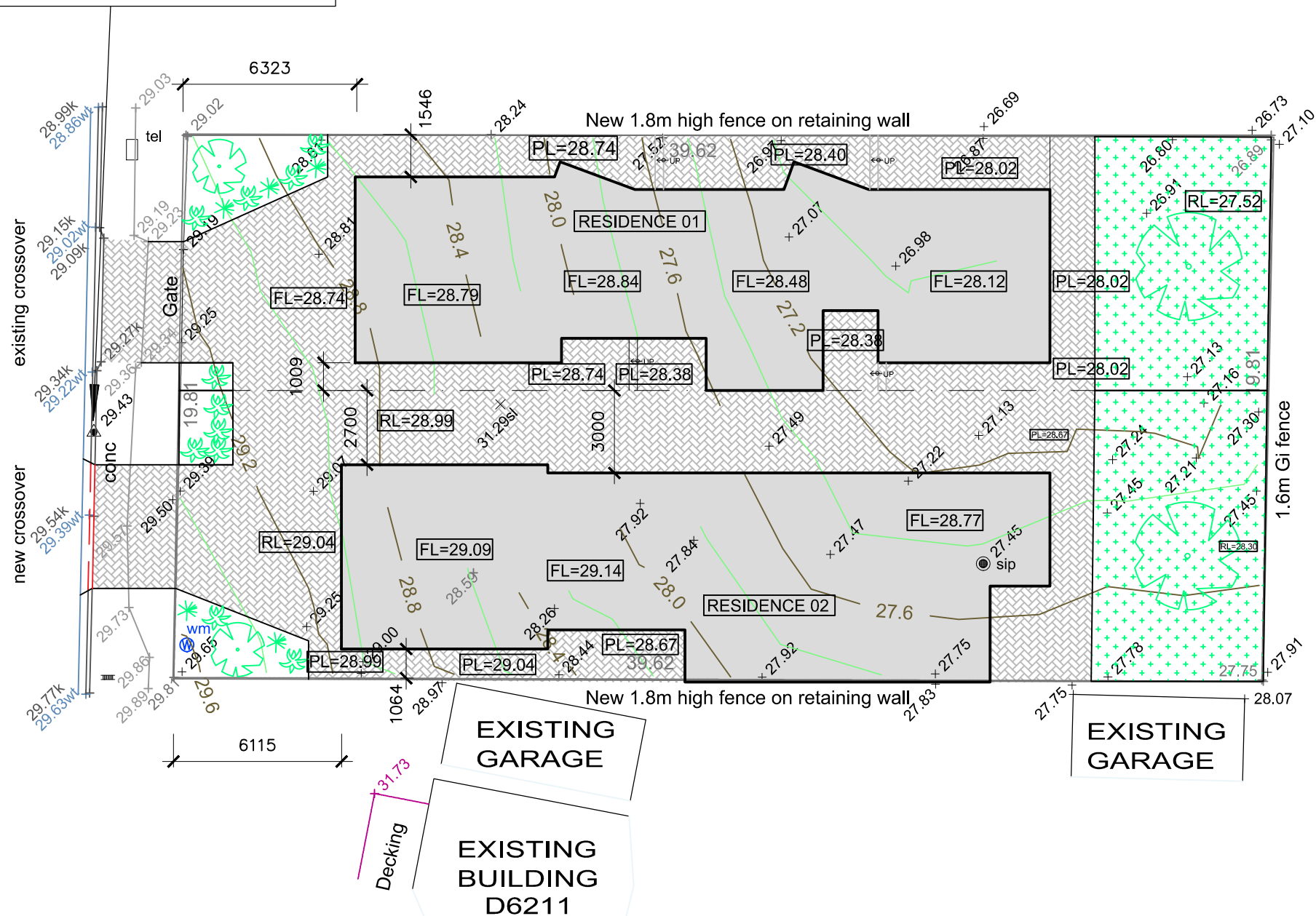


D113270

TBM : Masonry nail in the top of kerb
Adopted elevation = 29.43m AHD

ESPLANADE



1. CORDYLINE BANKSII
2. LAURAL BAYLEAF
- minimum planing height 2.0m for rear yard
3. PITTOSPORUM CRASSIFULUM (KARO)
4. GRASSED AREA, KIKUYU OR SIMILAR
5. PAVED AREA

AREAS

RESIDENCE 01	
SITE	=364SQM
GROUND FLOOR LIVING	=100SQM
GARAGE	= 44SQM
LEVEL 1 LIVING	=107SQM
BALCONIES	= 15SQM
RESIDENCE 02	
SITE	=420SQM
GROUND FLOOR LIVING	=116SQM
GARAGE	= 46SQM
LEVEL 1 LIVING	=128SQM
BALCONIES	= 20SQM

DEVELOPMENT APPROVAL

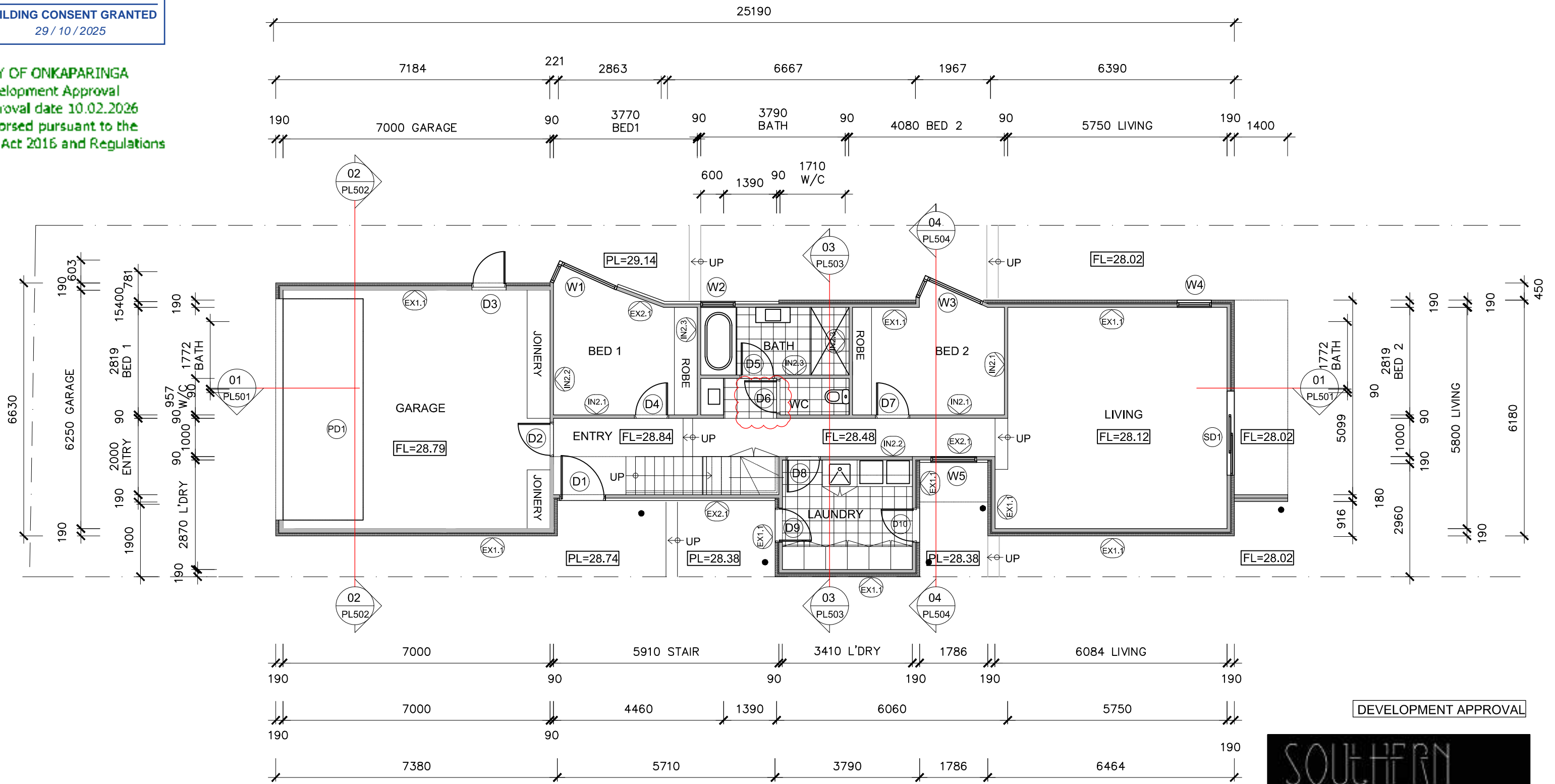


BAL 19 CONSTRUCTION NOTES
-FOR FURTHER DETAILS NOT LISTED ON THE DRAWINGS PLEASE REFER TO BAL RATING SA REPORT NO 107 APPENDIX A

GROUND FLOOR PLAN 1:200 @ A3
residence 01

DATE	20 OCTOBER 2025	DRAWING TITLE	SITE PLAN
SCALE	AS NOTED @ A3		
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	PAGE NO.	PL000
PROJECT	DEAN RESIDENCES	REV.	H

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GROUND FLOOR PLAN 1:100 @ A3
residence 01

AREAS	
RESIDENCE 01	
GROUND FLOOR LIVING	=100SQM
GARAGE	= 44SQM
LEVEL 1 LIVING	=107SQM
BALCONIES	= 15SQM

EXTERNAL WALL TYPES

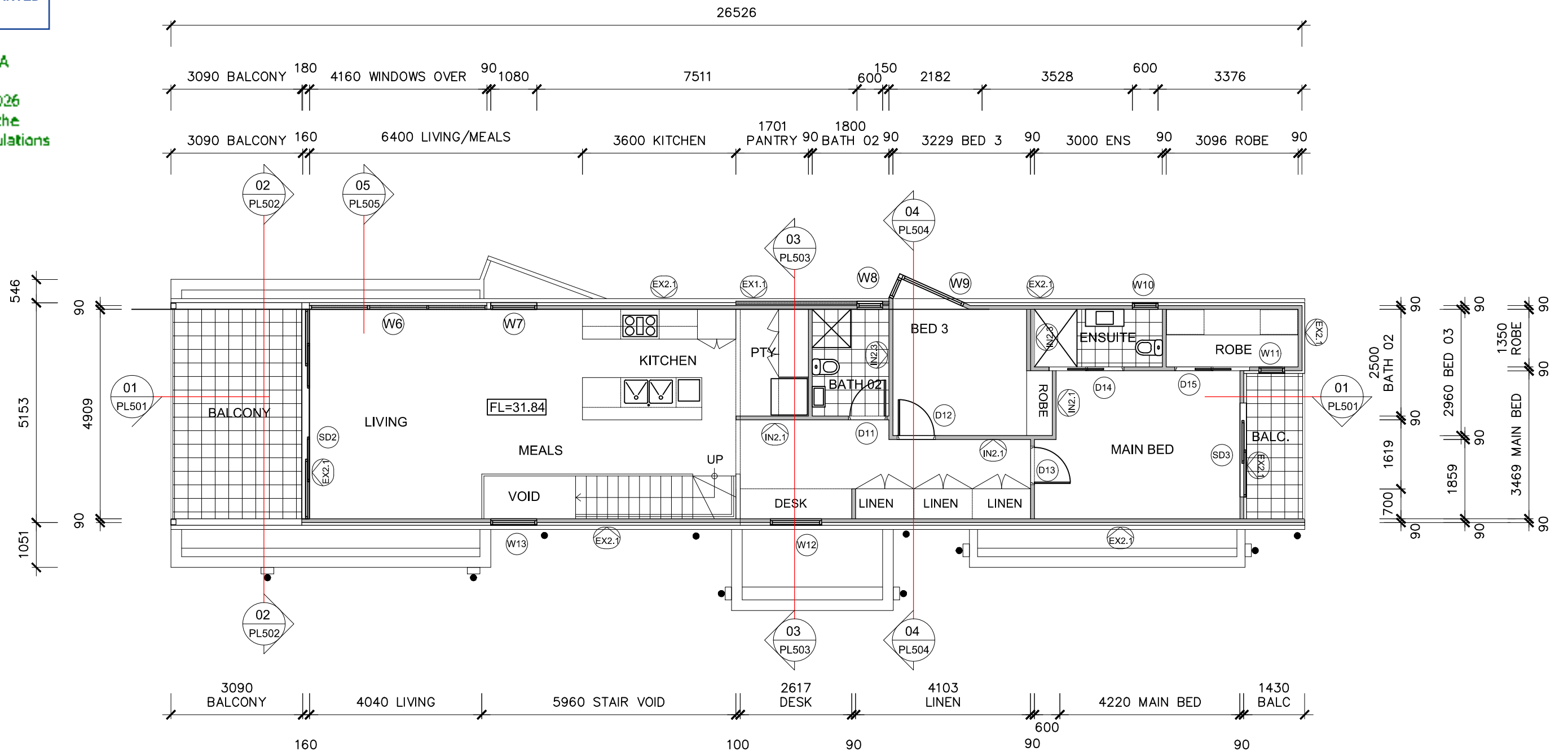
- | | |
|--|---|
| <p>EX1.1-EXTERNAL WALL TOTAL THICKNESS =200MM
75MM HEBEL PANELS
25MM TOP HATS
-CLASS 4 WALL WRAP, BRADFORD THERMO SEAL OR SIMILAR
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)</p> | <p>EX2.1-EXTERNAL WALL TOTAL THICKNESS =173MM
9MM AXOM CLADDING
64MM TOPHATS
-CLASS 4 WALL WRAP, BRADFORD THERMO SEAL OR SIMILAR
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)</p> |
|--|---|

OPEN D6 OUT TO PROVIDE MINIMUM CIRCULATION OF 1200MM X900MM CLEARANCE FROM DOOR TO PAN

DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	RESIDENCE 01 GROUND PLAN
SCALE	AS NOTED @ A3	PAGE NO.	PL101
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



FIRST FLOOR PLAN 1:100 @ A3
residence 01

DEVELOPMENT APPROVAL

INTERNAL WALL TYPES

IN2.1-INTERNAL WALL TOTAL THICKNESS =110MM
10MM PLASTERBOARD
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)

IN2.2-INTERNAL WALL TOTAL THICKNESS =110MM
10MM PLASTERBOARD
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED MR PLASTERBOARD

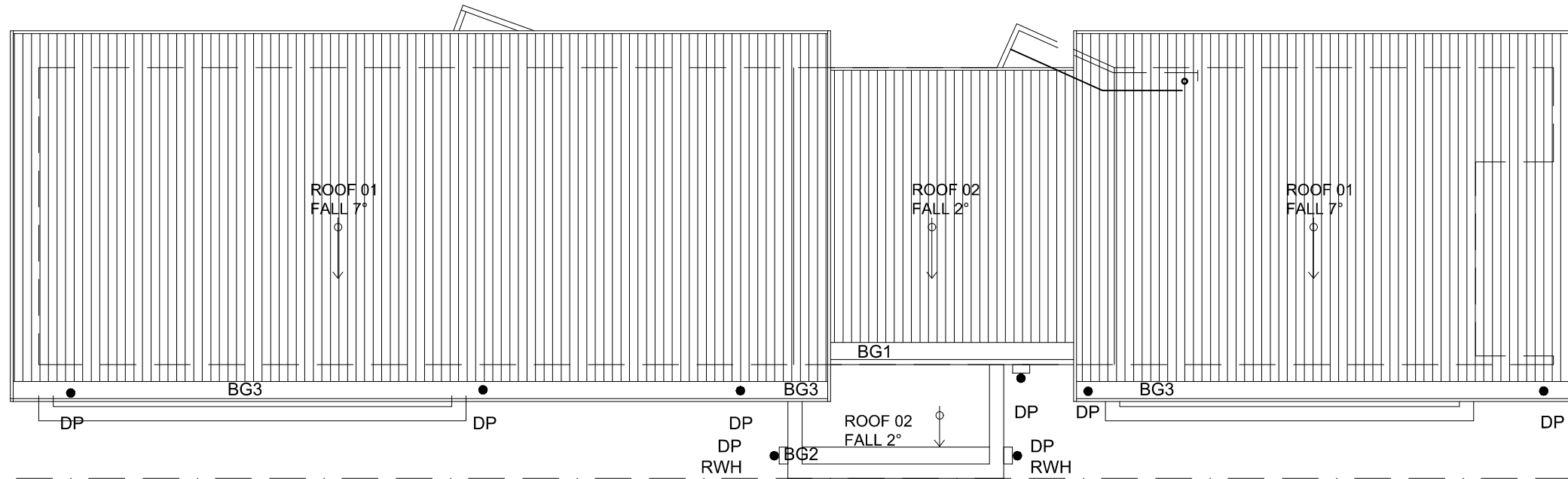
IN2.3-INTERNAL WALL TOTAL THICKNESS =106MM
6MM CEMENT SHEET- JOINTS TAPED (BATHROOM SIDE)
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)
*ALL INTERNAL LININGS TO COMPLY WITH THE NCC VOL 1 PART H3

PROVIDE LIFT OFF HINGES TO BATHROOM DOORS D11



DATE	20 OCTOBER 2025	DRAWING TITLE	RESIDENCE 01 LEVEL 01 PLAN
SCALE	AS NOTED @ A3	PAGE NO.	PL102
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

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ROOF PLAN 1: 100 @ A3
 residence 02

BAL 19 CONSTRUCTION NOTES
 -SEAL ALL GAPS WITH MINERAL WOOL INSULTAION OR SIMILAR
 -GUTTER TO BE GREATER THAN 0.4MM COLORBOND ULTRA STEEL
 -FLASH AND SEAL ALL PENETRATIONS
 -NON COMBUSTIBLE GUTTERS GUTTERS AND DOWN PIPES

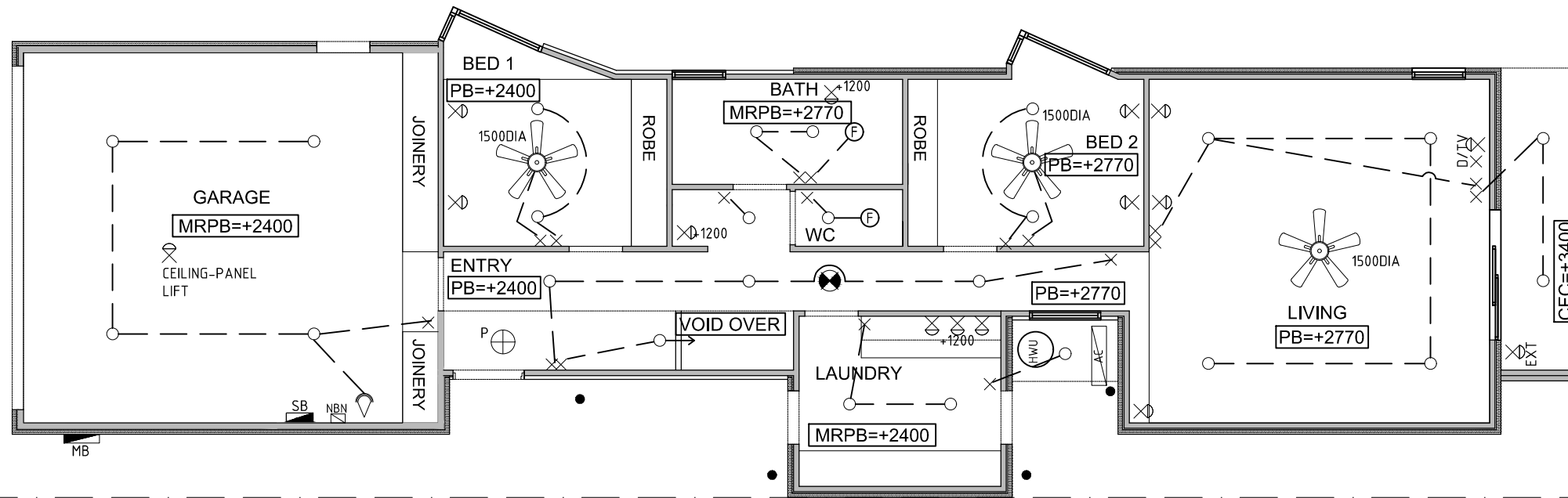
BG1	BOX GUTTER TYPE 3- COLORBOND ULTRA 300WX150DEEP	SPREADER	2.4M LONG SLOTTED 100DIA PVC SPREADER
BG2	BOX GUTTER TYPE 3- COLORBOND ULTRA 200WX100DEEP	ROOF 01	CUSTOM ORB- COLORBOND ULTRA- 7° PITCH- BRADFORD ANTICON 80 OR SIMILAR ROOF BLANKET- WITH ADDITIONAL R6.0 CEILING INSULATION
BG3	BOX GUTTER TYPE 3- COLORBOND ULTRA 300WX100DEEP	ROOF 02	TRIMDECK ROOFING - COLORBOND ULTRA- 2° PITCH BRADFORD ANTICON 80 OR SIMILAR ROOF BLANKET- WITH ADDITIONAL R6.0 CEILING INSULATION
DP	COLORED 100DIA PVC DOWNPIPE CONNECTED TO UNDERGROUND STORMWATER- AS PER CIVIL ENGINEERS DETAILS		
RWH	300Wx150Hx100D COLORBOND RAINWATER HEAD		

DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	ROOF PLAN RESIDENCE 1
SCALE	AS NOTED @ A3	PAGE NO.	PL105
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

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GROUND CEILING PLAN 1:100 @ A3
 residence 01

CEILING LEGEND

- MRPB- 10MM MOISTURE RESISTANT PLASTERBOARD
- PB- 10MM SUPERCEIL PLASTERBOARD
- CFC- CEMENT SHEET WITH EXPRESSED JOINTS

*PROVIDE R6.0 CEILING INSULATION THROUGHOUT ALL GROUND AND LEVEL 1 CEILINGS

- ⊗ DOUBLE GPO - 300AFL, UNLESS NOTED OTHERWISE,
- Ⓒ HARD WIRED COOK TOP PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
- Ⓔ HARD WIRED OVEN PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
- Ⓓ GPO IN OVERHEAD JOINERY FOR RANGE HOOD

- Ⓕ 300DIA FAN DUCTED TO OUTSIDE AIR, PROVIDE SURFACE SOCKET CONNECTION WIRED TO WALL SWITCH- PROVIDE RUN ON TIMER WHERE NO NATURAL VENTILATION IS ACHIEVED

- ⊗ CLIPSAL ICONIC LIGHT SWITCH- NUMBER OF GROUPED SWITCHES DENOTES LIGHT GANG QUANTITY

- ⊗ SMOKE ALARM HARDWIRED TO AS3786

- HANECO VIVA 90 DOWNLIGHT- PROVIDE DIMMING TO ALL LIVING AREAS AND BEDROOMS

- 1500DIA
 VARIABLE SPEED FAN
 1500DIA- 1500MM BLADE DIAMETER
 2100DIA- 2100MM BLADE DIAMETER

- MAIN SWITCH BOARD, RECESSED INTO EXTERNAL WALL SKIN

- SUB BOARD

- NBN JUNCTION BOX

- MOTION SENSOR

- FEATURE PENDANT- UP TO 50W

- HARD WIRED PROVISION FOR A/C ON SEPARATE CIRCUIT

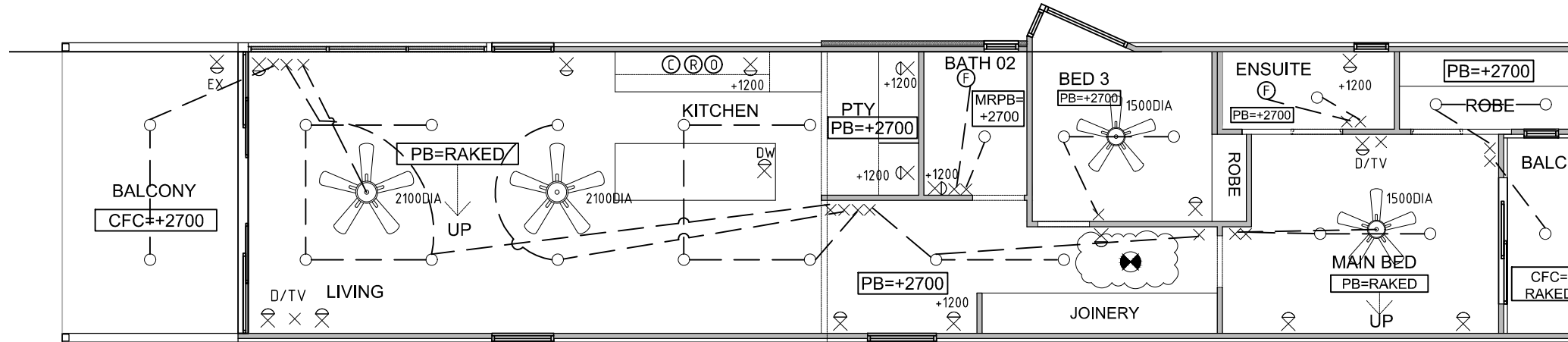
- HARD WIRED PROVISION FOR HWS ON SEPARATE CIRCUIT
 315L THERMANN HEAT PUMP HOT WATER UNIT-

DEVELOPMENT APPROVAL







DATE	20 OCTOBER 2025	DRAWING TITLE	GROUND FLOOR CEILING PLAN RES 1
SCALE	AS NOTED @ A3	PAGE NO.	PL109
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		





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


FIRST FLOOR CEILING PLAN 1:100 @ A3
residence 01

CEILING LEGEND

- MRPB- 10MM MOISTURE RESISTANT PLASTERBOARD
- PB- 10MM SUPERCEIL PLASTERBOARD
- CFC- CEMENT SHEET WITH EXPRESSED JOINTS
- *PROVIDE R6.0 CEILING INSULATION THROUGHOUT ALL GROUND AND LEVEL 1 CEILINGS
-  DOUBLE GPO - 300AFL, UNLESS NOTED OTHERWISE,
-  HARD WIRED COOK TOP PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
-  HARD WIRED OVEN PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
-  GPO IN OVERHEAD JOINERY FOR RANGE HOOD

-  300DIA FAN DUCTED TO OUTSIDE AIR, PROVIDE SURFACE SOCKET CONNECTION WIRED TO WALL SWITCH- PROVIDE RUN ON TIMER WHERE NO NATURAL VENTILATION IS ACHIEVED
-  CLIPSAL ICONIC LIGHT SWITCH- NUMBER OF GROUPED SWITCHES DENOTES LIGHT GANG QUANTITY
-  INTER CONNECTED SMOKE ALARM HARDWIRED TO AS3786
-  HANECO VIVA 90 DOWNLIGHT- PROVIDE DIMMING TO ALL LIVING AREAS AND BEDROOMS

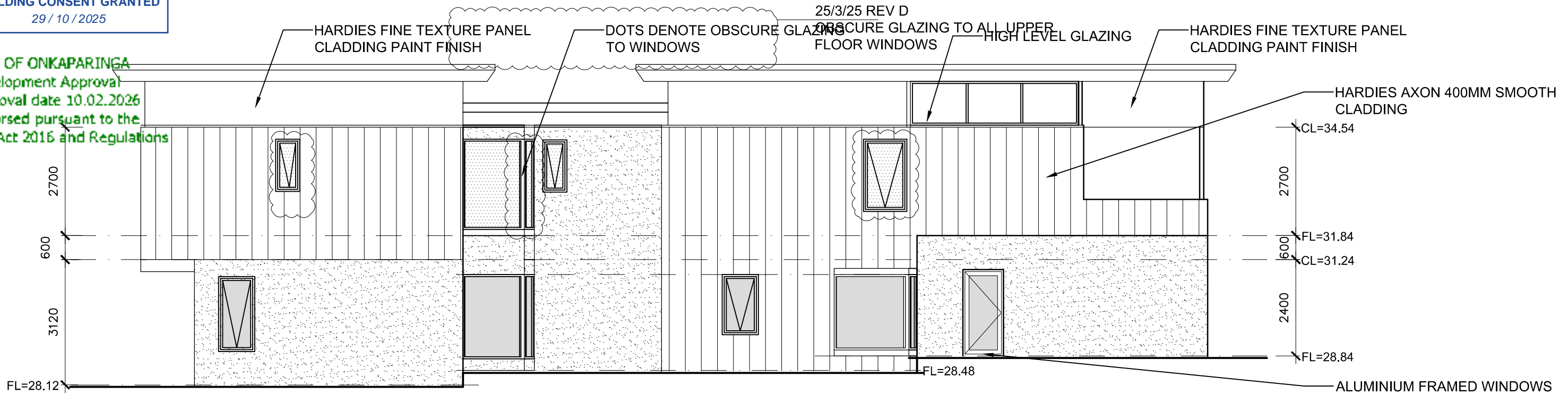
-  1500DIA VARIABLE SPEED FAN
1500DIA- 1500MM BLADE DIAMETER
2100DIA- 2100MM BLADE DIAMETER

DEVELOPMENT APPROVAL

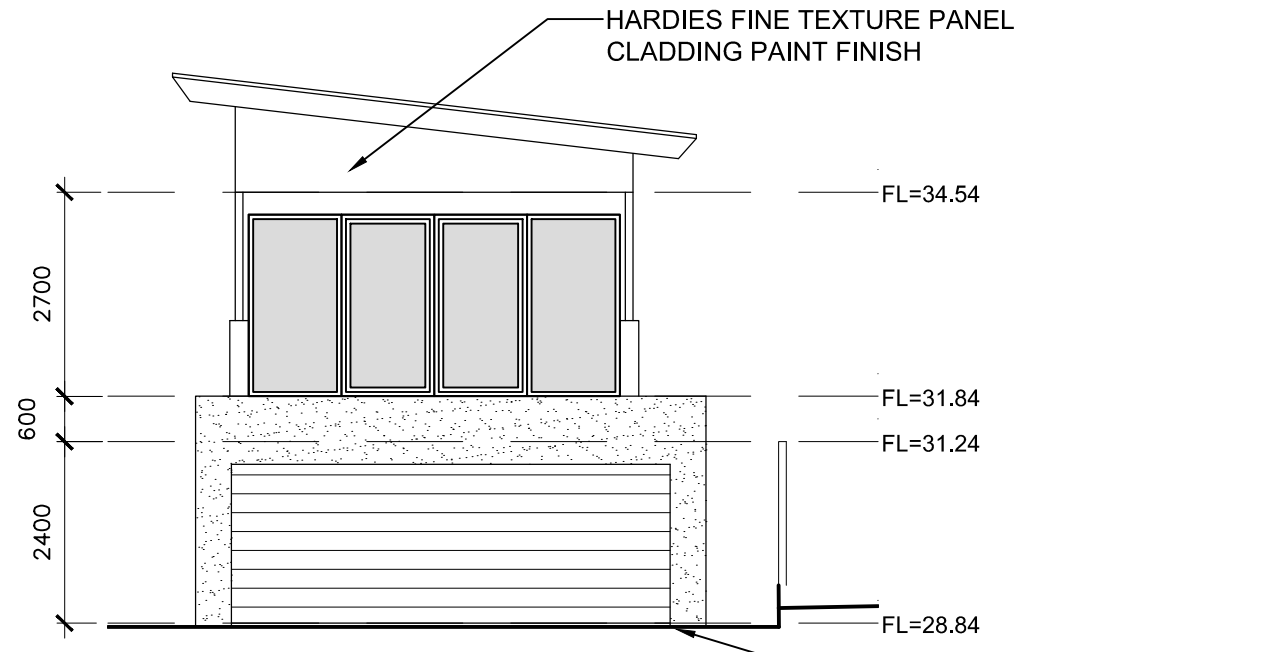


DATE	20 OCTOBER 2025	DRAWING TITLE	LEVEL 1 CEILING PLAN RES 1
SCALE	AS NOTED @ A3	PAGE NO.	PL108
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

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NORTH ELEVATION 1:100 @ A3
 residence 01



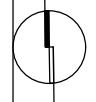
WEST ELEVATION 1:100 @ A3
 residence 01 & 02

BAL 19 CONSTRUCTION NOTES
 -SEAL ALL EXTERNAL GAPS GREATER THAN 3MM WITH FIRE RATED SILICONE
 -FIT CORROSION RESISTANT METAL MESH TO ALL WEEP HOLES (MAX APERTURE 2.0MM)

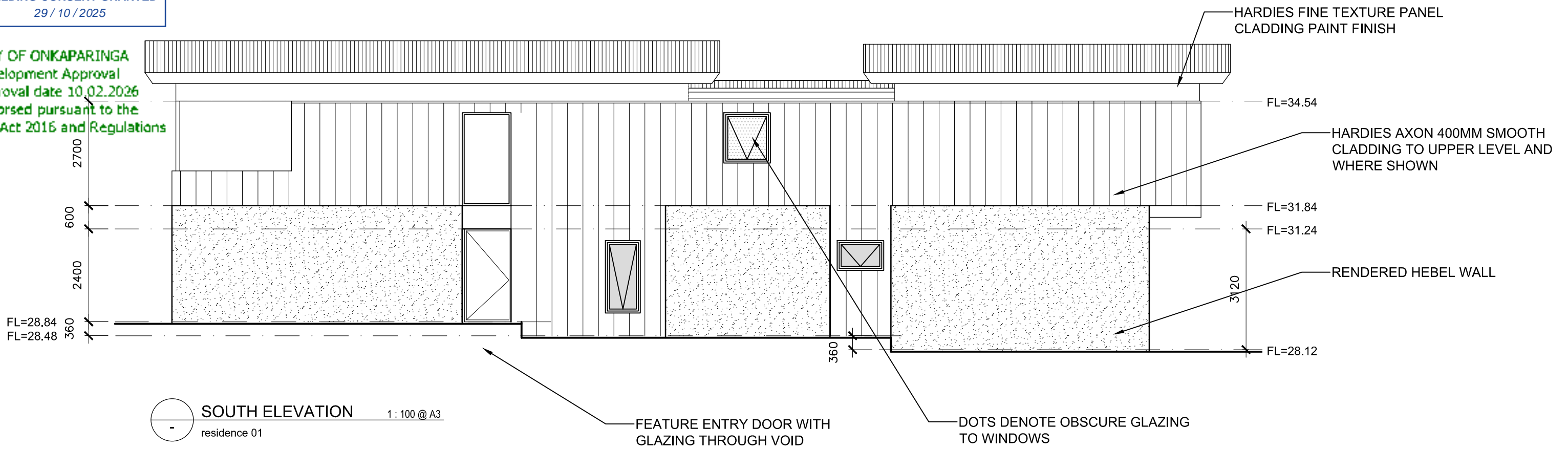
DEVELOPMENT APPROVAL



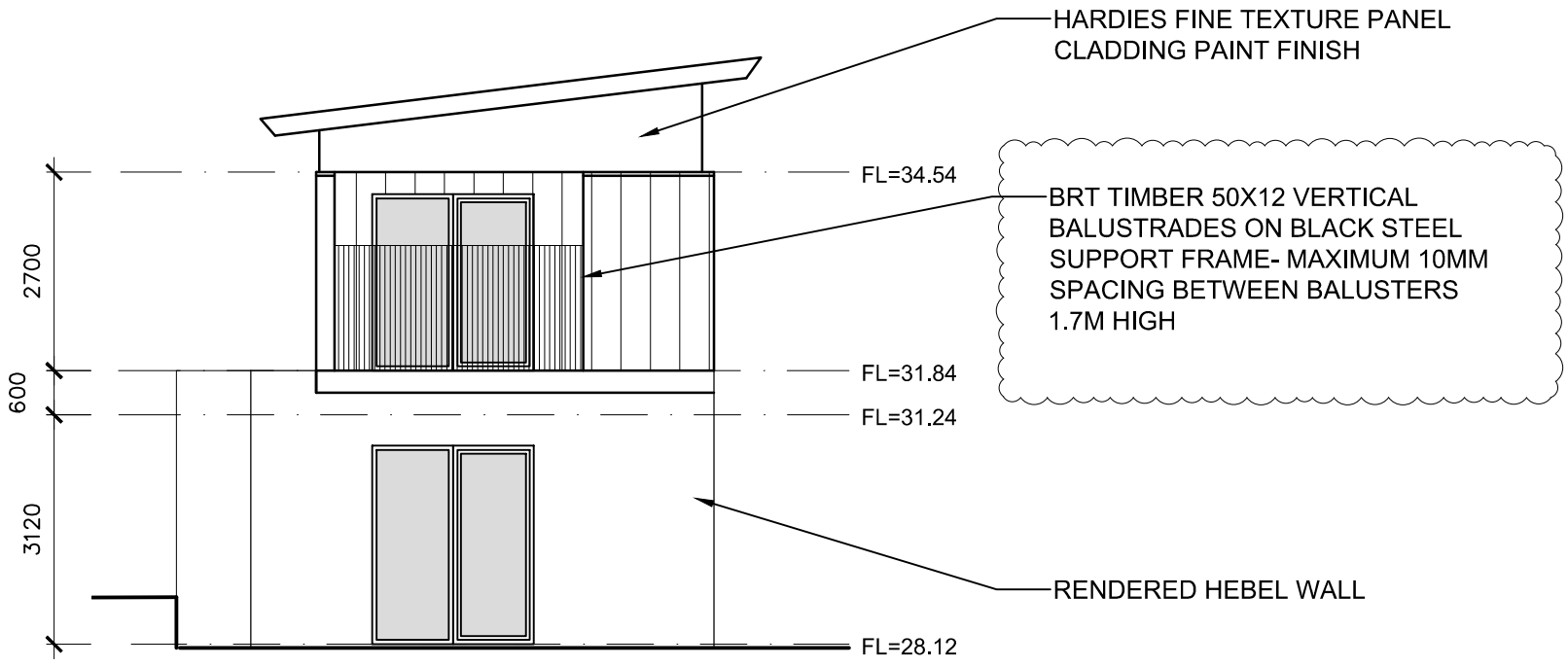
DATE	20 OCTOBER 2025	DRAWING TITLE	ELEVATIONS RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL201
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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SOUTH ELEVATION 1:100 @ A3
 residence 01

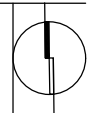


EAST ELEVATION 1:100 @ A3
 residence 01

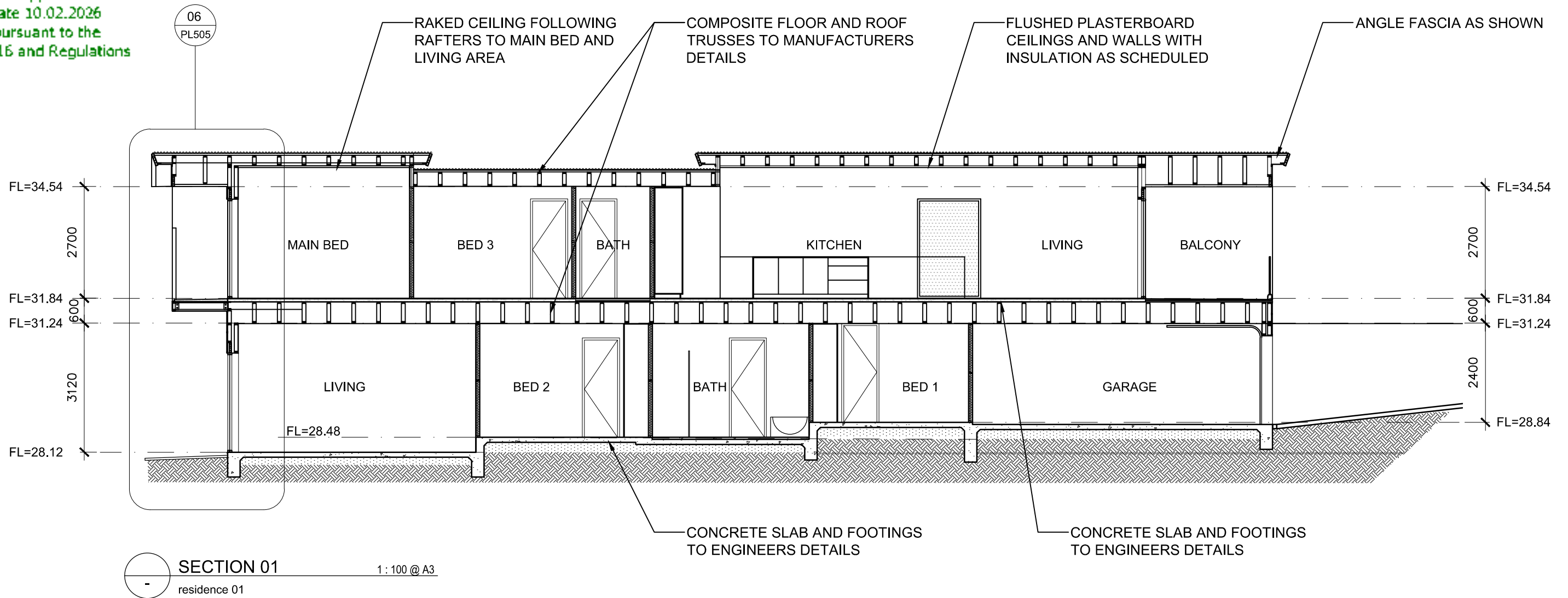
DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	ELEVATIONS RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL202
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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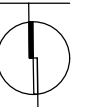


SECTION 01
 residence 01
 1 : 100 @ A3

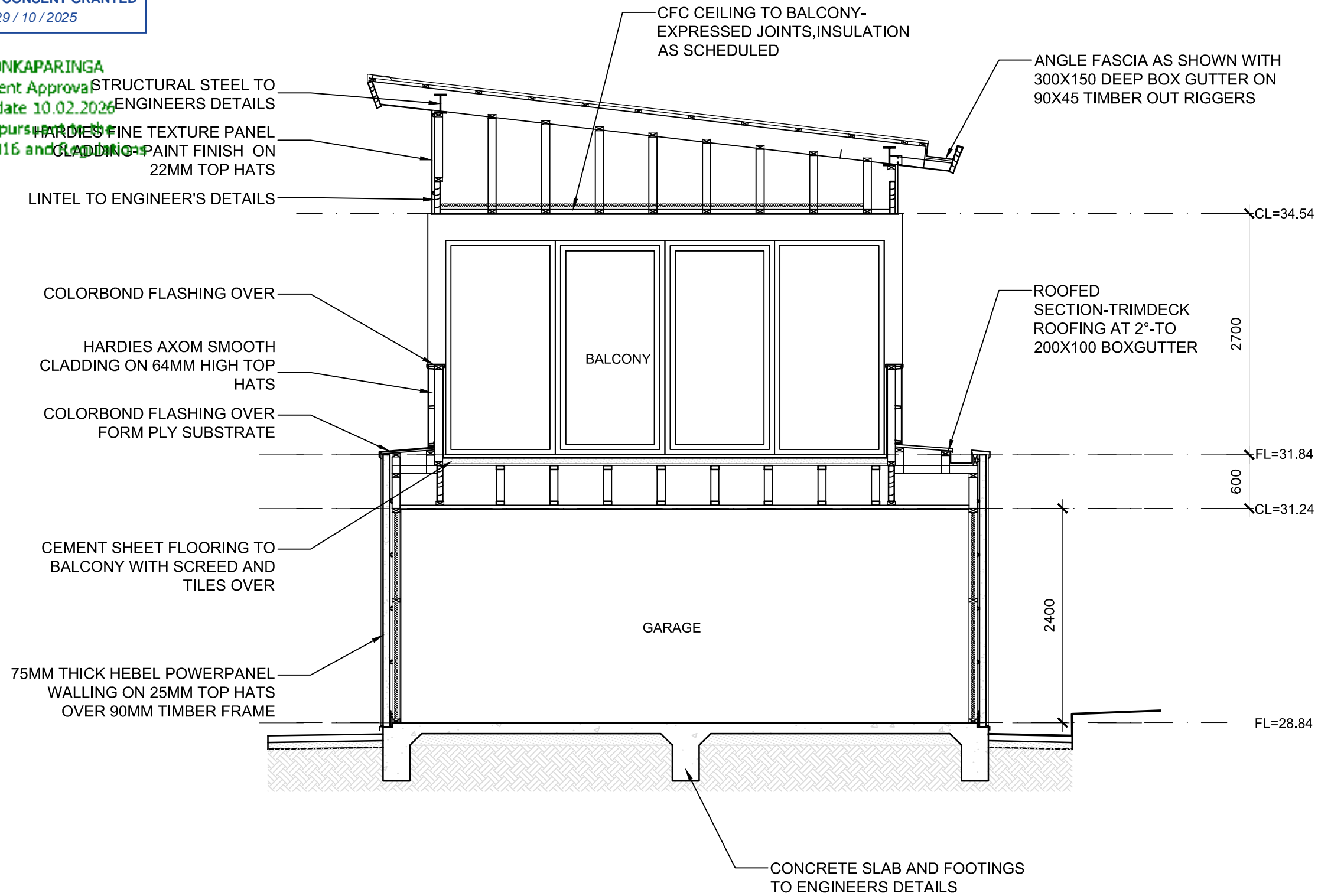
DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	SECTION 01 RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL501
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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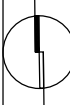


SECTION 02
 residence 01
 1:50 @ A3

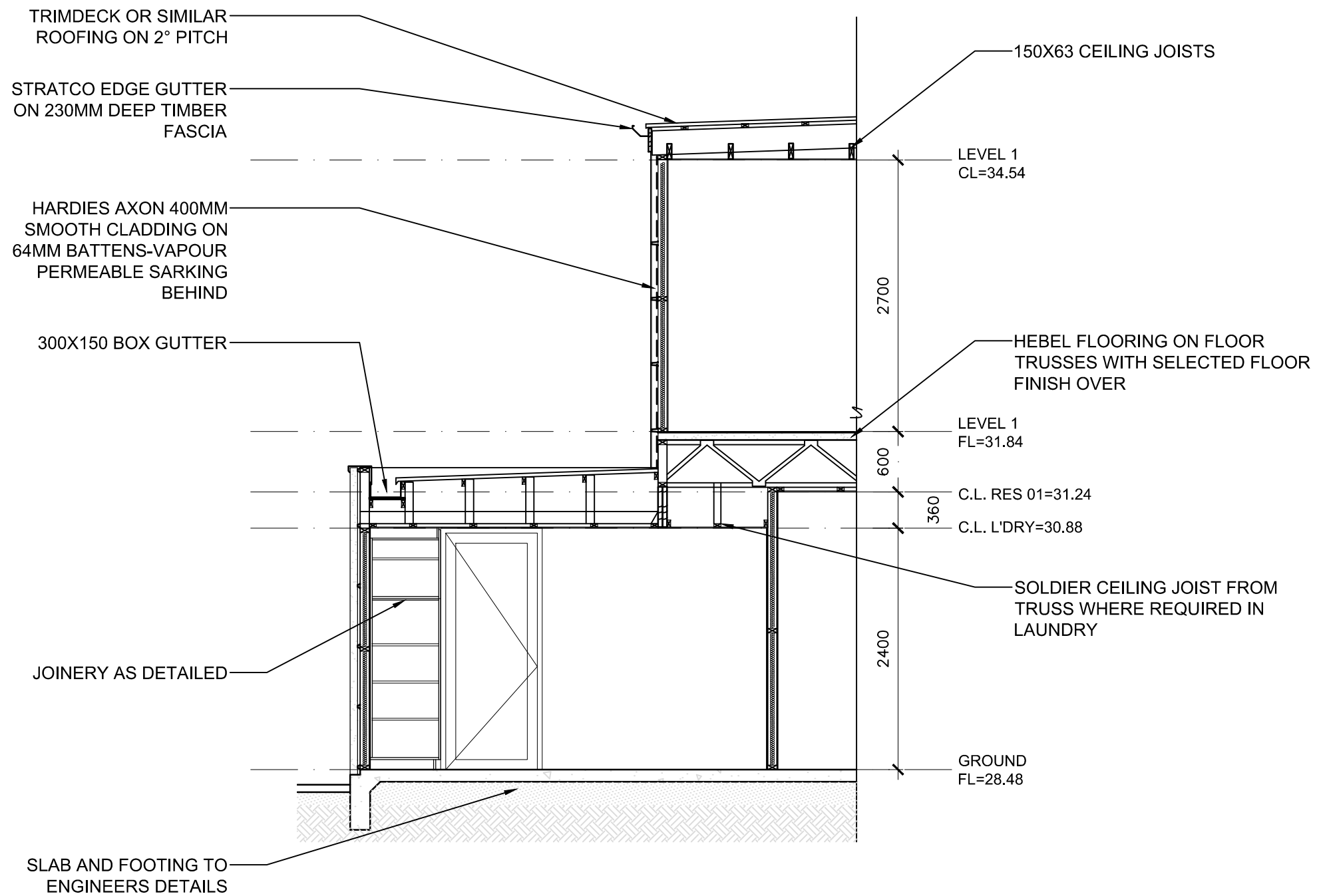
DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	SECTION 02 RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL502
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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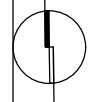


SECTION 03
 residence 01
 1 : 50 @ A3

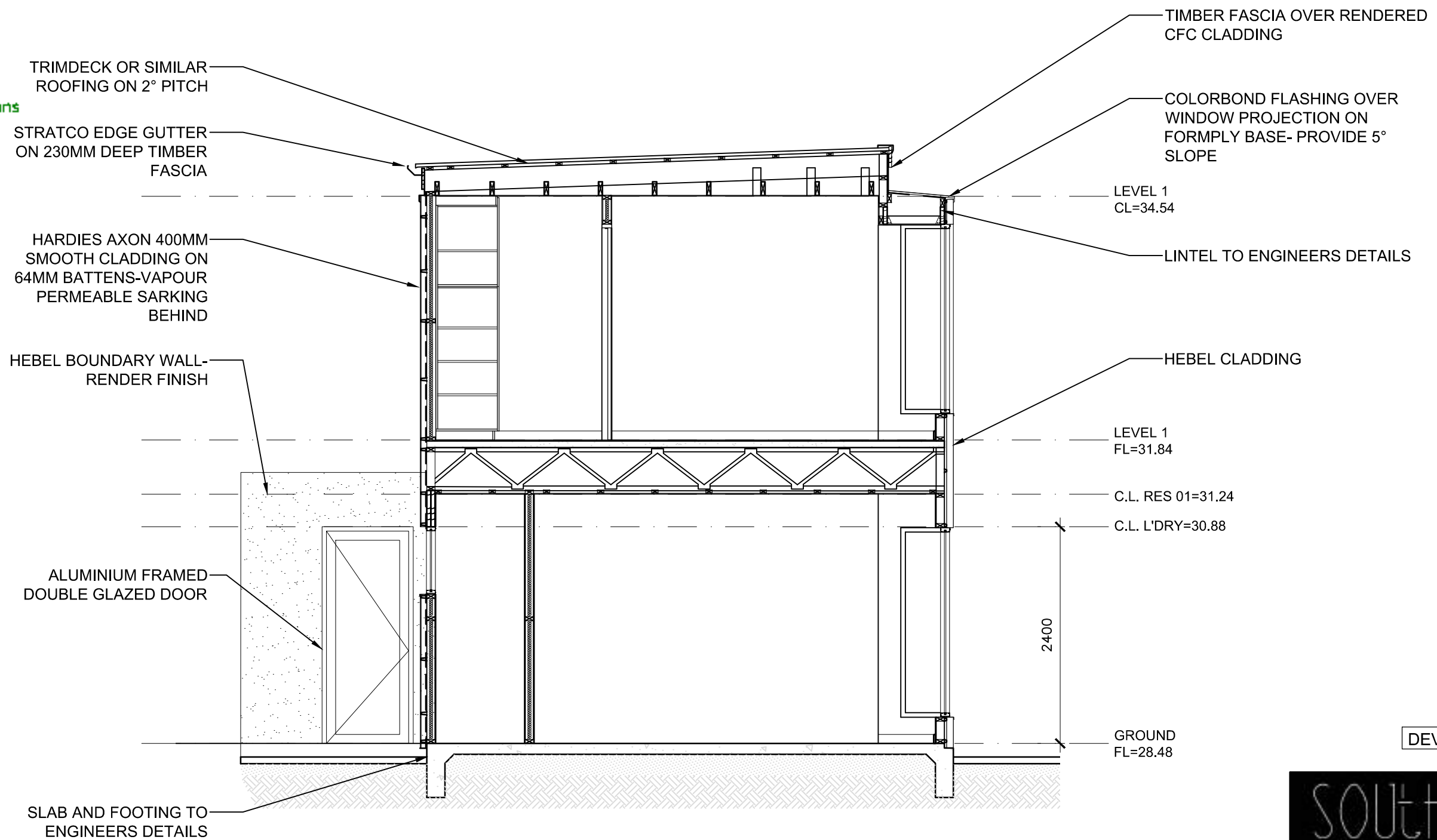
DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	SECTION 03 RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL503
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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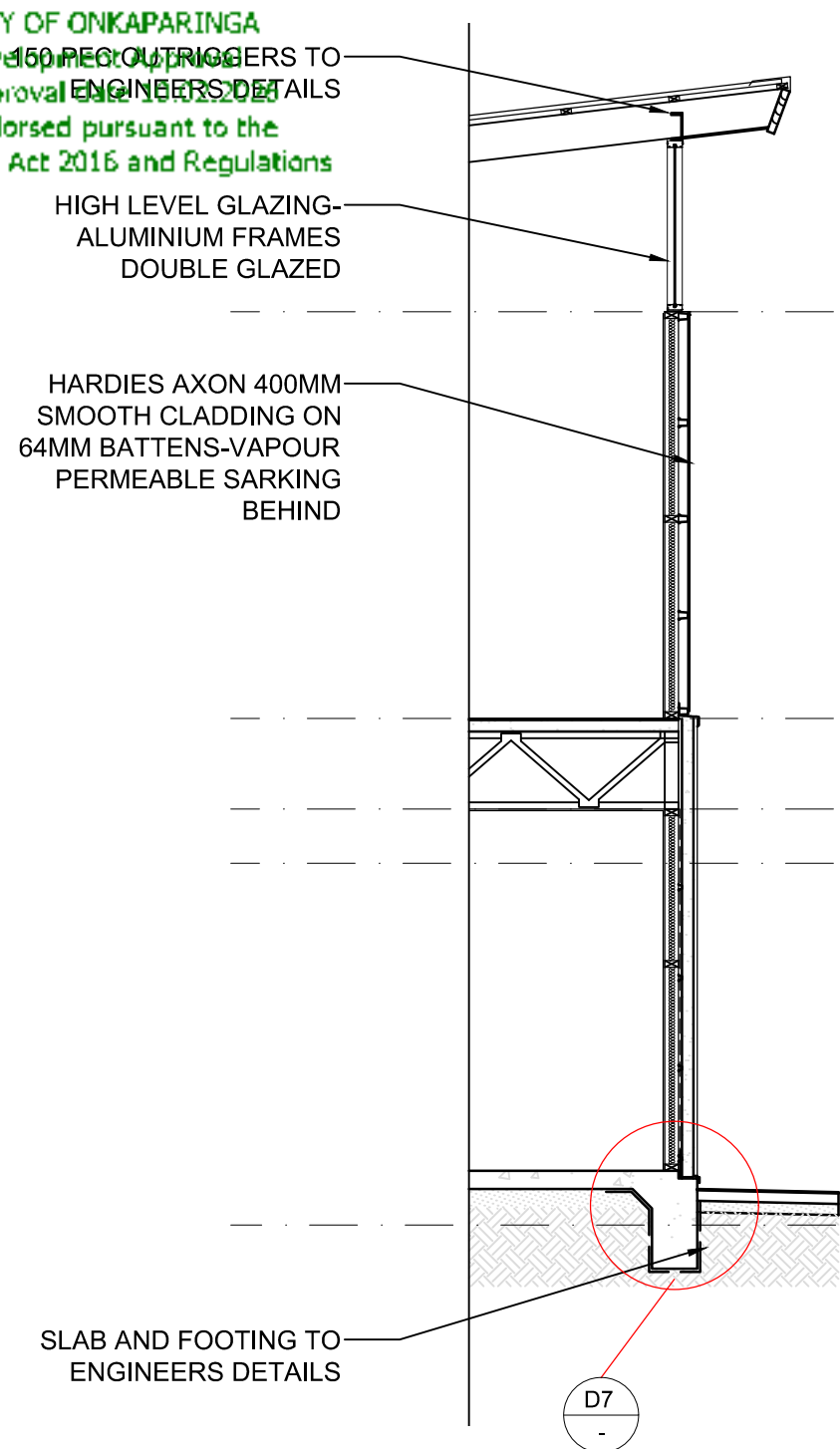
DEVELOPMENT APPROVAL



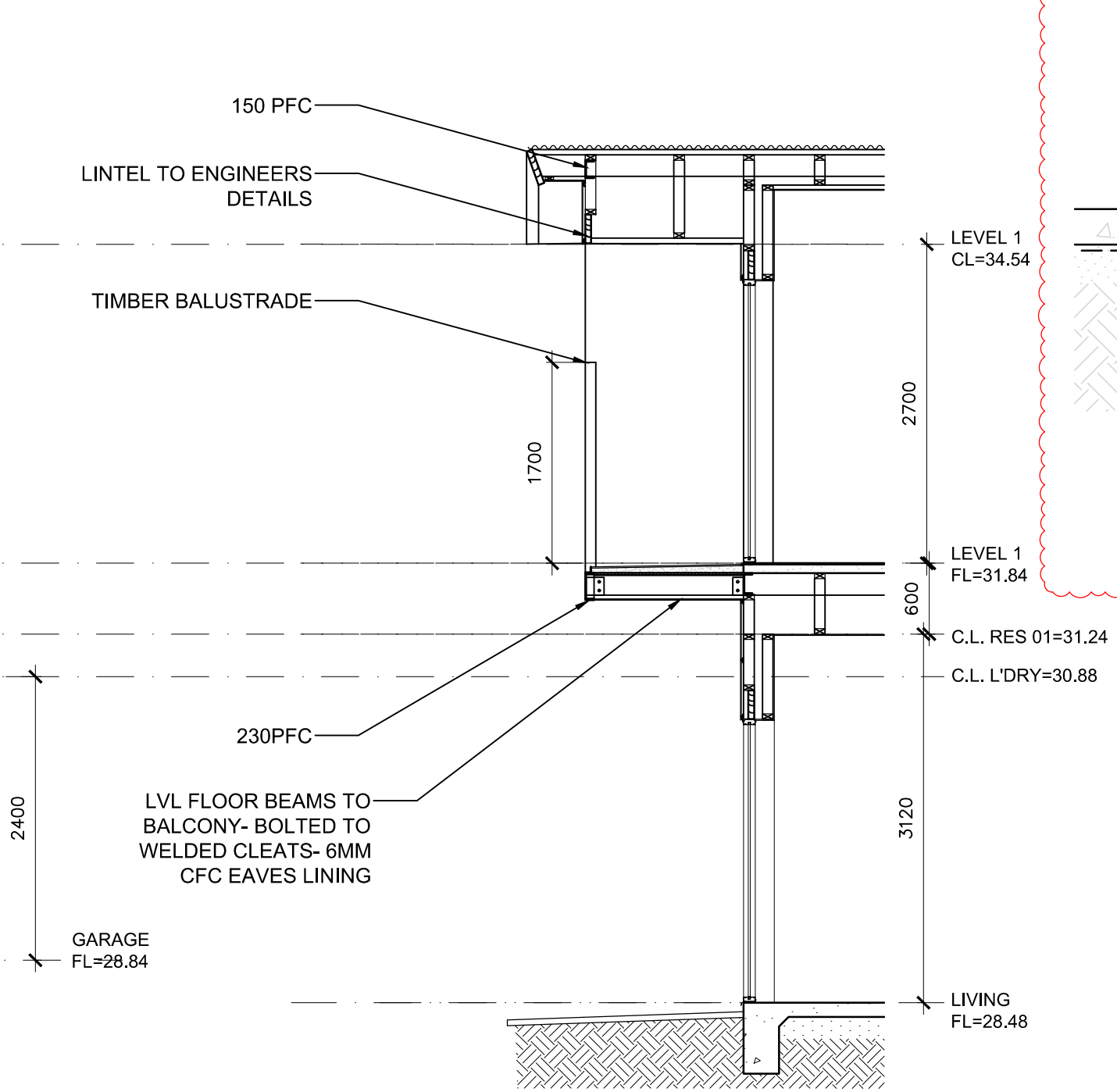
SECTION 04
 residence 01
 1 : 50 @ A3

DATE	20 OCTOBER 2025	DRAWING TITLE	SECTION 04 RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL504
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

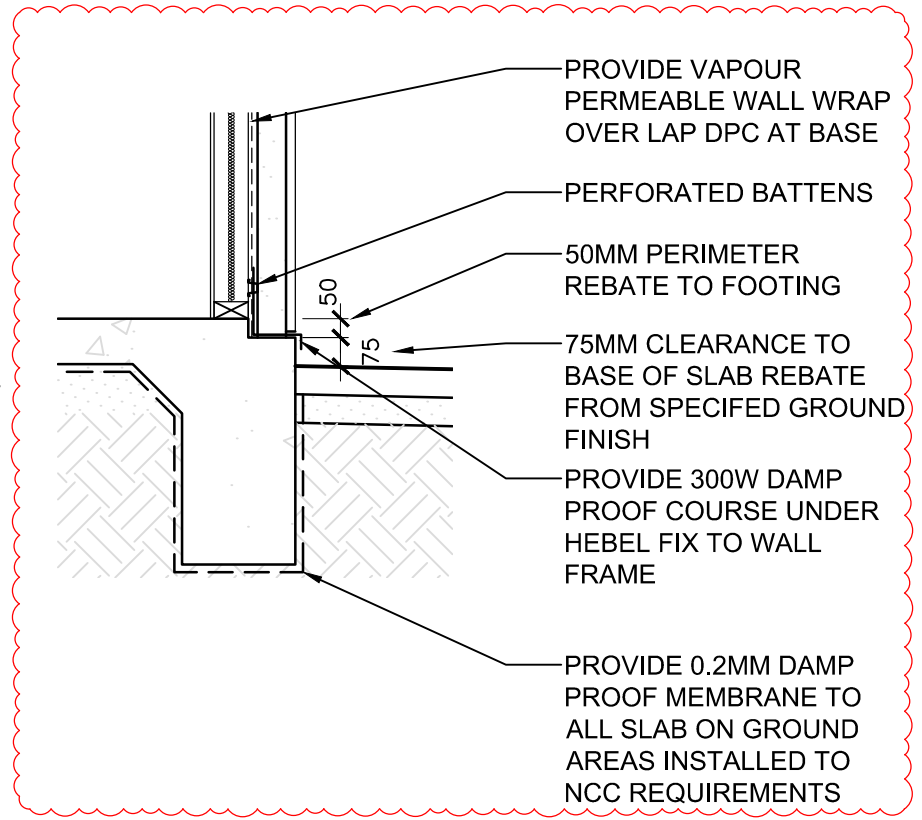
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SECTION 05 1:50 @ A3
 residence 01



SECTION 06 1:50 @ A3
 residence 01

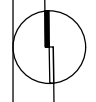


D7 DETAIL 7- SLAB EDGE 1:20 @ A3
 residence 01

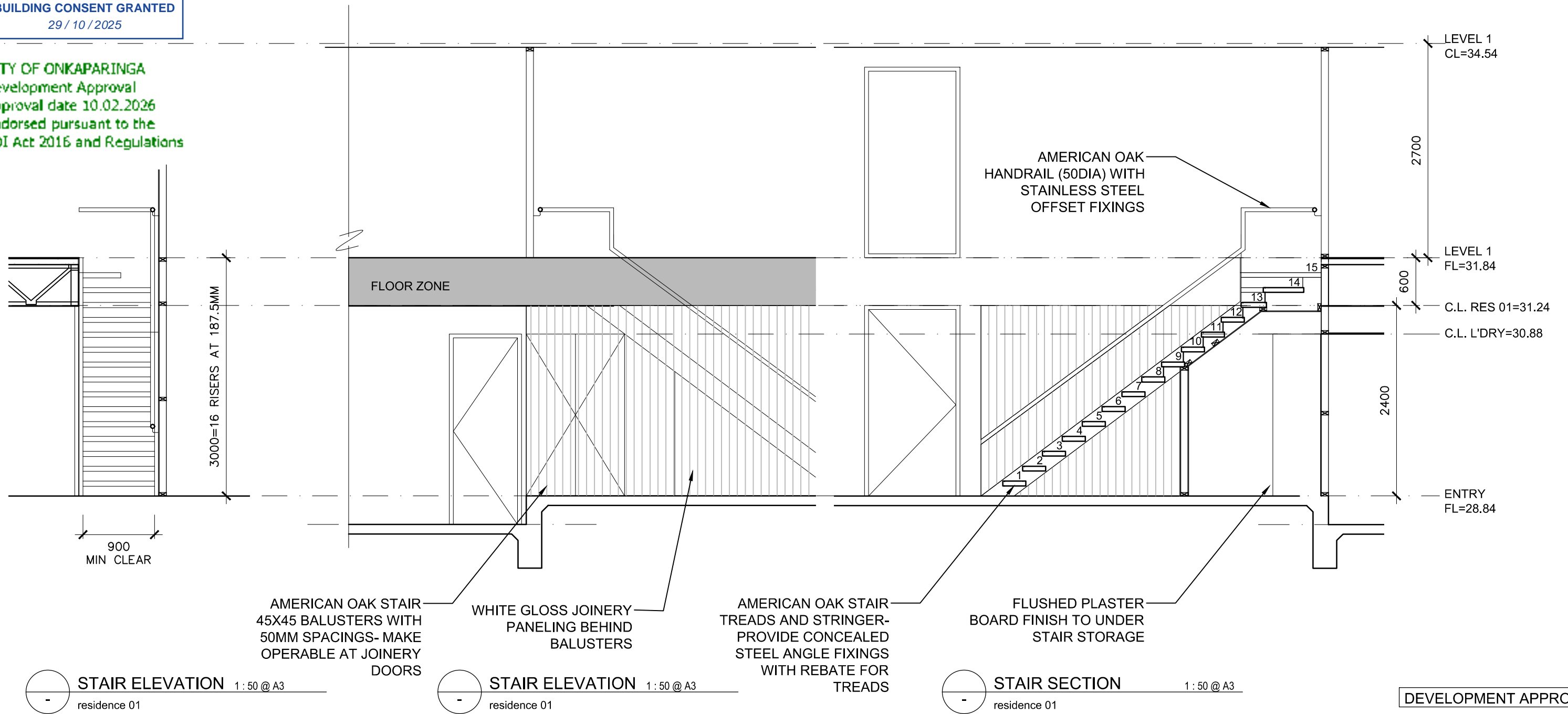
DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	SECTION 05 & 6 RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL505
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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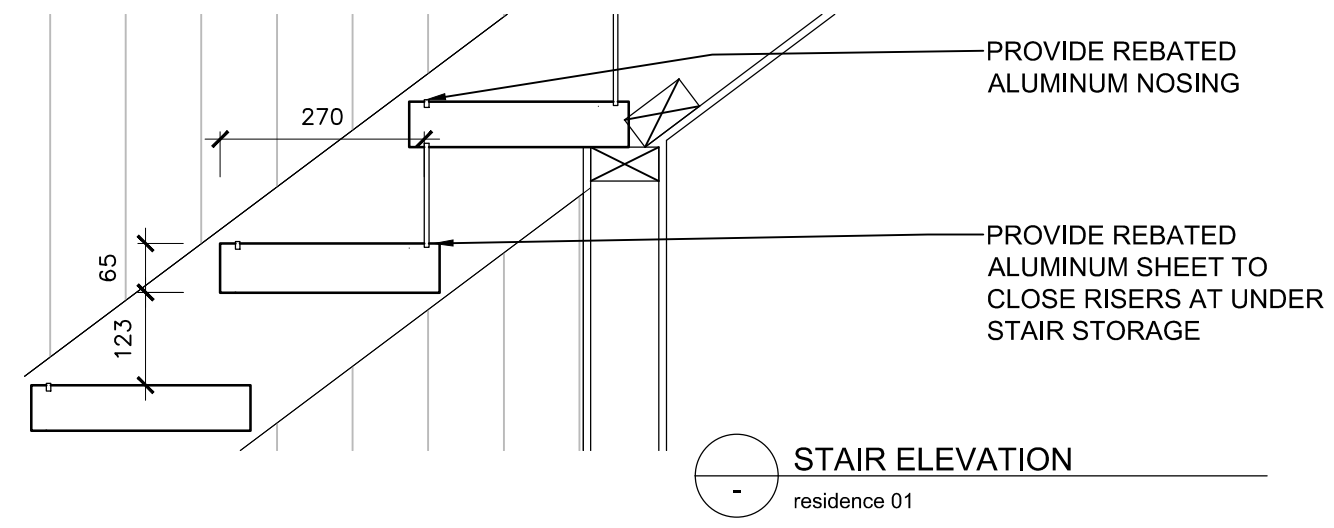


STAIR ELEVATION 1:50 @ A3
 residence 01

STAIR ELEVATION 1:50 @ A3
 residence 01

STAIR SECTION 1:50 @ A3
 residence 01

DEVELOPMENT APPROVAL

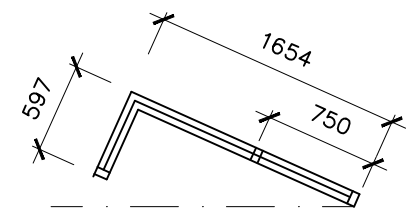
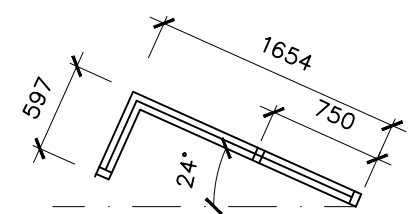
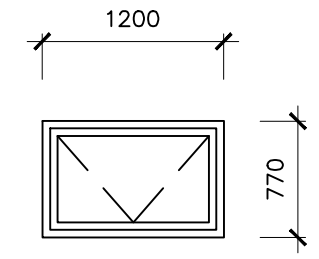
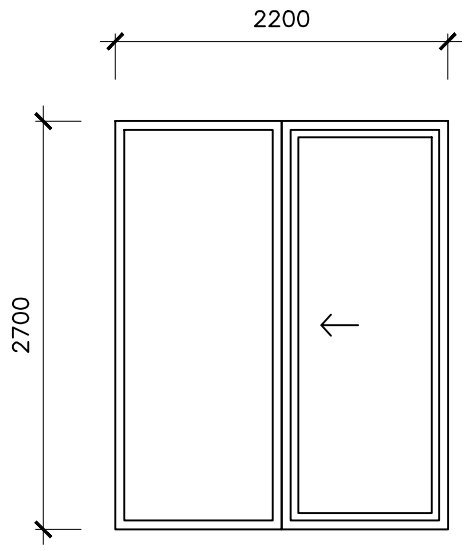
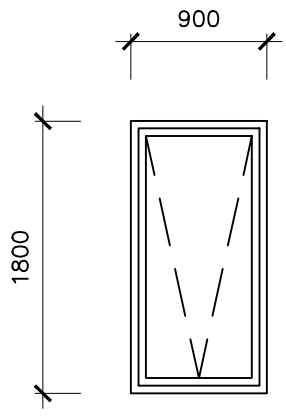
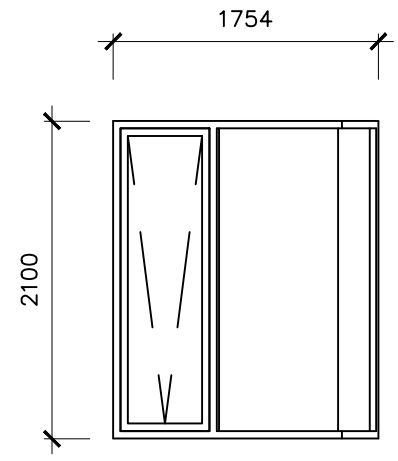
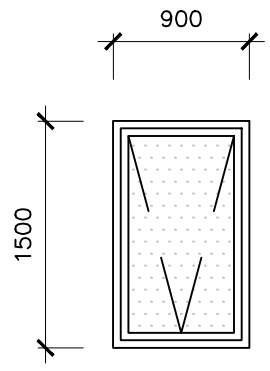
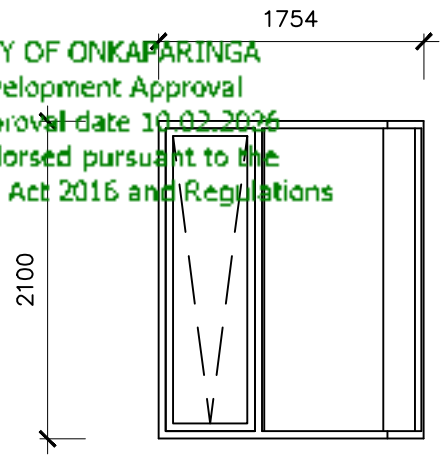


STAIR ELEVATION
 residence 01



DATE	20 OCTOBER 2025	DRAWING TITLE	STAIR DETAILS RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL506
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	PROJECT	DEAN RESIDENCES
REV.	H		

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W1- SILICONE BUTT JOINTED WINDOW WITH AWNING SIDE SASH

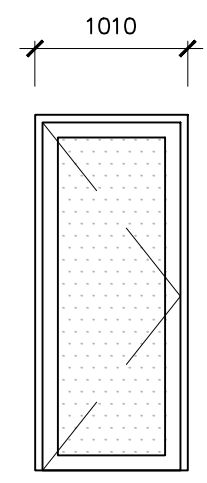
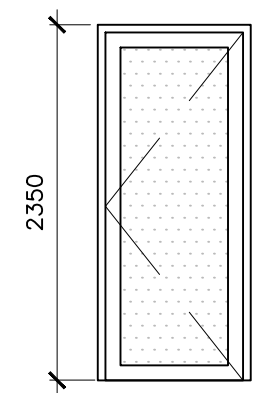
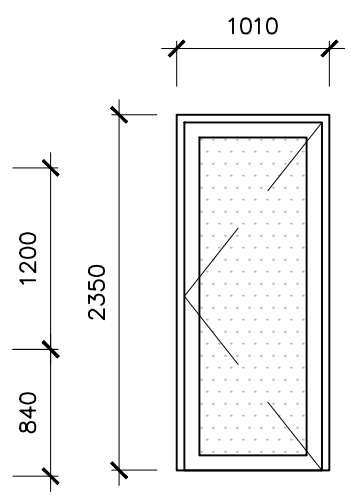
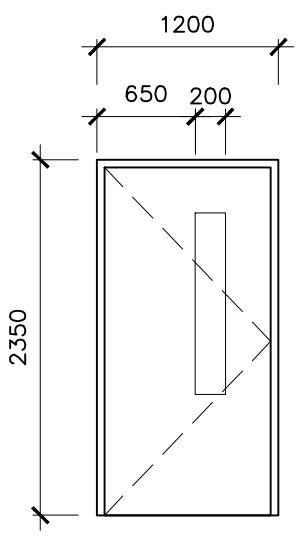
W2- AWNING WINDOW - OBSCURE GLAZING

W3- SILICONE BUTT JOINTED WINDOW WITH AWNING SIDE SASH

W4- AWNING WINDOW

SD1- SLIDING DOOR WITH SCREEN

W5- AWNING WINDOW



**-ALL AWNING WINDOWS
 JOLONG 100 SERIES WINDOWS (THERMAL BREAK) WITH
 6MM LOW E+12AR+6MM LOW E GLASS**
**-ALL SLIDING DOORS
 JOLONG 100 SERIES DOORS (THERMAL BREAK) WITH 6MM
 LOW E+12AR+6MM LOW E GLASS**
**-ALL SLIDING DOORS
 JOLONG 100 SERIES (THERMAL BREAK) WITH 5MM LOW
 E+12AR+5MM LOW E GLASS**

**-ALL OPERABLE SASHES TO BE SCREENED WITH
 STAINLESS STEEL FLYSCREENS (MAX APERTURE 2.0MM)**

**D1- ENTRY DOOR
 COLORBOND CLADDING
 EXTERNAL
 PAINT FINISH INTERNALLY
 WITH PERIMETER SEALS**

**D3- GLAZED DOOR
 WITH PERIMETER
 SEALS- OBSCURE
 GLAZING**

**D9- GLAZED DOOR
 WITH PERIMETER
 SEALS- OBSCURE
 GLAZING**

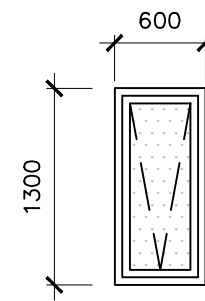
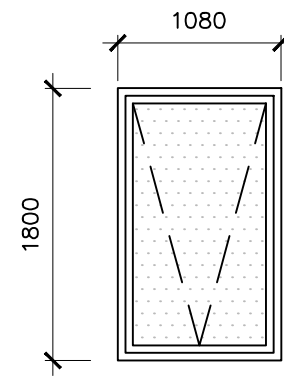
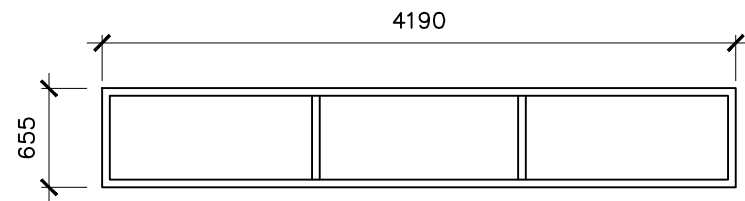
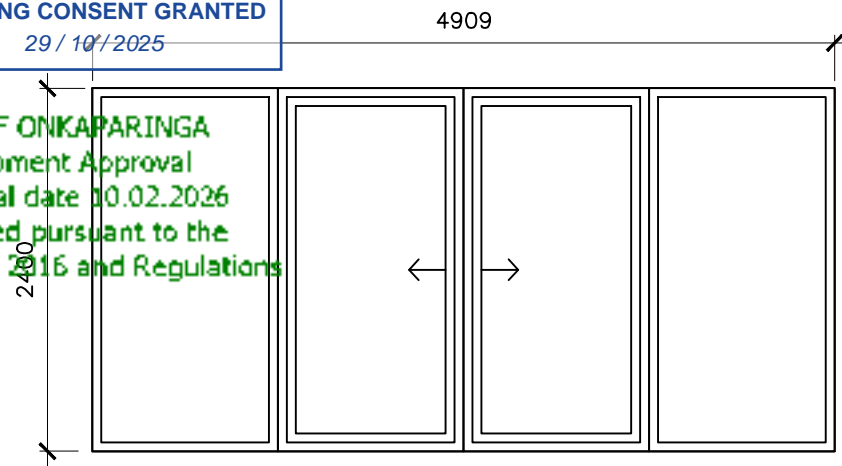
**D10- GLAZED DOOR
 WITH PERIMETER
 SEALS- OBSCURE
 GLAZING**

DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	WINDOW SCHEDULE GROUND-RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL601
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

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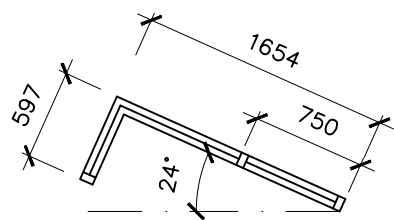
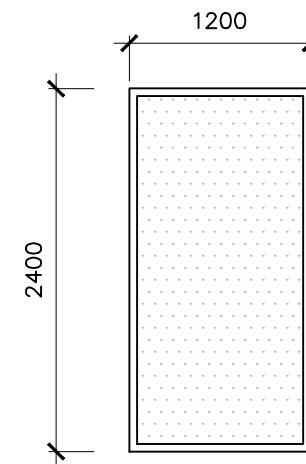
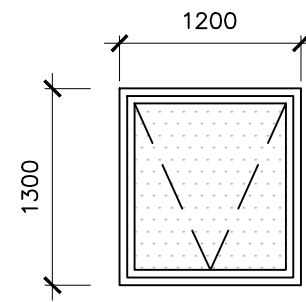
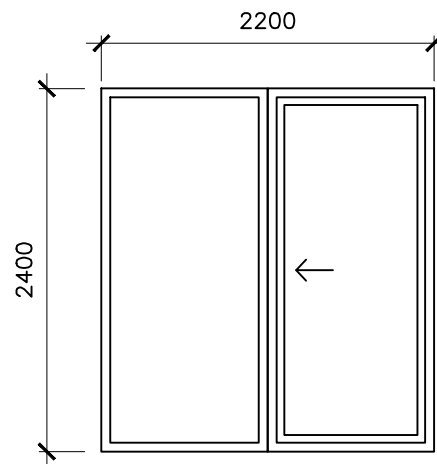
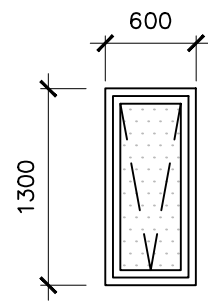
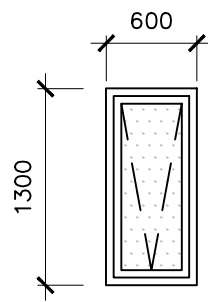
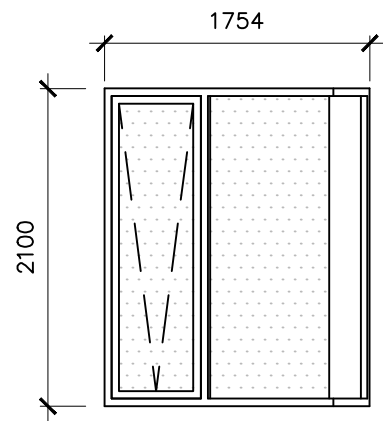


SD2- SLIDING DOOR 'X-O-O-X' FORMATION WITH SCREENS

W6- HIGH LEVEL FIXED GLAZING

W7- AWNING WINDOW- OBSCURE GLAZING

W8- AWNING WINDOW- OBSCURE GLAZING



W9- SILICONE BUTT JOINTED WINDOW WITH AWNING SIDE SASH- OBSCURE GLAZING TO LONG SIDE

W10- AWNING WINDOW- OBSCURE GLAZING

W11- AWNING WINDOW- OBSCURE GLAZING

SD3- SLIDING DOOR WITH SCREEN

W12- AWNING WINDOW- OBSCURE GLAZING

W13- FIXED WINDOW- OBSCURE GLAZING

**-ALL AWNING WINDOWS
 JOLONG 100 SERIES WINDOWS (THERMAL BREAK) WITH
 6MM LOW E+12AR+6MM LOW E GLASS
 -ALL SLIDING DOORS
 JOLONG 100 SERIES DOORS (THERMAL BREAK) WITH 6MM
 LOW E+12AR+6MM LOW E GLASS
 -ALL SLIDING DOORS
 JOLONG 100 SERIES (THERMAL BREAK) WITH 5MM LOW
 E+12AR+5MM LOW E GLASS**

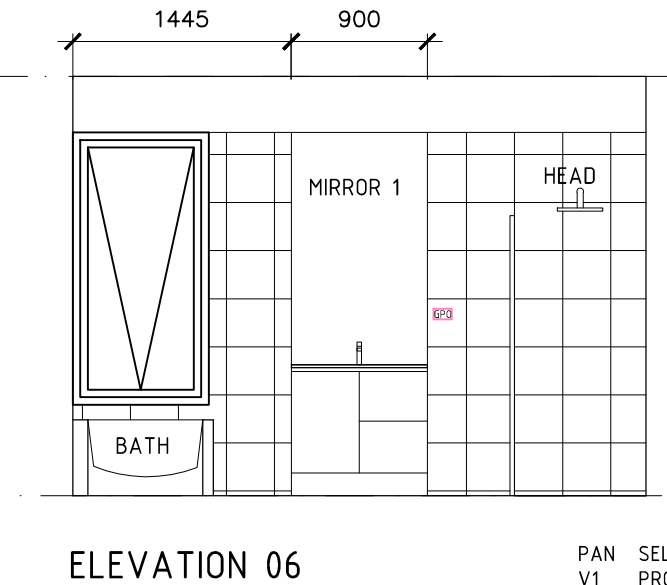
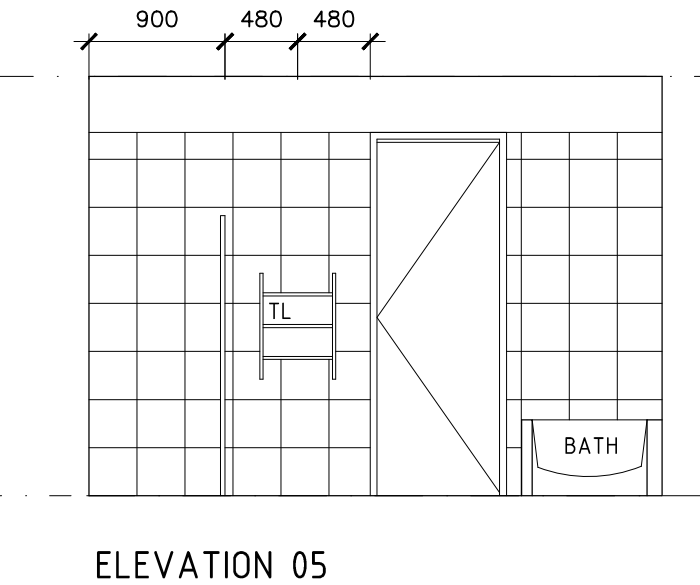
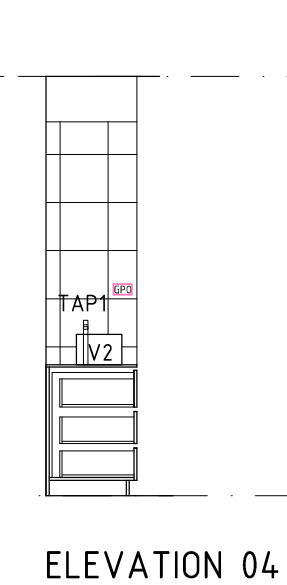
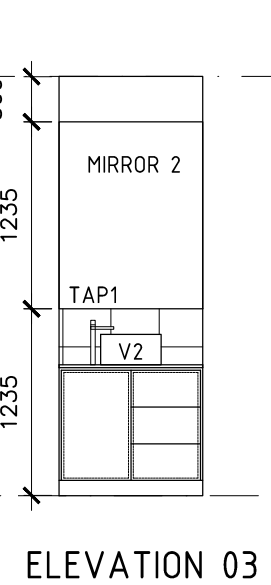
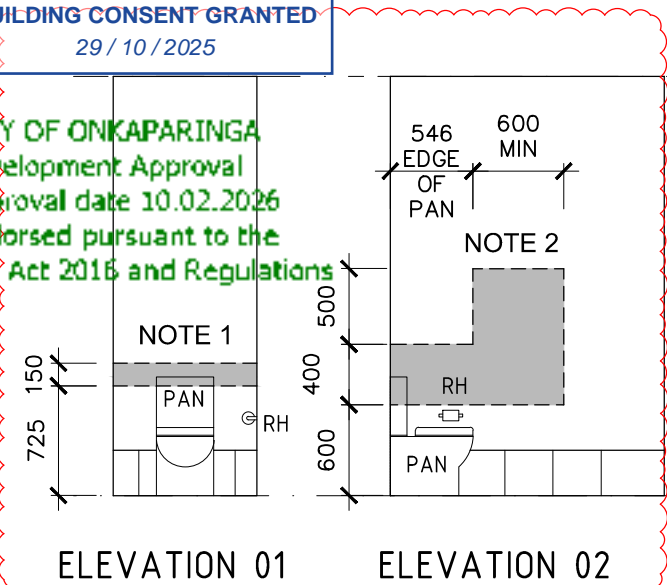
**-ALL OPERABLE SASHES TO BE SCREENED WITH
 STAINLESS STEEL FLYSCREENS (MAX APERTURE 2.0MM)
 LEVEL 1 WINDOWS TO BE RESTRICTED TO MAX OPENING
 100MM**

DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	WINDOW SCHEDULE LEVEL 1-RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL602
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

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NOTE 1
PROVIDE NOGGIN TO ZONE IN ACCORDANCE WITH LIVABLE HOUSING DESIGN PART 6

NOTE 2
PROVIDE SHEETING TO ZONE IN ACCORDANCE WITH LIVABLE HOUSING DESIGN PART 6

ELEVATION 01

ELEVATION 02

ELEVATION 03

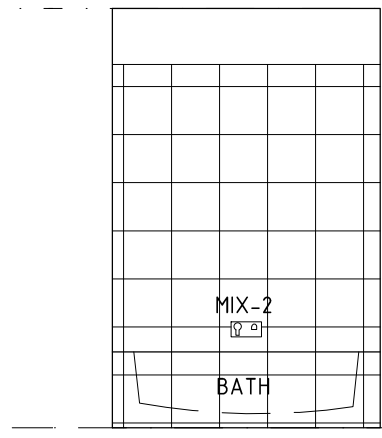
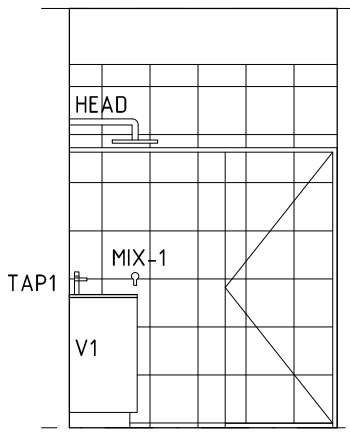
ELEVATION 04

ELEVATION 05

ELEVATION 06

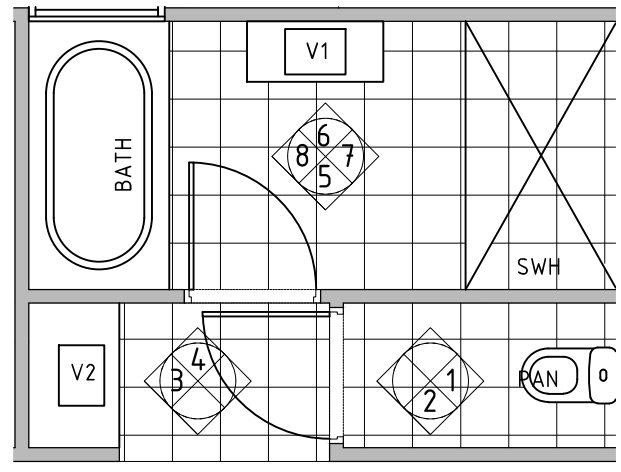
- PAN SELECTED TOILET SUITE
- V1 PROPRIETARY VANITY UNIT TYPE 1
- V2 CUSTOM VANITY UNIT TYPE 2
- WM WASHING MACHINE
- DR DRYER
- MIX-1 SHOWER WALL MIXER
- MIX-2 BATH WALL MIXER AND SPOUT
- HEAD SHOWER HEAD
- TL TOWEL LADDER
- TR LAUNDRY TROUGH
- RH ROLLER HOLDER
- TAP1 VANITY MIXER AS SELECTED

1. TYPICAL CUPBOARD
2. FINISH-SELECTED LAMINATE
3. INTERNAL CARCASES WHITE MELAMINE
4. PULL STYLE HANDLES UNDER BENCH
5. PUSH RELEASE TO OVERHEADS
6. SELECTED STONE SPLASHBACKS AND BENCH TOPS
7. SELECTED TILES

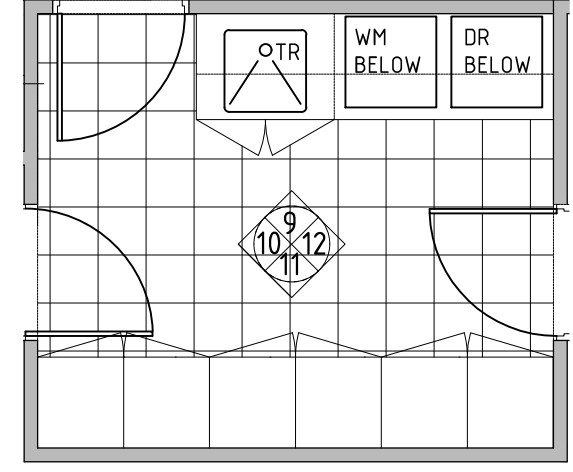


ELEVATION 07

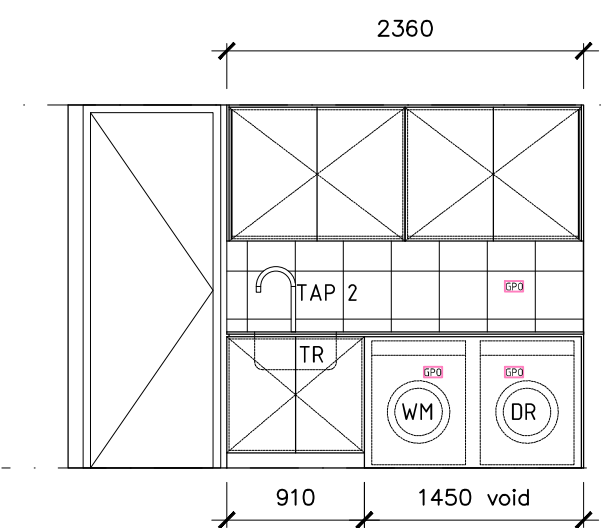
ELEVATION 08



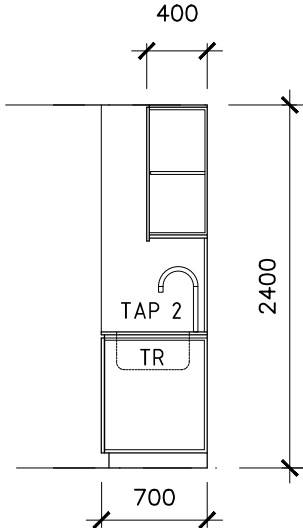
GROUND FLOOR BATH 1



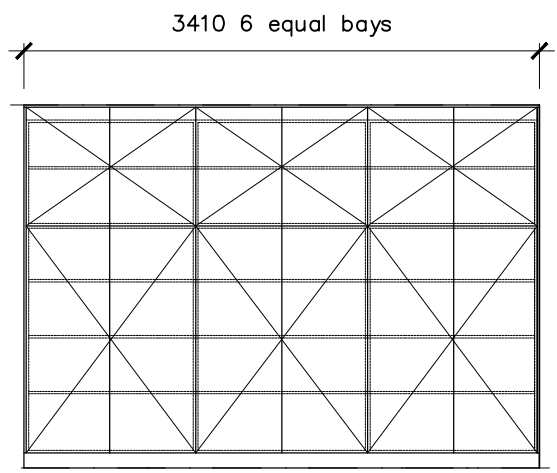
DIM AS PER DRAWINGS
MAX PANEL SIZE 800MM



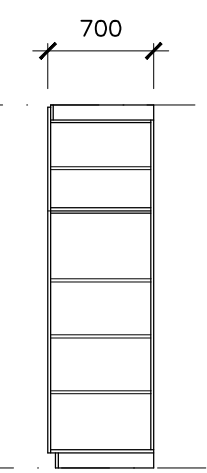
ELEVATION 09



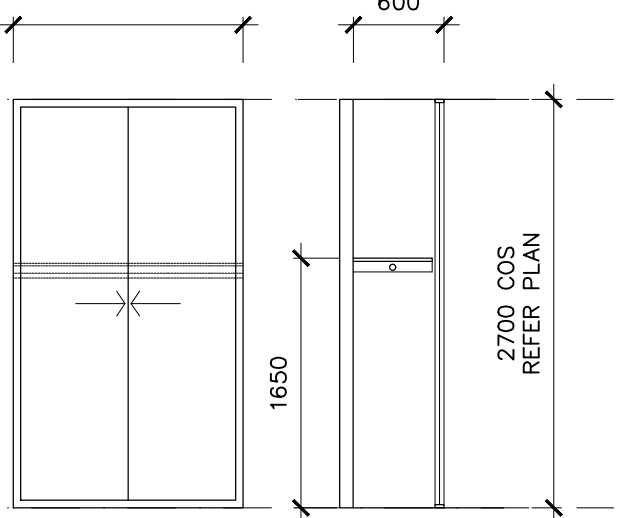
ELEVATION 10



ELEVATION 11



ELEVATION 12



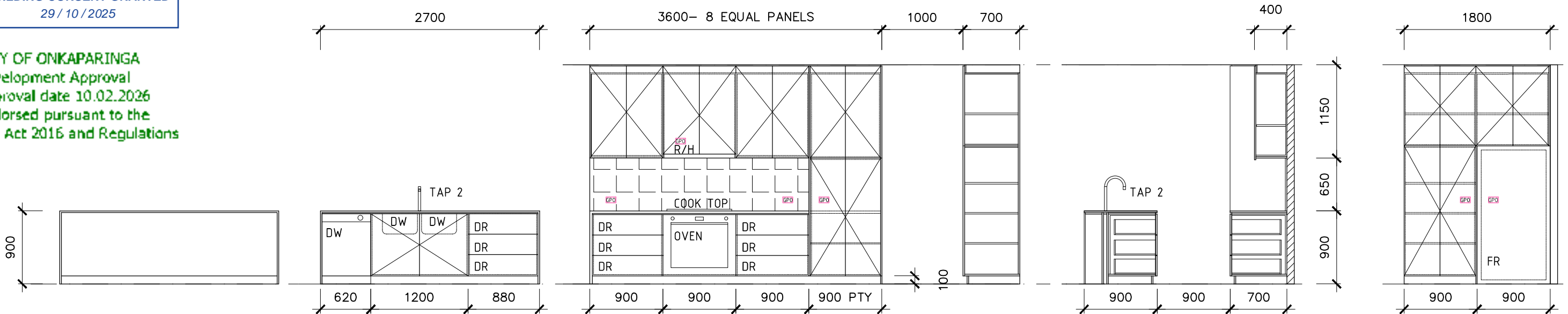
TYP. BIR- TO SUIT AS PER PLANS

DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	INTERNAL ELEVATIONS RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL603
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		

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Development Approval
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ELEVATION 01

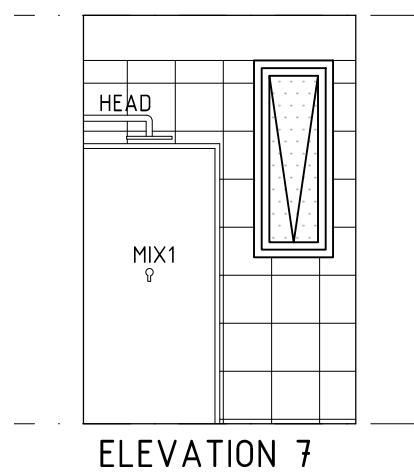
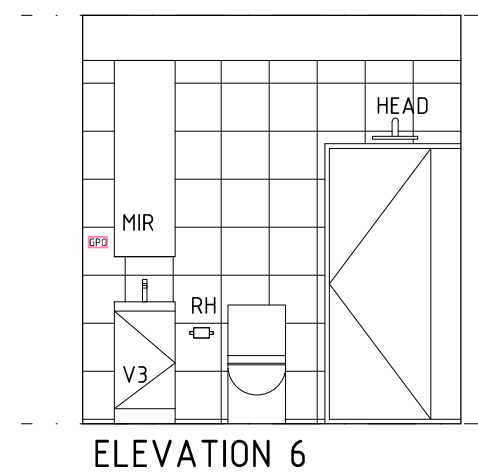
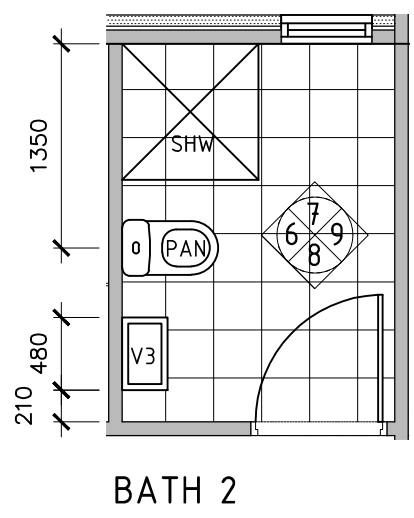
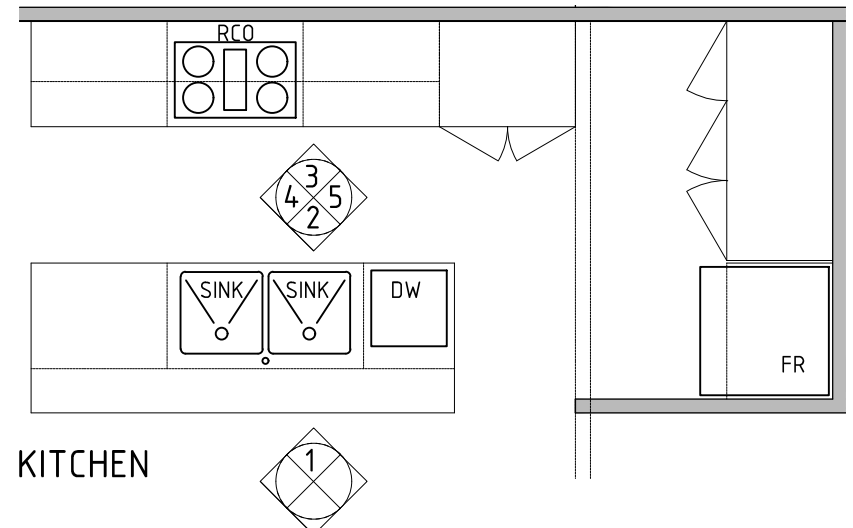
ELEVATION 02

ELEVATION 03

ELEVATION 04

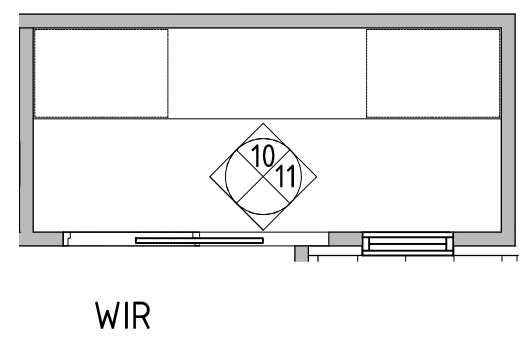
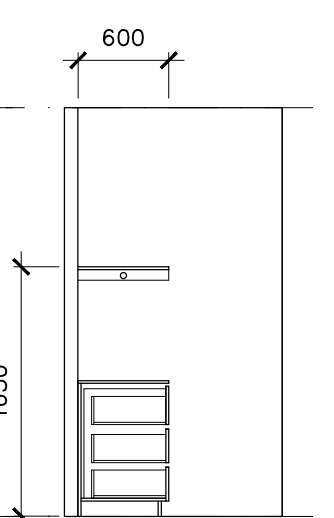
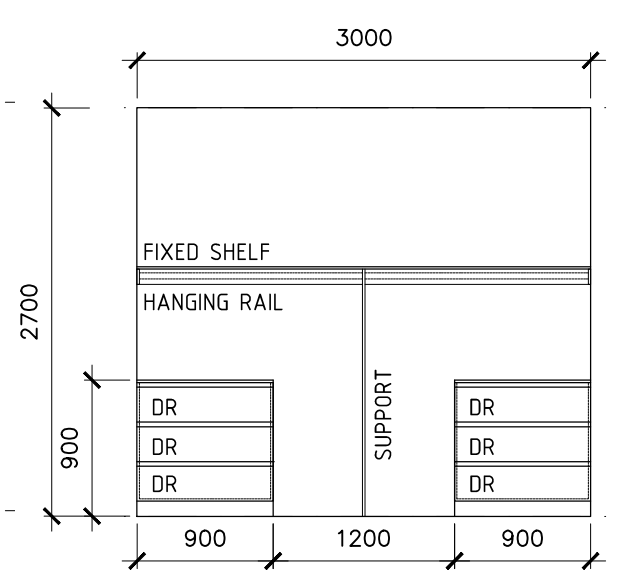
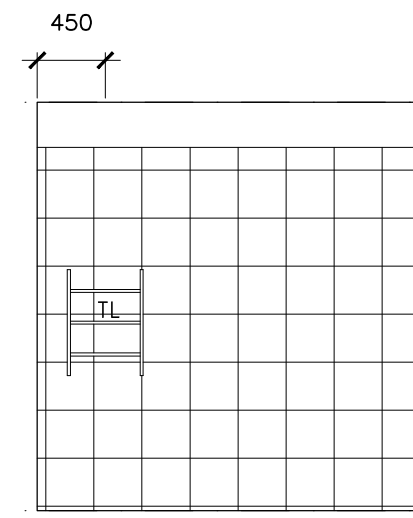
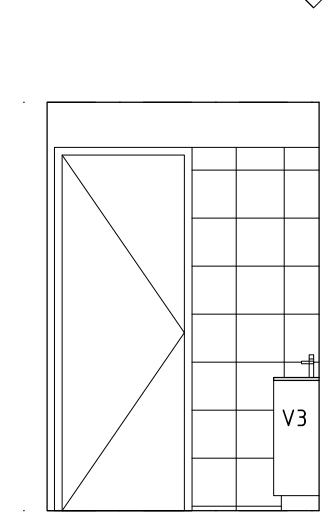
ELEVATION 05

- PAN SELECTED TOILET SUITE
- V1 PROPRIETARY VANITY UNIT TYPE 1
- V2 CUSTOM VANITY UNIT TYPE 2
- V3 CUSTOM VANITY UNIT TYPE 3
- WM WASHING MACHINE
- DR DRYER
- MIX-1 SHOWER WALL MIXER
- MIX-2 BATH WALL MIXER AND SPOUT
- HEAD SHOWER HEAD
- MIR 6MM MIRROR SILICONE TO WALL
- TL TOWEL LADDER
- TR LAUNDRY TROUGH
- RH ROLLER HOLDER
- TAP1 VANITY MIXER AS SELECTED
- TAP2 KITCHEN SINK MIXER AS SELECTED



1. TYPICAL CUPBOARD
2. FINISH-SELECTED LAMINATE
3. INTERNAL CARCASSES WHITE MELAMINE
4. PULL STYLE HANDLES UNDER BENCH
5. PUSH RELEASE TO OVERHEADS
6. SELECTED STONE SPLASHBACKS AND BENCH TOPS
6. SELECTED TILES

DEVELOPMENT APPROVAL



DATE	20 OCTOBER 2025	DRAWING TITLE	INTERNAL ELEVATIONS RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL604
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	H
PROJECT	DEAN RESIDENCES		



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Development Approval
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

e. energy@greenchoiceconsulting.com.au
t. 1300 864 944

Energy Efficiency Report

Address:

Residence 1, #418 Esplanade, Moana SA 5169

GC Consulting Job Number:

ER1-T4296

Client Job Number:

-

Building Type and Function:

Class 1 - New Home

Date:

14/08/2025

Assessment Method and Documentation:

NCC 2022 Volume Two - Amendment One

Compliance with Part H6 Energy Efficiency

Comprehensive Report indicating the final compliance outcome as assessed

Thermal Performance

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Achieved Rating

Total (MJ/m ²)	63.4
Heating (MJ/m ²)	37.7
Cooling (MJ/m ²)	25.7

Target Rating

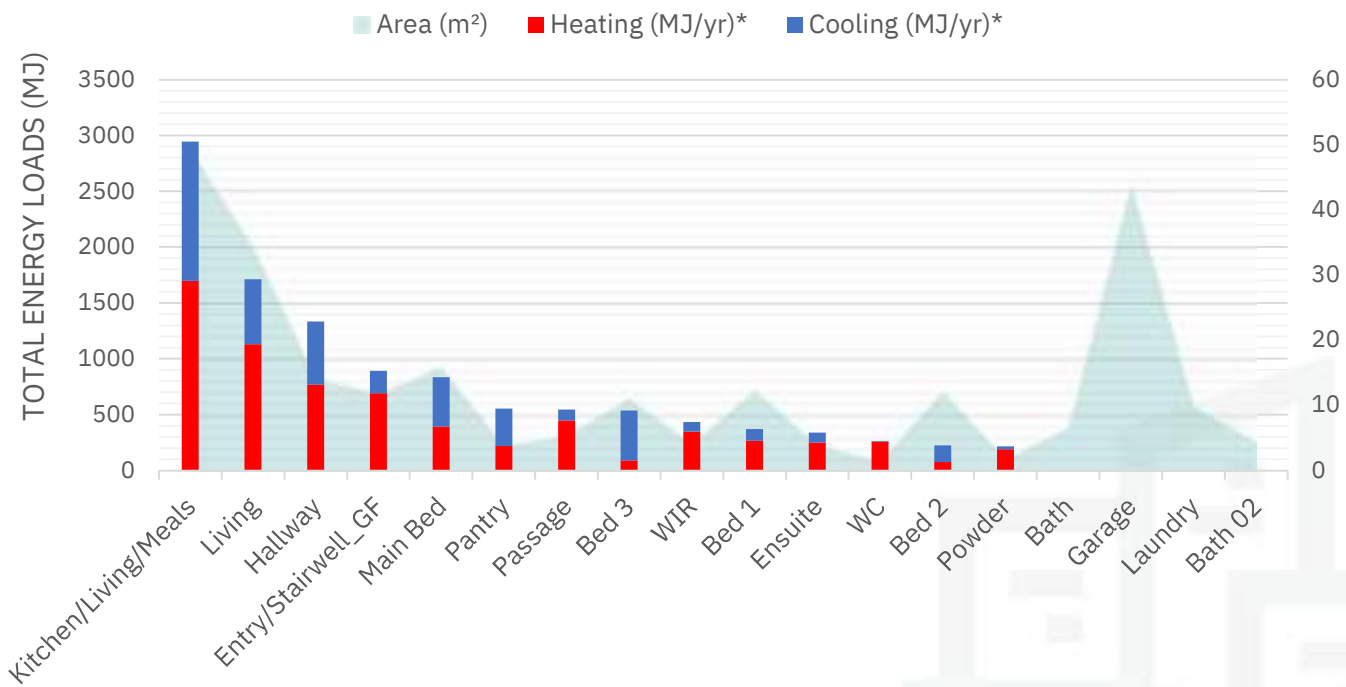
Total (MJ/m ²)	64
Heating (MJ/m ²)	54
Cooling (MJ/m ²)	37

7.0 Stars

Compliance is achieved when the following conditions are met:

1. The heating load must be equal to or lower than the heating load limit.
2. The cooling load must be equal to or lower than the cooling load limit.
3. The total energy load must be equal to or lower than the total energy limit.

