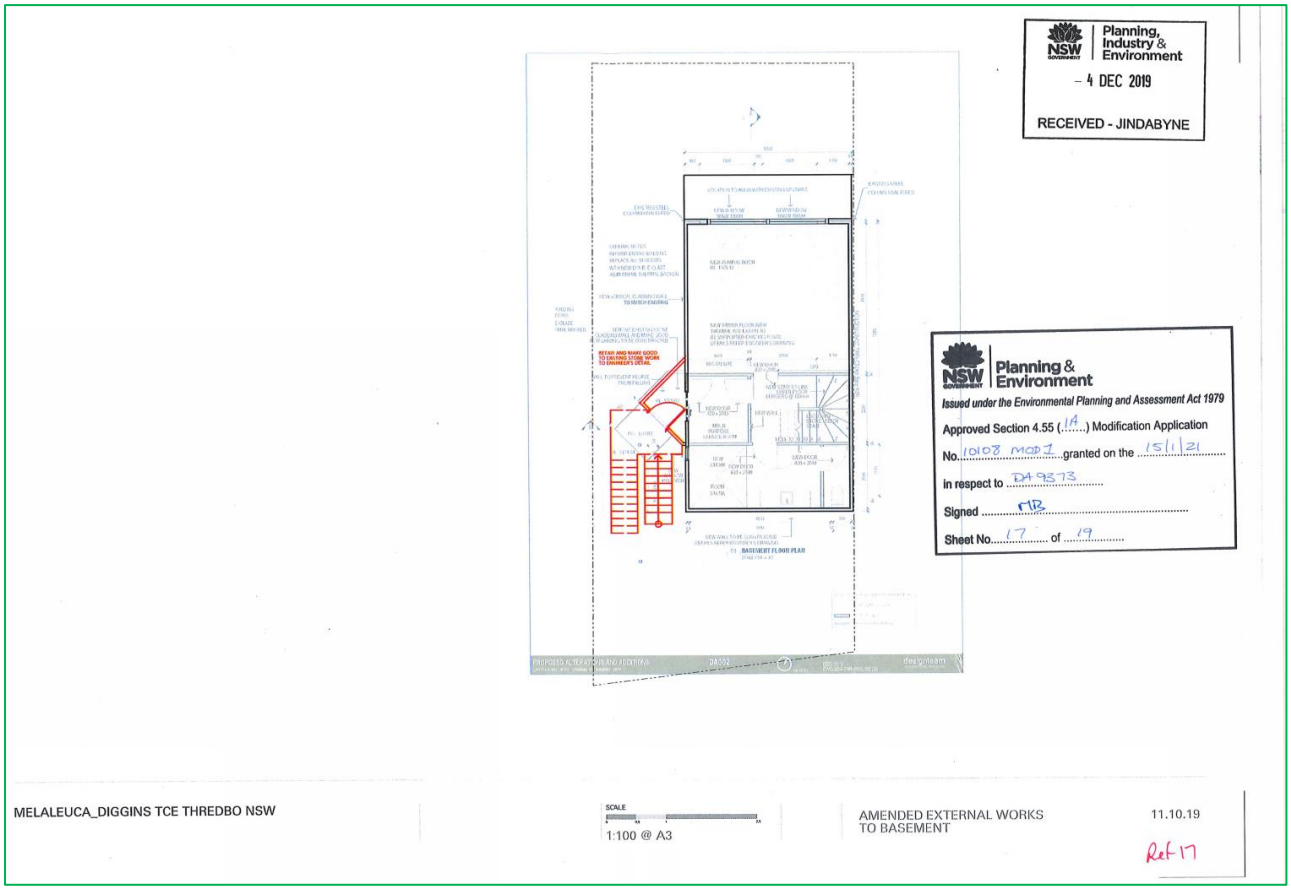


Figure 9-3 MOD 1 Amended Basement external works.