ZONED ENERGY LOAD DISTRIBUTION TOTALS (MJ)



Construction Requirements

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Development Approval

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External Walls

Construction	Insulation	Frame	Notes
Hebel Panel/AAC	R2.7 Insulation + Wrap	Timber Frame	As per drawings
Framed	R2.7 Insulation + Wrap	Timber Frame	As per drawings
Concrete Blockwork	None	No Frame	As per drawings

Internal Walls

Construction	Insulation	Notes
Stud Frame	R2.7 Insulation	Throughout

Floor/s

Construction	Underfloor Insulation	Slab Edge Insulation	Notes
Concrete Slab-on-Ground	R2.3 Insulation	None	Throughout (excl. Garage)
AAC Panel	R6.0 Insulation	N/A	Suspended Floors

Floor coverings as per drawings/client notes (NatHERS Defaults modelled if not specified)

Ceiling/s

Construction	Insulation	Notes
Plasterboard	R6.0 Insulation	Throughout
Plasterboard	R3.0 Insulation	To the ceiling perimeter

Roof/s

Construction	Insulation	Colour
Metal	R1.3 Anticon	Surfmist

Penetrations

Penetrations

If downlights are installed, they must be IC/IC-F rated
Exhaust fans must be sealed

Two ceiling fans to the Kitchen/Living/Meals with a minimum diameter of 2100mm
All remaining ceiling fans have been modelled with a minimum diameter of 1500mm

Supplier

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Not nominated - NatHERS / WERSLink defaults have been used

Type	Colour	U-Value	SHGC	Glass	Notes
Hinged Doors	White	4.45	0.49	Double Glazed	As per documentation
Awning Windows	White	1.90	0.37	TB Double Glazed + Low-E	As per documentation
Sliding Doors	White	1.96	0.41	TB Double Glazed + Low-E	As per documentation
Fixed Windows	White	1.97	0.39	TB Double Glazed + Low-E	As per documentation

The U-Value of the supplied product must be equal to or lower than the above nominated values.

A 5% tolerance is permitted to the above nominated SHGC values.

Your NatHERS Certificate may show codes for other suppliers. Suppliers may not have all their windows available in the software.

Contact us if your supplier cannot meet the values above.

Additional Notes



Calculator

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PDI Act 2016 and Regulations

ABCB

Whole-of-home

Home details		Net equivalent energy usage	
Your Project Name	ER1-T4296	Allowance	3.3
State/Territory	SA	Actual	2.7 <input checked="" type="checkbox"/>
NCC Climate zone	5 < Help		
Total Floor area (m ²)	197.5 < Help		
NCC Building classification	1		
Equipment details		Pools and spas	
If using a heat pump specify rating type > <input type="text" value="Seasonal Star Rating (2019)"/>		Pool volume (L) <input type="text"/>	
Type Star Rating (2019)		Pool pump star rating <input type="text"/>	
Main space conditioning - HEATING	Ducted heat pump < 2.25 < Help	Spa volume (L) <input type="text"/>	
Main space conditioning - COOLING	Ducted heat pump < 2.25 < Help		
Water heating		Photovoltaics	
Main water heater type	Heat pump (off peak)	Photovoltaic capacity (kW)	<input type="text"/>

Notes:

- This calculator automates the NCC whole-of-home energy usage requirements (Part 13.6 of the ABCB Housing Provisions and J3D14 of NCC Volume One).
- For the purposes of this calculator, floor area is measured within the inside face of the external walls of the sole-occupancy unit (SOU) and includes any conditioned attached Class 10a part.

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THIS CALCULATOR:

By accessing or using this calculator, you agree to the following: The ABCB (as the Commonwealth of Australia acting on behalf of the Commonwealth of Australia, the State of New South Wales, the State of Queensland, the State of Victoria, the State of South Australia, the State of Tasmania, the State of Western Australia, the Australian Capital Territory and the Northern Territory) provides the calculator for general information purposes only. While we make every effort to ensure that information provided is accurate and up to date, such information does in no way constitute the provision of professional advice.

The ABCB does not provide any warranties in relation to the accuracy, currency, reliability or completeness of any information provided by the ABCB. The ABCB accepts no responsibility or liability for any damage, loss, or expense incurred by you or anyone else that arises out of reliance on any information provided by the ABCB. You should make your own independent inquiries, undertake your own due diligence, and obtain your own independent professional advice prior to relying on, or making any decisions in relation to any information provided by the ABCB.

Declaration of Compliance

I certify that the details provided within this energy efficiency report are true, correct, and reflective of the plans and specifications of this dwelling. I certify that I am a specialist in the relevant discipline and compliance has been demonstrated with the requirements of the National Construction Code (NCC) as outlined in this report.

Name of assessor: Albert Burton
Qualification: CPP41212 Certificate IV in NatHERS Assessment
Accreditation number: DMN/21/2045
Signature: *Albert Burton*
Company Name: Green Choice Consulting Pty Ltd (ABN 63 658 893 415)

Additional Provisions

This assessment demonstrates compliance with Part H6 of the NCC. Calculations have been done using Hero and the Chenath Engine (v3.22).

- (1) Building must comply with Section 13 of the ABCB Housing Provisions clauses—
 - (a) 13.2.2, for building fabric thermal insulation; and
 - (b) 13.2.3(7) and 13.2.5(5), for thermal breaks; and
 - (c) 13.2.3(5), for compensating for a loss of ceiling insulation, other than where the house energy rating software has compensated for a loss of ceiling insulation; and
 - (d) 13.2.6(4), 13.2.6(5) and 13.2.6(6) for floor edge insulation; and
 - (e) Part 13.4, for building sealing
- (2) To comply with H6P2, in addition to S42C3, a building must comply with Part 13.7 of the ABC Housing Provisions.

Services must be installed as per Part 13.7.

All metal roof framing must have a thermal break, consisting of a material with an R-Value of greater than or equal to 0.2, installed between the metal sheet roofing and its supporting metal purlins, metal rafters or metal battens.

All metal wall framing must have a thermal break, consisting of a material with an R-Value greater than or equal to 0.2, installed between the external cladding and the metal frame.

State-Specific Provisions

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QLD only provisions (only applies for projects in QLD)

In accordance with the Queensland Development Code Part 4.1—

For applying S42C2 of Specification 42 of the BCA, a reference to climate zones 1 and 2 is taken to be a reference to climate zones 1, 2, 3 or 5.

Toilet cisterns must have a dual flush function, minimum 4-star WELS rating and be compatible with the size of the toilet bowl to allow for proper functioning of the toilet.

WA only provisions (only applies for projects in WA)

All tap fittings other than bath outlets and garden taps must be a minimum of 4 stars WELS rated.

All showerheads must be a minimum of 3 stars WELS rated.

All sanitary flushing systems must be a minimum of 4 stars WELS rated dual flush.

An outdoor private swimming pool or spa associated with a Class 1 building must be supplied with a cover, blanket or the like that is designed to reduce water evaporation and is accredited under the Smart Approved Watermark Scheme governed by the Australian Water Association, the Irrigation Association of Australia, the Nursery and Garden Industry Australia and the Water Services Association of Australia.

All internal heated water outlets (such as taps, showers and washing machine water supply fittings) must be connected to a heated water system or a re-circulating heated water system with pipes installed and insulated in accordance with AS/NZS 3500: Plumbing and Drainage, Part 4 Heated Water Services. The pipe from the heated water system or re-circulating heated water system to the furthest heated water outlet must not be more than 20 m in length or 2 liters of internal volume.

NSW only provisions (only applies for projects in NSW)

All requirements in this report are in accordance with the BASIX requirements.

All insulation must be installed as per NSW H6P1.

Building must be sealed as per NSW H6P2.

Domestic services must be selected and have features as per NSW H6P3.

Intellectual Property and Legal Disclaimer

CITY OF ONKAPARINGA
Development Approval

Approval No: 0600/2025
Endorsed pursuant to the

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Property
Development Approval
Approval date 10.02.2025
Endorsed pursuant to the
PDI Act 2016 and Regulations

Address Residence 1, #418 Esplanade, Moana,
SA, 5169
Lot/DP -/
NCC Class* 1a
Floor/all Floors 1 of 2 floors
Type New

Plans

Main Plan 17/07/2025
Prepared by Southern Architecture

Construction and environment

Assessed floor area (m²)*		Exposure Type
Conditioned*	176.5	Exposed
Unconditioned*	21.0	NATHERS climate zone
Total	241.3	16 - Adelaide (Kent Town)
Garage	43.8	



Accredited assessor

Name Albert Burton
Business name Green Choice Consulting
Email albert@greenchoiceconsulting.com.au
Phone +61 045219132
Accreditation No. DMN/21/2045
Assessor Accrediting Organisation DMN
Declaration of interest No Conflict of Interest

NCC Requirements

BCA provisions Volume 2
State/Territory variation No

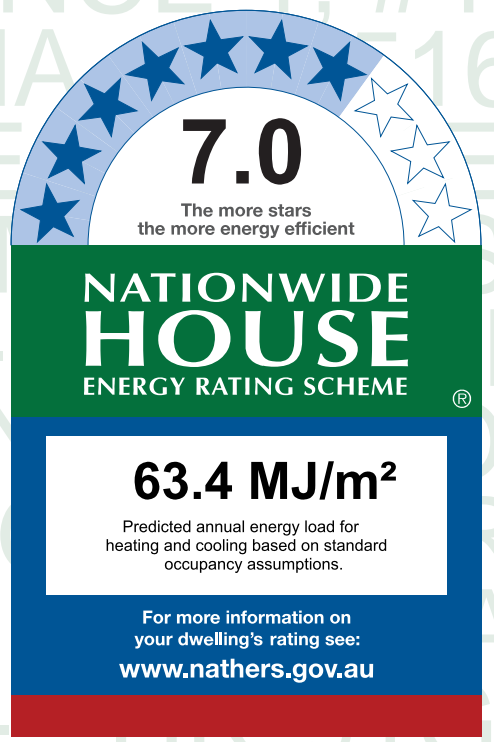
National Construction Code (NCC) requirements

The NCC allows the use of NatHERS accredited software to comply with the energy efficiency requirements for houses (Class 1 buildings) and apartments (Class 2 sole-occupancy units and Class 4 parts of buildings). The applicable requirements for houses are detailed in Specification 42 of NCC Volume Two. For apartments the requirements are detailed in clauses J2D2(2)(a) and (3) of NCC Volume One.

NCC 2022 includes enhanced thermal performance requirements for houses and apartments. It also includes a new whole-of-home annual energy use budget which applies to the major equipment in the home.

The NCC, and associated ABCB Standards and support material, can be accessed at www.abcb.gov.au.

Note, variations and additions to the NCC energy efficiency requirements may apply in some states and territories.



7.0
The more stars
the more energy efficient

NATIONWIDE HOUSE
ENERGY RATING SCHEME

63.4 MJ/m²
Predicted annual energy load for heating and cooling based on standard occupancy assumptions.

For more information on your dwelling's rating see:
www.nathers.gov.au

Thermal performance (MJ/m²)

Limits taken from ABCB Standard 2022

	Heating	Cooling
Modelled	37.7	25.7
Load limits	54	37

Features determining load limits

Floor type (lowest conditioned area) CSOG
NCC climate zone 1 or 2 N
Outdoor living area N
Outdoor living area ceiling fan N

Whole of Home performance rating

No Whole of Home performance rating generated for this certificate.

Verification

To verify this certificate, scan the QR code or visit <http://www.hero-software.com.au/pdf/HR-91G6T0-01>. When using either link, ensure you are visiting <http://www.hero-software.com.au>



* Refer to glossary.



#HERO41 NATHERS
CITY OF GONNERSVILLE
Development Approval
Approval date 10/02/2025
Endorsement of the
PDI Act 2016 and Regulations

About the ratings

Thermal performance rating

NATHERS Thermal software models the expected heating and cooling energy loads using information about the design, construction, climate and common patterns of household use. The thermal performance rating (shown as a star rating on this Certificate) does not take into account appliances, apart from the airflow impacts from ceiling fans.

Whole of Home performance rating

NATHERS Whole of Home software uses the heating and cooling energy loads combined with the energy performance of the home's appliances (heating, cooling, hot water, lighting, pool/spa pump and onsite renewable energy generation and storage) and models the expected energy value* of the whole home. The Whole of Home performance rating is shown as a score out of 100 on this Certificate.

Heating and Cooling Load Limits

Additional information

In some locations under the NCC NATHERS pathway, separate heating and cooling load limits may apply. Minimum required star ratings in northern parts of Australia may also be affected by the presence or absence of an outdoor living area and/or an outdoor living area ceiling fan. Refer to the *ABCB Standard: NATHERS heating and cooling load limits* for details or contact the relevant local building regulating authority, noting that State and Territory variations may also apply.

Setting options:

Floor type:

- CSOG - Concrete Slab on Ground
- SF - Suspended Floor (or a mixture of CSOG and SF)
- NA - Not Applicable

NCC climate Zone 1 or 2:

- Yes
- No
- NA - Not Applicable

Outdoor living area:

- Yes
- No
- NA - Not Applicable

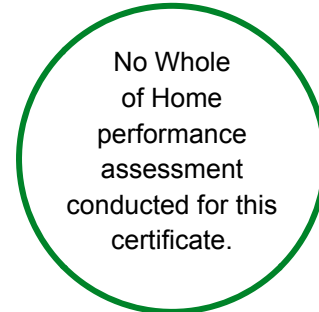
Outdoor living area ceiling fan:

- Yes
- No
- NA - Not Applicable

Predicted Whole of Home annual impact by appliance

Shows the contribution each appliance has on the home's annual energy use, greenhouse gas emissions and cost without solar.

Energy use:



Greenhouse gas emissions:



Cost:



Predicted onsite renewable energy impact

No Whole of Home performance assessment conducted for this certificate.

* Refer to glossary.

CITY OF GNAPARINGA
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Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

The checklist covers important items impacting the dwelling's

ratings. It is recommended that the accuracy of the whole certificate is checked.

Note: The boxes indicate when and who should check each item. It is not mandatory to complete this checklist.

Approval stage		Construction stage		
Assessor checked	Consent authority/surveyor checked	Builder checked	Consent authority/surveyor checked	Occupancy/other

Genuine certificate check

Does this Certificate match the one available at the web address or QR code verification link on the front page?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the NatHERS certificate number on the NatHERS-stamped plans match the number on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thermal performance check

Windows and glazed doors

Does the window size, opening type and location shown on the NatHERS-stamped plans or as installed match what is shown in 'Window and glazed door schedule' and 'Roof window schedule' tables on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the installed windows meet the substitution tolerances (AFRC* based SHGC* and U-values*) as shown in the 'Window and glazed door type and performance' and 'Roof window type and performance' tables on this Certificate?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

External walls

Does the external wall bulk insulation (R-value) shown on the NatHERS-stamped plans or as installed match what is shown in the 'External wall type table' on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the external wall shade (colour) match what is shown in the 'External wall type' table on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Floor

Does the floor insulation (R-value) shown on the NatHERS-stamped plans or as installed match what is shown in the 'Floor type' table on this certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Ceiling penetrations*

Does the 'quantity' and 'type' of ceiling penetrations* (e.g. downlights, exhaust fans, etc) shown on the NatHERS-stamped plans or as installed match what is shown in the 'Ceiling penetrations' table on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Ceiling

Does the ceiling insulation (R-value) shown on the NatHERS-stamped plans or as installed match what is shown in the 'Ceiling type' table on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Roof

Does the external roof shade (colour) on the NatHERS stamped plans or as installed match what is shown in the 'Roof type' table on this Certificate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Apartment entrance doors (NCC Class 2 assessments only)

Does the 'External Door Schedule' show apartment entrance doors? Please note that an "external door" between the modelled dwelling and a shared space, such as an enclosed corridor or foyer, should not be included in the assessment (because it overstates the possible ventilation) and would invalidate the Certificate.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
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Exposure*

Has the appropriate exposure type (terrain) (shown on page 1) been applied? For example, it is unlikely that a ground-floor apartment is "exposed" or a top floor high-rise apartment is "protected".	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
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Heating and cooling load limits*

Do the load limits settings (shown on page 1) match what is shown on the NatHERS-stamped plans?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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* Refer to glossary.



Certificate check

CITY OF ONKAPARINGA
Development Approval
Continued
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

Approval stage		Construction stage		
Assessor checked	Consent authority/surveyor checked	Builder checked	Consent authority/surveyor checked	Occupancy/other

Additional NCC requirements for thermal performance (not included in the NatHERS assessment)

Thermal bridging

Does the dwelling meet the NCC requirement for thermal bridging?

Insulation installation method

Has the insulation been installed according to the NCC requirements?

Building sealing

Does the dwelling meet the NCC requirements for Building Sealing?

Whole of Home performance check (not applicable if a Whole of Home assessment is not conducted)

Appliances

Does the cooling appliance/s type, location and efficiency/performance shown on the NatHERS-stamped plans or as installed match the location and minimum efficiency/performance requirements shown in the 'Appliance schedule' on this Certificate?

Does the heating appliance/s type, location and efficiency/performance shown on the NatHERS-stamped plans or installed, match the location and minimum efficiency/performance requirements shown in the 'Appliance schedule' on this Certificate?

Does the hot water system type and efficiency/performance shown on the NatHERS-stamped plans or as installed match the location and minimum efficiency/performance requirements shown in the 'Appliance schedule' on this Certificate?

Does the pool pump efficiency/performance shown on the NatHERS-stamped plans or as installed match the minimum efficiency/performance requirements shown in the 'Appliance schedule' on this Certificate?

Does the onsite renewable energy system type, orientation and system size or generation capacity shown on the NatHERS stamped plans or installed match the 'Onsite Renewable Energy schedule' on this Certificate?

Additional NCC Requirements for Services (not included in the NatHERS assessment)

Does the lighting meet the artificial lighting requirements specified in the NCC?

Does the hot water system meet the additional requirements specified in the NCC?

Provisional values* check

Have provisional values* been used in the assessment and, if so, are they noted in 'Additional notes' table below?

Other NCC requirements

Note: This Certificate only covers the energy efficiency requirements in the NCC. Additional requirements that must also be satisfied include, but are not limited to: condensation, structural and fire safety requirements and any state or territory variations to the NCC energy efficiency requirements.

* Refer to glossary.



CITY OF ONKAPARINGA
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Room schedule
Endorsed pursuant to the
PDI Act 2015 and Regulations

Room	Zone Type	Area (m ²)
Living	Living	34.28
Bed 2	Bedroom	12.25
Bath	Unconditioned	6.71
WC	Day Time	1.63
Powder	Day Time	1.90
Bed 1	Bedroom	12.44
Garage	Garage	43.81
Entry/Stairwell_GF	Day Time	11.83
Laundry	Unconditioned	9.77
Passage	Day Time	5.40
Kitchen/Living/Meals	Kitchen/Living	49.09
Pantry	Day Time	4.00
Bath 02	Unconditioned	4.50
Bed 3	Bedroom	11.09
Ensuite	Night Time	4.05
WIR	Night Time	4.17
Main Bed	Bedroom	15.91
Hallway	Day Time	14.23

Window and glazed door type and performance

Default* windows

Window ID	Window Description	Maximum U-value*	SHGC*	SHGC substitution tolerance ranges	
				lower limit	upper limit
HAHDD-045-050	Housing Aluminium Hinged Door Double Glazed	4.4	0.49	0.46	0.51
HBFW-020-041	Housing Thermally Broken Aluminium Fixed Window Double Glazed	2.0	0.39	0.37	0.41

* Refer to glossary.



Window and glazed door type and performance

Default* windows

Window ID	Window Description	Maximum U-value*	SHGC*	SHGC substitution tolerance ranges	
				lower limit	upper limit
HPAWD-020-037	Housing uPVC Awning Window Double Glazed	1.9	0.37	0.35	0.39
HPSDD-020-041	Housing uPVC Sliding Door Double Glazed	2.0	0.41	0.39	0.43

Custom* windows

Window ID	Window Description	Maximum U-value*	SHGC*	SHGC substitution tolerance ranges	
				lower limit	upper limit
None					

Window and glazed door schedule

Location	Window ID	Window no.	Height (mm)	Width (mm)	Window type	Opening %	Orient-ation	Shading device*
Bath	HPAWD-020-037	W02	1500	900	Awning	90	N	None
Bath 02	HPAWD-020-037	W08	1300	600	Awning	10	N	None
Bed 1	HBFWD-020-041	W01-A	2100	597	Fixed	0	WNW	None
Bed 1	HBFWD-020-041	W01-B	2100	1004	Fixed	0	NNE	None
Bed 1	HPAWD-020-037	W01-C	2100	750	Awning	90	NNE	None
Bed 2	HBFWD-020-041	W03-A	2100	597	Fixed	0	WNW	None
Bed 2	HPAWD-020-037	W03-C	2100	750	Awning	90	NNE	None
Bed 2	HBFWD-020-041	W03-B	2100	1004	Fixed	0	NNE	None
Bed 3	HPAWD-020-037	W09-B	2100	751	Awning	10	NNE	None
Bed 3	HBFWD-020-041	W09-C	2100	1004	Fixed	0	NNE	None
Bed 3	HBFWD-020-041	W09-A	2100	597	Fixed	0	WNW	None
Ensuite	HPAWD-020-037	W10	1300	600	Awning	10	N	None
Garage	HAHDD-045-050	D03	2350	820	Hinged Door	90	N	None
Hallway	HPAWD-020-037	W12	1300	1200	Awning	90	S	None
Kitchen/Living/Meals	HBFWD-020-041	W06	655	4190	Fixed	0	N	None
Kitchen/Living/Meals	HPAWD-020-037	W07	1800	1080	Awning	10	N	None

* Refer to glossary.



Window and glazed door schedule

CITY OF ONKAPARINGA
Development Applications
Approval date 10.02.2026
Endorsed under Building Meas
PDI Act 2016 and Regulations

Location	Window ID	Window no.	Height (mm)	Width (mm)	Window type	Opening %	Orient-ation	Shading device*
Kitchen/Living/Meals	HBFWD-020-041	W13	2400	1530	Fixed	0	S	None
Kitchen/Living/Meals	HPSDD-020-041	SD02	2400	4909	Sliding Door	45	W	None
Laundry	HAHDD-045-050	D09	2350	820	Hinged Door	90	E	None
Laundry	HAHDD-045-050	D10	2350	820	Hinged Door	90	W	None
Living	HPAWD-020-037	W04	1800	900	Awning	90	N	None
Living	HPSDD-020-041	SD01	2700	2200	Sliding Door	45	E	None
Main Bed	HPSDD-020-041	SD03	2400	2200	Sliding Door	45	E	None
Passage	HPAWD-020-037	W05	770	1200	Awning	90	S	None
WIR	HPAWD-020-037	W11	1300	600	Awning	90	S	None

Roof window type and performance value

Default* roof windows

Window ID	Window Description	Maximum U-value*	SHGC*	SHGC substitution tolerance ranges	
				lower limit	upper limit
None					

Custom* roof windows

Window ID	Window Description	Maximum U-value*	SHGC*	SHGC substitution tolerance ranges	
				lower limit	upper limit
None					

Roof window schedule

Location	Window ID	Window no.	Opening %	Height (mm)	Width (mm)	Orient-ation	Outdoor shade	Indoor shade
None								

Skylight type and performance

Skylight ID	Skylight description
None	

Skylight schedule

Location	Skylight ID	Skylight No.	Skylight shaft length (mm)	Area (m ²)	Orient-ation	Outdoor shade	Diffuser	Shaft Reflectance
None								

* Refer to glossary.



Skylight schedule

Location	Skylight ID	Skylight No.	Skylight shaft length (mm)	Area (m ²)	Orientation	Outdoor shade	Diffuser	Shaft Reflectance
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CITY OF ONKAPARINGA
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Approval date 10.02.2026
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PDI Act 2016 and Regulations

External door schedule

Location	Height (mm)	Width (mm)	Opening %	Orientation
Entry/Stairwell_GF	2350	1530	90	S
Garage	2100	5800	100	W

External wall type

Wall ID	Wall Type	Solar absorptance	Wall Colour	Bulk insulation (R-value)	Reflective wall wrap*
AAC-75-REFL-CAV	AAC (75mm) Clad (Refl Cavity) Stud Wall	0.50	Medium	2.70	Yes
CONCBLOCK-190-FCF-PB	Concrete Block 190mm Fully Core-Filled - Plasterboard Internally	0.50	Medium	0.00	No
FC-REFL-CAV	Fibre-Cement Clad Battened (Refl Cavity) Stud Wall	0.50	Medium	2.70	Yes

External wall schedule

Location	Wall ID	Height (mm)	Width (mm)	Orientation	Horizontal shading feature* projection (mm)	Vertical shading feature
Bath	FC-REFL-CAV	2760	2035	N		Yes
Bath	AAC-75-REFL-CAV	2760	1752	N		Yes
Bath	CONCBLOCK-190-FCF-PB	360	1773	W		No
Bath 02	AAC-75-REFL-CAV	2700	1798	N	570	Yes
Bed 1	FC-REFL-CAV	2400	621	WNW		Yes
Bed 1	FC-REFL-CAV	2400	2861	NNE		Yes
Bed 1	FC-REFL-CAV	2400	880	N		Yes
Bed 2	AAC-75-REFL-CAV	2760	1850	N		Yes
Bed 2	AAC-75-REFL-CAV	2760	867	WNW		Yes
Bed 2	AAC-75-REFL-CAV	2760	1782	NNE		Yes
Bed 2	AAC-75-REFL-CAV	2760	436	N		Yes
Bed 3	FC-REFL-CAV	2700	1774	NNE		Yes
Bed 3	FC-REFL-CAV	2700	1414	N	660	Yes

* Refer to glossary.



External wall schedule

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Location	Wall ID	Height (mm)	Width (mm)	Orientation	Horizontal shading feature* projection (mm)	Vertical shading feature
Bed 2	FC-REFL-CAV	2700	618	WNW		Yes
Bed 3	FC-REFL-CAV	2700	255	W		Yes
Ensuite	FC-REFL-CAV	2700	3000	N	645	Yes
Entry/Stairwell_GF	FC-REFL-CAV	2760	2260	S		Yes
Entry/Stairwell_GF	FC-REFL-CAV	2400	3648	S		Yes
Entry/Stairwell_GF	CONCBLOCK-190-FCF-PB	360	2002	W		No
Garage	AAC-75-REFL-CAV	2400	7000	N		Yes
Garage	AAC-75-REFL-CAV	2400	7000	S		Yes
Garage	AAC-75-REFL-CAV	2400	6259	W		Yes
Garage	AAC-75-REFL-CAV	2400	888	E		Yes
Hallway	FC-REFL-CAV	2700	6809	S	700	Yes
Kitchen/Living/Meals	FC-REFL-CAV	3850	10000	N	659	Yes
Kitchen/Living/Meals	FC-REFL-CAV	3250	10000	S	700	Yes
Kitchen/Living/Meals	FC-REFL-CAV	3550	4909	W	3607	Yes
Laundry	AAC-75-REFL-CAV	2760	2869	E	1930	Yes
Laundry	AAC-75-REFL-CAV	2760	3407	S		Yes
Laundry	AAC-75-REFL-CAV	2760	1959	W		Yes
Living	AAC-75-REFL-CAV	3120	5747	N		Yes
Living	AAC-75-REFL-CAV	3120	5000	E	1349	Yes
Living	AAC-75-REFL-CAV	3120	6082	S		Yes
Living	CONCBLOCK-190-FCF-PB	360	2907	W		No
Living	CONCBLOCK-190-FCF-PB	360	335	N		No
Living	CONCBLOCK-190-FCF-PB	360	1003	W		No
Living	AAC-75-REFL-CAV	3120	1887	W	1929	Yes
Living	AAC-75-REFL-CAV	3120	797	E	1349	Yes

* Refer to glossary.



External wall schedule

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Location	Wall ID	Height (mm)	Width (mm)	Orientation	Horizontal shading feature* projection (mm)	Vertical shading feature
Main Bed	FC-REFL-CAV	3470	3470	E	1868	Yes
Main Bed	FC-REFL-CAV	3250	4820	S	700	Yes
Pantry	AAC-75-REFL-CAV	2700	1600	N	570	Yes
Passage	FC-REFL-CAV	2760	1976	S	1033	Yes
Powder	CONCBLOCK-190-FCF-PB	360	956	W		No
WIR	FC-REFL-CAV	2700	3094	N	644	Yes
WIR	FC-REFL-CAV	2700	1344	E	505	No
WIR	FC-REFL-CAV	2700	1363	S	4259	Yes

Internal wall type

Wall ID	Wall Type	Area (m ²)	Bulk insulation
INT-PB	Internal Plasterboard Stud Wall	130.5	2.70
INT-PB-EXP1	Internal Plasterboard Stud Wall (exposed 1 side)	11.5	2.70

Floor type

Location	Construction	Area (m ²)	Sub-floor ventilation	Added insulation (R-value)	Covering
Bath	CSOG-100: Concrete Slab on Ground (100mm)	6.7	N/A	2.30	Tile (8mm)
Bath 02	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	4.4	N/A	6.00	Tile (8mm)
Bed 1	CSOG-100: Concrete Slab on Ground (100mm)	12.4	N/A	2.30	Carpet
Bed 2	CSOG-100: Concrete Slab on Ground (100mm)	12.2	N/A	2.30	Carpet
Bed 3	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	11.1	N/A	6.00	Carpet
Ensuite	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	4.0	N/A	6.00	Tile (8mm)
Entry/Stairwell_GF	CSOG-100: Concrete Slab on Ground (100mm)	11.8	N/A	2.30	Carpet
Garage	CSOG-100: Concrete Slab on Ground (100mm)	43.8	N/A	0.00	Exposed
Hallway	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	12.8	N/A	6.00	Carpet
Hallway	AAC-75-LINED: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm) - Lined Below	1.4	N/A	6.00	Carpet

* Refer to glossary.



Location
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Location	Construction	Area (m ²)	Sub-floor ventilation	Added insulation (R-value)	Covering
Kitchen/Living/Meals	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	49.1	N/A	6.00	Tile (8mm)
Caravan	CSOG-100: Concrete Slab on Ground (100mm)	9.8	N/A	2.30	Tile (8mm)
Living	CSOG-100: Concrete Slab on Ground (100mm)	34.3	N/A	2.30	Carpet
Main Bed	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	15.9	N/A	6.00	Carpet
Pantry	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	3.9	N/A	6.00	Tile (8mm)
Passage	CSOG-100: Concrete Slab on Ground (100mm)	5.4	N/A	2.30	Carpet
Powder	CSOG-100: Concrete Slab on Ground (100mm)	1.9	N/A	2.30	Tile (8mm)
WC	CSOG-100: Concrete Slab on Ground (100mm)	1.6	N/A	2.30	Tile (8mm)
WIR	AAC-75: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm)	2.5	N/A	6.00	Carpet
WIR	AAC-75-LINED: Suspended AAC (Aerated Autoclaved Concrete) Floor (75mm) - Lined Below	1.7	N/A	6.00	Carpet

Ceiling type

Location	Construction	Bulk insulation (R-value)	Reflective wrap*
Bath 02	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
Bed 1	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	3.00	Yes
Bed 3	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
Ensuite	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
Garage	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	3.00	Yes
Garage	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
Hallway	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
Hallway	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	3.00	Yes
Kitchen/Living/Meals	FLAT-01: Flat Framed / Skillion Metal Roof & Flat PB Ceiling	6.00	Yes
Laundry	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	3.00	Yes
Laundry	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
Living	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes

* Refer to glossary.



Location
CITY OF ONKAPARINGA
Development Approval
Approval Date 10.02.2026
Endorsed pursuant to the
PDI Act Main Res Regulations

Location	Construction	Bulk insulation (R-value)	Reflective wrap*
	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	3.00	Yes
	FLAT-01: Flat Framed / Skillion Metal Roof & Flat PB Ceiling	6.00	Yes
Pantry	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes
WIR	ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	6.00	Yes

Ceiling penetrations*

Location	Quantity	Type	Diameter (mm)	Sealed /unsealed
Bath	2	Downlight	90	Sealed
Bath	1	Exhaust Fan	350	Sealed
Bath 02	1	Downlight	90	Sealed
Bath 02	1	Exhaust Fan	350	Sealed
Bed 1	2	Downlight	90	Sealed
Bed 2	2	Downlight	90	Sealed
Bed 3	3	Downlight	90	Sealed
Ensuite	1	Downlight	90	Sealed
Ensuite	1	Exhaust Fan	350	Sealed
Entry/Stairwell_GF	3	Downlight	90	Sealed
Garage	4	Downlight	90	Sealed
Hallway	3	Downlight	90	Sealed
Kitchen/Living/Meals	1	Exhaust Fan	350	Sealed
Kitchen/Living/Meals	8	Downlight	90	Sealed
Laundry	2	Downlight	90	Sealed
Living	4	Downlight	90	Sealed
Main Bed	4	Downlight	90	Sealed
Pantry	1	Downlight	90	Sealed
Passage	2	Downlight	90	Sealed

* Refer to glossary.



*Ceiling penetrations**

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Location	Quantity	Type	Diameter (mm)	Sealed /unsealed
Power	1	Downlight	90	Sealed
WC	1	Downlight	90	Sealed
WC	1	Exhaust Fan	350	Sealed
WIR	1	Downlight	90	Sealed

Ceiling fans

Location	Quantity	Diameter (mm)
Bed 1	1	1500
Bed 2	1	1500
Bed 3	1	1500
Kitchen/Living/Meals	2	2100
Living	1	1500
Main Bed	1	1500

Roof type

Construction	Added insulation (R-value)	Solar absorptance	Roof Colour
ATTIC-METAL-01: Pitched / Attic Metal Roof (Roofspace) & Flat PB Ceiling	1.30	0.33	Light (Surfmist)
FLAT-01: Flat Framed / Skillion Metal Roof & Flat PB Ceiling	1.30	0.33	Light (Surfmist)

Thermal bridging schedule for steel frame elements

Building element	Steel section dimensions (height x width, mm)	Frame spacing (mm)	Steel thickness (BMT mm)	Thermal Break (R-value)
None				

Appliance schedule

(not applicable if a Whole of Home performance assessment is not conducted for this certificate)

Cooling system

Type	Location	Fuel Type	Minimum efficiency / performance	Recommended capacity
No Whole of Home Data				

* Refer to glossary.



Certificate 7.0 Star Rating as of 14 Aug 2025



Type	Location	Fuel Type	Minimum efficiency / performance	Recommended capacity
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No Whole of Home Data

Type	Fuel type	Hot Water CER Zone	Minimum efficiency / STC	Assessed daily load [litres]
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No Whole of Home Data

Pool / spa equipment

Type	Fuel type	Minimum efficiency / performance	Recommended capacity
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No Whole of Home Data

Onsite Renewable Energy *schedule*

Type	Orientation	Generation Capacity [kW]
------	-------------	--------------------------

No Whole of Home Data

Battery *schedule*

Type	Storage Capacity [kWh]
------	------------------------

No Whole of Home Data

* Refer to glossary.

About this report

NatHERS ratings are a reliable guide for comparing different dwelling designs and to demonstrate that designs meet the energy efficiency requirements in the National Construction Code.

NatHERS ratings use computer modelling to evaluate a home's energy efficiency and performance. They use localised climate data and standard assumptions on how people use the home to predict the heating and cooling energy loads and energy value* of the whole home. The thermal performance star rating uses the home's building specifications, layout, orientation and fabric (i.e. walls, windows, floors, roofs and ceilings) to predict the heating and cooling energy loads. The Whole of Home performance rating uses information about the home's appliances and onsite energy generation and storage to estimate the homes energy value*.

The actual energy loads, cost and greenhouse gas emissions of a home may vary from that predicted. This is because the assumptions will not always match the actual occupant usage patterns. For example, the number of occupants and how people use their appliances will vary.

Energy efficient homes use less energy, are warmer on cool days, cooler on hot days and cost less to run.

Accredited assessors

For quality assured NatHERS Certificates, always use an accredited or licenced assessor registered with an Assessor Accrediting Organisation (AAO). AAOs have strict quality assurance processes, and professional development requirements ensuring consistently high standards for assessments.

Non-accredited assessors (Raters) have no ongoing training requirements and

are not quality assured.

Any queries about this report should be directed to the assessor. If the assessor is unable to address questions or concerns, contact the AAO specified on the front of this certificate.

Disclaimer

The NatHERS Certificate format is developed by the NatHERS Administrator. However, the content in the certificate is entered by the assessor. It is the assessor's responsibility to use NatHERS accredited software correctly and follow the NatHERS Technical Note to produce a NatHERS Certificate.

The predicted annual energy load, cost and greenhouse gas emissions in this NatHERS Certificate are an estimate based on an assessment of the dwelling's design by the assessor. It is not a prediction of actual energy use, cost or emissions. The information and ratings may be used to compare how other dwellings are likely to perform when used in a similar way.

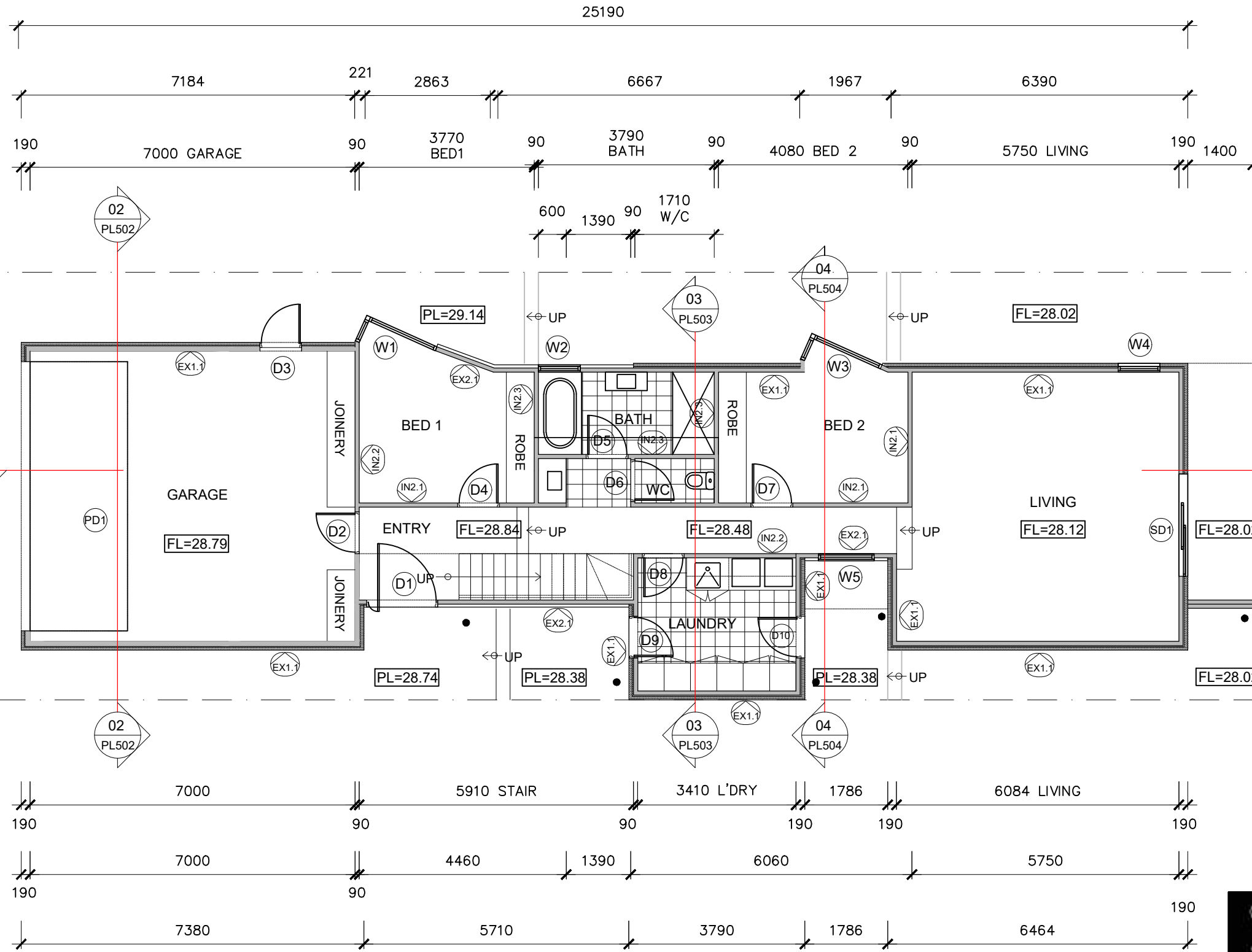
Information presented in this report relies on a range of standard assumptions (both embedded in NatHERS accredited software and made by the assessor who prepared this report), including assumptions about occupancy, behaviour, appliance performance, indoor air temperature and local climate.

Not all assumptions made by the assessor using the NatHERS accredited software tool are presented in this report and further details or data files may be obtained from the assessor.

Glossary

Annual energy load	the predicted amount of energy required for heating and cooling, based on standard occupancy assumptions.
AFRC	Australian Fenestration Rating Council
Assessed floor area	the floor area modelled in the software for the purpose of the NatHERS assessment. Note, this may not be consistent with the floor area in the design documents.
Ceiling penetrations	features that require a penetration to the ceiling, including downlights, vents, exhaust fans, range hoods, chimneys and flues. Excludes fixtures attached to the ceiling with small holes through the ceiling for wiring, e.g. ceiling fans; pendant lights, and heating and cooling ducts.
Conditioned	a zone within a dwelling that is expected to require heating and cooling based on standard occupancy assumptions. In some circumstances it will include garages.
COP	Coefficient of performance
Custom windows	windows listed in NatHERS software that are available on the market in Australia and have a WERS (Window Energy Rating Scheme) rating.
Default windows	windows that are representative of a specific type of window product and whose properties have been derived by statistical methods.
EER	Energy Efficiency Ratio, measure of how much cooling can be achieved by an air conditioner for a single kWh of electricity input
Energy use	This is your homes rating without solar or batteries.
Energy value	The net cost to society including, but not limited to, costs to the building user, the environment and energy networks (as defined in the ABCB Housing Provisions Standard).
Entrance door	these signify ventilation benefits in the modelling software and must not be modelled as a door when opening to a minimally ventilated corridor in a Class 2 building.
Exposure	see exposure categories below
Exposure category - exposed	terrain with no obstructions e.g. flat grazing land, ocean-frontage, desert, exposed high-rise unit (usually above 10 floors).
Exposure category - open	terrain with few obstructions at a similar height e.g. grasslands with few well scattered obstructions below 10m, farmland with scattered sheds, lightly vegetated bush blocks, elevated units (e.g. above 3 floors).
Exposure category - suburban	terrain with numerous, closely spaced obstructions below 10m e.g. suburban housing, heavily vegetated bushland areas.
Exposure category - protected	terrain with numerous, closely spaced obstructions over 10 m e.g. city and industrial areas.
Horizontal shading feature	provides shading to the building in the horizontal plane, e.g. eaves, verandahs, pergolas, carports, or overhangs or balconies from upper levels.
National Construction Code (NCC) Class	the NCC groups buildings by their function and use, and assigns a classification code. NatHERS software models NCC Class 1, 2 or 4 buildings and attached Class 10a buildings. Definitions can be found at www.abcb.gov.au .
Net zero home	a home that achieves a net zero energy value*.
Opening percentage	the openability percentage or operable (moveable) area of doors or windows that is used in ventilation calculations.
Provisional value	an assumed value that does not represent an actual value. For example, if the wall colour is unspecified in the documentation, a provisional value of 'medium' must be modelled. Acceptable provisional values are outlined in the NatHERS Technical Note and can be found at www.nathers.gov.au
Recommended capacity	this is the capacity or size of equipment that is recommended by NatHERS to achieve the desired comfort conditions in the zone or zones serviced. This is a recommendation and the final selection sizing should be confirmed by a suitably qualified person.
Reflective wrap (also known as foil)	can be applied to walls, roofs and ceilings. When combined with an appropriate airgap and emissivity value, it provides insulative properties.
Roof window	for NatHERS this is typically an operable window (i.e. can be opened), will have a plaster or similar light well if there is an attic space, and generally does not have a diffuser.
Shading features	includes neighbouring buildings, fences, and wing walls, but excludes eaves.
Solar heat gain coefficient (SHGC)	the fraction of incident solar radiation admitted through a window, both directly transmitted as well as absorbed and subsequently released inward. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits.
Skylight (also known as roof lights)	for NatHERS this is typically a moulded unit with flexible reflective tubing (light well) and a diffuser at ceiling level.
STCs	Small-scale Technology Certificates, certificates created by the REC registry for renewable energy technologies that may be bought and sold as part of the Small-scale Renewable Energy Scheme operated by the Clean Energy Regulatory
Thermal breaks	are materials with an R-value greater than or equal to 0.2 that must separate the metal frame from the cladding. This includes, but is not limited to, materials such as timber battens greater than or equal to 20mm thick, continuous thermal breaks such as polystyrene insulation sheeting, plastic strips or furring channels.
U-value	the rate of heat transfer through a window. The lower the U-value, the better the insulating ability.
Unconditioned	a zone within a dwelling that is assumed to not require heating and cooling based on standard occupancy assumptions
Vertical shading features	provides shading to the building in the vertical plane and can be parallel or perpendicular to the subject wall/window. Includes privacy screens, other walls in the building (wing walls), fences, other buildings, vegetation (protected or listed heritage trees).
Window shading device	a device fixed to windows that provides shading e.g. window awnings or screens but excludes horizontal* or vertical shading features* (eg eaves and balconies)

* Refer to glossary.



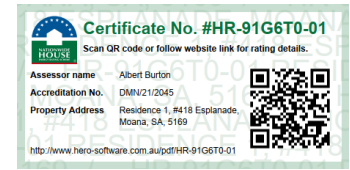
GROUND FLOOR PLAN 1:100 @ A3
residence 01

AREAS	
RESIDENCE 01	
GROUND FLOOR LIVING	=100SQM
GARAGE	= 44SQM
LEVEL 1 LIVING	=107SQM
BALCONIES	= 15SQM

EXTERNAL WALL TYPES

EX1.1-EXTERNAL WALL TOTAL THICKNESS =200MM
75MM HEBEL PANELS
25MM TOP HATS
-CLASS 4 WALL WRAP, BRADFORD THERMO SEAL OR SIMILAR
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)

EX2.1-EXTERNAL WALL TOTAL THICKNESS =173MM
9MM AXOM CLADDING
64MM TOPHATS
-CLASS 4 WALL WRAP, BRADFORD THERMO SEAL OR SIMILAR
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)

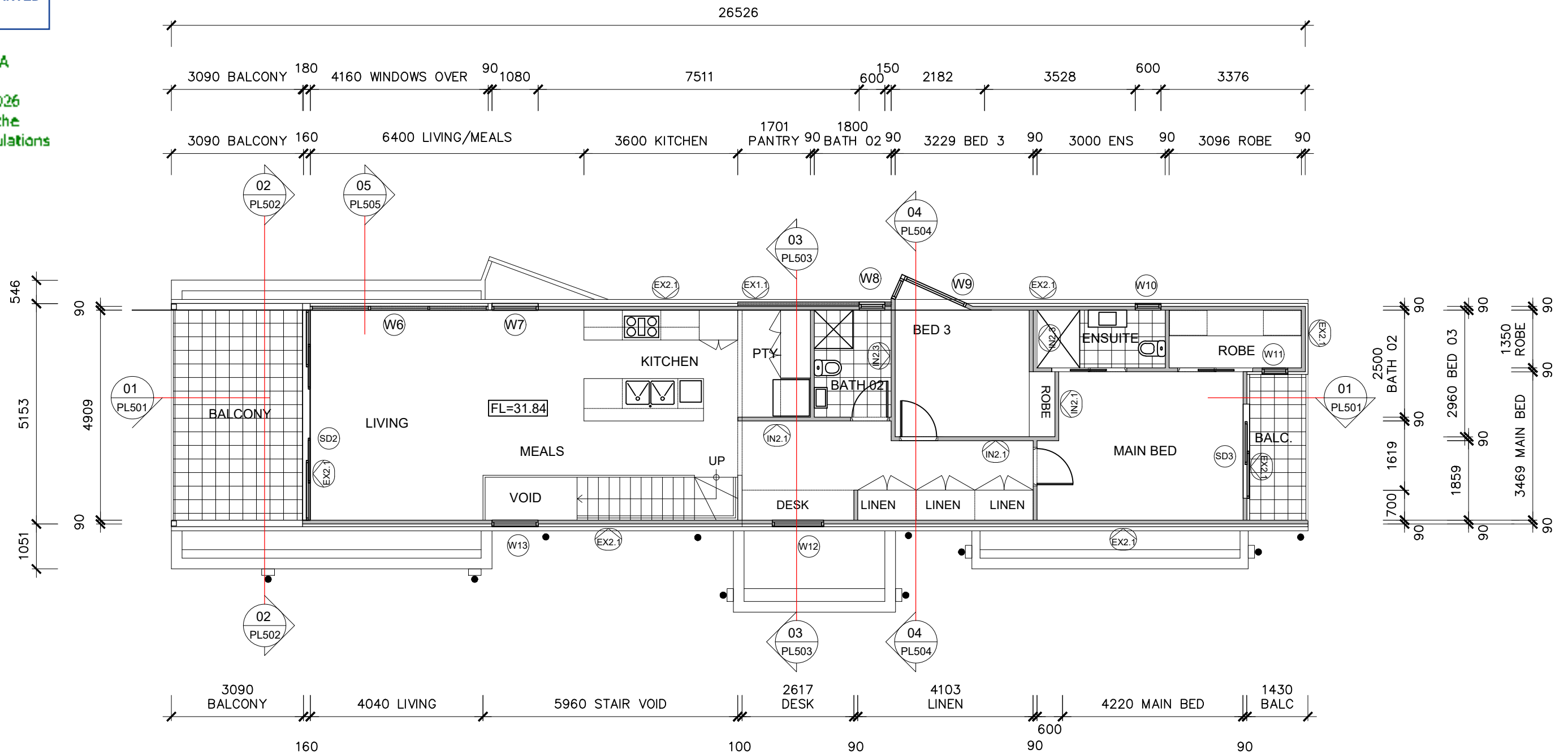


DEVELOPMENT APPROVAL



DATE	14 AUGUST 2025	DRAWING TITLE	RESIDENCE 01 GROUND PLAN
SCALE	AS NOTED @ A3	PAGE NO.	PL101
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	G
PROJECT	DEAN RESIDENCES		

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 **FIRST FLOOR PLAN** 1:100 @ A3
residence 01

DEVELOPMENT APPROVAL

INTERNAL WALL TYPES

IN2.1-INTERNAL WALL TOTAL THICKNESS =110MM
10MM PLASTERBOARD
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)

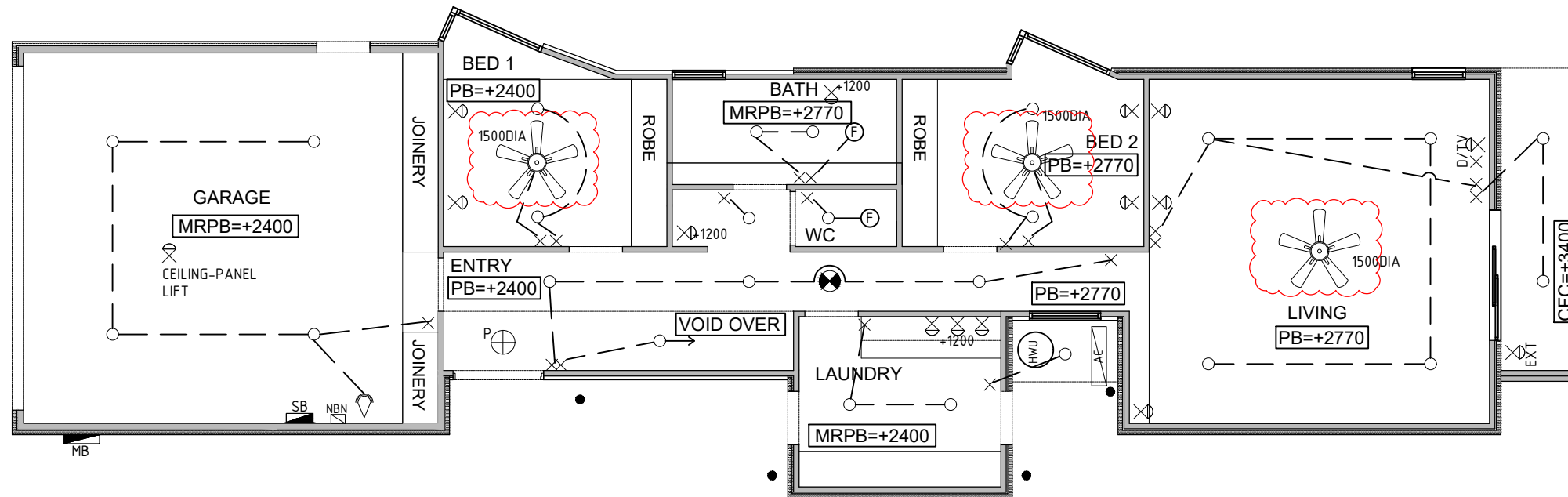
IN2.2-INTERNAL WALL TOTAL THICKNESS =110MM
10MM PLASTERBOARD
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED MR PLASTERBOARD

IN2.3-INTERNAL WALL TOTAL THICKNESS =106MM
6MM CEMENT SHEET- JOINTS TAPED (BATHROOM SIDE)
90MM TIMBER STUDS
R2.7 INSULATION BATTS
10MM FLUSHED PLASTERBOARD (MR TO WET AREAS AND GARAGE)
*ALL INTERNAL LININGS TO COMPLY WITH THE NCC VOL 1 PART H3



DATE	14 AUGUST 2025	DRAWING TITLE	RESIDENCE 01 LEVEL 01 PLAN
SCALE	AS NOTED @ A3	PAGE NO.	PL102
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	G
PROJECT	DEAN RESIDENCES		

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GROUND CEILING PLAN 1:100 @ A3
 residence 01

CEILING LEGEND

- MRPB- 10MM MOISTURE RESISTANT PLASTERBOARD
- PB- 10MM SUPERCEIL PLASTERBOARD
- CFC- CEMENT SHEET WITH EXPRESSED JOINTS

*PROVIDE R6.0 CEILING INSULATION THROUGHOUT ALL GROUND AND LEVEL 1 CEILINGS

- ⊗ DOUBLE GPO - 300AFL, UNLESS NOTED OTHERWISE,
- Ⓒ HARD WIRED COOK TOP PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
- Ⓔ HARD WIRED OVEN PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
- Ⓓ GPO IN OVERHEAD JOINERY FOR RANGE HOOD

- Ⓕ 300DIA FAN DUCTED TO OUTSIDE AIR, PROVIDE SURFACE SOCKET CONNECTION WIRED TO WALL SWITCH- PROVIDE RUN ON TIMER WHERE NO NATURAL VENTILATION IS ACHIEVED

- ⊗ CLIPSAL ICONIC LIGHT SWITCH- NUMBER OF GROUPED SWITCHES DENOTES LIGHT GANG QUANTITY

- ⊗ SMOKE ALARM HARDWIRED TO AS3786

- HANECO VIVA 90 DOWNLIGHT- PROVIDE DIMMING TO ALL LIVING AREAS AND BEDROOMS

- 1500DIA
 VARIABLE SPEED FAN
 1500DIA- 1500MM BLADE DIAMETER
 2100DIA- 2100MM BLADE DIAMETER

- ▬ MB MAIN SWITCH BOARD, RECESSED INTO EXTERNAL WALL SKIN

- ▬ SB SUB BOARD

- ⊠ NBN NBN JUNCTION BOX

- ⊗ MOTION SENSOR

- ⊕ P FEATURE PENDANT- UP TO 50W

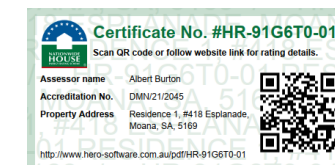
- ▬ AC HARD WIRED PROVISION FOR A/C ON SEPARATE CIRCUIT

- ⊗ HWS HARD WIRED PROVISION FOR HWS ON SEPARATE CIRCUIT 315L THERMANN HEAT PUMP HOT WATER UNIT-

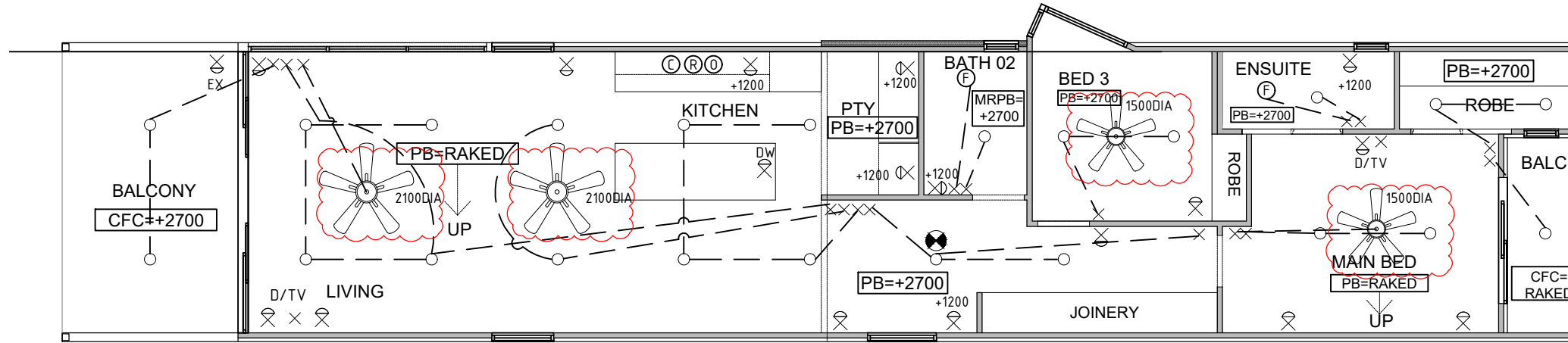
DEVELOPMENT APPROVAL



DATE	30 JULY 2025	DRAWING TITLE	GROUND FLOOR CEILING PLAN RES 1
SCALE	AS NOTED @ A3	PAGE NO.	PL109
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	F
PROJECT	DEAN RESIDENCES		



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FIRST FLOOR CEILING PLAN 1:100 @ A3
residence 01


CEILING LEGEND

- MRPB- 10MM MOISTURE RESISTANT PLASTERBOARD
- PB- 10MM SUPERCEIL PLASTERBOARD
- CFC- CEMENT SHEET WITH EXPRESSED JOINTS

*PROVIDE R6.0 CEILING INSULATION THROUGHOUT ALL GROUND AND LEVEL 1 CEILINGS

- ⊗ DOUBLE GPO - 300AFL, UNLESS NOTED OTHERWISE,
- Ⓢ HARD WIRED COOK TOP PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
- Ⓞ HARD WIRED OVEN PROVISION, ON SEPARATE CIRCUIT WITH ISOLATION SWITCH
- Ⓡ GPO IN OVERHEAD JOINERY FOR RANGE HOOD

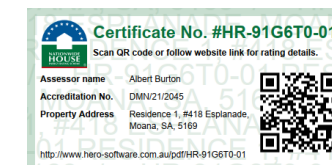
- ⓕ 300DIA FAN DUCTED TO OUTSIDE AIR, PROVIDE SURFACE SOCKET CONNECTION WIRED TO WALL SWITCH- PROVIDE RUN ON TIMER WHERE NO NATURAL VENTILATION IS ACHIEVED
- ⊗ CLIPSAL ICONIC LIGHT SWITCH- NUMBER OF GROUPED SWITCHES DENOTES LIGHT GANG QUANTITY
- ⊗ SMOKE ALARM HARDWIRED TO AS3786
- HANECO VIVA 90 DOWNLIGHT- PROVIDE DIMMING TO ALL LIVING AREAS AND BEDROOMS

1500DIA

VARIABLE SPEED FAN
 1500DIA- 1500MM BLADE DIAMETER
 2100DIA- 2100MM BLADE DIAMETER

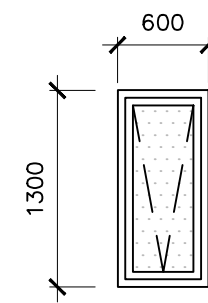
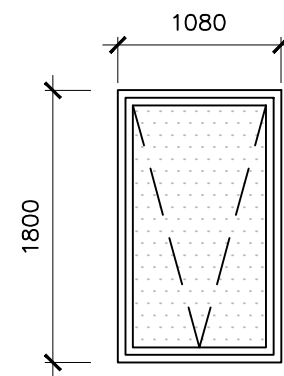
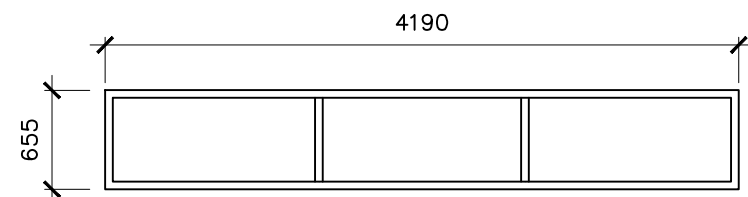
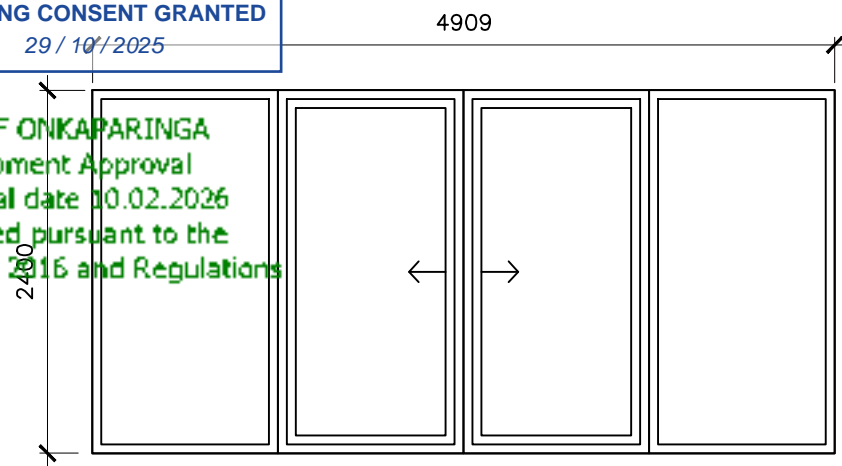
DEVELOPMENT APPROVAL



DATE	30 JULY 2025	DRAWING TITLE	LEVEL 1 CEILING PLAN RES 1
SCALE	AS NOTED @ A3	PAGE NO.	PL108
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	F
PROJECT	DEAN RESIDENCES		



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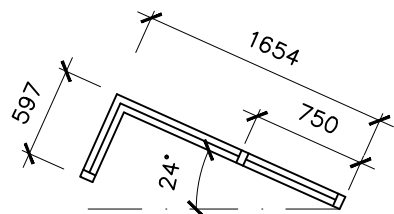
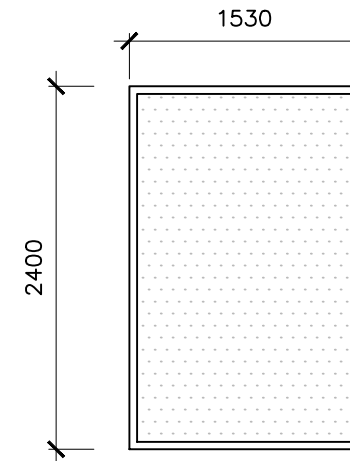
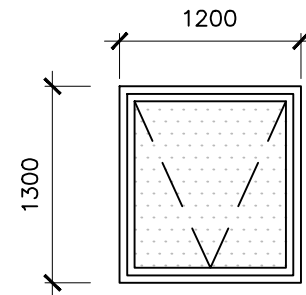
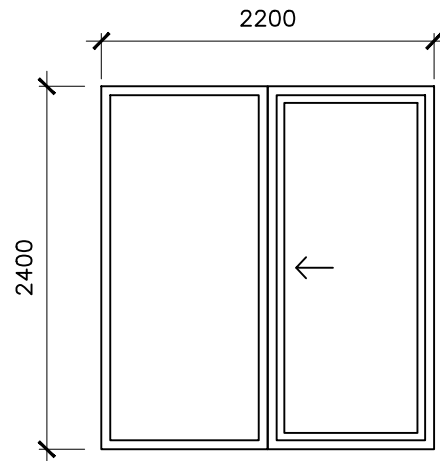
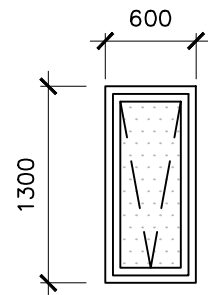
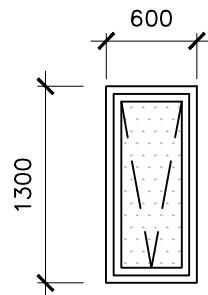
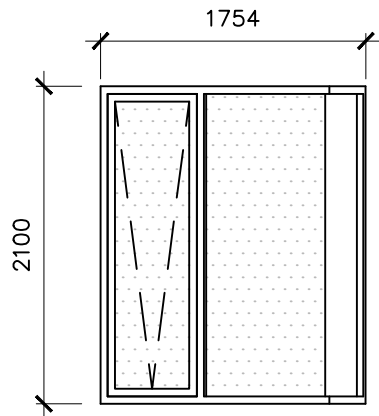


SD2- SLIDING DOOR 'X-O-O-X' FORMATION WITH SCREENS

W6- HIGH LEVEL FIXED GLAZING

W7- AWNING WINDOW- OBSCURE GLAZING

W8- AWNING WINDOW- OBSCURE GLAZING



W9- SILICONE BUTT JOINTED WINDOW WITH AWNING SIDE SASH- OBSCURE GLAZING TO LONG SIDE

W10- AWNING WINDOW- OBSCURE GLAZING

W11- AWNING WINDOW- OBSCURE GLAZING

SD3- SLIDING DOOR WITH SCREEN

W12- AWNING WINDOW- OBSCURE GLAZING

W13- FIXED WINDOW- OBSCURE GLAZING



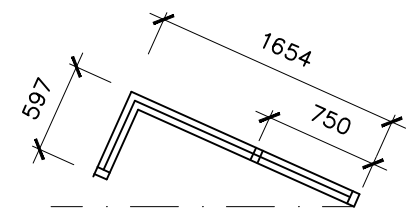
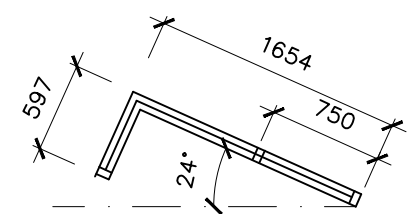
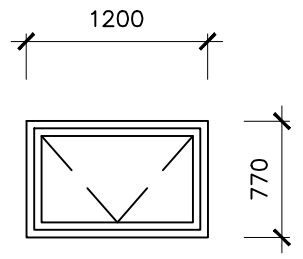
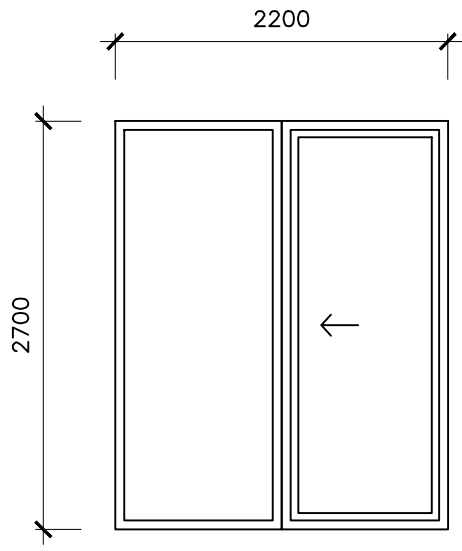
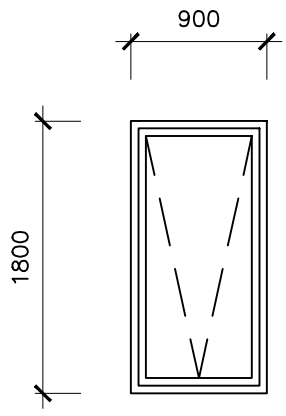
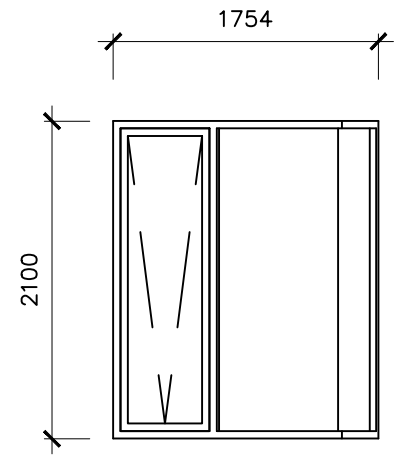
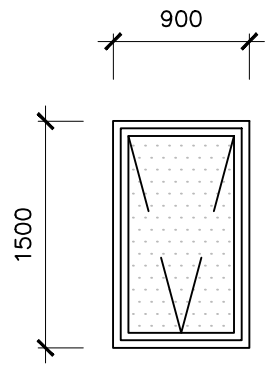
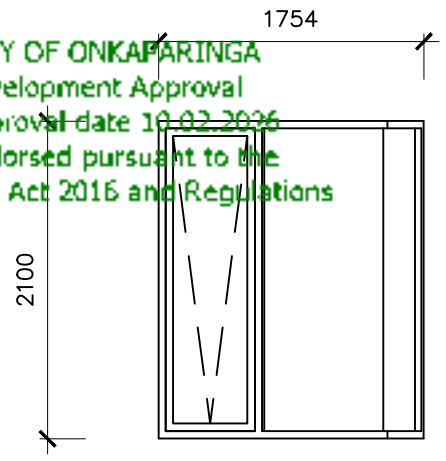
DEVELOPMENT APPROVAL



**ALL AWNING WINDOWS
JOLONG 100 SERIES WINDOWS (THERMAL BREAK) WITH
6MM LOW E+12AR+6MM LOW E GLASS
ALL SLIDING DOORS
JOLONG 100 SERIES DOORS (THERMAL BREAK) WITH 6MM
LOW E+12AR+6MM LOW E GLASS
ALL SLIDING DOORS
JOLONG 100 SERIES (THERMAL BREAK) WITH 5MM LOW
E+12AR+5MM LOW E GLASS**

DATE	30 JULY 2025	DRAWING TITLE	WINDOW SCHEDULE LEVEL 1-RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL507
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	F
PROJECT	DEAN RESIDENCES		

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W1- SILICONE BUTT JOINTED WINDOW WITH AWNING SIDE SASH

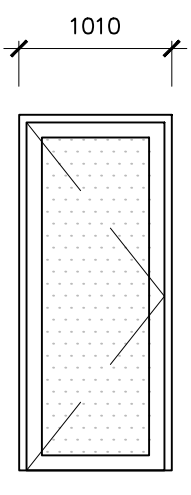
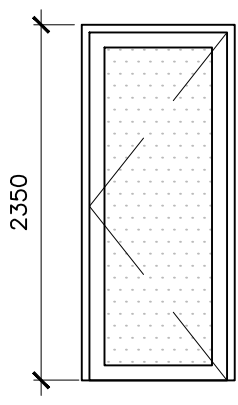
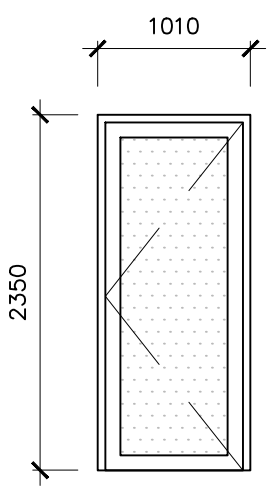
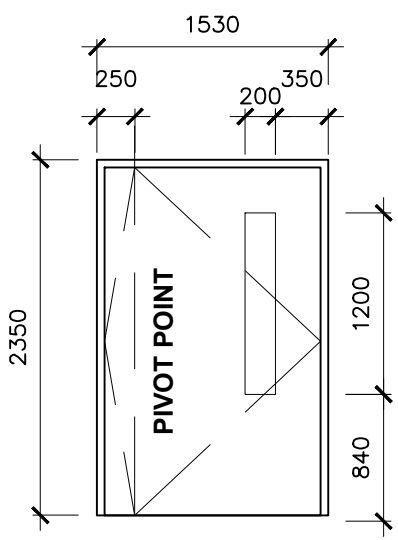
W2- AWNING WINDOW - OBSCURE GLAZING

W3- SILICONE BUTT JOINTED WINDOW WITH AWNING SIDE SASH

W4- AWNING WINDOW

SD1- SLIDING DOOR WITH SCREEN

W5- AWNING WINDOW



**ALL AWNING WINDOWS
 JOLONG 100 SERIES WINDOWS (THERMAL BREAK) WITH
 6MM LOW E+12AR+6MM LOW E GLASS
 ALL SLIDING DOORS
 JOLONG 100 SERIES DOORS (THERMAL BREAK) WITH 6MM
 LOW E+12AR+6MM LOW E GLASS
 ALL SLIDING DOORS
 JOLONG 100 SERIES (THERMAL BREAK) WITH 5MM LOW
 E+12AR+5MM LOW E GLASS**

**D1- PIVOT DOOR
 COLORBOND CLADDING
 EXTERNAL
 PAINT FINISH INTERNALLY
 WITH PERIMETER SEALS**

**D3- GLAZED DOOR
 WITH PERIMETER
 SEALS- OBSCURE
 GLAZING**

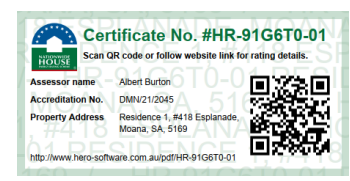
**D9- GLAZED DOOR
 WITH PERIMETER
 SEALS- OBSCURE
 GLAZING**

**D10- GLAZED DOOR
 WITH PERIMETER
 SEALS- OBSCURE
 GLAZING**

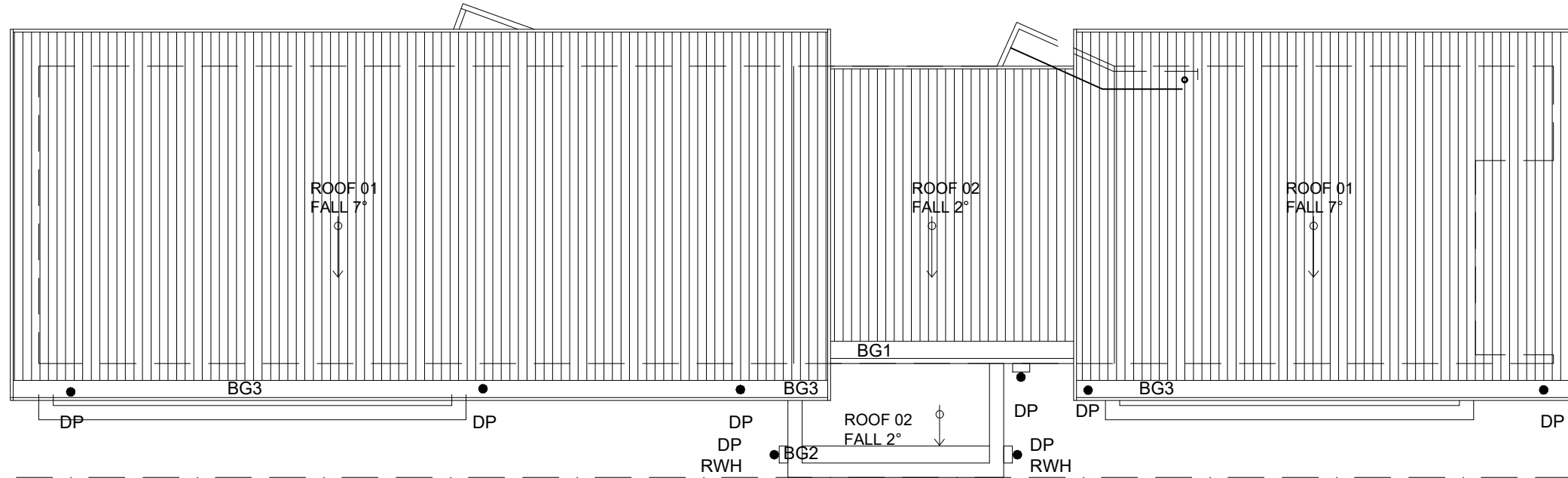
DEVELOPMENT APPROVAL



DATE	30 JULY 2025	DRAWING TITLE	WINDOW SCHEDULE GROUND-RES 01
SCALE	AS NOTED @ A3	PAGE NO.	PL506
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	F
PROJECT	DEAN RESIDENCES		



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ROOF PLAN 1: 100 @ A3
residence 02

- BG1 BOX GUTTER TYPE 3-COLORBOND ULTRA 300WX150DEEP
- BG2 BOX GUTTER TYPE 3-COLORBOND ULTRA 200WX100DEEP
- BG3 BOX GUTTER TYPE 3-COLORBOND ULTRA 300WX100DEEP
- DP COLORED 100DIA PVC DOWNPIPE CONNECTED TO UNDERGROUND STORMWATER- AS PER CIVIL ENGINEERS DETAILS
- RWH 300Wx150Hx100D COLORBOND RAINWATER HEAD

SPREADER 2.4M LONG SLOTTED 100DIA PVC SPREADER

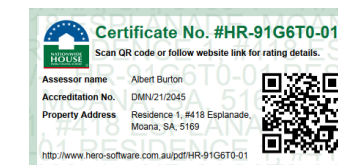
ROOF 01 CUSTOM ORB- COLORBOND ULTRA- 7° PITCH- BRADFORD ANTICON 80 OR SIMILAR ROOF BLANKET- WITH ADDITIONAL R6.0 CEILING INSULATION

ROOF 02 TRIMDECK ROOFING - COLORBOND ULTRA- 2° PITCH BRADFORD ANTICON 80 OR SIMILAR ROOF BLANKET- WITH ADDITIONAL R6.0 CEILING INSULATION

DEVELOPMENT APPROVAL



DATE	30 JULY 2025	DRAWING TITLE	ROOF PLAN RESIDENCE 1
SCALE	AS NOTED @ A3	PAGE NO.	PL105
CLIENTS	DEAN FAMILY 418 ESPLANADE MOANA	REV.	F
PROJECT	DEAN RESIDENCES		



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BUSHFIRE ATTACK LEVEL (BAL) ASSESSMENT REPORT

(Method 1 – AS 3959:2018)

Report Number: 107

Issue Date: 30/09/2025

Version 1.0



IMPORTANT NOTICE & LIMITATION OF LIABILITY

CITY OF ONKAPARINGA

Development Approval

Approval Date: 10/11/2025

Endorsed pursuant to the

PDI Act 2016 and Regulations

Indicative rating only

This Bushfire Attack Level (BAL) assessment has been prepared exclusively for Andrew & Annabelle Dean in respect of the proposed development at 17418 Esplanade, Moana SA 5169. It is based on the site and vegetation conditions observed on 25/09/2025 and utilises AS 3959:2018 (inc. 2019 amendments) Method 1.

The BAL rating provided is indicative and must be confirmed by the relevant consent authorities before any approval is granted or construction commences.

Scope & assumptions

The assessment assumes that:

- All site data supplied by the client is accurate
- No unauthorised earthworks, vegetation removal or additions occur after the inspection date
- Building works will be carried out strictly in accordance with the National Construction Code and AS 3959 for the stated BAL rating.

Ongoing maintenance obligations

The owner/builder is solely responsible for:

- Establishing and maintaining the Asset Protection Zone (APZ) / defendable space described in this report
- Managing surface fuels & ladder fuels at the intervals nominated in the Maintenance Schedule
- Keeping ember-guard mesh, seals, weather strips, gutters and downpipes free of debris
- Ensuring that any future landscaping, outbuildings or additions do not reduce the separation distance or increase the fire hazard.

Changes in site conditions

Vegetation growth, earthworks, new structures or policy changes may invalidate this assessment. A new BAL assessment should be commissioned if site conditions materially change.

Limitation of liability

To the fullest extent permitted by law BAL Rating SA, its employees and agents accept no responsibility for any loss, damage, personal injury or death arising from reliance on this report or from changed site conditions after the inspection date. Any liability (including for negligence) is limited to the lesser of the cost of re-supplying the report or the fee actually paid for this assessment. No third party may rely on this report without our written consent.

Professional indemnity

The assessor maintains Professional Indemnity Insurance for BAL assessments. A certificate of currency is available on request.

By using this report the client acknowledges and accepts the above limitations.

1. Property & Client Details

Report Number	107
Issue Date	30/09/2025
Client Name	Andrew & Annabelle Dean
Site Address:	1/418 Esplanade, Moana, SA, 5169
Lot/Plan No:	CT5622/997 D6211 A730
Assessor Name:	Timothy Dabrowski
Contact:	admin@Balratingsa.com.au
Version:	1.0

2. Site Description

Brief description of site and surroundings:	The subject land is a split (two-lot) residential site on the Esplanade at Moana. This assessment relates to the northern dwelling (Residence 1 of 2). The property sits in the urban interface zone, directly across The Esplanade is a steep, vegetated coastal sand-dune system mapped as High bushfire hazard overlay. Surrounding development to the east and along the street is typical suburban housing and roads.
Map/GIS Reference:	Lat :-35.2102206 Long:138.4726956
Zoning Information (if applicable):	The property sits in a General Neighbourhood zone, and is within the Hazards (Bushfire - Urban Interface) overlay. The site is within 100 metres of the Bushfire - High overlay.




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Fig 1. Site with Vegetation Classification, Distances, Plot points and Effective Slope marked.

Vegetation Classification (Clause 2.2.3)

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Plot ID	Vegetation Class	Description	Photo Reference.
<p>Developer Approval date 10.02.2026</p> <p>Endorsed pursuant to the PDI Act 2016 and Regulations</p>	A	Vegetation is classified as Shrubland (Class C) , characterised by a dominant layer of woody shrubs typically 0.5–3 m high; trees are absent or sparse, while shrubs are continuous or occur in frequent patches exceeding ~10% cover. Fine, twiggy fuels and leaf litter are present from near ground to mid-height, creating vertical continuity that promotes sustained flame contact and ember production. Compared with grassland, shrubland generally supports slower-moving but higher flame heights and greater radiant heat under severe fire weather.	 <p>North West © 306°NW (M) • -35.210087, 138.472116 ±1m ▲ 35m</p>
B	Shrubland	Vegetation is classified as Shrubland (Class C) , characterised by a dominant layer of woody shrubs typically 0.5–3 m high; trees are absent or sparse, while shrubs are continuous or occur in frequent patches exceeding ~10% cover. Fine, twiggy fuels and leaf litter are present from near ground to mid-height, creating vertical continuity that promotes sustained flame contact and ember production. Compared with grassland, shrubland generally supports slower-moving but higher flame heights and greater radiant heat under severe fire weather.	 <p>North West © 319°NW (M) • -35.210157, 138.472237 ±1m ▲ 30m</p>
C	Excluded / Low Threat Vegetation	Vegetation is less than 0.25 hectares in size and more than 20 metres from the site, vegetation within 20 metres that is maintained in a minimal fuel condition (such as managed lawns, gardens, orchards, vineyards, or cultivated land), and non-vegetated areas such as roads, driveways, waterways, buildings, and rocky outcrops.	 <p>North West © 334°NW (M) • -35.211078, 138.473388 ±1m ▲ 34m</p>

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D	29/10/2025 Excluded / Low Threat Vegetation	Vegetation is less than 0.25 hectares in size and more than 20 metres from the site, vegetation within 20 metres that is maintained in a minimal fuel condition (such as managed lawns, gardens, orchards, vineyards, or cultivated land), and non-vegetated areas such as roads, driveways, waterways, buildings, and rocky outcrops.	 <p>West © 2017 W (M) + 35.270262, 138.472518 (3m) ▲ 33m</p>
E	Excluded / Low Threat Vegetation	Vegetation is less than 0.25 hectares in size and more than 20 metres from the site, vegetation within 20 metres that is maintained in a minimal fuel condition (such as managed lawns, gardens, orchards, vineyards, or cultivated land), and non-vegetated areas such as roads, driveways, waterways, buildings, and rocky outcrops.	 <p>East © 89 E (M) + 35.270266, 138.472525 (3m) ▲ 32m</p>

4. Effective Slope Determination (Clause 2.2.5)

Plot ID	Slope Direction	Effective Slope (Degrees)	Measurement Method
A2	W	11.6 Degrees Downslope	Inclinometer and Verified with GIS contours
B2	W	14.8 Degrees Downslope	Inclinometer and Verified with GIS contours

5. Distance to Vegetation & Determination of Bushfire Attack Level (Clause 2.2.4 & 2.2.6)

Plot ID	Distance to Site (m)	Vegetation Class	Effective Slope	BAL Table Ref (Table 2.5)	Bal Result
A2	27.2	Shrubland	11.6 Degrees Downslope	Downslope >10 to 15 degrees	BAL-19
B2	26.4	Shrubland	14.8 Degrees Downslope	Downslope >10 to 15 degrees	BAL-19

Calculated using AS 3959:2018 Method 1, **FDI 80 (SA)**, Shrubland Class C, downslope **>10–15°**, distances **26–28 m** → **BAL-19**

Worst-case BAL across all plots = **BAL-19**, which is derived from the maximum of all plot results.

The Bushfire Attack Level (BAL) for the subject site at 1/418 Esplanade, Moana has been assessed in accordance with AS 3959:2018 Method 1. The assessment considered site topography, proximity to classified vegetation, and effective slopes in each direction.

Vegetation to the West of the site is classified as Shrubland, occurring on steep, coastal sand dune systems mapped as a High Bushfire Hazard Overlay. The effective downslope in this direction ranges between 11.6° and 14.8°, which increases fire run potential. Distances to this vegetation were measured at 27.2 metres and 26.4 metres from the dwelling. Vegetation in other directions was classified as Excluded / Low Threat under Clause 2.2.3.2 due to either minimal fuel loads (managed residential gardens, roads, and driveways) or non-vegetated areas.

Using Table 2.5 of AS 3959:2018, the calculated BAL outcomes for the western plots were BAL-19. This rating reflects a moderate risk of ember attack and windborne debris exposure during a bushfire event, and construction requirements for BAL-19 must be applied in accordance with AS 3959:2018 to mitigate bushfire risk.

FINAL BAL RATING: BAL-19



7. Supporting Evidence - Photos of hazards and surrounding area

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Fig 2. Plot A1, view from NW corner of proposed residence.



Fig 3. Plot B1, view from SW corner of proposed residence.



Fig 4. A1 external of Fence



Fig 5. Plot A2



Fig 6. Plot A3



Fig 7. Plot B2

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Fig 8. Plot B3



Fig 9. Facing Property from closest Vegetation



Fig 10. Proposed site



Fig 11. Street View front of proposed site



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8 Assessor Declaration

Approval date 10.02.2026

Endorsed pursuant to the

PDI Act 2016 and regulations

I hereby declare that the BAL assessment has been conducted in accordance with the requirements of AS 3959:2018 (Method 1), and the information provided in this report is accurate to the best of my knowledge.

Assessor Name: Timothy Dabrowski

Signature:

Date: 30/09/2025

Email: admin@balratingsa.com.au





Appendix – BAL-19 Construction Summary

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Development Approval
(AS 3959:2018 Method 1; FDI 80; summarised requirements)

Approval date 10.02.2026

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This appendix summarises the principal BAL-19 construction measures for ember attack, radiant heat ≤ 19 kW/m², and wind-borne debris. Always verify details against AS 3959:2018 (incl. Amdts 1–3), NCC 2022 and any SA variations/consents.

1) External Walls

- **Materials:** Non-combustible (e.g., masonry, concrete, FC sheet, metal) **or** bushfire-resisting timber (BRT) **or** timber clad on a compliant non-combustible substrate.
- **Joints & gaps:** Seal all external gaps >3 mm (e.g., around cladding joints, penetrations, service entries) with non-combustible rod + fire/heat-resistant sealant.
- **Weepholes:** If present, fit corrosion-resistant metal mesh (max aperture 2.0 mm).

2) Roof (covering, valleys, box gutters, penetrations)

- **Roof covering:** Tiled or sheet metal permitted; roofs must be **ember-resistant** with all openings sealed (e.g., under corrugations, at ridges/hips). Sarking or ember-guard under tiles recommended for ember control.
- **Valleys/flashings:** Metal valley gutters (≥ 0.4 mm steel or equiv.). Seal side laps and fixings per manufacturer for ember exclusion.
- **Eaves/soffits:** Non-combustible linings or BRT. Seal junctions to prevent ember entry.
- **Penetrations** (flues, vents, skylights, PV conduits): Flash and seal. Any ventilation openings to be screened with corrosion-resistant metal mesh (≤ 2.0 mm).
- **Gutters & downpipes:** Non-combustible. Where guards are fitted, they must be non-combustible. Provide means to **isolate/blank off** wet systems drawing from tanks if used for fire-fighting.

3) Verandahs, Decks, Steps, Ramps, Landings

- **Framing/lining:** Non-combustible or BRT primary members adjacent to the dwelling.
- **Decking:** Non-combustible or BRT allowed at BAL-19. Avoid debris traps; close gaps >3 mm to enclosed areas below.

Flashings & attachments: Where attached to the dwelling, detail interfaces to prevent ember entry (flash/close cavities; 2.0 mm mesh to undercroft if enclosed).

CITY OF ONKAPARINGA

Development Sub-floor (see §6): If deck/sub-floor is enclosed, all openings must be screened (≤ 2.0 mm).

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4) Windows (frames, glazing, screens)

- **Frames:** Metal or BRT (or other complying).
- **Glazing:** Minimum **5 mm toughened safety glass** to exposed panes (openable or fixed).
- **Screens:** Openable sashes must be screened with corrosion-resistant metal mesh (aperture ≤ 2.0 mm).
- **Seals:** Fit weather strips, smoke/ember seals as needed to limit gaps >3 mm.

5) External Doors (hinged, sliding, French, bifold)

- **Leaf:** Non-combustible or **solid-core timber ≥ 35 mm** (or BRT) for primary doors exposed to attack.
- **Glazed portions:** Toughened safety glass ≥ 5 mm.
- **Frames & sidelights:** Metal or BRT; treat glazing as above.
- **Screens:** If a screen door is fitted, it must be corrosion-resistant metal (≤ 2.0 mm mesh).
- **Thresholds:** Fit weather seals to limit gaps >3 mm at heads, jambs, sills and meeting stiles.

6) Sub-floor (enclosed or unenclosed)

- **Unenclosed:** Exposed supports may be non-combustible or BRT. Keep the area free of fine fuel; no stored combustible materials.
- **Enclosed:** Enclose with non-combustible materials or timber on a non-combustible substrate. Provide ventilation openings screened with corrosion-resistant metal mesh (≤ 2.0 mm). Any access doors to be sealed/screened.

7) Vents, Weepholes, Gables, Louvre Inserts

- All vents and openings (eaves, gables, sub-floor, wall vents) must be screened with **corrosion-resistant steel, bronze or aluminium mesh, maximum 2.0 mm aperture**. Avoid plastic insect mesh.

8) Ancillary Structures & Attachments

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- **Garage/Carport:** If attached, treat adjoining walls/ceilings as for the dwelling. External roller doors to have ember protection (bottom and side seals; no through-vents unless screened ≤ 2.0 mm).
 - **Water tanks:** If within flame zone of the building, use non-combustible tanks/stands; metal fittings and isolation valves.

- **LPG cylinders:** Position with relief valves directed away from the building; protect pipework; avoid under-deck locations unless open and clear.
- **Solar PV:** Seal roof penetrations; manage cable entries; maintain roof ember integrity around mounting feet.
- **Evaporative coolers:** Fit ember screens to air intakes (≤ 2.0 mm metal mesh) or use BAL-rated units.

9) Services (electrical, gas, comms)

- **Conduits & meter boxes:** Non-combustible covers or metal enclosures where exposed. Seal wall penetrations.
- **External luminaires:** Prefer enclosed/metal fittings; keep clear of leaf litter.
- **Downpipes to tanks:** Consider ember-proof first-flush diverters; ability to isolate tank feed during fire weather.

10) Landscaping & APZ Interface (operational, not a “material” control)

- Maintain an **Asset Protection Zone (APZ)** to the building envelope:
 - Keep fine fuels (leaf litter, bark, dry grasses) to minimal levels.
 - Separate shrubs from windows and from other shrubs; prune lower limbs of nearby trees; avoid ladder fuels.
 - Use non-combustible mulch (gravel/stone) within immediate perimeter ($\approx 0-2$ m).
 - Keep access ways clear for firefighting.

Acceptable Materials

- **Non-combustible:** masonry, concrete, fibre-cement, earth, metal (steel/aluminium/copper), terracotta/concrete roof tiles, mineral wool insulation, glass.
- **Bushfire-Resisting Timbers (BRT):** Use species certified as BRT (per AS 3959 or third-party equivalent evidence). Keep species list with the job file.



Maintenance (owner obligations)

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Approval date 10.02.2026
Endorsed pursuant to the
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- Clean roofs, gutters, valleys, and around penetrations regularly—especially pre-summer.
 - Replace damaged seals, mesh, and closures immediately.
 - Keep sub-floor and deck undercrofts free of stored combustibles and fine fuels.
 - Maintain APZ landscaping (litter removal, pruning, irrigation/green cover in fire danger season).

CITY OF ONKAPARINGA
Development Applications
Approval date: 10.05.2024
Endorsed pursuant to the
PDI Act 2016 and Regulations

- 29/10/2025
1. THESE DRAWINGS SHALL NOT BE SCALED.
 2. THE DRAWINGS IN CONJUNCTION WITH ALL THE CONSULTANT DRAWINGS, ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.
 3. CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE.
 4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION, ENSURING THAT NO PART SHALL BE OVERSTRESSED DURING CONSTRUCTION ACTIVITIES.
 5. THE CONTRACTOR SHALL PROVIDE INDEPENDENT STRUCTURAL CERTIFICATION FOR ALL BUILDERS' WORKS NOT DETAILED ON THE DRAWINGS, SUCH AS PROPPING, SHORING, TEMPORARY RETAINING, ERECTION PROCEDURES, ETC.
 6. ANY DISCREPANCIES SHALL BE REFERRED TO THIS OFFICE FOR CLARIFICATION.
 7. ALL CONSTRUCTION WORK TO BE PERFORMED IN ACCORDANCE WITH CURRENT WORKPLACE HEALTH & SAFETY STANDARDS.

STORMWATER NOTES:

1. PROVIDE ADEQUATE PROTECTION OR COVER TO STORMWATER PIPES (300mm COVER WHERE PIPE IS TO BE SUBJECTED TO VEHICULAR LOADING AND 100mm MINIMUM COVER OTHERWISE). 1 IN 200 MINIMUM FALL ON STORMWATER DRAINS EXCEPT IN SEALED SYSTEMS.
2. PROVIDE 125x75x2 RHS GALVANISED STEEL OUTLET DISCHARGE PIPE (U.N.O.). ALL STORMWATER OUTLET PIPES DISCHARGING TO KERB & GUTTER TO BE IN ACCORDANCE WITH COUNCIL STANDARD AND SPECIFICATIONS. OUTLET DISCHARGE PIPE TO BE A MINIMUM OF 2m AWAY FROM EXISTING STREET TREE.
3. ENSURE SEALED SYSTEM DRAIN LAID LOW ENOUGH WHERE REQUIRED TO ALLOW GRAVITY FLOW DRAIN TO PASS ABOVE WITH SPECIFIED GRADE AND COVER.
4. GRADE PAVING AND FILL AND GRADE GROUND TO SURFACE SUMP LOCATIONS AT 0.30% FALL.
5. THE NUMBER AND LOCATION OF SUMPS SHOWN ON THIS DRAWING ARE INDICATIVE ONLY AND MAY CHANGE SUBJECT TO ACTUAL SITE CONDITIONS AND THE EXTENT AND TYPE OF PAVEMENTS SELECTED.
6. PIPE UNDER DRIVEWAY: 300mm COVER ONLY REQUIRED WHERE PIPE NOT PROTECTED BY PAVING ABOVE.
7. USE ALTERNATIVE FLEXIBLE CONNECTION AT DP TO DRAIN PIPE JUNCTION.
8. ALL STORMWATER/DRAIN WITHIN DRIVEWAY WITH COVER LESS THAN 3XDIAMETER TO BE CONCRETE ENCASED.

STORMWATER TANK NOTES:

1. COMBINATION DETENTION/RETENTION TANK REFER TO RAINWATER TANK DETAIL ON SEPARATE PAGE.
2. DOWNPIPES (DP) TO TANK AS SHOWN ON PLAN.
3. ENSURE ANY FILL PLACED UNDER TANK STAND LOCATIONS IS PLACED AT LEAST AS "ROLLED FILL". HOWEVER SOME SETTLEMENT MAY OCCUR IF "CONTROLLED FILL IS NOT USED OR IF TANK STAND SLAB IS NOT PIERED TO FIRM NATURAL GROUND.
4. RAINWATER TANK PLUMBED TO DELIVER RECYCLED WATER ONE TOILET AND EITHER THE LAUNDRY COLD WATER OUTLETS OR HOT WATER SERVICE.
5. MAINS WATER BACKUP, PUMP AND PLUMBING ARRANGEMENTS AS TYPICALLY REQUIRED TO SUPPORT SUCH AN INSTALLATION ARE TO BE COMPLIANT WITH THE STANDARD BUILDING CODE REQUIREMENTS ASSOCIATED WITH A COMPULSORY RAINWATER TANK INSTALLATION.
6. THE STORMWATER COLLECTION AND RE-USE SYSTEM IS TO BE INSTALLED AND OPERATIONAL PRIOR TO OCCUPANCY OF THE DWELLING.

SITE WORK NOTES:

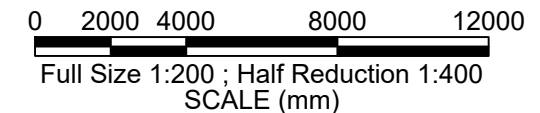
1. ADOPTING EXISTING AS CONSTRUCTED VERGE /FOOTPATH LEVELS FOR DRIVEWAY DESIGN. TO BE CONFIRMED AS APPROPRIATE BY COUNCIL PRIOR TO ANY COUNCIL APPROVALS GRANTED.
2. CONTRACTOR TO CHECK DEPTH OF EXISTING/NEW SEWER CONNECTION AND ENSURE ADEQUATE SEWER FALL CAN BE ACHIEVED PRIOR TO COMMENCING EARTHWORKS. REFER ANY CHANGES TO PROPOSED BENCH LEVEL TO THIS OFFICE FOR VERIFICATION PRIOR TO COMMENCEMENT OF ANY SITE WORKS.
3. LEVELS SHOWN ARE TO AN ASSUMED DATUM AS INDICATED ON SITE PLAN AND ARE APPROXIMATE ONLY.
4. FLEXIBLE CONNECTIONS TO STORM WATER AND WASTE DRAINS ARE NECESSARY ON THIS SITE.
5. STORMWATER DISPOSAL INCLUDING SURFACE DRAINAGE, AS PER PLAN AND TO COUNCIL REQUIREMENTS ALL TO BE CONSTRUCTED BY OWNER, INCLUDING RETAINING WALLS, UNLESS STATED OTHERWISE IN THE CONTRACT. THE STORMWATER DISPOSAL SYSTEM AS INDICATED MUST BE INSTALLED AS SOON AS PRACTICABLE.
6. WRITTEN DIMENSIONS SHALL TAKE PRIORITY OVER SCALED DIMENSIONS.
7. ANY DISCREPANCY BETWEEN THE FOOTING PLAN/REPORT AND THE CIVIL PLAN SHALL BE REPORTED TO HWC ENGINEERS IMMEDIATELY. FLOOR LEVELS MAY BE INCREASED TO ACCOMMODATE SEWER GRADE REQUIREMENTS. OWNER OR BUILDER ARE TO CHECK SEWER INVERTS PRIOR TO COMMENCEMENT OF ANY SITE WORKS.
8. ENSURE BENCH IS GRADED FROM HOUSE.
SLOPE OF 1 IN 100 FOR GRASSED AREAS.
SLOPE OF 1 IN 20 FOR PAVED AREAS.

DRIVEWAY CROSSOVER NOTES:

1. DRIVEWAY CROSSOVERS AND INVERTS TO BE CONCRETE/PAVED RESIDENTIAL TYPE AS PER COUNCIL STANDARD.
2. REDUNDANT SECTIONS OF DRIVEWAY INVERT & CROSSOVER TO BE REPLACED WITH KERB & GUTTER, VERGE AND DDA COMPLIANT CONCRETE/PAVED FOOTPATH AS PER COUNCIL STANDARDS.
3. REDUNDANT STORMWATER OUTLETS AND PIPES TO BE REMOVED AND REINSTATED TO MATCH EXISTING KERB & GUTTER, VERGE AND PATH AS PER COUNCIL STANDARDS.
4. CLARIFICATION TO BE SOUGHT FROM ASSET OWNER AS TO WHETHER ANY TELCO PIT NEEDS TO BE MADE TRAFFICABLE OR RE-LOCATED AT COST OF APPLICANT.

THIS DRAWING INCLUDES COLORED INFORMATION. YOU DO NOT HAVE ALL THE INFORMATION IF YOU ONLY HAVE A BLACK AND WHITE COPY. PLEASE NOTE THIS NOTE IS IN BLUE.

ISSUED FOR APPROVAL



D	01.08.2025	ISSUED FOR APPROVAL	H.W.C
C	24.03.2025	ISSUED FOR APPROVAL	H.W.C
B	21.03.2025	ISSUED FOR APPROVAL	H.W.C
A	13.12.2024	ISSUED FOR APPROVAL	H.W.C
REVISION	DATE	DETAILS	CHECKED



STRUCTURAL & CIVIL CONSULTING

e: marcus@hwcengineers.com.au m: 0422 238 038

DESIGNED: B.X DATE: DEC'24
DRAWN: B.X SHEET SIZE: A3

PROJECT
PROPOSED RESIDENCES
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

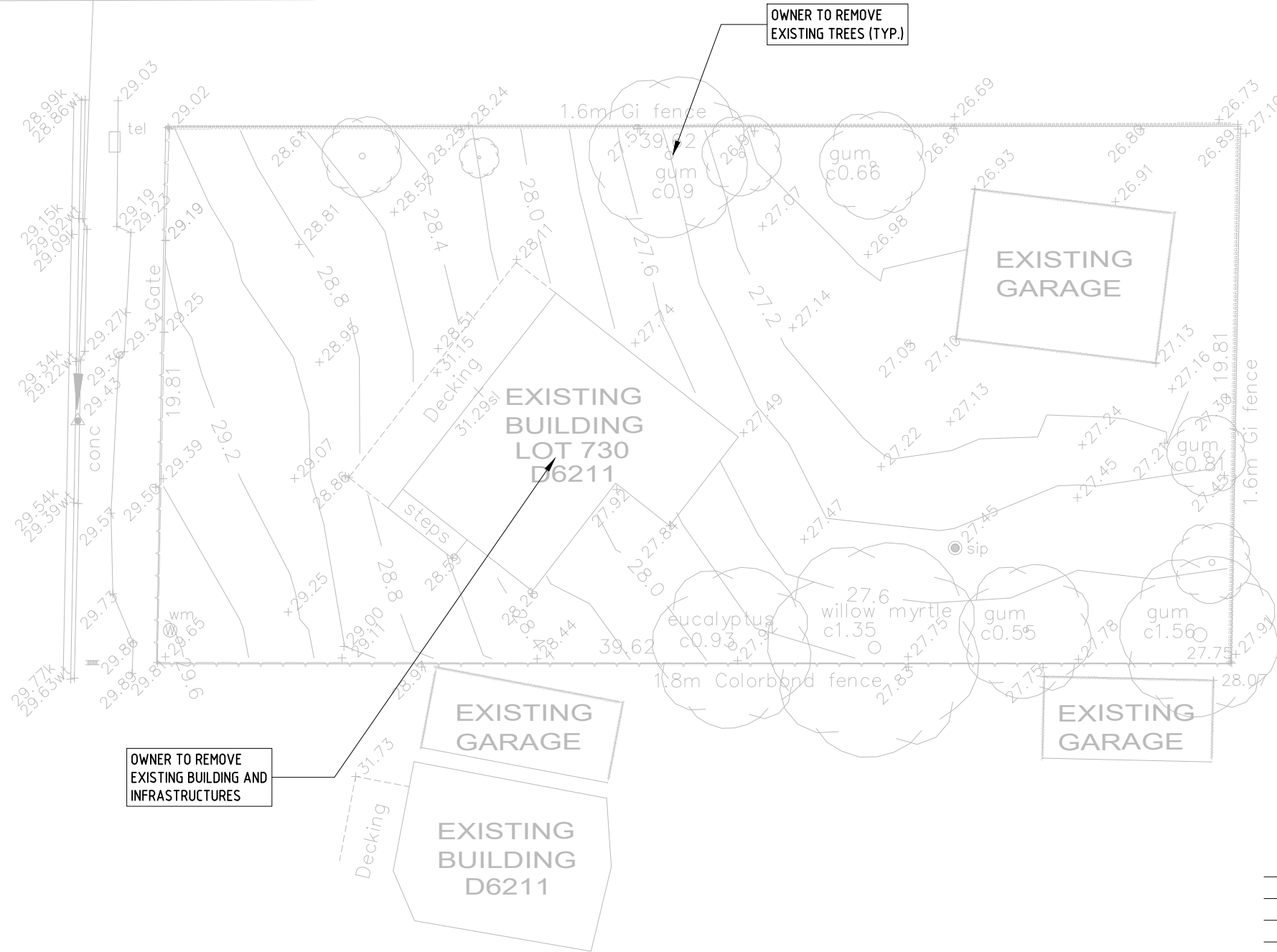
SHEET TITLE
GENERAL NOTES

PROJECT No.	DRAWING	REVISION
HWC-24261	C01	D

D113270

TBM : Masonry nail in the top of kerb
 Adopted elevation = 29.43m AHD

ESPLANADE

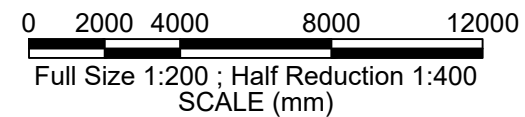


DEMOLITION PLAN
 (1:200)

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ISSUED FOR APPROVAL



REVISION	DATE	DETAILS	CHECKED
D	01.08.2025	ISSUED FOR APPROVAL	H.W.C
C	24.03.2025	ISSUED FOR APPROVAL	H.W.C
B	21.03.2025	ISSUED FOR APPROVAL	H.W.C
A	13.12.2024	ISSUED FOR APPROVAL	H.W.C

HWC
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STRUCTURAL & CIVIL CONSULTING

e: marcus@hwcengineers.com.au m: 0422 238 038

DESIGNED: B.X DATE: DEC'24
 DRAWN: B.X SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENCES
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 DEMOLITION PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	C02	D

CITY OF ONKAPARINGA
 Development Approval
 Approval date 10.02.2025
 Endorsed pursuant to the
 PDI Act 2016 and Regulations

D113270

TBM : Masonry nail in the top of kerb
 Adopted elevation = 29.43m AHD

RETAINING WALL SHOWN FOR
 INDICATIVE PURPOSES ONLY
 AND IS TO BE WITHIN SITE
 BOUNDARY (TYPICAL)

RETAINING WALL (FILL)
 TOW 28.75
 BOW 28.40
 HEIGHT 0.35m

RETAINING WALL (FILL)
 TOW 28.75
 BOW 27.80
 HEIGHT 0.95m

RETAINING WALL (FILL)
 TOW 28.40
 BOW 27.40
 HEIGHT 1m

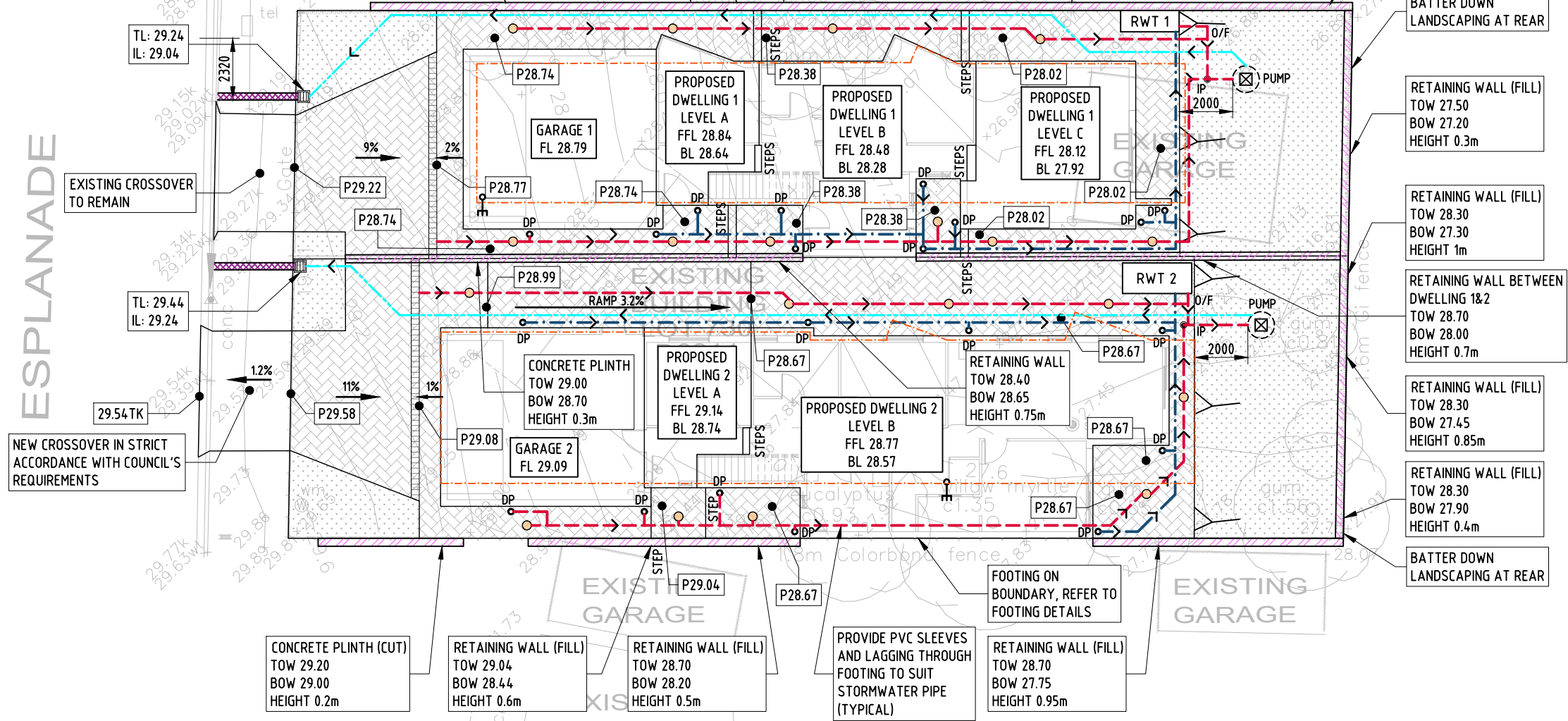
RETAINING WALL (FILL)
 TOW 28.00
 BOW 26.70
 HEIGHT 1.3m

RETAINING WALL (FILL)
 TOW 27.52
 BOW 26.72
 HEIGHT 0.8m

- HDPE PUMP PIPE TO STREET WATER TABLE
- DENOTES DIRECTION OF SURFACE FALL
- PROPOSED 250sq x 280d SUMP WITH CLASS A ALUMINIUM GRATE COVER (U.N.O.)
- 150Ø GRATED SURFACE S/W SUMP (TYPICAL)
- ACO DRAIN K100 OR SIMILAR APPROVED
- DENOTES SPREADER DRAIN
- DENOTES PROPOSED DESIGN LEVELS:
 FFL - FINISHED FLOOR LEVEL
 P - PLATFORM LEVEL
 BL - BENCH LEVEL
 EX - EXISTING LEVEL
 IL - INVERT LEVEL
 TL - TOP LEVEL
 RW - RETAINING WALL HEIGHT
 PR - PRAM RAMP
 L - LANDSCAPING
 TME - TO MATCH EXISTING
- RETAINING WALL
- PERIMETER/DRIVEWAY PAVING
- DENOTES LANDSCAPING AREA, REFER ARCHITECTS DRAWINGS
- DWELLING SLAB HATCH

ESPLANADE

NEW CROSSOVER IN STRICT ACCORDANCE WITH COUNCIL'S REQUIREMENTS



RAINWATER TANK NOTES:
 RAINWATER TANK COMPLYING WITH PLANNING CODE DTS/DPF 1.1 AND AS3500

PROPOSED DWELLING 1	
SITE AREA	367 M ²
ROOF AREA	171 M ² (47%)
PERVIOUS AREA	76 M ² (21%)
IMPERVIOUS AREA	291 M ² (79%)
ROOF AREA TO TANK	137 M ² (80%)

RETENTION TANK	2000L
DETENTION TANK	1000L

PROPOSED DWELLING 2	
SITE AREA	418 M ²
ROOF AREA	192 M ² (46%)
PERVIOUS AREA	77 M ² (18%)
IMPERVIOUS AREA	341 M ² (82%)
ROOF AREA TO TANK	115 M ² (60%)

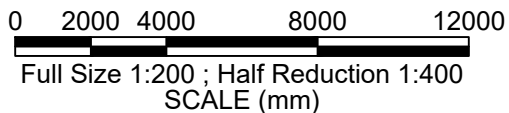
RETENTION TANK	4000L
DETENTION TANK	1000L

60% OF ROOF AREA IS TO CONNECT TO THE COMBINATION TANK AND BE CONNECTED TO ONE TOILET AND EITHER A LAUNDRY COLD WATER OUTLET OR HOT WATER SERVICE.

SITWORKS AND DRAINAGE PLAN
 (1:200)

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ISSUED FOR APPROVAL



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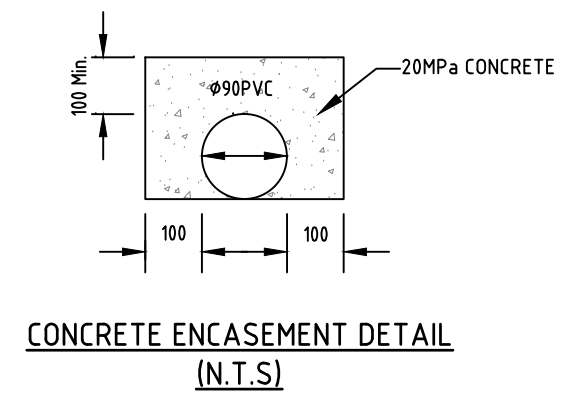
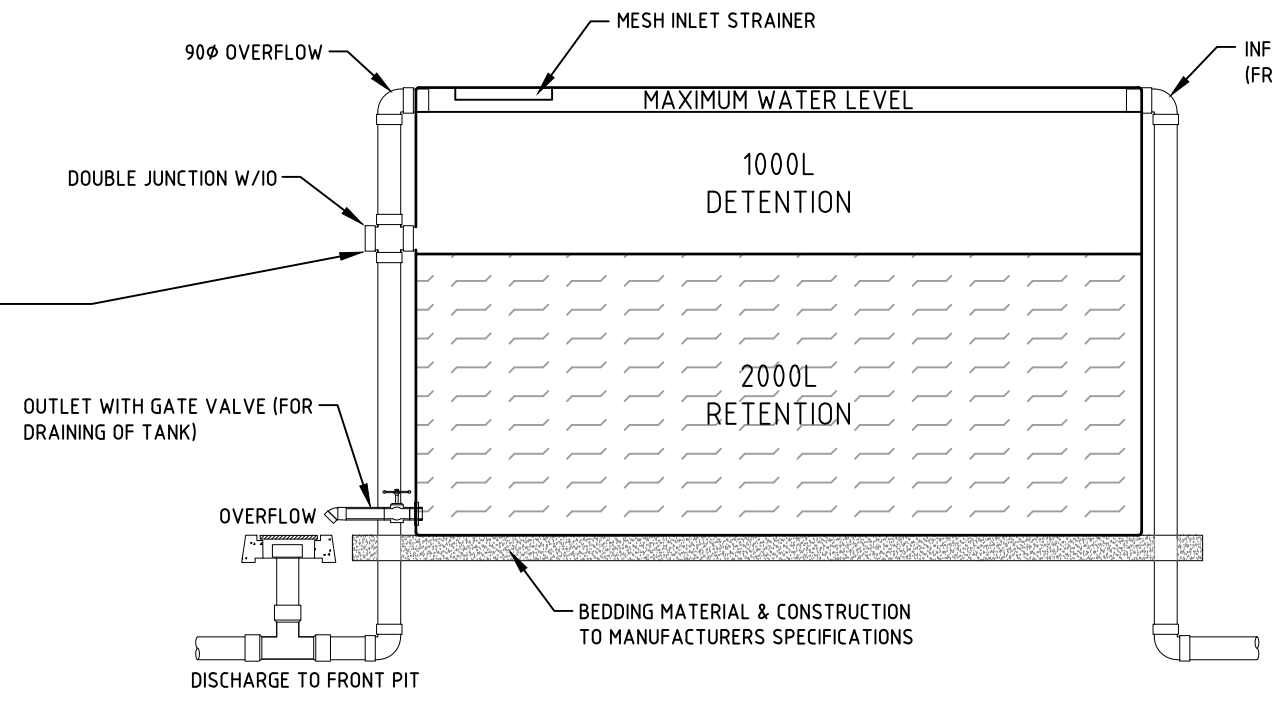
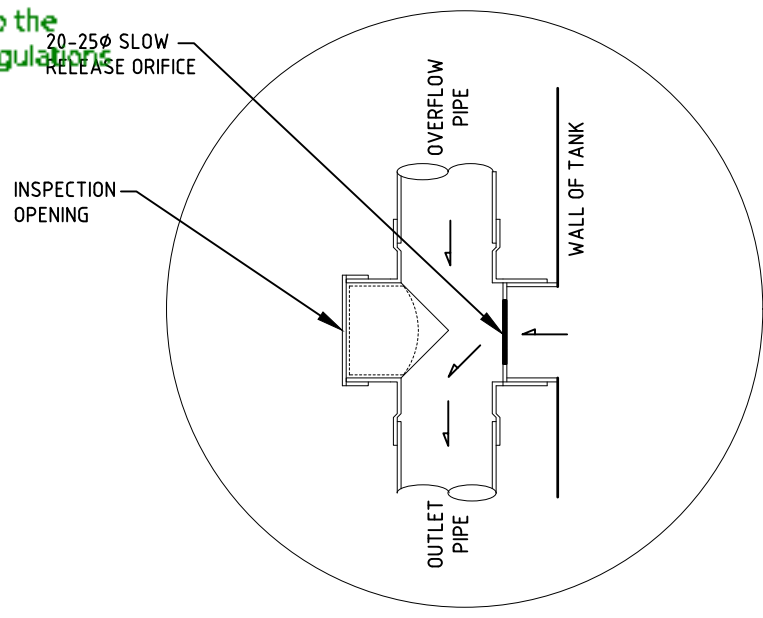
DESIGNED: B.X DATE: DEC'24
 DRAWN: B.X SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENCES
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

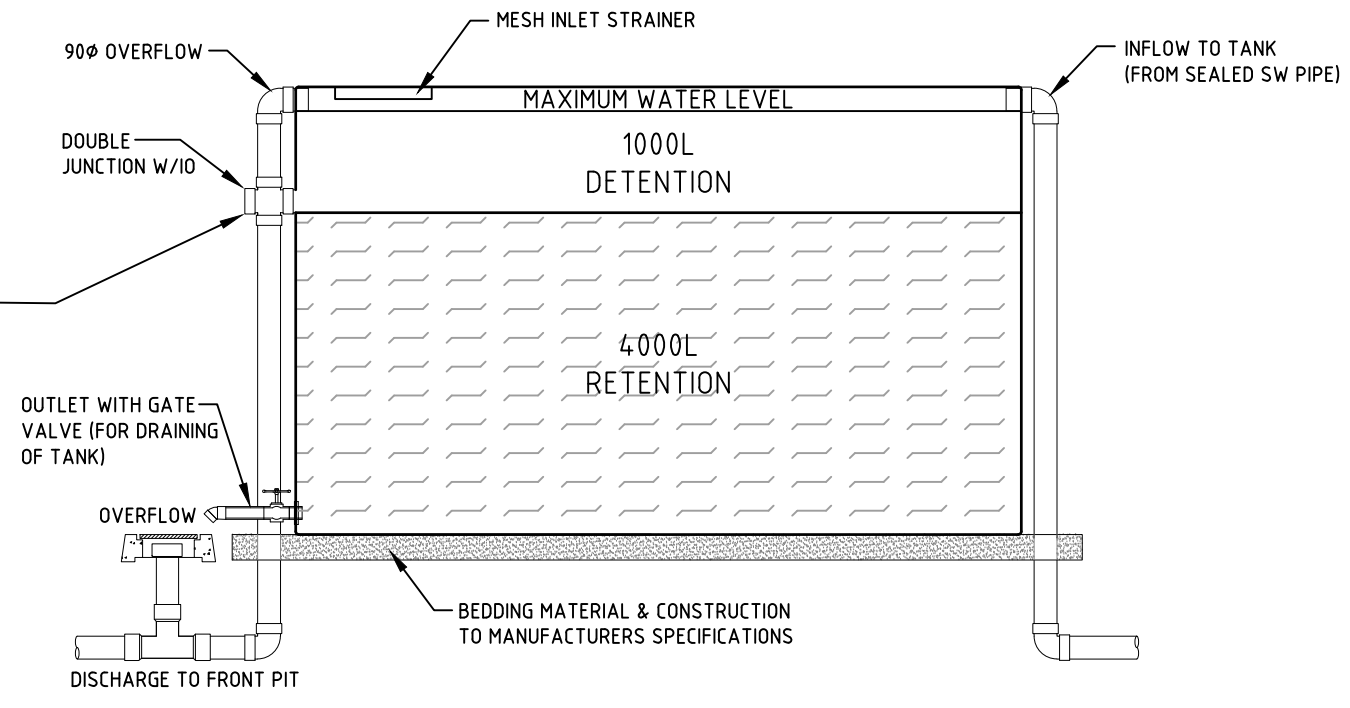
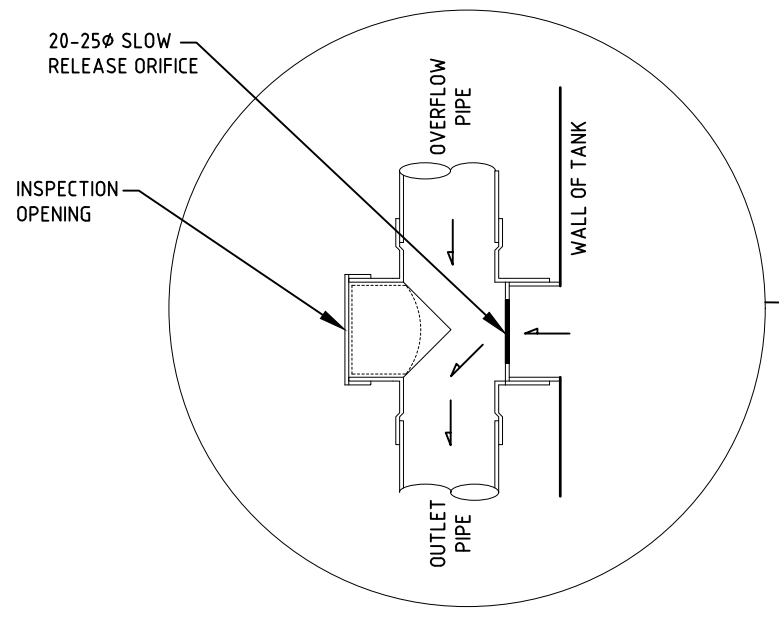
SHEET TITLE
 SITWORKS AND DRAINAGE PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	C03	D

1. THE MAXIMUM HEIGHT OF ANY RAINWATER TANK IS 2.4M.
2. ALL STORMWATER/DRAIN WITHIN DRIVEWAY WITH COVER LESS THAN 3xDIAMETER TO BE CONCRETE ENCASED.
3. SLOW RELEASE ORIFICE AS DTS/DPF 1.1 RECOMMENDATION.
4. SEAMLESS AUTOMATIC SWITCHING - A SUITABLE DEVICE MUST BE INSTALLED SO THAT SUPPLY AUTOMATICALLY SWITCHES BETWEEN RAINWATER AND ALTERNATIVE SUPPLY (TYPICALLY MAINS WATER) TO ENSURE A RELIABLE SUPPLY SYSTEM.
5. MOSQUITO CONTROL - TANKS NEED TO BE ADEQUATELY SCREENED.
6. BACKFLOW PREVENTION - DEVICES MUST BE FITTED TO MINIMISE RISK OF BACKFLOW INTO MAINS WATER SYSTEMS, COMPLIANT WITH PLUMBING REGULATIONS.



RAIN WATER TANK DETAIL - DWELLING 1
(N.T.S)



RAIN WATER TANK DETAIL - DWELLING 2
(N.T.S)

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ISSUED FOR APPROVAL

Full Size 1:200 ; Half Reduction 1:400
SCALE (mm)

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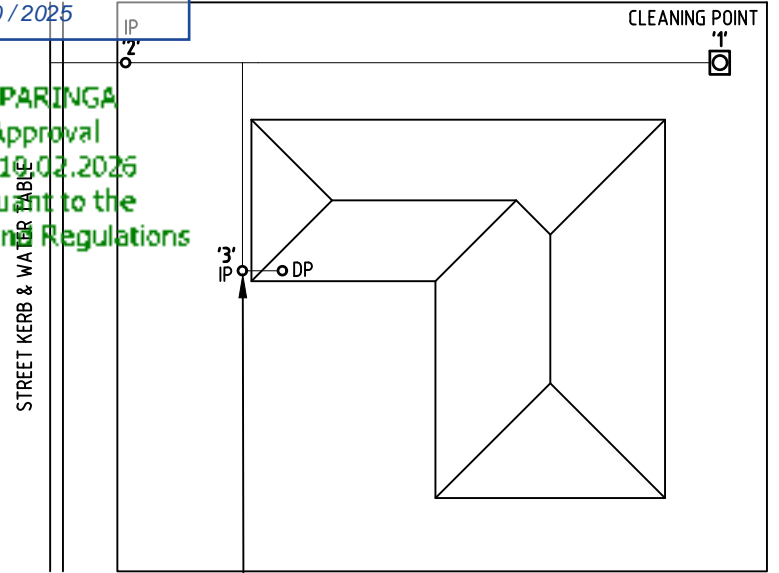
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DRAWN: B.X SHEET SIZE: A3

PROJECT
PROPOSED RESIDENCES
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
RAINWATER TANK DETAIL

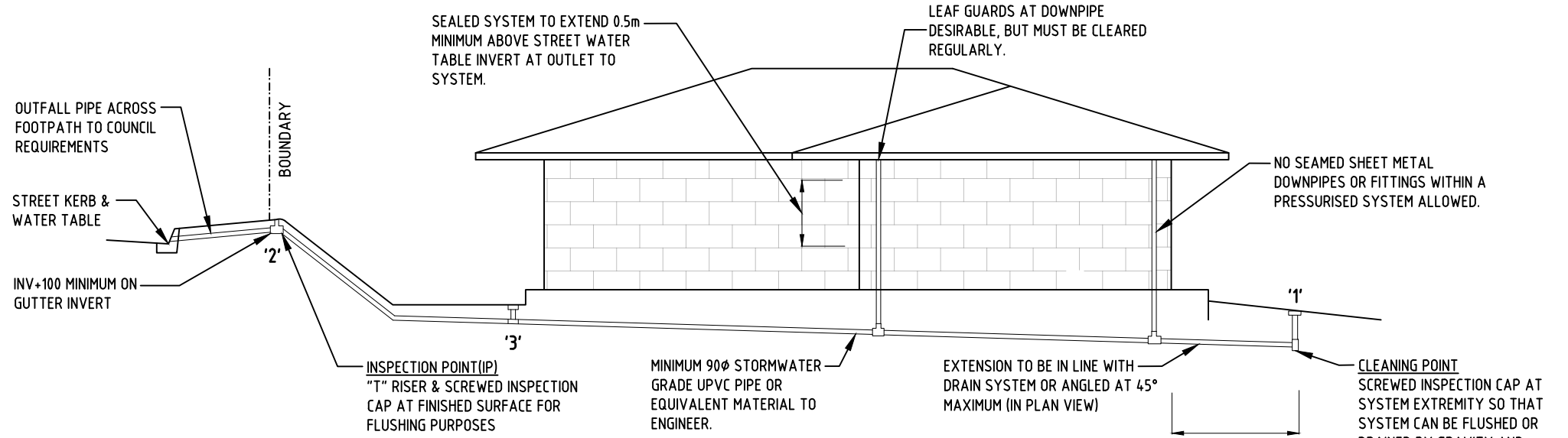
PROJECT No. HWC-24261 DRAWING C04 REVISION D

CITY OF ONKAPARINGA
 Development Approval
 Approval date 19.03.2025
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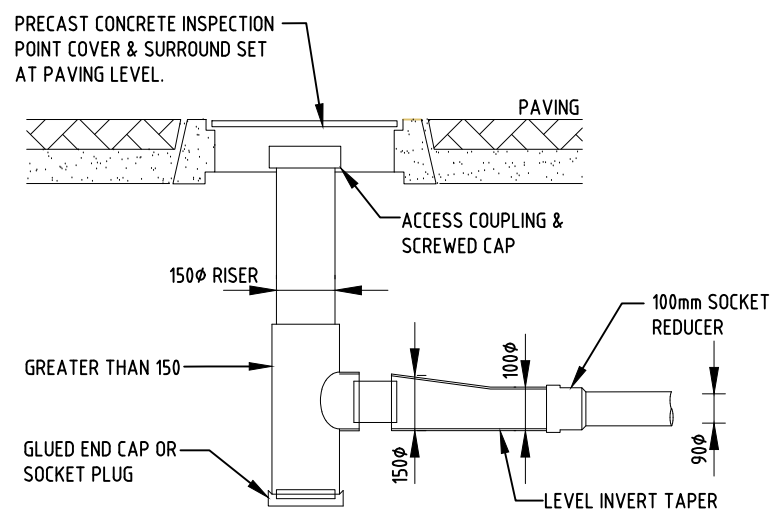


INSPECTION OPENING
 RISER & SCREWED INSPECTION CAP AT FINISHED SURFACE LEVEL OR CLEANING EYE IN DOWNPIPE FOR RODDING (AND/OR FLUSHING) PURPOSES AT "DEAD-END" BRANCHES.

- NOTE:**
- NO SURFACE INLETS (SUMPS OR GRATED INLET PITS) PERMITTED INTO SEALED SYSTEM.
 - SEALED SYSTEM TO BE CONSTRUCTED TO PRESSURE LINE STANDARD (SOLVENT WELDED JOINTS FOR UPVC PIPE). PREFERABLY STATIC WATER TESTED BEFORE BACKFILLING.
 - DUE TO POSSIBLE SERIOUS CONSEQUENCE OF BLOCKAGE OF THE SYSTEM BY SILT OR LEAF LITTER ETC., REGULAR FLUSHING AND MAINTENANCE (AT LEAST 4 TIMES PER YEAR) BY OWNER IS REQUIRED.



NOTE: ALL INTERNAL SYSTEM TO DRAIN TO LOW POINT AT EXTREMITY OF SYSTEM AT 1 IN 200 MINIMUM GRADE



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 SCALE (mm)

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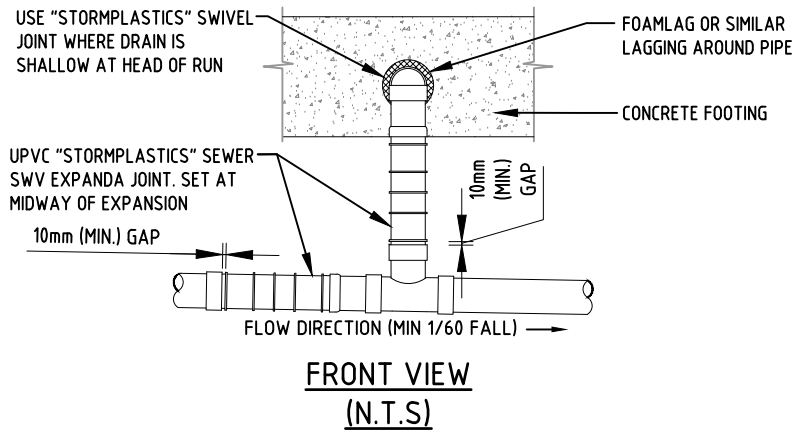
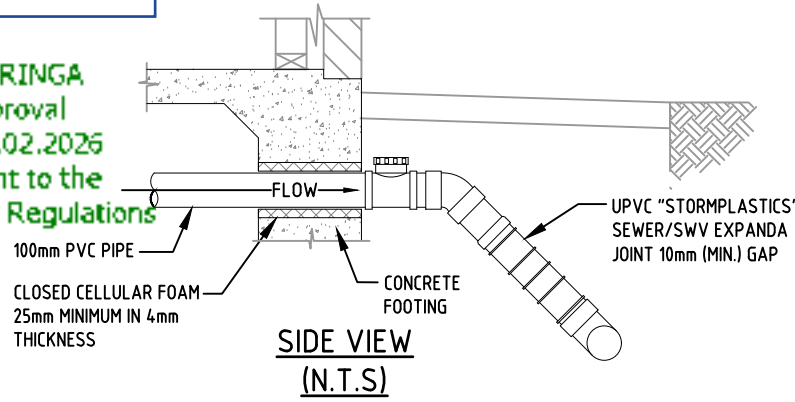
DESIGNED: B.X DATE: DEC'24
 DRAWN: B.X SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENCES
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 GENERAL CIVIL STANDARD DETAIL 1

PROJECT No. DRAWING REVISION
 HWC-24261 C05 D

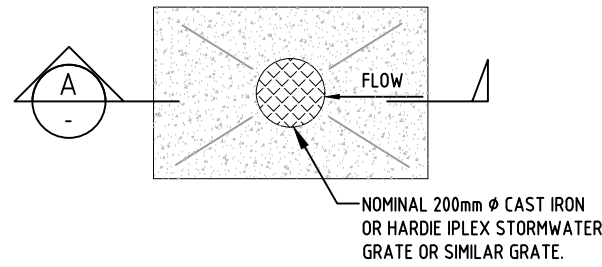
CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
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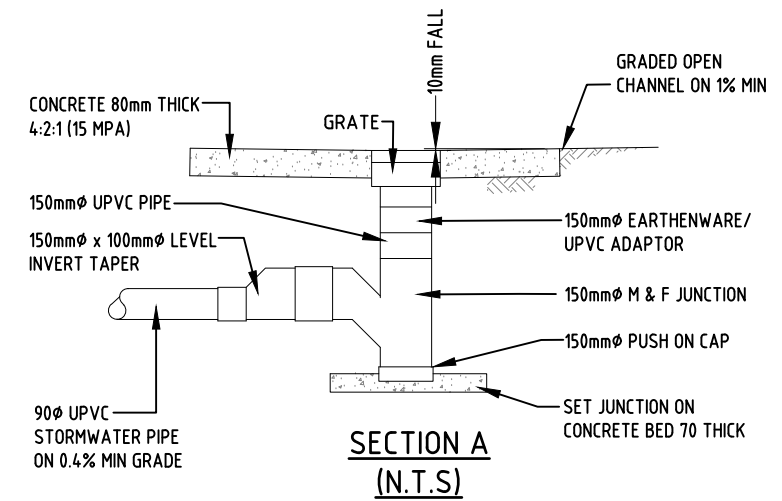
NOTE:
WHERE FLEXIBLE CONNECTIONS ARE REQUIRED TO THE SEWERAGE PLUMBING IT IS OUR ADVICE TO INCLUDE EXPANSION TYPE FLEXIBLE COUPLINGS IN THE FOLLOWING POSITIONS, EXTERNAL TO THE BUILDING.

- FOR 'H' & 'E' SITES : AT EACH 100mm UPVC TAKE-OFF FROM THE DWELLING A FLEXIBLE COUPLING MUST BE FITTED TO THE VERTICAL OR INCLINED RISER FROM THE MAIN RUN (OR A PAIR OF SEWER DWV SWIVEL EXPANSION JOINTS BY STORM PLASTICS). AT EACH TAKE-OFF AN ADDITIONAL FLEXIBLE COUPLING IS TO BE FITTED TO THE POINT OF CONNECTION ONTO THE MAIN RUN ON THE DOWNSTREAM SIDE (REFER FRONT VIEW ABOVE).
- JOINTS SO FORMED MUST BE SEALED TO PROTECT AGAINST PLANT ROOT AND GRIME INTRUSION BY WRAPPING WITH DENSO TAPE OVER A 50mm LENGTH BEYOND THE JOINT ON EITHER SIDE. THE DENSO TAPE MUST BE LAID OUT IN STRAIGHT LENGTHS AND SPRINKLED WITH COPPER SULPHATE CRYSTALS PRIOR TO WRAPPING.

SEWER FLEXIBLE EXPANSION JOINT FOR REACTIVE SOILS
(N.T.S)



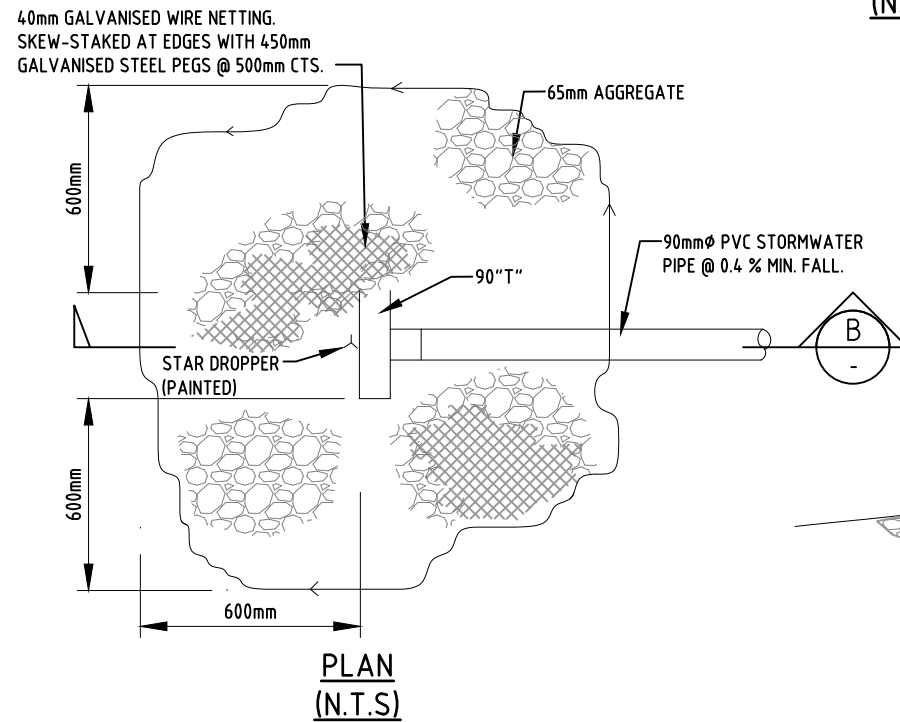
GRATE & APRON SURROUND PLAN
(N.T.S)



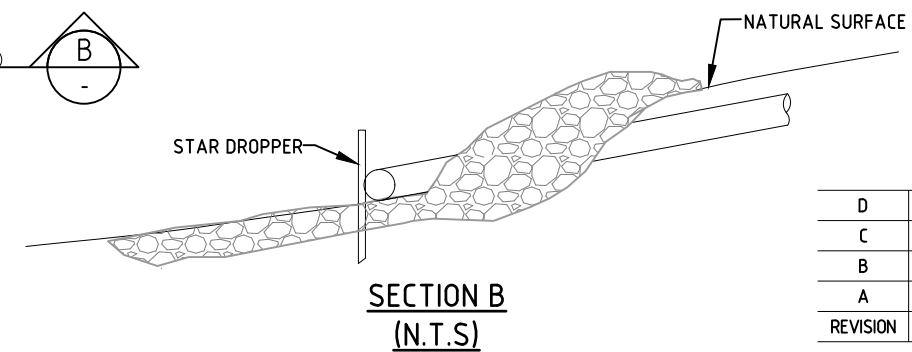
NOTE:

1. ADAPTOR SOCKET JUNCTION MAY BE REDUCED IN DEPTH TO RAISE LEVEL OF OUTLET PIPE.
2. LEVEL INVERT TAPER MAY BE ROTATED TO VARY LEVEL OF OUTLET PIPE.
3. ALL UPVC JOINTS TO BE SOLVENT WELDED.
4. DETAIL NOT TO BE USED WHERE LIKELY TO BE SUBJECTED TO VEHICULAR LOADINGS.
5. DETAIL SUITABLE ONLY FOR PITS AT TOP END OF DRAIN LINES.
6. NOT TO BE USED FOR OUTLET PIT FROM AGRICULTURAL DRAIN.

GRADED INLET PIT INSTALLATIONS DETAIL
(N.T.S)

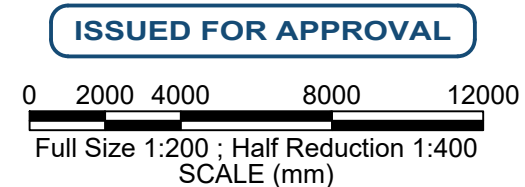


SPREADER PIPE DETAIL
(N.T.S)



SECTION B
(N.T.S)

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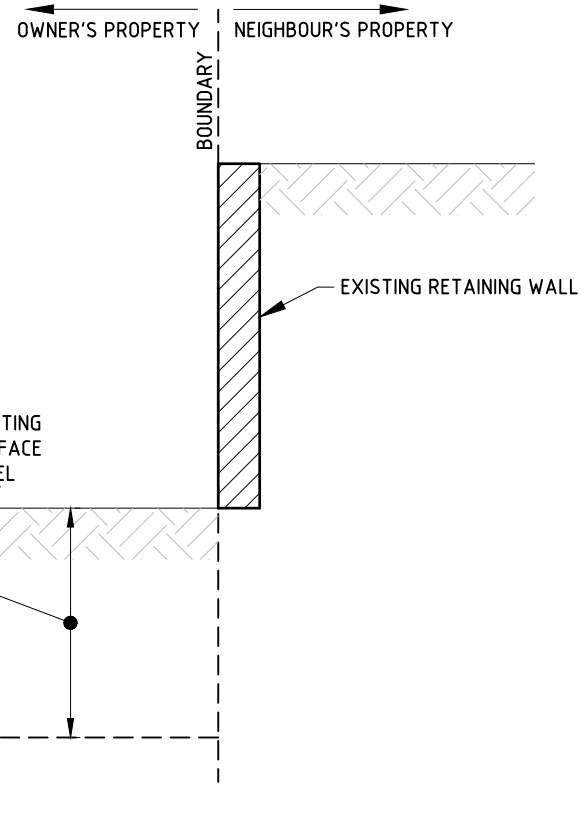
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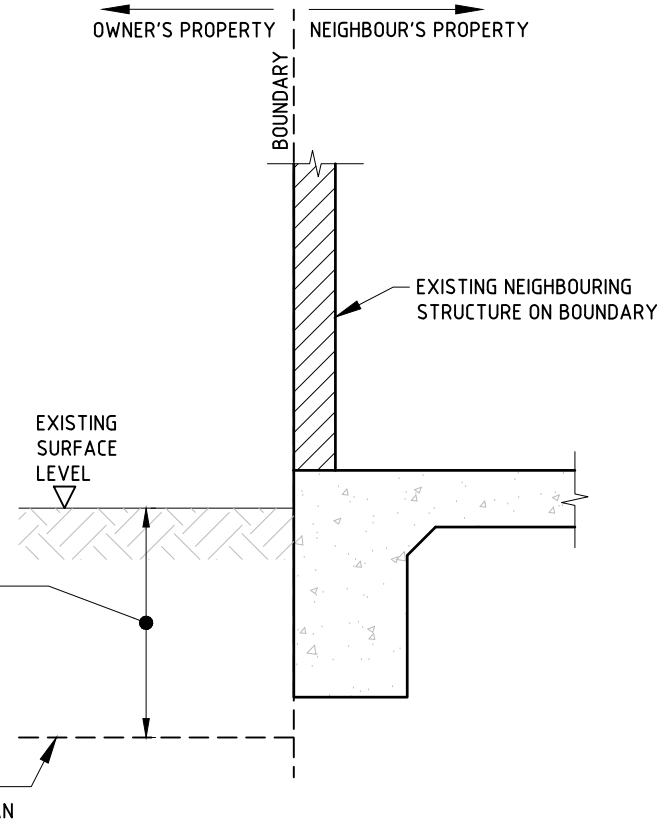
PROJECT
PROPOSED RESIDENCES
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
GENERAL CIVIL STANDARD DETAIL 2

PROJECT No. HWC-24261 DRAWING C06 REVISION D

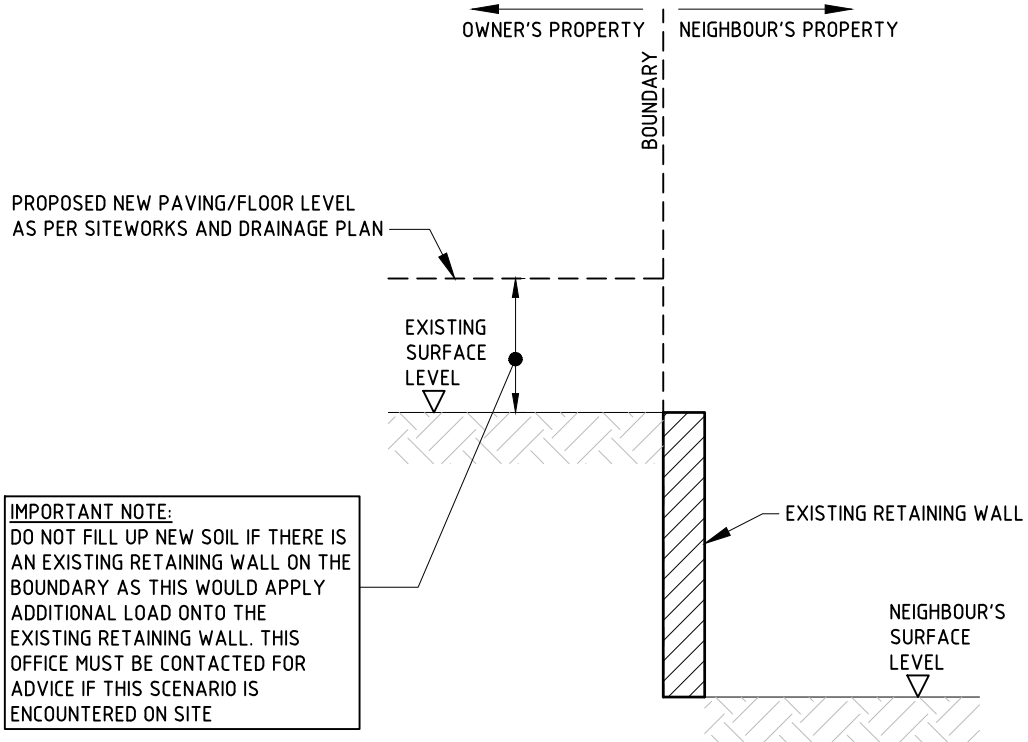


IMPORTANT NOTE:
 DO NOT EXCAVATE THE SITE IF THERE IS AN EXISTING RETAINING WALL ON THE BOUNDARY AS THIS WOULD UNDERMINE THE FOOTINGS OF THE EXISTING RETAINING WALL. THIS OFFICE MUST BE CONTACTED FOR ADVICE IF THIS SCENARIO IS ENCOUNTERED ON SITE

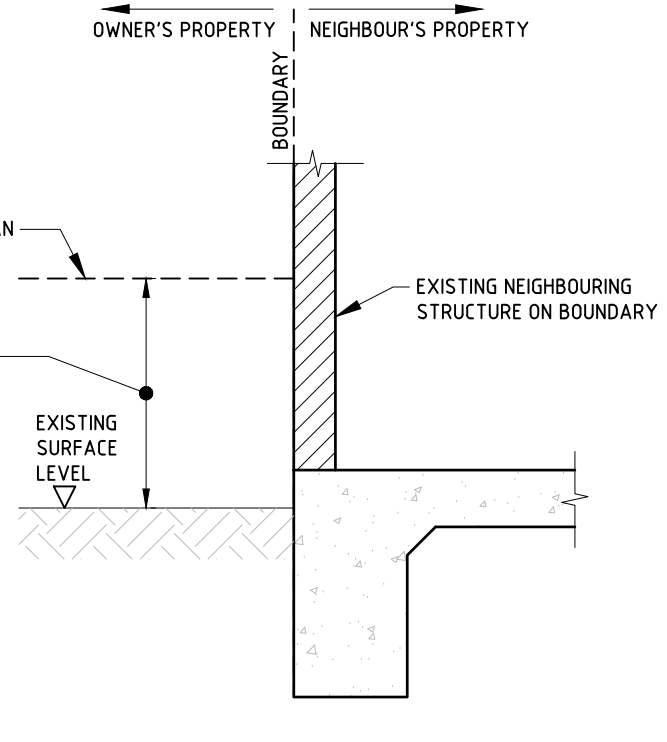


IMPORTANT NOTE:
 DO NOT EXCAVATE BELOW THE FOOTINGS OF THE EXISTING STRUCTURE ON THE BOUNDARY AS THIS WOULD UNDERMINE THE FOOTINGS OF THE EXISTING STRUCTURE. THIS OFFICE MUST BE CONTACTED FOR ADVICE IF THIS SCENARIO IS ENCOUNTERED ON SITE

EXCAVATION OF SOIL ON BOUNDARY (NTS)



IMPORTANT NOTE:
 DO NOT FILL UP NEW SOIL IF THERE IS AN EXISTING RETAINING WALL ON THE BOUNDARY AS THIS WOULD APPLY ADDITIONAL LOAD ONTO THE EXISTING RETAINING WALL. THIS OFFICE MUST BE CONTACTED FOR ADVICE IF THIS SCENARIO IS ENCOUNTERED ON SITE

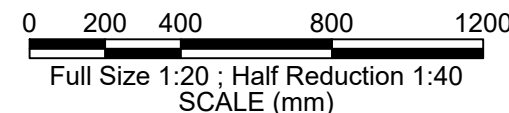


IMPORTANT NOTE:
 DO NOT FILL UP NEW SOIL IF THERE IS AN EXISTING STRUCTURE ON THE BOUNDARY AS THIS WOULD APPLY ADDITIONAL LOAD ONTO THE NEIGHBOURING STRUCTURE. THIS OFFICE MUST BE CONTACTED FOR ADVICE IF THIS SCENARIO IS ENCOUNTERED ON SITE

FILLING OF SOIL ON BOUNDARY (NTS)

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DESIGNED: B.X DATE: DEC'24
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PROJECT
 PROPOSED RESIDENCES
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 ADDITIONAL CIVIL DETAILS

PROJECT No. DRAWING REVISION
 HWC-24261 C07 D



CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

Fooling Construction Report

Project Number: HWC-24261
Project: Proposed Residential Development
Site Address: 418 Esplanade Moana
Client: Andrew Dean
Date: 10/07/2025
Revision: 0
Prepared by: J.S
Reviewed by: H.W.C

HWC ENGINEERS PTY LTD
ACN 643 591 208 ABN 20 785 336 981
152 Fisher Street,
MALVERN SA 5061



CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

Introduction

A set of two new residences on a singular land division is proposed in this project. This report will provide recommendations for Residence 1 only. Residence 1 consist of metal sheet roof and aerated concrete panel veneer wall system which will be supported by a stiffened concrete raft footing system.

This report must be read in conjunction with the attached structural drawings, structural specification, notes for the building owner, and CSIRO Foundation Maintenance and Footing Performance Guide.

Site Description and Soil Classification

A total of five (5) boreholes were drilled to determine the site classification in accordance with AS2870 Residential Slabs and Footings code. This soil profile has an estimated of 90.2 mm. It is a **Extremely** reactive clay site; thus, being susceptible to extreme ground movement from moisture changes. The presence of nearby trees on the site will affect the soil profile, consequently warranting a **Problem** classification.

The site is hence classified as Class **E-D/P**

The Classifier was HWC Engineers Pty Ltd.

Information regarding soil profiles for nearby sites has not been investigated.

Residence 1 Footing Recommendations

Based on the soil classification, a stiffened raft footing system is recommended, generally comprised of:

External footing beams	300 mm wide x 1000 mm deep beam reinforced with 4.N16 bars top and 4.N16 bottom
Internal footing beams	300 mm wide x 1000 mm deep beam reinforced with 4.N16 bars top and 4.N16 bottom
Footing beam ligatures	W8 ligatures at 300cts between piers, 800cts elsewhere
Typical Integral floor slab	125 mm thick floor slab with SL92 top and SL72 bottom



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Development Approval
Approval date 10.02.2019
Endorsed pursuant to the
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Site Work and Service Trenching

All topsoil and vegetation under the footprint of the works shall be removed prior to construction and excavation. Filling must be placed in layers and compacted as directed in the specifications. All footing beams shall be founded at a minimum of 200 mm below the finished surface level and a minimum of 100 mm into firm natural soil, whichever is deeper.

Footing beams parallel to and within 1200 mm of any services; sewerage, stormwater pipes or trenches must be founded at least 200 mm below the base of the service trench.

Tree Effects

There are many trees and bushes in the vicinity of the proposed new residence, as such, the influence of trees has been considered in the footing design. It must be noted that due to matters such as complex tree root geometry, variable moisture extraction (depending upon the tree species) and the difficulty in predicting future growth and watering patterns, a precise design for the effects of trees is outside the scope of current industry knowledge. The owner must be aware that although precautions have been taken for the effects of trees in our design, some distortion must be accepted. Please refer to CSIRO Sheet 10-91 'Guide to Homeowners on Foundation Maintenance and Footing Performance' for more information on tree root zone of influence.

Foundation Maintenance

Please refer to the CSIRO Sheet No. 10-91 'Guide to Homeowner or Foundation Maintenance and Footing Performance'. Upon completion of the building construction, appropriate site drainage, paving, and foundation maintenance must be implemented as soon as possible.

The AS2870 Residential Slabs and Footings Code embraces the philosophy that optimum performance of rational and economical footing designs can only be achieved with the cooperation of informed Property Owners who consistently maintain a stable moisture condition of the foundation soils as recommended in the above referenced CSIRO Notes.

CITY OF ONKAPARINGA Inspections

Development Approval

Approval date 10.02.2025

Endorsed pursuant to the
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A minimum of two separate site inspections are necessary to be performed by this office:

1. Once the excavations of the footing trenches are completed, but prior to installation of damp proof membrane.
2. Another, when the installation of the slab steel mesh and footing steel reinforcement has concluded, but prior to pouring of the concrete.

Please provide at least twenty-four hours' notice to arrange site inspections. The cost of inspections has not been included in the cost of the preparation of this report. Please refer to the fee proposal for inspection costs.

Additional Information

The following additional documents form part of this report, and must be read and conformed to in addition to the items noted above:

- Footing plan (separate attachments)
- Raft footings standard details sheets (separate attachments)
- Site wind classification
- Control joint details sheet
- Site borelogs results
- Footing design calculations
- Site preparation specification
- Concrete specification
- Concrete reinforcement specification
- Structural steelwork specification
- CSIRO Foundation Maintenance and Footing Performance Guide

Yours faithfully



Marcus Chin BE(Civil)

MIEAust

Civil & Structural Engineer; Director for
and on behalf of

HWC Engineers Pty Ltd



SOIL BORELOG

Job No: HWC-24261
 Site: 418 Esplanade Moana
 Date: 17-Jun-25

VISUAL ASSESSMENT OF PROPERTIES

BORE 1	BORE 2	BORE 3	Bore 4	Bore 5	COLOUR	TEXTURE	SOIL DESCRIPTION	U.S.C	FMC	Reactivity	BEARING	EST Ips (AVE)
0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	Brown	Friable, Granular	Clayey Sand	SM,SC	B	VLP	LM	0.005
0.2-0.4	0.2-0.8	0.2-0.6	-	-	Cream	Friable, Granular	Highly Calcareous, Sandy Gravel, Clay Pockets	CL,GM	B	LP	LM	0.010
-	-	-	0.2-1.5	0.2-1.7	Brown Cream	Friable, Granular	Silty Sandy Clay, Limey, Weathered Lime Stone Gravel	CL,ML	B/N	LMP	LM	0.015
-	-	-	1.5-2.0	1.7-2.6	Cream	Friable to Firm, Granular	Sandy Clay, Limey	CL	N/A	MP	LM	0.020
0.4-0.7	0.8-1.1	0.6-1.0	2.0-2.7	2.6-3.0	Red Brown	Hard, Granular	Sandy Clay	CH	B/N	HP	LM	0.035
0.7-1.9	1.1-2.0	1.0-2.1	2.7-3.0	-	Brown	Stiff, Blocky	Clay	CH	B	VHP	LM	0.055
1.9-2.5	2.0-3.0	2.1-3.0	-	-	Orange Red Brown	Firm to Hard, Granular	Sandy Clay	CH	B	HP	LM	0.04
2.5-3.0	-	-	-	-	Orange Brown	Friable to Fine, Granular	Sandy Clay	CL-CH	B	MHP	LM	0.025

REMARKS:	CLASSIFIER: MC
SOIL & FOUNDATION CHARACTERISTICS: Please refer to footing construction report	
AS 2870-2011 'SITE CLASSIFICATION': Please refer to footing construction report	

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Job No HWC-24261
Endorsed pursuant to the
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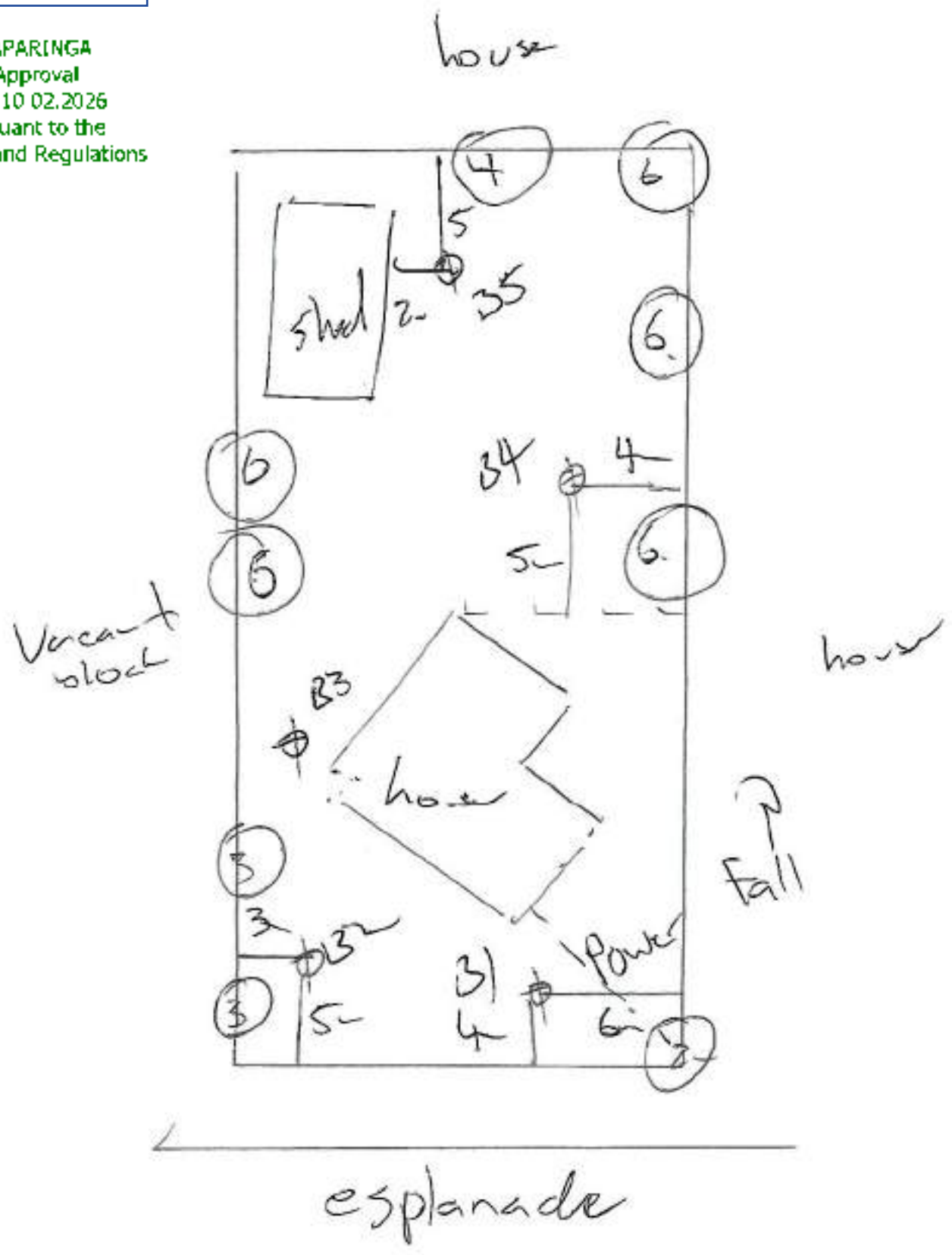
F - Fine Ga - Granular Br - Brown Gy - Grey
Fb - Friable B - Blocky Rd - Red Gr - Green
Fi - Firm Cr - Cream
Hd - Hard Or - Orange
St - Stiff Gr - Green

Date: 15/11/24
CLIENT: HWC

VISUAL ASSESSMENT OF PROPERTIES

1	2	3	4	5	COLOUR	CONSISTENCY, TEXTURE & STRUCTURE	SOIL DESCRIPTION	U.S.C	M.C.	BEARING	EST Ips (AVE)	
020	020	020	020	020	Pod	Fb, ga	Clayey sand VLP	SM SC	B	LM	0005	
020	020	020			Cream	Fb, ga	Highly calcareous, Sandy Gravel, Clay pebbles LP	CL LM	B	LM	0010	
			020	020	Brown Cream	Fb, ga	Silty Sandy CLAY, limonite, weathered limestone gravel LMP	CL ME	B/W	LM	0015	
			150	170								
			150	170	Cream	Fb-Fi, ga	Sandy CLAY, limonite MP	CL	N/A	LM	0020	
040	080	060	20	260	Red Brown	Hd, ga	Sandy CLAY	HS	CL	B/W	LM	0035
070	110	100	270	300								
070	110	160	270		Brown	St, Blocky	CLAY	VHP	CA	B	LM	0055
140	200	210	300									
190	200	210			OR RL AX	Fi-Hd, ga	Sandy CLAY	HP	CA	B	LM	0040
250	300	300			OR BR	(Fb-F, ga)	Sandy CLAY	MHP/CL-CA	B	LM	0025	
250-300												
REMARKS:								TYPE: BS				
								SOIL MAPS: Soil Association Map of Adelaide Region				
								SAMPLE METHOD: PUSH TUBE - RIG / HAND HELD				

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SITE ADDRESS: 418 Esplanade Moana

SITE FEATURES:

- PITS
- EXCAVATION
- ROCK OUTCROPS
- TREES
- CRACKS IN EXISTING STRUCTURE

YES		NO	/
YES		NO	/
YES	/	NO	/
YES	/	NO	
YES	/	NO	

ADDITIONAL SITE FEATURES:

- FILL
- SURFACE CRACK
- SLOPE
- SURFACE CONDITION
- SURFACE SOIL STRENGTH

YES		NO	
YES		NO	/
YES	/	NO	
DRY	/	MOIST	
LOOSE		SOFT	
			WET
			FIRM
			HARD

WATER TABLE:

YES		NO	/							
1	2	3	4	5	6	7	8	9	10	

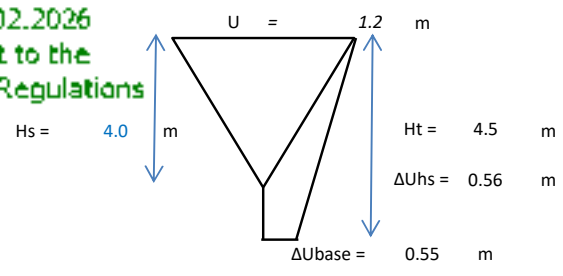
BOREHOLE DETAILS

5x3m

	1	2	3	4	5	6	7	8	9	10
DEPTH drilled (in meters)	3	3	3	3	3					
RIG (R) / HAND GEAR (HG)	R									
AUGER USED										
RESISTANCE (Overall)										
Low										
Medium	↓	↓	↓	↓	↓					
High										
BOTTOM RESISTANCE										
Low										
Medium	/	/	/	/	/					
High										
CORE RECOVERY 100%	/	/	/	/	/					
CORE LOSS										
CORE STRETCHED										

ADDITIONAL NOTES:

DRILLED BY: TC



Tree Effects - **Yes**
 Tree Type - **Tree Group (4 or more in row)**
 Tree Height, HT = **8** m
 Group Tree Height, HTg = **7.2** m
 Distance to Tree, Dt = **4** m
 Influence Distance, Di = **14.4** m
 Dt/HT = **0.5** >0.5, <1
 Di/HT = **1.8**
 Di: **1xHT for single**
1.5xHTg for group
2.0xHTg for 4 or more in row

Crack Depth, Hc = **3.00** m
 Natural Gradient = **0.15** m/m
 Tree Gradient = **0.011** m/m

Depth of Bore (mm) =
 Fill Depth (mm) =

Bore 1	Bore 2	Bore 3
3000	3000	3000
0	0	0

Borehole 1

Layer	Top (m)	Bottom (m)	Thickness (m)	Alpha	lps (%)	Ave. lpt	Ys (mm)	Ytmax (mm)	Yt (mm)	0.7Ys+Yt (mm)
1	0.00	0.20	0.20	1	0	0.005	1.17	0.01	0.01	0.83
2	0.20	0.40	0.20	1	0	0.010	2.22	0.08	0.08	1.64
3	0.40	0.70	0.30	1	0	0.035	10.87	0.80	0.80	8.41
4	0.70	1.90	1.20	1	0	0.055	53.46	11.92	11.92	49.34
5	1.90	2.50	0.60	1	0	0.040	12.96	7.33	7.33	16.41
6	2.50	3.00	0.50	1	0	0.025	4.69	4.77	4.77	8.06
7	3.00	4.00	1.00	1.3	0	0.025	4.88	12.15	12.15	15.57
Total (mm)							90.2	37.1	37.1	100.2

Borehole 2

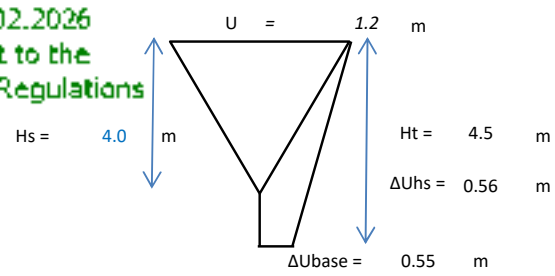
Layer	Top (m)	Bottom (m)	Thickness (m)	Alpha	lps (%)	Ave. lpt	Ys (mm)	Ytmax (mm)	Yt (mm)	0.7Ys+Yt (mm)
1	0.00	0.20	0.20	1	0	0.005	1.17	0.01	0.01	0.83
2	0.20	0.80	0.60	1	0	0.010	6.30	0.42	0.42	4.83
3	0.80	1.10	0.30	1	0	0.035	9.61	1.39	1.39	8.11
4	1.10	2.00	0.90	1	0	0.055	36.38	10.66	10.66	36.12
5	2.00	3.00	1.00	1	0	0.040	18.00	13.89	13.89	26.49
6	3.00	4.00	1.00	1.3	0	0.040	7.80	19.44	19.44	24.90
7			0.00	1	0		0.00	0.00	0.00	0.00
Total (mm)							79.3	45.8	45.8	101.3

Borehole 3

Layer	Top (m)	Bottom (m)	Thickness (m)	Alpha	lps (%)	Ave. lpt	Ys (mm)	Ytmax (mm)	Yt (mm)	0.7Ys+Yt (mm)
1	0.00	0.20	0.20	1	0	0.005	1.17	0.01	0.01	0.83
2	0.20	0.60	0.40	1	0	0.010	4.32	0.22	0.22	3.25
3	0.60	1.00	0.40	1	0	0.035	13.44	1.56	1.56	10.96
4	1.00	2.10	1.10	1	0	0.055	44.47	13.02	13.02	44.15
5	2.10	3.00	0.90	1	0	0.040	15.66	12.75	12.75	23.71
6	3.00	4.00	1.00	1.3	0	0.040	7.80	19.44	19.44	24.90
7			0.00	1	0		0.00	0.00	0.00	0.00
Total (mm)							86.9	47.0	47.0	107.8

Max Y _s	=	90.2	mm
Max Y _t	=	47.0	mm
Central Heave, Y _{m,c}	=	107.8	mm
Edge Heave, Y _{m,e}	=	45.1	mm
Site Classification	=	E-D	/P (Trees)

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Approval date **10.02.2026**
Endorsed pursuant to the
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Tree Effects - **Yes**
 Tree Type - **æ Group (4 or more in ro**
 Tree Height, HT = **8** m
 Group Tree Height, HTg = **7.2** m
 Distance to Tree, Dt = **4** m
 Influence Distance, Di = **14.4** m
 Dt/HT = **0.5** >0.5, <1
 Di/HT = **1.8**
 Di: **1xHT for single**
1.5xHTg for group
2.0xHTg for 4 or more in row

Crack Depth, Hc = **3.00** m
 Natural Gradient = **0.15** m/m
 Tree Gradient = **0.011** m/m

Depth of Bore (mm)	=	Bore 4	Bore 5	Bore 6
Fill Depth (mm)	=	3000	3000	0
		0	0	0

Borehole 4

Layer	Top (m)	Bottom (m)	Thickness (m)	Alpha	Ips (%)	Ave. Ipt	Ys (mm)	Ytmax (mm)	Yt (mm)	0.7Ys+Yt (mm)
1	0.00	0.20	0.20	1	0	0.005	1.17	0.01	0.01	0.83
2	0.20	1.50	1.30	1	0	0.015	18.43	2.30	2.30	15.20
3	1.50	2.00	0.50	1	0	0.020	6.75	2.43	2.43	7.16
4	2.00	2.70	0.70	1	0	0.035	12.13	8.00	8.00	16.49
5	2.70	3.00	0.30	1	0	0.055	5.69	6.53	6.53	10.52
6	3.00	4.00	1.00	1.3	0	0.055	10.73	26.74	26.74	34.24
7			0.00	1	0		0.00	0.00	0.00	0.00
Total (mm)							54.9	46.0	46.0	84.4

Borehole 5

Layer	Top (m)	Bottom (m)	Thickness (m)	Alpha	Ips (%)	Ave. Ipt	Ys (mm)	Ytmax (mm)	Yt (mm)	0.7Ys+Yt (mm)
1	0.00	0.20	0.20	1	0	0.005	1.17	0.01	0.01	0.83
2	0.20	1.70	1.50	1	0	0.015	20.59	2.97	2.97	17.38
3	1.70	2.60	0.90	1	0	0.020	9.99	5.38	5.38	12.37
4	2.60	3.00	0.40	1	0	0.035	5.04	5.44	5.44	8.97
5	3.00	4.00	1.00	1.3	0	0.035	6.83	17.01	17.01	21.79
6			0.00	1	0		0.00	0.00	0.00	0.00
7			0.00	1	0		0.00	0.00	0.00	0.00
Total (mm)							43.6	30.8	30.8	61.3

Borehole 6

Layer	Top (m)	Bottom (m)	Thickness (m)	Alpha	Ips (%)	Ave. Ipt	Ys (mm)	Ytmax (mm)	Yt (mm)	0.7Ys+Yt (mm)
1	0.00		0.00	1	0		0.00	0.00	0.00	0.00
2	0.00		0.00	1	0		0.00	0.00	0.00	0.00
3	0.00		0.00	1	0		0.00	0.00	0.00	0.00
4	0.00		0.00	1	0		0.00	0.00	0.00	0.00
5	0.00		0.00	1	0		0.00	0.00	0.00	0.00
6	0.00		0.00	1	0		0.00	0.00	0.00	0.00
7	0.00		0.00	1	0		0.00	0.00	0.00	0.00
Total (mm)							0.0	0.0	0.0	0.0

Max Y _s	=	90.2	mm
Max Y _t	=	47.0	mm
Central Heave, Y _{m,c}	=	107.8	mm
Edge Heave, Y _{m,e}	=	45.1	mm
Site Classification	=	E-D	/P (Trees)

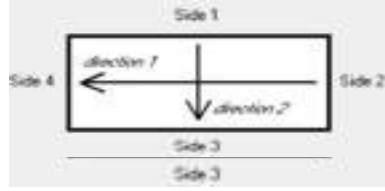
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 Development Approval
 Approval date 10/09/2026
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RECTANGLE 1
 Long dimension
 Short dimension

RECTANGLE LOADS

26.6 m with **3** Beams spanning long direction Direction 1 - Length
5.4 m with **10** Beams spanning short direction Direction 2 - Breadth

Refer borelogs and ys calculation sheet

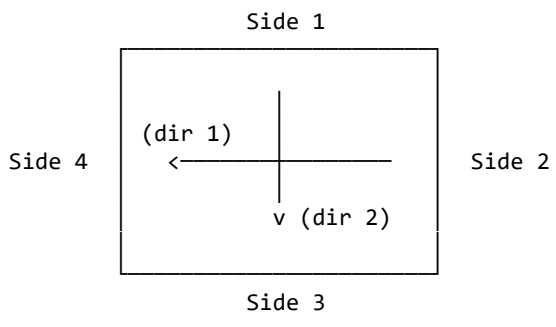


Side																				
1	=			3.40	m	x	0.40	kPa	=	1.4	kN/m	Colorbond Roof								
	+	0.5	x	3.40	m	x	0.25	kPa	=	0.4	kN/m	Roof Live Load								
	+			3.40	m	x	1.00	kPa	=	3.4	kN/m	Lower Hebel Veneer Wall								
	+			2.70	m	x	1.00	kPa	=	2.7	kN/m	Upper Hebel Veneer Wall								
	+			2.71	m	x	1.00	kPa	=	2.7	kN/m	Upper floor Dead Load								
	+	0.5	x	2.71	m	x	1.50	kPa	=	2.0	kN/m	Upper floor Live Load								
									=	12.6	kN/m	Total								
2	=			2.00	m	x	0.40	kPa	=	0.8	kN/m	Colorbond Roof								
	+	0.5	x	2.00	m	x	0.25	kPa	=	0.3	kN/m	Roof Live Load								
	+			3.40	m	x	1.00	kPa	=	3.4	kN/m	Lower Hebel Veneer Wall								
	+			2.70	m	x	1.00	kPa	=	2.7	kN/m	Upper Hebel Veneer Wall								
	+			0.60	m	x	1.00	kPa	=	0.6	kN/m	Upper floor Dead Load								
	+	0.5	x	0.60	m	x	1.50	kPa	=	0.5	kN/m	Upper floor Live Load								
									=	8.2	kN/m	Total								
UDL	=	0.5	x	1.5	kPa				=	0.75	kPa	Slab on ground Live Load								
	=	(0.3kpa*wall height*total wall length)/Slab area										=	0.46	kPa	Internal Walls					
	=						0.3	kPa		=	0.30	kPa	Superimposed dead load							
									=	1.51	kPa	Total								

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RECTANGLE 1 OF 1 (26.6m x 5.4m)

THE FOLLOWING VALUES WILL BE USED:
 Deflection Ratio = 1 / 400
 E conc. long term (max) =15.48 GPa
 Hs =4 m
 Footing design modified for tree effects - Yes
 Ys =91.00 mm
 Yt =47.00 mm
 Ym (centre) --> 0.7Ys + Yt =110.70 mm
 Ym (edge) --> 0.5Ys =45.50 mm
 Footing design accounts for tree removal - No



LOAD CALCULATION (Note: Footing self-weight is generated automatically)

Design edge load (kN/m)
 Side 1 = 12.10 kN/m
 Side 2 = 8.10 kN/m
 Side 3 = 12.10 kN/m
 Side 4 = 8.10 kN/m
 Footing self weight:-
 Direction 1 (0.9 x 0.3 x 24)= 6.48 kN/m
 Direction 2 (0.9 x 0.3 x 24)= 6.48 kN/m

PE (Side 1) = 18.58 kN/m
 PE (Side 2) = 14.58 kN/m
 PE (Side 3) = 18.58 kN/m
 PE (Side 4) = 14.58 kN/m

Distributed internal load W (kPa)
 Design UDL = 1.51 kPa
 Slab self weight (0.1 x 24) = 2.40 kPa
 Footing self weight:-
 Direction 1 ((1 x 0.3 x (1 - 0.1) x 24) / 5.4)= 1.20 kPa
 Direction 2 ((8 x 0.3 x (1 - 0.1) x 24) / 26.6)= 1.95 kPa
 Sub Total (Omega) = 7.06 kPa
 Longitudinal edge loads
 Direction 1 ((18.58 + 18.58) / 5.4)= 6.88 kPa
 Direction 2 ((14.58 + 14.58) / 26.6)= 1.10 kPa

W (Direction 1) = 13.94 kPa
 W (Direction 2) = 8.16 kPa

Total distributed load Q (kPa)
 Omega = 7.06 kPa
 Line loads
 Direction 1 ((18.58 + 0.00 + 18.58) x 26.6) / (26.6 x 5.4) = 6.88 kPa
 Direction 2 ((14.58 + 0.00 + 14.58) x 5.4) / (5.4 x 26.6) = 1.10 kPa

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Rectangle 1 of 1	DIRECTION 1	DIRECTION 2
L(m)	26.6	5.4
B(m)	5.4	26.6
P Edge (kN/m)	18.58	14.58
P Centre (kN/m)	0.00	0.00
W(kPa)	13.94	8.16
k(kPa/m)	1,503.66	1,503.66
Delta(mm)	30.00	13.50
No. of Beams	3	10
CENTRE HEAVE		
Delta > Ymc ?	NO	NO
Edge Dist. (m)	3.57	3.57
M Work (kNm/m)	131.71	59.27
I req($\times 10^6$ mm ⁴ /m)	16,565.01	737.56
EDGE HEAVE		
Delta > Yme ?	NO	NO
Edge Dist. (m)	2.42	1.08
M work (kNm/m)	54.14	23.26
I REq($\times 10^6$ mm ⁴ /m)	2,725.31	327.20

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RECTANGLE 1 of 1 (26.6m x 5.4m)

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BEAM DEFLECTED SHAPE	CENTER HEAVE		EDGE HEAVE	
	REQUIRED	ACTUAL	REQUIRED	ACTUAL
DIRECTION 1				
Moment of Intertia (x 10 ⁹ mm ⁴ /m)	16.565 (Ireq)	22.847 (Ieff)	2.725 (Ireq)	24.792 (Ieff)
Flexural Strength (kNm/m)	131.7 (M*)	229.1 (eMu)	54.1 (M*)	167.6 (eMu)
Ductility Check (kNm/m)	191.4 (1.5Mcr)	286.4 (Mu)	154.7 (1.5Mcr)	209.5 (Mu)
Flange Width (m)	External	Internal		
	1.4	2.7		

BEAM DEFLECTED SHAPE	CENTER HEAVE		EDGE HEAVE	
	REQUIRED	ACTUAL	REQUIRED	ACTUAL
DIRECTION 2				
Moment of Intertia (x 10 ⁹ mm ⁴ /m)	0.738 (Ireq)	14.962 (Ieff)	0.327 (Ireq)	14.962 (Ieff)
Flexural Strength (kNm/m)	59.3 (M*)	142.2 (eMu)	23.3 (M*)	112.4 (eMu)
Ductility Check (kNm/m)	102.9 (1.5Mcr)	177.7 (Mu)	99.0 (1.5Mcr)	140.5 (Mu)
Flange Width (m)	External	Internal		
	0.8	1.4		



HWC Engineers Pty Ltd

12:24 PM

Design (Version 9.0)

CITY OF ONKAPARINGA

Licensed User: HWC Engineers Pty Ltd

Job No: 24261-D1 - 10-07-2025 12:24:03 PM

Development Approval

Approval date 10.02.2026

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TABLE FOOTING PROPERTIES:-

Edge Beams:

Beam Width: 300mm

Beam Depth: 1000mm

Reinforcement:

- top = 4 x N16 bars, 40mm cover

- bottom = 4 x N16 bars, 65mm cover

Internal Beams:

Beam Width: 300mm

Beam Depth: 1000mm

Reinforcement:

- top = 4 x N16 bars, 40mm cover

- bottom = 4 x N16 bars, 65mm cover

Slab:

Thickness = 100mm

Reinforcement

- Layer 1 = 179 mm²/m in both directions in both directions, 20mm depth

Material Properties:

F_{sy} = 500MPa

F'_c = 20MPa

A COMPARISON OF THE REQUIRED DESIGN PROPERTIES AND THOSE OBTAINED FOR THE ABOVE FOOTING SYSTEM IS TABULATED BELOW

- Note that where relevant, the properties are expressed in units per metre width of total footing cross section
- The I required values have been factored up to take account of the variation in the long term creep factor for concrete, refer to AS3600, clause 8.5.4

FOR FOOTINGS USE :-

EXTERNALLY:- 300 mm (Wide) x 1000 mm (Deep)
 - With 8 /N16 Bars - 4 Top And 4 Bottom

INTERNALLY:- 300 mm (Wide) x 1000 mm (Deep)
 - With 8 /N16 Bars - 4 Top And 4 Bottom

0221 SITE PREPARATION

CITY OF ONKAPARINGA
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General

Requirement: Provide site preparation, as documented.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:

- 0171 General requirements.
- 0172 Environmental management.

1.3 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Authority: Any organisation with statutory authority relating to the project, including clearances.
- Clearances: A formal certificate, approval or condition issued by a statutory authority allowing work in a particular area.
- Plant establishment period: The period between the date of practical completion and the end of the defects liability period.
- Utility service provider: Includes organisations providing power, water, sewerage, gas and telecommunications services.

1.4 SUBMISSIONS

Certification

Vermin: Submit pest exterminator's certification as evidence that the completed site works are free from vermin.

Execution details

Requirement: Submit details of methods and equipment proposed for the following:

- Clearing and grubbing.
- Tree removal and transplanting.
- Protecting ground within and adjacent to tree driplines from compaction by proposed earthworks machinery.

1.5 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Enclosures around trees requiring protection.
- Trees requiring removal.
- Trees for transplanting to determine final orientation.

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2 EXECUTION

2.1 COMMUNITY LIAISON

Notification

General: Notify residents about construction activities which will affect access to, or disrupt the use of, their properties.

Notice: Minimum 5 working days, unless the work is of an urgent nature with safety implications.

Notification content:

- Description of the work.
- The reason for the work.
- The expected duration.
- Changes to traffic arrangements and property access.
- The 24-hour contact number of the representative responsible.

2.2 EXISTING SERVICES

General

Requirement: Before starting earthworks, locate and mark existing underground services in the areas affected by the earthworks operations including clearing, excavating and trenching.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

Excavation: Do not machine excavate within 1000 mm of existing services.

Existing service lines: If required, divert services detected during excavation, clear of the building, and reconnect to the utility service provider's requirements.

2.3 SITE CLEARING

Extent

Requirement: Clear only areas occupied by works such as structures, paving, excavation, regrading and landscaping or other areas documented for clearing.

Contractor's site areas: If not included within the areas documented above, clear only to the extent necessary for the performance of the works.

Clearing and grubbing

Clearing: Remove everything on or above the site surface, including rubbish, scrap, grass, vegetable matter and organic debris, scrub, trees, timber, stumps, boulders and rubble.

Grubbing: Grub out stumps and roots over 75 mm diameter to a minimum depth as follows:

- Below subgrade under buildings, embankments or paving: 500 mm.
- Below finished surface in unpaved areas: 300 mm.

Backfilling: Fill holes remaining after grubbing with sand material to prevent ponding of water. Compact the material to the relative density of the existing adjacent ground material.

Redundant/decommissioned works: Remove works no longer required, including slabs, foundations, paving, drain, and access chambers and covers within the works zone.

Batters

Temporary protection: If the change in level between crest and toe is more than 1500 mm, protect from erosion with geofabric, hessian and tar or heavy duty black polythene sheet cover. Securely fix down at crest and toe.

Surplus material

Topsoil and excavated material: Remove unwanted stripped soil and other material from the site as the work proceeds, including any material dropped on footpaths or roadways.

2.4 STORMWATER AND SEDIMENT CONTROL

General

Erosion and sediment control measures: To 0172 *Environmental management*.

Waterways and drains

Waterways: If required, temporarily divert ditches, field drains and other waterways affected by excavation and reconnections on completion.

Stormwater drains: Divert drains detected during excavation, clear of the building, and reconnect as documented or obtain approval.

2.5 EXISTING WORKS TO REMAIN

Marking

Requirement: Identify existing works to remain with 1000 mm high, 50 x 50 mm timber stakes connected by yellow plastic tape to prevent accidental damage.

2.6 TREE REMOVAL

Designation

Marking: Identify trees and shrubs for removal by tagging 1000 mm above ground level.

2.7 TREE PROTECTION

General

Warning signs: In a prominent position at each entrance to the site, display warnings that trees and plantings require protection during the contract. Remove on completion.

Lettering: Road sign type sans serif letters, 100 mm high to AS 4970 Appendix C.

Protection measures: Provide before starting the earthworks.

Trees to remain

Extent: Trees not marked for removal.

Tree protection

Tree protection zone (TPZ): To AS 4970 Section 3.

Tree protective measures: To AS 4970 Section 4.

Monitoring and certification: To AS 4970 Section 5.

Work near trees

Materials placement: Conform to the following:

- Keep the area within the dripline of trees free of sheds and paths, construction material and debris.
- Do not place bulk materials and harmful materials within the dripline of trees.
- Do not place spoil from excavations against tree trunks.
- Prevent wind-blown materials such as cement from harming trees and plants.

Damage: Prevent damage to tree bark. Do not attach stays, guys and similar material to trees.

Work under trees: Do not remove topsoil from, or add topsoil to, the area within the dripline of the trees.

Excavation: If excavation is required near trees, give notice. Minimise period and extent of excavation within the dripline.

Hand methods: Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If excavation is required within the dripline, use hand methods so that root systems remain intact and undamaged.

Roots: Do not cut tree roots exceeding 50 mm diameter. If required to cut tree roots, use cutting methods that do not excessively disturb the remaining root system. Immediately after cutting, water the tree and apply a liquid rooting hormone to stimulate the growth of new roots.

Backfilling: Backfill excavations around tree roots. Place the backfill in layers of 300 mm maximum depth and compact to a dry density similar to that of the original or surrounding soil. Do not backfill around tree trunks to a height greater than 200 mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.

Backfill material:

- Mix proportions (topsoil:well-rotted composts) by volume: 3:1.

Neutral pH value.

Free from weed growth and harmful materials.

- Compacted ground: Do not compact the ground or use skid-steer vehicles under the tree dripline. If compaction occurs, give notice.

- Compaction protection: Protect ground adjacent to the tree dripline.

Watering: Water trees as necessary, including where roots are exposed at ambient temperature more than 35°C.

Mulching: Spread 100 mm thick organic mulch to the whole of the area within the dripline of all existing trees to remain.

2.8 TEMPORARY LANDSCAPE FENCING

Fence dimensions

Height: 1200 mm.

Maximum post spacing: 5000 mm.

Component sizes

Corner and gate posts: Hardwood or preservative-treated softwood, 250 mm diameter.

Intermediate posts: Star picket.

Gate: Provide a suitable hinged gate with a gate latch.

Wire: Top, intermediate and bottom rows of 3.2 mm plain galvanized steel wire. Thread the top wire through pieces of plastic tube and through corner posts.

2.9 TREE TRANSPLANTING

General

Conditions: Select a time for transplanting based on the following criteria:

- Seasonal conditions.
- Length of operation.
- Rootball diameter and depth.
- Lifting methods.
- Weather conditions.

Preparation

Watering: Establish a temporary drip irrigation system, or manually water the identified trees for two weeks before ball excavation work.

Fertilising: Apply one application of liquid fertiliser mix, appropriate to the species, to the foliage and roots. Apply sufficient fertiliser to allow the spray to drip from foliage and soak into the rootball. Do not apply fertiliser on excessively hot, dry or windy days.

Rootball

General: Minimise the cutting of roots. Use only sharp tools, water blasting or water cutting.

Initial cut: Conform to the following:

- Cut manually or using chain trenching machine. Do not excavate using a backhoe or an excavator.
- Cut 250 mm beyond the required finished rootball dimension to allow trimming of damaged roots to final dimensions before sealing.

Hand trimming: To 100 mm less than the required finished rootball dimension. Cut back all roots greater than 25 mm diameter.

Rootball cutting: Conform to the following:

- Symmetrical about the trunk and in proportion to the overall size of the tree except where the limitations of individual tree planter openings require specific tailoring of the rootball dimension.
- Cut the rootball to a size that maximises the rootball for each specimen.

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Trench: Backfill and lightly compact with clean sand, free of any foreign matter, pathogens or any substances that may be harmful to future root growth. Apply root inducing formulation to the manufacturer's recommended concentration, to saturate the backfill in the trench.

Maintenance of on-site plant material

Watering: Maintain a temporary drip irrigation system around each tree, located within the trenched rootball perimeter. Program the system to supply water at an optimum rate to encourage growth and avoid drying out through excessive transpiration following the cutting of the roots. Monitor the system continuously until the tree is lifted and transplanted.

Pruning: If pruning of branches is required to balance root loss, obtain approval. Prune only as directed and as documented in **TREE MAINTENANCE**.

Fertilising: Apply fertiliser at regular intervals during this period to maintain healthy growth.

Responsibility: Safeguard the health and well-being of all on-site plant material as required, before lifting and transplanting.

Execution

Lifting: Two days before transplanting each specimen, thoroughly irrigate to the full depth of the rootball. Do not disturb the soil around the root system. Maintain rootball in firm condition during transplanting by wrapping in hessian or other appropriate open weave material, securely tied.

Storage: Transport trees to a designated nursery site. Store and maintain until ready for planting.

Planting: Avoid disturbing the rootball during moving and planting. After placement, remove the rootball wrapping and ties by cutting.

Watering: After transplanting, water the rootball thoroughly and continue to water until established.

Transplanting schedule

Species	Method	Pruning

2.10 SITE NURSERY

Temporary works

Perimeter: Provide a bund wall of compacted fill as follows:

- Height: 400 mm.
- Batter grade (horizontal:vertical): 2:1.

2.11 TREE MAINTENANCE

General

Notice: Give notice before starting tree maintenance.

Pruning: To AS 4373 using a fully qualified and experienced arborist. Carry out all required works in a safe manner.

Execution

Requirement: Rectify any damage to existing trees to remain.

Operations: Remove dead and decayed wood or damaged limbs. Make all cuts at branch collars. If trees show signs of deterioration after the work is completed, ameliorate the soil by soil aeration, irrigation or incorporation of organic material. Continue this program until the end of the plant establishment period.

Root pruning: Do not excessively disturb the remaining root system. Cut off damaged roots cleanly inside the exposed or damaged area. Cover exposed root area with soil immediately after pruning, do not leave roots exposed.

Wetting and new root stimulation: Form a water collecting basin and apply a rooting hormone and wetting agent to the rootball.

Precautions: Avoid damage to trees being treated and to nearby trees and surroundings. Do not use trees as anchors for winching operations or bracing. Provide bracing as necessary before cutting to prevent uncontrolled breakages and damage to surroundings.

Failure: If repair work is impracticable, or is attempted and is rejected, remove the tree and root system and make restitution.

Tree maintenance schedule

Tree species	Description of work

2.12 COMPLETION

Temporary works

Not applicable

Site restoration

Requirement: Reinstate undeveloped ground surfaces to the condition existing at the commencement of the contract.

Clean up

Progressive cleaning: Keep the works clean and tidy, and regularly remove from the site, waste and surplus material arising from execution of the work.

Waste disposal: To 0172 Environmental management.

Vermin management

Requirement: Employ a suitably qualified pest exterminator to remove vermin found during site preparation.

0310 CONCRETE – COMBINED

CITY OF ONKAPARINGA
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1.1 RESPONSIBILITIES

General

Requirement: Provide cast in situ reinforced concrete, as documented.

Performance

Requirements:

- Conforming to the design details and performance criteria.
- Satisfying quality and inspection requirements.
- Compatible with documented applied finishes.

1.2 DESIGN

General

Formwork: The design of formwork, other than permanent composite form systems, is the contractor's responsibility. Allow for dimensional changes, deflections and cambers resulting from the following:

- Imposed actions.
- Concrete shrinkage and creep.
- Temperature changes.
- The application of prestressing forces (if any).

Structural design: To AS 3600.

Post-tensioned concrete: To AS 3600.

Concrete structures retaining liquids: To AS 3735.

1.3 CROSS REFERENCES

General

Requirement: Conform to the following:

- 0171 *General requirements*.

1.4 STANDARDS

General

Formwork design and construction: To AS 3610.1.

Plywood formwork: To AS 6669.

Composite steel-concrete construction, including profiled steel sheeting and shear connectors: To AS/NZS 2327.

Reinforced concrete construction: To AS 3600.

Specification and supply of concrete: To AS 1379.

Residential ground slabs and footings: To AS 2870.

Post-tensioned concrete: To AS 3600.

Concrete structures for retaining liquids: To AS 3735.

Strand, bar and wire: To AS 4672.1.

Design, installation and testing of post-installed and cast-in fastenings: To AS 5216.

Formed surfaces: To AS 3610.1.

Slip resistance

Classification: To AS 4586.

1.5 INTERPRETATION

Definitions

General: For the purposes of this worksection the definitions given in AS/NZS 1314, AS 1379, AS 3600, AS 3610.1 and the following apply:

- Ambient temperature: The air temperature at the time of mixing and placing of concrete.
- Anti-bursting reinforcement: Reinforcement cage surrounding anchorages to control the tensile bursting stresses.
- Early age strength: A mean compressive strength at 7 days exceeding the values shown in AS 1379 Table 1.2.
- Green concrete: Concrete which has recently set but has not achieved any design strength.
- Sample: A physical example that illustrates workmanship, materials or equipment, and establishes standards by which the work will be judged. It includes samples and sample panels.
- Specimen: A portion of a sample which is submitted for testing.
- Weather – cold: Ambient shade temperature less than 10°C.
- Weather – hot: Ambient shade temperature greater than 30°C.

1.6 TOLERANCES

Formwork

Plumb of elements > 8 m high: 1:1000.

Plumb of elements ≤ 8 m high: To AS 3610.1.

Position: Construct formwork so that finished concrete conforms to AS 3600 clauses 3.3 and 17.5 and as documented in the **Formwork dimensional deviation schedule**.

Reinforcement

Fabrication: To AS 3600 clause 17.2.

Reinforcement and tendon position: To AS 3600 clause 17.5.3.

Formed surfaces

Finish quality: To AS 3610.1 Table 3.3.3.1.

Unformed surfaces

Flatness: To the **Flatness tolerance class table**, using a straightedge placed anywhere on the surface in any direction, for the documented class of finish.

Flatness tolerance class table

Class	Measurement	Maximum deviation (mm)
A	2 m straightedge	4
B	3 m straightedge	6
C	600 mm straightedge	6

1.7 SUBMISSIONS

Certification

Formwork design certification: For other than permanent composite form systems, submit certification by a professional engineer experienced in formwork design verifying conformance of the design.

Formwork execution certification: Submit certification by a professional engineer experienced in formwork design and construction, verifying conformance of the completed formwork, including the suitability of the formwork for the documented surface finish class.

Design documentation

Formwork calculations: Submit calculations by a professional engineer experienced in formwork design to show that allowable concrete stresses will not be exceeded and formwork capability will be maintained if the following is proposed:

- Formwork procedures or loadings that differ from those documented.
- Props above a floor that do not coincide with the props below.
- Undocumented formwork shoring or stripping procedures.

- Loadings from stacked materials.

Post-tensioning calculations: Submit the following:

Calculations of tendon jacking forces, theoretical extensions and losses for each stressing stage and at final stressing, before stressing operations begin.

Amount of draw-in expected in seating anchorages, friction along tendon (wobble) coefficient and friction curvature coefficient for tendons and duct-forming material.

Execution details

Moveable formwork: Provide the following details on the formwork drawings:

- Table form and climbing formwork: Proposed method and sequence of moving the formwork to provide concrete of the documented quality and surface finish.
- Continuously climbing formwork (Slipform): The average rate of movement.

Reshoring: Submit details of any proposed reshoring.

Reinforcement: Submit the following:

- General: Details of any proposed changes to documented reinforcement.
- Damaged galvanizing: Details of proposed repair to AS/NZS 4680 Section 8.
- Mechanical bar splices: Details and test certificates for each size and type of bar to be spliced.
- Provision for concrete placement: Details of spacing or cover to reinforcement that does not conform to AS 3600.
- Splicing: Details of any proposed changes to documented requirements.
- Welding: Details of any proposed welding of reinforcement to AS/NZS 1554.3.

Post-tensioning: Submit the following:

- Details of the proposed post-tensioning system tested and certified to AS/NZS 1314, including performance test certificates for each type and size of anchorage and coupler.
- Safe work method statements including the name and contact details of the subcontractor.
- Details of proposed gauging, stressing and grouting equipment and current calibration certificates for tensioning and tension measuring equipment.
- Concrete strength early age test results.

Loading: Submit details of proposed construction systems, loads and procedures, including propping and reshoring.

Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:

- Changes to the concrete mix.
- Curing and protection methods.
- Curing period for low-pressure steam curing.
- Cutting or displacing reinforcement, or cutting or coring hardened concrete.
- Handling, placing, compaction and finishing methods and equipment, including pumping.
- Placing under water.
- Sequence and times for concrete placement, and construction joint locations and relocations. Include any proposed sequential placement of slab segments.
- Site storage, mixing and transport methods and equipment, if applicable.
- Temperature control methods.
- Sawn joints: Submit details of proposed methods, timing and sequence of sawing joints.

Pre-mixed supply delivery docket: For each batch, submit a docket listing the information required by AS 1379, and the following:

- For special-class performance concrete: Documented performance and type of cement binder.
- For special-class prescription concrete: Details of mix, additives, and type of cement binder.
- Method of placement and climate conditions during pour.
- Name of concrete delivery supervisor.
- Project assessment carried out each day.

- The concrete element or part of the works for which the concrete was ordered, and where it was placed.
 - The total amount of water added at the plant and the maximum amount permitted to be added at the site.
- Surface repairs: If surface repairs are required, submit proposed methods.

Products and materials

Void formers: Submit type-test results as evidence of conformity to requirements of PRODUCTS, **FORMWORK**, and **VOID FORMERS**.

Reinforcement strength and ductility: Submit type-test reports as evidence of conformity to AS 3600 Table 3.2.1 for each reinforcement type.

Post-tensioning: Submit the following:

- Grout: Proposed grout mix and certified test results (including grading, proportions, compressive strength, shrinkage and additives if any).
- Epoxy grout: If required, proposed formulation.
- Duct-forming material: Samples of proposed material.
- Prestressing steel: Test certificates to AS/NZS 4672.2 for every delivery of strand, bar or wire proposed.

Product conformity: Submit evidence of conformity, as appropriate, as follows:

- Certification by a JAS-ANZ accredited third party.
- Report by an accredited testing laboratory describing tests and giving results which demonstrate that the product conforms.

Concrete mixes: Submit details, for each grade and type of concrete including any proposed use of special-purpose cement types.

Curing compounds: Submit details of any proposed curing compounds, including the following:

- Certified type-test results for water retention to AS 3799 Appendix B for liquid membrane-forming compounds.
- Evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.
- For visually important surfaces, evidence that an acceptable final surface colour will be obtained.

Admixtures: Submit details of any proposed admixtures, including the following:

- Brand name.
- Place of manufacture.
- Basic chemical composition.

Prototypes

Test panels: Provide test panels to AS 3610.1 clause 3.7 and as documented in the **Test panels schedule**.

Manufacture: Cast the panels using the form, concrete, compaction equipment, form release agents, curing and formwork removal methods which are to be used in the final work.

Storage: Once accepted, maintain the panels on site undamaged and protected from the weather, as reference prototypes for evaluation of completed work.

Surface treatment: Do not proceed with the related work until the acceptable range of surface treatments has been determined.

Records

Post-tensioning: Submit the following:

- Post-tensioning record.
- Post-tensioning stressing schedule.
- Post-tensioning grouting record.

Samples

Coloured concrete: Submit sample blocks of coloured concrete produced using the proposed mix and casting method before casting final concrete, as follows:

- Number: 4.
- Size (nominal): 300 x 300 x 50 mm.

Shop drawings

Formwork: Submit shop drawings including details of proposed forms, falsework, form liners, bolt positions, release agents and, where applicable, re-use of formwork.

Post-tensioned drawings: Submit shop drawings showing the following:

Profiles, sizes and details of tendons, tendon numbers, anchorages, ducts, duct formers, splicing, sheathing, end block reinforcement and other associated components.

- Stressing requirements including sequence of stressing, jacking forces and the basis of assumed loss calculations.
- Number, size and position of grout openings, vents and drain holes in the ducts.

Cores, fixings and embedded items: Submit the proposed locations, clearances and cover and show any proposed repositioning of reinforcement.

Subcontractors

Pre-mixed supply: Submit names and contact details of proposed pre-mixed concrete suppliers and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply.

Tests

Requirement: Submit test results, as follows:

- Concrete compressive strength test results to AS 1012.9.
- Slip resistance test of completed installations.

1.8 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Used forms, after cleaning and before re-use.
- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Completed formwork and reinforcement, tendons, cores, fixings and embedded items fixed in place before placing concrete.
- Concealed surfaces or elements before covering.
- Commencement of concrete placing.
- Evaluation of the off-form finishes.
- Evaluation of surface finish.

2 PRODUCTS

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2.1 CONCRETE

General

Approval date: General 2026

Stockpile: If uniform, consistent colour is documented, stockpile sand, cement and aggregates.

Properties

Concrete mix and supply: Conform to the following:

- Normal-class: To AS 1379 clause 1.5.3.
 - . Properties: As documented in the **Concrete properties schedule - performance**.
- Special-class: To AS 1379 clause 1.5.4.
 - . Performance properties: As documented in the **Concrete properties schedule - performance**.
 - . Prescription properties: As documented in the **Concrete properties schedule - prescription**.

Aggregates

Standard: To AS 2758.1.

Cement

Standard: To AS 3972.

Age: Less than 6 months old.

Storage: Store cement bags under cover and above ground.

Supplementary cementitious materials:

- Fly ash: To AS/NZS 3582.1.
- Slag: To AS 3582.2.
- Amorphous silica: To AS/NZS 3582.3.

Water

Standard: To AS 1379 clause 2.4.

Requirement: Clean, free from oil, acid, alkali, organic or vegetable matter and including not more than 500 mg/l of chloride ions.

Concrete colour

Standard: To AS 3610.1.

Chemical admixtures

Standard: To AS 1478.1, used to manufacturer's recommendations.

2.2 FORMWORK

General

Form face, linings and release agents: Compatible with documented concrete surface finish and any proposed applied finishes to concrete.

Trapped forms: Free of timber or chlorides and not to impair the structural performance of the concrete members.

Void formers

Requirement: Material capable of maintaining rigidity and shape until the concrete has set, capable of withstanding construction loads and non-collapsible on absorption of moisture.

Laboratory testing: Use void formers tested under laboratory conditions for conformance with the following:

- Deflection during placing and compaction of the concrete does not exceed beam or slab span/1000.
- Additional deflection between initial set and 7 days does not exceed span/400.

Test method: Place formers on damp sand and load with a mass of wet concrete at least equal to the mass of the beams or slabs to be supported.

Profiled steel sheeting composite forms

Material: Hot-dipped zinc-coated sheet steel to AS 1397.

Minimum steel grade: G550.

Accessories: Use materials and corrosion protection compatible with the profiled steel sheeting.

Plywood forms

Material: To AS 6669.

Grade: Use appropriate grade for the documented design dimensions, loading and surface quality.

Joints: Seal the joints consistent with the documented surface finish class.

Tolerances: To AS 3610.1 Section 3.

2.3 REINFORCEMENT

Fibre reinforcement

Steel fibres: To AS 3600 clause 16.7.1.

Other fibres: To CIA CPN35.

Steel reinforcement

Standard: To AS/NZS 4671.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Protective coating

Standard: To AS 3600 clause 17.2.1.2.

Requirement: For concrete elements containing protective coated reinforcement, provide the same coating type to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules, and protect other embedded metals with a suitable coating.

Epoxy coating: High-build, high solids, chemically resistant coating to AS/NZS 3750.14.

- Thickness: 200 µm minimum.

Galvanizing: To AS/NZS 4680, as follows:

- Sequence: If fabricating after galvanizing, repair damaged galvanizing and coat cut ends.

- Zinc-coating (minimum): 600 g/m².

Tie wire

General: Annealed steel 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

Supports

Standard: To AS/NZS 2425.

2.4 POST-TENSIONING

Not applicable

2.5 MISCELLANEOUS

Polymeric film underlay

Vapour barriers and damp-proofing membranes: To AS 2870 clause 5.3.3.

Curing compounds

Liquid membrane-forming compounds: To AS 3799.

Surface modifiers

Hardeners, sealants and protectors: If documented, proprietary products conforming to the manufacturer's recommendations.

Slip resistance treatment: If documented, proprietary products conforming to the manufacturer's recommendations.

3 EXECUTION

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3.1 POLYMERIC FILM UNDERLAY

Location

Requirement: Under slabs on ground, including integral ground beams and footings, provide a vapour barrier or in areas prone to rising damp or salt attack, a damp-proofing membrane.

Base preparation

Requirement: Conform to base type, as follows:

- Concrete working base: Remove projections above the plane surface, and any loose material.
- Graded prepared subgrade: Blind with sand to create a smooth surface free from hard projections. Lightly wet the sand just before laying the underlay.

Installation

Standard: To AS 2870 clause 5.3.3.

Requirement: Lay underlay over the base, as follows:

- Lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape.
- Face the laps away from the direction of concrete pour.
- Continue up vertical faces past the damp-proof course where applicable, and tape fix at the top.
- Patch or seal punctures or tears before placing concrete.
- Cut back as required after concrete has gained strength and formwork has been removed.

3.2 FORMWORK

General

Requirement: As documented in the **Formed surface finishes schedule**.

Substrates

Cleaning: Before placing concrete remove free water, dust, debris and stains from the form face and the formed space.

Bolt holes

Formwork tie bolts left in the concrete: Position more than 50 mm from the finished surface.

Corners

Work above ground: Bevel with a chamfer at re-entrant angles, and a fillet at corners.

Face of bevel: 25 mm.

Embedments

Fixing: Fix embedments through formwork to prevent movement, or loss of slurry or concrete, during concrete placement.

Openings

Requirement: In vertical forms provide openings or removable panels for inspection and cleaning, at the base of columns, walls and deep beams.

Access: For thin walls and columns, provide access panels for placing concrete.

Release agents

Application: Before placing reinforcement, apply a release agent to form face and linings.

Climbing formwork

Provision for inspection: Provide access below the movable formwork, from which surface treatment and inspection may be carried out.

Profiled steel sheeting composite formwork

Fixing: If sheeting cannot be fixed to structural steel supports with puddle welds, or with welded shear studs, provide details of proposed fixings.

Steel linings

Rust: Clean off any rust and apply rust inhibiting agent prior to re-use.

Visually important surfaces

Surface finish classes 1, 2 or 3: Set out the formwork to give a regular arrangement of panels, joints, bolt holes, and similar visible elements in the formed surface.

Void formers

Protection: Keep void formers dry until use, install on a firm level surface and place reinforcement and concrete with minimum delay.

3.3 REINFORCEMENT

Dowels

Fixing: If a dowel has an unpainted half, embed that half in the concrete placed first.

Tolerances:

- Alignment: 1:150.
- Location: \pm half the diameter of the dowel.

Grade: 250 N.

Cover

Concrete cover generally: To AS 3600 clause 4.10.

Concrete cover for structures for retaining liquids: To AS 3735 clause 4.4.

Concrete cover for residential ground slabs and footings: To AS 2870.

Supports

Concrete, metal or plastic supports: Provide as follows:

- Able to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal, located within the concrete cover zone, or are used with galvanized or zinc-coated reinforcement.

Spacing:

- Bars: \leq 60 bar diameter.
- Mesh: \leq 600 mm.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.

Projecting reinforcement

Protection: If starter or other bars extend beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is cast into later work.

Tying

Requirement: Secure the reinforcement against displacement at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of formwork or unformed faces to prevent the ties projecting into the concrete cover.

Beams: Tie stirrups to bars in each corner of each stirrup. Fix other longitudinal bars to stirrups at 1 m maximum intervals.

Bundled bars: If required, tie bundled bars in closest possible contact. Provide tie wire at least 2.5 mm diameter and spaced not more than 24 times the diameter of the smallest bar in the bundle.

Columns: Secure longitudinal column reinforcement to all fitments (or helical reinforcement) at every intersection.

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

Fibre-reinforced concrete

Steel fibres: To AS 3600 Section 16.

3.4 POST-TENSIONING

Not applicable

3.5 CONCRETE SUPPLY

Elapsed delivery time

General: Make sure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in compliance with the **Elapsed delivery time table**. Do not discharge at ambient temperature below 10°C or above 30°C unless approved heating or cooling measures are taken to deliver concrete within the range 5°C to 35°C.

Elapsed delivery time table

Concrete temperature at time of discharge (°C)	Maximum elapsed time (minutes)
5 – 24	120
24 – 27	90
27 – 30	60
30 – 35	45

Pre-mixed supply

Addition of water: To AS 1379 clause 4.2.3.

Transport method: Select to prevent segregation, loss of material and contamination of the environment, and not to adversely affect placing or compaction.

Site mixed supply

Emergencies: If mixing by hand, provide details.

Plant: Mix concrete in a plant located on the construction site.

3.6 TESTING

General

Test authority: Concrete supplier or an Accredited Testing Laboratory.

Reports and records of test results: To the relevant parts of the AS 1012 series. Keep results on site.

Assessment process of test results

Standard: To AS 1379.

Method of assessment: Project assessment.

Sampling

Method of sampling: AS 1012.1.

Sampling locations: To AS 1012.1 and the following:

- Slump tests: On site, at the point of discharge from the agitator.
- Compressive strength tests: Spread the site sampling evenly throughout the pour.

Frequency of sampling: To AS 1379 Sections 5 and 6 and the following:

- Slump tests: Take at least one sample from each batch.
- Compressive strength tests: To the **Project assessment strength grade sampling table**.

Project assessment strength grade sampling table

Number of batches for each type and grade of concrete per day	Minimum number of samples: Columns and load bearing wall elements/batch	Minimum number of samples: Other elements/day
1	1	1
2-5	1	2
6-10	1	3
11-20	1	4
each additional 10	1	1 additional

Making and curing of specimens

General: To AS 1012.8.1 and AS 1012.8.2.

Specimens for compressive strength tests: Make and cure at least two specimens from the sample of each grade.

Specimen size:

Aggregate size ≤ 20 mm: Nominally 200 x 100 mm diameter.

Aggregate size > 20 mm: Nominally 300 x 150 mm diameter.

Test methods

General: To the relevant parts of the AS 1012 series.

Acceptance criteria:

- General: As documented in the **Concrete properties schedule – performance**.
- Early age compressive strength: As documented in the **Control tests schedule**.

Drying shrinkage at 56 days: To AS 1012.8.4 and AS 1012.13.

Liquid retaining structures

Testing for liquid tightness: To AS 3735.

3.7 CORES, FIXINGS AND EMBEDDED ITEMS

General

Requirement: Install fasteners to manufacturer's recommendations and the assumptions of AS 5216 Appendix D.

Adjoining elements

Fixings: Provide fixings for adjoining elements. If required, provide temporary support to the adjoining elements during concreting, to prevent movement.

Protection

General: Grease threads. Protect embedded items against damage.

Compatibility: Provide inserts, fixings and embedded items that are compatible with each other, with the reinforcement and with the documented concrete mix and surface finish.

Corrosion: In external or exposed locations, galvanize anchor bolts and embedded fixings.

Structural integrity

Position: Fix cores and embedded items to prevent movement during concrete placement. In locating cores, fixings and embedded items, displace but do not cut reinforcement, and maintain documented cover to reinforcement.

Isolation: Isolate embedded items to prevent water tracking to concrete that provides minimum cover to reinforcement.

Tolerances

General: Maximum deviation from correct positions:

- Anchor bolt groups for structural steel: To AS/NZS 5131.
- Cores and embedded items generally: 10 mm.
- Other fixing bolts: 3 mm.

3.8 CONCRETE WORKING BASE

Finish

Membrane support: Wood float finish or equivalent.

Installation

General: Lay over the base or subgrade and screed to the required level.

Surface flatness tolerance

Maximum deviation: 6 mm from a 3 m straightedge.

3.9 PLACING AND COMPACTION

Placing

Horizontal transport: Use suitable conveyors, clean chutes, troughs, hoppers or pipes.

Methods: Avoid segregation and loss of concrete, and minimise plastic settlement. Maintain a nominally vertical and plastic concrete edge during placement.

Horizontal elements: Place concrete in layers not more than 300 mm thick. Compact the following layer into previous layer before previous layer has taken initial set.

Compaction

Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate to remove entrapped air and to fully compact the mix.

Vibrators: Do not allow vibrators to contact set concrete, reinforcement or items including pipes and conduits embedded in concrete. Do not use vibrators to move concrete along the formwork. Avoid causing segregation by over-vibration.

Placing records

Log book: Keep on site and make available for inspection a log book recording each placement of concrete, including the following:

- Date.
- Specified grade and source of concrete.
- Slump measurements.
- The portion of work.
- Volume placed.

Rain

Protection: During placement and before setting, protect the surface from damage.

Time between adjacent placements

Minimum time delay: As documented in the **Minimum time delay schedule**.

Vertical elements

Placement: Limit the free fall of concrete to maximum of 2000 mm.

Placing in cold weather

Cement: Do not use high alumina cement.

Temperature limits: Maintain the following:

- Freshly mixed concrete: $\geq 5^{\circ}\text{C}$.
- Forms and reinforcement before and during placing: $\geq 5^{\circ}\text{C}$.
- Water: Maximum 60°C when placed in the mixer.

High early strength cement: If deteriorating weather conditions are predicted, use high early strength cement.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary so that the temperature of the placed concrete is $\geq 5^{\circ}\text{C}$.

Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.

Freezing: Prevent concrete from freezing.

Placing in hot weather

Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses.

Temperature limits: Maintain the following:

- Normal concrete in footings, beams, columns, walls and slabs: $\leq 35^{\circ}\text{C}$.
- For concrete strength grade less than 40 MPa with section thickness ≥ 1 m in all dimensions: $\leq 27^{\circ}\text{C}$.
- For concrete strength grade 40 MPa or greater with section thickness ≥ 600 mm in all dimensions: $\leq 27^{\circ}\text{C}$.
- Forms and reinforcement before and during placing: $\leq 35^{\circ}\text{C}$.

Evaporation control barriers: Erect barriers to protect freshly placed concrete from drying winds.

Temperature control: Select one or more of the following methods of maintaining the temperature of the placed concrete at 35°C or less:

- Cool the concrete using liquid nitrogen injection before placing.
- Cover horizontal transport containers.
- Spray the coarse aggregate using cold water before mixing.

- Use chilled mixing water.

Placing under water

General: Do not place under water unless conditions prevent dewatering.

Minimum cement content for the mix: Increase by 25%.

3.10 JOINTS

Construction joints

Location: Do not relocate or eliminate construction joints, or form undocumented construction joints. If emergency construction joints are made necessary by unforeseen interruptions to the concrete pour, submit a report on the action taken.

Finish: Butt join the surfaces of adjoining pours. In visually important surfaces make the joint straight and true, and free from blemishes impermissible for its surface finish class.

Preparation: Roughen and clean the hardened concrete joint surface. Remove loose or soft material, free water, foreign matter and laitance. Dampen the surface just before placing the fresh concrete and coat with a neat cement slurry.

Expansion joints

Joint filling: Fill with jointing materials as documented. Finish visible jointing material neatly, flush with adjoining surfaces.

Preparation: Before filling, dry and clean the joint surfaces, and prime.

Watertightness: Apply the jointing material so that joints subject to ingress of water are made watertight.

Jointing materials: Provide jointing materials compatible with each other, and non-staining to concrete in visible locations.

Bond breaking: Provide back-up materials for sealants, including backing rods, which do not adhere to the sealant.

Foamed materials (in compressible fillers): Closed-cell or impregnated, not water absorbing.

Slip joints

Requirement: If concrete slabs are supported on masonry, provide proprietary slip joints.

3.11 SURFACE MODIFIERS

General

Application: Apply to clean surfaces, to the manufacturer's recommendations.

3.12 FORMED SURFACES

General

Surface finish: As documented in the **Surface finish class schedule** and the **Formed surface finishes schedule**.

Damage: Do not damage concrete works through premature removal of formwork.

Curing

Requirement: If formwork is stripped before the minimum curing period for the concrete has elapsed, continue curing the exposed faces as soon as the stripping is completed.

Evaluation of formed surfaces

General: If evaluation of formed surface is required, complete the evaluation before surface treatment.

Finishing methods

Requirement: If soffits of horizontal concrete elements or faces of vertical concrete elements are to have a finish other than an off-form finish, provide finishes as documented.

Form removal: If vertical face formwork needs to be removed for finishing methods, while the concrete is green, make sure the concrete has sufficiently set to prevent slump.

Blasted finishes:

- Abrasive: Blast the cured surface using hard, sharp graded abrasive particles until the coarse aggregate is in uniform relief.
- Light abrasive: Blast the cured surface using hard, sharp graded abrasive particles to provide a uniform matt finish without exposing the coarse aggregate.

Bush hammered finish: Remove the minimum matrix using bush hammering to expose the coarse aggregate, recessing the matrix no deeper than half the aggregate size, to give a uniform texture.

Exposed aggregate finish: While the concrete is green, wet the surface and scrub with stiff fibre or wire brushes, flushing continuously with clean water, until the aggregate is uniformly exposed. Do not use acid etching. Rinse the surface with water.

Floated finishes:

- Sand floated finish: While the concrete is green, wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.
- Grout floated finish: While the concrete is green, dampen the surface and spread a slurry, using hessian pads or sponge rubber floats. Remove surplus slurry and work until a uniform colour and texture are produced.

Smooth rubbed finish: While the concrete is green, wet the surface and rub using a carborundum or similar abrasive brick until a uniform colour and texture are produced.

3.13 UNFORMED SURFACES

General

Surface finish: As documented in the **Unformed surface finishes schedule**.

Finished levels: Strike off, screed and level slab surfaces to finished levels and to the flatness tolerance class documented.

Finishing methods – primary finish

Machine float finish:

- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.

Steel trowel finish: After machine floating, finish as follows:

- Use power or hand steel trowels to produce a smooth surface relatively free from defects.
- When the surface has hardened sufficiently, re-trowel to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.

Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy finish, uniform in texture and appearance, and free of trowel marks and defects.

Wood float finish: After machine floating, use wood or plastic hand floats to produce the final consolidated finish free of float marks and uniform in texture and appearance.

Broom finish: After machine floating and steel trowelling use a broom or hessian belt drawn across the surface to produce a coarse even-textured transverse-scored surface.

Scored or scratch finish: After screeding, use a stiff brush or rake drawn across the surface before final set, to produce a coarse scored texture.

Sponge finish: After machine floating and steel trowelling, use a damp sponge to wipe the surface to produce an even textured sand finish.

Exposed aggregate finish: After floating and when concrete has stiffened, wet the surface and scrub with stiff fibre or wire brushes, flushing continuously with clean water, until the aggregate is uniformly exposed. Rinse the surface with water.

Finishing methods – supplementary finish

Abrasive blast: After steel trowelling, abrasive blast the cured surface to provide texture or to form patterns without exposing the coarse aggregate, using hard, sharp graded abrasive particles.

Coloured applied finish: After machine floating, apply a proprietary liquid or dry shake material to the manufacturer's recommendations and trowel to achieve the required appearance.

Stamped and coloured pattern finish: Provide a proprietary finishing system.

Polished finish: After steel trowelling, grind the cured surface of the concrete.

3.14 CURING

General

Requirements: Taking into account the average ambient temperature at site over the relevant period affecting the curing, adopt procedures to make sure of the following:

Curing: Cure continuously from completion of finishing, when the concrete has set sufficiently not to be damaged by the curing process, until the minimum total cumulative number of days or fractions of days, during which the air temperature in contact with the concrete is above 10°C, conforms to the following, unless accelerated curing is adopted:

- . Fully enclosed internal surfaces/Early age strength concrete: 3 days.
- . Other concrete surfaces: 7 days.
- End of curing period: Prevent rapid drying out at the end of the curing period.
- Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

Curing compounds

Liquid membrane-forming compounds: Provide a uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken for at least the required curing period after application.

Substrates: Do not use wax-based or chlorinated rubber-based curing compounds on surfaces forming substrates to applied finishes, concrete toppings and cement-based render.

Self-levelling toppings: If used also as curing compounds, conform to AS 3799.

Visually important surfaces: Apply curing compounds to produce uniform colour on adjacent surfaces.

Cold weather curing

Temperature: Maintain concrete surface temperatures above 5°C for the duration of the curing period.

Hot weather curing

Requirement: If the concrete temperature exceeds 25°C, or the ambient shade temperature exceeds 30°C, protect from drying winds and sun by using an evaporative retarder until curing is commenced.

Water curing

Method: Select a method of ponding or continuously sprinkling to prevent damage to the concrete surface during the required curing period.

3.15 COMPLETION

Formwork removal

Extent: Remove formwork, other than permanent forms and trapped forms, including formwork in concealed locations.

Timing: Do not disturb formwork until concrete has reached sufficient hardness to withstand formwork movements and removal without damage.

Stripping:

- General: To AS 3600 where it is more stringent than AS 3610.1.
- Vertical formwork: To AS 3610.1 Appendix C Table C2.
- Multi-storey work: Remove formwork without disturbing props supporting succeeding floors.
- Post-tensioned concrete: Remove formwork supporting post-tensioned concrete members to AS 3600 clause 17.6.2.7.

Removable bolts: Remove tie bolts without damaging the concrete.

Bolt hole filling: Provide material with durability and colour matching the concrete.

Recessed filling: Fill or plug the hole to 6 mm below the finished surface.

Curing: If formwork is stripped before the minimum curing period for the concrete has elapsed, continue curing the exposed faces as soon as the stripping is completed.

Protection

General: Protect the concrete from damage due to construction loads, physical and thermal shocks, and excessive vibrations, particularly during the curing period.

Surface protection: Protect finished concrete surfaces and applied finishes from damage.



Completion tests

Slip resistance of completed installation: To AS 4663.

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4 SELECTIONS

4.1 SCHEDULES

Formwork dimensional deviation schedule

Dimension or measurement	Location or element	Deviation (mm)

Tendon schedule

Structural element	Tendon material	Tendon size (mm)

Concrete properties schedule – performance

Property	A	B	C
Normal and special-class			
Air entrainment – air volume (%)			
Maximum aggregate size (mm)			
Assessment process			
Slump (mm)			
Strength grade/characteristic compressive strength f'_c (MPa)			
Special-class			
Bleeding (mL/mm ²)			
Cement type			
Density of hardened concrete (kg/m ³)			
Density of plastic concrete (kg/m ³)			
Early age strength (MPa)			
Flexural strength (MPa)			
Indirect tensile strength (MPa)			
Mineral oxide content			
Mix type			
Water:cement ratio maximum			
Drying shrinkage			
Duration of air drying			

Concrete properties schedule – prescription

Property	A	B	C
Aggregate water absorption, maximum (%)			
Admixtures: Proportions			
Admixtures: Types			
Coarse aggregate: Proportions			
Coarse aggregate: Size (mm)			
Coarse aggregate: Types			
Coarse aggregate: Colour			
Fine aggregate: Proportions			
Fine aggregate: Types			
Minimum cement content (kg/m ³)			
Mix type			
Water:cement ratio, maximum			

Control tests schedule

Concrete element	28 day strength	Transfer strength (MPa)	Days after placement	Early strength (MPa)	Days after placement

Minimum time delay schedule

Between (pour locations)	Minimum period between adjacent pours (days)
Adjacent pours abutting horizontal construction joints in walls or columns	
Adjacent pours abutting vertical construction joints in walls	
Columns and slabs	
Floor slab construction joints	
Pour strips and adjacent concrete	
Retaining wall construction joints	

Test panels schedule

Application	Incorporated features	Panel size

Formed surface finishes schedule

Property	A	B	C
Location			
Surface finish class to AS Regulations			
Formwork lining type			
Bolt hole filling			
Surface finishing method			
Abrasive particle type			
Evaluation			

Surface finish class schedule

Property	Class 1	Class 2	Class 3
Colour control			
Critical faces of elements			
Distance between face steps (mm)			
Form face span and direction of span			
Repairs	Not permitted		
Liner details, pattern and accuracy			
Surface pattern details and accuracy			
Surface treatment pattern			
Tie rod pattern			

Unformed surface finishes schedule

Property	A	B	C
Location			
Flatness tolerance class			
Primary finish			
Supplementary finish			
Slip resistance treatment			
Slip resistance classification			
Surface modifier			

0312 CONCRETE REINFORCEMENT

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1.1 RESPONSIBILITIES

General

Requirement: Provide concrete reinforcement, as documented.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:

- 0171 General requirements.
- 0314 Concrete in situ.

1.3 STANDARDS

General

Reinforced concrete construction: To AS 3600.

1.4 TOLERANCES

Reinforcement

Fabrication: To AS 3600 clause 17.2.

Reinforcement and tendon position: To AS 3600 clause 17.5.3.

1.5 SUBMISSIONS

Execution details

Reinforcement: Submit the following:

- General: Details of any proposed changes to documented reinforcement.
- Damaged galvanizing: Details of proposed repair to AS/NZS 4680 Section 8.
- Mechanical bar splices: Details and test certificates for each size and type of bar to be spliced.
- Provision for concrete placement: Details of spacing or cover to reinforcement that does not conform to AS 3600.
- Splicing: Details of any proposed changes to documented requirements.
- Welding: Details of any proposed welding of reinforcement to AS/NZS 1554.3.

Products and materials

Reinforcement strength and ductility: Submit type-test reports as evidence of conformity to AS 3600 Table 3.2.1 for each reinforcement type.

1.6 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Cores and embedments fixed in place.
- Reinforcement fixed in place, with formwork completed.

Fibre reinforcement

Steel fibres: To AS 3600 clause 16.7.1.

Other fibres: To CIA CPN35.

Steel reinforcement

Standard: To AS/NZS 4671.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Protective coating

Standard: To AS 3600 clause 17.2.1.2.

Requirement: For concrete elements containing protective coated reinforcement, provide the same coating type to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules, and protect other embedded metals with a suitable coating.

Epoxy coating: High-build, high solids, chemically resistant coating to AS/NZS 3750.14.

- Thickness: 200 µm minimum.

Galvanizing: To AS/NZS 4680, as follows:

- Sequence: If fabricating after galvanizing, repair damaged galvanizing and coat cut ends.
- Zinc-coating (minimum): 600 g/m².

Tie wire

General: Annealed steel 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

Supports

Standard: To AS/NZS 2425.

3 EXECUTION

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3.1 CONSTRUCTION

Dowels

Fixing of a dowel has an unpainted half, embed that half in the concrete placed first.

Tolerances

- Alignment: 1:150.
- Location: \pm half the diameter of the dowel.

Grade: 250 N.

Cover

Concrete cover generally: To AS 3600 clause 4.10.

Concrete cover for structures for retaining liquids: To AS 3735 clause 4.4.

Concrete cover for residential ground slabs and footings: To AS 2870.

Supports

Concrete, metal or plastic supports: Provide as follows:

- Able to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal, located within the concrete cover zone, or are used with galvanized or zinc-coated reinforcement.

Spacing:

- Bars: \leq 60 bar diameter.
- Mesh: \leq 600 mm.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.

Projecting reinforcement

Protection: If starter or other bars extend beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is cast into later work.

Tying

Requirement: Secure the reinforcement against displacement at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of formwork or unformed faces to prevent the ties projecting into the concrete cover.

Beams: Tie stirrups to bars in each corner of each stirrup. Fix other longitudinal bars to stirrups at 1 m maximum intervals.

Bundled bars: If required, tie bundled bars in closest possible contact. Provide tie wire at least 2.5 mm diameter and spaced not more than 24 times the diameter of the smallest bar in the bundle.

Columns: Secure longitudinal column reinforcement to all fitments (or helical reinforcement) at every intersection.

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

Fibre-reinforced concrete

Steel fibres: To AS 3600 Section 16.

0341 STRUCTURAL STEELWORK

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General

Requirement: Provide structural steelwork, as documented.

Performance

Adjoining elements: Provide for the fixing of adjoining building elements that are to be connected to or supported on the structural steel.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:

- 0171 General requirements.
- 0344 Steel – hot-dip galvanized coatings.
- 0345 Steel – protective paint coatings.
- 0346 Structural fire protection systems.

1.3 STANDARDS

General

Materials and design: To AS 4100.

Materials and design of cold-formed decking, purlins and girts: To AS/NZS 4600.

Composite steel-concrete construction including profiled steel sheeting and shear connectors: To AS/NZS 2327.

Fabrication and erection: To AS/NZS 5131.

1.4 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- AESS: Architecturally Exposed Structural Steelwork.
- CC: Construction Category.
- NDE: Non-Destructive Examination.

Definitions

General: For the purposes of this worksection the definitions given in AS/NZS 5131 apply.

1.5 TOLERANCES

General

Requirement: To AS/NZS 5131 Section 12 and Appendix F.

Tolerance class: 1.

AESS: To the **AESS schedule**.

1.6 SUBMISSIONS

Fabrication details

Distortions: Submit proposals for the following:

- Preventing or minimising distortion of galvanized components, welded components or welded and galvanized components.
- Restoration to the designed shape.

Identification marks: If members and/or connections will be exposed to view, submit details of proposed marking.

Program: Submit a fabrication program showing the proposed sequence of operations and time required.

Execution details

Anchor bolts: If anchor bolts do not meet documented location tolerances, submit proposals for rectification before proceeding.

Bolting connections: For connections not documented, submit proposals.

Bolt tensioning procedure: Submit details of procedure, equipment to be used and calibration of the process.

Site base plate heling: If hand cutting of bolt holes in column base plates is required, submit details.

Purlins and girts: If purlins and girts support components other than roofing or cladding, submit details.

Site modifications: Submit details of proposed on-site modifications or rectifications to any steel member, connection component, mechanical fastener, weld or corrosion protection.

Splices: If variations to documented splice locations or additional splices are proposed, submit details.

Temporary connections or attachments: If not documented, submit details.

Undocumented weld types: Submit proposals for weld type and electrodes.

Welding plan: Submit a welding plan to AS/NZS 5131 clause 7.2.

Work method statement: Before any erection work commences, submit a work method statement to AS/NZS 5131 clause 11.2.3.

Products and materials

Steel members and sections: Submit test reports or test certificates conforming to AS 4100 clause 2.2.2.

Bolts, nuts and washers: Submit test reports or test certificates conforming to AS/NZS 1252.1 Section 6.

Verification testing of bolt assemblies: Submit test reports or certificates conforming to AS/NZS 1252.2 Section 2, together with the Supplier Declaration of Conformity (SDoC).

Anchor bolts: If anchors, other than those documented, are required or proposed for supporting or fixing structural steel, submit evidence of the anchor capacity to carry the load.

Substitution: If alternative sections or connections are proposed, submit details.

Records

Survey: Submit survey of erected structural steel to verify components have been installed as documented.

Drawings: Submit as-built structural drawings, upon completion.

Samples

AESS: Submit samples of AESS to the **AESS schedule**.

Special finishes: Submit samples of finished steel to the **Special finishes schedule**.

Minimum sample size: 0.1 m².

Shop detail documentation

General: Submit shop detail documentation to a scale that best describes the detail, conforming to AS/NZS 5131 clause 4.4.

Subcontractors

General: Submit names and contact details of proposed fabricator, detailer and installer.

Responsibilities: Submit names and contact details corresponding to the person/organisation assigned responsibility to the items listed in AS/NZS 5131 Table B3.

Tests

Site tests: Submit results, as follows:

- Bars and sections: Non-destructive tests.
- Plates: Ultrasonic tests.
- Welds: Non-destructive examinations.

1.7 INSPECTION

Notice – off-site

Inspection: Give notice so that inspection may be made of the following:

Materials including welding consumables before fabrication.

Testing of welding procedures and welder qualification tests.

- Commencement of shop fabrication.
- Commencement of welding.
- Complete penetration butt welds before the placement of root runs.
- High-strength bolt tensioning (when completed off-site).
- Completion of fabrication before surface preparation.
- Surface preparation before protective coating.
- Completion of protective coating before delivery to site.

Notice – on-site

Inspection: Give notice so that inspection may be made of the following:

- Steelwork on-site before erection.
- Anchor bolts in position before casting in.
- Steelwork and column bases erected on site, before grouting, encasing, site protective coating or cladding.
- Tensioning of bolts in categories 8.8/TB and 8.8/TF.
- Reinforcement and formwork in place before any encasement.
- Completed grouting, encasement, fire protection or site applied protective coating.

2 PRODUCTS

2.1 GENERAL

Materials

Requirement: To AS/NZS 5131 Section 5.

Storage and handling

Requirement: Pack, support, transport and handle members and components without overstressing, deforming or damaging them or their protective coating.

Damaged items: Rectify or replace. Do not assemble into the structure without approval.

Protection: Wrap or otherwise protect members or components to prevent damage to surface finishes during handling and erection.

Storage: Store off the ground.

Lifting points: Do not allow steel slings to come into direct contact with coated steelwork.

Purchasing and traceability

Purchasing documentation and procedure: To AS/NZS 5131 clause 4.6.

Level of traceability: As defined in AS/NZS 5131 clause 4.7 and the following:

- CC1: Basic traceability.
- CC2: Partial traceability.
- CC3: Full traceability.
- CC4: Full traceability.

2.2 STRUCTURAL STEEL

Steel members and sections steel grade table

Type of steel	Minimum grade
Hot-rolled sections to AS/NZS 3679.1 and SA TS 102	300
Welded sections to AS/NZS 3679.2	300
Hot-rolled plates, floor plates and slabs to AS/NZS 3678	250

Type of steel	Minimum grade
Hot-rolled flat products to AS/NZS 1594	HA300
Hollow sections to AS/NZS 1163 and SA TS 102: Circular sections less than 166 mm nominal outside diameter	C250
Hollow sections to AS/NZS 1163 and SA TS 102: Sections other than circular sections less than 166 mm nominal outside diameter	C350
Cold-formed purlins and girts to AS 1397	G450, Z350 or Z450

Certification

Steel: Minimum requirements for test and inspection certificates, to the following:

- Hot-rolled bars or sections: To AS/NZS 3679.1 clause 11.2.4.
- Welded I sections: To AS/NZS 3679.2 clause 11.2.4.
- Hot-rolled plate: To AS/NZS 3678 clause 11.2.4.
- Cold-formed hollow sections: To AS/NZS 1163 clause 11.2.4.

Testing

Requirement: To the **Non-destructive testing of bars and sections schedule**.

Ultrasonic testing of plates

2.3 MECHANICAL FASTENERS

Standards

Bolts: To AS 1110.1, AS 1111.1 and AS/NZS 1252.1.

Nuts: To AS 1112.1, AS 1112.2, AS 1112.3, AS 1112.4 and AS/NZS 1252.1.

Bolting category

Requirement: To the **Bolting category schedule**.

Certification

High-strength bolt assemblies: Minimum requirements for test reports, to AS/NZS 1252.1 clause 6.4.2.

Finish

Bolts, nuts and washers: Hot-dip galvanized to AS/NZS 1214, corrosion-free, and in serviceable condition.

Anchor bolts

Hexagonal bolts: To AS 1111.1.

Hexagonal nuts: To AS 1112.3.

Plain washers: To AS 1237.1.

Requirement: Provide each anchor bolt with 2 nuts and 2 oversize washers with sufficient thread for the levelling nut and washer to set below the base plate.

Mechanical and chemical anchors: To AS 5216, installed to manufacturer's recommendations.

2.4 OTHER MATERIALS

Welding consumables

Requirement: To the relevant part of the AS/NZS 1554 series.

Studs and shear connectors

Requirement: To AS/NZS 5131 clause 5.6.

Grout

Requirement: To AS/NZS 5131 clause 5.8.

3 EXECUTION

CITY OF ONKAPARINGA
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Endorsed pursuant to the
PDI Act 2016 and King's Orders

3.1 PREPARATION, ASSEMBLY AND FABRICATION

Identification

Traceability To AS/NZS 5131 clause 6.2.

Marking: Provide marks or other means of identifying each member compatible with the finish, for setting out, locating, erecting and connecting the steelwork to the marking plans.

High-strength bolting: If the work includes more than one bolting category, mark high-strength structural bolted connections with a 75 mm wide flash of colour, clear of holes.

Cold-formed members: Clearly mark material thickness.

Monorail beams: Identify and mark rated capacity in conformance with AS 1418.18 clause 5.12.6.

Natural beam camber

General: If steel beams have a natural camber, within the straightness tolerance, fabricate the steelwork element with the camber up.

Cutting

Shearing: Do not shear edges in areas designated as yielding regions for seismic design to AS 4100 earthquake design categories D and E.

Shaping

Requirement: Where forming, shaping or correcting distorted members, avoid damage and conform to AS/NZS 5131 clause 6.6.

Holing

Slotted holes: Do not use slotted holes for connections, other than those documented.

Tolerances

Measurement: Check tolerances by measurement after fabrication and application of corrosion protection.

3.2 WELDING

General

Requirements: To AS/NZS 5131 Section 7.

Standard: To AS/NZS 1554.1.

Weld category

Weld categories not documented: Category GP.

Weld type

Weld type not documented: Submit proposals for weld type and electrodes

Stress relief treatment

Non-destructive weld examination (NDE)

Requirement: To AS/NZS 5131 clause 13.6.2.

Non-visual NDE: By a third party testing authority.

Repairs: Repair welds revealed as faulty by NDE and repeat the examination.

Site welds

Completion: Weld only when correct alignment and preset or camber have been achieved.

3.3 MECHANICAL FASTENING

Connection contact surfaces

General: To AS/NZS 5131 clause 8.4.1.

Bolting category 8.8/TF: Clean, as rolled and free from applied finishes.

Washers

Requirement: Place one washer under the part rotated during tightening process (nut or bolt head).

Tensioning of bolting categories 8.8/TB and 8.8/TF

Method: Use part-turn method or a direct tension indicator device.

Permanent bolting

Completion: Bolt only when correct alignment and preset or camber has been achieved.

3.4 SURFACE PREPARATION AND TREATMENT

General

Requirement: Conform to 0344 Steel – hot-dip galvanized coatings and/or 0345 Steel – protective paint coating, as appropriate.

3.5 SPECIAL FINISHES

General

Requirement: Apply special finishes to the **Special finishes schedule**.

3.6 METAL SPRAYING

General

Standard: To ISO 2063.2.

Requirement: Apply sprayed metal finishes to the **Metal spray schedule**.

Process: Electric arc.

Application: Apply the coating as soon as possible after blasting.

3.7 FIRE PROTECTION COATINGS

General

Requirement: Apply fire protection to structural steelwork to 0346 Structural fire protection systems.

3.8 ARCHITECTURALLY EXPOSED STRUCTURAL STEELWORK

General

Requirement: Provide AESS to AS/NZS 5131 Section 10 and the **AESS schedule**.

AESS category

Fabrication

Additional requirements: To AS/NZS 5131 clause 10.4.

Corners and edges: Grind smooth sharp, marred, or roughened corners and edges.

Rough surfaces: Deburr and ground smooth.

Erection

Additional requirements: To AS/NZS 5131 clause 10.5.

3.9 ERECTION

General

Execution: Make sure every part of the structure has sufficient design capacity and is stable under construction loads produced by the construction procedure.

Temporary work

General: Provide all necessary temporary bracing or propping.

Temporary connections: Detail required cleats, if not shown on shop detail documentation.

Temporary members: If temporary members are required, fix so as not to weaken or deface permanent steelwork.

Anchor bolts

General: For each group of anchor bolts, provide a template with set-out lines clearly marked for positioning the bolts when casting in.

Beam camber

Requirement: If beam elements have a camber (natural or induced), erect them with the camber up.

Site work

General: Other than work shown on the shop detail documentation as site work, do not fabricate, modify or weld structural steel on-site.

Purlins

Trimming members: Provide to support edges of roof sheeting along hips, valleys and roof penetrations.

Movements

General: Allow for thermal movements during erection.

Grouting at supports

Preparation: Before grouting steelwork supported by concrete or masonry, set steelwork on packing or wedges.

- Permanent packing or wedges: Form with solid steel or grout of similar strength to the permanent grout.
- Temporary packing or wedges: Remove before completion of grouting.

Timing: Grout at supports before constructing supported floors, walls and roofing.

Temperature: Do not grout if the temperature of the base plate or the footing surface exceeds 35°C.

Drifting

Limitation: Use drifting only to bring members into position, without enlarging holes or distorting components.

3.10 REPAIRS

General

Requirement: Repair finishes to restore the full integrity of any coating.

3.11 COMPLETION

Tolerances

Conformance: After completing erection, verify conformance with AS/NZS 5131 Section 12 and Appendix F.

Temporary connections

General: Remove temporary cleats on completion and restore the surface.

4 SELECTIONS

CITY OF ONKAPARINGA
4.1 SCHEDULES
Development Approval

Approval date 10/02/2025
Non-destructive testing of bars and sections schedule
Endorsed pursuant to the
PDI Act 2016 and Regulations

Item to be tested	Test method	Other requirements

Bolting category schedule

Joint location	Bolt type/size	Bolting category

AESS schedule

Location	AESS category	Tolerance	Samples	Connections

Special finishes schedule

Steelwork location	Shop or site application	Defined special finish

Metal spray schedule

Steel member or surface	Abrasive blast cleaning to AS 1627.4	Metal spray type	Minimum thickness (µm)	Seal coat

0318 SHOTCRETE

CITY OF ONKAPARINGA
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Endorsed pursuant to the
PDI Act 2016 and Regulations

1.1 RESPONSIBILITIES

General

Requirement: Provide shotcrete, as documented.

Performance

Requirement:

- Conforming to the design details and performance criteria.
- Satisfying quality and inspection requirements.
- Readily sprayable into corners and around reinforcement and built-in items without segregation, vertical slumping or sag.
- Compatible with documented applied finishes.

1.2 DESIGN

General

Structural design: To AS 3600.

Concrete structures retaining liquids: To AS 3735.

Requirements

1.3 CROSS REFERENCES

General

Requirement: Conform to the following:

- 0171 General requirements.

1.4 STANDARDS

General

Specification and supply of concrete: To AS 1379.

Reinforced concrete construction: To AS 3600.

Concrete structures for retaining liquids: To AS 3735.

Design, installation and testing of post-installed and cast-in fastenings: To AS 5216.

1.5 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviation applies:

- SDS: Safety Data Sheets.

Definitions

General: For the purposes of this worksection the definitions given in CIA Z5 and the following apply:

- Ambient temperature: The air temperature at the time of mixing and placing of concrete.
- Average ambient temperature: Average value of the daily maximum and minimum ambient temperatures over the defined period at a site.
- Batch: A quantity of concrete containing a fixed amount of ingredients and produced in a discrete operation.
- Sample: A physical example that illustrates workmanship, materials or equipment, and establishes standards by which the work will be judged. It includes samples and sample panels.
- Shotcrete: Cement concrete, containing aggregate up to 13 mm in size, applied from a spray nozzle by means of compressed air.
- Specimen: A portion of a sample which is submitted for testing.
- Weather – cold: Ambient shade temperature less than 10°C.
- Weather – hot: Ambient shade temperature greater than 30°C.

1.6 TOLERANCES

Reinforcement

Fabrication: To AS 3600 clause 17.2.

Reinforcement position: To AS 3600 clause 17.5.3.

Finishes

Flatness: To the **Flatness tolerance class table**, using a straightedge placed anywhere on the surface in any direction, for the documented class of finish.

Flatness tolerance class table

Class	Measurement	Maximum deviation (mm)
A	2 m straightedge	4
B	3 m straightedge	6
C	600 mm straightedge	6

1.7 SUBMISSIONS

Execution details

General: Submit proposals for placing, finishing and curing shotcrete including the following:

- Changes to concrete mix.
- Curing and protection methods.
- Cutting or displacing reinforcement, or cutting or coring hardened concrete.
- Finishing methods and shotcreting equipment.
- Temperature control methods.

Control of water: Submit proposals for the temporary and permanent control of ground water flows and seepage, if encountered.

Pre-mixed supply delivery dockets: For each batch, submit a docket listing the information required by AS 1379, and the following:

- Climate conditions during spraying.
- Name of concrete delivery supervisor.
- The concrete element or part of the works for which the concrete was ordered, and where it was placed.
- The total amount of water added at the plant and the maximum amount permitted to be added at the site.

Reinforcement: Submit the following:

- General: Details of any proposed changes to documented reinforcement.
- Damaged galvanizing: Details of proposed repair to AS/NZS 4680 Section 8.
- Provision for concrete placement: Details of spacing or cover to reinforcement that does not conform to AS 3600.
- Welding: Details of any proposed welding of reinforcement to AS/NZS 1554.3.

Safety plan: Submit a full safety plan to include the following minimum requirements:

- Equipment prestart checks and maintenance.
- Housekeeping.
- Job safety and environmental analysis.
- Moving equipment.
- Product SDS requirements.
- Risk assessments.
- Safe work method statements.
- Toolbox talks.
- Unsupported groundwork procedures.
- Workplace inspections.

Surface repairs: If surface repairs are required, submit proposed methods.

Products and materials

General: Submit details of proposed sources of materials.

Alternative supply: Submit an alternate source in the event of breakdown of supply.

Mix: Submit proposed concrete mix for shotcrete.

Curing compounds: Submit details of any proposed curing compounds, including the following:

Certified test results for water retention to AS 3799 Appendix B for liquid membrane-forming compounds.

- Evidence of compatibility with shotcrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.

Admixtures: Submit details of any proposed admixtures, including the following:

- Brand name.
- Place of manufacture.
- Basic chemical composition.
- Accelerating admixture initial set time.
- Accelerating admixture final set time.

Fibre reinforcement: Submit details of any fibre reinforcement proposed for use.

Subcontractors

Requirement: Submit the name, contact details and experience of proposed sprayers.

Tests

Requirement: Submit test results, as follows:

- Concrete compressive strength test results to AS 1012.9.
- Liquid tightness tests for liquid retaining structures.

1.8 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Excavated or exposed faces before covering.
- Membrane or drainage strips installed against excavated or exposed faces.
- Reinforcement, fixings and embedded items fixed in place before placing shotcrete.
- Concealed surfaces or elements before covering.
- Commencement of shotcreting.
- Evaluation of surface finish.

2 PRODUCTS

2.1 CONCRETE

Aggregates

Standard: To AS 2758.1.

Individual aggregates in mix: Consistent grading within allowable variation to AS 2758.1 clause 8.

Cement

Standard: To AS 3972.

Age: Less than 6 months old.

Storage: Store cement bags under cover and above ground.

Supplementary cementitious materials:

- Fly ash to AS/NZS 3582.1.
- Slag: To AS 3582.2.
- Amorphous silica: To AS/NZS 3582.3.

Water

Standard: To AS 1379 clause 2.4.

Requirement: Clean, free from oil, acid, alkali, organic or vegetable matter and including not more than 500 mg/l of chloride ions.

Accelerating admixture

Standard: To AS 1478.1, used to manufacturer's recommendations.

Purpose: Use where required to develop quick set and high early strength to suit site requirements and finishing. Do not use calcium chloride based accelerators.

Other chemical admixtures

Standard: To AS 1478.1, used to manufacturer's recommendations.

2.2 SHOTCRETE MIX

Shotcrete wet-mix design table

Constituent materials	Mix design per m ³
Cement (kg)	335
Fly ash (kg)	85
Coarse aggregate (kg)	610
Coarse sand (kg)	585
Fine sand (kg)	530
Water reducer (litres)	1.6
Superplasticiser (litres)	1.0
Air entraining agent (litres)	0.1
Water (litres)	200
Slump (mm)	60

2.3 REINFORCEMENT

Fibre reinforcement

Steel fibres: To AS 3600 clause 16.7.1.

Other fibres: To CIA CPN35.

Steel reinforcement

Standard: To AS/NZS 4671.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Protective coating

Standard: To AS 3600 clause 17.2.1.2.

Requirement: For concrete elements containing protective coated reinforcement, provide the same coating type to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules, and protect other embedded metals with a suitable coating.

Epoxy coating: High build, high solids, chemically resistant coating to AS/NZS 3750.14.

- Thickness: 200 µm minimum.

Galvanizing: To AS/NZS 4680, as follows:

- Sequence: If fabricating after galvanizing, repair damaged galvanizing and coat cut ends.
- Zinc-coating (minimum): 600 g/m².

Tie wire

General: Annealed steel 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

Supports

Standard: To AS/NZS 2425.

2.4 MISCELLANEOUS

Curing compounds

Liquid membrane-forming compounds: To AS 3799.

3 EXECUTION

3.1 REINFORCEMENT

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Cover

Concrete cover generally: To AS 3600 clause 4.10.

Concrete cover for structures for retaining liquids: To AS 3735 clause 4.4.

Supports

Concrete, metal or plastic supports: Provide as follows:

- Able to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal, located within the concrete cover zone, or are used with galvanized or zinc-coated reinforcement.

Spacing:

- Bars: ≤ 60 diameters.
- Mesh: ≤ 600 mm.

Projecting reinforcement

Protection: If starter or other bars extend beyond reinforcement mats or cages or from cast concrete, provide a plastic protective cap to each bar until it is cast into later work.

Tying

Requirement: Secure the reinforcement against displacement at intersections with either wire ties, or clips. Bend the ends of wire ties to prevent the ties projecting into the concrete cover.

Fibre reinforced concrete

Steel fibres: To AS 3600 Section 16.

3.2 TESTING

General

Test authority: Concrete supplier or Accredited Testing Laboratory.

Reports and records of test results: To the relevant parts of the AS 1012 series. Keep results on site.

Assessment process of test results

Standard: To AS 1379.

Method of assessment: Project assessment.

Sampling

Method of sampling: AS 1012.1.

Sampling locations: To AS 1012.1 and the following:

- Slump tests: On site, at the point of discharge from the agitator.
- Compressive strength tests: Spread the site sampling evenly throughout the spray.

Frequency of sampling: To AS 1379 Sections 5 and 6, and the following:

- Slump tests: Take at least one sample from each batch.
- Compressive strength tests: To the **Project assessment strength grade sampling table**.

Project assessment strength grade sampling table

Number of batches for each type and grade of concrete per day	Minimum number of samples: Columns and load bearing wall elements/batch	Minimum number of samples: Other elements/day
1	1	1
2-5	1	2
6-10	1	3
11-20	1	4
each additional 10	1	1 additional

Making and curing of specimens

General: To AS 1012.8.1 and AS 1012.8.2.

Specimens for compressive strength tests: Make and cure at least two specimens from the sample of each grade.

Specimen size: Nominally 200 x 100 mm diameter.

Test methods

General: To the relevant parts of the AS 1012 series.

Acceptance criteria:

- Average strength of all samples must equal or exceed the required value.
- Strength of any one sample must be at least 0.85 of the required value.

Slump tests: Assess slump for every batch. Perform slump test on each strength sample.

Liquid retaining structures

Testing for liquid tightness: To AS 3735.

3.3 CORES, FIXINGS AND EMBEDDED ITEMS

General

Requirement: Install fasteners to manufacturer's recommendations and the assumptions of AS 5216 Appendix D.

Protection

General: Grease any threads. Protect embedded items against damage.

Compatibility: Provide inserts, fixings and embedded items that are compatible with each other, with the reinforcement, with the documented concrete mix and surface finish.

Corrosion: In external or exposed locations, galvanize anchor bolts and embedded fixings.

Structural integrity

Position: Fix cores and embedded items to prevent movement during shotcreting. In locating cores, fixings and embedded items, displace but do not cut reinforcement, and maintain documented cover to reinforcement.

Tolerances

General: Maximum deviation from correct positions:

- Anchor bolt groups for structural steel: To AS/NZS 5131.
- Cores and embedded items generally: 10 mm.
- Other fixing bolts: 3 mm.

3.4 SHOTCRETING

Preparation

Requirement: Clean loose material and other foreign matter from surfaces to receive shotcrete and compact earth surfaces.

Equipment: Use clean delivery hoses and provide back-up equipment to allow continuous application of shotcrete to all surfaces in the event of equipment breakdown.

Mixing

Timing: Use mixed materials within 60 minutes of the addition of cement to the mix.

Admixture: Add any accelerating admixture at the nozzle of delivery hose immediately before placing shotcrete.

Spraying

Technique: Minimise rebound by directing the nozzle perpendicular to the surface to be covered at all times, unless varying angle to encapsulate reinforcement. Apply shotcrete in a circular motion to build up the required thickness in layers, starting at the lower sections and moving upwards.

Sprayer: Use a sprayer with previous experience in the application of coarse aggregate shotcrete, or they must work under the immediate supervision of a sprayer or instructor with such experience.

Joints: Provide construction or control joints as required, or as documented, to the details shown in CIA Z5 clause 9.5.3.

Adverse weather

Rain: Do not place shotcrete during rain, unless adequate shelter can be provided. Protect all exposed faces of fresh shotcrete from rain.

Strong winds: Provide for screening of nozzle, jet and surface if shotcreting in windy conditions. Protect all exposed faces of fresh shotcrete with screening.

Control of water

General: If water flows and seepage occur, submit proposals for their control, to avoid detrimental effects.

Acceptance

General: Provide dense uniform shotcrete without discernible weakness of bond (between layers).

Consistency: Provide a uniform consistency in order to maximise binding, bonding, cohesion and density, minimise rebound and prevent sagging of the applied shotcrete.

Soundness: Remove all laitance, loose material and rebound. Sound the surface with a hammer to locate any voids, aggregate pockets or unbonded areas.

Defective work: If drummy areas are found or if probing, drilling or other observations indicate non-conformance with thickness or strength requirements, core to determine and replace such defective areas.

Removal: Remove defective shotcrete from site.

Shotcreting in cold weather

Cement: Do not use high alumina cement.

Temperature limits: Maintain the following:

- Freshly mixed concrete: $\geq 5^{\circ}\text{C}$.
- Substrates and reinforcement before and during placing: $\geq 5^{\circ}\text{C}$.
- Water: Max 60°C when placed in mixer.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary so that the temperature of the shotcrete is $\geq 5^{\circ}\text{C}$.

Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any materials, substrates and equipment coming in contact with the concrete.

Freezing: Prevent shotcrete from freezing.

Shotcreting in hot weather

Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses.

Temperature limits: Maintain temperature at 35°C or less.

Substrates and reinforcement: Before and during placing maintain temperature at 35°C or less.

Evaporation control barriers: Erect barriers to protect fresh shotcrete from drying winds.

Temperature control: Select one or more of the following methods of maintaining the temperature of the shotcrete at 35°C or less:

- Cool the concrete using liquid nitrogen injection before placing.
- Spray the coarse aggregate using cold water before mixing.
- Use chilled mixing water.

3.5 FINISHING

General

Surface finish: As documented in the **Unformed surface finishes schedule**.

Finished surface: Unless an off-nozzle finish has been documented, strike off, screed and level surfaces to the documented position or level and the flatness tolerance class documented.

Finishing methods

Off-nozzle finish: No additional finishing required to the natural textured surface left by spraying.

Screed finish: Trim, slice or screed surface to a true line and grade to produce a surface which may exhibit defects such as drag marks from aggregate.

Steel trowel finish: After screeding finish, as follows:

- Use power or hand steel trowels to produce a smooth surface relatively free from defects.
- When the surface has hardened sufficiently, re-trowel to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.

Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy finish, uniform in texture and appearance, and free of trowel marks and defects.

Wood float finish: After screeding, use wood or plastic hand floats to produce the final consolidated finish free of float marks and uniform in texture and appearance.

Broom finish: After screeding and steel trowelling use a broom or hessian belt drawn across the surface to produce a coarse even-textured transverse-scored surface.

Scored or scratch finish: After screeding, use a stiff brush or rake drawn across the surface before final set, to produce a coarse scored texture.

Sponge finish: After screeding and steel trowelling, use a damp sponge to wipe the surface to produce an even textured sand finish.

3.6 CURING

General

Requirements: Taking into account the average ambient temperature at site over the relevant period affecting the curing, adopt procedures to make sure of the following:

- Curing: Cure continuously from completion of finishing, when the concrete has set sufficiently not to be damaged by the curing process, until the minimum total cumulative number of days or fractions of days, during which the air temperature in contact with the shotcrete is above 10°C, is at least 7 days.
- End of curing period: Prevent rapid drying out at the end of the curing period.
- Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

Curing compounds

Liquid membrane-forming compounds: Provide a uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken for at least 7 days after application.

Substrates: Do not use wax-based or chlorinated rubber-based curing compounds on surfaces forming substrates to subsequent shotcrete layers, applied finishes, concrete toppings and cement-based render.

Cold weather curing

Temperature: Maintain shotcrete surface temperature above 5°C for the duration of the curing period.

Hot weather curing

Requirement: If the concrete temperature exceeds 25°C, or the ambient shade temperature exceeds 30°C, protect from drying winds and sun by using an evaporative retarder until curing is commenced.

Water curing

Method: Select a method of ponding or continuously sprinkling to prevent damage to the shotcrete surface during the required curing period.

4 SELECTIONS

4.1 SCHEDULES

Concrete properties schedule – performance

Property	A	B	C
Normal and special class			
Air entrainment – air volume (%)			
Maximum aggregate size (mm)			
Assessment process			
Slump (mm)			
Strength grade/characteristic			

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Property	A	B	C
compressive strength f_c (MPa)			
Special class			
Bleeding (mL/mm ²)			
Cement type			
Density of hardened concrete (kg/m ³)			
Density of plastic concrete (kg/m ³)			
Early age strength (MPa)			
Flexural strength (MPa)			
Indirect tensile strength (MPa)			
Mineral oxide content			
Mix type			
Water:cement ratio maximum			
Drying shrinkage			
Duration of air drying			

Unformed surface finishes schedule

Property	A	B	C
Location			
Flatness tolerance class			
Finish			

Foundation Maintenance and Footing Performance: A Homeowner's Guide



BTF 18
replaces
Information
Sheet 10/91

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PDI ACT 2018 AND REGULATIONS

Buildings can, and often do, move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

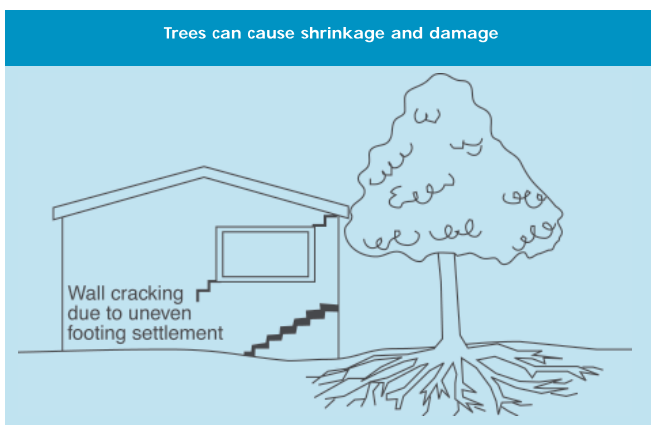
- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Trees and shrubs that are allowed to grow in the vicinity of footings settlement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
 In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
 Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
 Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpend).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.



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The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked, if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter

It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

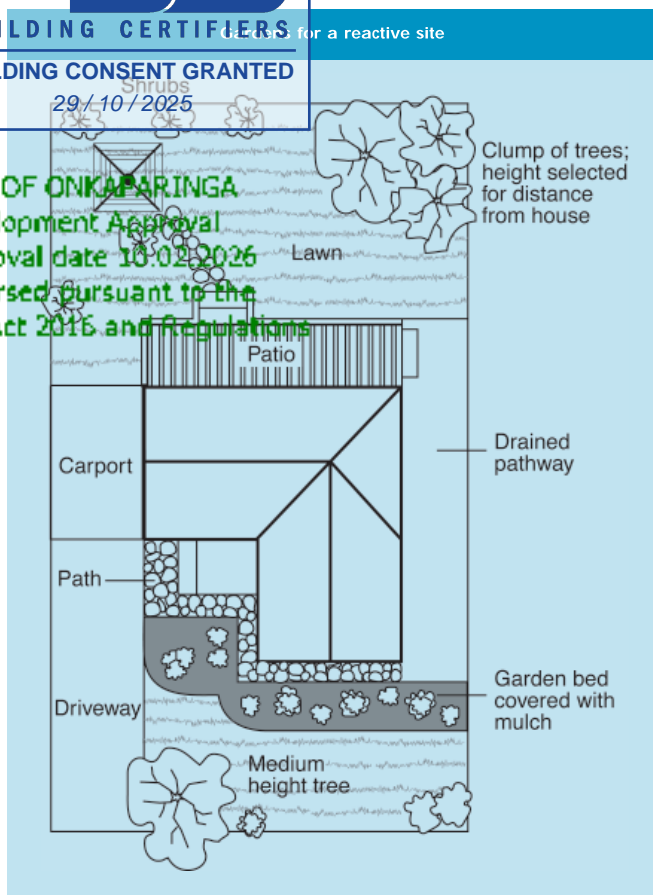
For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

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- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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1. THESE DRAWINGS SHALL NOT BE SCALED
2. READ THE STRUCTURAL DRAWINGS IN CONJUNCTION WITH THE SPECIFICATION AND THE CONSTRUCTION REPORT
3. VERIFY ALL DIMENSIONS ON SITE
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION, ENSURING THAT NO PART SHALL BE OVERSTRESSED DURING CONSTRUCTION ACTIVITIES
5. THE CONTRACTOR SHALL PROVIDE INDEPENDENT STRUCTURAL CERTIFICATION FOR ALL BUILDERS' WORKS NOT DETAILED ON THE DRAWINGS SUCH AS PROPPING, SHORING, TEMPORARY RETAINING, ERECTION PROCEDURES, ETC.
6. ANY DISCREPANCIES SHALL BE REFERRED TO THIS OFFICE FOR CLARIFICATION
7. ALL CONSTRUCTION WORK TO BE PERFORMED IN ACCORDANCE WITH CURRENT WORKPLACE HEALTH & SAFETY STANDARDS
8. THE STRUCTURAL WORK ON THESE DRAWINGS HAS BEEN DESIGNED FOR THE FOLLOWING LIVE LOADS:
 FLOOR: 1.50 kPa
 BALCONY: 2.00 kPa
9. BUILDER AND ARCHITECT TO CONFIRM DIMENSIONS AND SET-OUT OF ALL MEMBERS PRIOR TO FABRICATION AND CONSTRUCTION. THIS OFFICE WILL NOT TAKE RESPONSIBILITY FOR ERRORS THAT OCCUR AS A RESULT OF INCORRECT DIMENSIONS AND SET-OUT. CONTACT THIS OFFICE FOR REVIEW IF THERE ARE DISCREPANCIES.

GROUT NOTES:

1. CHARACTERISTIC COMPRESSIVE STRENGTH 20MPa
2. CEMENT CONTENT NOT LESS THAN 300kg/m³
3. COARSE AGGREGATE OF 10mm MAX
4. IT SHOULD HAVE A POURING CONSISTENCY, ENSURING THAT THE CORES ARE COMPLETELY FILLED AND REINFORCED, COMPLETELY SURROUNDED WITHOUT SEGREGATE TO LAY BLOCKS
5. THE WALL SHOULD BE CONSTRUCTED IN 1.0m HEIGHTS AND CORE FILLED BEFORE CONTINUING TO LAY BLOCKS
6. CLEAN OUT OPENINGS ARE REQUIRED AT THE BASE OF ALL REINFORCED WALLS AND ABOVE HORIZONTAL CONSTRUCTION JOINTS
7. WALL TIES SHALL BE IN ACCORDANCE WITH AS3700 & AS2699
8. ALL FORMWORK AND PROPS UNDER SUSPENDED CONCRETE WORK SHALL BE REMOVED BEFORE ANY BRICKWORK OR BLOCKWORK IS BUILT ABOVE
9. PROVIDE VERTICAL CONTROL JOINTS AT MAX 6m CENTRES, SIDES OF OPENINGS AND AT STEPS IN WALL OF FOOTING (U.N.O)
10. TIE MASONRY TO ABUTTING STRUCTURE USING MASONRY WALL TIES AT 400CTS MAX U.N.O

MASONRY NOTES:

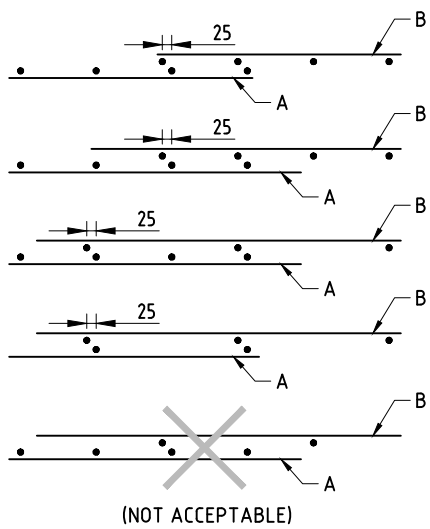
1. ALL CONSTRUCTION, WORKMANSHIP AND MATERIALS TO COMPLY WITH AS 3700 MASONRY STRUCTURES, AS 4773 MASONRY IN SMALL BUILDINGS AND OTHER ASSOCIATED AUSTRALIAN STANDARDS.
2. MASONRY MATERIALS, ACCESSORIES AND BUILT-IN ITEMS SHALL BE SELECTED IN ACCORDANCE WITH AS 3700 TO SUIT THE EXPOSURE ENVIRONMENT AND LOCATION.
3. ALL BLOCK UNITS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 15 MPA.
4. MORTAR CLASS AND MIX PROPORTIONS SHALL BE SELECTED IN ACCORDANCE WITH AS 3700 TO SUIT THE EXPOSURE ENVIRONMENT AND LOCATION. THE BUILDER MUST CONFIRM THAT THE MIX DESIGN IS COMPATIBLE WITH ANY SPECIFIED SURFACE FINISH PRIOR TO CONSTRUCTION. MINIMUM M3 MORTAR CLASS, U.N.O.
5. ALL MORTAR JOINTS TO BE FULLY BEDDED WITH NO MORTAR PROTRUDING INTO CAVITY SPACE. PROVIDE CLEANOUT BLOCKS AT BASE OF WALLS WHERE REQUIRED.
6. WHERE FILLING IS REQUIRED, USE GROUT OF MINIMUM 20 MPA STRENGTH, 10mm MAXIMUM AGGREGATE SIZE, 200mm SLUMP AND A WATERPROOFING ADDITIVE.
7. ALLOW MINIMUM 3 DAYS BETWEEN MORTAR PLACEMENT AND GROUT FILLING.
8. VERTICAL ARTICULATION AJOINTS SHALL BE PROVIDED IN ACCORDANCE WITH THE NCC, UNLESS NOTED OTHERWISE ON THE DRAWINGS.
9. PROVIDE WALL TIES IN ACCORDANCE WITH AS 4773.1 MASONRY IN SMALL BUILDINGS.

DESIGN NOTES:

ROOF: SHEETED COLORBOND ROOF
 LOWER WALL SYSTEM: HEBEL VENEER
 UPPER WALL SYSTEM: HEBEL VENEER
 SITE SOIL CLASSIFICATION: E-D/P (40mm THICK LAGGING TO PIPEWORK REQUIRED)

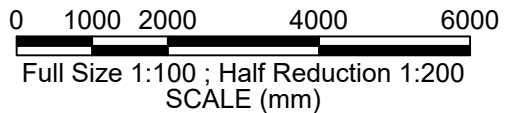
FOOTING NOTES:

1. THE DEPTHS TO UNDERSIDE OF ALL FOOTINGS ARE PROVISIONAL ONLY. AFTER EXCAVATION, APPROVAL SHALL BE OBTAINED FROM THIS OFFICE FOR THE FOUNDING LEVELS WHICH MAY BE VARIED IF NECESSARY, PRIOR TO FURTHER WORK. ALL FOOTINGS TO BE FOUNDED 200mm INTO FIRM NATURAL SOIL
2. THE FOUNDATION OF EXCAVATIONS SHALL BE KEPT FREE OF WATER AT ALL TIMES BY BAILING AND PUMPING IF NECESSARY
3. ALL CONCRETE SLABS AND FOOTINGS IN CONTACT WITH THE GROUND ARE TO BE POURED IN 0.2mm DAMP-PROOF MEMBRANES U.N.O.
4. REFER TO FOOTING CONSTRUCTION REPORT OR CIVIL ENGINEERING DOCUMENTS FOR SUB-BASE AND SUB-GRADE PREPARATION
5. WHERE DEPTH OF UNDER SLAB FILL EXCEEDS 400mm AND IS NOT COMPACTED TO THE SPECIFICATION, INCREASE SLAB THICKNESS TO 125mm WITH ADDITIONAL SL72 BOTTOM MESH. PROVIDE BACKHOE PIERS TO ALL FOOTINGS AS PER THE STANDARD DETAILS IF FOOTINGS ARE NOT FOUNDED 200mm INTO NATURAL GROUND.
6. FOOTING ON BOUNDARY LINES ARE TO BE FOUNDED 600mm BELOW ADJACENT GROUND LEVEL
7. THE BUILDER SHALL MAINTAIN THE STRUCTURE AND EXCAVATIONS IN A STABLE CONDITION AND ENSURE NO PART IS OVERSTRESSED DURING CONSTRUCTION
8. FLEXIBLE END CONNECTIONS ARE TO BE PROVIDED TO SEWER AND STORM-WATER PIPES. REFER TO THE STANDARD DETAILS IN THE FOOTING CONSTRUCTION REPORT
9. CAST-IN HYDRONIC HEATING PIPE, IF USED; THEY ARE TO BE LAID ON A SACRIFICIAL LAYER OF SL72 FABRIC, IN THE CENTRE OF THE SLAB. INCREASE THE SLAB THICKNESS BY 25mm TO ACCOMMODATE. IT IS NOT ACCEPTABLE TO LAY HYDRONIC HEATING PIPES DIRECTLY ON TOP OF THE TOP FABRIC
10. WHERE A POLISHED/BURNISHED CONCRETE FINISH IS REQUIRED, INCREASE SLAB THICKNESS BY 10mm, INCREASE CONCRETE COVER TO 30mm, INCREASE CONCRETE STRENGTH TO 32MPa AND PROVIDE SL81 TOP MESH (PROVIDE BOTTOM MESH IF IT IS NOMINATED IN THE FOOTING SCHEDULE)
11. WHERE TILED FLOORING IS TO BE USED IN AREAS GREATER THAN 16 SQUARE METERS THE SLAB REINFORCEMENT SHALL BE INCREASED TO SL92 IN ACCORDANCE WITH AS2870 SECTION 5.3.7, OR USE A FLEXIBLE GROUT BED TO ACCOMMODATE SHRINKAGE MOVEMENT ASSOCIATED WITH CONCRETE AND SCREEDS
12. RAMP 10mm TO ROLLER DOOR OPENINGS U.N.O
13. REBATE REFER TO ARCHITECTS DETAILS
14. MINIMUM STRENGTH OF CONCRETE:
 f'c = 25MPa (NORMAL)
 f'c = 32MPa (POLISHED & EXPOSED)
15. COVER TO REINFORCEMENT:
 SLAB: 20mm TOP; 30mm BOTTOM
 SLAB: 40mm TOP EXPOSED
 BEAMS: 40mm ALL ROUND
 BEAMS: 65mm ALL ROUND EXPOSED
 STRIP: 65mm ALL ROUND
16. MINIMUM BAR REINFORCEMENT LAP:
 N12 600mm
 N16 800mm
 N20 1000mm
 N24 1400mm
 N28 1700mm
17. MINIMUM MESH REINFORCEMENT LAP:



THIS DRAWING INCLUDES COLORED INFORMATION. YOU DO NOT HAVE ALL THE INFORMATION IF YOU ONLY HAVE A BLACK AND WHITE COPY. PLEASE NOTE THIS NOTE IS IN BLUE.

ISSUED FOR APPROVAL



REVISION	DATE	DETAILS	CHECKED
C	11.08.2025	ISSUED FOR APPROVAL	H.W.C
B	31.07.2025	ISSUED FOR APPROVAL	H.W.C
A	10.07.2025	ISSUED FOR APPROVAL	H.W.C

HWC ENGINEERS
 STRUCTURAL & CIVIL CONSULTING

e: marcus@hwcengineers.com.au m: 0422 238 038

DESIGNED: J.S DATE: JUN'25
 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT AT 418 ESPLANADE, MOANA FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 GENERAL NOTES

PROJECT No.	DRAWING	REVISION
HWC-24261	GN01	C

- TIMBER EXPOSURE NOTES:**
1. WALL FRAMES TO STEEL COLUMNS & BEAMS (WHERE APPLICABLE) TO BE SHOT FIRED AT 400CTS
 2. STUDS TO BE PROVIDED DIRECTLY UNDER RAFTERS & FLOOR/ROOF TRUSSES WHERE APPLICABLE. SHOULD MISALIGNMENT OCCUR UPGRADING OF TOP PLATE MAY BE REQUIRED
 3. PROVIDE ROOF TIE DOWNS. REFER TO STRUCTURAL TIE DOWN SHEET FOR DETAILS
 4. ALL DOUBLE/TRIPPLE MEMBERS TO BE NAIL LAMINATED
 5. POINT STRENGTH OF TIMBER TO BE JD4 OR BETTER U.N.O
 6. BRICKS TO BE SHOT FIRED VERTICALLY/HORIZONTALLY TO STRUCTURAL MEMBERS AT 300CTS MAX, WHERE APPLICABLE
 7. ALL BOLTS, SCREWS & NAILS TO BE GALVANISED AS REQUIRED IN ACCORDANCE WITH AS1720
 8. ALL BOLT CONNECTIONS TO BE PROVIDED WITH A WASHER AT EACH END, WITH BOLT SPACING & EDGE DISTANCE TO AS1720. ALLOW FOR 2mm HOLES DRILLED IN TIMBER FOR BOLTS UP TO AND INCLUDING 16mm DIA & 3mm FOR BOLTS >= 20mm DIAMETER
 9. ALL TIMBER CONSTRUCTION METHODS TO BE IN ACCORDANCE WITH AS1684.2 U.N.O
 10. REFER TO MANUFACTURER'S SPECIFICATIONS FOR ANY PROPRIETARY PRODUCTS
 11. UNLESS NOTED OTHERWISE, PROVIDE TIMBER TREATMENT BELOW:

TIMBER EXPOSURE TABLE			
HAZARD CLASS	EXPOSURE	HAZARD	TYPICAL USES
H1	INSIDE ABOVE GROUND	INSECTS OTHER THAN TERMITES LYCTID AND ANOBIID ATTACK	FLOORING, FURNITURE, INTERIOR JOINERY
H2	INSIDE ABOVE GROUND	TERMITES AND BORERS	FRAMING, FLOORING AND SIMILAR USED IN DRY SITUATIONS
H3	OUTSIDE ABOVE GROUND	MODERATE DECAY, TERMITES AND BORERS	CLADDING, FASCIA, PERGOLAS (ABOVE GROUND), JOINERY, FRAMING, DECKING
H4	OUTSIDE IN-GROUND	SEVERE DECAY, TERMITES AND BORERS	FENCE POSTS, GREENHOUSES, PERGOLAS (IN-GROUND), LANDSCAPING
H5	OUTSIDE IN-GROUND FRESH WATER CONTACT	VERY SEVERE DECAY, TERMITES AND BORERS	RETAINING WALLS, PILING, HOUSE STUMPS, BUILDING POLES.

12. BUILDER TO PROVIDE ADEQUATE TERMITE PROTECTION IN ACCORDANCE WITH LOCAL COUNCIL REQUIREMENTS AND AS3660.1 - TERMITE MANAGEMENT
13. ALL GLUE LAMINATED AND LAMINATED VENEER LUMBER MEMBERS MUST BE CLADDED AND PROTECTED FROM THE WEATHER.

STRUCTURAL STEEL WORK NOTES:

1. ALL MATERIALS, WORKMANSHIP, FABRICATION AND ERECTION SHALL COMPLY WITH THE REQUIREMENTS OF AS4100, AS/NZ4600, AS1554 AND THE SPECIFICATION
2. UNLESS SHOWN OTHERWISE, ALL STEEL SHALL BE IN ACCORDANCE WITH AS3679 GRADE 300. ALL STEEL HOLLOW SECTIONS SHALL BE GRADE 350 IN ACCORDANCE WITH AS1163
3. BOLT DESIGNATION:
4.6/S REFERS TO COMMERCIAL BOLTS OF STRENGTH GRADE 4.6 TO AS1111. TIGHTENED TO A SNUG TIGHT CONDITION.
8.8/S REFERS TO HIGH STRENGTH STRUCTURAL BOLTS OF GRADE 8.8/S TO AS1252 TIGHTENED TO A SNUG TIGHT CONDITION. ALL BOLTS TO BE MINIMUM 8.8/S GRADE UNLESS NOTED OTHERWISE.
4. BOLTS WITH INTEGRAL WASHERS IN BOTH THE HEAD & NUT SHALL BE USED FOR ALL STEEL PURLINS CLEATS TO SUPPORTS U.N.O
5. U.N.O, ALL WELDS SHALL BE 6mm FILLET WELD OR MIN. 4.24mm THROAT THICKNESS IN ACCORDANCE WITH AS1554. ALL ELECTRODES SHALL HAVE MIN. F_{uw}=490MPa WELD METAL U.N.O, ALL BUTT WELDS SHALL BE FULL STRENGTH COMPLETE PENETRATION WELDS
6. SUBSTITUTIONS FOR STEEL SECTIONS SHOWN ON DRAWINGS SHALL NOT BE MADE WITHOUT THE APPROVAL OF THE ENGINEER
7. THE CONTRACTOR SHALL PROVIDE ALL CLEATS, TIMBER PACKERS TO WEB/FLANGE AND DRILL ALL HOLES NECESSARY FOR FIXING STEEL, TIMBER & OTHER ELEMENTS TO STEEL WHETHER OR NOT DETAILED ON THE STRUCTURAL DRAWINGS
8. THE FABRICATION AND ERECTION OF THE STRUCTURAL STEEL WORK SHALL BE SUPERVISED BY QUALIFIED PERSONNEL, EXPERIENCED IN SUCH SUPERVISION TO ENSURE THAT ALL REQUIREMENTS OF THE DESIGN ARE MET. DETAILS OF ERECTION SEQUENCE SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO COMMENCEMENT OF ERECTION
9. COLUMNS AND MULLIONS SHALL HAVE THEIR BASE PLATES FULLY GROUTED IN ACCORDANCE WITH THE SPECIFICATIONS AFTER PLUMBING AND LEVELING ON STEEL PACKERS
10. REFER TO THE SPECIFICATION FOR ALL STEEL FINISHED/TREATMENTS. CONFIRM WITH ARCHITECT
11. ALL EXPOSED AND/OR UNDERGROUND STEEL MEMBERS, PLATES, BOLTS AND ANCHORS TO BE HOT DIP GALVANISED UNLESS NOTED OTHERWISE
12. ALL STEEL MEMBERS, PLATES, BOLTS AND ANCHORS THAT ARE BELOW GROUND/PAVING TO BE PROTECTED WITH 2 COATS OF EPIREZ 215 BITUMINOUS PAINT.
13. UNLESS NOTED OTHERWISE, ALL STEEL WORK SHALL HAVE CORROSION PROTECTION APPLIED AFTER FABRICATION IN ACCORDANCE WITH AS 2312 AND THE BELOW:
 1. GRIT BLAST TO CLASS 2.5 SURFACE TO AS 16721.
 2. SHOP PRIME WITH 75um INORGANIC ZINC SILICATE.
 3. TOP COAT TO ARCHITECT'S SPECIFICATIONS.
 4. DAMAGE TO THE PRIMER SHALL BE REPAIRED TO THE SAME STANDARD USED FOR THE ORIGINAL COATING. SURFACES SHALL BE FREE OF DIRT OR GREASE, VISIBLE OXIDATION AND OTHER CONTAMINANTS BEFORE THE APPLICATION OF THE PRIMER.
 5. EXTERNAL AND EXPOSED STEELWORK TO BE HOT DIP GALVANISED OR COATED WITH CORROSION RESISTANT PRIMER AND TOP COATING TO MEET THE EXPOSURE CONDITIONS AND ATMOSPHERIC CORROSIVITY CATEGORIES FOR THE APPLICATION. THE PRIMER AND COATING IS TO BE SELECTED FROM AN APPROVED MANUFACTURER AND APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. CONTACT THE MANUFACTURER FOR RECOMMENDATIONS OF THE APPLICABLE PRIMER AND COATING.
14. BUILDER AND ARCHITECT TO CONFIRM DIMENSIONS AND SET-OUT OF ALL MEMBERS PRIOR TO FABRICATION AND CONSTRUCTION. THIS OFFICE WILL NOT TAKE RESPONSIBILITY FOR ERRORS THAT OCCUR AS A RESULT OF INCORRECT DIMENSIONS AND SET-OUT. CONTACT THIS OFFICE FOR REVIEW IF THERE ARE DISCREPANCIES.

DRAWINGS LIST		
DRAWING NO.	DRAWING TITLE	REVISION
GN01	GENERAL NOTES	C
GN02	GENERAL NOTES	C
F01	FOOTING PLAN	B
F02	GROUND LEVEL CONTROL JOINT PLAN	B
F03	LEVEL 1 CONTROL JOINT PLAN	B
S01	LEVEL 1 FLOOR & GROUND LEVEL WALL FRAMING PLAN	B
S02	LEVEL 1 ROOF & WALL FRAMING PLAN	B
S03	GROUND LEVEL BRACING PLAN	B
S04	LEVEL 1 BRACING PLAN	B
S10	SECTIONS	B
S11	SECTIONS & DETAILS	B
S12	SECTIONS & DETAILS	B
S13	SECTIONS & DETAILS	B
S14	SECTIONS & DETAILS	B
S15	SECTIONS & DETAILS	A
FS1	FOOTING DETAILS	A
FS2	FOOTING DETAILS	A
FS3	FOOTING DETAILS	A
FS4	FOOTING DETAILS	A
SS1	DETAILS	A
SS2	DETAILS	A
SS3	DETAILS	A
SS4	DETAILS	A
SS5	DETAILS	A
SS6	DETAILS	A

C	11.08.2025	ISSUED FOR APPROVAL	H.W.C
B	31.07.2025	ISSUED FOR APPROVAL	H.W.C
A	10.07.2025	ISSUED FOR APPROVAL	H.W.C
REVISION	DATE	DETAILS	CHECKED



STRUCTURAL & CIVIL CONSULTING

e: marcus@hwcengineers.com.au m: 0422 238 038

DESIGNED: J.S DATE: JUN'25
DRAWN: S.T.C SHEET SIZE: A3

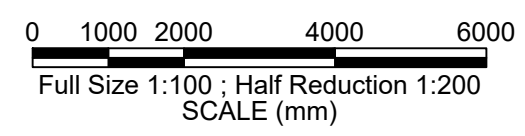
PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
GENERAL NOTES

PROJECT No. DRAWING REVISION
HWC-24261 GN02 C

THIS DRAWING INCLUDES COLORED INFORMATION. YOU DO NOT HAVE ALL THE INFORMATION IF YOU ONLY HAVE A BLACK AND WHITE COPY. PLEASE NOTE THIS NOTE IS IN BLUE.

ISSUED FOR APPROVAL



NOTES

BUILDING CONSENT GRANTED
29/10/2025

1. FOOTINGS ON THE BOUNDARY ARE FOUNDED TO A MINIMUM DEPTH OF 600mm BELOW ADJACENT FINISHED GROUND LEVELS; CONTINUOUSLY TRENCHED (TYPICAL) DURING INITIAL SITE WORKS, IF THE SURFACE OF THE ADJACENT SITE IS HIGHER OR LOWER THAN THE NOMINATED FLOOR LEVEL, CONTACT THIS OFFICE FOR THE APPROPRIATE REMEDIAL UPSTAND DETAIL. FOOTINGS ON BOUNDARY IS DESIGNED BASED ON ADJACENT LAND IN ITS "AS SURVEYED" CONDITION. THIS OFFICE TAKES NO RESPONSIBILITY SHOULD THE ADJACENT OWNER ALTER THE CONDITION OF THE SOIL OR BUILD ON THE BOUNDARY.

2. THE DEPTHS TO UNDERSIDE OF ALL FOOTINGS ARE PROVISIONAL ONLY. AFTER EXCAVATION, APPROVAL SHALL BE OBTAINED FROM THIS OFFICE FOR THE FOUNDING LEVELS WHICH MAY BE VARIED IF NECESSARY, PRIOR TO FURTHER WORK. ALL FOOTINGS TO BE FOUNDED 200mm INTO FIRM NATURAL SOIL.

3. WHERE DEPTH OF UNDER SLAB FILL EXCEEDS 400mm AND IS NOT COMPACTED TO THE SPECIFICATION, INCREASE SLAB THICKNESS TO 125mm WITH ADDITIONAL SL72 BOTTOM MESH. PROVIDE BACKHOE PIERS TO ALL FOOTINGS AS PER THE STANDARD DETAILS IF FOOTINGS ARE NOT FOUNDED 200mm INTO NATURAL GROUND.









4. PROVIDE 2 LAYERS OF 0.2mm MOISTURE VAPOUR BARRIER FOR RAFT FOOTING DEPTHS EQUAL OR GREATER THAN 1100mm.

5. PROVIDE 2 LAYERS OF 0.2mm MOISTURE VAPOUR BARRIER FOR STRIP FOOTING DEPTHS EQUAL OR GREATER THAN 700mm.

6. BUILDER TO CONFIRM WHETHER THERE ARE ANY EXISTING UNDERGROUND SERVICES THAT WOULD BE IMPACTED BY THE EXCAVATION WORKS TO AVOID DAMAGING THEM.

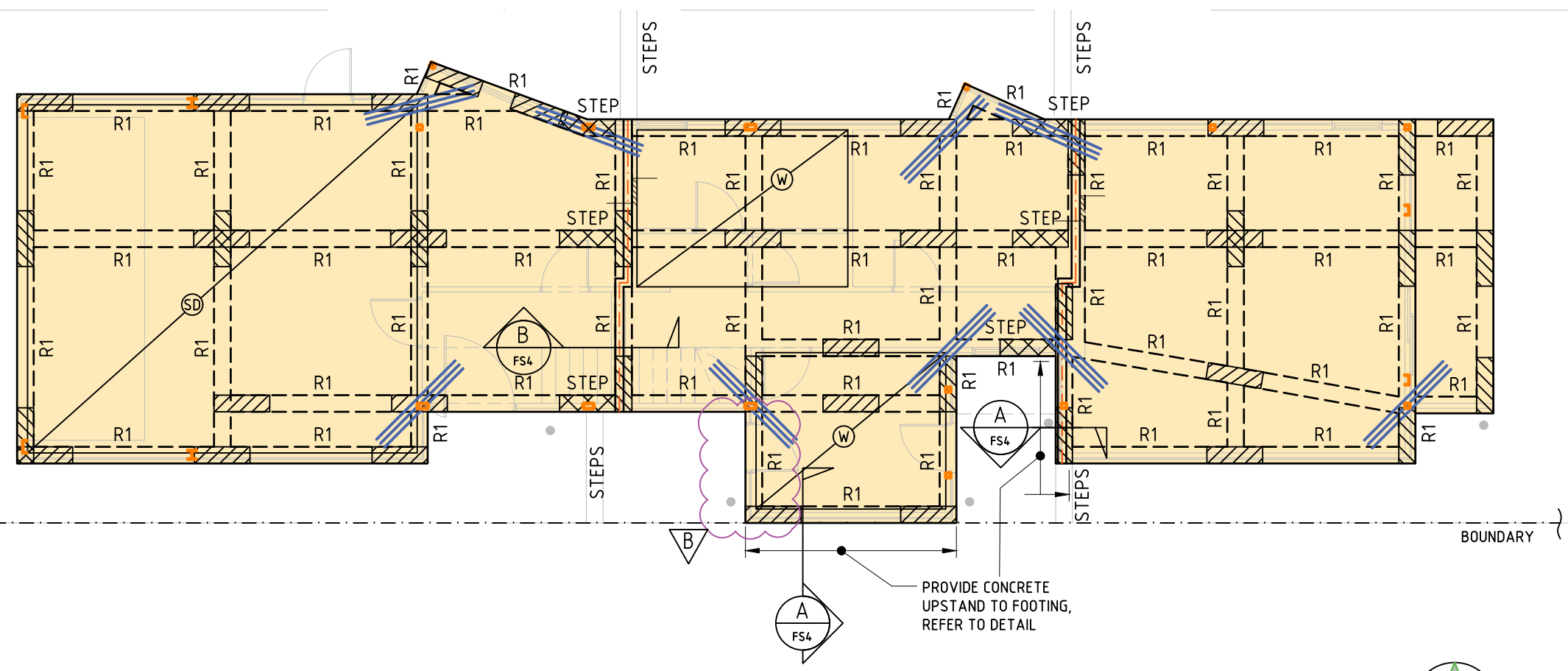
7. POLISHED/BURNISHED CONCRETE SLAB FINISH HAS NOT BEEN ALLOWED FOR IN THIS PROJECT. WHERE A POLISHED/BURNISHED CONCRETE FINISH IS REQUIRED, INCREASE SLAB THICKNESS BY 10mm, INCREASE CONCRETE STRENGTH TO 32MPa AND PROVIDE SL81 TOP MESH (PROVIDE BOTTOM MESH IF IT IS NOMINATED IN THE FOOTING SCHEDULE). CONTACT THIS OFFICE TO CONFIRM PRIOR TO CONSTRUCTION.

LEGEND

-  PROVIDE 3.N12 TOP x 2000mm LONG CRACK CONTROL BARS TIED TO UNDERSIDE OF MESH AS PER AS2870
-  SETDOWN TO ARCHITECT'S DETAILS.
-  WET AREA SETDOWN TO ARCHITECT'S DETAILS. IF NOT SPECIFIED BY ARCHITECT, PROVIDE 30mm SETDOWN TO WET AREA AND 50mm SETDOWN TO SHOWER.
-  DENOTE STEP IN SLAB FOR SEPARATE LEVELS. REFER TO ARCHITECT'S SITE CIVIL PLAN FOR FFL. REFER TO TYPICAL STEP FOOTING DETAILS IN FOOTING CONSTRUCTION REPORT
-  1000 LONG x FOOTING WIDTH TRENCH PIER TO BE FOUNDED 200mm INTO NATURAL SOIL; PROVIDE 4-N12 VERTICAL BARS WHERE PIER DEPTH EXCEED 500mm.
-  1000 LONG STEP FOOTING. REFER TO FOOTING STEP DETAIL ON DRAWING FS4.
-  150 THICK STEP RETAINING WALL WITH N12-250CTS VERTICAL AND HORIZONTAL BARS, REFER TO "TYPICAL STEP AT FOOTING DETAIL" ON DRAWING FS4.
-  STEEL COLUMN, SIZE AS SPECIFIED

FOOTING SCHEDULE				
MARK	SIZE	REINFORCEMENT	LIGATURE	
RAFT FOOTING	R1	300Wx1000D	4.N16 TOP & 4.N16 BOTTOM	
MINOR FOOTING	M1	300Wx400D	2.N16 TOP & 2.N16 BOTTOM	
RAFT SLAB	125 THICK	SL92 TOP MESH AND SL72 BOTTOM MESH U.N.O		

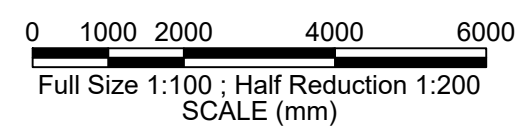
NOTE: PROVIDE N32 CONCRETE U.N.O.



FOOTING PLAN
(1:100)

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RESIDENCE 01

REVISION	DATE	DETAILS	CHECKED
B	31.07.2025	ISSUED FOR APPROVAL	H.W.C
A	10.07.2025	ISSUED FOR APPROVAL	H.W.C

HWC
ENGINEERS

STRUCTURAL & CIVIL CONSULTING

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DESIGNED: J.S DATE: JUN'25
DRAWN: S.T.C SHEET SIZE: A3

PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
FOOTING PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	F01	B

CONTROL JOINTS:

AAC PANELS I.E. POWER PANELS:

PROVISION OF CONTROL JOINTS TO AAC POWER PANELS ARE TO BE PLACED IN ALL INTERNAL AND EXTERNAL CORNERS AS PER MANUFACTURER'S DETAILS, IN ADDITION TO THE CONTROL JOINTS AS COMMUNICATED VIA THE CONTROL JOINTS PLAN.

LIGHTWEIGHT CLADDING:

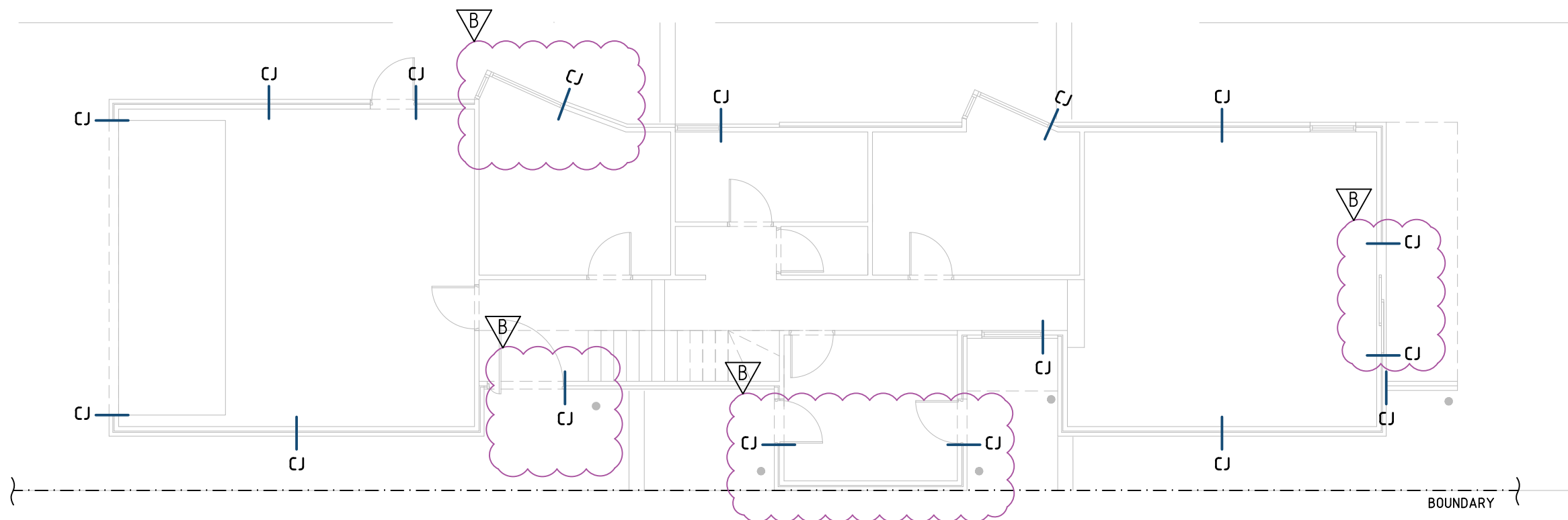
FOR PLACEMENT OF CONTROL JOINTS IN LIGHTWEIGHT CLADDING, REFER TO MANUFACTURER'S DETAILS.

PROVIDE FIRE RATED SEALANT TO BOUNDARY WALLS WHERE APPLICABLE (TYPICAL)

- PROVIDE CONTROL JOINTS BETWEEN THE TRANSITIONS OF THE GROUND FLOOR AND UPPER STOREY WALLS.

LEGEND

CJ — CONTROL JOINTS TO WALL IN CORRESPONDING DIRECTION. PLEASE REFER TO NOTES.



RESIDENCE 01

GROUND LEVEL CONTROL JOINT PLAN
(1:100)

REVISION	DATE	DETAILS	CHECKED
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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
GROUND LEVEL CONTROL JOINT PLAN

PROJECT No. DRAWING REVISION
HWC-24261 F02 B



ISSUED FOR APPROVAL

0 1000 2000 4000 6000
Full Size 1:100 ; Half Reduction 1:200
SCALE (mm)

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CONTROL JOINTS:

AAC PANELS I.E. POWER PANELS:

29/10/2025
PROVISION OF CONTROL JOINTS TO AAC POWER PANELS ARE TO BE PLACED IN ALL INTERNAL AND EXTERNAL CORNERS AS PER MANUFACTURER'S DETAILS, IN ADDITION TO THE CONTROL JOINTS AS COMMUNICATED VIA THE CONTROL JOINTS PLAN.

LIGHTWEIGHT CLADDING:

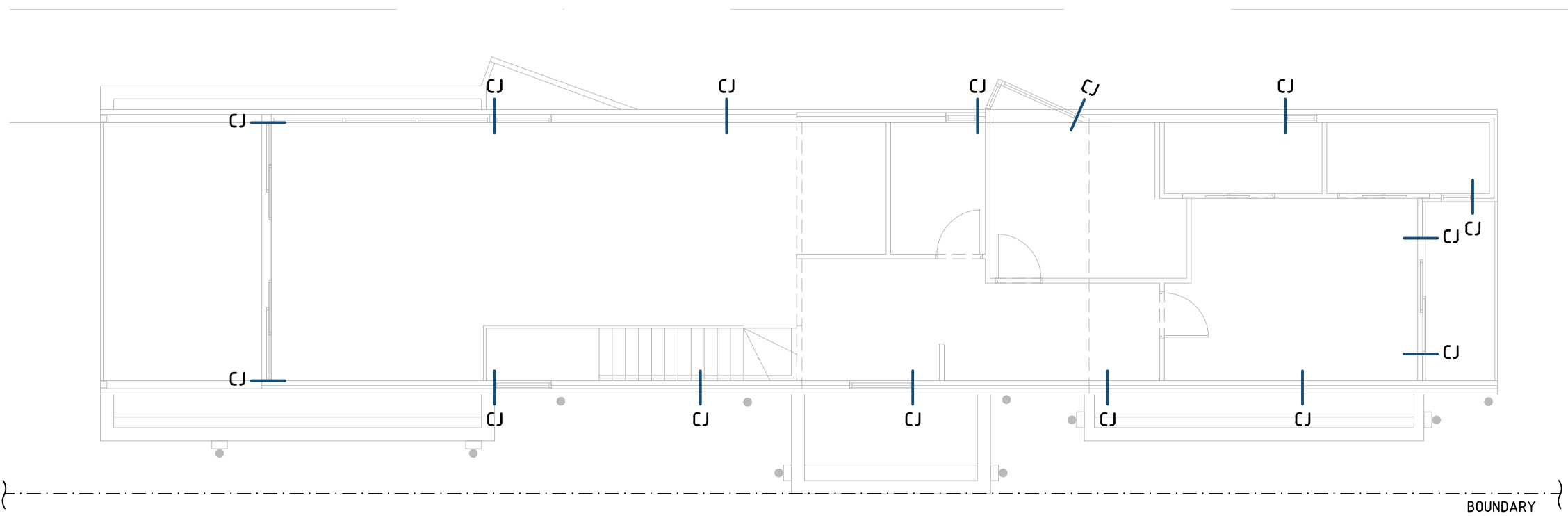
FOR PLACEMENT OF CONTROL JOINTS IN LIGHTWEIGHT CLADDING, REFER TO MANUFACTURER'S DETAILS.

PROVIDE FIRE RATED SEALANT TO BOUNDARY WALLS WHERE APPLICABLE (TYPICAL)

- PROVIDE CONTROL JOINTS BETWEEN THE TRANSITIONS OF THE GROUND FLOOR AND UPPER STOREY WALLS.

LEGEND

CJ — CONTROL JOINTS TO WALL IN CORRESPONDING DIRECTION. PLEASE REFER TO NOTES.



LEVEL 1 CONTROL JOINT PLAN
(1:100)

RESIDENCE 01

REVISION	DATE	DETAILS	CHECKED
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DESIGNED: J.S DATE: JUN'25
DRAWN: S.T.C SHEET SIZE: A3

PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
LEVEL 1 CONTROL JOINT PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	F03	B



ISSUED FOR APPROVAL

0 1000 2000 4000 6000
Full Size 1:100 ; Half Reduction 1:200
SCALE (mm)

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ALL FRAME SPECIFICATIONS:

29/10/2025
ALL MATERIALS ALLOWED TO BE TERMINATOR H2F IN ACCORDANCE TO AS 1684.2.
UNRESTRAINED STUD HEIGHT: 2400mm TO 3120mm - CHECK BEFORE CONSTRUCTION.

IF WALL STUD IS IN LINE WITH FLOOR TRUSS PROVIDE 45x90 MGP10, OTHERWISE PROVIDE 2/45x90 MGP10
45x90 MGP10
90x45 MGP10 NOGGINGS AT 1350 CTS

OPENING STUDS AS SHOWN:

- DOUBLE STUDS / 2S 2/90x45 MGP10
- TRIPLE STUDS / 3S 3/90x45 MGP10
- QUADRUPLE STUDS / 4S 4/90x45 MGP10
- STEEL COLUMNS SIZE AS SPECIFIED

LEGEND:

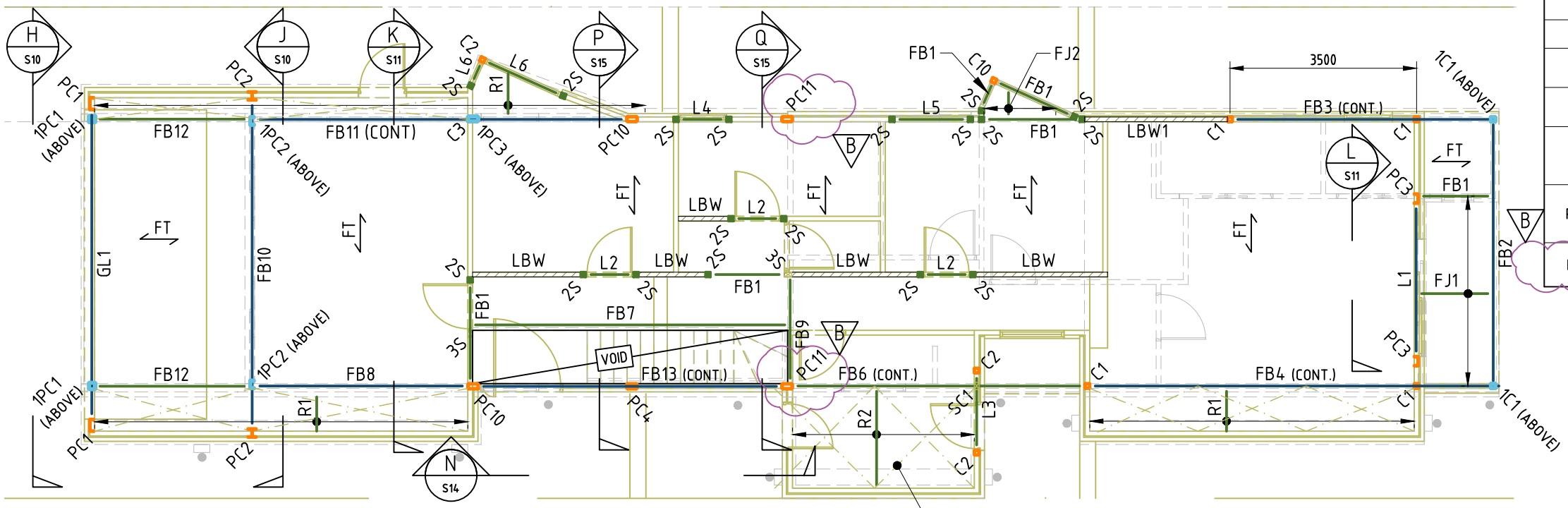
- TIMBER
- STRUCTURAL STEEL
- LBW LOAD BEARING WALL - 90x45 MGP10 STUD AT 600CTS
- LBW1 LOAD BEARING WALL - 90x45 LVL13 STUD AT 600CTS
- FT FLOOR TRUSS BY OTHERS
- RT ROOF TRUSS BY OTHERS

MEMBER SCHEDULE

MARK	SIZE	DESCRIPTION
R1	90x35 MGP10	FLAT RAFTER AT 600CTS WITH SOLDIERED BATTENS OVER
R2	120x45 MGP10	FLAT RAFTER AT 600CTS WITH SOLDIERED BATTENS OVER
L1	180PFC	LINTEL
L2	190x45 MGP10	LINTEL
L3	2/300x45 SMARTLVL13	LINTEL - NAIL LAMINATED
L4	190x45 MGP10	LINTEL
L5	200x45 SMARTLVL13	LINTEL
L6	190x45 MGP10	LINTEL
GL1	250PFC	GARAGE LINTEL

MEMBER SCHEDULE

MARK	SIZE	DESCRIPTION
FJ1		BALCONY FLOOR JOISTS AT 450CTS
FB1	400x45 SMARTLVL13	FLOOR BEAM
FB2	230PFC	FLOOR BEAM
FB3	300PFC	FLOOR BEAM
FB4	300PFC	FLOOR BEAM
FB5	DELETED	FLOOR BEAM
FB6	2/400x45 SMARTLVL13	FLOOR BEAM
FB7	2/400x45 SMARTLVL13	FLOOR BEAM - NAIL LAMINATED
FB8	250PFC	FLOOR BEAM
FB9	400x45 SMARTLVL13	FLOOR BEAM
FB10	360UB57	FLOOR BEAM
FB11	380PFC	FLOOR BEAM
FB12	400x63 SMARTLVL13	FLOOR BEAM
FB13	2/150x100x9.0 RHS	FLOOR WIND BEAM
C1	89x5.0 SHS	COLUMN FROM GROUND TO LEVEL 1 FLOOR
C2	89x3.5 SHS	COLUMN FROM GROUND TO LEVEL 1 FLOOR
C3	89x6.0 SHS	COLUMN FROM GROUND TO LEVEL 1 FLOOR
C10	89x3.5 SHS	FULL HEIGHT COLUMN FROM GROUND TO UPPER ROOF
SC1	3/90x45 MGP10	STUB POSTS ABOVE LINTEL
PC1	230PFC	PORTAL FRAME COLUMN
PC2	150UC37	PORTAL FRAME COLUMN FROM GROUND TO LEVEL 1 FLOOR.
PC3	180PFC	PORTAL FRAME COLUMN FROM GROUND TO LEVEL 1 FLOOR
PC4	200x100x9.0 RHS + 150WIDEX12THK PLATE (350GRADE)	PORTAL FRAME COLUMN FROM GROUND TO LEVEL 1 FLOOR. COLUMN TO BE HIDDEN WITHIN WALL FRAME AND CAVITY
PC10	200x100x9.0 RHS + 150WIDEX12THK PLATE (350GRADE)	FULL HEIGHT PORTAL FRAME COLUMN FROM GROUND TO UPPER ROOF. COLUMN TO BE HIDDEN WITHIN WALL FRAME AND CAVITY
PC11	200x100x9.0 RHS	FULL HEIGHT PORTAL FRAME COLUMN FROM GROUND TO UPPER ROOF

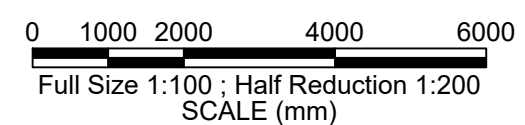


LEVEL 1 FLOOR & GROUND LEVEL WALL FRAMING PLAN
(1:100)

ROOF BRACING:
PRYDA SPEEDBRACE INSTALLED TO
MANUFACTURER'S SPECIFICATIONS

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ISSUED FOR APPROVAL



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ENGINEERS

STRUCTURAL & CIVIL CONSULTING

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DESIGNED: J.S DATE: JUN'25
DRAWN: S.T.C SHEET SIZE: A3

PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE
LEVEL 1 FLOOR & GROUND LEVEL WALL
FRAMING PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	S01	B

CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

UPPER LEVEL WALL FRAME SPECIFICATIONS:

ALL MATERIALS ALLOWED TO BE TERMINATOR H2F IN ACCORDANCE TO AS 1684.2. UNRESTRAINED STUD HEIGHT: 3200mm TO 3800mm - CHECK BEFORE CONSTRUCTION.	
TOP PLATES IF WALL STUD IS IN LINE WITH RAFTER/TRUSS PROVIDE 45x90 MGP10, OTHERWISE PROVIDE 2/45x90 MGP10	
BTM PLATES IF WALL STUD IS IN LINE WITH RAFTER/TRUSS PROVIDE 45x90 MGP10, OTHERWISE PROVIDE 2/45x90 MGP10	
HEIGHT 3200mm	90x45 MGP10 AT 600CTS, NOGGINGS AT 1350CTS
HEIGHT 3800mm	90x63 LVL13 AT 600CTS, NOGGINGS AT 1350CTS

OPENING STUDS AS SHOWN:

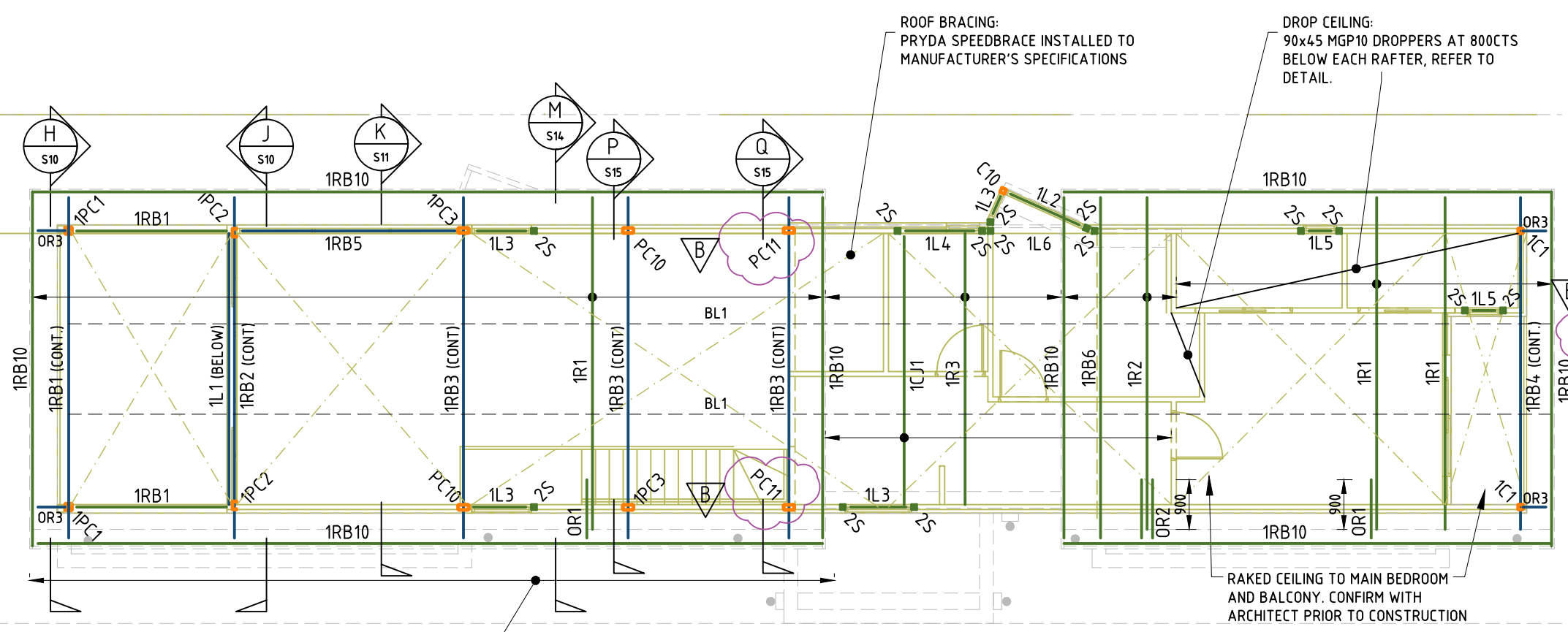
- DOUBLE STUDS / 2S 2/90x45 MGP10
- ▣ TRIPLE STUDS / 3S 3/90x45 MGP10
- ▣ QUADRUPLE STUDS / 4S 4/90x45 MGP10
- STEEL COLUMNS SIZE AS SPECIFIED

LEGEND:

- TIMBER
- STRUCTURAL STEEL
- LBW LOAD BEARING WALL SUPPORTING FLOOR TRUSSES
- FT FLOOR TRUSS BY OTHERS
- RT ROOF TRUSS BY OTHERS

MEMBER SCHEDULE

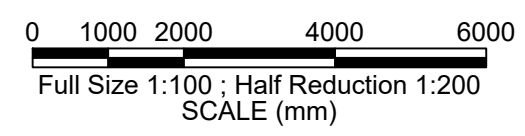
MARK	SIZE	DESCRIPTION
1CJ1	150x45 SMARTLVL13	CEILING JOIST AT 600CTS
1R1	240x45 MGP10	RAFTER AT 600CTS TO RAKED CEILING AREA
1R2	240x45 SMARTLVL13	RAFTER AT 1200CTS
1R3	240x45 SMARTLVL13	RAFTER AT 1200CTS
1L1	180PFC	LINTEL
1L2	190x45 MGP10	LINTEL
1L3	140x45 MGP10	LINTEL
1L4	140x45 MGP10	LINTEL
1L5	90x45 MGP10	LINTEL
1L6	190x45 MGP10	LINTEL
1RB1	200UB30	ROOF BEAM
1RB2	200UB30	ROOF BEAM
1RB3	200UC46	ROOF BEAM
1RB4	150PFC	ROOF BEAM
1RB5	180PFC	ROOF BEAM
1RB6	240x63 SMARTLVL13	ROOF BEAM
1RB10	290x35 F17 KD HARDWOOD	ROOF BEAM
OR1	90x45 MGP10	OUTRIGGER UNDER BOX GUTTER. SPACING TO MATCH RAFTER
OR2	90x45 SMARTLVL13	OUTRIGGER UNDER BOX GUTTER. SPACING TO MATCH RAFTER
OR3	150PFC	OUTRIGGER
BL1	140x35 MGP10	TIMBER BLOCKING BETWEEN RAFTERS AT A THIRD SPAN
1C1	89x5.0 SHS	COLUMN FROM LEVEL 1 FLOOR TO UPPER ROOF
PC10	200x100x9.0 RHS + 150WIDEx12THK PLATE (350GRADE)	FULL HEIGHT PORTAL FRAME COLUMN FROM GROUND TO UPPER ROOF
PC11	200x100x9.0 RHS	FULL HEIGHT PORTAL FRAME COLUMN FROM GROUND TO UPPER ROOF
1PC1	125x6.0 SHS	PORTAL FRAME COLUMN FROM LEVEL 1 FLOOR TO UPPER ROOF
1PC2	180PFC	PORTAL FRAME COLUMN FROM LEVEL 1 FLOOR TO UPPER ROOF
1PC3	200x100x9.0 RHS + 150WIDEx12THK PLATE (350GRADE)	PORTAL FRAME COLUMN FROM LEVEL 1 FLOOR TO UPPER ROOF. COLUMN TO BE HIDDEN WITHIN WALL FRAME AND CAVITY



LEVEL 1 ROOF & WALL FRAMING PLAN
(1:100)

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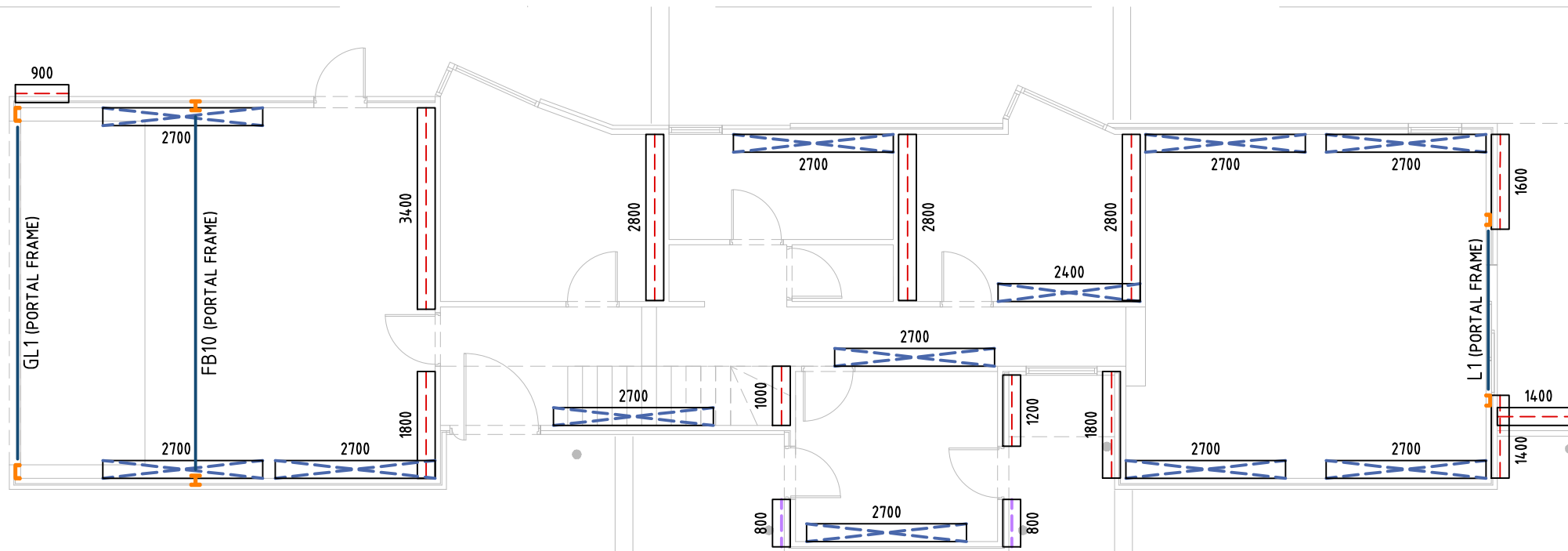
HWC ENGINEERS
STRUCTURAL & CIVIL CONSULTING
e: marcus@hwcengineers.com.au m: 0422 238 038

DESIGNED: J.S	DATE: JUN'25
DRAWN: S.T.C	SHEET SIZE: A3
PROJECT	
PROPOSED RESIDENTIAL DEVELOPMENT AT 418 ESPLANADE, MOANA FOR SOUTHERN ARCHITECTURE	
SHEET TITLE	
LEVEL 1 ROOF & WALL FRAMING PLAN	
PROJECT No. HWC-24261	DRAWING S02
REVISION	B



LEGEND

- 
 'X' DENOTES TENSIONED STRAP CROSS BRACING - 3.0kN/m CAPACITY. LENGTH NOTED ON PLAN. INSTALL IN ACCORDANCE WITH AS1684.2-2021 TABLE 8.18 (d)
- 
 'X' EGGER'S OS BRACE SYSTEM TYPE #1 - 3.4kN/m CAPACITY. LENGTH NOTED ON PLAN INSTALLED TO MANUFACTURER'S SPECIFICATIONS
- 
 'X' EGGER'S OS BRACE SYSTEM TYPE #3 - 6.0kN/m CAPACITY. LENGTH NOTED ON PLAN INSTALLED TO MANUFACTURER'S SPECIFICATIONS

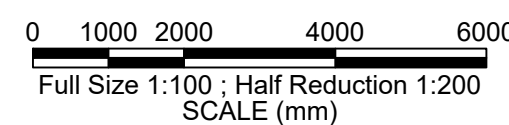


GROUND LEVEL BRACING PLAN
 (1:100)

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B	11.08.2025	ISSUED FOR APPROVAL	H.W.C
A	31.07.2025	ISSUED FOR APPROVAL	H.W.C

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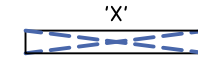
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 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

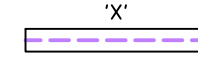
SHEET TITLE
 GROUND LEVEL BRACING PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	S03	B

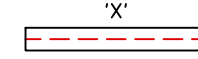
LEGEND



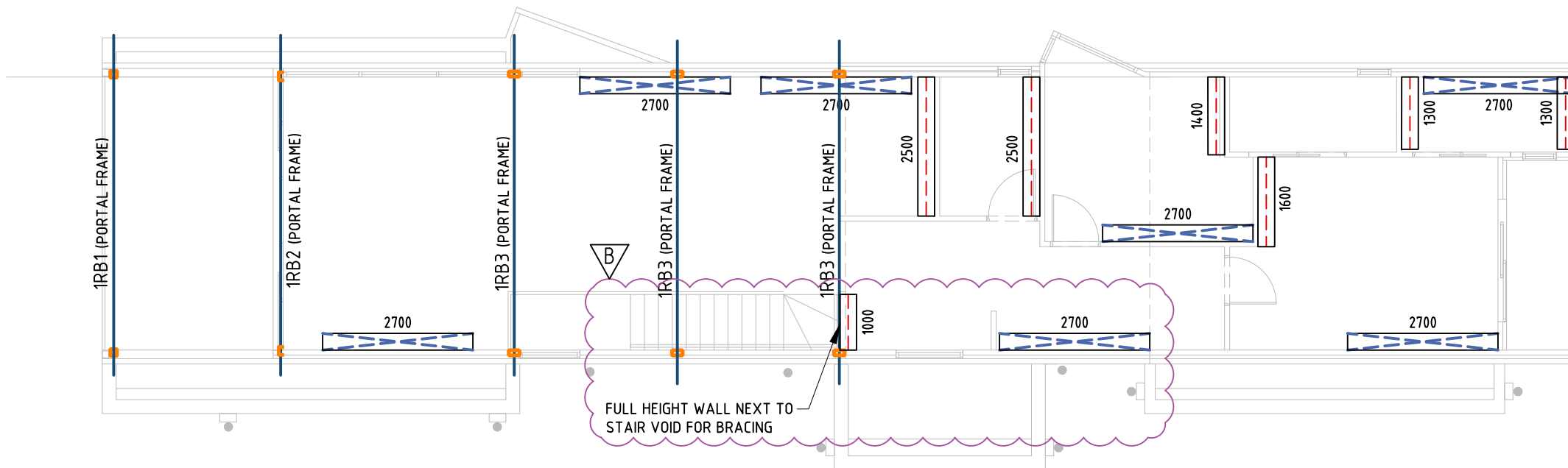
'X'
 DENOTES TENSIONED STRAP CROSS BRACING - 3.0kN/m CAPACITY. LENGTH NOTED ON PLAN. INSTALL IN ACCORDANCE WITH AS1684.2-2021 TABLE 8.18 (d)



'X'
 EGGER'S OS BRACE SYSTEM TYPE #1 - 3.4kN/m CAPACITY. LENGTH NOTED ON PLAN INSTALLED TO MANUFACTURER'S SPECIFICATIONS



'X'
 EGGER'S OS BRACE SYSTEM TYPE #3 - 6.0kN/m CAPACITY. LENGTH NOTED ON PLAN INSTALLED TO MANUFACTURER'S SPECIFICATIONS



LEVEL 1 BRACING PLAN
 (1:100)

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0 1000 2000 4000 6000
 Full Size 1:100 ; Half Reduction 1:200
 SCALE (mm)

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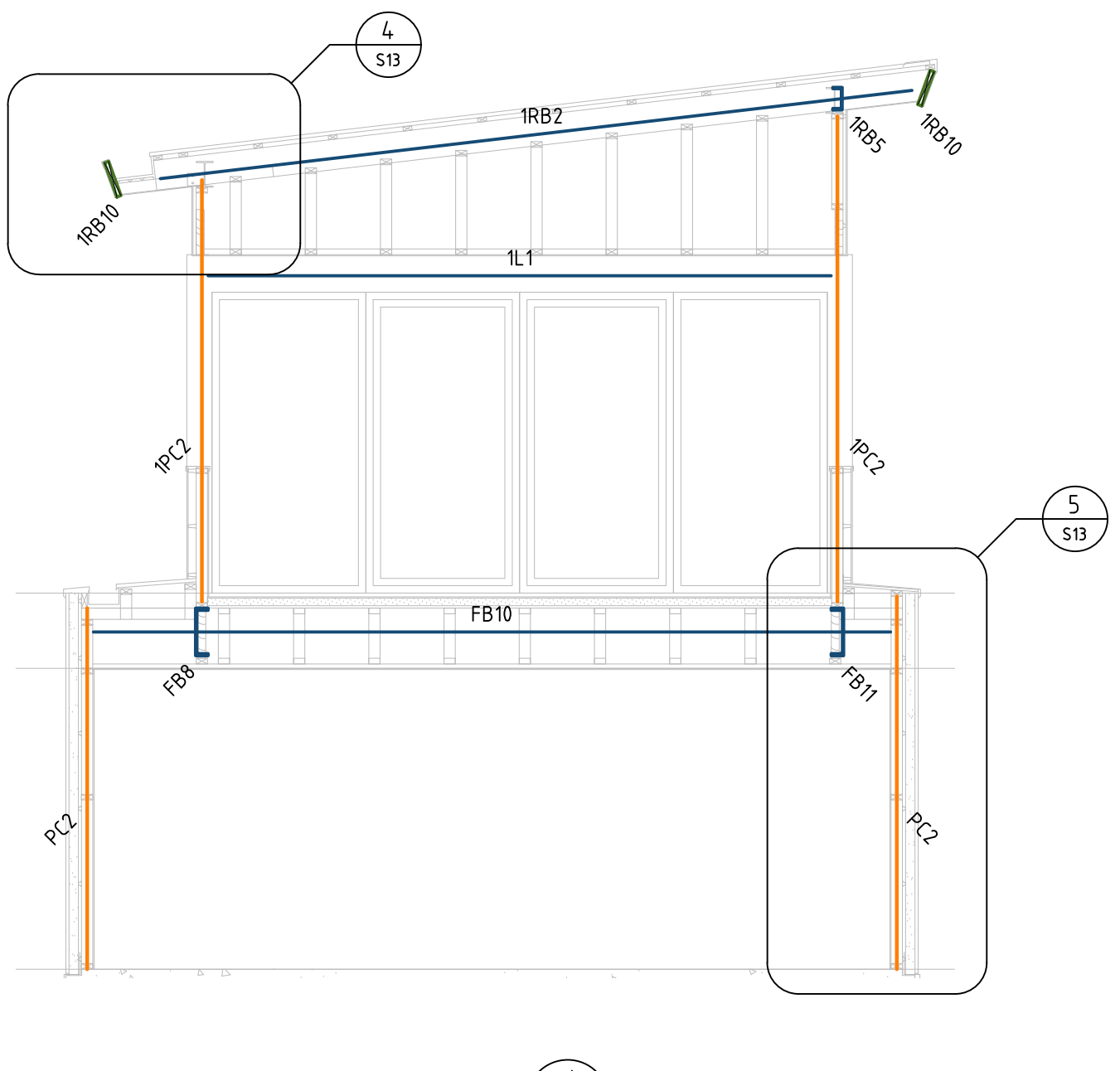
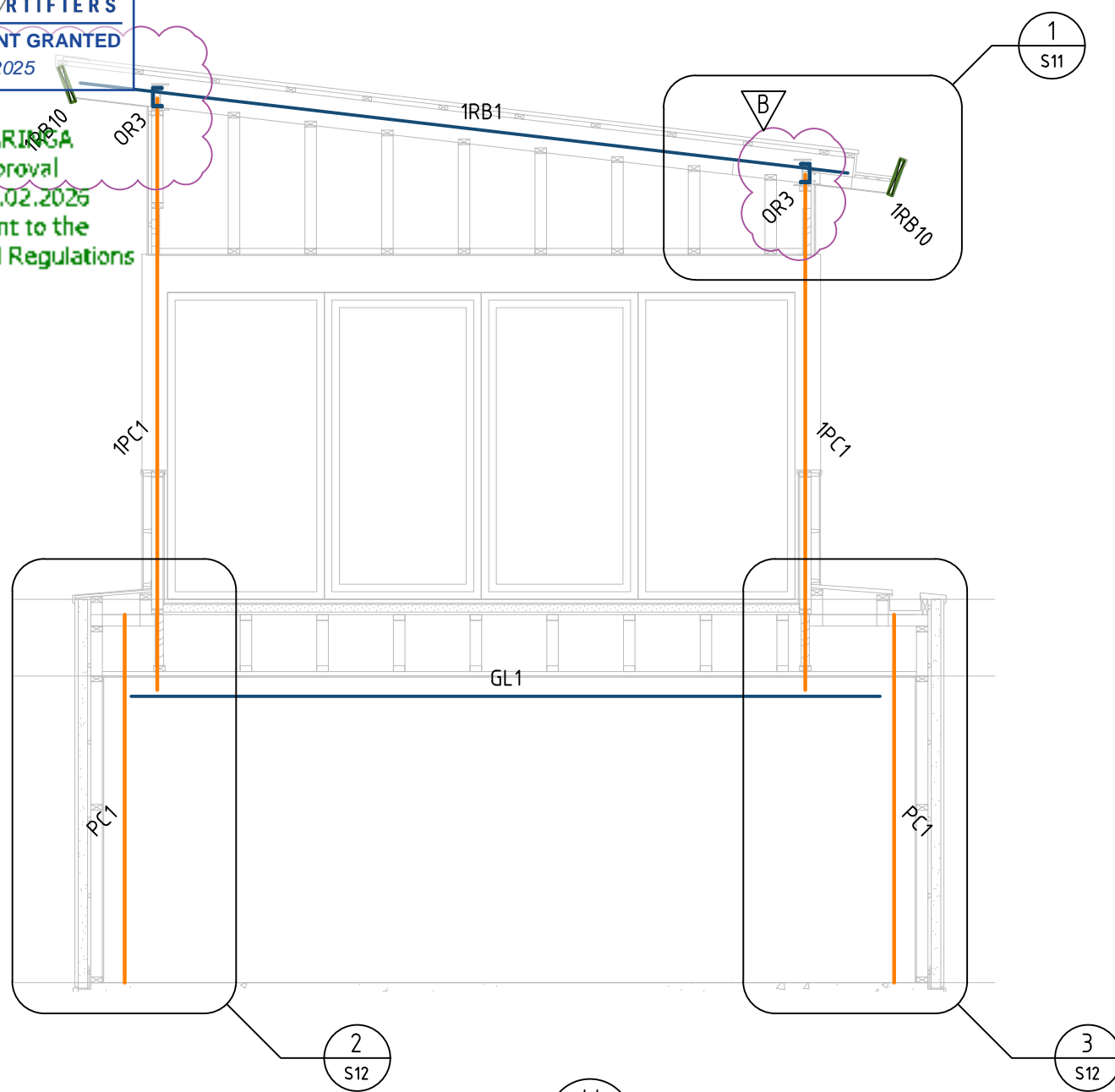
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DRAWN:	S.T.C	SHEET SIZE:	A3

PROJECT
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 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 LEVEL 1 BRACING PLAN

PROJECT No.	DRAWING	REVISION
HWC-24261	S04	B

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Full Size 1:50 ; Half Reduction 1:100
 SCALE (mm)

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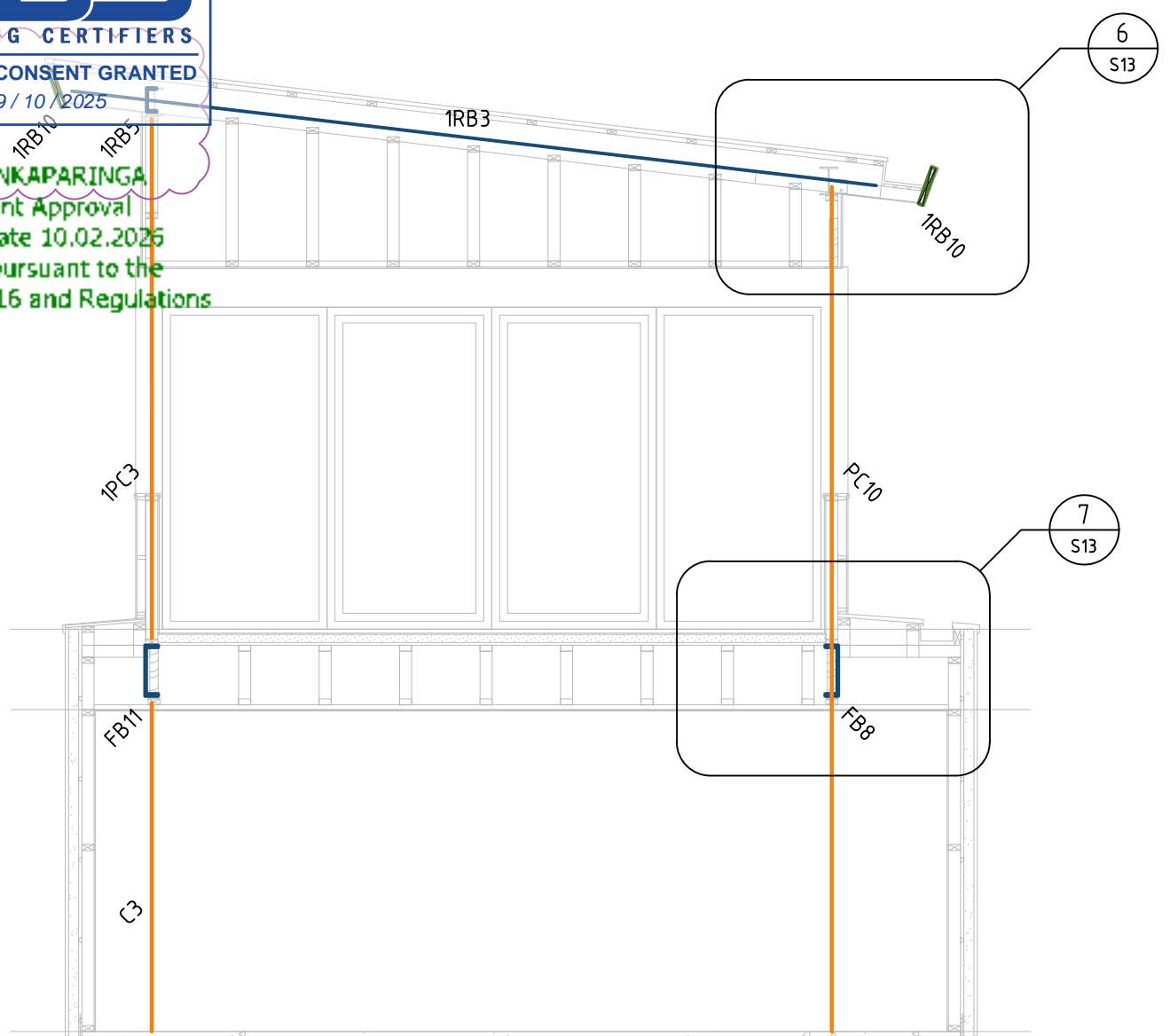
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 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

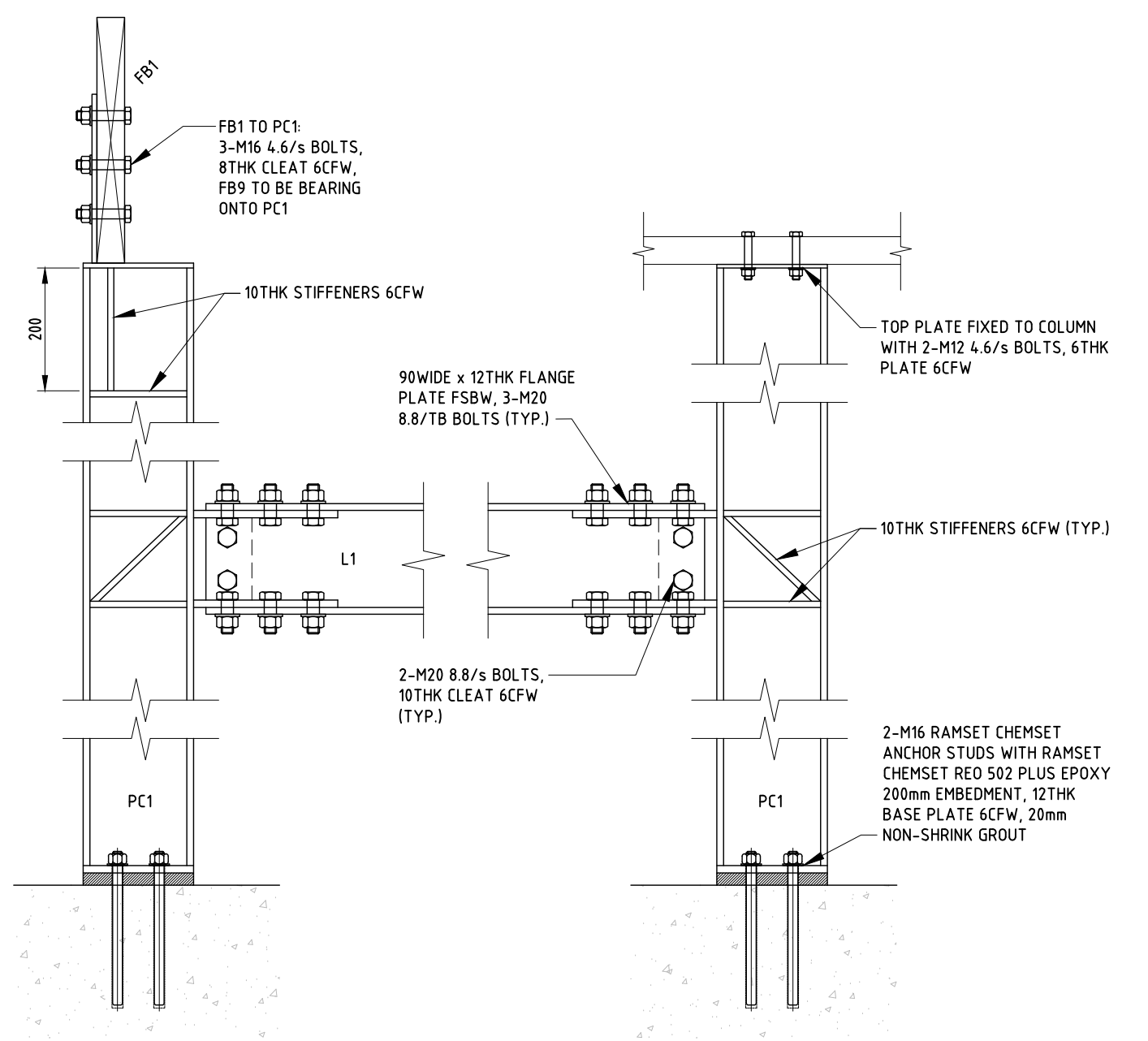
SHEET TITLE
 SECTIONS

PROJECT No.	DRAWING	REVISION
HWC-24261	S10	B

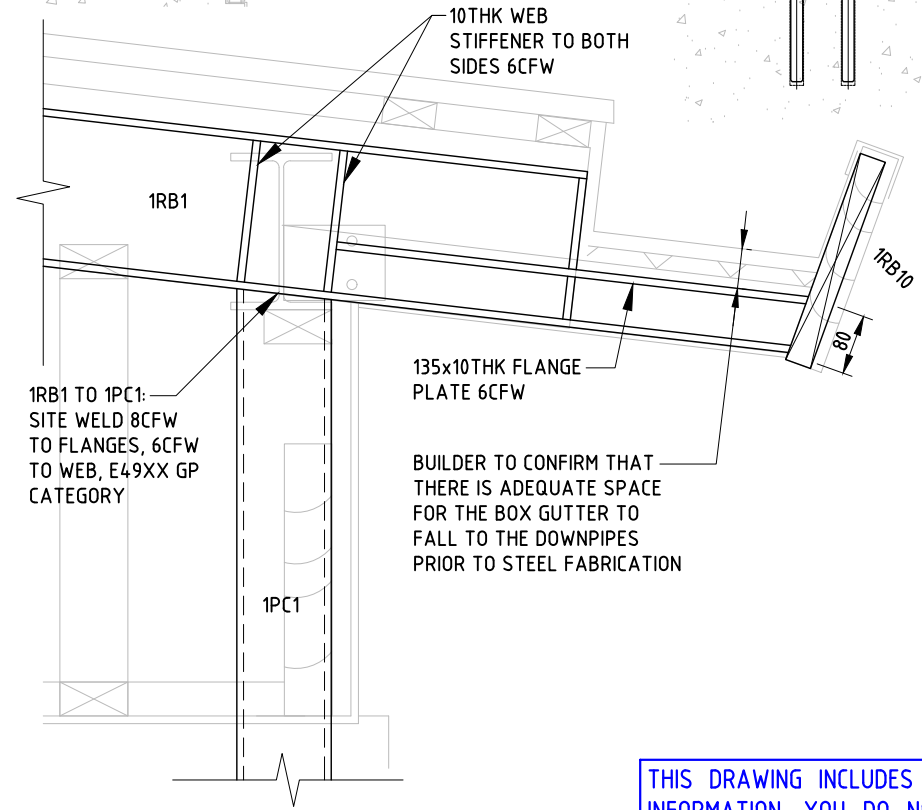
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SECTION **K**
 1:50 **S01**



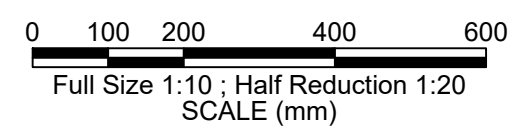
SECTION **L**
 1:10 **S01**



DETAIL **1**
 1:10 **S10**

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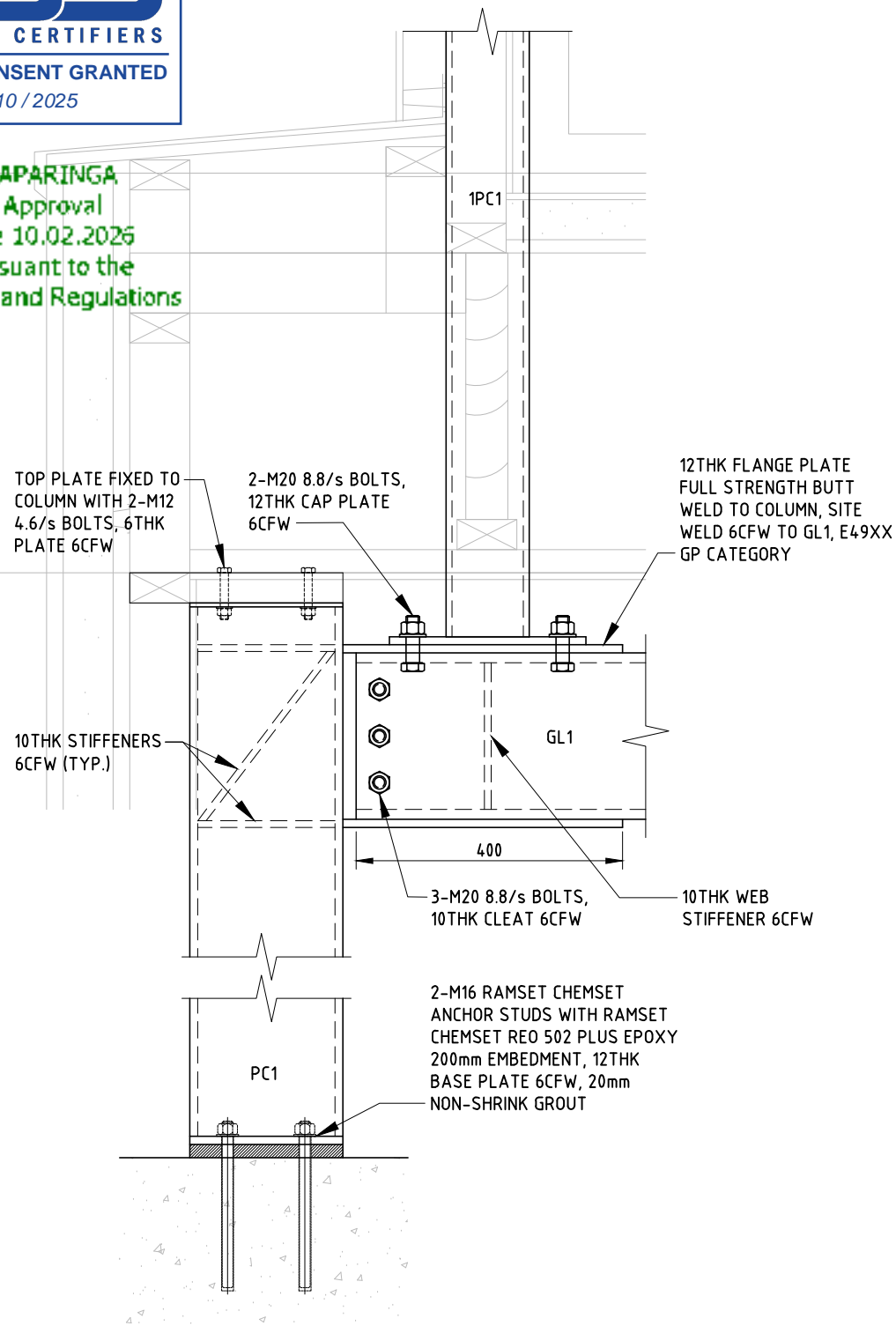
DESIGNED: J.S DATE: JUN'25
 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
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 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

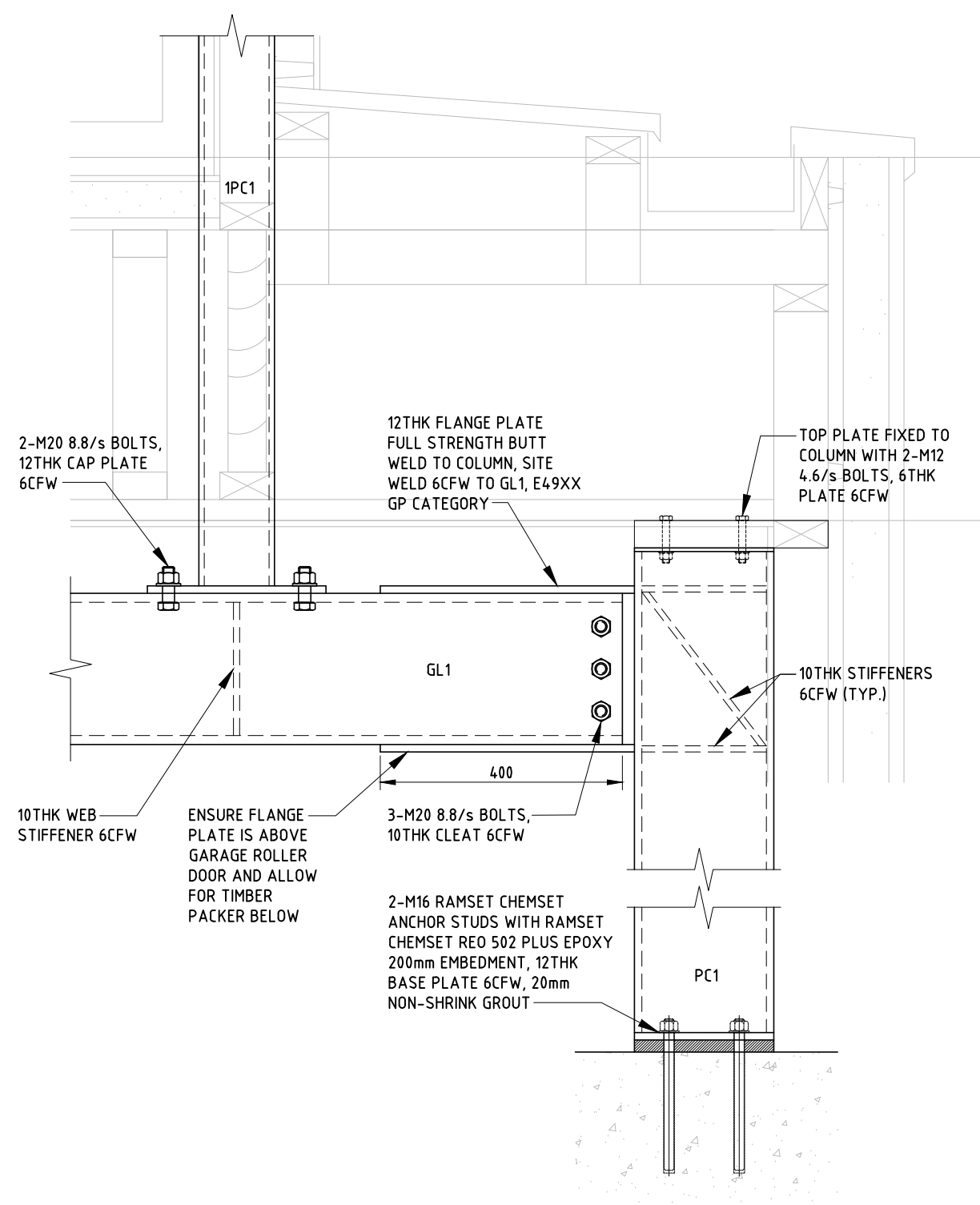
SHEET TITLE
 SECTIONS & DETAILS

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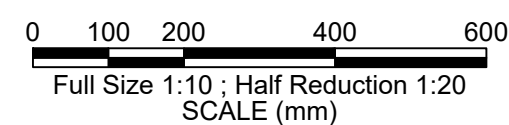
DETAIL 2
 1:10 (S10)



DETAIL 3
 1:10 (S10)

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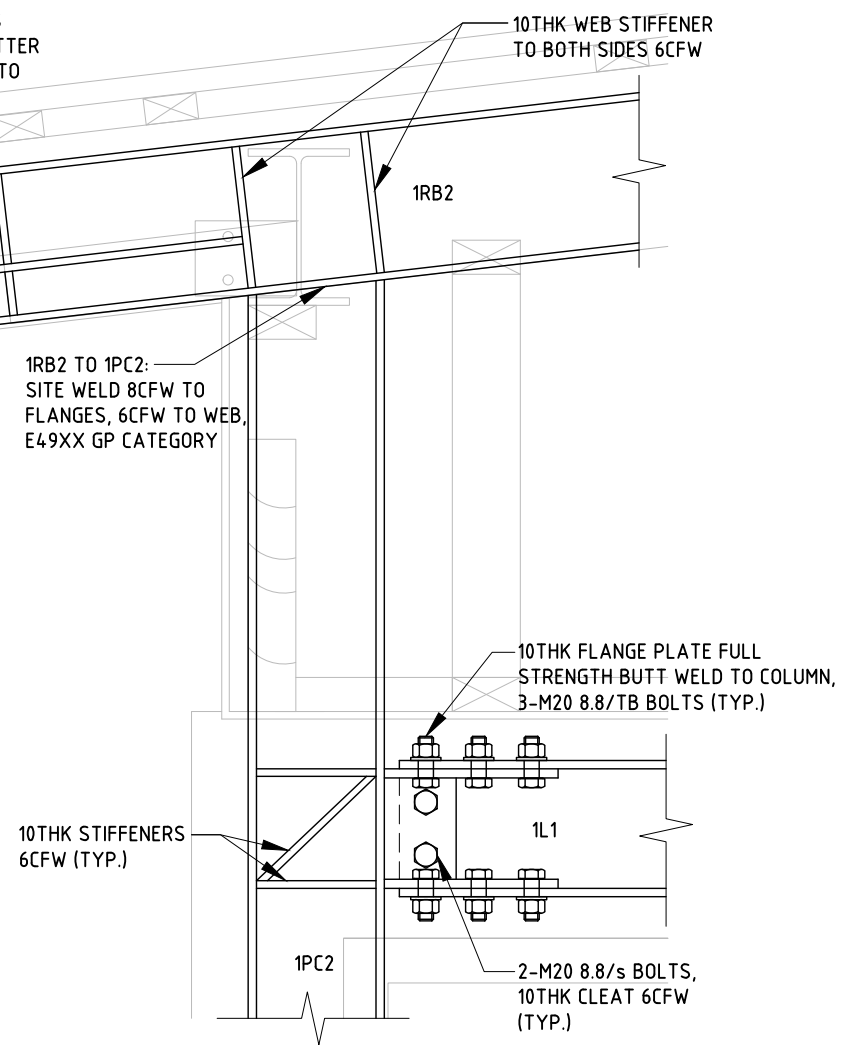
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 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 SECTIONS & DETAILS

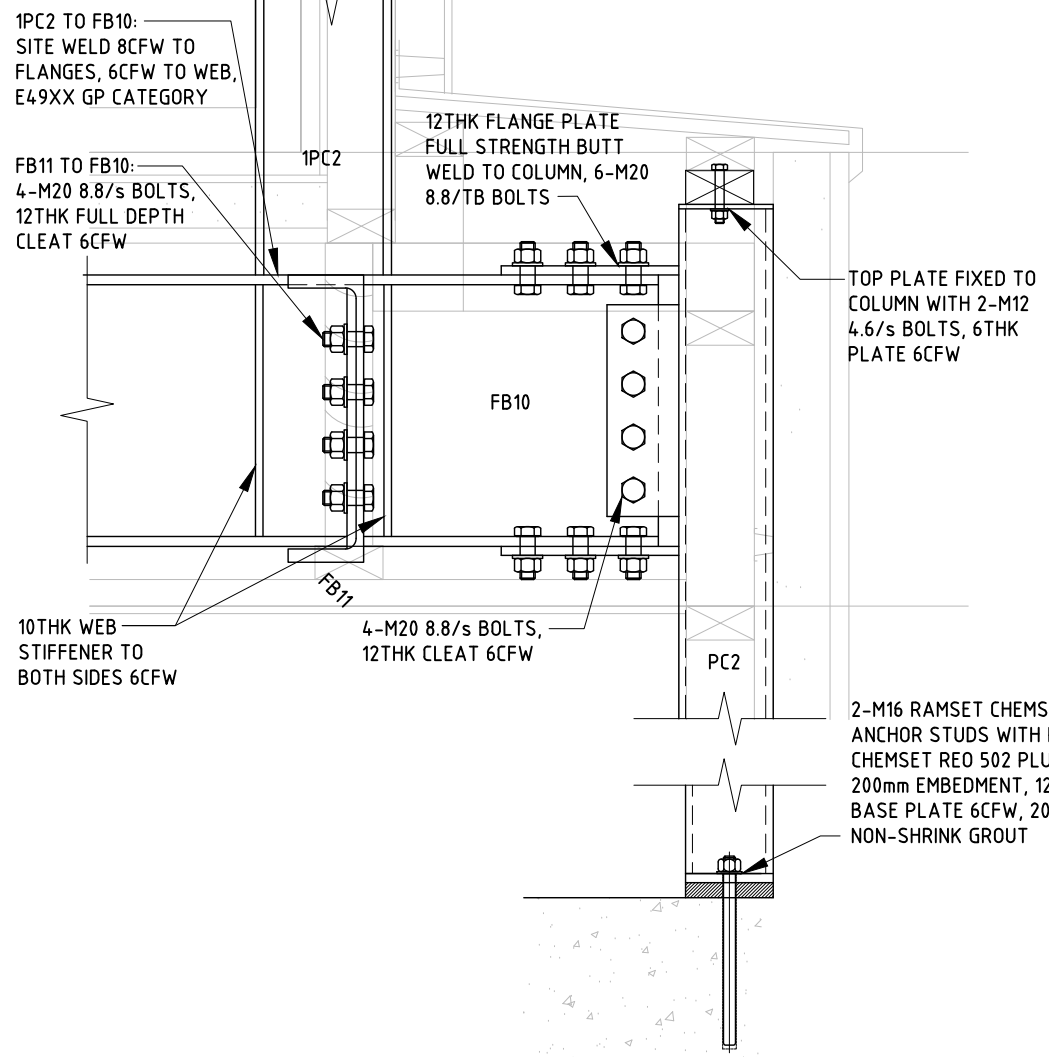
PROJECT No.	DRAWING	REVISION
HWC-24261	S12	B

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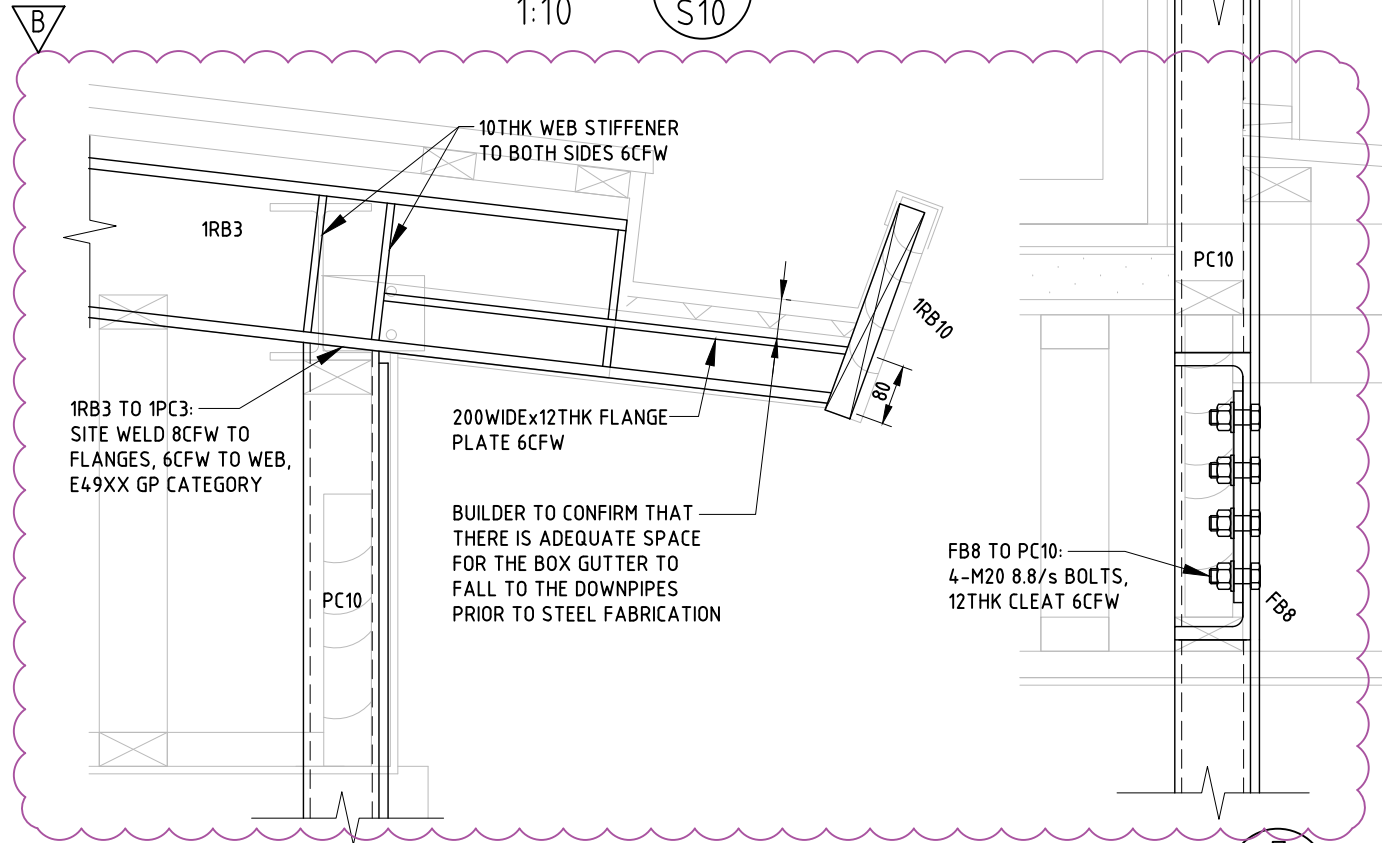
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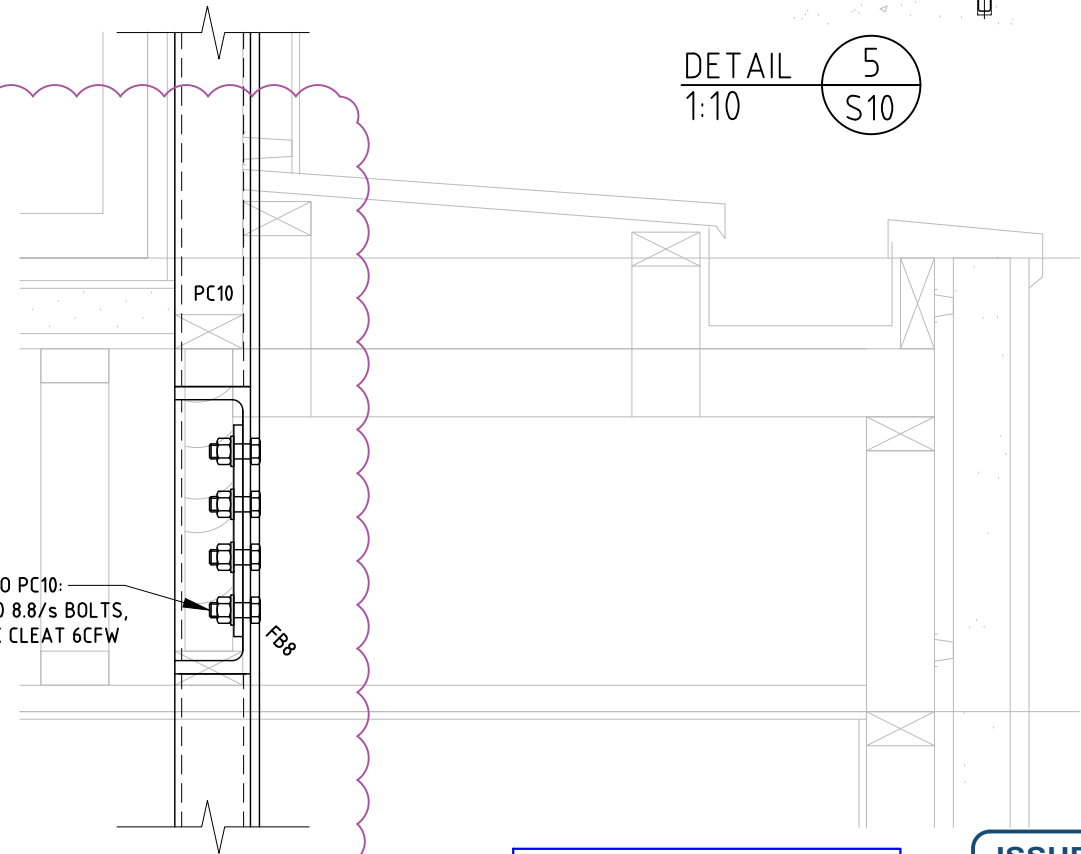
DETAIL 4
 1:10 S10



DETAIL 5
 1:10 S10



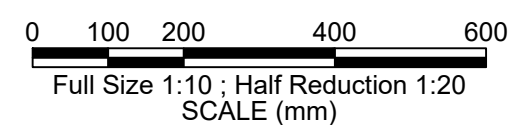
DETAIL 6
 1:10 S11



DETAIL 7
 1:10 S11

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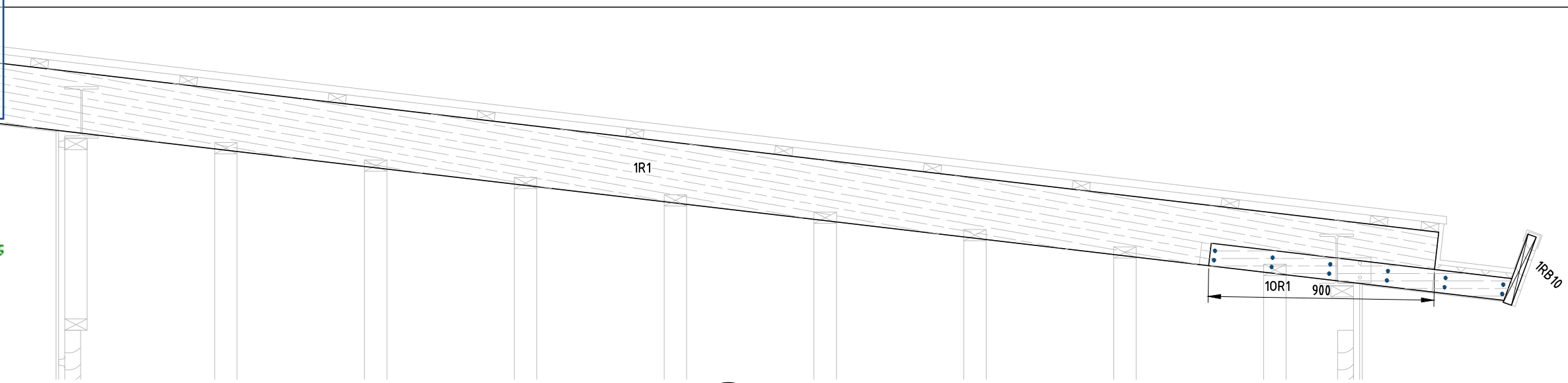
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 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

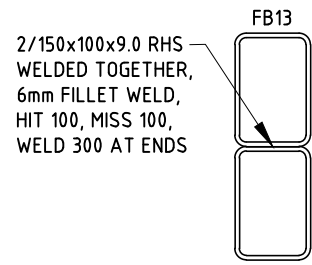
SHEET TITLE
 SECTIONS & DETAILS

PROJECT No.	DRAWING	REVISION
HWC-24261	S13	B

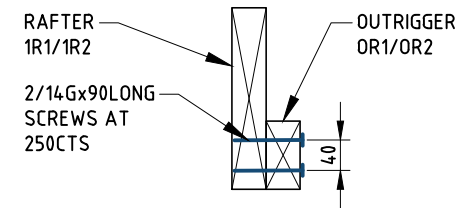
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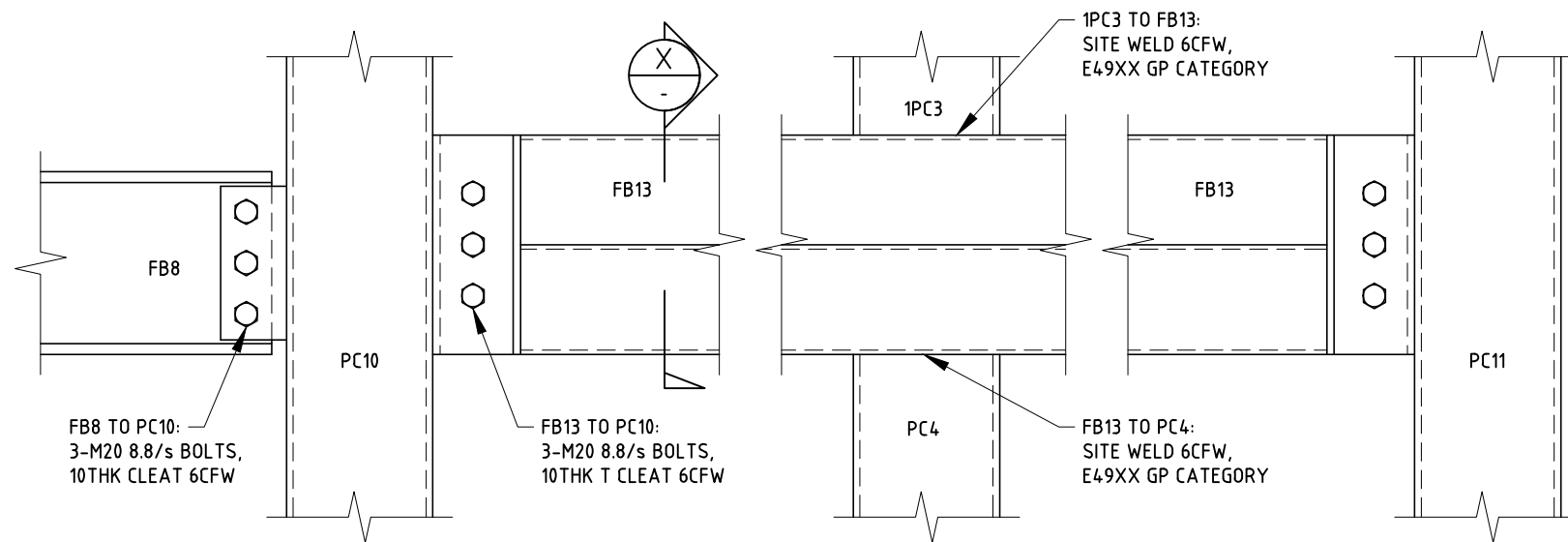
SECTION M
 1:20 S02



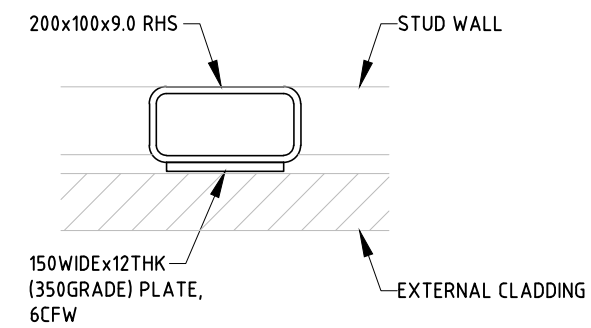
SECTION X
 1:10 -



TYPICAL RAFTER AND OUTRIGGER DETAIL
 (1:10)



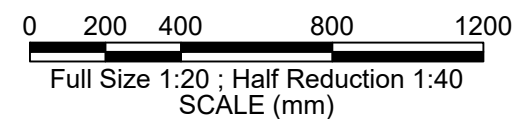
SECTION N
 1:10 S01



PC10/1PC3/PC4
 SECTION DETAIL
 (1:10)

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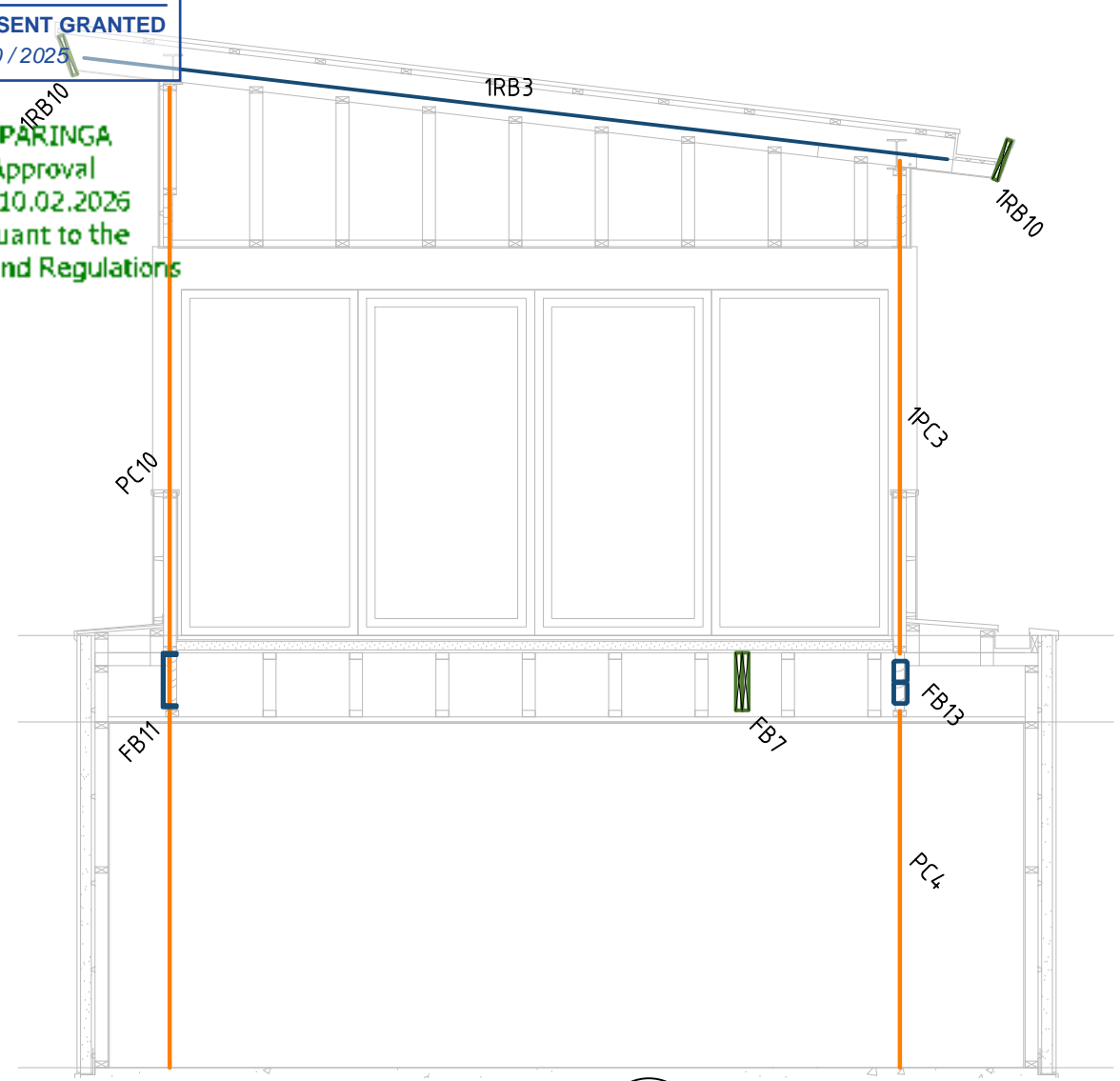
DESIGNED: J.S DATE: JUN'25
 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

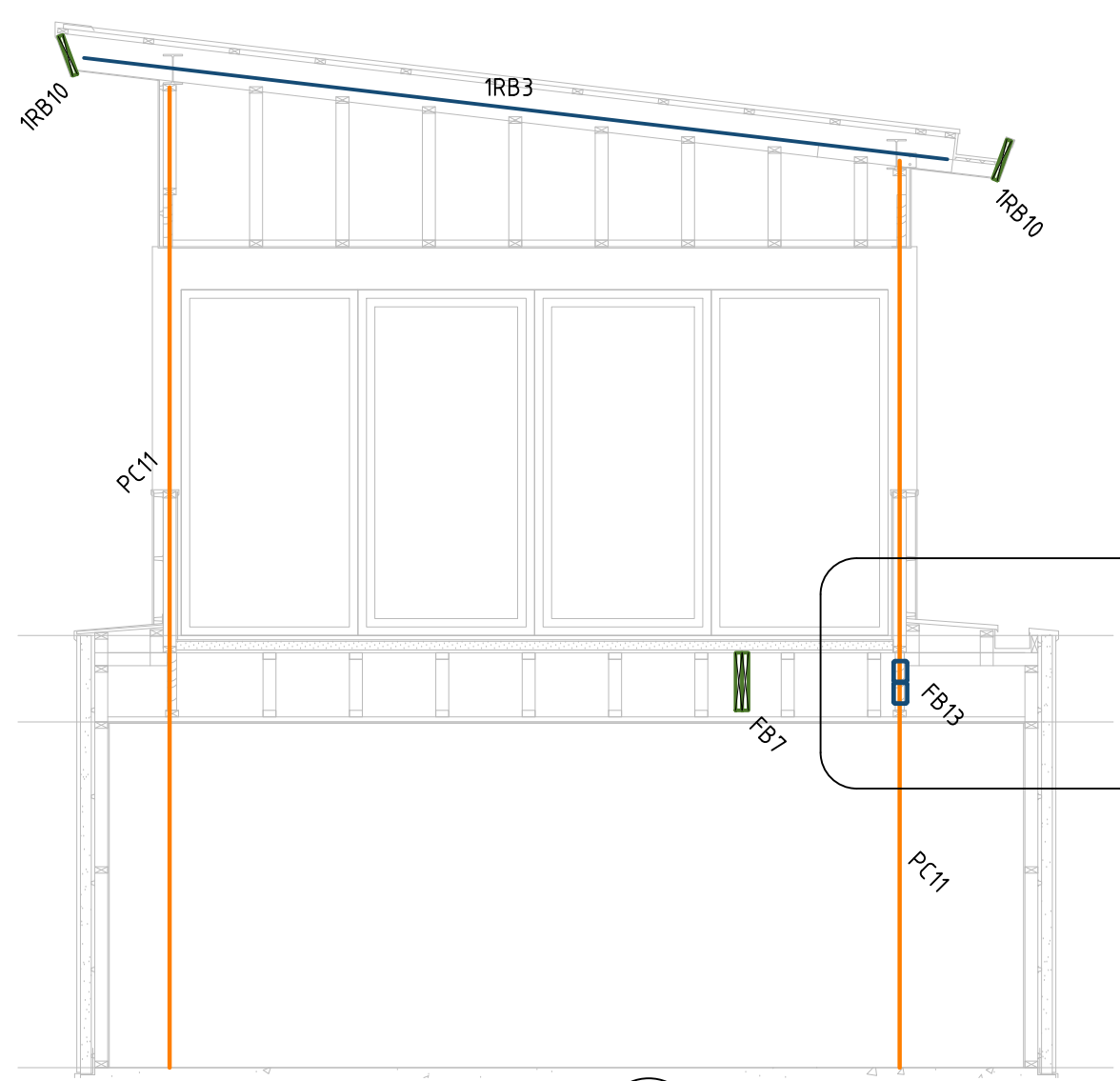
SHEET TITLE
 SECTIONS & DETAILS

PROJECT No. DRAWING REVISION
 HWC-24261 S14 B

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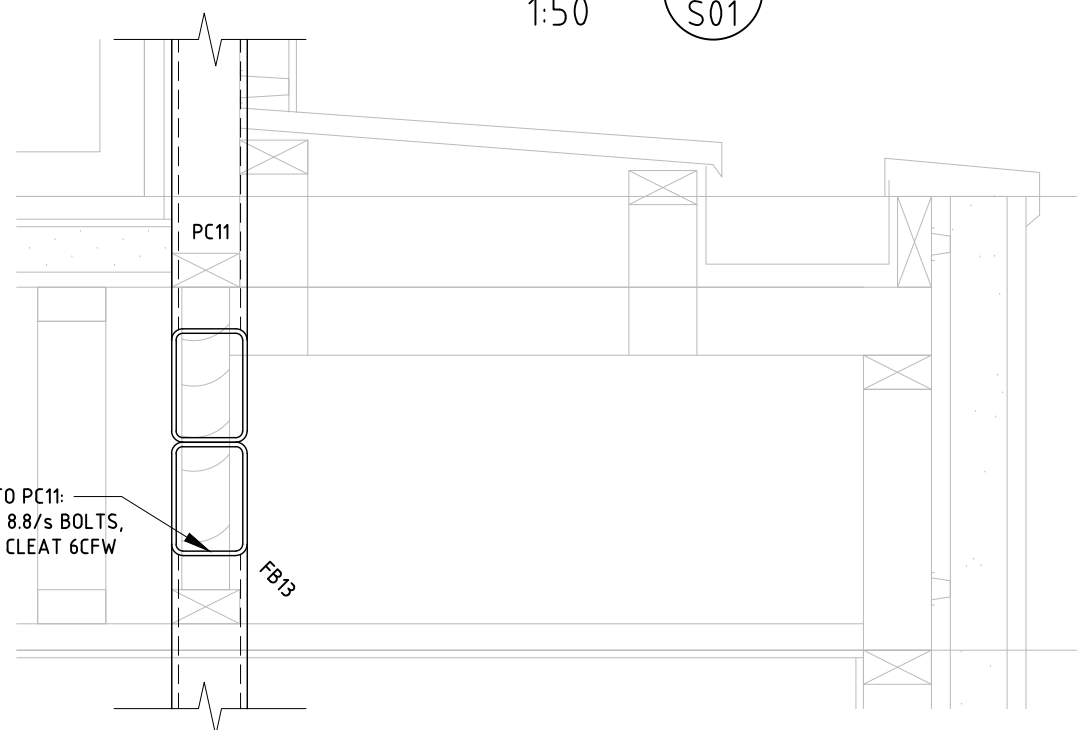


SECTION P
 1:50 (P/S01)



SECTION Q
 1:50 (Q/S01)

8
 -

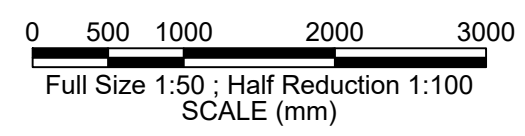


FB13 TO PC11:
 3-M20 8.8/s BOLTS,
 10THK CLEAT 6CFW

DETAIL 8
 1:10

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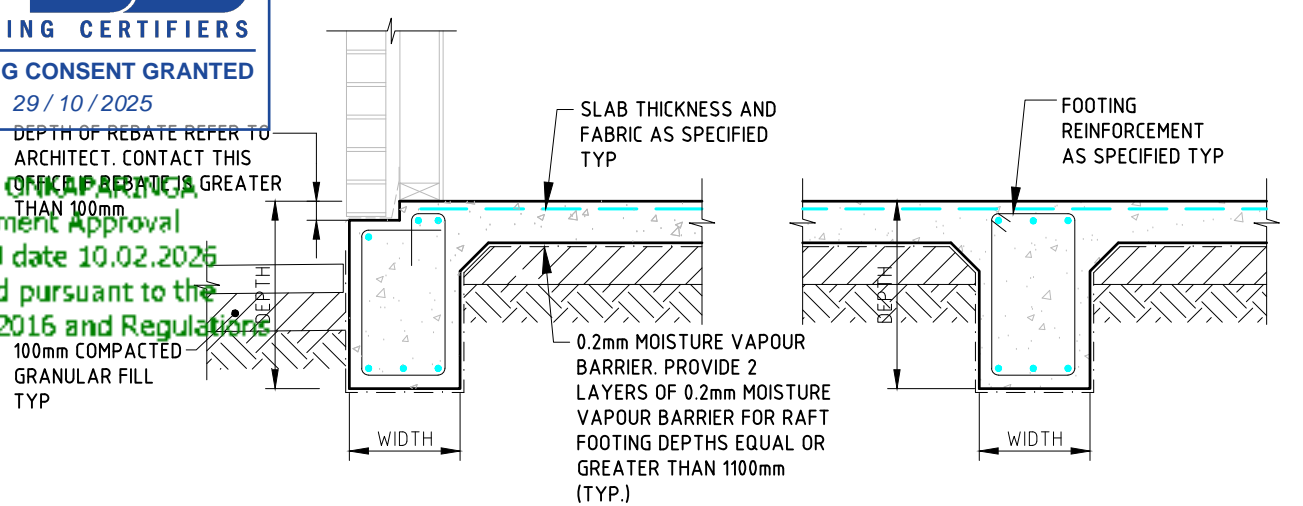
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PROJECT
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 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 SECTIONS & DETAILS

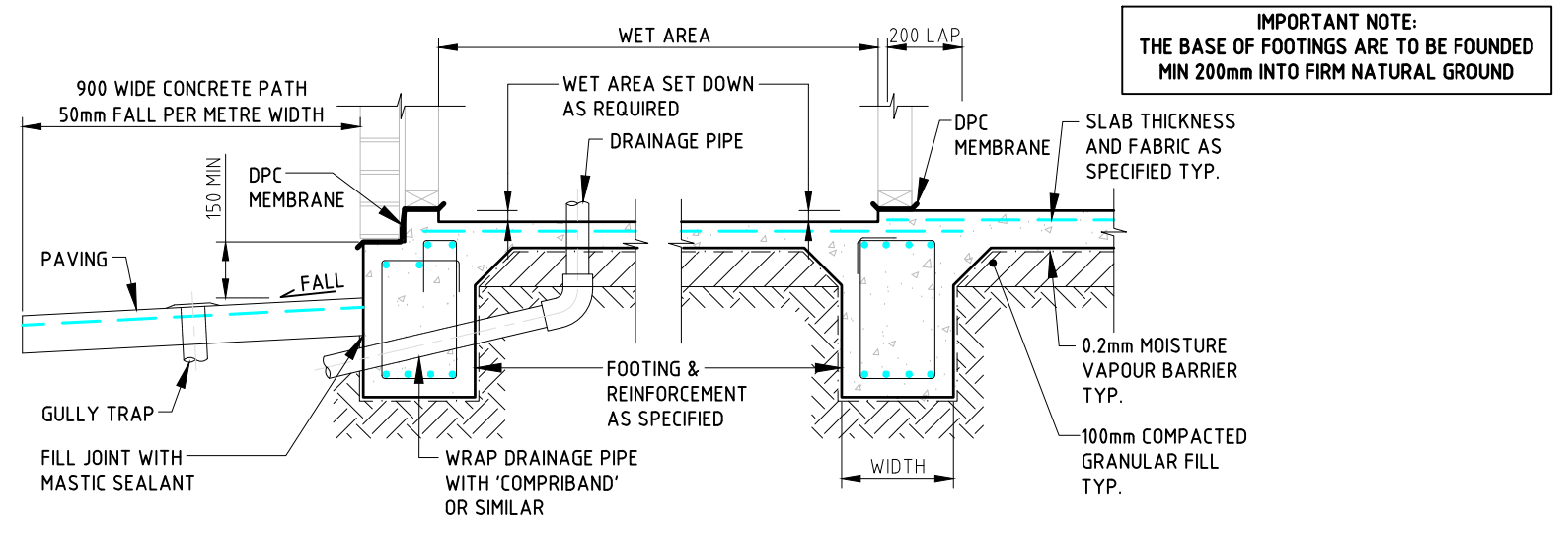
PROJECT No.	DRAWING	REVISION
HWC-24261	S15	A

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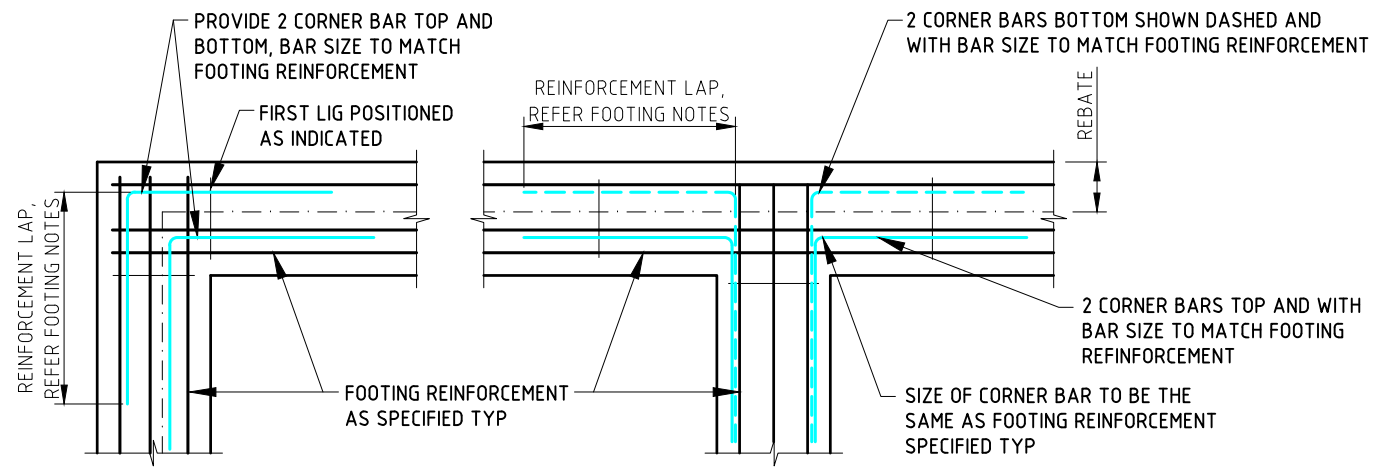
TYPICAL EXTERNAL RAFT FOOTING
(1:20)

TYPICAL INTERNAL RAFT FOOTING
(1:20)

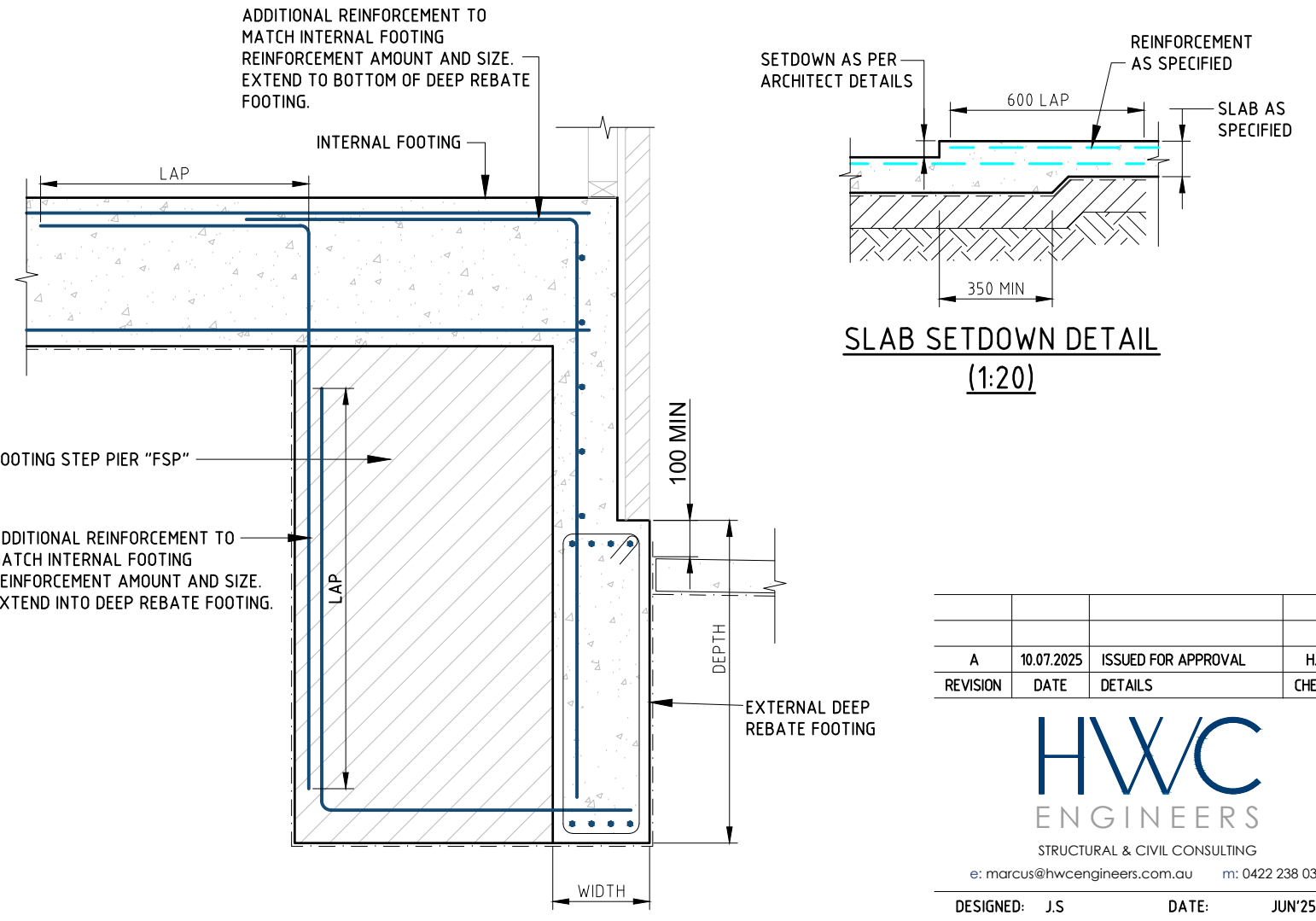


TYPICAL SECTION THROUGH WET AREA & GULLY TRAP RISER
(1:20)

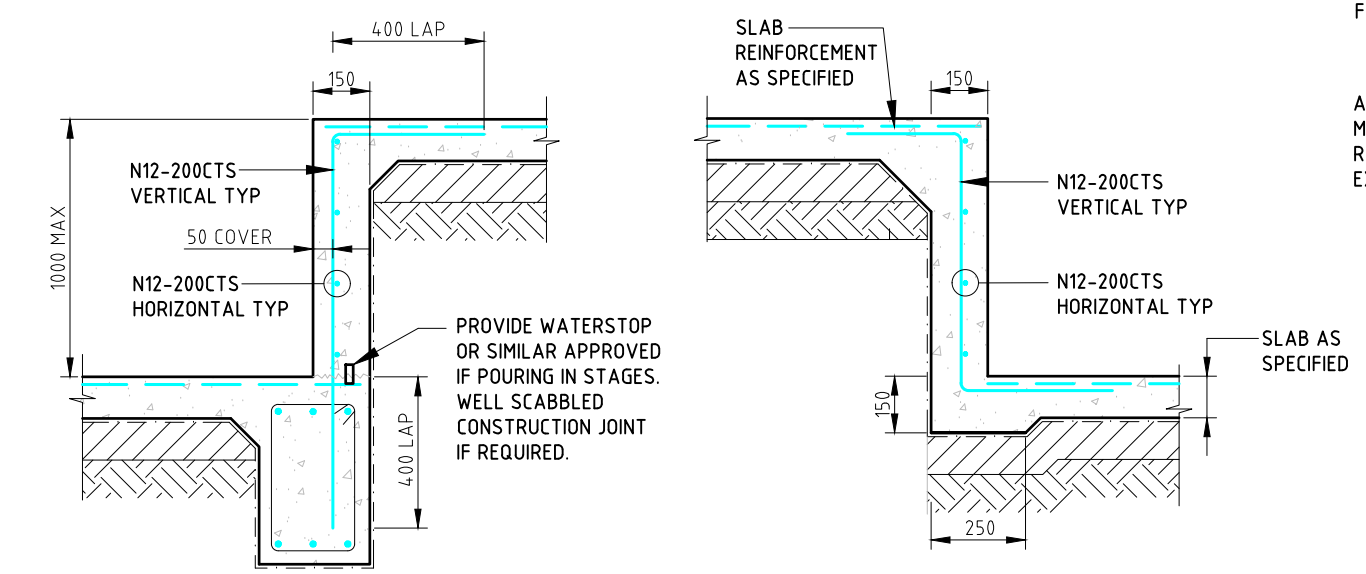
IMPORTANT NOTE:
THE BASE OF FOOTINGS ARE TO BE FOUNDED MIN 200mm INTO FIRM NATURAL GROUND



TYPICAL BEAM JUNCTION DETAILS
(1:20)



FOOTING STEP LAP PIER "FSP" DETAIL
(N.T.S)



TYPICAL STEP AT FOOTING DETAIL
(1:20)

TYPICAL SLAB STEP DETAIL
(1:20)

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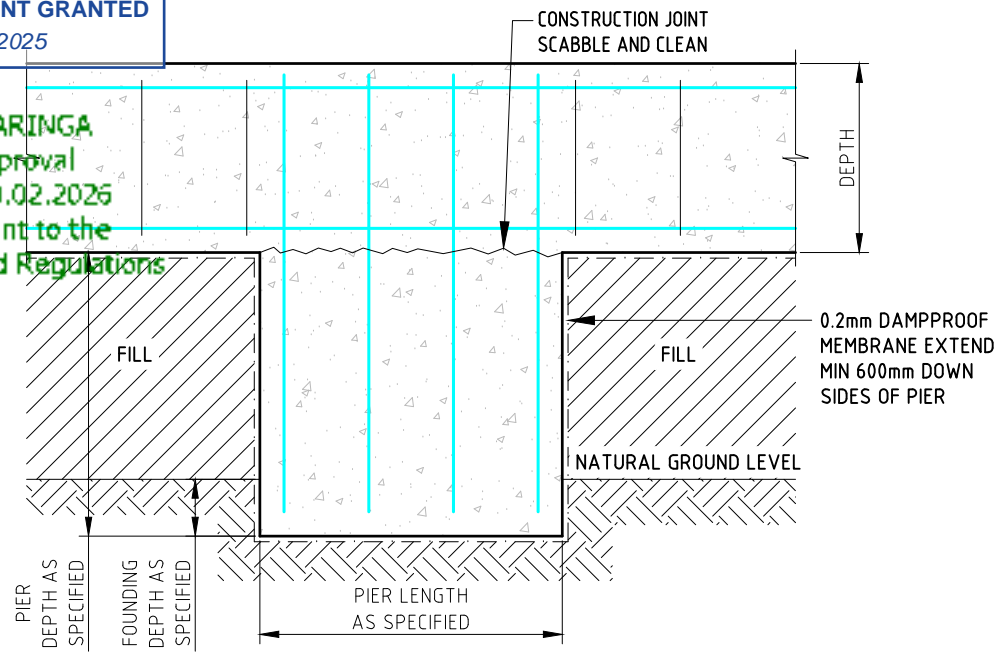
Full Size 1:20 ; Half Reduction 1:40
SCALE (mm)

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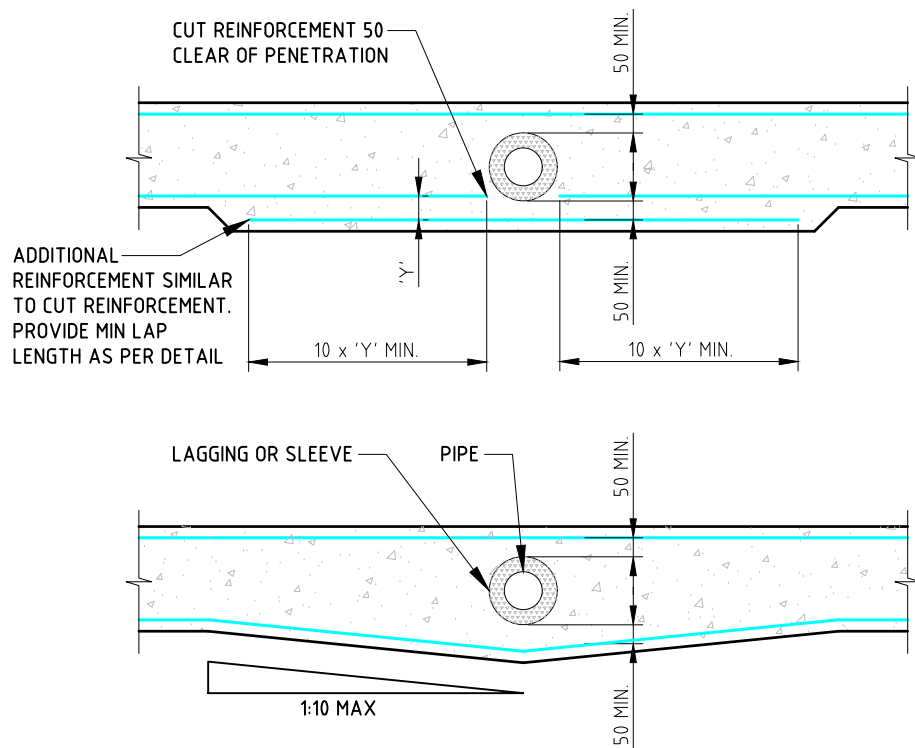
DESIGNED:	J.S	DATE:	JUN'25
DRAWN:	S.T.C	SHEET SIZE:	A3
PROJECT			
PROPOSED RESIDENTIAL DEVELOPMENT AT 418 ESPLANADE, MOANA FOR SOUTHERN ARCHITECTURE			
SHEET TITLE			
FOOTING DETAILS			
PROJECT No.	DRAWING	REVISION	
HWC-24261	FS1	A	

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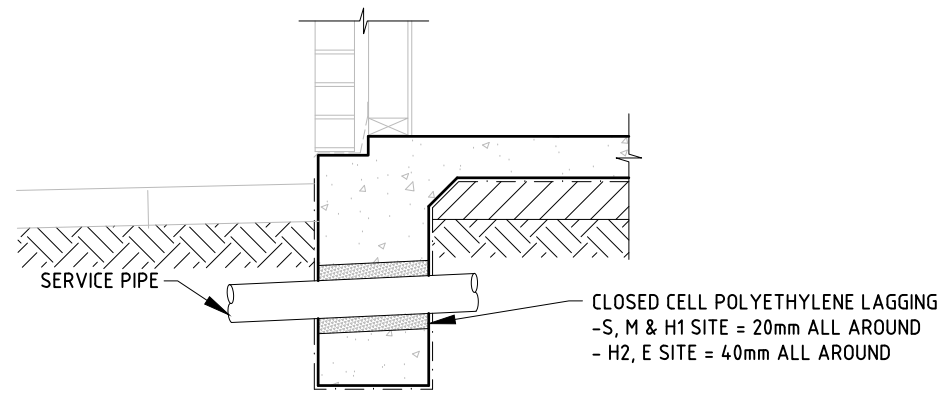


TYPICAL FOOTING PIER DETAIL
(1:20)

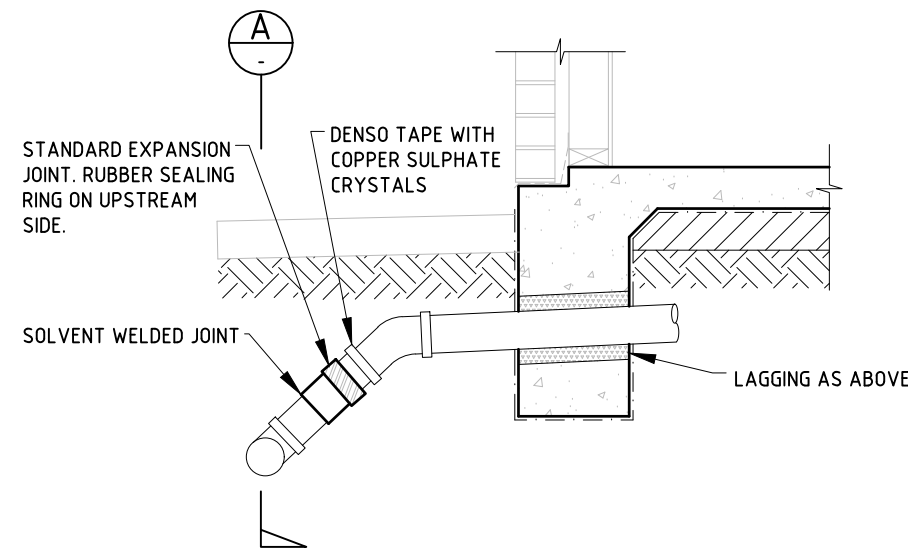
- NOTE:
- PIERS ONLY REQUIRED WHERE NECESSARY TO ACHIEVE REQUIRED FOUNDING DEPTH. LOCATIONS AND EXTENT AS SPECIFIED ON FOOTING PLAN.
 - WHERE PIER DEPTH IS GREATER THAN 500mm, PROVIDE 4-N12 BARS CENTRAL AS SHOWN.
 - LIGATURES ARE TO BE REDUCED TO 300 CTS BETWEEN PIERS



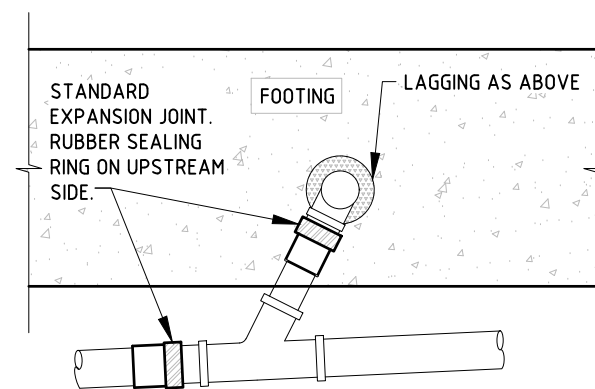
DETAILS WHERE PENETRATIONS UNAVOIDABLY CLASH WITH REINFORCEMENT
(1:20)



SERVICE PIPE LAGGING DETAILS
(1:20)



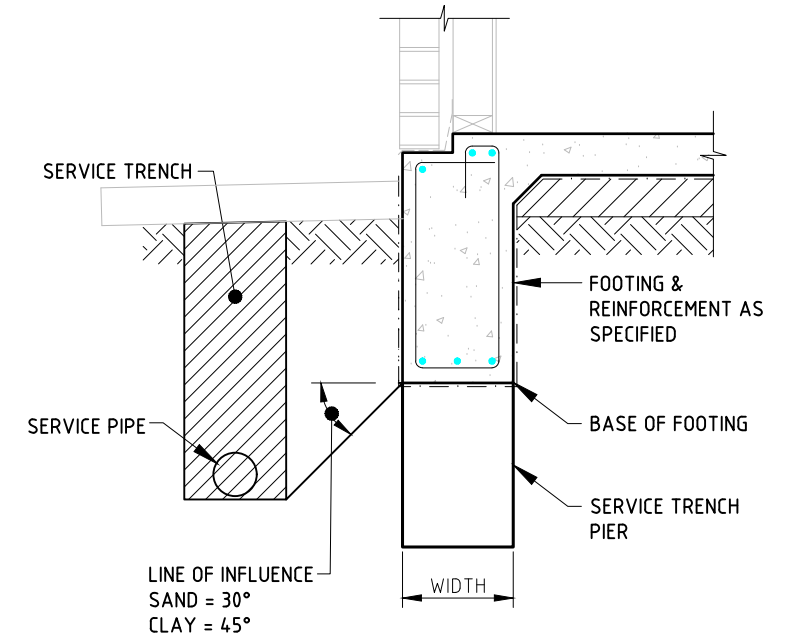
FLEXIBLE CONNECTION DETAIL FOR CLASS M, H & E SITES
(1:20)



SECTION A
(1:20)

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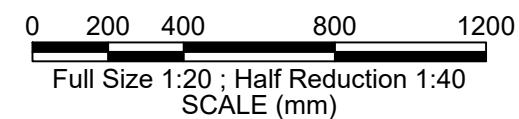
- NOTE:
- IF THE EDGE OF THE FOOTING'S LINE OF INFLUENCE INTERSECT WITH THE SERVICE PIPE AS SHOWN ABOVE, SERVICE TRENCH PIERS SHALL BE PROVIDED.
 - TYPICAL SERVICE TRENCH PIER SHALL BE 1200mm LONG OF MASS CONCRETE SPACED AT MAXIMUM OF CENTRE SPACING 3000mm FOUNDED AT THE SAME LEVEL AS THE SERVICE PIPE.
 - SERVICE TRENCH MUST BE CAREFULLY BACKFILLED WITH APPROVED MATERIAL AND COMPACTED TO AN ACCEPTABLE STANDARD.



SERVICE TRENCH PIER DETAIL
(1:20)

- NOTE:
- SERVICE PIPE SHALL BE PLACED AT THE MID DEPTH OF THE FOOTING AND A MINIMUM OF 50mm COVER SHALL BE PROVIDED BETWEEN THE SERVICE PIPE AND THE REINFORCING STEEL.
 - IF PIPE IS CLOSE TO BOTTOM REINFORCEMENT, PROVIDE ADDITIONAL EXCAVATION AND LAPPING REINFORCEMENTS SO THE CORRECT COVER TO THE SERVICE PIPE IS MAINTAINED.
 - STANDARD EXPANSION JOINT SHALL BE PROVIDED FOR CLASS M, H & E SITE IN STORMWATER AND SEWER PIPES AT LOCATION WHERE THEY EXIT FROM THE EXTERNAL FOOTING.
 - FLEXIBLE JOINT SHALL BE SEALED TO PROTECT AGAINST PLANT ROOT AND GRIME INTRUSION WITH DENSO TAPE. THE DENSO TAPE SHALL BE LAID OUT IN STRAIGHT AND SPRINKLED WITH COPPER SULPHATE CRYSTALS PRIOR TO WRAPPING.

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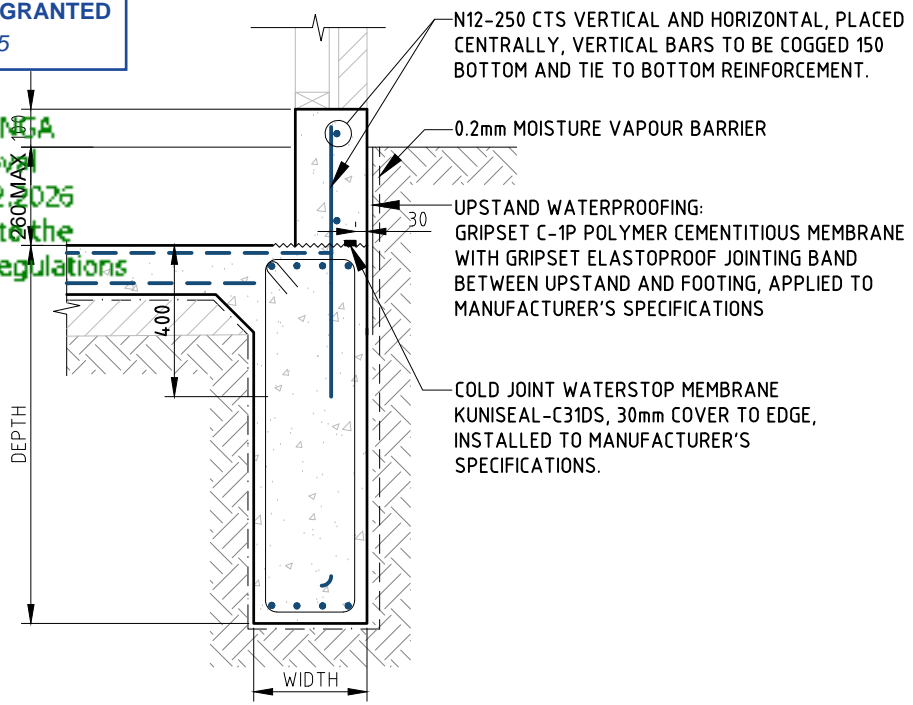
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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

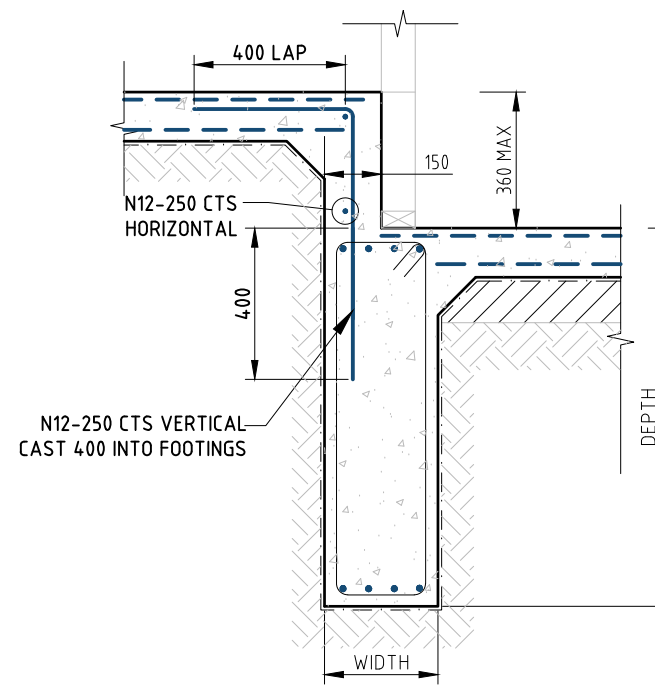
SHEET TITLE
FOOTING DETAILS

PROJECT No. HWC-24261 DRAWING FS2 REVISION A

CITY OF ONKAPARINGA
 Development Approval
 Approval date 10.02.2025
 Endorsed pursuant to the
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SECTION A
 1:20
 F01



SECTION B
 1:20
 F01

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Full Size 1:20 ; Half Reduction 1:40
 SCALE (mm)

REVISION	DATE	DETAILS	CHECKED
A	10.07.2025	ISSUED FOR APPROVAL	H.W.C

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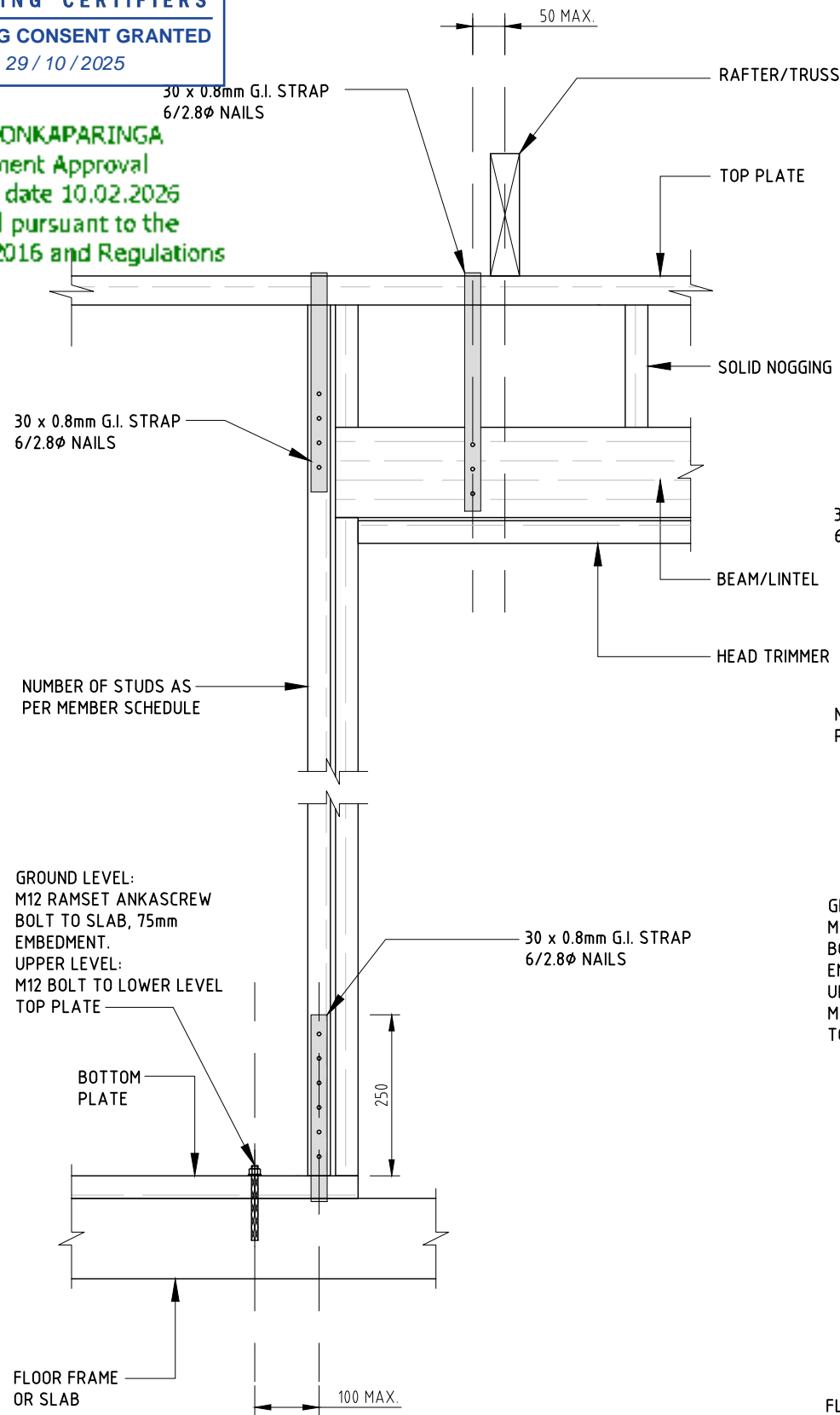
DESIGNED: J.S DATE: JUN'25
 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
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 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

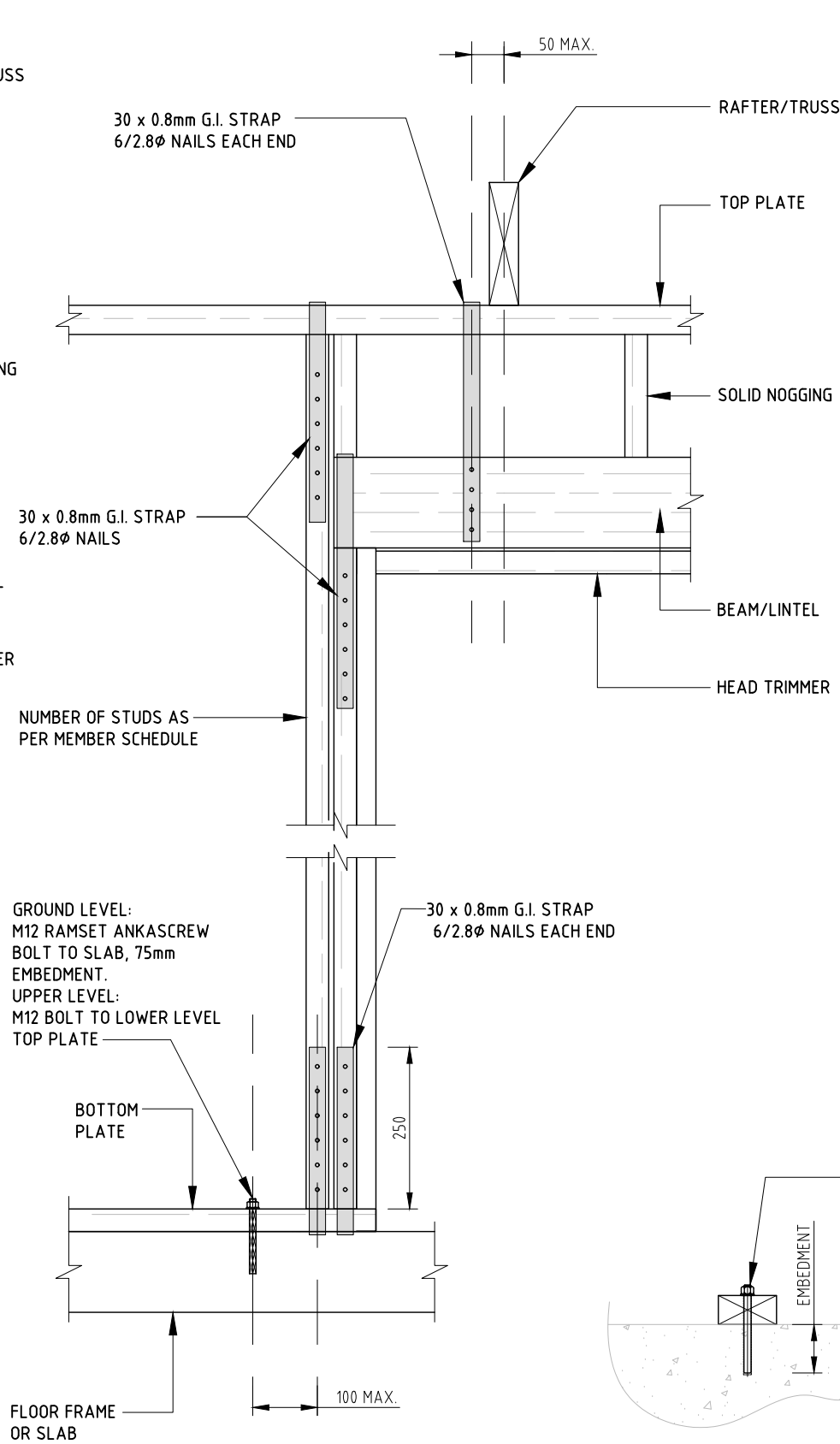
SHEET TITLE
 FOOTING DETAILS

PROJECT No. DRAWING REVISION
 HWC-24261 FS4 A

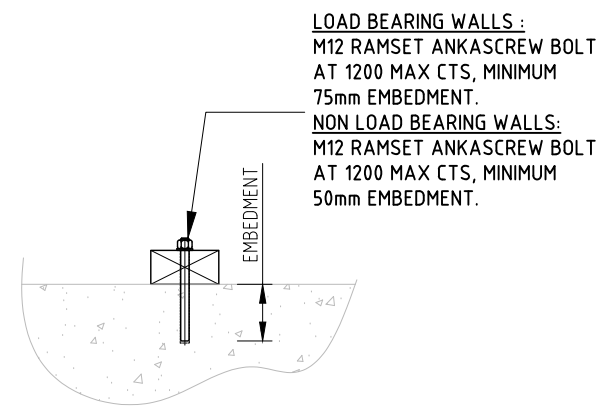
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TYPICAL LINTEL SPANNING LESS THAN 1.8m
TIE-DOWN DETAIL
 (1:10)

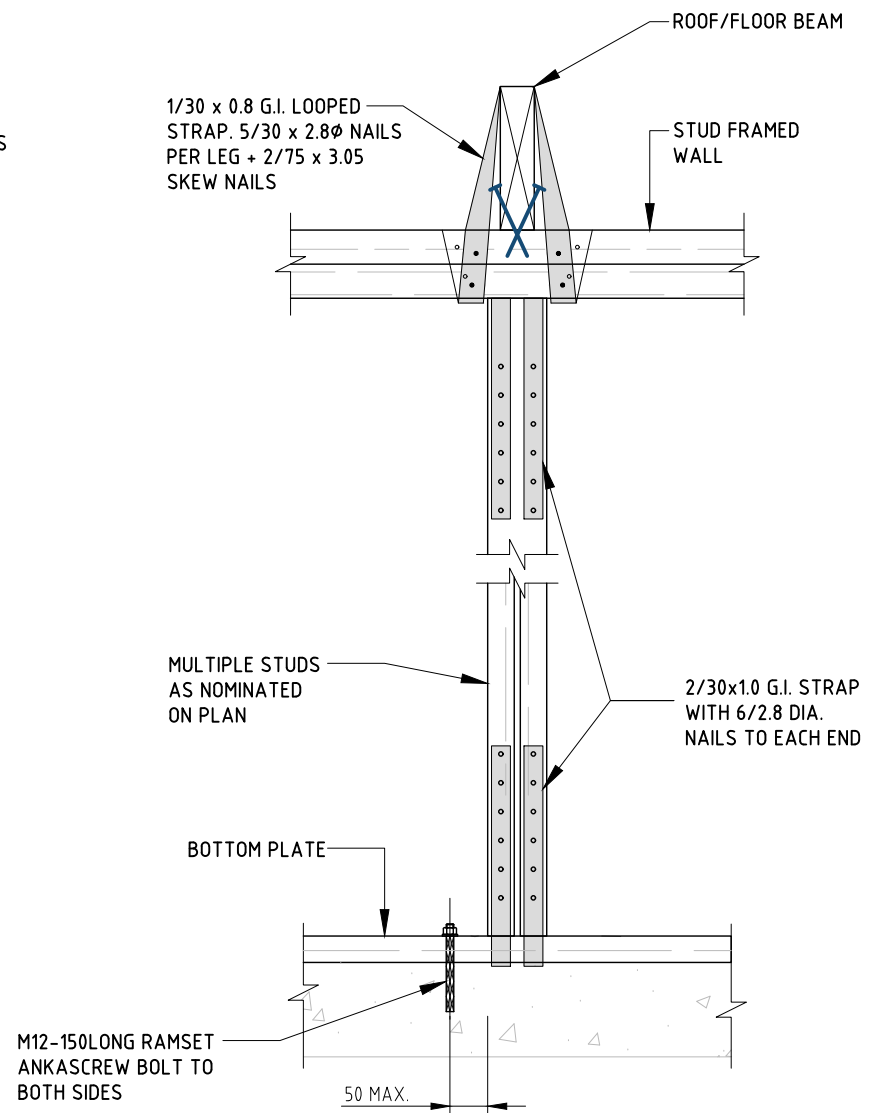


TYPICAL LINTEL SPANNING 1.8m TO 3.6m
TIE-DOWN DETAIL
 (1:10)



TYPICAL BOTTOM PLATE TO SLAB
CONNECTION DETAIL
 (1:10)

LOAD BEARING WALLS :
 M12 RAMSET ANKASCREW BOLT
 AT 1200 MAX CTS, MINIMUM
 75mm EMBEDMENT.
NON LOAD BEARING WALLS:
 M12 RAMSET ANKASCREW BOLT
 AT 1200 MAX CTS, MINIMUM
 50mm EMBEDMENT.



TYPICAL ROOF/FLOOR BEAM TO WALL FRAME
CONNECTION DETAIL
 (1:10)

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 SCALE (mm)

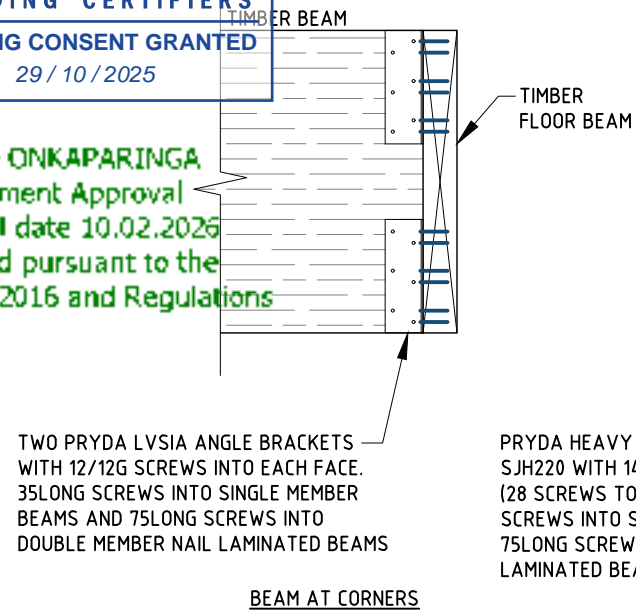
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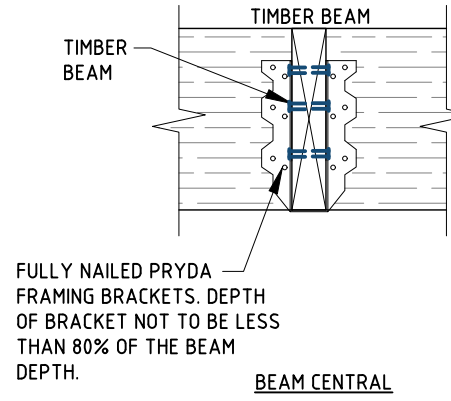
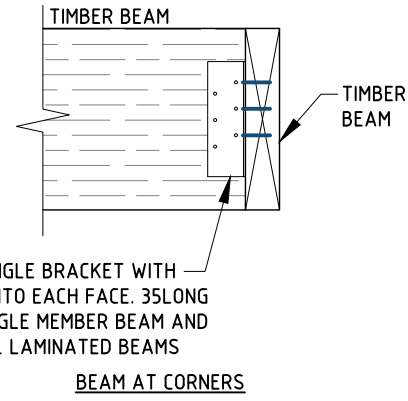
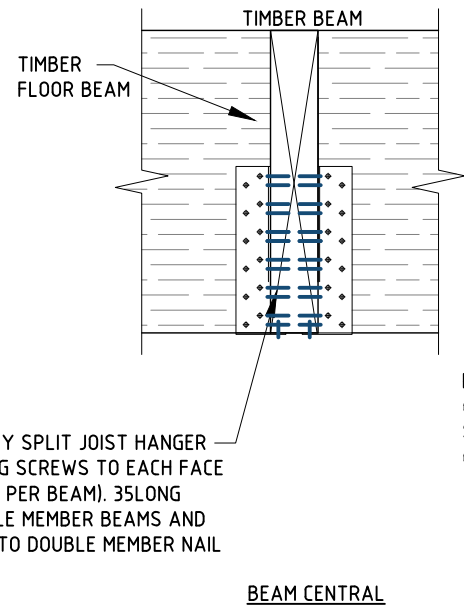
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DESIGNED:	J.S	DATE:	JUN'25
DRAWN:	S.T.C	SHEET SIZE:	A3
PROJECT			
PROPOSED RESIDENTIAL DEVELOPMENT AT 418 ESPLANADE, MOANA FOR SOUTHERN ARCHITECTURE			
SHEET TITLE			
DETAILS			
PROJECT No.	DRAWING	REVISION	
HWC-24261	SS1	A	

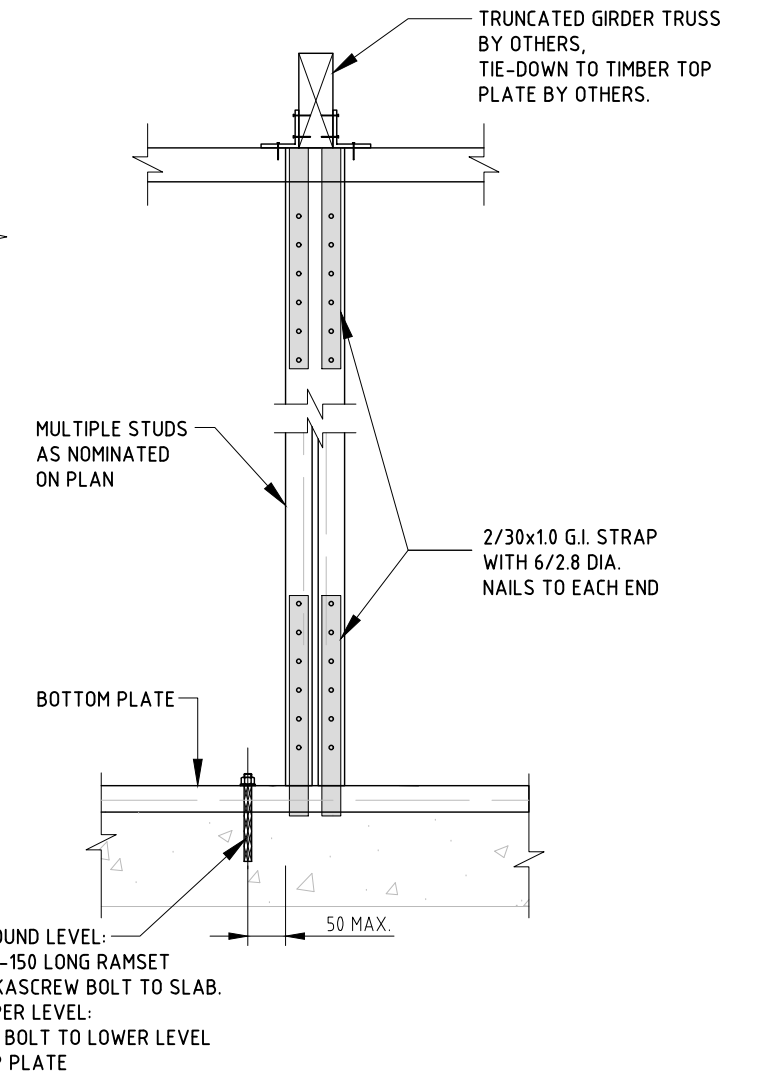
CITY OF ONKAPARINGA
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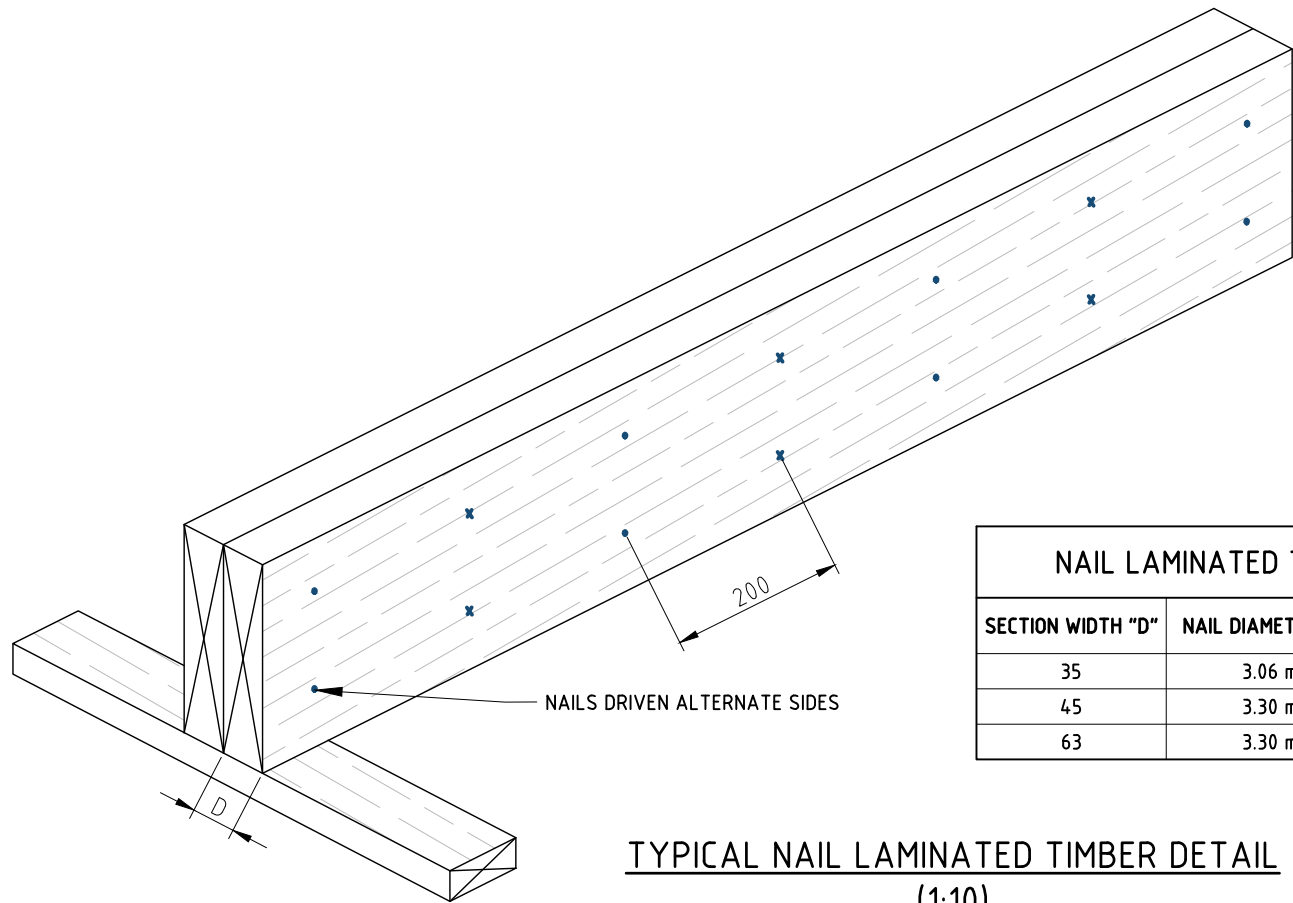
TIMBER FLOOR BEAM TO TIMBER FLOOR BEAM CONNECTION DETAIL
 (1:10)



TIMBER ROOF BEAM TO ROOF BEAM CONNECTION DETAIL
 (1:10)

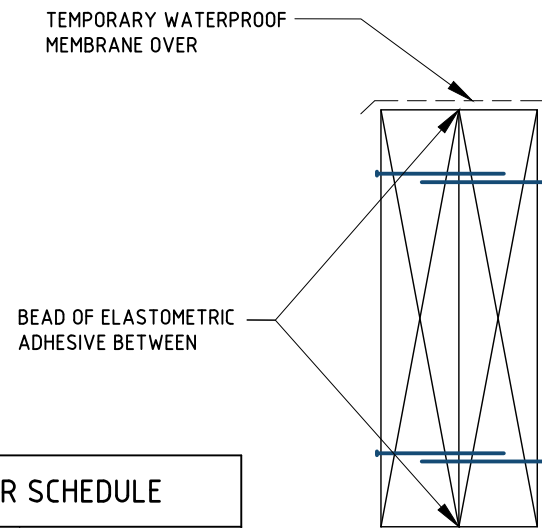


TRUNCATED GIRDER TRUSS TO WALL FRAME CONNECTION DETAIL
 (1:10)

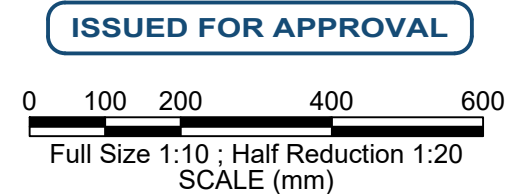


TYPICAL NAIL LAMINATED TIMBER DETAIL
 (1:10)

NAIL LAMINATED TIMBER SCHEDULE		
SECTION WIDTH "D"	NAIL DIAMETER (MIN.)	NAIL LENGTH (MIN.)
35	3.06 mm	75mm
45	3.30 mm	90mm
63	3.30 mm	100mm



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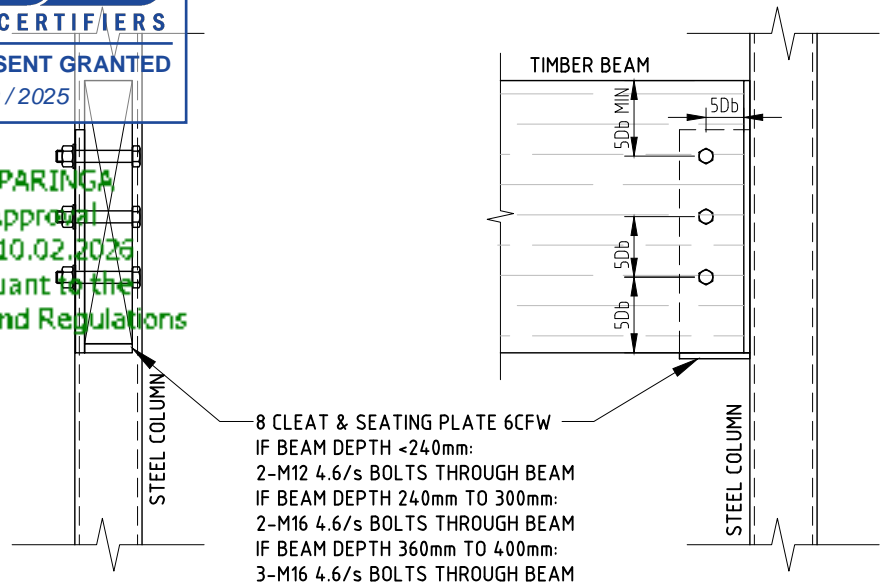
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DESIGNED: J.S DATE: JUN'25
 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

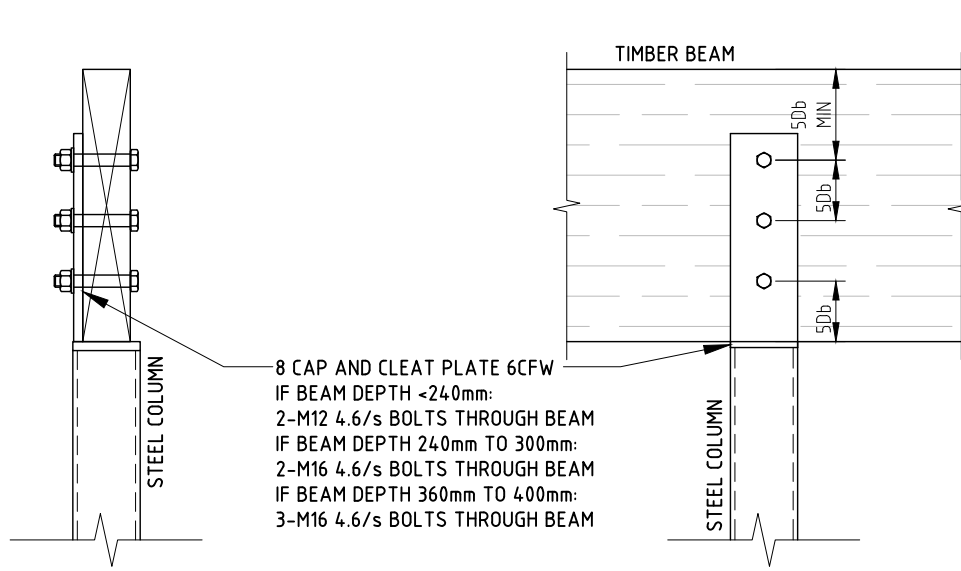
PROJECT No.	DRAWING	REVISION
HWC-24261	SS2	A

CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2025
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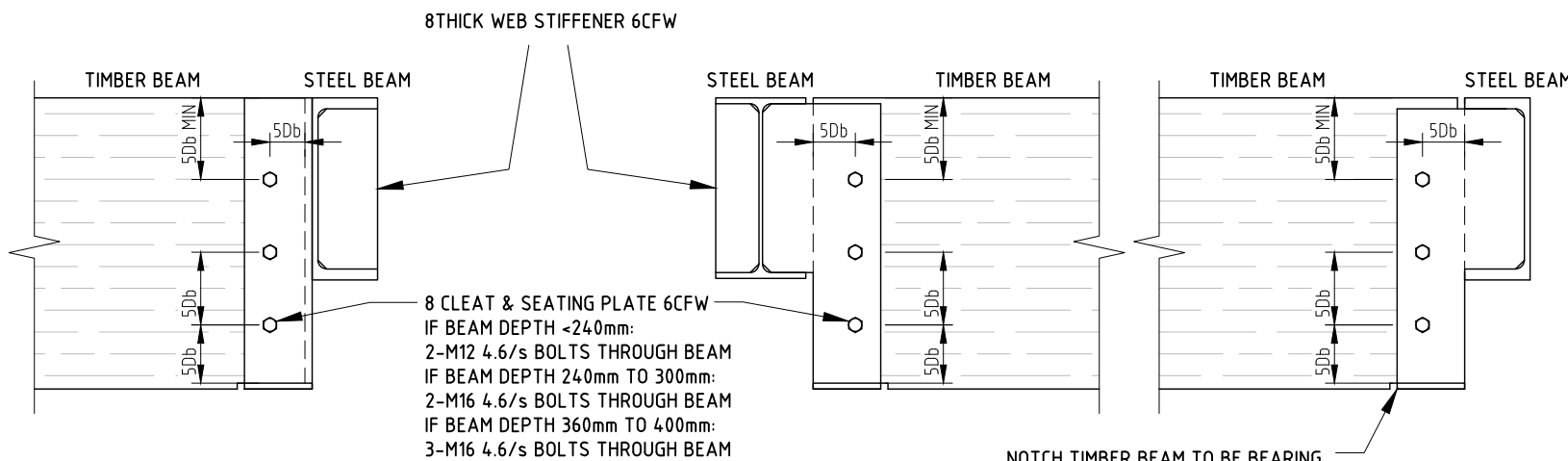


SEATING PLATE WIDTH TO MATCH
TIMBER BEAM WIDTH

TYPICAL TIMBER BEAM TO STEEL COLUMN DETAIL
(1:10)

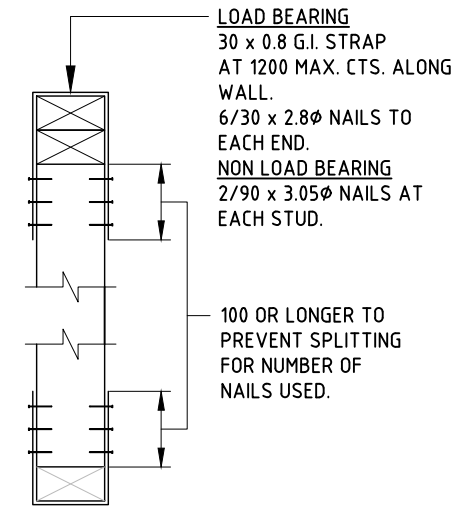


TYPICAL TIMBER BEAM OVER STEEL COLUMN DETAIL
(1:10)

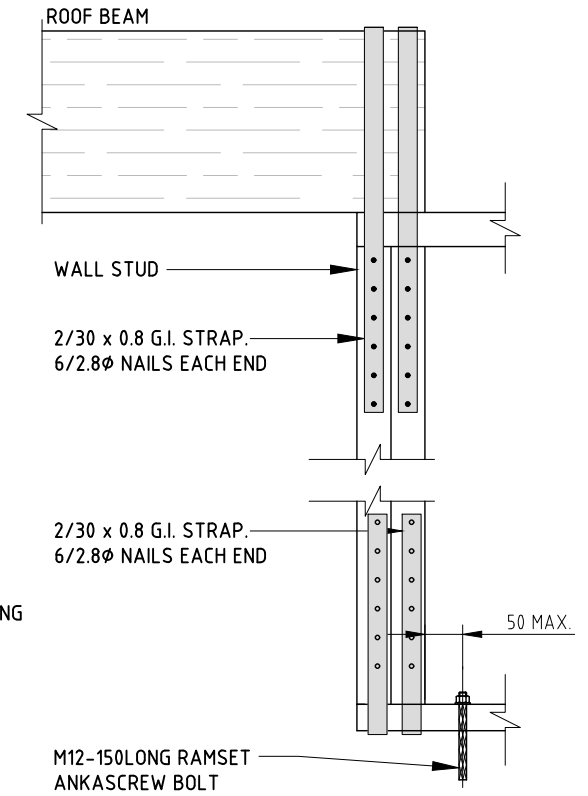


TYPICAL TIMBER BEAM TO STEEL BEAM CONNECTION
(1:10)

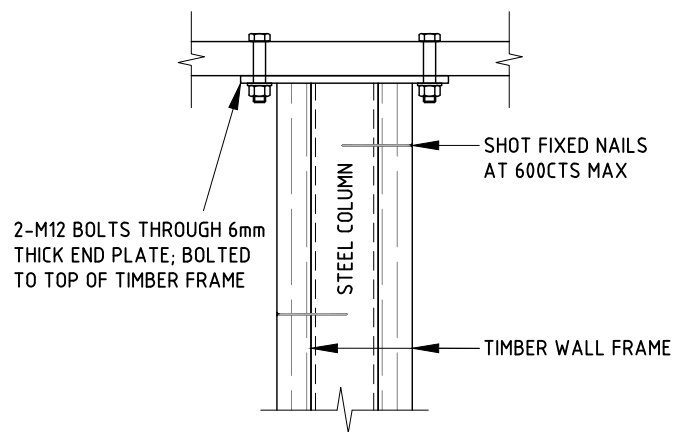
NOTCH TIMBER BEAM TO BE BEARING
ONTO SEATING PLATE. SEATING
PLATE TO MATCH WIDTH OF TIMBER
BEAM



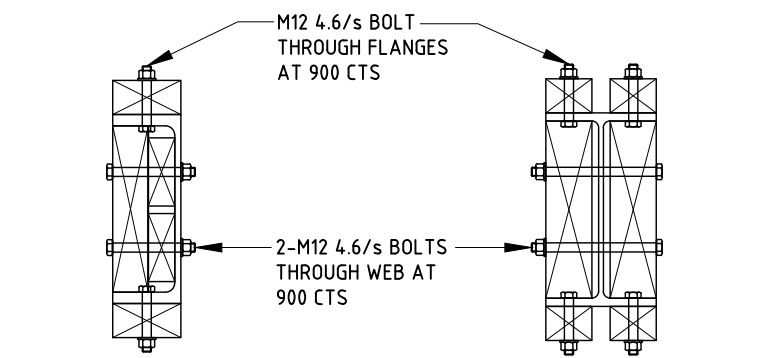
**TYPICAL STUD TO BOTTOM & TOP
PLATE CONNECTION DETAIL**
(1:10)



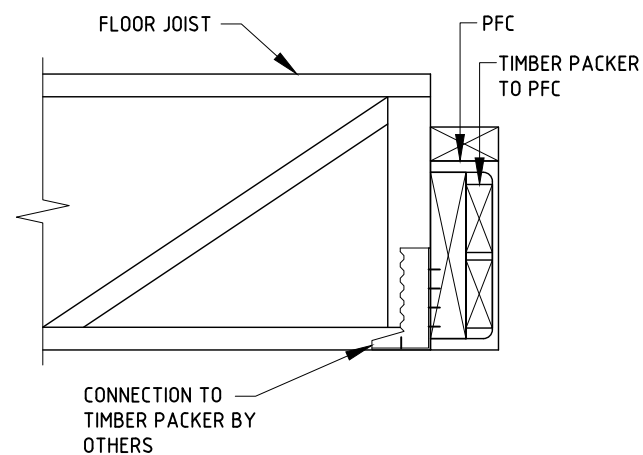
**ROOF BEAM TO
WALL FRAME CONNECTION**
(1:10)



**TYPICAL STEEL COLUMN TO TIMBER
WALL FRAME CONNECTION DETAIL**
(1:10)



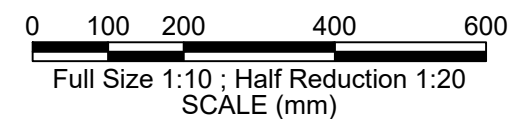
TYPICAL TIMBER PACKER TO STEEL BEAM FIXING
(1:10)



**TYPICAL FLOOR JOIST/TRUSS
TO STEEL BEAM FIXING**
(1:10)

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A	31.07.2025			

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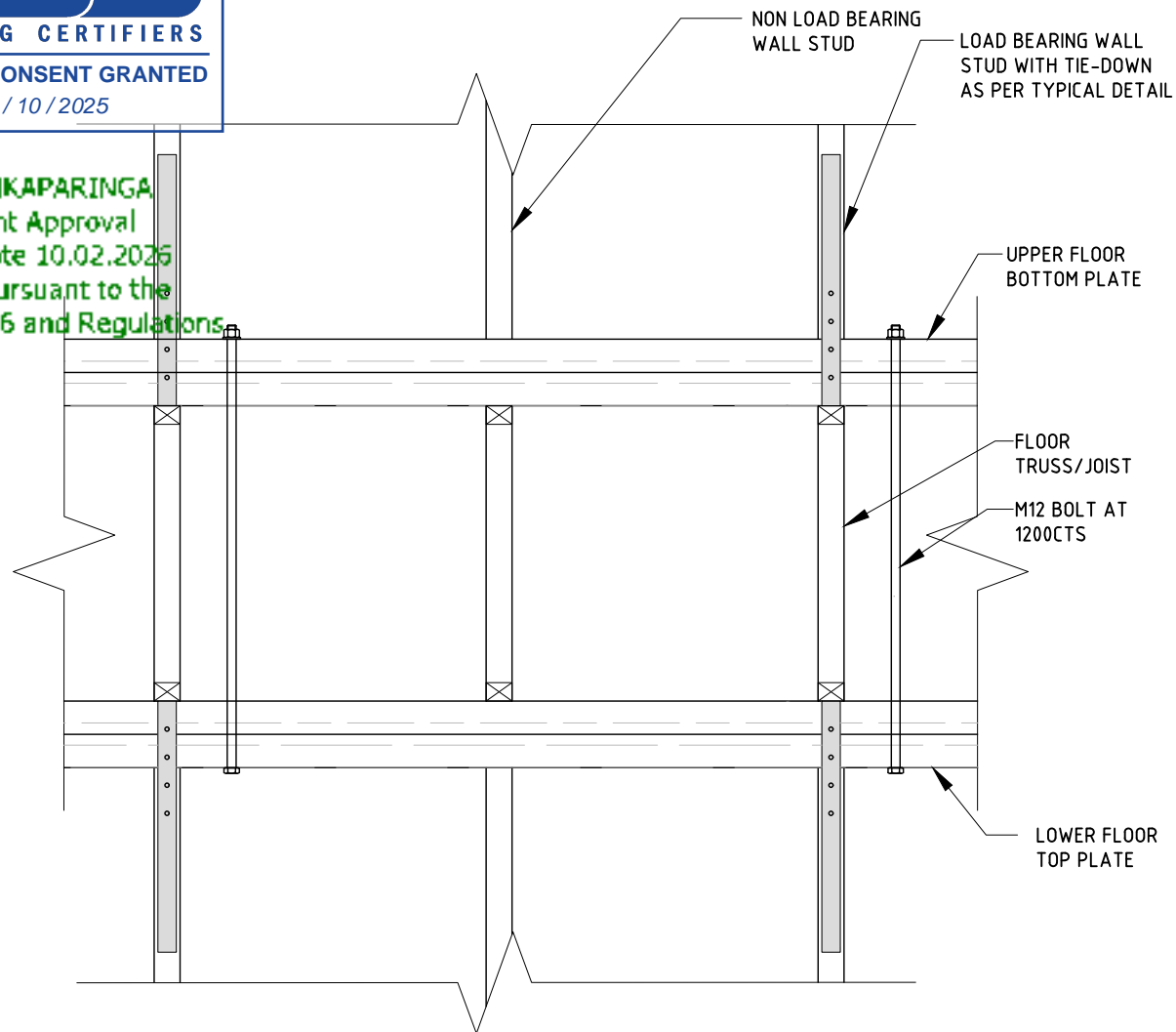
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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

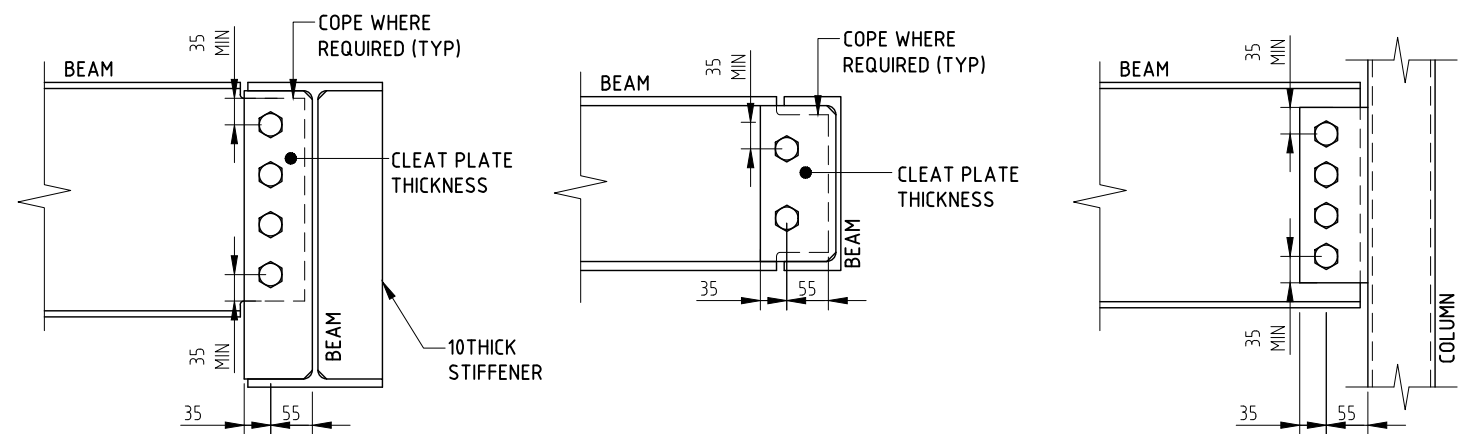
SHEET TITLE
DETAILS

PROJECT No. DRAWING REVISION
HWC-24261 SS3 A

CITY OF ONKAPARINGA
Development Approval
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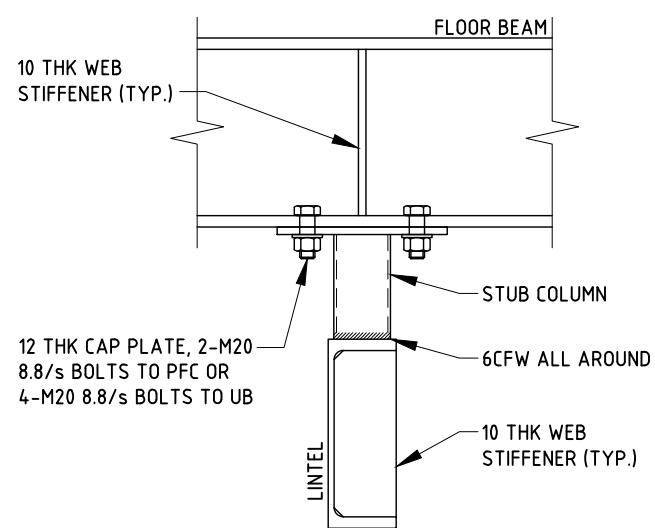


TYPICAL UPPER WALL BOTTOM PLATE TO LOWER WALL TOP PLATE CONNECTION DETAIL
(1:10)

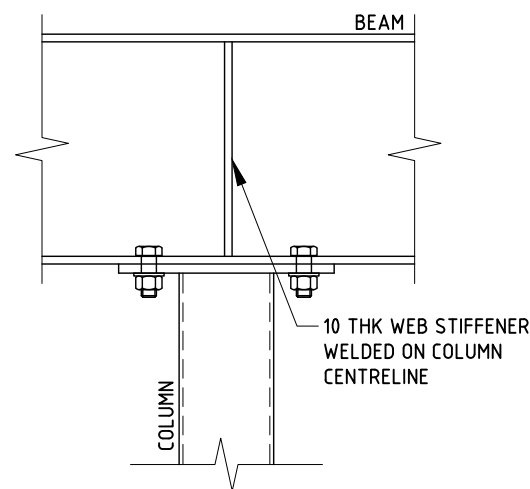


BEAM TO BEAM/COLUMN CONNECTION SCHEDULE		
MEMBER SIZE	BOLTS (8.8/s)	CLEAT PLATE THICKNESS
150UB, 150PFC, 150UC	2-M16	10
180UB, 180PFC, 200UB, 200PFC, 200UC, 230PFC	2-M20	10
250PFC, 250UB, 250UC	3-M20	10
300PFC, 310UB, 310UC, 360UB	3-M20	10
380PFC, 410UB	4-M20	12
460UB	5-M20	12
530UB	6-M20	12
610UB	7-M20	12

TYPICAL BEAM TO BEAM/COLUMN CONNECTION
(1:10)



TYPICAL STUB COLUMN TO BEAM/LINTEL CONNECTION
(1:10)



BEAM TO COLUMN CONNECTION SCHEDULE		
MEMBER SIZE	BOLTS (8.8/s)	CAP PLATE THICKNESS
UB/UC	4-M20	12
PFC	2-M20	12

TYPICAL BEAM OVER COLUMN CONNECTION
(1:10)

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SCALE (mm)

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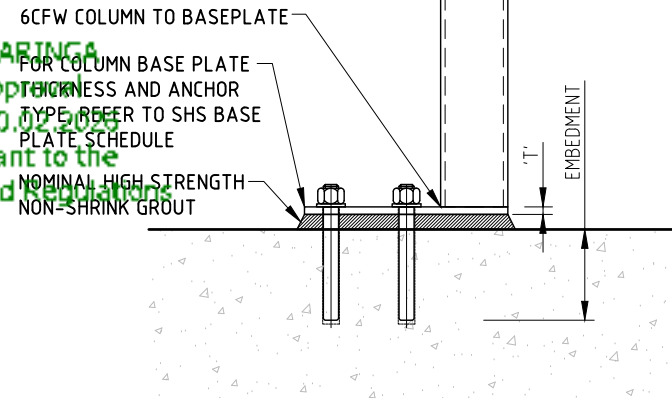
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DRAWN: S.T.C SHEET SIZE: A3

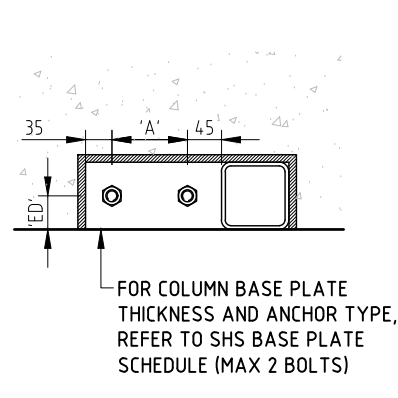
PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
AT 418 ESPLANADE, MOANA
FOR SOUTHERN ARCHITECTURE

SHEET TITLE		
DETAILS		
PROJECT No.	DRAWING	REVISION
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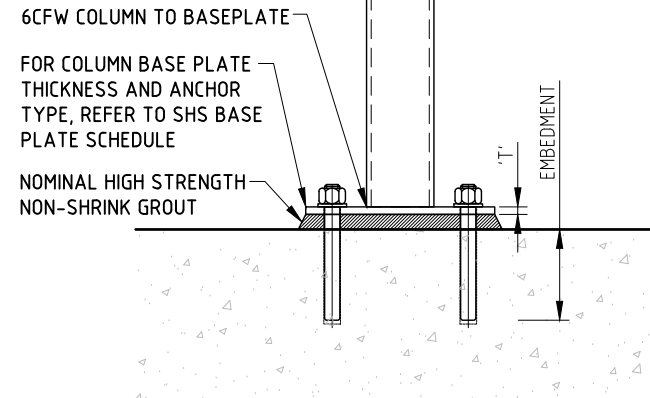
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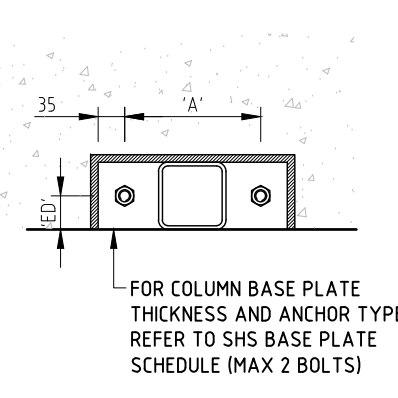
PLAN

SHS BASE PLATE SCHEDULE						
COLUMNS	BOLTS/ANCHORS	DIMENSIONS				GROUT (mm)
		'A'	'T'	'ED'	EMBEDMENT	
C1/C2/C20	2-M16 RAMSET CHEMSET REO 502 PLUS	100	12	45	200 MIN.	20

TYPICAL COLUMN (SHS) BASE CONNECTION DETAILS
(2 BOLT CONNECTION TYPE 1)
(1:10)



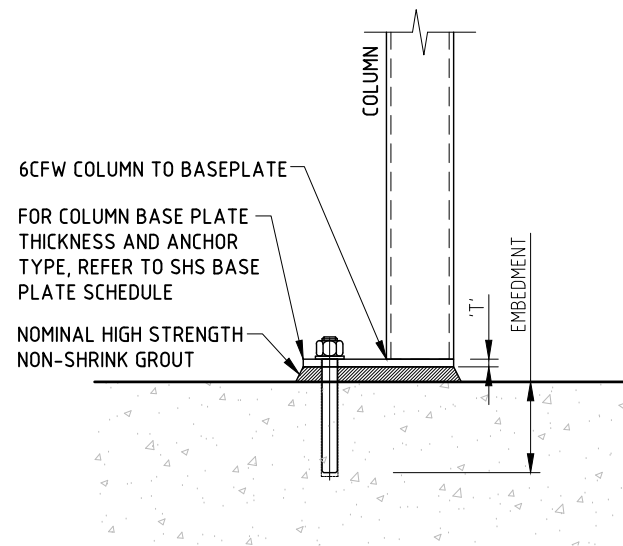
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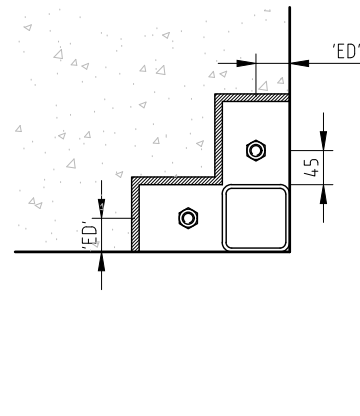
PLAN

SHS BASE PLATE SCHEDULE						
COLUMNS	BOLTS/ANCHORS	DIMENSIONS				GROUT (mm)
		'A'	'T'	'ED'	EMBEDMENT	
C1/C2/C20	2-M16 RAMSET CHEMSET REO 502 PLUS	180	12	45	200 MIN.	20

TYPICAL COLUMN (SHS) BASE CONNECTION DETAILS
(2 BOLT CONNECTION TYPE 2)
(1:10)



ELEVATION



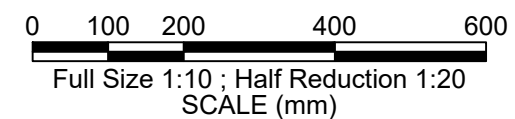
PLAN

SHS BASE PLATE SCHEDULE						
COLUMNS	BOLTS/ANCHORS	DIMENSIONS				GROUT (mm)
		'A'	'T'	'ED'	EMBEDMENT	
C1/C2	2-M16 RAMSET CHEMSET REO 502 PLUS	-	12	45	200 MIN.	20

TYPICAL COLUMN (SHS) BASE CONNECTION DETAILS
(2 BOLT CONNECTION TYPE 3)
(1:10)

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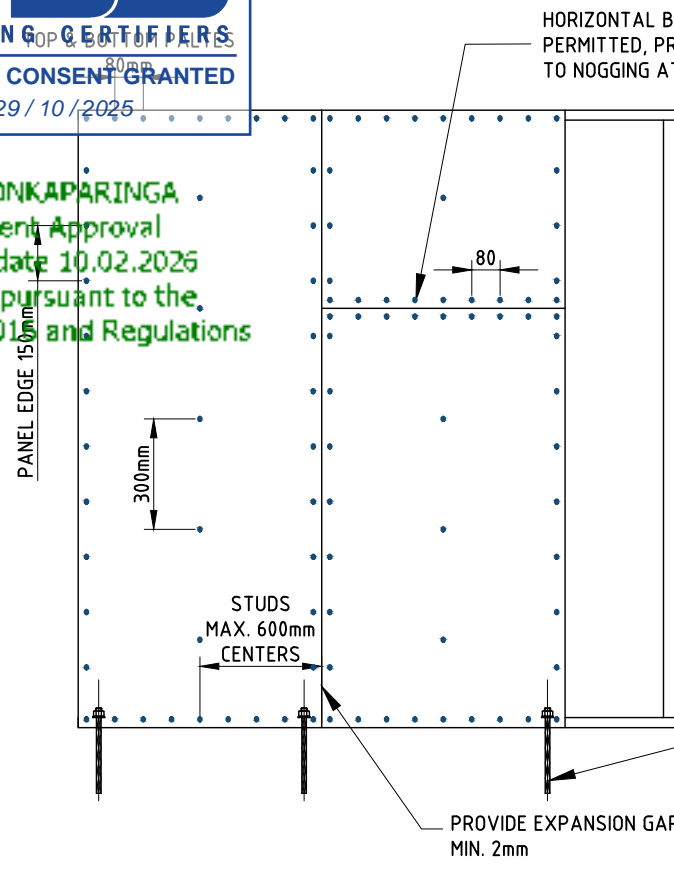
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PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT 418 ESPLANADE, MOANA
 FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 DETAILS

PROJECT No. DRAWING REVISION
 HWC-24261 SS5 A

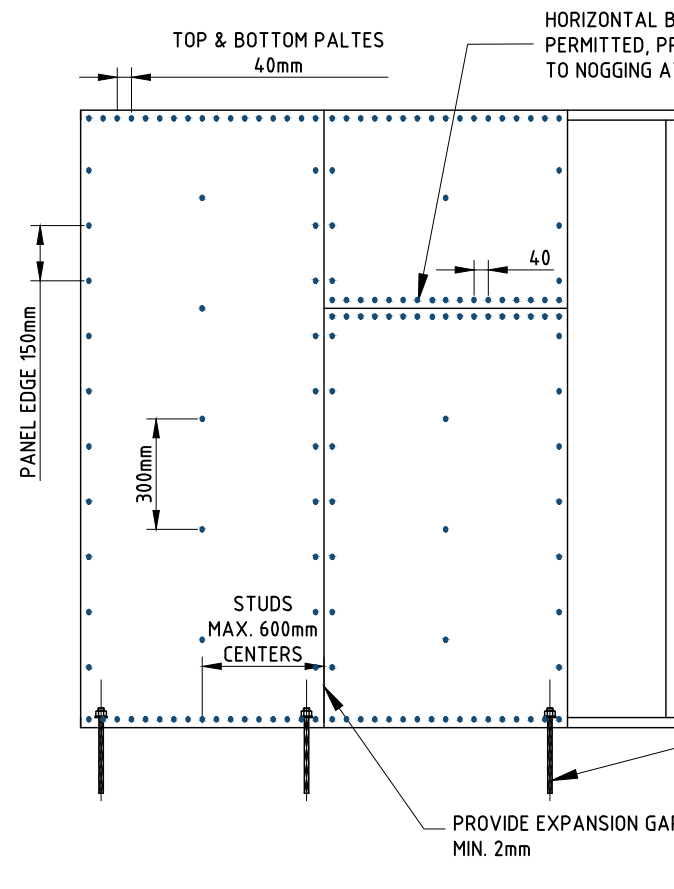
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- TYPE 1 | SYSTEM 3.4 kN/m
- FASTENER CENTERS
 80mm FOR TOP AND BOTTOM PLATES
 150mm FOR VERTICAL EDGES
 300mm FOR INTERMEDIATE STUDS
 - MINIMUM SECTION OF BRACING OF 600mm
 - 2mm EXPANSION GAP AROUND PERIMETER OF EVERY PANEL
 - FOR PANEL WIDTH OF 600mm BRACING CAPACITY SHALL BE HALF OF THAT FOR 900mm
 - FOR PANEL LENGTH BETWEEN 600mm AND 900mm, THE BRACING CAPACITY CAN BE CALCULATED BY MULTIPLYING THE RESPECTIVE CAPACITIES BY 0.5 FOR 600mm LONG VARYING LINEARLY TO 1.0 FOR 900mm.
 - INSTALL TO MANUFACTURER'S SPECIFICATIONS.
 - FOR THE EGGER OS'BRACE SYSTEMS DETAILED IN THE MANUAL, 2.8mm DIAMETER x 30mm FLATHEAD GALVANISED OR CORROSION RESISTANT NAILS, OR THEIR GUN-DRIVEN EQUIVALENT ARE SPECIFIED ACCORDING TO AS 1684. FASTENER EDGE DISTANCES ALONG TOP AND BOTTOM PLATES AND EDGE STUDS SHOULD BE A MINIMUM OF 15mm AND 8mm WHERE PANELS ARE FIXED TO INTERNAL FRAMING.

GROUND LEVEL:
 M12-RAMSET WERCS ANKASCREW SCREW IN ANCHOR AT ENDS AND INTERMEDIATELY AT MAX. 1200CTS WITH 75mm EMBEDMENT INTO THE SLAB
 UPPER LEVEL:
 M12 BOLT TO LOWER LEVEL TOP PLATE

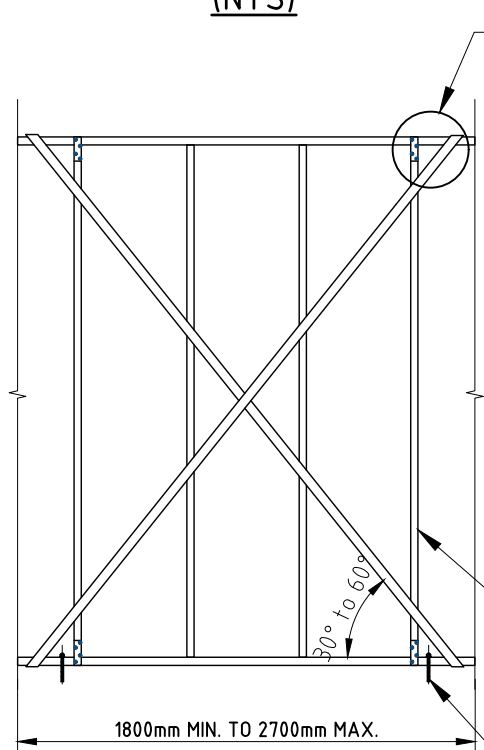
EGGER'S OS BRACE TYPE 1 - SYSTEM 3.4 kN/m
 (NTS)



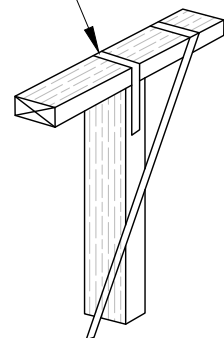
- TYPE 3 | SYSTEM 6.0 kN/m
- FASTENER CENTERS
 40mm FOR TOP AND BOTTOM PLATES
 150mm FOR VERTICAL EDGES
 300mm FOR INTERMEDIATE STUDS
 - MINIMUM SECTION OF BRACING OF 900mm
 - 2mm EXPANSION GAP AROUND PERIMETER OF EVERY PANEL
 - INSTALL TO MANUFACTURER'S SPECIFICATIONS.
 - FOR THE EGGER OS'BRACE SYSTEMS DETAILED IN THE MANUAL, 2.8mm DIAMETER x 30mm FLATHEAD GALVANISED OR CORROSION RESISTANT NAILS, OR THEIR GUN-DRIVEN EQUIVALENT ARE SPECIFIED ACCORDING TO AS 1684. FASTENER EDGE DISTANCES ALONG TOP AND BOTTOM PLATES AND EDGE STUDS SHOULD BE A MINIMUM OF 15mm AND 8mm WHERE PANELS ARE FIXED TO INTERNAL FRAMING.

GROUND LEVEL:
 M12-RAMSET WERCS ANKASCREW SCREW IN ANCHOR AT ENDS AND INTERMEDIATELY AT MAX. 1200CTS WITH 75mm EMBEDMENT INTO THE SLAB
 UPPER LEVEL:
 M12 BOLT TO LOWER LEVEL TOP PLATE

EGGER'S OS BRACE TYPE 3 - SYSTEM 6.0 kN/m
 (NTS)



30mm x 0.8mm GALV. METAL STRAP LOOPED OVER PLATE AND FIXED TO STUD WITH 4/30mm x Ø2.8mm GALV. FLAT-HEAD NAILS (OR EQUIVALENT) TO EACH END. ALTERNATIVELY, PROVIDE SINGLE STRAPS TO BOTH SIDES, WITH 4 NAILS PER STRAP END, OR EQUIVALENT ANCHORS OR OTHER FASTENERS.



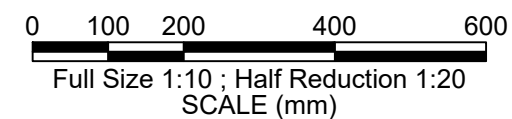
30mm x 0.8mm TENSIONED METAL STRAP FIXED TO STUDS WITH ONE 30mm x Ø2.8mm GALV. FLAT-HEAD NAIL (OR EQUIVALENT) AND TO PLATES WITH 4/30mm x Ø2.8mm GALV. FLAT-HEAD NAILS, OR ALTERNATIVE METAL STRAP, FIXED AS ABOVE, WITH A NET SECTIONAL AREA NOT LESS THAN 21 mm²

GROUND LEVEL:
 M12-RAMSET WERCS ANKASCREW SCREW IN ANCHOR WITH 75mm EMBEDMENT INTO THE SLAB
 UPPER LEVEL:
 M12 BOLT TO LOWER LEVEL TOP PLATE

TENSIONED METAL STRAP BRACING - TABLE 8.18(d), AS 1684.2
 (NTS)

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DESIGNED: J.S DATE: JUN'25
 DRAWN: S.T.C SHEET SIZE: A3

PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT AT 418 ESPLANADE, MOANA FOR SOUTHERN ARCHITECTURE

SHEET TITLE
 DETAILS

PROJECT No. DRAWING REVISION
 HWC-24261 SS6 A



CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
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Structural Calculations

Project Number: HWC-24261
Project: Proposed Residence
Site Address: 418 Esplanade, Moana SA
Client: Southern Architecture
Date: 11/08/2025
Revision: 0
Prepared by: J.S
Reviewed by: H.W.C

HWC ENGINEERS PTY LTD
ACN 643 591 208 ABN 20 785 336 981
152 Fisher Street,
MALVERN SA 5061

BUILDING CONSENT GRANTED

STRUT/10/2025

ORIENTATION:

WIDTH:

LENGTH:

HEIGHT (h):

BASE REL:

HOUSE

0°

6.75 m

26.50 m

6.35 m

0.00 m

LATITUDE: -35.210221

LONGITUDE: 138.472627

ELEVATION: 29.00 m

WIND:

REGION: A

Vh,ult: 61 m/s

Vh,serv: 39 m/s

CRITICAL DIRECTION: South West

TERRAIN CATEGORY: 1

TOPOGRAPHY CLASS: T3

SHIELDING CLASS: NS

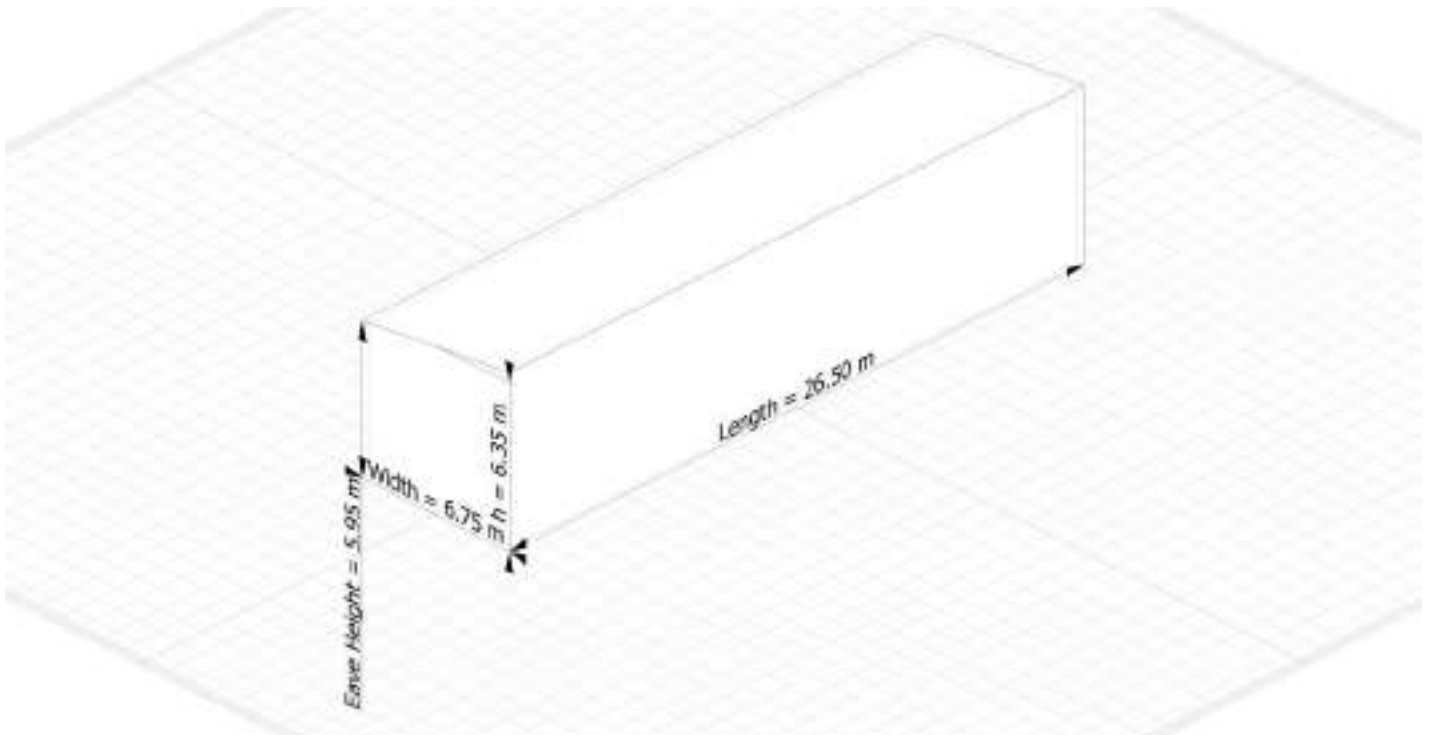
WIND CLASS: N4

WIND PRESSURE (qh): 2.2326 kPa

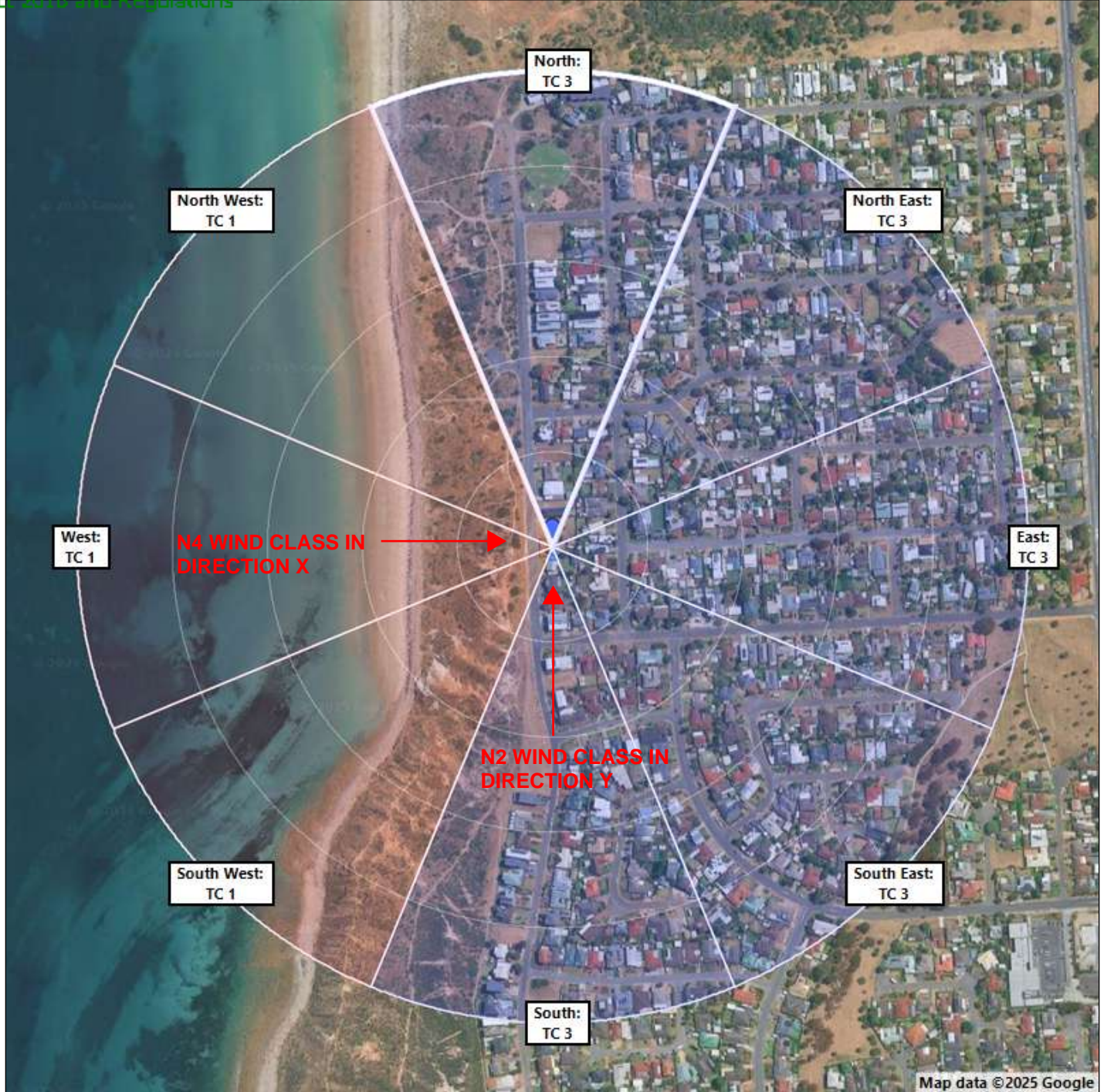
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N4 WIND CLASS IN
DIRECTION X

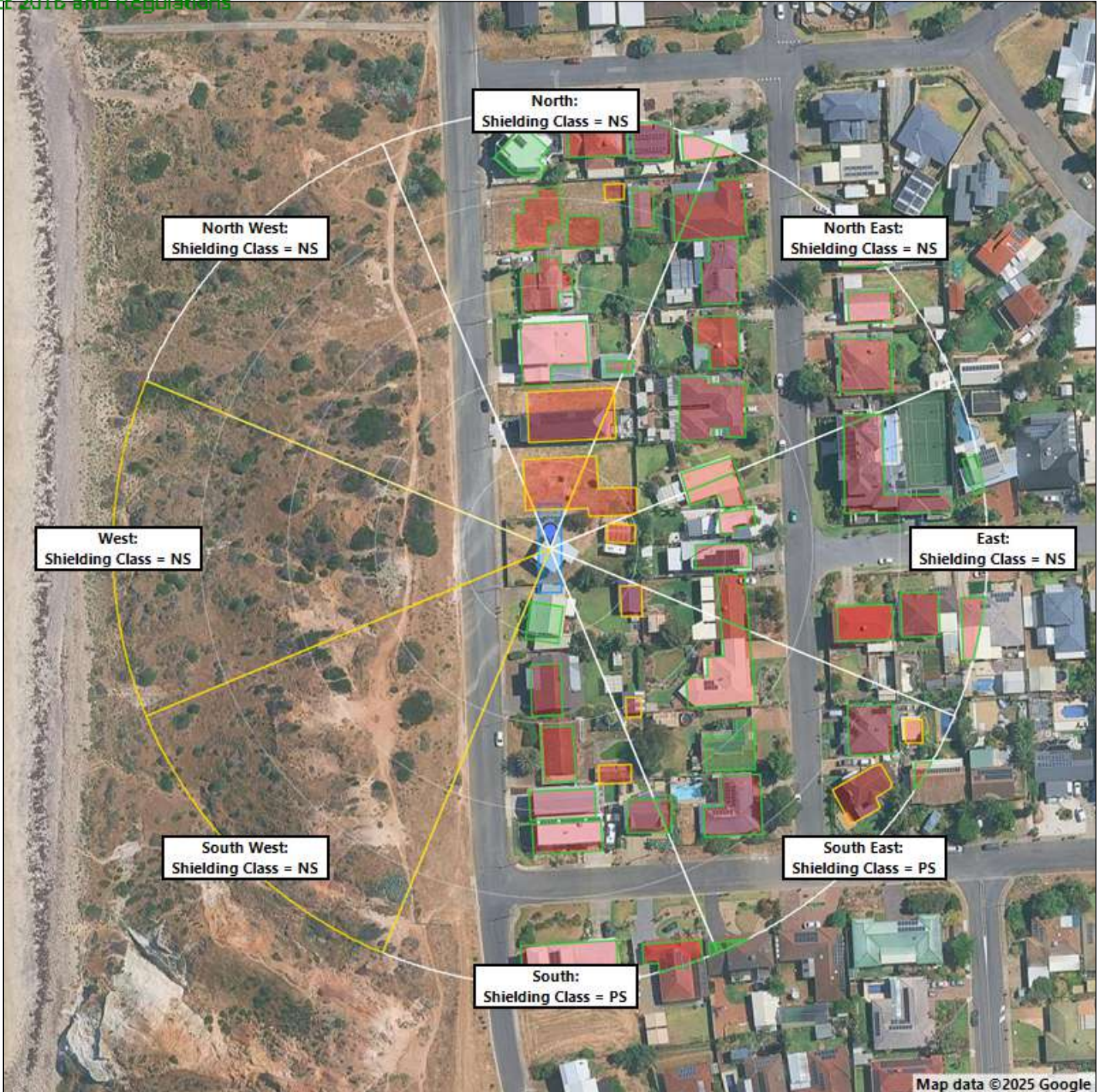
N2 WIND CLASS IN
DIRECTION Y



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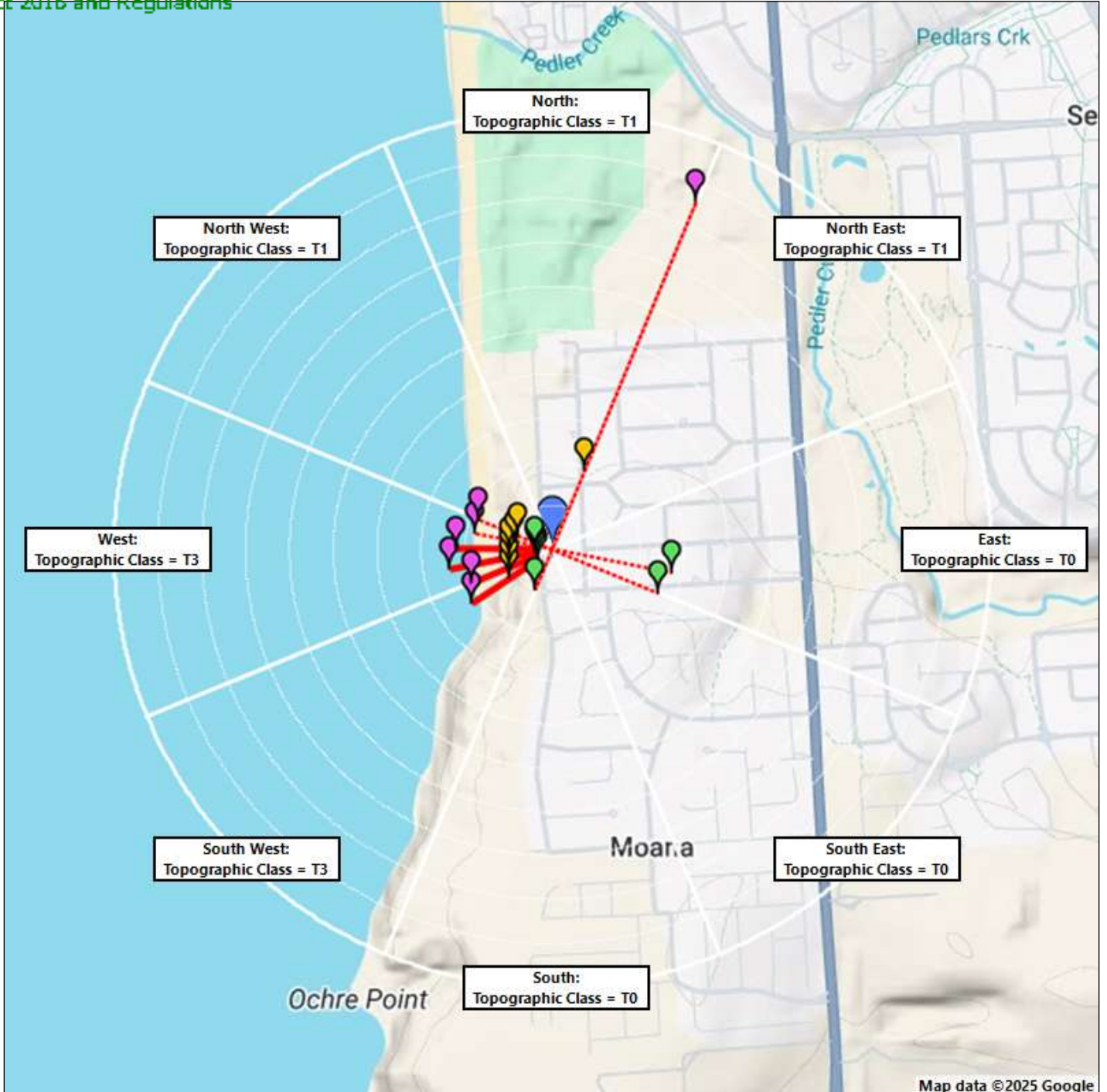
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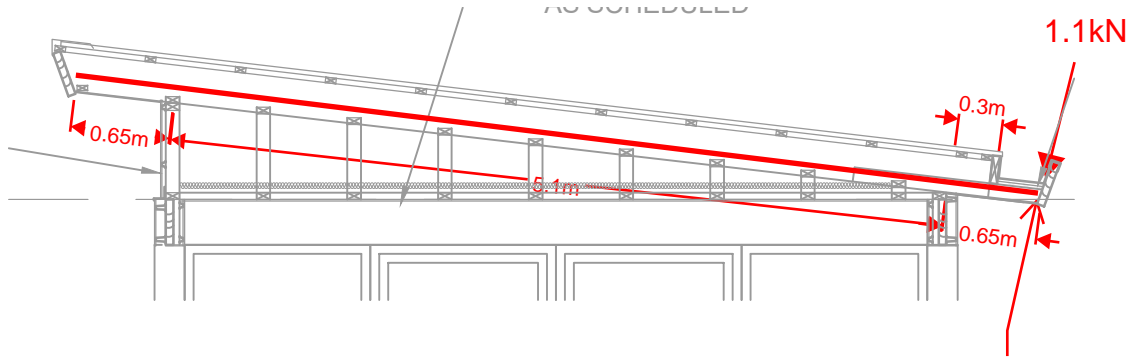
TITLE: 418 Esplanade, Moana SA
PROJECT:
CODE:

CHECKWIND 8.3.1
Wednesday, June 18, 2025 4:03:49 PM
John Si @ HWC Engineers

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Loads

$W \cdot G = 0.4 \text{ kPa} \cdot 0.6 \text{ m} = 0.24 \text{ kN/m}$

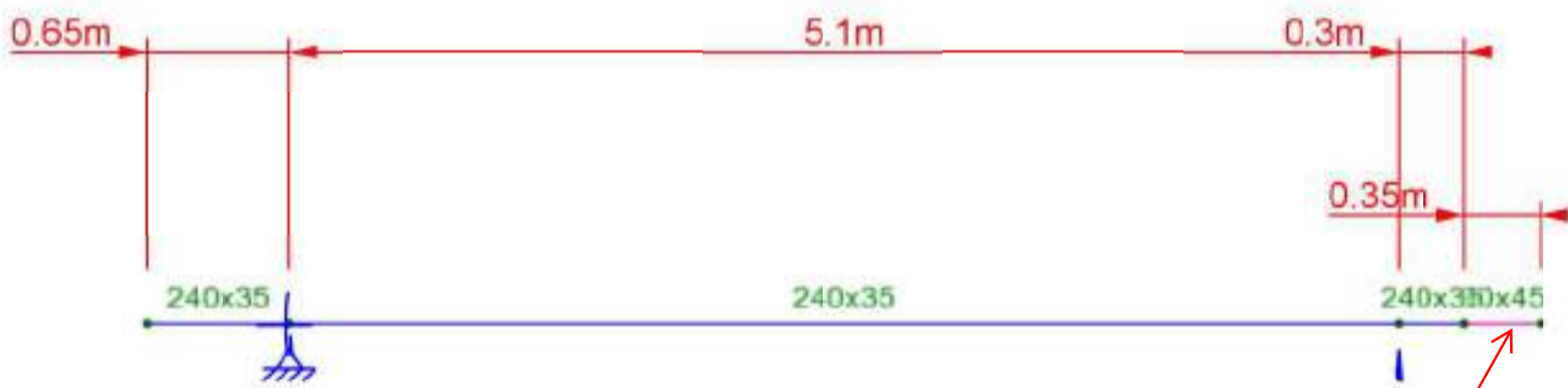
$W \cdot Q = 0.25 \text{ kPa} \cdot 0.6 \text{ m} = 0.15 \text{ kN/m}$

$\text{Wind} \cdot \text{ult} = -2.2 \text{ kPa} \cdot 0.6 \text{ m} = -1.32 \text{ kN/m up}$

$\text{Wind} \cdot \text{ser} = 0.68 \cdot -1.32 = -0.9 \text{ kN/m up}$

REFER FOLLOWING PAGES FOR SPACEGASS ANALYSIS

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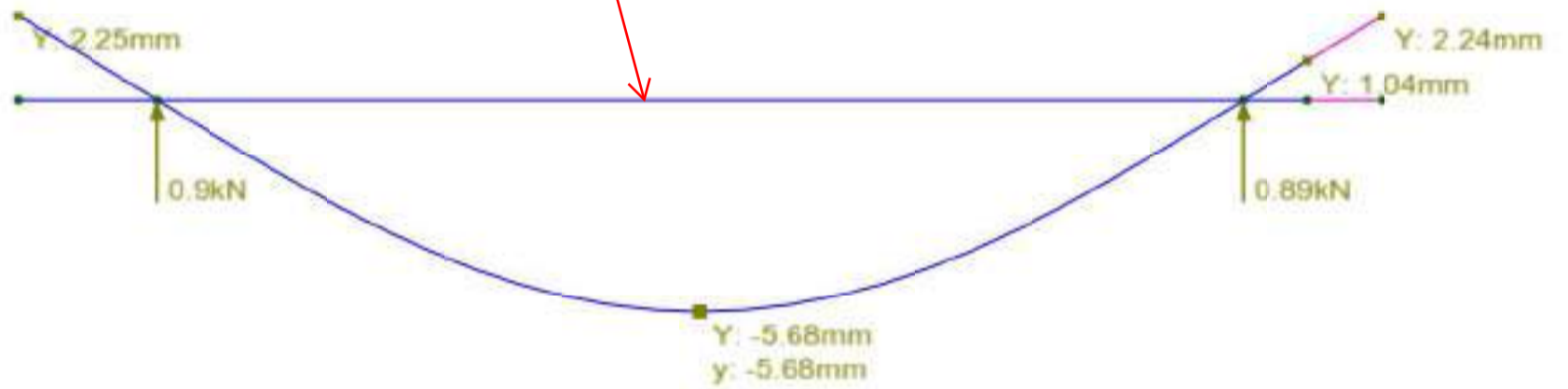
90x45 section under box gutter

1 (SW) G

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deflection G with J2 factor = 2*5.68mm
 = 11.4mm

def/L = 1/440. OK



Viewpoint (0,0), Displacements, Reactions

Materials: 2 MGP10
 Sections: 2 240x35, 3 90x45



29/10/2025

2Q

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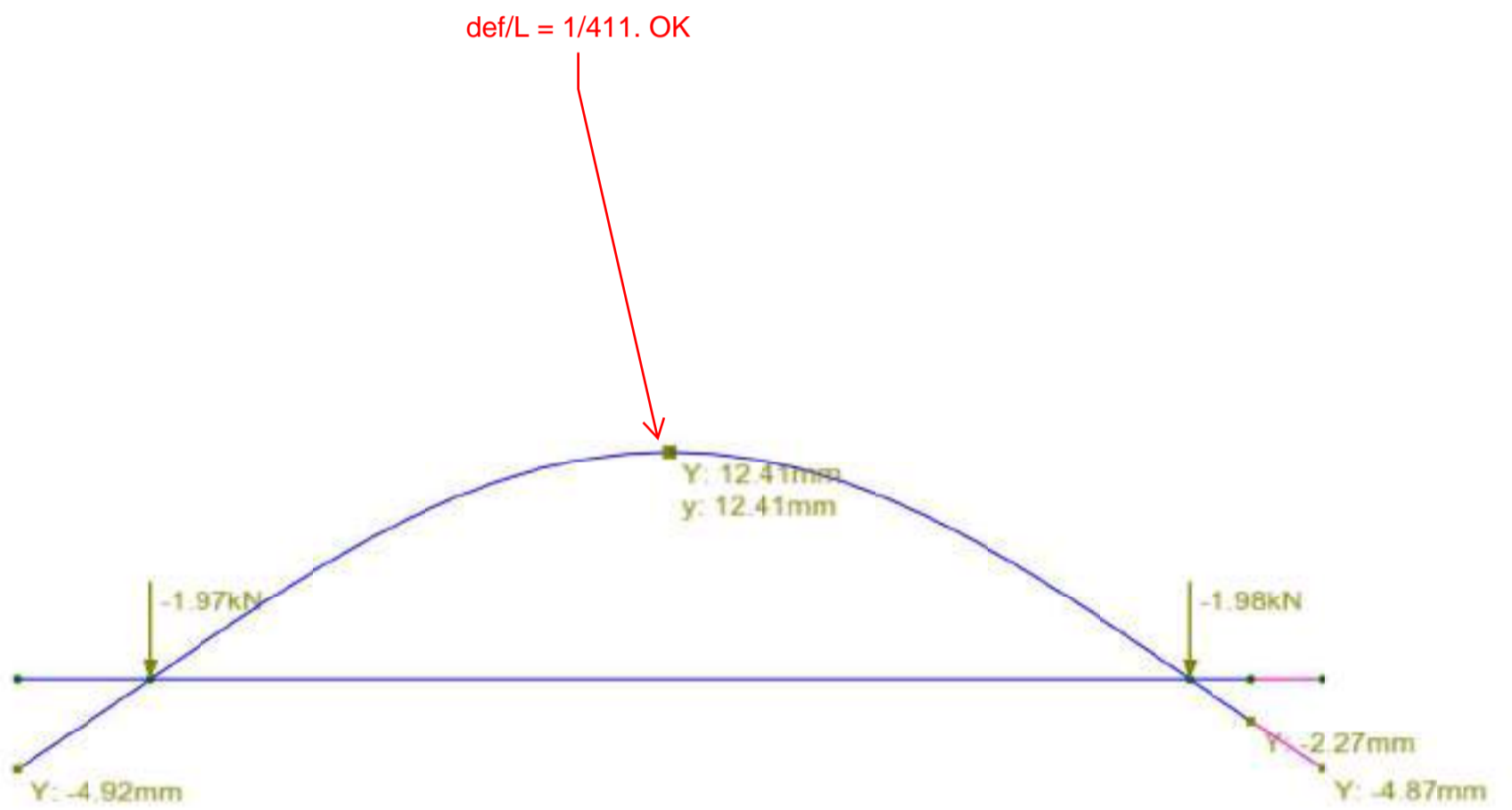
Viewpoint (0,0), Displacements, Reactions

Materials: ■ 2 240x35 ■ 3 90x45

Sections: ■ 2 240x35 ■ 3 90x45

11 (SW) G+WS

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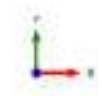
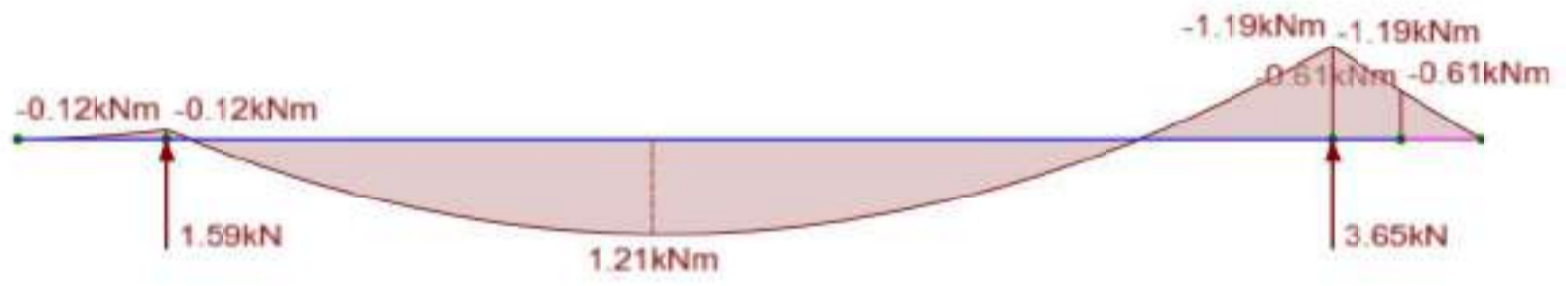


Viewpoint (0,0), Displacements, Reactions

Materials: ■ 2 240x35 ■ 3 90x45
■ 2 MGP10



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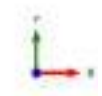
9LHZSRLQW

0RPHQWV 5HDFWLRQV

6HFWLRQV
 0DWHULDO
 0*3



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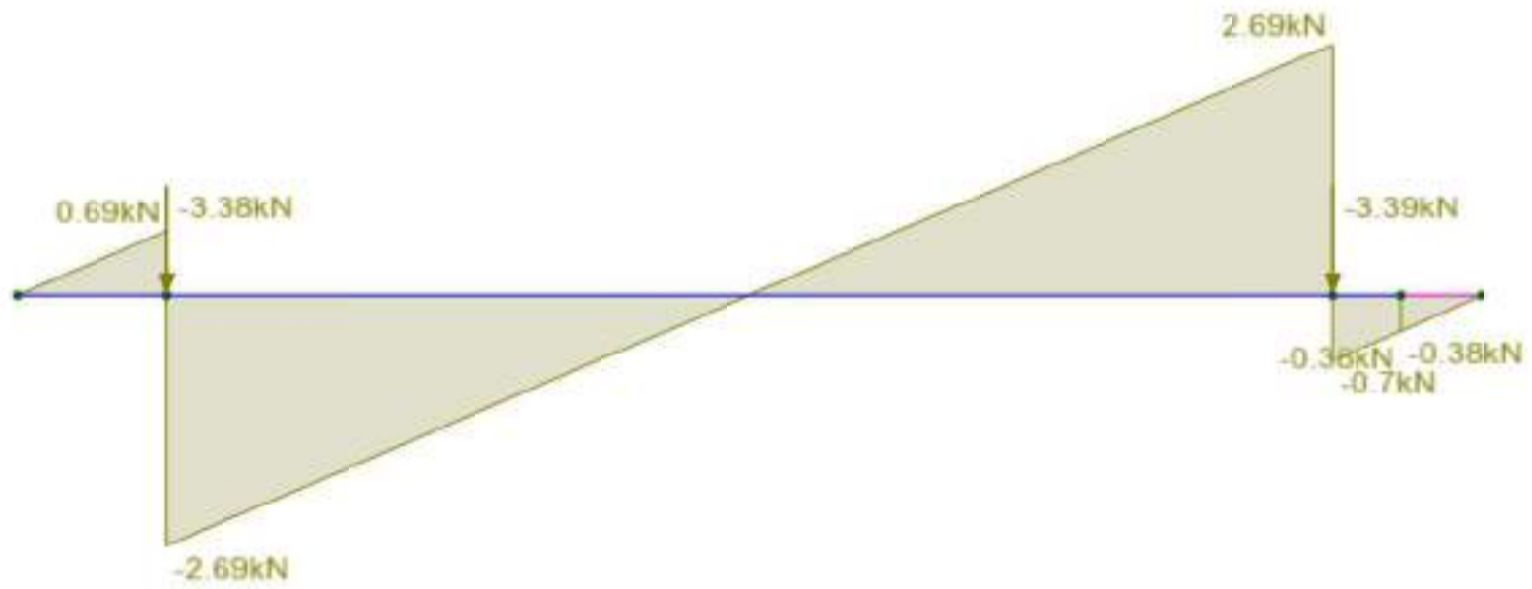
9LHZSRLQW

0RPHQWV 5HDFWLRQV

6HFWLRQV
 0DWHULDO
 0*3

21 (SW) 0.9G+Wu

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Viewpoint (0,0), Shears, Reactions

Materials: ■ 2 240x45 ■ 3 90x45
■ 2 MGP10

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Beam: (Rafter 1R1-240x35 MGP10) 240mm x 35mm MGP10*
Bending: $M^* = 3.20\text{kNm} > \phi M(0.94) = 2.92\text{kNm}$
Shear: $V^* = 0.00\text{kN} < \phi V(0.94) = 11.35\text{kN}$
Axial: No compression, No tension
Compliance: Refer below

240x35 MGP10 INADEQUATE
FOR 0.9G+Wu case. TRY 240x45
MGP10, REFER FOLLOWING
PAGE

No Good (1.10)
OK (0.00)
No Good (1.10)

Geometry (House member affecting $\leq 25\text{m}^2$ or secondary building member) **Warning - Dead load only case must be checked**

Category =	1 (1) House, (2) Primary building elements, (3) Important		
Span for compression (L) =	5100 mm	Edge restrained =	C (T)ension, (C)omp.
Strong axis eff. length (Lax) =	1700 mm	Bending (Layb) =	1700 mm
Weak axis eff. length (Lay) =	1700 mm, (C)ont	Effective length factor (g13) =	1.00 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2
Checked dead load only case =	N (Y)es,(N)o	Duration of load =	Roof

Bending & shear

Analysis values =	M (M)annual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical		
$\delta PII/\delta Tot.II =$	1.00		1.2*G+1.5*Q
Major bending (Mx*) =	3.2 kNm	Major bending (Mx*) =	3.20 kNm
Minor bending (My*) =	0.0 kNm	Minor bending (My*) =	0.00 kNm
Shear Force (V*) =	0.0 kN	Shear Force (V*) =	0.00 kN
Duration (k1) =	0.94	Compression (Nc*) =	0.00 kN
		Tension (Nt*) =	0.00 kN

Bending and Shear Capacity - Cl 3.2 & Cl 3.2.5

Member =	240mm x 35mm MGP10*	Area (A) =	8400 mm ²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	336 x10 ³ mm ³
Design depth (dD) =	240 mm	Section modulus (Zy) =	49 x10 ³ mm ³
Design width (dW) =	35 mm	Stiffness (Ix) =	40.3 x10 ⁶ mm ⁴
Strength red. factor (ϕ) =	0.9 Table 2.1	Modulus of elasticity (E) =	10000 MPa - Table H3.1
$S1 = 1.25*dD/dW*(Layb/dD)^{0.5} =$	22.81 for comp. edge restrained - Cl 3.2.3.2		
$S1y = 1.25*dW/dD*(Lax/dW)^{0.5} =$	1.27 for comp. edge restrained		
$k12d = 1.5-0.05*pb*d*S1d =$	0.707 for $10 \leq pb*d*S1 \leq 20$ - Cl 3.2.4		
$k12 = 1.5-0.05*pb*S =$	0.707 - $10 \leq pb*S \leq 20$ - Cl 3.2.4	$f'b =$	14.5 MPa
$k12y =$	1.000 for $pb*S_y \leq 10$ - Cl 3.2.4	$f's =$	2.4 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.70 (rbd=0.25)
$\phi M(dl) = \phi*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =$	1.77 kNm	Material constant (pb) =	0.70 (rb=0.25)
$\phi M = \phi*k1*k4*k6*k9*k12*f'b*Zx =$	2.92 kNm	Duration factor (k1) =	0.94
$\phi V(dl) = \phi*(k1=0.57)*k4*k6*f's*(2/3*A) =$	6.88 kN	Factor (k4) =	1.00
$\phi V = \phi*k1*k4*k6*f's*(2/3*A) =$	11.35 kN	Temp. factor (k6) =	1.00
$\phi My(dl) = \phi*(k1=0.57)*k4*k6*k9*k12y*f'b*Zy =$	0.37 kNm	Sharing factor (k9) =	1.00
$\phi My = \phi*k1*k6*k9*k12y*f'b*Zy =$	0.60 kNm	Size modifier (mod.b) =	0.85
		Size modifier (mod.s) =	0.92

Axial Capacity - Cl 3.3 & Cl 3.4

$S3x = \min(g13*L/dD \& Lax/dD) =$	7.1	$k12cx =$	1.000 for $pc*S3x \leq 10$ - Cl 3.3.3
$S4y = \min(g13*L \& Lay)/dW =$	48.6	$k12cy =$	0.098 for $pc*S4y \geq 20$ - Cl 3.3.3
Critical S =	48.6	$k12d =$	0.098 for $pc*S \geq 20$ - Cl 3.3.3
		$k12 =$	0.098 for $pc*S \geq 20$ - Cl 3.3.3
Strength reduction factor (ϕ) =	0.9 Table 2.1	Lay =	1700 mm
$\phi Nc(dl) = \phi*(k1=0.57)*k4*k6*k12cd*f'c*A =$	7.1 kN	$f'c =$	16.8 MPa
$\phi Nc = \phi*k1*k4*k6*k12c*f'c*A =$	11.7 kN	$f't =$	6.7 MPa
$\phi Nt(dl) = \phi*(k1=0.57)*k4*k6*f't*A =$	29.0 kN	Temp. factor (k6) =	1.00
$\phi Nt = \phi*k1*k4*k6*f't*A =$	47.9 kN	Size modifier (mod.c) =	0.93
		Size modifier (mod.t) =	0.88

Combined - Cl 3.2.1.2

Bending: $Mx^*/\phi Mx + My^*/\phi My =$ **1.10**

Deflections (From Analysis)

	Duration factor ($j2$) = 2.0	$\psi_s = 0.00$
Instantaneous $\delta DL =$	0.0 mm at 0mm from LHS	Span / -
Live load $\delta LL =$	0.0 mm at 0mm from LHS	Span / -
Permanent $\delta DL = j2*(\delta DL + \psi_I.\delta LL) =$	0.0 mm	Span / -
Short term $\psi_s.\delta LL =$	0.0 mm	Span / -



TIMBER MEMBER V5.15

HWC Engineers

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Beam:	(Rafter 1R1-240x45 MGP10) 240mm x 45mm MGP10	
Bending:	M* = 3.20kNm < $\phi M(0.94)$ = 4.69kNm	OK (0.68)
Shear:	V* = 0.00kN < $\phi V(0.94)$ = 14.60kN	OK (0.00)
Axis:	No compression, No tension	
Combined:	Refer below	OK (0.68)

Geometry (House member affecting $\leq 25m^2$ or secondary building member) Warning - Dead load only case must be checked

Category =	1 (1) House, (2) Primary building elements, (3) Important	
Span for compression (L) =	5100 mm	
Strong axis eff. length (Lax) =	1700 mm	Edge restrained = C (T)ension, (C)omp.
Weak axis eff. length (Lay) =	1700 mm, (C)ont	Bending (Layb) = 1700 mm
Effective length factor (g13) =	1.00	Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2
Checked dead load only case =	N (Y)es,(N)o	Duration of load = Roof

Bending & shear

Analysis values =	M (M)annual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical	
$\delta PII/\delta Tot.II$ =	1.00	1.2*G+1.5*Q
Major bending (Mx*) =	3.2 kNm	Major bending (Mx*) = 3.20 kNm
Minor bending (My*) =	0.0 kNm	Minor bending (My*) = 0.00 kNm
Shear Force (V*) =	0.0 kN	Shear Force (V*) = 0.00 kN
Duration (k1) =	0.94	Compression (Nc*) = 0.00 kN
		Tension (Nt*) = 0.00 kN

Bending and Shear Capacity - Cl 3.2 & Cl 3.2.5

Member =	240mm x 45mm MGP10	Area (A) =	10800 mm ²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	432 x10 ³ mm ³
Design depth (dD) =	240 mm	Section modulus (Zy) =	81 x10 ³ mm ³
Design width (dW) =	45 mm	Stiffness (Ix) =	51.8 x10 ⁶ mm ⁴
Strength red. factor (ϕ) =	0.9 Table 2.1	Modulus of elasticity (E) =	10000 MPa - Table H3.1
$S1=1.25*dD/dW*(Layb/dD)^{0.5}$ =	17.74 for comp. edge restrained - Cl 3.2.3.2		
$S1y=1.25*dW/dD*(Lax/dW)^{0.5}$ =	1.44 for comp. edge restrained		
$k12d = 1.5-0.05*pb*d*S1d$ =	0.883 for $10 \leq pb*d*S1 \leq 20$ - Cl 3.2.4		
$k12 = 1.5-0.05*pb*S$ =	0.883 - $10 \leq pb*S1 \leq 20$ - Cl 3.2.4	f'b =	14.5 MPa
$k12y = 1.000$ for $pb*Sy \leq 10$ - Cl 3.2.4		f's =	2.4 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.70 (rbd=0.25)
$\phi M(dl) = \phi*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx$ =	2.84 kNm	Material constant (pb) =	0.70 (rb=0.25)
$\phi M = \phi*k1*k4*k6*k9*k12*f'b*Zx$ =	4.69 kNm	Duration factor (k1) =	0.94
$\phi V(dl) = \phi*(k1=0.57)*k4*k6*f's*(2/3*A)$ =	8.85 kN	Factor (k4) =	1.00
$\phi V = \phi*k1*k4*k6*f's*(2/3*A)$ =	14.60 kN	Temp. factor (k6) =	1.00
$\phi My(dl) = \phi*(k1=0.57)*k4*k6*k9*k12y*f'b*Zy$ =	0.60 kNm	Sharing factor (k9) =	1.00
$\phi My = \phi*k1*k6*k9*k12y*f'b*Zy$ =	1.00 kNm	Size modifier (mod.b) =	0.85
		Size modifier (mod.s) =	0.92

Axial Capacity - Cl 3.3 & Cl 3.4

$S3x = \min(g13*L/dD \& Lax/dD)$ =	7.1	$k12cx =$	1.000 for $pc*S3x \leq 10$ - Cl 3.3.3
$S4y = \min(g13*L \& Lay)/dW$ =	37.8	$k12cy =$	0.162 for $pc*S4y \geq 20$ - Cl 3.3.3
Critical S =	37.8	$k12d =$	0.162 for $pc*S \geq 20$ - Cl 3.3.3
		$k12 =$	0.162 for $pc*S \geq 20$ - Cl 3.3.3
Strength reduction factor (ϕ) =	0.9 Table 2.1	Lay =	1700 mm
$\phi Nc(dl) = \phi*(k1=0.57)*k4*k6*k12cd*f'c*A$ =	15.0 kN	f'c =	16.8 MPa
$\phi Nc = \phi*k1*k4*k6*k12c*f'c*A$ =	24.8 kN	f't =	6.7 MPa
$\phi Nt(dl) = \phi*(k1=0.57)*k4*k6*f't*A$ =	37.3 kN	Temp. factor (k6) =	1.00
$\phi Nt = \phi*k1*k4*k6*f't*A$ =	61.6 kN	Size modifier (mod.c) =	0.93
		Size modifier (mod.t) =	0.88

Combined - Cl 3.2.1.2

Bending:	$Mx*/\phi Mx + My*/\phi My =$	0.68
----------	-------------------------------	------

Deflections (From Analysis)

	Duration factor (j2) = 2.0	$\Psi_s = 0.00$
Instantaneous δDL =	0.0 mm at 0mm from LHS	Span / -
Live load δLL =	0.0 mm at 0mm from LHS	Span / -
Permanent $\delta DL = j2*(\delta DL+\Psi.I.\delta LL)$ =	0.0 mm	Span / -
Short term $\Psi_s.\delta LL =$	0.0 mm	Span / -



TIMBER MEMBER V5.15

HWC Engineers

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Beam:	(Rafter 1R1-90x45 MGP10) 90mm x 45mm MGP10	
Bending:	$M^* = 0.60\text{kNm} < \phi M(0.94) = 0.87\text{kNm}$	OK (0.69)
Shear:	$V^* = 0.40\text{kN} < \phi V(0.94) = 5.94\text{kN}$	OK (0.07)
Axial:	No compression, No tension	
Combined:	Refer below	OK (0.69)

Geometry (House member affecting $\leq 25\text{m}^2$ or secondary building member) Warning - Dead load only case must be checked

Category =	1 (1) House, (2) Primary building elements, (3) Important		
Span for compression (L) =	650 mm		
Strong axis eff. length (Lax) =	650 mm	Edge restrained =	C (T)ension, (C)omp.
Weak axis eff. length (Lay) =	650 mm, (C)ont	Bending (Layb) =	650 mm
Effective length factor (g13) =	1.00 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2		
Checked dead load only case =	N (Y)es,(N)o	Duration of load =	Roof

Bending & shear

Analysis values =	M (M)annual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical		
$\delta PII/\delta Tot.II =$	1.00 1.2*G+1.5*Q		
Major bending (Mx*) =	0.6 kNm	Major bending (Mx*) =	0.60 kNm
Minor bending (My*) =	0.0 kNm	Minor bending (My*) =	0.00 kNm
Shear Force (V*) =	0.4 kN	Shear Force (V*) =	0.40 kN
Duration (k1) =	0.94	Compression (Nc*) =	0.00 kN
		Tension (Nt*) =	0.00 kN

Bending and Shear Capacity - Cl 3.2 & Cl 3.2.5

Member =	90mm x 45mm MGP10	Area (A) =	4050 mm ²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	61 x10 ³ mm ³
Design depth (dD) =	90 mm	Section modulus (Zy) =	30 x10 ³ mm ³
Design width (dW) =	45 mm	Stiffness (Ix) =	2.7 x10 ⁶ mm ⁴
Strength red. factor (ϕ) =	0.9 Table 2.1	Modulus of elasticity (E) =	10000 MPa - Table H3.1
$S1=1.25*dD/dW*(Layb/dD)^{0.5} =$	6.72 for comp. edge restrained - Cl 3.2.3.2		
$S1y=1.25*dW/dD*(Lax/dW)^{0.5} =$	2.38 for comp. edge restrained		
$k12d =$	1.000 for $pbd*S1 \leq 10$ - Cl 3.2.4		
$k12 =$	1.000 for $pb*S1 \leq 10$ - Cl 3.2.4	$f'b =$	17.0 MPa
$k12y =$	1.000 for $pb*Sy \leq 10$ - Cl 3.2.4	$f's =$	2.6 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.75 (rbd=0.25)
$\phi M(dl) = \phi*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =$	0.53 kNm	Material constant (pb) =	0.75 (rb=0.25)
$\phi M = \phi*k1*k4*k6*k9*k12*f'b*Zx =$	0.87 kNm	Duration factor (k1) =	0.94
$\phi V(dl) = \phi*(k1=0.57)*k4*k6*f's*(2/3*A) =$	3.60 kN	Factor (k4) =	1.00
$\phi V = \phi*k1*k4*k6*f's*(2/3*A) =$	5.94 kN	Temp. factor (k6) =	1.00
$\phi My(dl) = \phi*(k1=0.57)*k4*k6*k9*k12y*f'b*Zy =$	0.26 kNm	Sharing factor (k9) =	1.00
$\phi My = \phi*k1*k6*k9*k12y*f'b*Zy =$	0.44 kNm	Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Axial Capacity - Cl 3.3 & Cl 3.4

$S3x = \min(g13*L/dD \& Lax/dD) =$	7.2	$k12cx =$	1.000 for $pc*S3x \leq 10$ - Cl 3.3.3
$S4y = \min(g13*L \& Lay)/dW =$	14.4	$k12cy =$	0.808 for $10 \leq pc*S4y \leq 20$ - Cl 3.3.3
Critical S =	14.4	$k12d =$	0.808 for $10 \leq pc*S \leq 20$ - Cl 3.3.3
		$k12 =$	0.808 for $10 \leq pc*S \leq 20$ - Cl 3.3.3
Strength reduction factor (ϕ) =	0.9 Table 2.1	Lay =	650 mm
$\phi Nc(dl) = \phi*(k1=0.57)*k4*k6*k12cd*f'c*A =$	30.2 kN	$f'c =$	18.0 MPa
$\phi Nc = \phi*k1*k4*k6*k12c*f'c*A =$	49.9 kN	$f't =$	7.7 MPa
$\phi Nt(dl) = \phi*(k1=0.57)*k4*k6*f't*A =$	16.0 kN	Temp. factor (k6) =	1.00
$\phi Nt = \phi*k1*k4*k6*f't*A =$	26.4 kN	Size modifier (mod.c) =	1.00
		Size modifier (mod.t) =	1.00

Combined - Cl 3.2.1.2

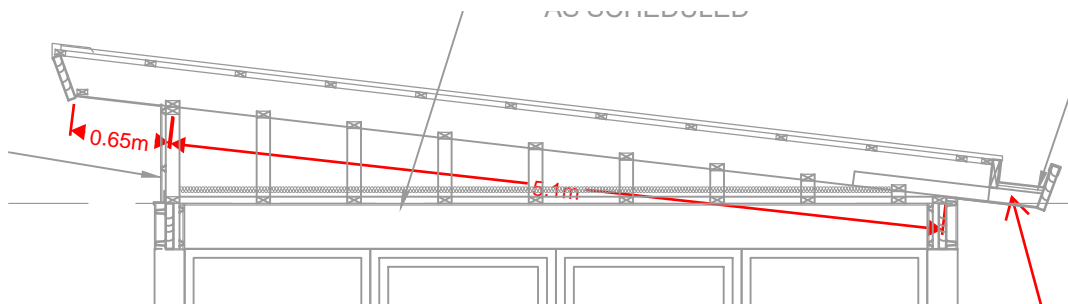
Bending:	$Mx^*/\phi Mx + My^*/\phi My =$	0.69
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Deflections (From Analysis)

	Duration factor ($j2$) = 2.0	$\psi_s = 0.00$
Instantaneous $\delta DL =$	0.0 mm at 0mm from LHS	Span / -
Live load $\delta LL =$	0.0 mm at 0mm from LHS	Span / -
Permanent $\delta DL = j2*(\delta DL + \psi_i.\delta LL) =$	0.0 mm	Span / -
Short term $\psi_s.\delta LL =$	0.0 mm	Span / -

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RAFTER 1R2



90deep section
under the box gutter

Loads

$W*G = 0.4kPa * 1.2m = 0.48kN/m$
 $W*Q = 0.25kPa * 1.2m = 0.3kN/m$
 $Wind*ult = -2.2kPa * 1.2m = -2.64kN/m$ up
 $Wind*ser = 0.68 * -2.64 = -1.8kN/m$ up

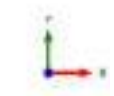
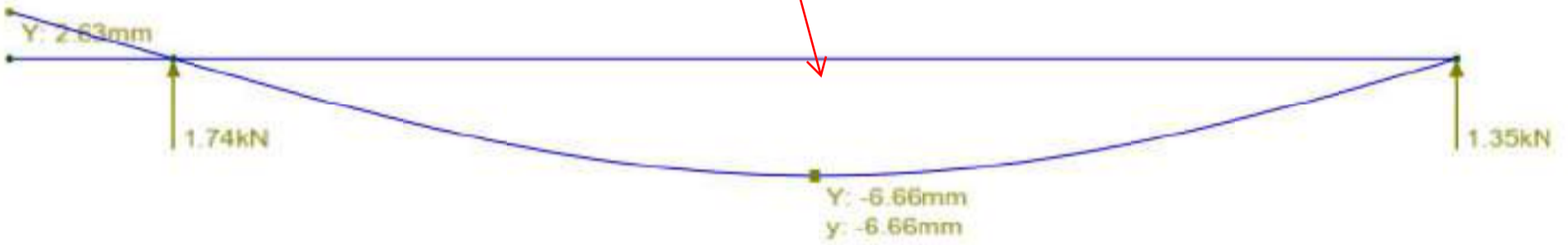
REFER FOLLOWING PAGES FOR SPACEGASS ANALYSIS

1 (SW) G

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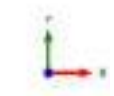
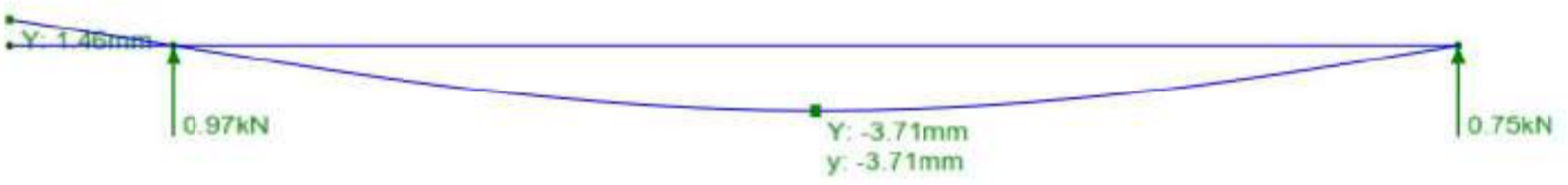
deflection G with J2 factor = 2*6.7mm
 = 13.4mm

def/L = 1/380. OK





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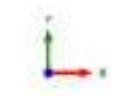
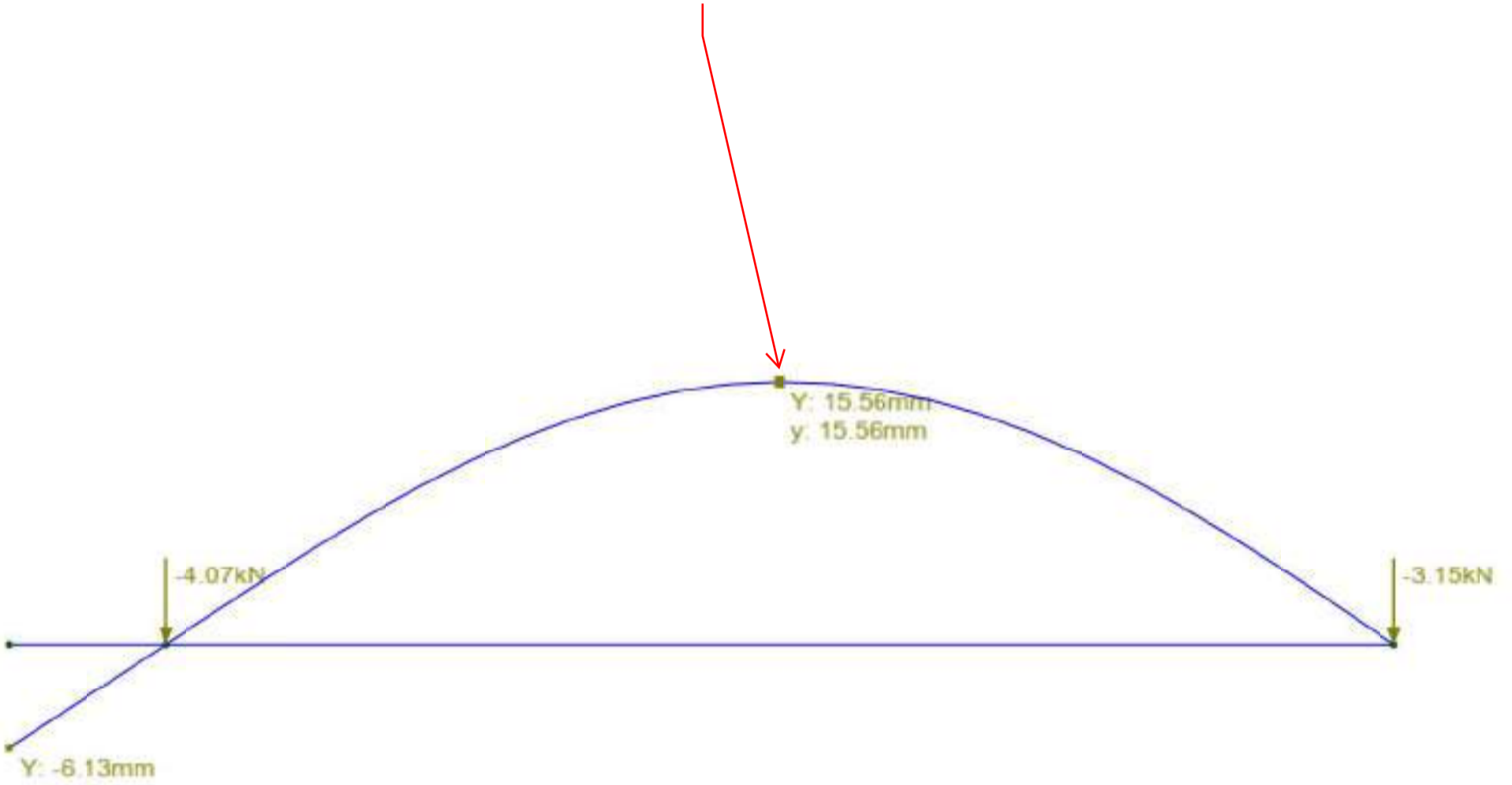
Viewpoint (0,0), Displacements, Reactions

Materials: Sections:
■ 3 Smart LVL 13 ■ 2 240x45

11 (SW) G+WS

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def/L = 1/326. OK

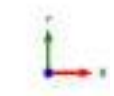
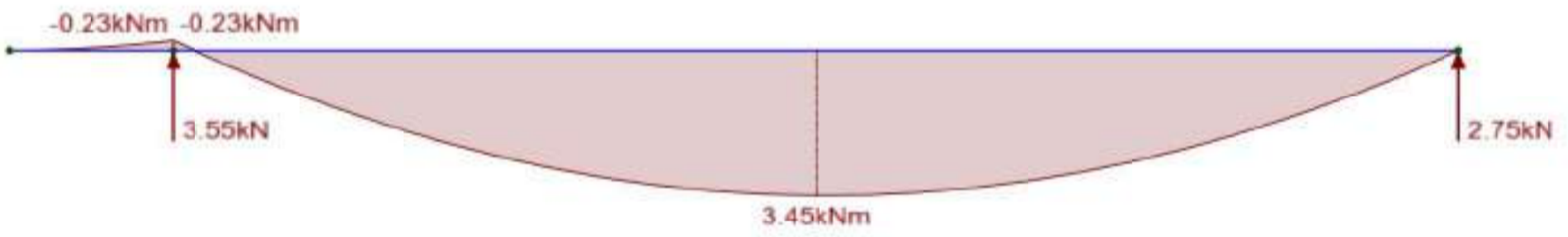


Viewpoint (0,0), Displacements, Reactions

Materials: 3 Smart LVL 13
 Sections: 2 240x45

20 (SW) 1.2G+1.5Q

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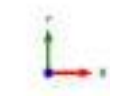
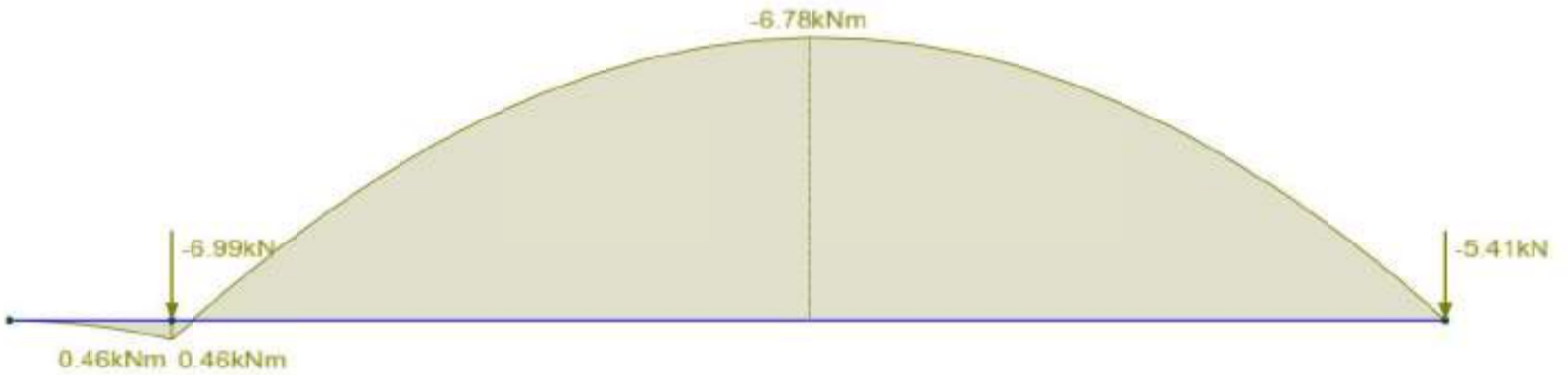


Viewpoint (0,0), Moments, Reactions

Materials: ■ 3 Smart LVL 13 Sections: ■ 2 240x45

21 (SW) 0.9G+Wu

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Viewpoint (0,0), Moments, Reactions

Materials: 3 Smart LVL 13
 Sections: 2 240x45



TIMBER MEMBER V5.15

HWC Engineers

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Beam:	(Rafter 1R2) 240mm x 45mm Smart LVL13 (Varies)	
Bending:	M* = 6.80kNm < $\phi M(0.94) = 9.69kNm$	OK (0.70)
Shear:	V* = 0.00kN < $\phi V(0.94) = 32.15kN$	OK (0.00)
Axial:	No compression, No tension	
Combined:	Refer below	OK (0.70)

Geometry (House member affecting $\leq 25m^2$ or secondary building member) Warning - Dead load only case must be checked

Category =	1 (1) House, (2) Primary building elements, (3) Important	
Span for compression (L) =	5100 mm	
Strong axis eff. length (Lax) =	1700 mm	Edge restrained = C (T)ension, (C)omp.
Weak axis eff. length (Lay) =	1700 mm, (C)ont	Bending (Layb) = 1700 mm
Effective length factor (g13) =	1.00 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2	
Checked dead load only case =	N (Y)es,(N)o	Duration of load = Roof

Bending & shear

Analysis values =	M (M)annual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical	
$\delta PII/\delta Tot.II =$	1.00 1.2*G+1.5*Q	
Major bending (Mx*) =	6.8 kNm	Major bending (Mx*) = 6.80 kNm
Minor bending (My*) =	0.0 kNm	Minor bending (My*) = 0.00 kNm
Shear Force (V*) =	0.0 kN	Shear Force (V*) = 0.00 kN
Duration (k1) =	0.94	Compression (Nc*) = 0.00 kN
		Tension (Nt*) = 0.00 kN

Bending and Shear Capacity - Cl 3.2 & Cl 3.2.5

Member =	240mm x 45mm Smart LVL13	Area (A) =	10800 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	432 x10 ³ mm ³
Design depth (dD) =	240 mm	Section modulus (Zy) =	81 x10 ³ mm ³
Design width (dW) =	45 mm	Stiffness (Ix) =	51.8 x10 ⁶ mm ⁴
Strength red. factor (ϕ) =	0.95 Table 2.1	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
$S1=1.25*dD/dW*(Layb/dD)^{0.5} =$	17.74 for comp. edge restrained - Cl 3.2.3.2		
$S1y=1.25*dW/dD*(Lax/dW)^{0.5} =$	1.44 for comp. edge restrained		
$k12d = 1.5-0.05*pb*d*S1d =$	0.609 for $10 \leq pb*d*S1 \leq 20$ - Cl 3.2.4		
$k12 = 1.5-0.05*pb*S =$	0.609 - $10 \leq pb*S \leq 20$ - Cl 3.2.4	f'b =	41.2 MPa
$k12y =$	1.000 for $pb*S_y \leq 10$ - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.95 Table 2.1	Material constant (pbd) =	1.00 (rbd=0.25)
$\phi M(dl) = \phi*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =$	5.88 kNm	Material constant (pb) =	1.00 (rb=0.25)
$\phi M = \phi*k1*k4*k6*k9*k12*f'b*Zx =$	9.69 kNm	Duration factor (k1) =	0.94
$\phi V(dl) = \phi*(k1=0.57)*k4*k6*f's*(2/3*A) =$	19.49 kN	Factor (k4) =	1.00
$\phi V = \phi*k1*k4*k6*f's*(2/3*A) =$	32.15 kN	Temp. factor (k6) =	1.00
$\phi My(dl) = \phi*(k1=0.57)*k4*k6*k9*k12y*f'b*Zy =$	1.81 kNm	Sharing factor (k9) =	1.00
$\phi My = \phi*k1*k6*k9*k12y*f'b*Zy =$	2.98 kNm	Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Axial Capacity - Cl 3.3 & Cl 3.4

$S3x = \min(g13*L/dD \& Lax/dD) =$	7.1	$k12cx =$	1.000 for $pc*S3x \leq 10$ - Cl 3.3.3
$S4y = \min(g13*L \& Lay)/dW =$	37.8	$k12cy =$	0.096 for $pc*S4y \geq 20$ - Cl 3.3.3
Critical S =	37.8	$k12d =$	0.096 for $pc*S \geq 20$ - Cl 3.3.3
		$k12 =$	0.096 for $pc*S \geq 20$ - Cl 3.3.3
Strength reduction factor (ϕ) =	0.95 Table 2.1	Lay =	1700 mm
$\phi Nc(dl) = \phi*(k1=0.57)*k4*k6*k12cd*f'c*A =$	23.6 kN	f'c =	42.0 MPa
$\phi Nc = \phi*k1*k4*k6*k12c*f'c*A =$	38.9 kN	f't =	20.3 MPa
$\phi Nt(dl) = \phi*(k1=0.57)*k4*k6*f't*A =$	118.9 kN	Temp. factor (k6) =	1.00
$\phi Nt = \phi*k1*k4*k6*f't*A =$	196.2 kN	Size modifier (mod.c) =	1.00
		Size modifier (mod.t) =	1.00

Combined - Cl 3.2.1.2

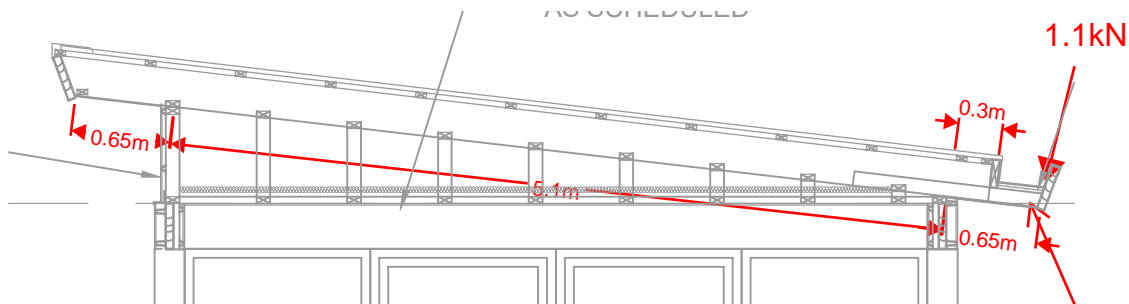
Bending:	$Mx*/\phi Mx + My*/\phi My =$	0.70
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Deflections (From Analysis)

		Duration factor ($j2$) = 2.0	$\Psi_s = 0.00$
Instantaneous $\delta DL =$	0.0 mm at 0mm from LHS		Span / -
Live load $\delta LL =$	0.0 mm at 0mm from LHS		Span / -
Permanent $\delta DL = j2*(\delta DL+\Psi.I.\delta LL) =$	0.0 mm		Span / -
Short term $\Psi_s.\delta LL =$	0.0 mm		Span / -

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RAFTER 1R3



Loads

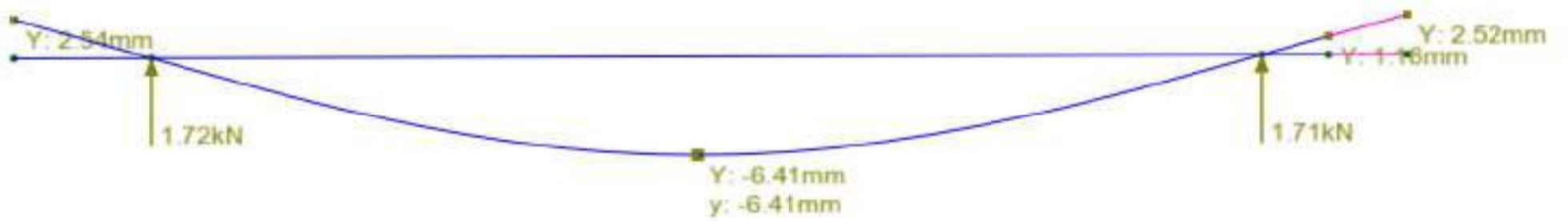
$W*G = 0.4kPa * 1.2m = 0.48kN/m$
 $W*Q = 0.25kPa * 1.2m = 0.3kN/m$
 $Wind*ult = -2.2kPa * 1.2m = -2.64kN/m$ up
 $Wind*ser = 0.68 * -2.64 = -1.8kN/m$ up

REFER FOLLOWING PAGES FOR SPACEGASS ANALYSIS

90 deep section under the box gutter

1 (SW) G

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Viewpoint (7,0), Displacements, Reactions

Materials:
 3 Smart LVL 13

Sections:
 2 240x45
 3 90x45

2Q

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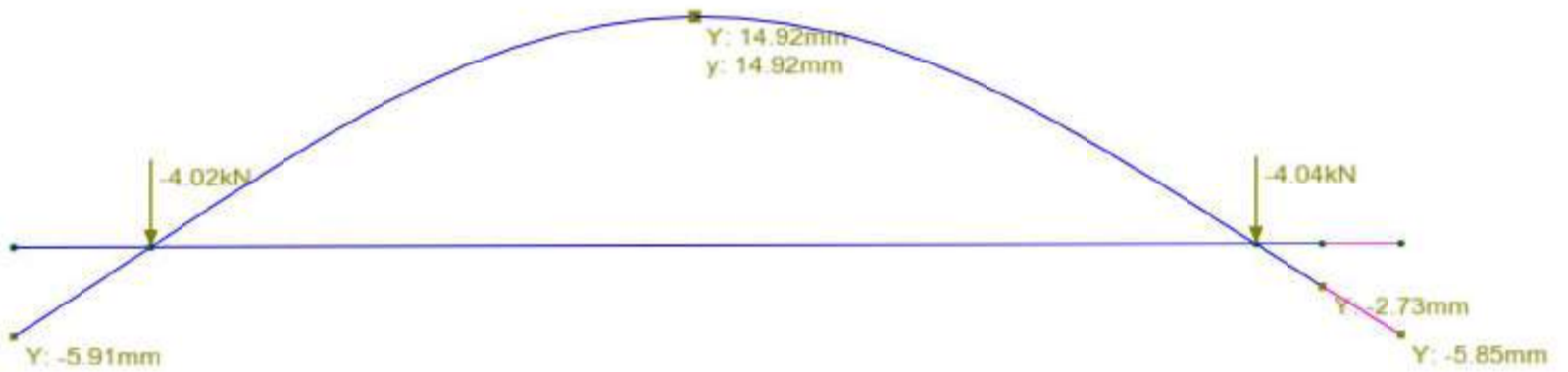


Viewpoint (7,0), Displacements, Reactions

Materials: ■ 2 240x45 ■ 3 90x45
■ 3 Smart LVL 13

■ 11 (SW) G+WS

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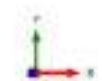
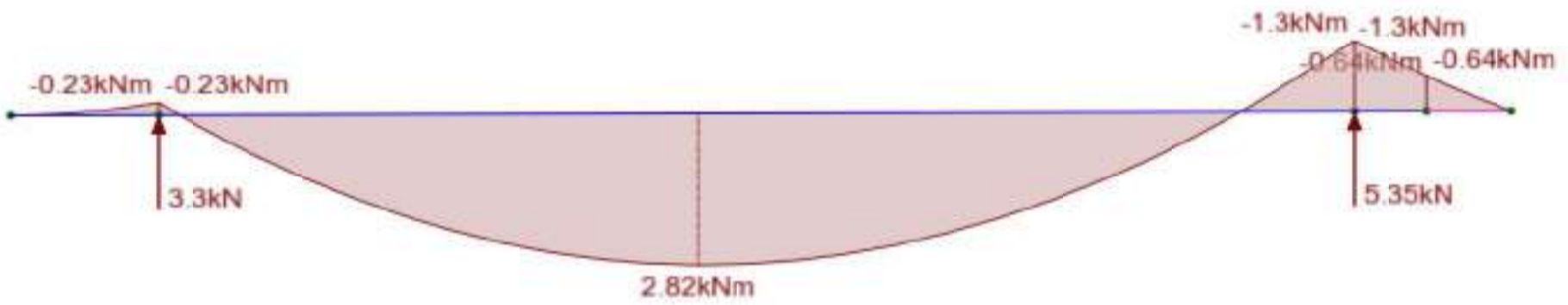
Viewpoint (7,0), Displacements, Reactions

Materials:
 ■ 3 Smart LVL 13

Sections:
 ■ 2 240x45
 ■ 3 90x45

20 (SW) 1.2G+1.5Q

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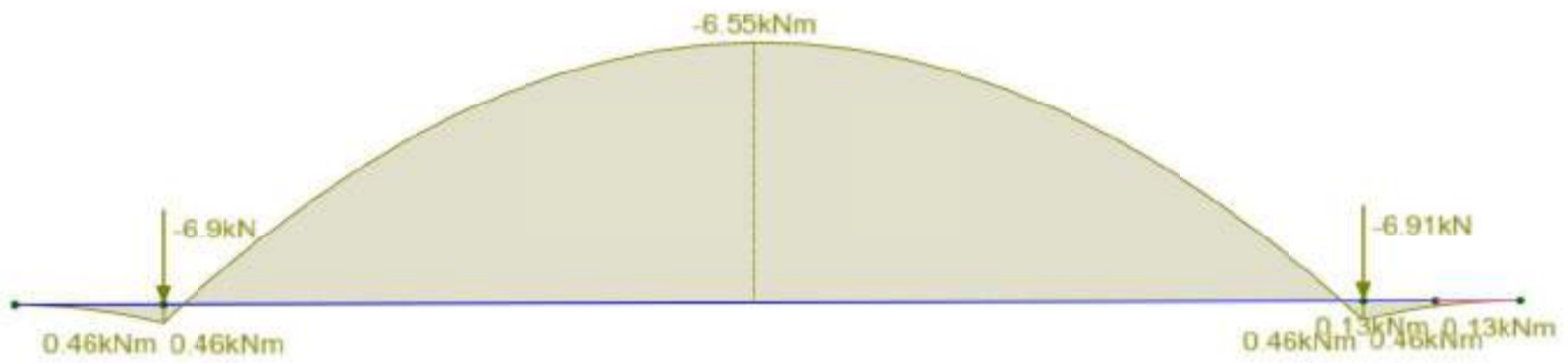
Viewpoint (7,0), Moments, Reactions

Materials:
 3 Smart LVL 13

Sections:
 2 240x45
 3 90x45

21 (SW) 0.9G+Wu

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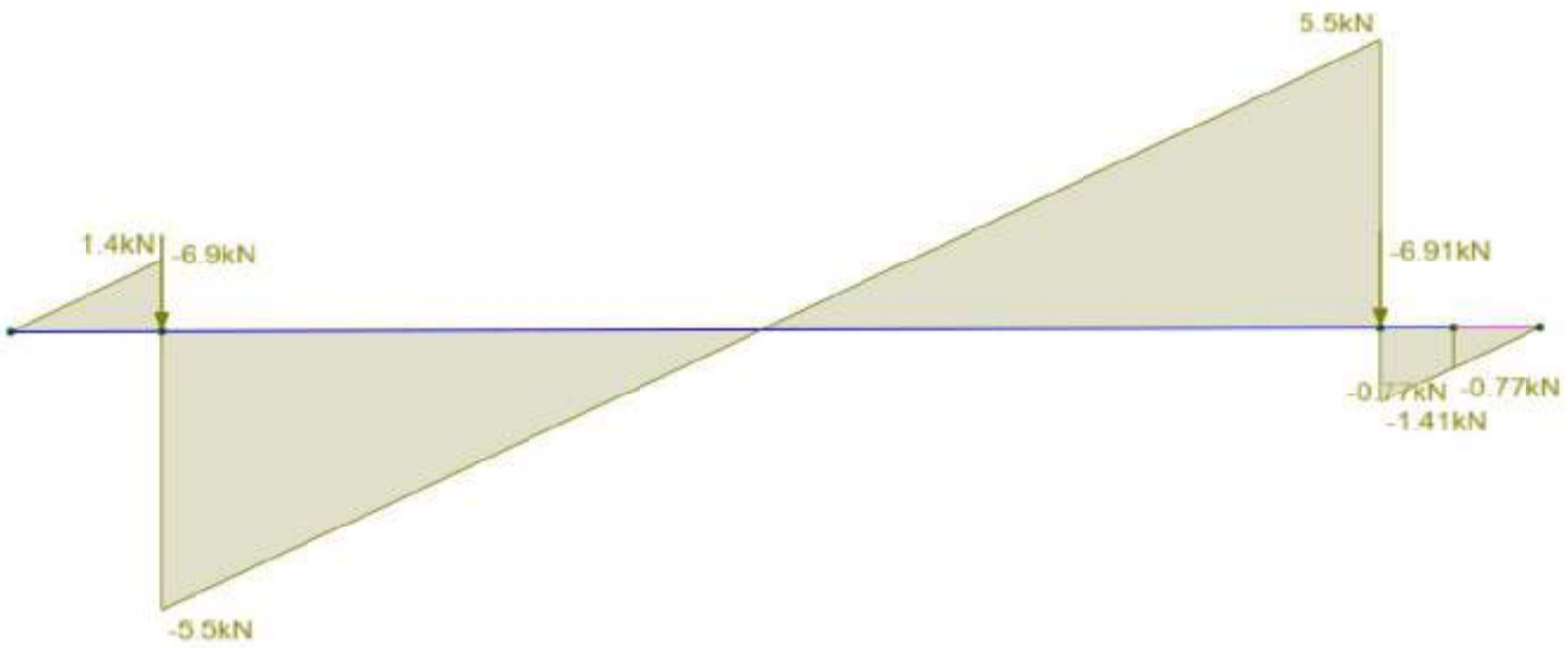
Viewpoint (7,0), Moments, Reactions

Materials:
 3 Smart LVL 13

Sections:
 2 240x45
 3 90x45

21 (SW) 0.9G+Wu

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Viewpoint (7,0), Shears, Reactions

Materials:
 3 Smart LVL 13

Sections:
 2 240x45
 3 90x45



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Beam:	(Rafter 1R3-240x45 SMARTLVL13) 240mm x 45mm Smart LVL13 (Varies)	
Bending:	M* = 6.60kNm < $\phi M(0.94) = 9.69kNm$	OK (0.68)
Shear:	V* = 0.00kN < $\phi V(0.94) = 32.15kN$	OK (0.00)
Axis:	No compression, No tension	
Combined:	Refer below	OK (0.68)

Geometry (House member affecting $\leq 25m^2$ or secondary building member) Warning - Dead load only case must be checked

Category =	1 (1) House, (2) Primary building elements, (3) Important	
Span for compression (L) =	5100 mm	
Strong axis eff. length (Lax) =	1700 mm	Edge restrained = C (T)ension, (C)omp.
Weak axis eff. length (Lay) =	1700 mm, (C)ont	Bending (Layb) = 1700 mm
Effective length factor (g13) =	1.00	Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2
Checked dead load only case =	N (Y)es,(N)o	Duration of load = Roof

Bending & shear

Analysis values =	M (M)annual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical	
$\delta PII/\delta Tot.II =$	1.00	1.2*G+1.5*Q
Major bending (Mx*) =	6.6 kNm	Major bending (Mx*) = 6.60 kNm
Minor bending (My*) =	0.0 kNm	Minor bending (My*) = 0.00 kNm
Shear Force (V*) =	0.0 kN	Shear Force (V*) = 0.00 kN
Duration (k1) =	0.94	Compression (Nc*) = 0.00 kN
		Tension (Nt*) = 0.00 kN

Bending and Shear Capacity - Cl 3.2 & Cl 3.2.5

Member =	240mm x 45mm Smart LVL13	Area (A) =	10800 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	432 x10 ³ mm ³
Design depth (dD) =	240 mm	Section modulus (Zy) =	81 x10 ³ mm ³
Design width (dW) =	45 mm	Stiffness (Ix) =	51.8 x10 ⁶ mm ⁴
Strength red. factor (ϕ) =	0.95 Table 2.1	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
$S1=1.25*dD/dW*(Layb/dD)^{0.5} =$	17.74 for comp. edge restrained - Cl 3.2.3.2		
$S1y=1.25*dW/dD*(Lax/dW)^{0.5} =$	1.44 for comp. edge restrained		
$k12d = 1.5-0.05*pb*d*S1d =$	0.609 for $10 \leq pb*d*S1 \leq 20$ - Cl 3.2.4		
$k12 = 1.5-0.05*pb*S =$	0.609 - $10 \leq pb*S \leq 20$ - Cl 3.2.4	f'b =	41.2 MPa
$k12y =$	1.000 for $pb*S_y \leq 10$ - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.95 Table 2.1	Material constant (pbd) =	1.00 (rbd=0.25)
$\phi M(dl) = \phi*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =$	5.88 kNm	Material constant (pb) =	1.00 (rb=0.25)
$\phi M = \phi*k1*k4*k6*k9*k12*f'b*Zx =$	9.69 kNm	Duration factor (k1) =	0.94
$\phi V(dl) = \phi*(k1=0.57)*k4*k6*f's*(2/3*A) =$	19.49 kN	Factor (k4) =	1.00
$\phi V = \phi*k1*k4*k6*f's*(2/3*A) =$	32.15 kN	Temp. factor (k6) =	1.00
$\phi My(dl) = \phi*(k1=0.57)*k4*k6*k9*k12y*f'b*Zy =$	1.81 kNm	Sharing factor (k9) =	1.00
$\phi My = \phi*k1*k6*k9*k12y*f'b*Zy =$	2.98 kNm	Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Axial Capacity - Cl 3.3 & Cl 3.4

$S3x = \min(g13*L/dD \& Lax/dD) =$	7.1	$k12cx =$	1.000 for $pc*S3x \leq 10$ - Cl 3.3.3
$S4y = \min(g13*L \& Lay)/dW =$	37.8	$k12cy =$	0.096 for $pc*S4y \geq 20$ - Cl 3.3.3
Critical S =	37.8	$k12d =$	0.096 for $pc*S \geq 20$ - Cl 3.3.3
		$k12 =$	0.096 for $pc*S \geq 20$ - Cl 3.3.3
Strength reduction factor (ϕ) =	0.95 Table 2.1	Lay =	1700 mm
$\phi Nc(dl) = \phi*(k1=0.57)*k4*k6*k12cd*f'c*A =$	23.6 kN	f'c =	42.0 MPa
$\phi Nc = \phi*k1*k4*k6*k12c*f'c*A =$	38.9 kN	f't =	20.3 MPa
$\phi Nt(dl) = \phi*(k1=0.57)*k4*k6*f't*A =$	118.9 kN	Temp. factor (k6) =	1.00
$\phi Nt = \phi*k1*k4*k6*f't*A =$	196.2 kN	Size modifier (mod.c) =	1.00
		Size modifier (mod.t) =	1.00

Combined - Cl 3.2.1.2

Bending:	$Mx*/\phi Mx + My*/\phi My =$	0.68
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Deflections (From Analysis)

	Duration factor (j2) = 2.0	$\psi_s = 0.00$
Instantaneous $\delta DL =$	0.0 mm at 0mm from LHS	Span / -
Live load $\delta LL =$	0.0 mm at 0mm from LHS	Span / -
Permanent $\delta DL = j2*(\delta DL+\psi_i.\delta LL) =$	0.0 mm	Span / -
Short term $\psi_s.\delta LL =$	0.0 mm	Span / -



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Beam:	(Rafter 1R3-90x45 SMARTLVL13) 240mm x 45mm Smart LVL13 (Varies)	
Bending:	M* = 0.50kNm < $\phi M(0.94) = 9.69\text{kNm}$	OK (0.05)
Shear:	V* = 0.80kN < $\phi V(0.94) = 32.15\text{kN}$	OK (0.02)
Axis:	No compression, No tension	
Combined:	Refer below	OK (0.05)

Geometry (House member affecting $\leq 25\text{m}^2$ or secondary building member) Warning - Dead load only case must be checked

Category =	1 (1) House, (2) Primary building elements, (3) Important	
Span for compression (L) =	5100 mm	
Strong axis eff. length (Lax) =	1700 mm	Edge restrained = C (T)ension, (C)omp.
Weak axis eff. length (Lay) =	1700 mm, (C)ont	Bending (Layb) = 1700 mm
Effective length factor (g13) =	1.00 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2	
Checked dead load only case =	N (Y)es,(N)o	Duration of load = Roof

Bending & shear

Analysis values =	M (M)annual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical	
$\delta PII/\delta Tot.II =$	1.00 1.2*G+1.5*Q	
Major bending (Mx*) =	0.5 kNm	Major bending (Mx*) = 0.50 kNm
Minor bending (My*) =	0.0 kNm	Minor bending (My*) = 0.00 kNm
Shear Force (V*) =	0.8 kN	Shear Force (V*) = 0.80 kN
Duration (k1) =	0.94	Compression (Nc*) = 0.00 kN
		Tension (Nt*) = 0.00 kN

Bending and Shear Capacity - Cl 3.2 & Cl 3.2.5

Member =	240mm x 45mm Smart LVL13	Area (A) =	10800 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	432 x10 ³ mm ³
Design depth (dD) =	240 mm	Section modulus (Zy) =	81 x10 ³ mm ³
Design width (dW) =	45 mm	Stiffness (Ix) =	51.8 x10 ⁶ mm ⁴
Strength red. factor (ϕ) =	0.95 Table 2.1	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
$S1=1.25*dD/dW*(Layb/dD)^{0.5} =$	17.74 for comp. edge restrained - Cl 3.2.3.2		
$S1y=1.25*dW/dD*(Lax/dW)^{0.5} =$	1.44 for comp. edge restrained		
$k12d = 1.5-0.05*pb*d*S1d =$	0.609 for $10 \leq pb*d*S1 \leq 20$ - Cl 3.2.4		
$k12 = 1.5-0.05*pb*S =$	0.609 - $10 \leq pb*S \leq 20$ - Cl 3.2.4	f'b =	41.2 MPa
$k12y =$	1.000 for $pb*S_y \leq 10$ - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.95 Table 2.1	Material constant (pbd) =	1.00 (rbd=0.25)
$\phi M(dl) = \phi*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =$	5.88 kNm	Material constant (pb) =	1.00 (rb=0.25)
$\phi M = \phi*k1*k4*k6*k9*k12*f'b*Zx =$	9.69 kNm	Duration factor (k1) =	0.94
$\phi V(dl) = \phi*(k1=0.57)*k4*k6*f's*(2/3*A) =$	19.49 kN	Factor (k4) =	1.00
$\phi V = \phi*k1*k4*k6*f's*(2/3*A) =$	32.15 kN	Temp. factor (k6) =	1.00
$\phi My(dl) = \phi*(k1=0.57)*k4*k6*k9*k12y*f'b*Zy =$	1.81 kNm	Sharing factor (k9) =	1.00
$\phi My = \phi*k1*k6*k9*k12y*f'b*Zy =$	2.98 kNm	Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Axial Capacity - Cl 3.3 & Cl 3.4

$S3x = \min(g13*L/dD \& Lax/dD) =$	7.1	$k12cx =$	1.000 for $pc*S3x \leq 10$ - Cl 3.3.3
$S4y = \min(g13*L \& Lay)/dW =$	37.8	$k12cy =$	0.096 for $pc*S4y \geq 20$ - Cl 3.3.3
Critical S =	37.8	$k12d =$	0.096 for $pc*S \geq 20$ - Cl 3.3.3
		$k12 =$	0.096 for $pc*S \geq 20$ - Cl 3.3.3
Strength reduction factor (ϕ) =	0.95 Table 2.1	Lay =	1700 mm
$\phi Nc(dl) = \phi*(k1=0.57)*k4*k6*k12cd*f'c*A =$	23.6 kN	f'c =	42.0 MPa
$\phi Nc = \phi*k1*k4*k6*k12c*f'c*A =$	38.9 kN	f't =	20.3 MPa
$\phi Nt(dl) = \phi*(k1=0.57)*k4*k6*f't*A =$	118.9 kN	Temp. factor (k6) =	1.00
$\phi Nt = \phi*k1*k4*k6*f't*A =$	196.2 kN	Size modifier (mod.c) =	1.00
		Size modifier (mod.t) =	1.00

Combined - Cl 3.2.1.2

Bending:	$Mx*/\phi Mx + My*/\phi My =$	0.05
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Deflections (From Analysis)

	Duration factor (j2) = 2.0	$\Psi_s = 0.00$
Instantaneous $\delta DL =$	0.0 mm at 0mm from LHS	Span / -
Live load $\delta LL =$	0.0 mm at 0mm from LHS	Span / -
Permanent $\delta DL = j2*(\delta DL+\Psi.I.\delta LL) =$	0.0 mm	Span / -
Short term $\Psi_s.\delta LL =$	0.0 mm	Span / -



STEEL ROOF BEAM V5.13

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Member:	(Roof Beam 1RB4) 150x75PFC (G300) - Btm flange restraint at 5100mm cts	
Bending:	M.dn*(max) = 4.3kNm < $\phi Mb(5100, \alpha.m.t=1.17) = 17.5kNm$	OK (0.25)
	M.up*(max) = 3.5kNm < $\phi Mb(5100, \alpha.m.b=1.17) = 17.5kNm$	OK (0.20)
Shear:	V.max*=3.4kN < $\phi Vvm = 155.5kN$ (Web area full depth)	OK (0.02)
	V.wl*=2.7kN < $\phi Vw = 155.5kN$ (Web area full depth)	OK (0.02)
Deflection:	$\delta DL = L/2317$ (2mm), $\delta \Psi s.LL = L/3141$ (2mm), $\delta WLs = L/978$ (5mm)	OK
Precamber:	Not required	
Reactions:	(Each end) Rdl = 1.1kN, Rll = 1.4kN, Rwl* = -3.7kN, R.dn* = 3.4kN, R.up* = 2.7kN	

Geometry

Span (L) =	5100 mm	Top flange restraint/purlin cts (Le) =	5100 mm (Top flange)
Centres (cts) =	600 mm		
Design at =	M mm from LHS, (M)ax, (S)eg	Flybraces / Leb =	5100 mm (<500 for No. fb's)
Span type =	S (S)ingle, (D)ouble		
Bottom $\alpha.m.b =$	1.17 (Calc. $\alpha.m$, Leb = 5100 mm)	Top $\alpha.m.t =$	1.17 (Calc. $\alpha.m$, Le = 5100 mm)

Loadings

Roof area (A) =	3.1 m ²	Apply wind reduction =	Y (Y)es, (N)o
LL = 1.8/A+0.12 \geq 0.25 =	0.71 kPa AS 1170.1 T3.2	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
		Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	600 mm +		kN/m =	0.24 kN/m
Other dead load (wdl) =	kPa *	600 mm +		kN/m =	0.00 kN/m
Down only load (wdl) =	kPa *	mm +		kN/m =	0.00 kN/m
Include S.Wt =	Y (Y)es, (N)o			S.Wt =	0.18 kN/m
		$\Sigma wdl.up =$	0.42 kN/m	$\Sigma wdl =$	0.42 kN/m

Uniform live loads

Roof live load (wll) =	0.71 kPa *	600 mm +		kN/m =	0.42 kN/m
Other live load (wll) =	kPa *	600 mm +		kN/m =	0.00 kN/m
Alternate point live load =	1.40 kN (critical)	Distr. to	1 members	$\Sigma wll =$	0.55 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	600 mm			
Cp,e =	0.9	Cp,i =	0.2	w.wl* =	-1.45 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	2550 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es, (N)o
Wind load (pwl*) =	kN (-ve up)		
w* = 1.2*wdl + 1.5*wll =	1.32 kN/m	M* =	4.30 kNm (Max at 2550mm)
p* = 1.2*pdl + 1.5*pll =	0.00 kN	Mw.up* =	3.50 kNm (Max at 2550mm)
w.up* = 0.9*wdl.up + ww* =	1.08 kN/m (up)	V* =	3.38 kN
p.up* = 0.9*pdl + pwl* =	0.00 kN	Vw.up* =	2.75 kN

Capacity

Description = 150x75PFC (G300)		Warping constant (Iw) =	4.59 x10 ⁹ mm ⁶
Flange yield (fyf) =	320 MPa	Torsional constant (J) =	56.6 x10 ³ mm ⁴
Web yield (fyw) =	320 MPa	Effective section mod. (Zex) =	129 x10 ³ mm ³
Area (Ag) =	2250 mm ²	Effective section mod. (Zey) =	38.5 x10 ³ mm ³
Stiffness (Ix) =	8.34 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4
$\phi =$	0.9 Table 3.4	Shear modulus (G) =	80000 MPa - Cl 1.4
Msx = min(fyf, fyw)*Zex =	41.3 kNm - Cl 5.2.1	$\phi Msx =$	37.2 kNm
Down: Moa =	21.8 kNm $\alpha.s.t = 0.404$	$\alpha.m.t = 1.17$	$\phi Mb.x.d =$ 17.5 kNm
Uplift: Moa =	21.8 kNm $\alpha.s.b = 0.404$	$\alpha.m.b = 1.17$	$\phi Mb.x.u =$ 17.5 kNm

Deflections

Ireq'd DL (L/250) =	0.9 x10 ⁶ mm ⁴	$\delta DL =$	2.2 mm	Span / 2317
Ireq'd LL (L/240) =	0.6 x10 ⁶ mm ⁴	$\delta \Psi s.LL =$	1.6 mm	Span / 3141
Ireq'd WLs (L/250) =	2.1 x10 ⁶ mm ⁴	$\delta WLs =$	5.2 mm	Span / 978
	< Critical			
Max. precamber (0.3%*span) =	15 mm	Min. precamber =	15 mm	
Precamber 80% of $\delta DL =$	2 mm	Adopted precamber =	0 mm	



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Member:	(Roof Beam 1RB5) 180x75PFC (G300) - Btm flange restraint at 1200mm cts	
Bending:	M.dn*(max) = 6.8kNm < $\phi Mb(1200, \alpha.m.t=1.00)$ = 43.3kNm	OK (0.16)
	M.up*(max) = 14.1kNm < $\phi Mb(1200, \alpha.m.b=1.00)$ = 43.3kNm	OK (0.33)
Shear:	V.max*=6.4kN < $\phi Vvm = 186.6kN$ (Web area full depth)	OK (0.07)
	V.wl* = 13.3kN < $\phi Vw = 186.6kN$ (Web area full depth)	OK (0.07)
Deflection:	$\delta DL = L/1895$ (2mm), $\delta \Psi s.LL = L/4991$ (1mm), $\delta WLs = L/546$ (8mm)	OK
Precamber:	Not required	
Reactions:	(Each end) Rdl = 3.2kN, Rll = 1.7kN, Rwl* = -16.1kN, R.dn* = 6.4kN, R.up* = 13.3kN	

Geometry

Span (L) =	4250 mm	Top flange restraint/purlin cts (Le) =	1200 mm (Top flange)
Centres (cts) =	3200 mm	Moment mod. factor ($\alpha.m.t$) =	1.00
Design at =	M mm from LHS, (M)ax, (S)eg	Flybraces / Leb =	1200 mm (<500 for No. fb's)
Span type =	S (S)ingle, (D)ouble	Moment mod. factor ($\alpha.m.b$) =	1.00

Bottom $\alpha.m.b$ = 1.00 (Man. $\alpha.m$, Leb = 1200 mm) Top $\alpha.m.t$ = 1.00 (Man. $\alpha.m$, Le = 1200 mm)

Loadings

Roof area (A) =	13.6 m ²	Apply wind reduction =	Y (Y)es, (N)o
LL = 1.8/A+0.12 \geq 0.25 =	0.25 kPa AS 1170.1 T3.2	Roof reduction (Ka) =	0.98 AS/NZS 1170.2, Table 5.4
		Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m	
Other dead load (wdl) =	kPa *	3200 mm +	kN/m =	0.00 kN/m	
Down only load (wdl) =	kPa *	mm +	kN/m =	0.00 kN/m	
Include S.Wt =	Y (Y)es, (N)o		S.Wt =	0.21 kN/m	
		$\Sigma wdl.up$ =	1.49 kN/m	Σwdl =	1.49 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.81 kN/m	
Other live load (wll) =	kPa *	3200 mm +	kN/m =	0.00 kN/m	
Alternate point live load =	1.40 kN	Distr. to	1 members	Σwll =	0.81 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	3200 mm			
Cp,e =	0.9	Cp,i =	0.2	w.wl* =	-7.59 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	2125 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es, (N)o
Wind load (pwl*) =	kN (-ve up)		
w* = 1.2*wdl + 1.5*wll =	3.00 kN/m	M* =	6.77 kNm (Max at 2125mm)
p* = 1.2*pdl + 1.5*pll =	0.00 kN	Mw.up* =	14.12 kNm (Max at 2125mm)
w.up* = 0.9*wdl.up + ww* =	6.25 kN/m (up)	V* =	6.37 kN
p.up* = 0.9*pdl + pwl* =	0.00 kN	Vw.up* =	13.29 kN

Capacity

Description = 180x75PFC (G300)	Warping constant (Iw) =	7.82 x10 ⁹ mm ⁶
Flange yield (fyf) = 300 MPa	Torsional constant (J) =	84.5 x10 ³ mm ⁴
Web yield (fyw) = 320 MPa	Effective section mod. (Zex) =	182 x10 ³ mm ³
Area (Ag) = 2660 mm ²	Effective section mod. (Zey) =	44.9 x10 ³ mm ³
Stiffness (Ix) = 14.1 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4
ϕ = 0.9 Table 3.4	Shear modulus (G) =	80000 MPa - Cl 1.4
Msx = min(fyf, fyw)*Zex = 54.6 kNm - Cl 5.2.1	ϕ Msx = 49.1 kNm	ϕ Msy = 12.1 kNm - Cl 5.2.1
Down: Moa = 190.2 kNm $\alpha.s.t = 0.881$	$\alpha.m.t = 1.00$	ϕ Mbx.d = 43.3 kNm
Uplift: Moa = 190.2 kNm $\alpha.s.b = 0.881$	$\alpha.m.b = 1.00$	ϕ Mbx.u = 43.3 kNm

Deflections

Ireq'd DL (L/250) =	1.9 x10 ⁶ mm ⁴	δDL =	2.2 mm	Span / 1895
Ireq'd LL (L/240) =	0.7 x10 ⁶ mm ⁴	$\delta \Psi s.LL$ =	0.9 mm	Span / 4991
Ireq'd WLs (L/250) =	6.5 x10 ⁶ mm ⁴	δWLs =	7.8 mm	Span / 546

Max. precamber (0.3%*span) = 13 mm Min. precamber = 15 mm
Preamber 80% of δDL = 2 mm Adopted precamber = 0 mm



TIMBER ROOF BEAM V5.10

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Beam:	(Lintel 1L2) 190mm x 45mm MGP10 (Single span)	
Bending:	M(dl)* = 0.79kNm (+ve) < øM(dl) = 2.03kNm, M* = 1.40kNm (+ve) < øM = 3.44kNm	OK (0.39,0.41)
	Mw* = 2.27kNm (-ve) < øMw = 3.84kNm	OK (0.59)
Shear:	V(dl)* = 1.86kN < øV(dl) = 7.29kN, V* = 3.31kN < øV = 12.03kN	OK (0.26,0.27)
	Vw* = 5.34kN < øVw = 12.79kN	OK (0.42)
Deflection:	δDL = L/1239 (1mm), δΨs.LL = L/3884 (0mm), δWLs = L/764 (-2mm)	OK
Reactions:	(Each end) Rdl = 1.38kN, Rll = 1.10kN, Rwl* = -6.58kN, R.dn* = 3.31kN, R.up* = 5.34kN	

Geometry (House member affecting ≤ 25m² or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	1700 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	3200 mm	Lay.t (Top) =	1700 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	5.44 m²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Other dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.04 kN/m
			Σwdl =	1.62 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m	
Other live load (wll) =	kPa *	3200 mm +	kN/m =	0.00 kN/m	
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	Σwll =	1.29 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	3200 mm			
Cp,e =	0.9	Cp,i =	0.2	Σwwl* =	-7.74 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	850 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
w(dl)* = 1.35*wdl =	2.19 kN/m	M(dl)* =	0.79 kNm (Max at 850mm)
w* = 1.2*wdl + 1.5*wll =	3.89 kN/m	M* =	1.40 kNm (Max at 850mm)
w.up* = 0.9*wdl + wll* =	6.28 kN/m (up)	Mw.up* =	2.27 kNm (Max at 850mm)
p(dl)* = 1.35*pdl =	0.00 kN	V(dl)* =	1.86 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	3.31 kN
p.up* = 0.9*pdl + pwl* =	0.00 kN	Vw.up* =	5.34 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member = 190mm x 45mm MGP10	Area (A) =	8550 mm²	
Description = MGP10 seasoned softwood	Section modulus (Zx) =	271 x10³ mm³	
Design depth (dD) = 190 mm	Stiffness (Ix) =	25.7 x10⁶ mm⁴	
Design width (dW) = 45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1	
S1d = 1.25*dD/dW*(Lay.t/dD)⁰·⁵ =	15.79 For top comp. edge restrained - Cl 3.2.3.2(a)		
S1u = (dD/dW)¹·³⁵*(Lay.t/dD)⁰·²⁵ =	12.09 For top tension edge restrained in uplift - Cl 3.2.3.2(a)		
k12d = 1.5-0.05*pbd*S1d =	0.930 for 10 ≤ pbd*S1d ≤ 20 - Cl 3.2.4		
k12 = 1.5-0.05*pb*S1d =	0.953 for 10 ≤ pb*S1d ≤ 20 - Cl 3.2.4	f'b = 15.7 MPa	
k12u =	1.000 for pbu*S1u ≤ 10 - Cl 3.2.4	f's = 2.5 MPa	
Strength reduction factor (ø) =	0.9 Table 2.1	Material constant (pbd) =	0.72 (rbd=0.25)
øM(dl) = ø*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =	2.03 kNm	Material constant (pb) =	0.69 (rb=0.50)
øM = ø*k1*k4*k6*k9*k12*f'b*Zx =	3.44 kNm	Stress reversal (pbu) =	0.66 (rbu=1.00)
øMw = ø*(k1=1)*k4*k6*k9*k12u*f'b*Zx =	3.84 kNm	Duration factor (k1) =	0.94 (Live)
øV(dl) = ø*(k1=0.57)*k4*k6*f's*(2/3*A) =	7.29 kN	Moisture factor (k4) =	1.00
øV = ø*k1*k4*k6*f's*(2/3*A) =	12.03 kN	Temp. factor (k6) =	1.00
øVw = ø*(k1=1)*k4*k6*f's*(2/3*A) =	12.79 kN	Sharing factor (k9) =	1.00
		Size modifier (mod.b & s) =	0.93 & 0.96

Deflections

	Duration factor (j2) =	2.0		
Ireq'd j2.(DL+Ψl.LL) (L/300) =	6.2 x10⁶ mm⁴	< Critical		
Ireq'd LL (L/240) =	1.6 x10⁶ mm⁴	δDL=	1.4 mm	Span / 1239
Ireq'd WLs (L/180) =	6.1 x10⁶ mm⁴	δΨs.LL =	0.4 mm	Span / 3884
		δWLs =	-2.2 mm	Span / 764

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TIMBER ROOF BEAM V5.10

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Beam:	(Lintel 1L3) 140mm x 45mm MGP10 (Single span)	
Bending:	$M(dI)^* = 0.46kNm (+ve) < \phi M(dI) = 1.28kNm$, $M^* = 0.94kNm (+ve) < \phi M = 2.11kNm$	OK (0.36,0.45)
	$Mw^* = 1.33kNm (-ve) < \phi Mw = 2.24kNm$	OK (0.59)
Shear:	$V(dI)^* = 1.41kN < \phi V(dI) = 5.58kN$, $V^* = 2.91kN < \phi V = 9.21kN$	OK (0.25,0.32)
	$Vw^* = 4.09kN < \phi Vw = 9.80kN$	OK (0.42)
Deflection:	$\delta DL = L/1116 (1mm)$, $\delta \Psi s.LL = L/2657 (0mm)$, $\delta WLs = L/683 (-2mm)$	OK
Reactions:	(Each end) $Rdl = 1.05kN$, $Rll = 1.10kN$, $Rwl^* = -5.03kN$, $R.dn^* = 2.91kN$, $R.up^* = 4.09kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	1300 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	3200 mm	Lay.t (Top) =	1300 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	4.16 m ²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Other dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.03 kN/m
			$\Sigma wdl =$	1.61 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m
Other live load (wll) =	kPa *	3200 mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	$\Sigma wll =$ 1.69 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	3200 mm		
Cp,e =	0.9	Cp,i =	0.2	$\Sigma wwI^* =$ -7.74 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	650 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
$w(dI)^* = 1.35 * wdl =$	2.18 kN/m	$M(dI)^* =$	0.46 kNm (Max at 650mm)
$w^* = 1.2 * wdl + 1.5 * wll =$	4.47 kN/m	$M^* =$	0.94 kNm (Max at 650mm)
$w.up^* = 0.9 * wdl + wll =$	6.29 kN/m (up)	$Mw.up^* =$	1.33 kNm (Max at 650mm)
$p(dI)^* = 1.35 * pdl =$	0.00 kN	$V(dI)^* =$	1.41 kN
$p^* = 1.2 * pdl + 1.5 * pll =$	0.00 kN	$V^* =$	2.91 kN
$p.up^* = 0.9 * pdl + pwl^* =$	0.00 kN	$Vw.up^* =$	4.09 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	140mm x 45mm MGP10	Area (A) =	6300 mm ²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	147 x10 ³ mm ³
Design depth (dD) =	140 mm	Stiffness (Ix) =	10.3 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1
$S1d = 1.25 * dD / dW^* (Lay.t / dD)^{0.5} =$	11.85		For top comp. edge restrained - Cl 3.2.3.2(a)
$S1u = (dD / dW)^{1.35} * (Lay.t / dD)^{0.25} =$	8.08		For top tension edge restrained in uplift - Cl 3.2.3.2(a)
$k12d =$	1.000		for $pbd * S1d \leq 10$ - Cl 3.2.4
$k12 =$	1.000		for $pb * S1d \leq 10$ - Cl 3.2.4
$k12u =$	1.000		for $pbu * S1u \leq 10$ - Cl 3.2.4
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.75 (rbd=0.25)
$\phi M(dI) = \phi * (k1=0.57) * k4 * k6 * k9 * k12d * f'b * Zx =$	1.28 kNm	Material constant (pb) =	0.71 (rb=0.57)
$\phi M = \phi * k1 * k4 * k6 * k9 * k12 * f'b * Zx =$	2.11 kNm	Stress reversal (pbu) =	0.69 (rbu=1.00)
$\phi Mw = \phi * (k1=1) * k4 * k6 * k9 * k12u * f'b * Zx =$	2.24 kNm	Duration factor (k1) =	0.94 (Live)
$\phi V(dI) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) =$	5.58 kN	Moisture factor (k4) =	1.00
$\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) =$	9.21 kN	Temp. factor (k6) =	1.00
$\phi Vw = \phi * (k1=1) * k4 * k6 * f's * (2/3 * A) =$	9.80 kN	Sharing factor (k9) =	1.00
		Size modifier (mod.b & s) =	1.00 & 1.00

Deflections

		Duration factor ($j2$) =	2.0
Ireq'd $j2.(DL+\Psi.LL) (L/300) =$	2.8 x10 ⁶ mm ⁴	< Critical	$\delta DL =$ 1.2 mm
Ireq'd $\Psi.LL (L/240) =$	0.9 x10 ⁶ mm ⁴	$\delta \Psi s.LL =$	0.5 mm
Ireq'd $WLs (L/180) =$	2.7 x10 ⁶ mm ⁴	$\delta WLs =$	-1.9 mm
			Span / 1116
			Span / 2657
			Span / 683

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Beam:	(Lintel 1L4) 140mm x 45mm MGP10 (Single span)	
Bending:	$M(dl)^* = 0.61kNm (+ve) < \phi M(dl) = 1.28kNm$, $M^* = 1.16kNm (+ve) < \phi M = 2.11kNm$	OK (0.48,0.55)
	$Mw^* = 1.77kNm (-ve) < \phi Mw = 2.24kNm$	OK (0.79)
Shear:	$V(dl)^* = 1.63kN < \phi V(dl) = 5.58kN$, $V^* = 3.10kN < \phi V = 9.21kN$	OK (0.29,0.34)
	$Vw^* = 4.72kN < \phi Vw = 9.80kN$	OK (0.48)
Deflection:	$\delta DL = L/727 (2mm)$, $\delta \Psi s.LL = L/1996 (1mm)$, $\delta WLs = L/445 (-3mm)$	OK
Reactions:	(Each end) $Rdl = 1.21kN$, $Rll = 1.10kN$, $Rwl^* = -5.81kN$, $R.dn^* = 3.10kN$, $R.up^* = 4.72kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	1500 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	3200 mm	Lay.t (Top) =	1500 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	4.80 m ²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Other dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.03 kN/m
			$\Sigma wdl =$	1.61 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m
Other live load (wll) =	kPa *	3200 mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	$\Sigma wll =$ 1.47 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	3200 mm		
Cp,e =	0.9	Cp,i =	0.2	$\Sigma wwll^* =$ -7.74 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	750 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
$w(dl)^* = 1.35 * wdl =$	2.18 kN/m	$M(dl)^* =$	0.61 kNm (Max at 750mm)
$w^* = 1.2 * wdl + 1.5 * wll =$	4.13 kN/m	$M^* =$	1.16 kNm (Max at 750mm)
$w.up^* = 0.9 * wdl + wll^* =$	6.29 kN/m (up)	$Mw.up^* =$	1.77 kNm (Max at 750mm)
$p(dl)^* = 1.35 * pdl =$	0.00 kN	$V(dl)^* =$	1.63 kN
$p^* = 1.2 * pdl + 1.5 * pll =$	0.00 kN	$V^* =$	3.10 kN
$p.up^* = 0.9 * pdl + pwl^* =$	0.00 kN	$Vw.up^* =$	4.72 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	140mm x 45mm MGP10	Area (A) =	6300 mm ²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	147 x10 ³ mm ³
Design depth (dD) =	140 mm	Stiffness (Ix) =	10.3 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1
$S1d = 1.25 * dD / dW^* (Lay.t / dD)^{0.5} =$	12.73		For top comp. edge restrained - Cl 3.2.3.2(a)
$S1u = (dD / dW)^{1.35} * (Lay.t / dD)^{0.25} =$	8.37		For top tension edge restrained in uplift - Cl 3.2.3.2(a)
$k12d =$	1.000		for $pbd * S1d \leq 10$ - Cl 3.2.4
$k12 =$	1.000		for $pb * S1d \leq 10$ - Cl 3.2.4
$k12u =$	1.000		for $pbu * S1u \leq 10$ - Cl 3.2.4
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.75 (rbd=0.25)
$\phi M(dl) = \phi * (k1=0.57) * k4 * k6 * k9 * k12d * f'b * Zx =$	1.28 kNm	Material constant (pb) =	0.72 (rb=0.53)
$\phi M = \phi * k1 * k4 * k6 * k9 * k12 * f'b * Zx =$	2.11 kNm	Stress reversal (pbu) =	0.69 (rbu=1.00)
$\phi Mw = \phi * (k1=1) * k4 * k6 * k9 * k12u * f'b * Zx =$	2.24 kNm	Duration factor (k1) =	0.94 (Live)
$\phi V(dl) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) =$	5.58 kN	Moisture factor (k4) =	1.00
$\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) =$	9.21 kN	Temp. factor (k6) =	1.00
$\phi Vw = \phi * (k1=1) * k4 * k6 * f's * (2/3 * A) =$	9.80 kN	Sharing factor (k9) =	1.00
		Size modifier (mod.b & s) =	1.00 & 1.00

Deflections

		Duration factor ($j2$) =	2.0
Ireq'd $j2.(DL+\Psi.LL) (L/300) =$	4.2 x10 ⁶ mm ⁴	< Critical	$\delta DL =$ 2.1 mm
Ireq'd $\Psi.LL (L/240) =$	1.2 x10 ⁶ mm ⁴		$\delta \Psi s.LL =$ 0.8 mm
Ireq'd $WLs (L/180) =$	4.2 x10 ⁶ mm ⁴		$\delta WLs =$ -3.4 mm
			Span / 727
			Span / 1996
			Span / 445



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Beam:	(Lintel 1L5) 90mm x 45mm MGP10 (Single span)	
Bending:	$M(dI)^* = 0.15kNm (+ve) < \phi M(dI) = 0.53kNm$, $M^* = 0.44kNm (+ve) < \phi M = 0.87kNm$	OK (0.29,0.51)
	$Mw^* = 0.44kNm (-ve) < \phi Mw = 0.93kNm$	OK (0.48)
Shear:	$V(dI)^* = 0.81kN < \phi V(dI) = 3.60kN$, $V^* = 2.37kN < \phi V = 5.94kN$	OK (0.22,0.40)
	$Vw^* = 2.36kN < \phi Vw = 6.32kN$	OK (0.37)
Deflection:	$\delta DL = L/1555 (0mm)$, $\delta \Psi s.LL = L/2121 (0mm)$, $\delta WLs = L/945 (-1mm)$	OK
Reactions:	(Each end) $Rdl = 0.60kN$, $Rll = 1.10kN$, $Rwl^* = -2.90kN$, $R.dn^* = 2.37kN$, $R.up^* = 2.36kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	750 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	3200 mm	Lay.t (Top) =	750 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	2.40 m ²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Other dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.02 kN/m
			$\Sigma wdl =$	1.60 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m
Other live load (wll) =	kPa *	3200 mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	$\Sigma wll =$ 2.93 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	3200 mm		
Cp,e =	0.9	Cp,i =	0.2	$\Sigma wwI^* =$ -7.74 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	375 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
$w(dI)^* = 1.35 * wdl =$	2.16 kN/m	$M(dI)^* =$	0.15 kNm (Max at 375mm)
$w^* = 1.2 * wdl + 1.5 * wll =$	6.32 kN/m	$M^* =$	0.44 kNm (Max at 375mm)
$w.up^* = 0.9 * wdl + wll =$	6.30 kN/m (up)	$Mw.up^* =$	0.44 kNm (Max at 375mm)
$p(dI)^* = 1.35 * pdl =$	0.00 kN	$V(dI)^* =$	0.81 kN
$p^* = 1.2 * pdl + 1.5 * pll =$	0.00 kN	$V^* =$	2.37 kN
$p.up^* = 0.9 * pdl + pwl^* =$	0.00 kN	$Vw.up^* =$	2.36 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member = 90mm x 45mm MGP10	Area (A) =	4050 mm ²
Description = MGP10 seasoned softwood	Section modulus (Zx) =	61 x10 ³ mm ³
Design depth (dD) = 90 mm	Stiffness (Ix) =	2.7 x10 ⁶ mm ⁴
Design width (dW) = 45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1
$S1d = 1.25 * dD / dW^* (Lay.t / dD)^{0.5} =$	7.22 For top comp. edge restrained - Cl 3.2.3.2(a)	
$S1u = (dD / dW)^{1.35} * (Lay.t / dD)^{0.25} =$	4.33 For top tension edge restrained in uplift - Cl 3.2.3.2(a)	
k12d =	1.000 for pbd * S1d \leq 10 - Cl 3.2.4	
k12 =	1.000 for pb * S1d \leq 10 - Cl 3.2.4	f'b = 17.0 MPa
k12u =	1.000 for pbu * S1u \leq 10 - Cl 3.2.4	f's = 2.6 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) = 0.75 (rbd=0.25)
$\phi M(dI) = \phi * (k1=0.57) * k4 * k6 * k9 * k12d * f'b * Zx =$	0.53 kNm	Material constant (pb) = 0.70 (rb=0.70)
$\phi M = \phi * k1 * k4 * k6 * k9 * k12 * f'b * Zx =$	0.87 kNm	Stress reversal (pbu) = 0.69 (rbu=1.00)
$\phi Mw = \phi * (k1=1) * k4 * k6 * k9 * k12u * f'b * Zx =$	0.93 kNm	Duration factor (k1) = 0.94 (Live)
$\phi V(dI) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) =$	3.60 kN	Moisture factor (k4) = 1.00
$\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) =$	5.94 kN	Temp. factor (k6) = 1.00
$\phi Vw = \phi * (k1=1) * k4 * k6 * f's * (2/3 * A) =$	6.32 kN	Sharing factor (k9) = 1.00
		Size modifier (mod.b & s) = 1.00 & 1.00

Deflections

		Duration factor (j2) =	2.0
Ireq'd j2.(DL+ Ψ l.LL) (L/300) =	0.5 x10 ⁶ mm ⁴	< Critical	$\delta DL =$ 0.5 mm
Ireq'd `LL (L/240) =	0.3 x10 ⁶ mm ⁴		$\delta \Psi s.LL =$ 0.4 mm
Ireq'd WLs (L/180) =	0.5 x10 ⁶ mm ⁴		$\delta WLs =$ -0.8 mm
			Span / 1555
			Span / 2121
			Span / 945

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Beam:	(Lintel 1L6) 190mm x 45mm MGP10 (Single span)	
Bending:	$M(dI)^* = 0.99kNm (+ve) < \phi M(dI) = 1.96kNm$, $M^* = 1.66kNm (+ve) < \phi M = 3.32kNm$	OK (0.50,0.50)
	$Mw^* = 2.84kNm (-ve) < \phi Mw = 3.84kNm$	OK (0.74)
Shear:	$V(dI)^* = 2.08kN < \phi V(dI) = 7.29kN$, $V^* = 3.50kN < \phi V = 12.03kN$	OK (0.29,0.29)
	$Vw^* = 5.97kN < \phi Vw = 12.79kN$	OK (0.47)
Deflection:	$\delta DL = L/887 (2mm)$, $\delta \Psi s.LL = L/3109 (1mm)$, $\delta WLs = L/547 (-3mm)$	OK
Reactions:	(Each end) $Rdl = 1.54kN$, $Rll = 1.10kN$, $Rwl^* = -7.36kN$, $R.dn^* = 3.50kN$, $R.up^* = 5.97kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	1900 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	3200 mm	Lay.t (Top) =	1900 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	6.08 m ²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Other dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.04 kN/m
			$\Sigma wdl =$	1.62 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m
Other live load (wll) =	kPa *	3200 mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	$\Sigma wll =$ 1.16 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	3200 mm		
Cp,e =	0.9	Cp,i =	0.2	$\Sigma wwll^* =$ -7.74 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	950 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
$w(dI)^* = 1.35 * wdl =$	2.19 kN/m	$M(dI)^* =$	0.99 kNm (Max at 950mm)
$w^* = 1.2 * wdl + 1.5 * wll =$	3.68 kN/m	$M^* =$	1.66 kNm (Max at 950mm)
$w.up^* = 0.9 * wdl + wll^* =$	6.28 kN/m (up)	$Mw.up^* =$	2.84 kNm (Max at 950mm)
$p(dI)^* = 1.35 * pdl =$	0.00 kN	$V(dI)^* =$	2.08 kN
$p^* = 1.2 * pdl + 1.5 * pll =$	0.00 kN	$V^* =$	3.50 kN
$p.up^* = 0.9 * pdl + pwl^* =$	0.00 kN	$Vw.up^* =$	5.97 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member = 190mm x 45mm MGP10	Area (A) =	8550 mm ²	
Description = MGP10 seasoned softwood	Section modulus (Zx) =	271 x10 ³ mm ³	
Design depth (dD) = 190 mm	Stiffness (Ix) =	25.7 x10 ⁶ mm ⁴	
Design width (dW) = 45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1	
$S1d = 1.25 * dD / dW^* (Lay.t / dD)^{0.5} =$	16.69 For top comp. edge restrained - Cl 3.2.3.2(a)		
$S1u = (dD / dW)^{1.35} * (Lay.t / dD)^{0.25} =$	12.43 For top tension edge restrained in uplift - Cl 3.2.3.2(a)		
$k12d = 1.5 - 0.05 * pbd * S1d =$	0.897 for $10 \leq pbd * S1d \leq 20$ - Cl 3.2.4		
$k12 = 1.5 - 0.05 * pb * S1u =$	0.920 for $10 \leq pb * S1u \leq 20$ - Cl 3.2.4	$f'b =$ 15.7 MPa	
$k12u =$	1.000 for $pbu * S1u \leq 10$ - Cl 3.2.4	$f's =$ 2.5 MPa	
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.72 (rbd=0.25)
$\phi M(dI) = \phi * (k1=0.57) * k4 * k6 * k9 * k12d * f'b * Zx =$	1.96 kNm	Material constant (pb) =	0.70 (rb=0.47)
$\phi M = \phi * k1 * k4 * k6 * k9 * k12 * f'b * Zx =$	3.32 kNm	Stress reversal (pbu) =	0.66 (rbu=1.00)
$\phi Mw = \phi * (k1=1) * k4 * k6 * k9 * k12u * f'b * Zx =$	3.84 kNm	Duration factor (k1) =	0.94 (Live)
$\phi V(dI) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) =$	7.29 kN	Moisture factor (k4) =	1.00
$\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) =$	12.03 kN	Temp. factor (k6) =	1.00
$\phi Vw = \phi * (k1=1) * k4 * k6 * f's * (2/3 * A) =$	12.79 kN	Sharing factor (k9) =	1.00
		Size modifier (mod.b & s) =	0.93 & 0.96

Deflections

	Duration factor ($j2$) =	2.0
Ireq'd j2.(DL+ Ψ l.LL) (L/300) =	8.7 x10 ⁶ mm ⁴	< Critical
Ireq'd Ψ s.LL (L/240) =	2.0 x10 ⁶ mm ⁴	$\delta DL =$ 2.1 mm
Ireq'd WLs (L/180) =	8.5 x10 ⁶ mm ⁴	$\delta \Psi s.LL =$ 0.6 mm
		$\delta WLs =$ -3.5 mm
		Span / 887
		Span / 3109
		Span / 547

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Beam:	(Ceiling Joist 1CJ1) 150mm x 45mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dl)* = 0.48kNm (+ve) < ϕM(dl) = 3.98kNm, M* = 2.53kNm (+ve) < ϕM = 6.81kNm	OK (0.12,0.37)
	Mw* = 0.54kNm (-ve) < ϕMw = 7.25kNm	OK (0.07)
Shear:	V(dl)* = 0.38kN < ϕV(dl) = 12.18kN, V* = 1.98kN < ϕV = 20.09kN	OK (0.03,0.10)
	Vw* = 0.42kN < ϕVw = 21.38kN	OK (0.02)
Deflection:	δDL = L/443 (12mm), δΨs.LL = L/280 (18mm), δWLs = L/539 (-9mm)	OK
Reactions:	(Each end) Rdl = 0.28kN, Rll = 1.10kN, Rwl* = -0.67kN, R.dn* = 1.98kN, R.up* = 0.42kN	

Geometry (House member affecting ≤ 25m² or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	5100 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	600 mm	Lay.t (Top) =	900 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	3.06 m²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.00 kPa *	600 mm +	kN/m =	0.00 kN/m
Other dead load (wdl) =	0.12 kPa *	600 mm +	kN/m =	0.07 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.04 kN/m
			Σwdl =	0.11 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	600 mm +	kN/m =	0.15 kN/m	
Other live load (wll) =	kPa *	600 mm +	kN/m =	0.00 kN/m	
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	Σwll =	0.43 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	600 mm			
Cp,e =	0	Cp,i =	0.2	Σwwl* =	-0.26 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	2550 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
w(dl)* = 1.35*wdl =	0.15 kN/m	M(dl)* =	0.48 kNm (Max at 2550mm)
w* = 1.2*wdl + 1.5*wll =	0.78 kN/m	M* =	2.53 kNm (Max at 2550mm)
w.up* = 0.9*wdl + wll* =	0.17 kN/m (up)	Mw.up* =	0.54 kNm (Max at 2550mm)
p(dl)* = 1.35*pdl =	0.00 kN	V(dl)* =	0.38 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	1.98 kN
p.up* = 0.9*pdl + pwl* =	0.00 kN	Vw.up* =	0.42 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	150mm x 45mm Smart LVL13	Area (A) =	6750 mm²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	169 x10³ mm³
Design depth (dD) =	150 mm	Stiffness (Ix) =	12.7 x10⁶ mm⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1d = 1.25*dD/dW*(Lay.t/dD)⁰·⁵ =	10.21	For top comp. edge restrained - Cl 3.2.3.2(a)	
S1u = (dD/dW)¹·³⁵*(Lay.t/dD)⁰·²⁵ =	7.95	For top tension edge restrained in uplift - Cl 3.2.3.2(a)	
k12d = 1.5-0.05*pbD*S1d =	0.964	for 10 ≤ pbD*S1d ≤ 20 - Cl 3.2.4	
k12 =	1.000	for pb*S1d ≤ 10 - Cl 3.2.4	f'b = 45.2 MPa
k12u =	1.000	for pbu*S1u ≤ 10 - Cl 3.2.4	f's = 5.0 MPa
Strength reduction factor (ϕ) =	0.95	Table 2.1	Material constant (pbd) = 1.05 (rbd=0.25)
ϕM(dl) = ϕ*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =	3.98 kNm		Material constant (pb) = 0.98 (rb=0.83)
ϕM = ϕ*k1*k4*k6*k9*k12u*f'b*Zx =	6.81 kNm		Stress reversal (pbu) = 0.96 (rbu=1.00)
ϕMw = ϕ*(k1=1)*k4*k6*k9*k12u*f'b*Zx =	7.25 kNm		Duration factor (k1) = 0.94 (Live)
ϕV(dl) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	12.18 kN		Moisture factor (k4) = 1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	20.09 kN		Temp. factor (k6) = 1.00
ϕVw = ϕ*(k1=1)*k4*k6*f's*(2/3*A) =	21.38 kN		Sharing factor (k9) = 1.00
			Size modifier (mod.b & s) = 1.00 & 1.00

Deflections

		Duration factor (j2) =	2.0
eq'd j2.(DL+Ψl.LL) (16mm max) =	9.1 x10⁶ mm⁴	δDL =	11.5 mm
Ireq'd LL (L/240) =	10.8 x10⁶ mm⁴	< Critical	δΨs.LL = 18.2 mm
Ireq'd WLs (L/180) =	4.2 x10⁶ mm⁴		δWLs = -9.5 mm
			Span / 443
			Span / 280
			Span / 539



TIMBER FLOOR BEAM V5.10

HWC Engineers

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Beam:	(Floor Beam FB1) 400mm x 45mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dl)* = 2.27kNm (+ve) < ϕM(dl) = 19.48kNm, M* = 2.88kNm (+ve) < ϕM = 27.77kNm	OK (0.12,0.10)
Shear:	V(dl)* = 6.07kN < ϕV(dl) = 30.78kN, V* = 7.69kN < ϕV = 43.20kN	OK (0.20,0.18)
Deflection:	δL = L/5839 (0mm), δΨs.LL = L/37547 (0mm), δTotal = L/5054 (0mm), 1kN mid. δ = 0.0mm	OK
Reaction:	(Each end) Rdl = 4.15kN, Rll = 1.80kN, R* = 7.69kN	

Geometry (House member affecting > 25m² or primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	1500 mm
Centres (cts) =	600 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	600 mm

Loadings

Floor area (A) =	0.90 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	600 mm +	kN/m =	0.60 kN/m
Wall dead load (wdl) =	1.00 kPa *	3800 mm +	kN/m =	3.80 kN/m
Other dead load (wdl) =	0.40 kPa *	2600 mm +	kN/m =	1.04 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.10 kN/m
			Σwdl =	5.54 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	600 mm +	kN/m =	0.90 kN/m
Partitions (wll) =	0.25 kPa *	2600 mm +	kN/m =	0.65 kN/m
Alternate point live load =	1.80 kN (critical)	Distr. to	1 members	Σwll = 2.40 kN/m

Point loads

Dead load (pdl) =	kN	Position =	750 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	8.09 kN/m	M(dl+Ψl.ll)* =	2.27 kNm (Max at 750mm)
w* = 1.2*wdl+1.5*wll =	10.25 kN/m	M* =	2.88 kNm (Max at 750mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	0.00 kN	V(dl+Ψl.ll)* =	6.07 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	7.69 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	400mm x 45mm Smart LVL13	Area (A) =	18000 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	1200 x10 ³ mm ³
Design depth (dD) =	400 mm	Stiffness (Ix) =	240.0 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	13.61 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d = 1.5-0.05*pb*d*S1 =	0.849 for 10 ≤ pb*d*S1 ≤ 20 - Cl 3.2.4	f'b =	37.3 MPa
k12 = 1.5-0.05*pb*S1 =	0.863 for 10 ≤ pb*S1 ≤ 20 - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.96 (rbd=0.25)
ϕM(dl) = ϕ*(k1=0.57)*k4*k6*k9*k12*f'b*Zx =	19.48 kNm	Material constant (pb) =	0.94 (rb=0.35)
ϕM = ϕ*k1*k4*k6*k9*k12*f'b*Zx =	27.77 kNm	Duration factor (k1) =	0.80
ϕV(dl) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	30.78 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	43.20 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

		Duration factor (j2) =	2.0
Ireq'd j2.(DL+Ψl.LL) (L/300) =	12.3 x10 ⁶ mm ⁴	< Critical j2.(DL+Ψl.LL) =	0.3 mm
Ireq'd Ψs.LL (L/300) =	1.9 x10 ⁶ mm ⁴	Ψs.δLL =	0.0 mm
Ireq'd Total (L/250) =	11.9 x10 ⁶ mm ⁴	δTotal =	0.3 mm
		1kN midspan δ =	0.0 mm



STEEL MEMBER V5.17

HWC Engineers

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Section: (Floor Beam FB2) 230x75PFC (G300)
Bending: $M_x^* = 20.5\text{kNm} < \phi M_{bx} = \phi M_{sx} = 73.2\text{kNm}$ OK (0.28)
No minor bending
Shear: $V_x^* = 18.9\text{kN} < \phi V_{vm} = 258.3\text{kN}$ (Web area full depth) OK (0.07)
No minor shear
Compression: No compression

Tension: No tension

Torsion: No torsion

Deflection: $\delta DL = L/1104$ (5mm), $\delta \Psi_{s.LL} = L/2191$ (2mm), $\delta Total = L/734$ (7mm) at 2500mm from LHS OK

Bending & Shear at critical locations - Section 5 Max. restraint (2.5% flange force) = 2.3 kN

(M* to include first order amplification as required - Cl 4.4.2)

Analysis values = C (M) anual, (L) eft, Position (X) from analysis, (R) ight, (C)ritical
Transverse load = N (Y) es, (N) o

Refer to the analysis output

Analysis Axis = X (X),(Y)

Major bending (M_x^*) = 20.5 kNm
Minor bending (M_y^*) = 0.000 kNm
Shear Force (V_x^*) = 18.9 kN
Shear Force (V_y^*) = 0.000 kN

Minor bending (M_y^*) = 0 kNm
Torsion (M_z^*) = 0 kNm
Shear Force (V_y^*) = 0 kN

Effective length factor (k_e) = Calc

Restraint code = FF From [Restraint] Tab
 $k_e = (k_t=1.00) * (k_l=1.00) * (k_r=1.00) = 1.00$ From [Restraint] Tab
Effective length ($L_e = L * k_e$) = 600 mm

Max. length for Cl 5.3.2.3 = 428 mm
Span / Segment Length (L) = 600 mm
Moment modification factor (α_m) = 1.13 kN

$\phi = 0.9$ Table 3.4

$\phi M_{sx} = 73.2$ kNm
 $\phi M_{bx}(\alpha_m=1) = 73.2$ kNm
 $\phi M_{bx} = 73.2$ kNm
 $\phi M_{syL} = 12.2$ kNm
 $\phi V_v = 258.3$ kN
 $\phi V_{vm} = 258.3$ kN
 $\phi M_z = 1.51$ kNm

Bending (x) = OK (0.28)

Shear = OK (0.07)

$\phi M_{syR} = 13.6$ kNm

$I_x = 26.8 \times 10^6$ mm⁴
S.Wt = 0.252 kN/m

Compression - Section 6 (No compression)

Axial compression (N_c^*) = 0.0 kN
Major axis length (L_x) = 10000 mm
Minor axis length (L_y) = 1500 mm
Braced or Sway member = S (B) raced, (S) way

Axial compression (N_c^*) = 0 kN
Eff. X length factor (k_{ex}) = 1.00
Eff. Y length factor (k_{ey}) = 1.00

$\phi N_s = 864.0$ kN
 $\phi N_{cx}(k_{ex}=1.00) = 331.6$ kN
In-Plane $\phi N_{cx}(k_{ex}=1.00) = 331.6$ kN
 $\phi N_{cy}(k_{ey}=1.00) = 587.2$ kN
In-Plane $\phi N_{cy}(k_{ey}=1.00) = 587.2$ kN
 $\phi N_c = 331.6$ kN

Major axis effective length (L_{ex}) = 10000 mm
Minor axis effective length (L_{ey}) = 1500 mm

Tension - Section 7 (No tension)

Axial tension (N_t^*) = 0.0 kN
 $k_t = 1.00$ Table 7.3.2

Axial tension (N_t^*) = 0 kN

$\phi N_t = 864.0$ kN

Combined

$\phi M_{rxt} = 73.2$ kNm $\phi M_{mixt} = 73.2$ kNm $\phi M_{oxt} = 73.2$ kNm
 $\phi M_{rxc} = 73.2$ kNm $\phi M_{mixc} = 73.2$ kNm $\phi M_{oxc} = 73.2$ kNm
 $\phi M_{ryt} = 12.2$ kNm $\phi M_{miyc} = 12.2$ kNm $\phi M_{tx} = 73.2$ kNm
 $\phi M_{ryc} = 12.2$ kNm $\phi M_{cxc} = 73.2$ kNm

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Geometry for (Floor Beam FB2): Steel Simple Beam

Description = 230x75PFC (G300)
Span (L) = 5000 mm
Span type = S (S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther
Material type = S (T)imber,(S)teel,(C)onc.,(SC)omp. steel,(O)ther

Ix = 26.8 x10⁶ mm⁴
Axis = X (X),(Y)
Ag = 3200 mm²
Density = 78.6 kN/m³
E = 200000 MPa

Loading

	DL	LL
FB1	3.3	1.8

Uniform loads	Uniform loads (kN/m)		
	UDL	Partial 1	Partial 2
Dead load (wdl) =		1.48	4.00
Live load (wll) =		1.60	1.20
Start from LHS (mm) =	0	0	3600
End from LHS (mm) =	5000	3600	5000
S.Wt =	0.25	kN/m	
Ultimate load (w*) =	0.30	4.18	6.60
Live Load type =	Floor (Steel)		
Short term LL (Ψsu) =	0.70	(Ψsp) =	1.00
Long term LL (Ψlu) =	0.40	(Ψlp) =	0.60
Actual LL (Ψsa) =	0.77	(Ψla) =	0.44

Point loads	Point loads (kN)		
	PL 1	PL 2	PL 3
Dead load (pdl) =	3.33		
Live load (pll) =	1.80		
Pos. from LHS (mm) =	3600		
Ultimate load (p*) =	6.70	0.00	0.00
Include S.Wt =	Y (Y)es,(N)o		
Strength loadcase =	C (D)ead Only,(C)omb.		

Results at midspan

Position of result (x) = 2500 mm

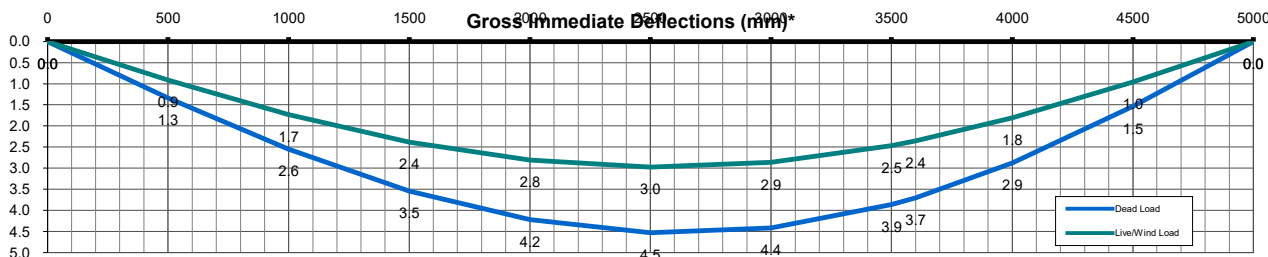
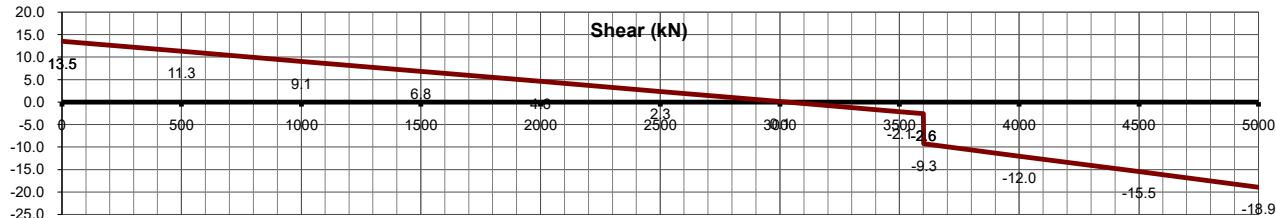
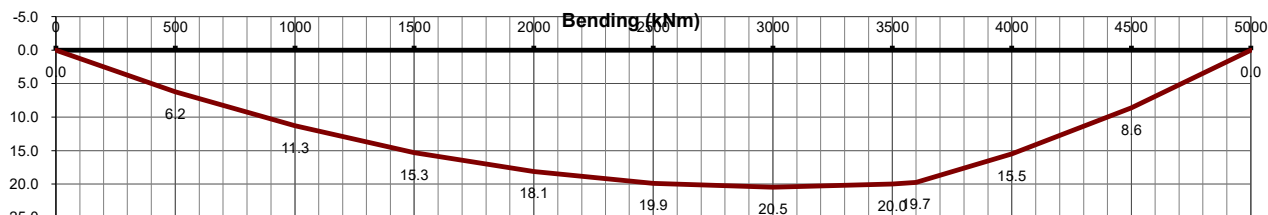
1.20*G+1.50*Q analysed

	Left	At x	Right	Max	At	Min	At	Units	Span /
Rdl	5.75		9.76					kN	
Rll	4.43		4.81					kN	
R*	13.54		18.93					kN	
M*	0.00	19.87	0.00	20.48	3020	0.00	0	kNm	
V*	13.54	2.35	-18.93	18.93	5000			kN	Span /
δdl	0.00	4.53	0.00	4.53	2500	0.00	0	mm	1104
δll	0.00	2.98	0.00	2.98	2500	0.00	0	mm	1679
δdl+Ψs*δll	0.00	6.81	0.00	6.81	2500	0.00	0	mm	734

δPll/δTot.II = 0.221

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered



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STEEL PROPPED BEAM V5.06

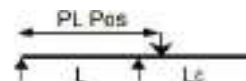
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Member:	(Floor Beam FB3) 300x90PFC (G300)	
Bending:	M+* = 7.5kNm < $\phi Mb(600, \alpha m=1.13) = 152.3 \text{ kNm}$	OK (0.05)
Bending:	M-* = 45.7kNm < $\phi Mb(1500, \alpha m=1.25) = 152.3 \text{ kNm}$	OK (0.30)
Shear:	Vmax* = 43.4kN (Left of cantilever span) < $\phi Vm = 414.7 \text{ kN}$ (Web area full depth)	OK (0.10)
Deflection:	$\delta DL = Lc/15632$ (0mm), $\delta \Psi s.LL = L/24463$ (0mm), $\delta Total = L/9537$ (0mm), 1kN mid. $\delta = 0.1 \text{ mm}$	OK
Deflection tip:	$\delta DL = Lc/620$ (2mm), $\delta \Psi s.LL = Lc/1323$ (1mm), $\delta Total = Lc/422$ (3mm)	OK
Reactions:	Left Rdl = 7.3kN, Rll = 4.6kN, R* = 15.6kN, Right Rdl = 42.6kN, Rll = 22.7kN, R* = 85.2kN	

Geometry

Span (L) =	3500 mm		
Cantilever (Lc) =	1450 mm past right support		
Centres (cts) =	2500 mm		
Effective segment length (Le) =	600 mm	Cantilever eff. seg. length (Lec) =	1500 mm
$\alpha m =$	1.13	$\alpha m c =$	1.25
Live Load type =	N (N)ormal, (S)orage, (M)annual AS/NZS 1170.0 - Table 4.1		



Loadings

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	2500 mm +	kN/m =	2.50 kN/m
Wall dead load (wdl) =	1.00 kPa *	3800 mm +	kN/m =	3.80 kN/m
Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Include S.Wt =	Y (Y)es, (N)o		S.Wt =	0.40 kN/m
			$\Sigma wdl =$	7.98 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	2500 mm +	kN/m =	3.75 kN/m
Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m
			$\Sigma wll =$	4.55 kN/m

Point loads

Dead Load (pdl) =	10.35 kN	DL	LL	
Live Load (pll) =	4.81 kN	FB2*	10.4	4.8 :
				T mm from LHS, (T)ip of cantilever
				(Load at tip)
Short term LL (Ψsu) =	0.70		Rdl.left =	7.28 kN
Short term LL (Ψsp) =	1.00		Rll.left =	4.60 kN
			R.left* =	15.64 kN
$w* = 1.2*wdl + 1.5*wll =$	16.40 kN/m			
$p* = 1.2*pdl + 1.5*pll =$	19.65 kN		Rdl.right =	42.58 kN
M+* =	7.46 kNm at 953mm		Rll.right =	22.74 kN
M-* =	45.73 kNm		R.right* =	85.20 kN

Capacity

Description =	300x90PFC (G300)	Warping constant (Iw) =	58.2 x10 ⁹ mm ⁶
Flange yield (fyf) =	300 MPa	Torsional constant (J) =	304 x10 ³ mm ⁴
Web yield (fyw) =	320 MPa	Effective section mod. (Zex) =	564 x10 ³ mm ³
Area (Ag) =	5110 mm ²	Effective section mod. (Zey) =	82.3 x10 ³ mm ³
Stiffness (Ix) =	72.4 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4
Stiffness (Iy) =	4.04 x10 ⁶ mm ⁴	Shear modulus (G) =	80000 MPa - Cl 1.4
$\phi =$	0.9 Table 3.4		
$Msx = \min(fyf, fyw) * Zex =$	169.2 kNm - Cl 5.2.1	$\phi Msy = \phi * \min(fyf, fyw) * Zey =$	22.2 kNm - Cl 5.2.1
Moa =	2758.2 kNm - Cl 5.6.1.1(3)	$\phi Msx =$	152.3 kNm
$\alpha s = 1.000$	$\alpha m = 1.13$	$\phi Mbx = \alpha s * \alpha m * \phi Msx =$	152.3 kNm (= ϕMsx)
Cant: Moa.c =	516.9 kNm - Cl 5.6.1.1(3)		
$\alpha s.c = 0.861$	$\alpha m.c = 1.25$	$\phi Mbx.c =$	152.3 kNm (= ϕMsx)

Deflections

Ireq'd DL (span/360) =	21.0 x10 ⁶ mm ⁴
Ireq'd $\Psi s.LL$ (span/360) =	9.9 x10 ⁶ mm ⁴
Ireq'd DL+ $\Psi s.LL$ (span/250) =	21.4 x10 ⁶ mm ⁴ < Critical

Between supports at 2021mm from LHS (approx. max)

Tip of cantilever

$\delta DL =$	-0.2 mm (up)	Span / 15632	$\delta DL =$	2.3 mm (down)	Span / 620
$\Psi s.\delta LL =$	-0.1 mm (up)	Span / 24463	$\Psi s.\delta LL =$	1.1 mm (down)	Span / 1323
$\delta(DL+\Psi s.LL) =$	-0.4 mm (up)	Span / 9537	$\delta(DL+\Psi s.LL) =$	3.4 mm (down)	Span / 422

STEEL PROPPED BEAM V5.06

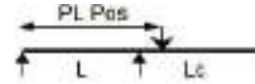
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Member:	(Floor Beam FB4) 250x90PFC (G300)	
Bending:	M+* = 52.2kNm < $\phi Mb(600, \alpha m = 1.13) = 113.7 \text{ kNm}$	OK (0.46)
Bending:	M-* = 43.3kNm < $\phi Mb(1500, \alpha m c = 1.25) = 113.7 \text{ kNm}$	OK (0.38)
Shear:	Vmax* = 53.6kN (Right of first span) < $\phi Vvm = 345.6 \text{ kN}$ (Web area full depth)	OK (0.15)
Deflection:	$\delta DL = Lc/744$ (8mm), $\delta \Psi s.LL = L/1642$ (4mm), $\delta Total = L/512$ (12mm), 1kN mid. $\delta = 0.6 \text{ mm}$	OK
Deflection tip:	$\delta DL = Lc/629$ (-2mm), $\delta \Psi s.LL = Lc/1584$ (-1mm), $\delta Total = Lc/450$ (-3mm)	OK
Reactions:	Left Rdl = 17.7kN, Rll = 12.2kN, R* = 39.6kN, Right Rdl = 44.3kN, Rll = 27.4kN, R* = 94.3kN	

Geometry

Span (L) =	6200 mm		
Cantilever (Lc) =	1450 mm past right support		
Centres (cts) =	2500 mm		
Effective segment length (Le) =	600 mm	Cantilever eff. seg. length (Lec) =	1500 mm
$\alpha m =$	1.13	$\alpha m c =$	1.25
Live Load type =	N (N)ormal, (S)orage, (M)annual AS/NZS 1170.0 - Table 4.1		



Loadings

Uniform dead loads			
Floor dead load (wdl) =	1.00 kPa *	2500 mm +	kN/m = 2.50 kN/m
Wall dead load (wdl) =	1.00 kPa *	2700 mm +	kN/m = 2.70 kN/m
Roof dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m = 1.28 kN/m
Include S.Wt =	Y (Y)es, (N)o		S.Wt = 0.36 kN/m
			$\Sigma wdl = 6.84 \text{ kN/m}$
Uniform live loads			
Floor live load (wll) =	1.50 kPa *	2500 mm +	kN/m = 3.75 kN/m
Roof live load (wll) =	0.25 kPa *	3200 mm +	kN/m = 0.80 kN/m
			$\Sigma wll = 4.55 \text{ kN/m}$
Point loads			
Dead Load (pdl) =	9.76 kN	FB2* DL LL = 9.8 4.8	T mm from LHS, (T)ip of cantilever
Live Load (pll) =	4.81 kN		(Load at tip)
Short term LL (Ψsu) =	0.70		Rdl.left = 17.75 kN
Short term LL (Ψsp) =	1.00		Rll.left = 12.21 kN
			R.left* = 39.61 kN
$w* = 1.2 * wdl + 1.5 * wll =$	15.03 kN/m		
$p* = 1.2 * pdl + 1.5 * pll =$	18.93 kN		Rdl.right = 44.30 kN
M+* =	52.20 kNm at 2636mm		Rll.right = 27.41 kN
M-* =	43.25 kNm		R.right* = 94.28 kN

Capacity

Description = 250x90PFC (G300)	Warping constant (Iw) =	35.9 x10 ⁹ mm ⁶
Flange yield (fyf) = 300 MPa	Torsional constant (J) =	248 x10 ³ mm ⁴
Web yield (fyw) = 320 MPa	Effective section mod. (Zex) =	421 x10 ³ mm ³
Area (Ag) = 4520 mm ²	Effective section mod. (Zey) =	88.7 x10 ³ mm ³
Stiffness (Ix) = 45.1 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4
Stiffness (Iy) = 3.64 x10 ⁶ mm ⁴	Shear modulus (G) =	80000 MPa - Cl 1.4
$\phi = 0.9$ Table 3.4		
Msx = min(fyf, fyw) * Zex = 126.3 kNm - Cl 5.2.1	$\phi Msy = \phi * \min(fyf, fyw) * Zey =$	23.9 kNm - Cl 5.2.1
Moa = 2079.6 kNm - Cl 5.6.1.1(3)	$\phi Msx =$	113.7 kNm
$\alpha s = 1.000$ $\alpha m = 1.13$	$\phi Mbx = \alpha s * \alpha m * \phi Msx =$	113.7 kNm (= ϕMsx)
Cant: Moa.c = 404.9 kNm - Cl 5.6.1.1(3)		
$\alpha s.c = 0.869$ $\alpha m.c = 1.25$	$\phi Mbx.c =$	113.7 kNm (= ϕMsx)

Deflections

Ireq'd DL (span/360) =	21.8 x10 ⁶ mm ⁴
Ireq'd $\Psi s.LL$ (span/360) =	9.9 x10 ⁶ mm ⁴
Ireq'd DL+ $\Psi s.LL$ (span/250) =	22.0 x10 ⁶ mm ⁴ < Critical

Between supports at 3580mm from LHS (approx. max)

$\delta DL =$	8.3 mm (down)	Span / 744
$\Psi s. \delta LL =$	3.8 mm (down)	Span / 1642
$\delta(DL + \Psi s.LL) =$	12.1 mm (down)	Span / 512

Tip of cantilever

$\delta DL =$	-2.3 mm (up)	Span / 629
$\Psi s. \delta LL =$	-0.9 mm (up)	Span / 1584
$\delta(DL + \Psi s.LL) =$	-3.2 mm (up)	Span / 450



TIMBER FLOOR BEAM V5.10

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Beam: (Floor Beam FB6) 2 / 400mm x 45mm Smart LVL13 (Varies) (Single span)
Bending: $M(dI)^* = 12.98kNm (+ve) < \phi M(dI) = 38.96kNm$, $M^* = 15.98kNm (+ve) < \phi M = 55.26kNm$
Shear: $V(dI)^* = 13.49kN < \phi V(dI) = 61.56kN$, $V^* = 16.60kN < \phi V = 86.40kN$
Deflection: $\delta L = L/771 (5mm)$, $\delta \Psi s.LL = L/4737 (1mm)$, $\delta Total = L/663 (6mm)$, 1kN mid. $\delta = 0.2mm$
Reaction: (Each end) $Rdl = 9.51kN$, $Rll = 3.47kN$, $R^* = 16.60kN$

OK (0.33,0.29)
OK (0.22,0.19)
OK

Geometry (House member affecting > 25m² or primary building member)

Category = 2 (1) House, (2) Primary building elements, (3) Important
House = Y (Y)es,(N)o Edge restrained = C (T)ension, (C)ompression, (B)oth
Span (L) = 3850 mm Lay.t (Top) = 600 mm
Centres (cts) = 600 mm
Span type = S (S)ingle,(D)ouble

Loadings

Floor area (A) = 2.31 m² Live load type = N (N)ormal, (S)torage, (M)annual
AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) = 1.00 kPa * 600 mm + kN/m = 0.60 kN/m
Wall dead load (wdl) = 1.00 kPa * 2700 mm + kN/m = 2.70 kN/m
Other dead load (wdl) = 0.40 kPa * 3600 mm + kN/m = 1.44 kN/m
Include S.Wt = Y (Y)es,(N)o S.Wt = 0.20 kN/m
 $\Sigma wdl = 4.94 kN/m$

Uniform live loads

Floor live load (wll) = 1.50 kPa * 600 mm + kN/m = 0.90 kN/m
Partitions (wll) = 0.25 kPa * 3600 mm + kN/m = 0.90 kN/m
Alternate point live load = 1.80 kN Distr. to 1 members $\Sigma wll = 1.80 kN/m$

Point loads

Dead load (pdl) = kN Position = 1925 mm from LHS
Live load (pll) = kN Shear using PL at support = N (Y)es,(N)o

Short term LL factor (Ψsu) = 1.00 (Ψsp) = 1.00
Long term LL factor (Ψlu) = 0.33 / 0.40 (wdl*) (Ψlp) = 0.33 / 0.40 (pdl*)
 $wdl^* = 1.2 * wdl + 1.5 * \Psi lu * wll = 7.01 kN/m$ $M(dI + \Psi l.II)^* = 12.98 kNm$ (Max at 1925mm)
 $w^* = 1.2 * wdl + 1.5 * wll = 8.63 kN/m$ $M^* = 15.98 kNm$ (Max at 1925mm)
 $pdl^* = 1.2 * pdl + 1.5 * \Psi lp * pll = 0.00 kN$ $V(dI + \Psi l.II)^* = 13.49 kN$
 $p^* = 1.2 * pdl + 1.5 * pll = 0.00 kN$ $V^* = 16.60 kN$

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member = 2 / 400mm x 45mm Smart LVL13 Area (A) = 36000 mm²
Description = LVL13 seasoned softwood Section modulus (Zx) = 2400 x10³ mm³
Design depth (dD) = 400 mm Stiffness (Ix) = 480.0 x10⁶ mm⁴
Design width (dW) = 45 mm Modulus of elasticity (E) = 13200 MPa - Cl 8.3

$S1 = 1.25 * dD / dW * (Lay.t / dD)^{0.5} = 13.61$ For top comp. edge restrained - Cl 3.2.3.2(a)
 $k12d = 1.5 - 0.05 * pbd * S1 = 0.849$ for $10 \leq pbd * S1 \leq 20$ - Cl 3.2.4 $f'b = 37.3 MPa$
 $k12 = 1.5 - 0.05 * pb * S1 = 0.858$ for $10 \leq pb * S1 \leq 20$ - Cl 3.2.4 $f's = 5.0 MPa$
Material constant (pbd) = 0.96 (rbd=0.25)
Material constant (pb) = 0.94 (rb=0.31)
Strength reduction factor (ϕ) = 0.9 Table 2.1
 $\phi M(dI) = \phi * (k1=0.57) * k4 * k6 * k9 * k12 * f'b * Zx = 38.96 kNm$ Duration factor (k1) = 0.80
 $\phi M = \phi * k1 * k4 * k6 * k9 * k12 * f'b * Zx = 55.26 kNm$ Moisture factor (k4) = 1.00
 $\phi V(dI) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) = 61.56 kN$ Temp. factor (k6) = 1.00
 $\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) = 86.40 kN$ Sharing factor (k9) = 1.00
Size modifier (mod.b) = 1.00
Size modifier (mod.s) = 1.00

Deflections

Duration factor (j2) = 2.0
Ireq'd j2.(DL+ Ψ l.LL) (L/300) = 186.8 x10⁶ mm⁴ < Critical j2.(DL+ Ψ l.LL) = 5.0 mm Span / 771
Ireq'd Ψ s.LL (12mm) = 32.5 x10⁶ mm⁴ Ψ s. δ LL = 0.8 mm Span / 4737
Ireq'd Total (L/250) = 181.0 x10⁶ mm⁴ δ Total = 5.8 mm Span / 663
1kN midspan $\delta = 0.2 mm$

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Beam:	(Floor Beam FB7) 2 / 400mm x 45mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dl)* = 8.42kNm (+ve) < ϕM(dl) = 38.96kNm, M* = 11.71kNm (+ve) < ϕM = 56.26kNm	OK (0.22,0.21)
Shear:	V(dl)* = 5.91kN < ϕV(dl) = 61.56kN, V* = 8.22kN < ϕV = 86.40kN	OK (0.10,0.10)
Deflection:	δL = L/834 (7mm), δΨs.LL = L/2920 (2mm), δTotal = L/649 (9mm), 1kN mid. δ = 0.6mm	OK
Reaction:	(Each end) Rdl = 3.64kN, Rll = 2.57kN, R* = 8.22kN	

Geometry (House member affecting > 25m² or primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	5700 mm
Centres (cts) =	600 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	600 mm

Loadings

Floor area (A) =	3.42 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	600 mm +	kN/m =	0.60 kN/m
Wall dead load (wdl) =	0.40 kPa *	1200 mm +	kN/m =	0.48 kN/m
Other dead load (wdl) =	kPa *	mm +	kN/m =	0.00 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.20 kN/m
			Σwdl =	1.28 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	600 mm +	kN/m =	0.90 kN/m
Partitions (wll) =	kPa *	mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.80 kN	Distr. to	1 members	Σwll = 0.90 kN/m

Point loads

Dead load (pdl) =	kN	Position =	2850 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	2.07 kN/m	M(dl+Ψl.ll)* =	8.42 kNm (Max at 2850mm)
w* = 1.2*wdl+1.5*wll =	2.88 kN/m	M* =	11.71 kNm (Max at 2850mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	0.00 kN	V(dl+Ψl.ll)* =	5.91 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	8.22 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	2 / 400mm x 45mm Smart LVL13	Area (A) =	36000 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	2400 x10 ³ mm ³
Design depth (dD) =	400 mm	Stiffness (Ix) =	480.0 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	13.61 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d = 1.5-0.05*pbD*S1 =	0.849 for 10 ≤ pbD*S1 ≤ 20 - Cl 3.2.4	f'b =	37.3 MPa
k12 = 1.5-0.05*pb*S1 =	0.874 for 10 ≤ pb*S1 ≤ 20 - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.96 (rbd=0.25)
ϕM(dl) = ϕ*(k1=0.57)*k4*k6*k9*k12*d*f'b*Zx =	38.96 kNm	Material constant (pb) =	0.92 (rb=0.47)
ϕM = ϕ*k1*k4*k6*k9*k12*f'b*Zx =	56.26 kNm	Duration factor (k1) =	0.80
ϕV(dl) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	61.56 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	86.40 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

		Duration factor (j2) =	2.0
Ireq'd j2.(DL+Ψl.LL) (16mm) =	205.0 x10 ⁶ mm ⁴	< Critical j2.(DL+Ψl.LL) =	6.8 mm
Ireq'd Ψs.LL (12mm) =	78.1 x10 ⁶ mm ⁴	Ψs.δLL =	2.0 mm
Ireq'd Total (L/250) =	185.0 x10 ⁶ mm ⁴	δTotal =	8.8 mm
		1kN midspan δ =	0.6 mm

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Beam:	(Floor Beam FB9) 400mm x 45mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dI)* = 4.45kNm (+ve) < ϕM(dI) = 13.30kNm, M* = 6.51kNm (+ve) < ϕM = 19.98kNm	OK (0.33,0.33)
Shear:	V(dI)* = 5.52kN < ϕV(dI) = 30.78kN, V* = 8.29kN < ϕV = 43.20kN	OK (0.18,0.19)
Deflection:	δL = L/2600 (1mm), δΨs.LL = L/7900 (0mm), δTotal = L/1956 (1mm), 1kN mid. δ = 0.1mm	OK
Reaction:	(Each end) Rdl = 3.06kN, Rll = 3.08kN, R* = 8.29kN	

Geometry (House member affecting > 25m² or primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	2100 mm
Centres (cts) =	600 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	1200 mm

Loadings

Floor area (A) =	1.26 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	600 mm +	kN/m =	0.60 kN/m
Wall dead load (wdl) =	0.40 kPa *	1200 mm +	kN/m =	0.48 kN/m
Other dead load (wdl) =	kPa *	mm +	kN/m =	0.00 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.10 kN/m
			Σwdl =	1.18 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	600 mm +	kN/m =	0.90 kN/m
Partitions (wll) =	kPa *	mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.80 kN (critical)	Distr. to	1 members	Σwll = 1.71 kN/m

Point loads

Dead load (pdl) =	3.64 kN	DL	3.6	LL	2.6	Position =	1050 mm from LHS
Live load (pll) =	2.57 kN	FB7	3.6	2.6	:	using PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	2.44 kN/m	M(dI+Ψl.II)* =	4.45 kNm (Max at 1050mm)
w* = 1.2*wdl+1.5*wll =	3.99 kN/m	M* =	6.51 kNm (Max at 1050mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	5.91 kN	V(dI+Ψl.II)* =	5.52 kN
p* = 1.2*pdl+1.5*pll =	8.22 kN	V* =	8.29 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	400mm x 45mm Smart LVL13	Area (A) =	18000 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	1200 x10 ³ mm ³
Design depth (dD) =	400 mm	Stiffness (Ix) =	240.0 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	19.25 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d = 1.5-0.05*pbd*S1 =	0.580 for 10 ≤ pbd*S1 ≤ 20 - Cl 3.2.4	f'b =	37.3 MPa
k12 = 1.5-0.05*pb*S1 =	0.621 for 10 ≤ pb*S1 ≤ 20 - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.96 (rbd=0.25)
ϕM(dI) = ϕ*(k1=0.57)*k4*k6*k9*k12*f'b*Zx =	13.30 kNm	Material constant (pb) =	0.91 (rb=0.53)
ϕM = ϕ*k1*k4*k6*k9*k12*f'b*Zx =	19.98 kNm	Duration factor (k1) =	0.80
ϕV(dI) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	30.78 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	43.20 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

Duration factor (j2) =	2.0			
Ireq'd j2.(DL+Ψl.LL) (L/300) =	27.7 x10 ⁶ mm ⁴ < Critical	j2.(DL+Ψl.LL) =	0.8 mm	Span / 2600
Ireq'd Ψs.LL (L/300) =	9.1 x10 ⁶ mm ⁴	Ψs.δLL =	0.3 mm	Span / 7900
Ireq'd Total (L/250) =	30.7 x10 ⁶ mm ⁴	δTotal =	1.1 mm	Span / 1956
		1kN midspan δ =	0.1 mm	

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Beam:	(Floor Beam FB12) 400mm x 63mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dI)* = 8.61kNm (+ve) < ϕM(dI) = 14.86kNm, M* = 10.10kNm (+ve) < ϕM = 20.86kNm	OK (0.58,0.48)
Shear:	V(dI)* = 11.48kN < ϕV(dI) = 43.09kN, V* = 13.47kN < ϕV = 60.48kN	OK (0.27,0.22)
Deflection:	δL = L/1030 (3mm), δΨs.LL = L/8553 (0mm), δTotal = L/919 (3mm), 1kN mid. δ = 0.1mm	OK
Reaction:	(Each end) Rdl = 8.46kN, Rll = 2.21kN, R* = 13.47kN	

Geometry (House member affecting > 25m² or primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	3000 mm
Centres (cts) =	300 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	3000 mm

Loadings

Floor area (A) =	0.90 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Wall dead load (wdl) =	1.00 kPa *	3800 mm +	kN/m =	3.80 kN/m
Other dead load (wdl) =	0.40 kPa *	3500 mm +	kN/m =	1.40 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.14 kN/m
			Σwdl =	5.64 kN/m

Uniform live loads

Floor live load (wll) =	2.00 kPa *	300 mm +	kN/m =	0.60 kN/m
Partitions (wll) =	0.25 kPa *	3500 mm +	kN/m =	0.88 kN/m
Alternate point live load =	1.80 kN	Distr. to	1 members	Σwll = 1.48 kN/m

Point loads

Dead load (pdl) =	kN	Position =	1500 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	7.65 kN/m	M(dI+Ψl.II)* =	8.61 kNm (Max at 1500mm)
w* = 1.2*wdl+1.5*wll =	8.98 kN/m	M* =	10.10 kNm (Max at 1500mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	0.00 kN	V(dI+Ψl.II)* =	11.48 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	13.47 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	400mm x 63mm Smart LVL13	Area (A) =	25200 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	1680 x10 ³ mm ³
Design depth (dD) =	400 mm	Stiffness (Ix) =	336.0 x10 ⁶ mm ⁴
Design width (dW) =	63 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	21.74 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d = 200/(S1*pbd) ² =	0.463 for pbd*S1 ≥ 20 - Cl 3.2.4	f'b =	37.3 MPa
k12 = 1.5-0.05*pb*S1 =	0.463 for pb*S1 ≥ 20 - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.96 (rbd=0.25)
ϕM(dI) = ϕ*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =	14.86 kNm	Material constant (pb) =	0.96 (rb=0.25)
ϕM = ϕ*k1*k4*k6*k9*k12d*f'b*Zx =	20.86 kNm	Duration factor (k1) =	0.80
ϕV(dI) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	43.09 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	60.48 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

Duration factor (j2) =	2.0			
Ireq'd j2.(DL+Ψl.LL) (L/300) =	97.9 x10 ⁶ mm ⁴ < Critical	j2.(DL+Ψl.LL) =	2.9 mm	Span / 1030
Ireq'd Ψs.LL (L/300) =	11.8 x10 ⁶ mm ⁴	Ψs.δLL =	0.4 mm	Span / 8553
Ireq'd Total (L/250) =	91.4 x10 ⁶ mm ⁴	δTotal =	3.3 mm	Span / 919
		1kN midspan δ =	0.1 mm	



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Beam: (Lintel L2) 190mm x 45mm MGP10 (Single span)
Bending: $M(dI)^* = 0.66kNm (+ve) < \phi M(dI) = 1.70kNm$, $M^* = 1.08kNm (+ve) < \phi M = 2.39kNm$
Shear: $V(dI)^* = 2.65kN < \phi V(dI) = 5.67kN$, $V^* = 4.34kN < \phi V = 7.96kN$
Deflection: $\delta L = L/2613$ (0mm), $\delta \psi s.LL = L/5268$ (0mm), $\delta Total = L/1747$ (1mm), 1kN mid. $\delta = 0.1mm$
Reaction: (Each end) $RdI = 1.27kN$, $RlI = 1.88kN$, $R^* = 4.34kN$

OK (0.39,0.45)
OK (0.47,0.54)
OK

Geometry (House member affecting > 25m² or primary building member)

Category = 2 (1) House, (2) Primary building elements, (3) Important
House = Y (Y)es,(N)o Edge restrained = C (T)ension, (C)ompression, (B)oth
Span (L) = 1000 mm Lay.t (Top) = 1000 mm
Centres (cts) = 2500 mm
Span type = S (S)ingle,(D)ouble

Loadings

Floor area (A) = 2.50 m² Live load type = N (N)ormal, (S)torage, (M)annual
AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) = 1.00 kPa * 2500 mm + kN/m = 2.50 kN/m
Wall dead load (wdl) = kPa * 2500 mm + kN/m = 0.00 kN/m
Other dead load (wdl) = kPa * mm + kN/m = 0.00 kN/m
Include S.Wt = Y (Y)es,(N)o S.Wt = 0.04 kN/m
 $\Sigma wdl = 2.54 kN/m$

Uniform live loads

Floor live load (wll) = 1.50 kPa * 2500 mm + kN/m = 3.75 kN/m
Partitions (wll) = kPa * mm + kN/m = 0.00 kN/m
Alternate point live load = 1.80 kN Distr. to 1 members $\Sigma wll = 3.75 kN/m$

Point loads

Dead load (pdl) = kN Position = 500 mm from LHS
Live load (pll) = kN Shear using PL at support = N (Y)es,(N)o

Short term LL factor (ψsu) = 1.00 (ψsp) = 1.00
Long term LL factor (ψlu) = 0.33 / 0.40 (wdl*) (ψlp) = 0.33 / 0.40 (pdl*)
 $wdl^* = 1.2 * wdl + 1.5 * \psi lu * wll = 5.30 kN/m$ $M(dI + \psi l.II)^* = 0.66 kNm$ (Max at 500mm)
 $w^* = 1.2 * wdl + 1.5 * wll = 8.68 kN/m$ $M^* = 1.08 kNm$ (Max at 500mm)
 $pdl^* = 1.2 * pdl + 1.5 * \psi lp * pll = 0.00 kN$ $V(dI + \psi l.II)^* = 2.65 kN$
 $p^* = 1.2 * pdl + 1.5 * pll = 0.00 kN$ $V^* = 4.34 kN$

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member = 190mm x 45mm MGP10 Area (A) = 8550 mm²
Description = MGP10 seasoned softwood Section modulus (Zx) = 271 x10³ mm³
Design depth (dD) = 190 mm Stiffness (Ix) = 25.7 x10⁶ mm⁴
Design width (dW) = 45 mm Modulus of elasticity (E) = 10000 MPa - Table H3.1

$S1 = 1.25 * dD / dW * (Lay.t / dD)^{0.5} = 12.11$ For top comp. edge restrained - Cl 3.2.3.2(a)
 $k12d = 1.000$ for $pbD * S1 \leq 10$ - Cl 3.2.4 $f'b = 15.7 MPa$
 $k12 = 1.000$ for $pb * S1 \leq 10$ - Cl 3.2.4 $f's = 2.5 MPa$
Material constant (pbd) = 0.72 (rbd=0.25)
Material constant (pb) = 0.68 (rb=0.65)
Duration factor (k1) = 0.80
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Sharing factor (k9) = 1.00
Size modifier (mod.b) = 0.93
Size modifier (mod.s) = 0.96

Strength reduction factor (ϕ) = 0.7 Table 2.1
 $\phi M(dI) = \phi * (k1=0.57) * k4 * k6 * k9 * k12d * f'b * Zx = 1.70 kNm$
 $\phi M = \phi * k1 * k4 * k6 * k9 * k12d * f'b * Zx = 2.39 kNm$
 $\phi V(dI) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) = 5.67 kN$
 $\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) = 7.96 kN$

Deflections

Duration factor (j2) = 2.0
 $Ireq'd j2.(DL + \psi l.LL) (L/300) = 3.0 x 10^6 mm^4$ < Critical $j2.(DL + \psi l.LL) = 0.4 mm$ Span / 2613
 $Ireq'd \psi s.LL (L/300) = 1.5 x 10^6 mm^4$ $\psi s.\delta LL = 0.2 mm$ Span / 5268
 $Ireq'd Total (L/250) = 3.7 x 10^6 mm^4$ $\delta Total = 0.6 mm$ Span / 1747
1kN midspan $\delta = 0.1 mm$

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Beam:	(Lintel L3) 2 / 300mm x 45mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dI)* = 6.65kNm (+ve) < ϕM(dI) = 25.15kNm, M* = 8.44kNm (+ve) < ϕM = 35.93kNm	OK (0.26,0.23)
Shear:	V(dI)* = 24.18kN < ϕV(dI) = 46.17kN, V* = 30.87kN < ϕV = 64.80kN	OK (0.52,0.48)
Deflection:	δL = L/2164 (1mm), δΨs.LL = L/10367 (0mm), δTotal = L/1790 (1mm), 1kN mid. δ = 0.0mm	OK
Reaction:	(1 End) Rdl.max = 16.43kN, Rll.max = 7.44kN, R.max* = 30.87kN (1 End) Rdl.min = 4.52kN, Rll.min = 3.09kN, R.min* = 10.06kN	
Geometry	(House member affecting > 25m ² or primary building member)	

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	1500 mm
Centres (cts) =	300 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	600 mm

Loadings

Floor area (A) =	0.45 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	300 mm +	kN/m =	0.30 kN/m
Wall dead load (wdl) =	1.00 kPa *	600 mm +	kN/m =	0.60 kN/m
Other dead load (wdl) =	0.40 kPa *	600 mm +	kN/m =	0.24 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.15 kN/m
			Σwdl =	1.29 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	300 mm +	kN/m =	0.45 kN/m
Partitions (wll) =	0.25 kPa *	600 mm +	kN/m =	0.15 kN/m
Alternate point live load =	1.80 kN (critical)	Distr. to	1 members	Σwll = 2.40 kN/m

Point loads

Dead load (pdl) =	19.01 kN	DL	19.0	LL	6.9	Position =	280 mm from LHS
Live load (pll) =	6.93 kN	FB6	2*L	2*L		PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	2.99 kN/m	M(dI+Ψl.II)* =	6.65 kNm (Max at 280mm)
w* = 1.2*wdl+1.5*wll =	5.15 kN/m	M* =	8.44 kNm (Max at 280mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	26.97 kN	V(dI+Ψl.II)* =	24.18 kN
p* = 1.2*pdl+1.5*pll =	33.21 kN	V* =	30.87 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	2 / 300mm x 45mm Smart LVL13	Area (A) =	27000 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	1350 x10 ³ mm ³
Design depth (dD) =	300 mm	Stiffness (Ix) =	202.5 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	11.79 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d = 1.5-0.05*pbd*S1 =	0.921 for 10 ≤ pbd*S1 ≤ 20 - Cl 3.2.4	f'b =	39.4 MPa
k12 = 1.5-0.05*pb*S1 =	0.937 for 10 ≤ pb*S1 ≤ 20 - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.98 (rbd=0.25)
ϕM(dI) = ϕ*(k1=0.57)*k4*k6*k9*k12*d*f'b*Zx =	25.15 kNm	Material constant (pb) =	0.96 (rb=0.40)
ϕM = ϕ*k1*k4*k6*k9*k12*f'b*Zx =	35.93 kNm	Duration factor (k1) =	0.80
ϕV(dI) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	46.17 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	64.80 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

Duration factor (j2) =	2.0			
Ireq'd j2.(DL+Ψl.LL) (L/300) =	28.1 x10 ⁶ mm ⁴ < Critical	j2.(DL+Ψl.LL) =	0.7 mm	Span / 2164
Ireq'd Ψs.LL (L/300) =	5.9 x10 ⁶ mm ⁴	Ψs.δLL =	0.1 mm	Span / 10367
Ireq'd Total (L/250) =	28.3 x10 ⁶ mm ⁴	δTotal =	0.8 mm	Span / 1790
		1kN midspan δ =	0.0 mm	



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Beam:	(Lintel L4) 190mm x 45mm MGP10 (Single span)	
Bending:	M(dl)* = 1.26kNm (+ve) < ϕM(dl) = 1.70kNm, M* = 1.67kNm (+ve) < ϕM = 2.39kNm	OK (0.74,0.70)
Shear:	V(dl)* = 5.05kN < ϕV(dl) = 5.67kN, V* = 6.67kN < ϕV = 7.96kN	OK (0.89,0.84)
Deflection:	δL = L/1304 (1mm), δΨs.LL = L/6859 (0mm), δTotal = L/1096 (1mm), 1kN mid. δ = 0.1mm	OK
Reaction:	(Each end) Rdl = 3.31kN, Rll = 1.80kN, R* = 6.67kN	

Geometry (House member affecting > 25m² or primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	1000 mm
Centres (cts) =	1500 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	1000 mm

Loadings

Floor area (A) =	1.50 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	1500 mm +	kN/m =	1.50 kN/m
Wall dead load (wdl) =	1.00 kPa *	3800 mm +	kN/m =	3.80 kN/m
Other dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.04 kN/m
			Σwdl =	6.62 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	1500 mm +	kN/m =	2.25 kN/m
Partitions (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m
Alternate point live load =	1.80 kN (critical)	Distr. to	1 members	Σwll = 3.60 kN/m

Point loads

Dead load (pdl) =	kN	Position =	500 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	10.11 kN/m	M(dl+Ψl.ll)* =	1.26 kNm (Max at 500mm)
w* = 1.2*wdl+1.5*wll =	13.35 kN/m	M* =	1.67 kNm (Max at 500mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	0.00 kN	V(dl+Ψl.ll)* =	5.05 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	6.67 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	190mm x 45mm MGP10	Area (A) =	8550 mm ²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	271 x10 ³ mm ³
Design depth (dD) =	190 mm	Stiffness (Ix) =	25.7 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1

S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	12.11 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d =	1.000 for pbd*S1 ≤ 10 - Cl 3.2.4	f'b =	15.7 MPa
k12 =	1.000 for pb*S1 ≤ 10 - Cl 3.2.4	f's =	2.5 MPa
Strength reduction factor (ϕ) =	0.7 Table 2.1	Material constant (pbd) =	0.72 (rbd=0.25)
ϕM(dl) = ϕ*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =	1.70 kNm	Material constant (pb) =	0.70 (rb=0.40)
ϕM = ϕ*k1*k4*k6*k9*k12d*f'b*Zx =	2.39 kNm	Duration factor (k1) =	0.80
ϕV(dl) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	5.67 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	7.96 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	0.93
		Size modifier (mod.s) =	0.96

Deflections

Duration factor (j2) =	2.0		
Ireq'd j2.(DL+Ψl.LL) (L/300) =	5.9 x10 ⁶ mm ⁴	< Critical j2.(DL+Ψl.LL) =	0.8 mm
Ireq'd Ψs.LL (L/300) =	1.1 x10 ⁶ mm ⁴	Ψs.δLL =	0.1 mm
Ireq'd Total (L/250) =	5.9 x10 ⁶ mm ⁴	δTotal =	0.9 mm
		1kN midspan δ =	0.1 mm



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Beam:	(Lintel L5) 200mm x 45mm Smart LVL13 (Varies) (Single span)	
Bending:	M(dI)* = 2.40kNm (+ve) < ϕM(dI) = 4.93kNm, M* = 3.07kNm (+ve) < ϕM = 7.07kNm	OK (0.49,0.43)
Shear:	V(dI)* = 6.85kN < ϕV(dI) = 15.39kN, V* = 8.77kN < ϕV = 21.60kN	OK (0.45,0.41)
Deflection:	δL = L/726 (2mm), δΨs.LL = L/3634 (0mm), δTotal = L/605 (2mm), 1kN mid. δ = 0.1mm	OK
Reaction:	(Each end) Rdl = 4.64kN, Rll = 2.14kN, R* = 8.77kN	

Geometry (House member affecting > 25m² or primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Span (L) =	1400 mm
Centres (cts) =	1500 mm
Span type =	S (S)ingle,(D)ouble
Edge restrained =	C (T)ension, (C)ompression, (B)oth
Lay.t (Top) =	1400 mm

Loadings

Floor area (A) =	2.10 m ²	Live load type =	N (N)ormal, (S)torage, (M)annual
			AS/NZS 1170.0 - Table 4.1

Uniform dead loads

Floor dead load (wdl) =	1.00 kPa *	1500 mm +	kN/m =	1.50 kN/m
Wall dead load (wdl) =	1.00 kPa *	3800 mm +	kN/m =	3.80 kN/m
Other dead load (wdl) =	0.40 kPa *	3200 mm +	kN/m =	1.28 kN/m
Include S.Wt =	Y (Y)es,(N)o		S.Wt =	0.05 kN/m
			Σwdl =	6.63 kN/m

Uniform live loads

Floor live load (wll) =	1.50 kPa *	1500 mm +	kN/m =	2.25 kN/m	
Partitions (wll) =	0.25 kPa *	3200 mm +	kN/m =	0.80 kN/m	
Alternate point live load =	1.80 kN	Distr. to	1 members	Σwll =	3.05 kN/m

Point loads

Dead load (pdl) =	kN	Position =	700 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Y)es,(N)o

Short term LL factor (Ψsu) =	1.00	(Ψsp) =	1.00
Long term LL factor (Ψlu) =	0.33 / 0.40 (wdl*)	(Ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*Ψlu*wll =	9.79 kN/m	M(dI+Ψl.II)* =	2.40 kNm (Max at 700mm)
w* = 1.2*wdl+1.5*wll =	12.53 kN/m	M* =	3.07 kNm (Max at 700mm)
pdl* = 1.2*pdl+1.5*Ψlp*pll =	0.00 kN	V(dI+Ψl.II)* =	6.85 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	8.77 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	200mm x 45mm Smart LVL13	Area (A) =	9000 mm ²
Description =	LVL13 seasoned softwood	Section modulus (Zx) =	300 x10 ³ mm ³
Design depth (dD) =	200 mm	Stiffness (Ix) =	30.0 x10 ⁶ mm ⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	13200 MPa - Cl 8.3
S1 = 1.25*dD/dW*(Lay.t/dD) ^{0.5} =	14.70 For top comp. edge restrained - Cl 3.2.3.2(a)		
k12d = 1.5-0.05*pb*d*S1 =	0.749 for 10 ≤ pb*d*S1 ≤ 20 - Cl 3.2.4	f'b =	42.7 MPa
k12 = 1.5-0.05*pb*S1 =	0.767 for 10 ≤ pb*S1 ≤ 20 - Cl 3.2.4	f's =	5.0 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	1.02 (rbd=0.25)
ϕM(dI) = ϕ*(k1=0.57)*k4*k6*k9*k12*d*f'b*Zx =	4.93 kNm	Material constant (pb) =	1.00 (rb=0.37)
ϕM = ϕ*k1*k4*k6*k9*k12*f'b*Zx =	7.07 kNm	Duration factor (k1) =	0.80
ϕV(dI) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	15.39 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	21.60 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

		Duration factor (j2) =	2.0
Ireq'd j2.(DL+Ψl.LL) (L/300) =	12.4 x10 ⁶ mm ⁴	< Critical j2.(DL+Ψl.LL) =	1.9 mm
Ireq'd Ψs.LL (L/300) =	2.5 x10 ⁶ mm ⁴	Ψs.δLL =	0.4 mm
Ireq'd Total (L/250) =	12.4 x10 ⁶ mm ⁴	δTotal =	2.3 mm
		1kN midspan δ =	0.1 mm



TIMBER ROOF BEAM V5.10

HWC Engineers

CITY OF ONKAPARINGA
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PDI Act 2016 and Regulations

Beam:	(Lintel L6) 190mm x 45mm MGP10 (Single span)	
Bending:	M(dl)* = 0.60kNm (+ve) < ϕM(dl) = 1.93kNm, M* = 1.35kNm (+ve) < ϕM = 3.30kNm	OK (0.31,0.41)
	Mw* = 0.33kNm (-ve) < ϕMw = 3.84kNm	OK (0.09)
Shear:	V(dl)* = 1.19kN < ϕV(dl) = 7.29kN, V* = 2.71kN < ϕV = 12.03kN	OK (0.16,0.23)
	Vw* = 0.66kN < ϕVw = 12.79kN	OK (0.05)
Deflection:	δDL = L/1399 (1mm), δΨs.LL = L/2806 (1mm), δWLs = L/2501 (-1mm)	OK
Reactions:	(Each end) Rdl = 0.88kN, Rll = 1.10kN, Rwl* = -1.45kN, R.dn* = 2.71kN, R.up* = 0.66kN	

Geometry (House member affecting ≤ 25m² or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important	House =	Y (Yes),(N)o
Span (L) =	2000 mm	Edge restrained (down) =	C (T)ension,(C)ompression,(B)oth
Centres (cts) =	600 mm	Lay.t (Top) =	2000 mm
Span type =	S (S)ingle,(D)ouble		

Loadings

Roof area (A) =	1.20 m²	Apply wind reduction =	Y (Yes),(N)o
Live load (LL) =	0.25 kPa	Roof reduction (Ka) =	1.00 AS/NZS 1170.2, Table 5.4
	Refer AS/NZS 1170.1, Table 3.2, Note 3	Ratio Ws/Wu =	0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	600 mm +	kN/m =	0.24 kN/m
Other dead load (wdl) =	1.00 kPa *	600 mm +	kN/m =	0.60 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.04 kN/m
			Σwdl =	0.88 kN/m

Uniform live loads

Roof live load (wll) =	0.25 kPa *	600 mm +	kN/m =	0.15 kN/m
Other live load (wll) =	kPa *	600 mm +	kN/m =	0.00 kN/m
Alternate point live load =	1.10 kN (critical)	Distr. to	1 members	Σwll = 1.10 kN/m

Uniform wind loads

Ult. wind load (Wu) =	2.20 kPa *	600 mm		
Cp,e =	0.9	Cp,i =	0.2	Σwwl* = -1.45 kN/m (up)

Point loads

Dead load (pdl) =	kN	Position =	1000 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	Y (Yes),(N)o
Wind load (pwl*) =	kN (-ve up)		
w(dl)* = 1.35*wdl =	1.19 kN/m	M(dl)* =	0.60 kNm (Max at 1000mm)
w* = 1.2*wdl + 1.5*wll =	2.71 kN/m	M* =	1.35 kNm (Max at 1000mm)
w.up* = 0.9*wdl + wll* =	0.66 kN/m (up)	Mw.up* =	0.33 kNm (Max at 1000mm)
p(dl)* = 1.35*pdl =	0.00 kN	V(dl)* =	1.19 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	2.71 kN
p.up* = 0.9*pdl + pwl* =	0.00 kN	Vw.up* =	0.66 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	190mm x 45mm MGP10	Area (A) =	8550 mm²
Description =	MGP10 seasoned softwood	Section modulus (Zx) =	271 x10³ mm³
Design depth (dD) =	190 mm	Stiffness (Ix) =	25.7 x10⁶ mm⁴
Design width (dW) =	45 mm	Modulus of elasticity (E) =	10000 MPa - Table H3.1
S1d = 1.25*dD/dW*(Lay.t/dD)⁰·⁵ =	17.12	For top comp. edge restrained - Cl 3.2.3.2(a)	
S1u = (dD/dW)¹·³⁵*(Lay.t/dD)⁰·²⁵ =	12.59	For top tension edge restrained in uplift - Cl 3.2.3.2(a)	
k12d = 1.5-0.05*pbd*S1d =	0.881	for 10 ≤ pbd*S1d ≤ 20 - Cl 3.2.4	
k12 = 1.5-0.05*pb*S1d =	0.914	for 10 ≤ pb*S1d ≤ 20 - Cl 3.2.4	f'b = 15.7 MPa
k12u =	1.000	for pbu*S1u ≤ 10 - Cl 3.2.4	f's = 2.5 MPa
Strength reduction factor (ϕ) =	0.9 Table 2.1	Material constant (pbd) =	0.72 (rbd=0.25)
ϕM(dl) = ϕ*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =	1.93 kNm	Material constant (pb) =	0.68 (rb=0.61)
ϕM = ϕ*k1*k4*k6*k9*k12*f'b*Zx =	3.30 kNm	Stress reversal (pbu) =	0.66 (rbu=1.00)
ϕMw = ϕ*(k1=1)*k4*k6*k9*k12u*f'b*Zx =	3.84 kNm	Duration factor (k1) =	0.94 (Live)
ϕV(dl) = ϕ*(k1=0.57)*k4*k6*f's*(2/3*A) =	7.29 kN	Moisture factor (k4) =	1.00
ϕV = ϕ*k1*k4*k6*f's*(2/3*A) =	12.03 kN	Temp. factor (k6) =	1.00
ϕVw = ϕ*(k1=1)*k4*k6*f's*(2/3*A) =	12.79 kN	Sharing factor (k9) =	1.00
		Size modifier (mod.b & s) =	0.93 & 0.96

Deflections

		Duration factor (j2) =	2.0
Ireq'd j2.(DL+Ψl.LL) (L/300) =	5.5 x10⁶ mm⁴	< Critical	δDL= 1.4 mm
Ireq'd `LL (L/240) =	2.2 x10⁶ mm⁴		δΨs.LL = 0.7 mm
Ireq'd WLs (L/180) =	1.9 x10⁶ mm⁴		δWLs = -0.8 mm
			Span / 1399
			Span / 2806
			Span / 2501

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STEEL COLUMN V5.07

HWC Engineers

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Member:	(Column C1 CLEAT) 89 x 5.0 SHS (G350)# (Connection 100mm from face)	
Compression:	$N_c^* = 56.2\text{kN} < \phi N_c = 246.5\text{kN}$	OK (0.23)
Bending:	$M_x^* = 8.1\text{kNm} < \phi M_b(3300, \alpha_m=1.75) = 15.5\text{kNm}$	OK (0.53)
	No minor bending	
Combined:	In-plane = 0.75, Out-of-plane = 0.75	OK (0.75)

Geometry

Column length (L) =	3300 mm	L = L _b = L _x = L _y =	Y (Y)es,(N)o
Compression:			
Major axis length (L _x) =	3300 mm		
Minor axis length (L _y) =	3300 mm		
Effective length X factor (k _{ex}) =	1.00 Fig 4.6.3.2		
Effective length Y factor (k _{ey}) =	1.00 Fig 4.6.3.2	Holes =	0 mm ² (axial reduction only)
Bending:			
Bending length (L _b) =	3300 mm	Eff. length L _{ex} (3300,1.00) =	3300 mm
Bending effective length factor (k _e) =	1.00 Cl 5.6.3	Eff. length L _{ey} (3300,1.00) =	3300 mm
Moment modification factor (α _m) =	1.75 Cl 5.6.1.1(a)	Eff. length L _{eb} (3300,1.00) =	3300 mm

Loadings

S.Wt =	0.12 kN/m (excluded)		
Dead load comp. (N _{dl}) =	27.3 kN	DL	17.7
Live load comp. (N _{ll}) =	15.7 kN	LL	12.2
N _c * = 1.2*N _{dl} +1.5*N _{ll} =	56.2 kN	FB4	9.5
		FB6	3.5
Beam End Connection (For moment) =	F (C)ap,(F)ace,(M)anual,(L)oadng	Elastic Analysis	
Major axis M _x *=δ _{bx} .N _c *(D/2+100) =	8.1 kNm	type =	1 (1)st order,(2)nd order
Minor axis M _y *=δ _{by} .M _y * =	0.0 kNm - App. E	type =	B (B)raced/(S)way - Cl 4.1.2
D =	89 mm (Bending about the strong axis only)	β _m =	0.0 cm = 0.60
		δ _{bx} = cm/(1-N*/Nom _x) =	1.00 and δ _{by} = 1.00

Capacity

Section doubly symmetric			
Description = 89 x 5.0 SHS (G350)#	Warping constant (I _w) =		0 x10 ⁹ mm ⁶
Flange yield (f _{yf}) = 350 MPa	Torsional constant (J) =		3060 x10 ³ mm ⁴
Web yield (f _{yw}) = 350 MPa	Effective section mod. (Z _{ex}) =		49.1 x10 ³ mm ³
Area (A _g) = 1590 mm ²	Effective section mod. (Z _{ey}) =		49.1 x10 ³ mm ³
Stiffness (I _x) = 1.82 x10 ⁶ mm ⁴	Elastic modulus (E) =		200000 MPa - Cl 1.4
Stiffness (I _y) = 1.82 x10 ⁶ mm ⁴	Shear modulus (G) =		80000 MPa - Cl 1.4
r _x = 33.8 mm	α _b =		-0.5 (Comp.)
r _y = 33.8 mm	Net area (A _n) =		1590 mm ²
	Nom _x = π ² *E*I _x /(k _{ex} *L _x) ² =		330 kN - Cl 4.6.2
Compression - Section 6	Nom _y = π ² *E*I _y /(k _{ey} *L _y) ² =		330 kN
φ = 0.9 Table 3.4	φN _s = φ*k _f *A _n *f _y =		500.9 kN - Cl 6.2.1
α _{cx} (L _{ex}) = 0.492	φN _{cx} = φN _s *α _{cx} =		246.5 kN - Cl 6.3.3
α _{cx1} (k _{ex} =1, L _{ex} =L _x) = 0.492	φN _{cy} = φN _s *α _{cy} =		246.5 kN - Cl 6.3.3
α _{cy} (L _{ey}) = 0.492	φN _c =		246.5 kN
α _{cy1} (k _{ey} =1, L _{ey} =L _y) = 0.492	φN _{cx1} = φN _s *α _{cx1} =		246.5 kN - Cl 8.4.2.2
	φN _{cy1} = φN _s *α _{cy1} =		246.5 kN - Cl 8.4.2.2
Bending - Section 5			
φ = 0.9 Table 3.4		φM _{sy} =	15.5 kNm
M _{sx} = min(f _{yf} ,f _{yw})*Z _{ex} =	17.2 kNm - Cl 5.2.1	φM _{sx} =	15.5 kNm
M _{oa} =	284.2 kNm α _s = 1.000	α _m = 1.75	φM _{bx} (α _m =1) = 15.5 kNm
Combined - Section 8			
Uniaxial bending about major axis - φM _{rxc} = φM _{sx} *(1-N _c */φN _s) =	13.7 kNm - Cl 8.3.2		OK (0.59)
In-plane capacity - φM _{mixc} = φM _{sx} *(1-N _c */φN _{cx1}) =	11.9 kNm - Cl 8.4.2.2		OK (0.68)
Out-of-plane capacity - φM _{oxc} = φM _{bx} *(1-N _c */φN _{cy}) =	11.9 kNm - Cl 8.4.4.1		OK (0.68)
In-plane member ratio = M _x */φM _{sx} + N _c */φN _{cx1} =	0.75		OK (0.75)
In-plane member ratio = M _y */φM _{sy} + N _c */φN _{cy1} =	0.23		OK (0.23)
Out-of-plane member ratio = M _x */φM _{bx} + N _c */φN _{cy} =	0.75		OK (0.75)
φM _{cx} = min(φM _{oxc} & φM _{mixc}) =	11.9 kNm - Cl 8.4.5		
φM _{iy} = φM _{sy} *(1-N _c */φN _{cy1}) =	11.9 kNm - Cl 8.4.2.2		
Biaxial bending ratio = (M _x */φM _{cx}) ^{1.4} + (M _y */φM _{iy}) ^{1.4} =	0.58 Cl 8.4.5		OK (0.58)
Biaxial section ratio = N _c */φN _s + M _x */φM _{sx} + M _y */φM _{sy} =	0.64		OK (0.64)

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Member:	(Column C1 CAP) 89 x 5.0 SHS (G350)# (Cap plate connection)	
Compression:	$N_c^* = 94.3\text{kN} < \phi N_c = 246.5\text{kN}$	OK (0.38)
Bending:	$M_x^* = 4.2\text{kNm} < \phi M_b(3300, \alpha_m=1.75) = 15.5\text{kNm}$	OK (0.27)
	No minor bending	
Combined:	In-plane = 0.65, Out-of-plane = 0.65	OK (0.65)

Geometry

Column length (L) =	3300 mm	L = L _b = L _x = L _y =	Y (Y)es,(N)o
Compression:			
Major axis length (L _x) =	3300 mm		
Minor axis length (L _y) =	3300 mm		
Effective length X factor (k _{ex}) =	1.00 Fig 4.6.3.2		
Effective length Y factor (k _{ey}) =	1.00 Fig 4.6.3.2	Holes =	0 mm ² (axial reduction only)
Bending:			
Bending length (L _b) =	3300 mm	Eff. length L _{ex} (3300,1.00) =	3300 mm
Bending effective length factor (k _e) =	1.00 Cl 5.6.3	Eff. length L _{ey} (3300,1.00) =	3300 mm
Moment modification factor (α _m) =	1.75 Cl 5.6.1.1(a)	Eff. length L _{eb} (3300,1.00) =	3300 mm

Loadings

S.Wt =	0.12 kN/m (excluded)		
Elastic Analysis			
Dead load comp. (N _{dl}) =	44.3 kN	DL	44.3
Live load comp. (N _{ll}) =	27.4 kN	LL	27.4
N _c * = 1.2*N _{dl} +1.5*N _{ll} =	94.3 kN		
Beam End Connection (For moment) =	C (C)ap,(F)ace,(M)annual,(L)oadng	type =	1 (1)st order,(2)nd order
Major axis M _x * = δ _{bx} .N _c *(D/2) =	4.2 kNm	type =	B (B)raced/(S)way - Cl 4.1.2
Minor axis M _y * = δ _{by} .M _y * =	0.0 kNm - App. E	β _m =	0.0 cm = 0.60
D =	89 mm (Bending about the strong axis only)	δ _{bx} = cm/(1-N*/Nom _x) =	1.00 and δ _{by} = 1.00

Capacity

Section doubly symmetric			
Description =	89 x 5.0 SHS (G350)#	Warping constant (I _w) =	0 x10 ⁹ mm ⁶
Flange yield (f _{fy}) =	350 MPa	Torsional constant (J) =	3060 x10 ³ mm ⁴
Web yield (f _{yw}) =	350 MPa	Effective section mod. (Z _{ex}) =	49.1 x10 ³ mm ³
Area (A _g) =	1590 mm ²	Effective section mod. (Z _{ey}) =	49.1 x10 ³ mm ³
Stiffness (I _x) =	1.82 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4
Stiffness (I _y) =	1.82 x10 ⁶ mm ⁴	Shear modulus (G) =	80000 MPa - Cl 1.4
r _x =	33.8 mm	α _b =	-0.5 (Comp.)
r _y =	33.8 mm	Net area (A _n) =	1590 mm ²
Compression - Section 6		Nom _x = π ² *E*I _x /(k _{ex} *L _x) ² =	330 kN - Cl 4.6.2
φ =	0.9 Table 3.4	Nom _y = π ² *E*I _y /(k _{ey} *L _y) ² =	330 kN
α _{cx} (L _{ex}) =	0.492	φN _s = φ*k _f *A _n *f _y =	500.9 kN - Cl 6.2.1
α _{cx1} (k _{ex} =1, L _{ex} =L _x) =	0.492	φN _{cx} = φN _s *α _{cx} =	246.5 kN - Cl 6.3.3
α _{cy} (L _{ey}) =	0.492	φN _{cy} = φN _s *α _{cy} =	246.5 kN - Cl 6.3.3
α _{cy1} (k _{ey} =1, L _{ey} =L _y) =	0.492	φN _c =	246.5 kN
		φN _{cx1} = φN _s *α _{cx1} =	246.5 kN - Cl 8.4.2.2
		φN _{cy1} = φN _s *α _{cy1} =	246.5 kN - Cl 8.4.2.2
Bending - Section 5		φM _{sy} =	15.5 kNm
M _{sx} = min(f _{fy} ,f _{yw})*Z _{ex} =	17.2 kNm - Cl 5.2.1	φM _{sx} =	15.5 kNm
M _{oa} =	284.2 kNm α _s = 1.000	α _m = 1.75	φM _{bx} (α _m =1) = 15.5 kNm
Combined - Section 8			
Uniaxial bending about major axis - φM _{rxc} = φM _{sx} *(1-N _c */φN _s) =		12.6 kNm - Cl 8.3.2	OK (0.33)
In-plane capacity - φM _{ixc} = φM _{sx} *(1-N _c */φN _{cx1}) =		9.6 kNm - Cl 8.4.2.2	OK (0.44)
Out-of-plane capacity - φM _{oxc} = φM _{bx} *(1-N _c */φN _{cy}) =		9.6 kNm - Cl 8.4.4.1	OK (0.44)
In-plane member ratio = M _x */φM _{sx} + N _c */φN _{cx1} =		0.65	OK (0.65)
In-plane member ratio = M _y */φM _{sy} + N _c */φN _{cy1} =		0.38	OK (0.38)
Out-of-plane member ratio = M _x */φM _{bx} + N _c */φN _{cy} =		0.65	OK (0.65)
φM _{cx} = min(φM _{oxc} & φM _{ixc}) =		9.6 kNm - Cl 8.4.5	
φM _{iyc} = φM _{sy} *(1-N _c */φN _{cy1}) =		9.6 kNm - Cl 8.4.2.2	
Biaxial bending ratio = (M _x */φM _{cx}) ^{1.4} + (M _y */φM _{iyc}) ^{1.4} =		0.32 Cl 8.4.5	OK (0.32)
Biaxial section ratio = N _c */φN _s + M _x */φM _{sx} + M _y */φM _{sy} =		0.46	OK (0.46)

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Member:	(Column C2 CLEAT) 89 x 3.5 SHS (G350)# (Connection 100mm from face)	
Compression:	$N_c^* = 30.9\text{kN} < \phi N_c = 184.7\text{kN}$	OK (0.17)
Bending:	$M_x^* = 4.5\text{kNm} < \phi M_b(3300, \alpha_m = 1.75) = 11.5\text{kNm}$	OK (0.39)
	No minor bending	
Combined:	In-plane = 0.56, Out-of-plane = 0.56	OK (0.56)

Geometry

Column length (L) =	3300 mm	L = L _b = L _x = L _y =	Y (Y)es,(N)o
Compression:			
Major axis length (L _x) =	3300 mm		
Minor axis length (L _y) =	3300 mm		
Effective length X factor (k _{ex}) =	1.00 Fig 4.6.3.2		
Effective length Y factor (k _{ey}) =	1.00 Fig 4.6.3.2	Holes =	0 mm ² (axial reduction only)
Bending:			
Bending length (L _b) =	3300 mm	Eff. length L _{ex} (3300,1.00) =	3300 mm
Bending effective length factor (k _e) =	1.00 Cl 5.6.3	Eff. length L _{ey} (3300,1.00) =	3300 mm
Moment modification factor (α _m) =	1.75 Cl 5.6.1.1(a)	Eff. length L _{eb} (3300,1.00) =	3300 mm

Loadings

S.Wt =	0.09 kN/m (excluded)		
Elastic Analysis			
Dead load comp. (N _{dl}) =	16.4 kN	DL LL	type = 1 (1st order,(2)nd order
Live load comp. (N _{ll}) =	7.4 kN	L3 16.4 7.4	type = B (B)raced/(S)way - Cl 4.1.2
N _c * = 1.2*N _{dl} +1.5*N _{ll} =	30.9 kN		β _m = 0.0 cm = 0.60
		δ _{bx} = cm/(1-N*/Nom _x) =	1.00 and δ _{by} = 1.00
Beam End Connection (For moment) =	F (C)ap,(F)ace,(M)anual,(L)oadng		
Major axis M _x *=δ _{bx} .N _c *(D/2+100) =	4.5 kNm		
Minor axis M _y *=δ _{by} .M _y * =	0.0 kNm - App. E	Minor bending (M _y *) =	0.0 kNm
D =	89 mm (Bending about the strong axis only)		

Capacity

Section doubly symmetric			
Description = 89 x 3.5 SHS (G350)#	Warping constant (I _w) =	0 x10 ⁹ mm ⁶	
Flange yield (f _{fy}) = 350 MPa	Torsional constant (J) =	2250 x10 ³ mm ⁴	
Web yield (f _{yw}) = 350 MPa	Effective section mod. (Z _{ex}) =	36.5 x10 ³ mm ³	
Area (A _g) = 1150 mm ²	Effective section mod. (Z _{ey}) =	36.5 x10 ³ mm ³	
Stiffness (I _x) = 1.38 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4	
Stiffness (I _y) = 1.38 x10 ⁶ mm ⁴	Shear modulus (G) =	80000 MPa - Cl 1.4	
r _x = 34.6 mm	α _b =	-0.5 (Comp.)	
r _y = 34.6 mm	Net area (A _n) =	1150 mm ²	
	Nom _x = π ² *E*I _x /(k _{ex} *L _x) ² =	250 kN - Cl 4.6.2	
	Nom _y = π ² *E*I _y /(k _{ey} *L _y) ² =	250 kN	
Compression - Section 6	φ _{Ns} = φ*k _f *A _n *f _y =	362.3 kN - Cl 6.2.1	
φ = 0.9 Table 3.4	φN _c = φN _s *α _{cx} =	184.7 kN - Cl 6.3.3	
α _{cx} (L _{ex}) = 0.510	φN _c y = φN _s *α _{cy} =	184.7 kN - Cl 6.3.3	
α _{cy} (L _{ey}) = 0.510	φN _c =	184.7 kN	
α _{cy} 1 (key=1, L _{ey} =L _y) = 0.510	φN _c x1 = φN _s *α _{cx} 1 =	184.7 kN - Cl 8.4.2.2	
	φN _c y1 = φN _s *α _{cy} 1 =	184.7 kN - Cl 8.4.2.2	
Bending - Section 5		φM _{sy} =	11.5 kNm
φ = 0.9 Table 3.4	M _{sx} = min(f _{fy} ,f _{yw})*Z _{ex} =	φM _{sx} =	11.5 kNm
M _{sx} = 12.8 kNm - Cl 5.2.1	Moa = 212.2 kNm α _s = 1.000	α _m = 1.75	φM _{bx} (α _m =1) = 11.5 kNm
Combined - Section 8			
Uniaxial bending about major axis - φM _{rxc} = φM _{sx} *(1-N _c */φN _s) =	10.5 kNm - Cl 8.3.2		OK (0.42)
In-plane capacity - φM _{ixc} = φM _{sx} *(1-N _c */φN _c x1) =	9.6 kNm - Cl 8.4.2.2		OK (0.47)
Out-of-plane capacity - φM _{oxc} = φM _{bx} *(1-N _c */φN _c y) =	9.6 kNm - Cl 8.4.4.1		OK (0.47)
In-plane member ratio = M _x */φM _{sx} + N _c */φN _c x1 =	0.56		OK (0.56)
In-plane member ratio = M _y */φM _{sy} + N _c */φN _c y1 =	0.17		OK (0.17)
Out-of-plane member ratio = M _x */φM _{bx} + N _c */φN _c y =	0.56		OK (0.56)
φM _c x = min(φM _{oxc} & φM _{ixc}) =	9.6 kNm - Cl 8.4.5		
φM _i yc = φM _{sy} *(1-N _c */φN _c y1) =	9.6 kNm - Cl 8.4.2.2		
Biaxial bending ratio = (M _x */φM _c x) ^{1.4} + (M _y */φM _i yc) ^{1.4} =	0.34 Cl 8.4.5		OK (0.34)
Biaxial section ratio = N _c */φN _s + M _x */φM _{sx} + M _y */φM _{sy} =	0.47		OK (0.47)

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STEEL COLUMN V5.07

HWC Engineers

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Development Approval
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Member:	(Column C10 CLEAT) 89 x 3.5 SHS (G350)# (Connection 100mm from face)	
Compression:	$N_c^* = 8.9\text{kN} < \phi N_c = 184.7\text{kN}$	OK (0.05)
Bending:	$M_x^* = 1.3\text{kNm} < \phi M_b(3300, \alpha_m=1.75) = 11.5\text{kNm}$	OK (0.11)
	No minor bending	
Combined:	In-plane = 0.16, Out-of-plane = 0.16	OK (0.16)

Geometry

Column length (L) =	3300 mm	L = L _b = L _x = L _y =	Y (Y)es,(N)o
Compression:			
Major axis length (L _x) =	3300 mm		
Minor axis length (L _y) =	3300 mm		
Effective length X factor (k _{ex}) =	1.00 Fig 4.6.3.2		
Effective length Y factor (k _{ey}) =	1.00 Fig 4.6.3.2	Holes =	0 mm ² (axial reduction only)
Bending:			
Bending length (L _b) =	3300 mm	Eff. length L _{ex} (3300,1.00) =	3300 mm
Bending effective length factor (k _e) =	1.00 Cl 5.6.3	Eff. length L _{ey} (3300,1.00) =	3300 mm
Moment modification factor (α _m) =	1.75 Cl 5.6.1.1(a)	Eff. length L _{eb} (3300,1.00) =	3300 mm

Loadings

S.Wt =	0.09 kN/m (excluded)		
Elastic Analysis			
Dead load comp. (N _{dl}) =	3.3 kN	DL	1.1
Live load comp. (N _{ll}) =	3.3 kN	LL	1.1
N _c * = 1.2*N _{dl} +1.5*N _{ll} =	8.9 kN	1L2	1.4
Beam End Connection (For moment) =	F (C)ap,(F)ace,(M)anual,(L)oadng		
Major axis M _x *=δ _{bx} .N _c *(D/2+100) =	1.3 kNm		
Minor axis M _y *=δ _{by} .M _y * =	0.0 kNm - App. E	Minor bending (M _y *) =	0.0 kNm
D =	89 mm (Bending about the strong axis only)		

Capacity

Section doubly symmetric			
Description = 89 x 3.5 SHS (G350)#	Warping constant (I _w) =	0 x10 ⁹ mm ⁶	
Flange yield (f _{fy}) = 350 MPa	Torsional constant (J) =	2250 x10 ³ mm ⁴	
Web yield (f _{yw}) = 350 MPa	Effective section mod. (Z _{ex}) =	36.5 x10 ³ mm ³	
Area (A _g) = 1150 mm ²	Effective section mod. (Z _{ey}) =	36.5 x10 ³ mm ³	
Stiffness (I _x) = 1.38 x10 ⁶ mm ⁴	Elastic modulus (E) =	200000 MPa - Cl 1.4	
Stiffness (I _y) = 1.38 x10 ⁶ mm ⁴	Shear modulus (G) =	80000 MPa - Cl 1.4	
r _x = 34.6 mm	α _b =	-0.5 (Comp.)	
r _y = 34.6 mm	Net area (A _n) =	1150 mm ²	
Compression - Section 6		Nom _x = π ² *E*I _x /(k _{ex} *L _x) ² = 250 kN - Cl 4.6.2	
φ = 0.9 Table 3.4	Nom _y = π ² *E*I _y /(k _{ey} *L _y) ² = 250 kN		
α _{cx} (L _{ex}) = 0.510	φN _s = φ*k _f *A _n *f _y = 362.3 kN - Cl 6.2.1		
α _{cx1} (k _{ex} =1, L _{ex} =L _x) = 0.510	φN _{cx} = φN _s *α _{cx} = 184.7 kN - Cl 6.3.3		
α _{cy} (L _{ey}) = 0.510	φN _{cy} = φN _s *α _{cy} = 184.7 kN - Cl 6.3.3		
α _{cy1} (k _{ey} =1, L _{ey} =L _y) = 0.510	φN _c = 184.7 kN		
	φN _{cx1} = φN _s *α _{cx1} = 184.7 kN - Cl 8.4.2.2		
	φN _{cy1} = φN _s *α _{cy1} = 184.7 kN - Cl 8.4.2.2		
Bending - Section 5		φM _{sy} = 11.5 kNm	
φ = 0.9 Table 3.4	M _{sx} = min(f _{fy} ,f _{yw})*Z _{ex} = 12.8 kNm - Cl 5.2.1	φM _{sx} = 11.5 kNm	φM _{bx} = 11.5 kNm
M _{oa} = 212.2 kNm	α _s = 1.000	α _m = 1.75	φM _{bx} (α _m =1) = 11.5 kNm
Combined - Section 8			
Uniaxial bending about major axis - φM _{rxc} = φM _{sx} *(1-N _c */φN _s) =	11.2 kNm - Cl 8.3.2	OK (0.11)	
In-plane capacity - φM _{ixc} = φM _{sx} *(1-N _c */φN _{cx1}) =	10.9 kNm - Cl 8.4.2.2	OK (0.12)	
Out-of-plane capacity - φM _{oxc} = φM _{bx} *(1-N _c */φN _{cy}) =	10.9 kNm - Cl 8.4.4.1	OK (0.12)	
In-plane member ratio = M _x */φM _{sx} + N _c */φN _{cx1} =	0.16	OK (0.16)	
In-plane member ratio = M _y */φM _{sy} + N _c */φN _{cy1} =	0.05	OK (0.05)	
Out-of-plane member ratio = M _x */φM _{bx} + N _c */φN _{cy} =	0.16	OK (0.16)	
φM _{cx} = min(φM _{oxc} & φM _{ixc}) =	10.9 kNm - Cl 8.4.5		
φM _{iy} = φM _{sy} *(1-N _c */φN _{cy1}) =	10.9 kNm - Cl 8.4.2.2		
Biaxial bending ratio = (M _x */φM _{cx}) ^{1.4} + (M _y */φM _{iy}) ^{1.4} =	0.05 Cl 8.4.5	OK (0.05)	
Biaxial section ratio = N _c */φN _s + M _x */φM _{sx} + M _y */φM _{sy} =	0.14	OK (0.14)	

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Member:	(Ground level wall studs 2.7m high) 90mm x 45mm MGP10	
Comp:	$N_c(dl)^* = 7.43kN < \phi N_c(dl) = 9.06kN$, $N_c^* = 10.00kN < \phi N_c = 13.78kN$	OK (0.82,0.73)
	$N_{cw}^* = 7.43kN < \phi N_{cw} = 19.52kN$	OK (0.38)
Bending:	$M(dl)^* = 0.17kNm < \phi M(dl) = 0.53kNm$, $M^* = 0.23kNm < \phi M = 0.74kNm$	OK (0.32,0.30)
	$M_{wi}^* = 0.33kNm < \phi M_{wi} = 0.93kNm$, $M_{w.out}^* = 0.47kNm < \phi M_{wo} = 0.93kNm$	OK (0.36,0.51)
Combined:	Refer table below	OK (0.93)
Deflection:	$\delta_{in} = L/432$ (6mm), $\delta_{out} = L/466$ (6mm)	OK
Reactions:	(Each end) $R_{.in}^* = 0.5kN$, (Each end) $R_{.out}^* = 0.5kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important		
House =	Y (Y)es,(N)o		
Length (L) =	2700 mm		
Centres (cts) =	600 mm		
Strong axis eff. length (Lax) =	2700 mm	Edge restrained =	B (O)uter,(I)nnner,(B)oth
Weak axis eff. length (Lay) =	1350 mm, (C)ontinuous	Bending (Layb) =	2700 mm
Effective length factor (g13) =	0.9 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2		

Loadings Wind area reduction not applied

Compression

Dead load (Ndl) =	4.76 kN	Eccentricity (ecc) =	22.5 mm (+ve increases out)
Live load (Nll) =	2.86 kN	D/2 =	45 mm
Wind load (Nwl*) =	kN (Comp.)		

Live load duration =	Floor
Duration (k1) =	0.80 Table 2.3
Long term LL factor (Ψ_{lp}) =	0.40 AS/NZS 1170.0 Table 4.1
Combination factor (Ψ_{cp}) =	0.40 AS/NZS 1170.0 Table 4.1

$\phi . 9K_a * \phi . 7C_{pe}$
 $\phi . 9K_a * \phi . 65C_{pe}$

Bending

Wall area =	1.6 m ²	Apply wind reduction =	N (N)one,(S)ide,(W)ind,(L)ee		
W_s/W_u =	0.68	Area reduction (k_a) =	1.00 AS/NZS 1170.2 Table 5.4		
Ult. wind load in ($W_{u.in}$) =	0.96 kPa				
cpe =	0.63	cpi =	0	$w_{.in}^* =$	0.36 kN/m
Ult. wind load out ($W_{u.out}$) =	0.96 kPa				
cpe =	0.585	cpi =	0	$w_{.out}^* =$	0.34 kN/m
$N_{dl}^* = 1.2 * N_{dl} + 1.5 * \Psi_{lp} * N_{ll}$ =	7.43 kN	$M_{(dl)}^* =$	0.17 kNm		
$N_c^* = 1.2 * N_{dl} + 1.5 * N_{ll}$ =	10.00 kN	$M^* =$	0.23 kNm		
$N_{cw}^* = 1.2 * N_{dl} + N_{wl}^* + 1.5 * \Psi_{cp} * N_{ll}$ =	7.43 kN	$M_{wi}^* =$	0.00 kNm		
		$M_{wo}^* =$	0.17 kNm		

Horz. Point loads

Wind load ($p_{wl.in}^*$) =	kN	Position =	1350 mm from bottom		
Wind load ($p_{wl.out}^*$) =	kN				
$w_{.in}^* =$	0.36 kN/m	$w_{.out}^* =$	0.34 kN/m	$R_{.in}^* =$	0.5 kN
$p_{.in}^* =$	0.00 kN	$p_{.out}^* =$	0.00 kN	$R_{.out}^* =$	0.5 kN
$M_{w.in}^* =$	0.33 kNm	$M_{w.out}^* =$	0.47 kNm		

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Axial Capacity - Cl 3.3

Member = 90mm x 45mm MGP10
Description = MGP10 seasoned softwood
Design depth (dD) = 90 mm
Design width (dW) = 45 mm

Area (A) = 4050 mm²
Section modulus (Zx) = 60.8 x10³ mm³
Section modulus (Zy) = 30.4 x10³ mm³
Stiffness (Ix) = 2.73 x10⁶ mm⁴
Stiffness (Iy) = 0.68 x10⁶ mm⁴
Modulus of elasticity (E) = 10000 MPa - Table H3.1

S3x = min(g13*L/dD & Lax/dD) = 27.00
S4y = min(g13*L/dW & Lay/dW) = 30.00
Critical S = 30.00

k12cx = 0.324 for pc*S3x ≥ 20 - Cl 3.3.3
k12cy = 0.262 for pc*S4y ≥ 20 - Cl 3.3.3
k12c = 0.262 for pc*S ≥ 20 - Cl 3.3.3
k12cd = 0.242 for pcd*S ≥ 20 - Cl 3.3.3
k12cw = 0.297 for pcw*S ≥ 20 - Cl 3.3.3

Strength reduction factor (φ) = 0.9 Table 2.1
φNc(dl) = φ*0.57*k4*k6*k12cd*f*c*A = 9.1 kN
φNc = φ*k1*k4*k6*k12c*f*c*A = 13.8 kN
φNcw = φ*(k1=1)*k4*k6*k12cw*f*c*A = 19.5 kN

f'c = 18.0 MPa
f't = 7.7 MPa
Material constant (pcd) = 0.96 (rcd=0.25)
Material constant (pc) = 0.92 (rc=0.43)
Material constant (pcw) = 0.86 (rcw=1.00)
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Size modifier (mod.c) = 1.00

Bending Capacity - Cl 3.2

S1i = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 5.97 for tension edge restrained - Cl 3.2.3.2
S1o = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 5.97 for tension edge restrained - Cl 3.2.3.2

k12di = 1.000 for pbd*S1i ≤ 10 - Cl 3.2.4
k12i = 1.000 for pb*S1i ≤ 10 - Cl 3.2.4
k12wi = 1.000 for pbi*S1i ≤ 10 - Cl 3.2.4
k12do = 1.000 for pbd*S1o ≤ 10 - Cl 3.2.4
k12o = 1.000 for pb*S1o ≤ 10 - Cl 3.2.4
k12wo = 1.000 for pbo*S1o ≤ 10 - Cl 3.2.4

Strength reduction factor (φ) = 0.9 Table 2.1
φM(dl) = φ*(k1=0.57)*k4*k6*k9*min(k12di,k12do)*f'b*Zx = 0.53 kNm
φM = φ*k1*k4*k6*k9*min(k12i,k12o)*f'b*Zx = 0.74 kNm
φMwi = φ*(k1=1)*k4*k6*k9*k12wi*f'b*Zx = 0.93 kNm
φMwo = φ*(k1=1)*k4*k6*k9*k12wo*f'b*Zx = 0.93 kNm

f'b = 17.0 MPa
Material constant (pbd) = 0.75 (rbd=0.25)
Material constant (pb) = 0.69 (rb=1.00)
Material constant (pbi) = 0.69 (rbi=1.00)
Stress reversal (pbo) = 0.69 (rbo=1.00)
Duration factor (k1) = 0.80
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Sharing factor (k9) = 1.00
Size modifier (mod.b) = 1.00

Combined - Cl 3.5.1 & Appendix E5

Comp/Bend	Nc(dl)*	Nc*	Ncw*
Minor buckling	0.86	0.82	0.69
Major buckling	0.93	0.89	0.86

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Proposed Residential Development
418 Esplanade, Moana SA

Page:
Project No.: 24261
Designed: JS

Ground level wall studs 3.1m high supporting ground roof only

TIMBER MULLION V5.08

HWC Engineers

CITY OF ONKAPARINGA
Development Approval
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PDI Act 2016 and Regulations

Member:	(Ground level wall studs 3.1m high supporting ground roof only) 90mm x 45mm MGP10	
Comp:	$N_c(dl)^* = 6.42kN < \phi N_c(dl) = 8.49kN$, $N_c^* = 10.00kN < \phi N_c = 15.16kN$	OK (0.76,0.66)
	$N_{cw}^* = 5.71kN < \phi N_{cw} = 18.28kN$	OK (0.31)
Bending:	$M(dl)^* = 0.14kNm < \phi M(dl) = 0.53kN$, $M^* = 0.23kN < \phi M = 0.87kNm$	OK (0.27,0.26)
	$M_{wi}^* = 0.44kNm < \phi M_{wi} = 0.93kNm$, $M_{w.out}^* = 0.53kN < \phi M_{wo} = 0.93kNm$	OK (0.47,0.57)
Combined:	Refer table below	OK (0.97)
Deflection:	$\delta_{in} = L/286$ (11mm), $\delta_{out} = L/308$ (10mm)	OK
Reactions:	(Each end) $R_{.in}^* = 0.6kN$, (Each end) $R_{.out}^* = 0.5kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category = 1 (1) House, (2) Primary building elements, (3) Important

Length (L) = 3100 mm
Centres (cts) = 600 mm

Strong axis eff. length (Lax) = 3100 mm Edge restrained = B (O)uter,(I)inner,(B)oth
Weak axis eff. length (Lay) = 1350 mm, (C)ontinuous Bending (Layb) = 3100 mm
Effective length factor (g13) = 0.9 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2

Loadings Wind area reduction not applied

Compression

Dead load (Ndl) = 4.76 kN Eccentricity (ecc) = 22.5 mm (+ve increases out)
Live load (Nll) = 2.86 kN D/2 = 45 mm
Wind load (Nwl*) = kN (Comp.)

Live load duration = Roof
Duration (k1) = 0.94 Table 2.3
Long term LL factor (Ψ_{lp}) = 0.00 AS/NZS 1170.0 Table 4.1
Combination factor (Ψ_{cp}) = 0.00 AS/NZS 1170.0 Table 4.1

$\phi . 9K_a * \phi . 7C_{pe}$
 $\phi . 9K_a * \phi . 65C_{pe}$

Bending

Wall area = 1.9 m² Apply wind reduction = N (N)one,(S)ide,(W)ind,(L)ee
 $W_s/W_u = 0.68$ Area reduction (k_a) = 1.00 AS/NZS 1170.2 Table 5.4

Ult. wind load in ($W_{u.in}$) = 0.96 kPa
cpe = 0.63 cpi = 0 $w_{.in}^* = 0.36$ kN/m

Ult. wind load out ($W_{u.out}$) = 0.96 kPa
cpe = 0.585 cpi = 0 $w_{.out}^* = 0.34$ kN/m

$N_{dl}^* = 1.35 * N_{dl} = 6.42$ kN $M_{(dl)}^* = 0.14$ kNm
 $N_c^* = 1.2 * N_{dl} + 1.5 * N_{ll} = 10.00$ kN $M^* = 0.23$ kNm
 $N_{cw}^* = 1.2 * N_{dl} + N_{wl}^* + 1.5 * \Psi_{cp} * N_{ll} = 5.71$ kN $M_{wi}^* = 0.00$ kNm
 $M_{wo}^* = 0.13$ kNm

Horz. Point loads

Wind load (pwl.in*) = kN Position = 1550 mm from bottom
Wind load (pwl.out*) = kN

$w_{.in}^* = 0.36$ kN/m $w_{.out}^* = 0.34$ kN/m $R_{.in}^* = 0.6$ kN
 $p_{.in}^* = 0.00$ kN $p_{.out}^* = 0.00$ kN $R_{.out}^* = 0.5$ kN
 $M_{w.in}^* = 0.44$ kNm $M_{w.out}^* = 0.53$ kNm

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Ground level wall studs 3.1m high supporting ground roof only

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Axial Capacity - Cl 3.3

Member = 90mm x 45mm MGP10
Description = MGP10 seasoned softwood
Design depth (dD) = 90 mm
Design width (dW) = 45 mm

Area (A) = 4050 mm²
Section modulus (Zx) = 60.8 x10³ mm³
Section modulus (Zy) = 30.4 x10³ mm³
Stiffness (Ix) = 2.73 x10⁶ mm⁴
Stiffness (Iy) = 0.68 x10⁶ mm⁴
Modulus of elasticity (E) = 10000 MPa - Table H3.1

S3x = min(g13*L/dD & Lax/dD) = 31.00
S4y = min(g13*L/dW & Lay/dW) = 30.00
Critical S = 31.00

k12cx = 0.246 for pc*S3x ≥ 20 - Cl 3.3.3
k12cy = 0.262 for pc*S4y ≥ 20 - Cl 3.3.3
k12c = 0.246 for pc*S ≥ 20 - Cl 3.3.3
k12cd = 0.227 for pcd*S ≥ 20 - Cl 3.3.3
k12cw = 0.279 for pcw*S ≥ 20 - Cl 3.3.3

Strength reduction factor (φ) = 0.9 Table 2.1
φNc(dl) = φ*0.57*k4*k6*k12cd*f*c*A = 8.5 kN
φNc = φ*k1*k4*k6*k12c*f*c*A = 15.2 kN
φNcw = φ*(k1=1)*k4*k6*k12cw*f*c*A = 18.3 kN

f'c = 18.0 MPa
f't = 7.7 MPa
Material constant (pcd) = 0.96 (rcd=0.25)
Material constant (pc) = 0.92 (rc=0.43)
Material constant (pcw) = 0.86 (rcw=1.00)
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Size modifier (mod.c) = 1.00

Bending Capacity - Cl 3.2

S1i = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 6.18 for tension edge restrained - Cl 3.2.3.2
S1o = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 6.18 for tension edge restrained - Cl 3.2.3.2

k12di = 1.000 for pbd*S1i ≤ 10 - Cl 3.2.4
k12i = 1.000 for pb*S1i ≤ 10 - Cl 3.2.4
k12wi = 1.000 for pbi*S1i ≤ 10 - Cl 3.2.4
k12do = 1.000 for pbd*S1o ≤ 10 - Cl 3.2.4
k12o = 1.000 for pb*S1o ≤ 10 - Cl 3.2.4
k12wo = 1.000 for pbo*S1o ≤ 10 - Cl 3.2.4

Strength reduction factor (φ) = 0.9 Table 2.1
φM(dl) = φ*(k1=0.57)*k4*k6*k9*min(k12di,k12do)*f'b*Zx = 0.53 kNm
φM = φ*k1*k4*k6*k9*min(k12i,k12o)*f'b*Zx = 0.87 kNm
φMwi = φ*(k1=1)*k4*k6*k9*k12wi*f'b*Zx = 0.93 kNm
φMwo = φ*(k1=1)*k4*k6*k9*k12wo*f'b*Zx = 0.93 kNm

f'b = 17.0 MPa
Material constant (pbd) = 0.75 (rbd=0.25)
Material constant (pb) = 0.69 (rb=1.00)
Material constant (pbi) = 0.69 (rbi=1.00)
Stress reversal (pbo) = 0.69 (rbo=1.00)
Duration factor (k1) = 0.94
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Sharing factor (k9) = 1.00
Size modifier (mod.b) = 1.00

Combined - Cl 3.5.1 & Appendix E5

Comp/Bend	Nc(dl)*	Nc*	Ncw*
Minor buckling	0.73	0.68	0.66
Major buckling	0.97	0.92	0.93

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Proposed Residential Development
418 Esplanade, Moana SA

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Project No.: 24261
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Ground level wall studs 3.1m high supporting floor trusses

TIMBER MULLION V5.08

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LOAD BEARING STUDS LBW1

Member:	(Ground level wall studs 3.1m high supporting floor trusses) 90mm x 45mm Smart LVL13 (Varies)	
Comp:	$N_c(dl)^* = 7.43kN < \phi N_c(dl) = 13.13kN$, $N_c^* = 10.00kN < \phi N_c = 19.96kN$	OK (0.57,0.50)
	$N_{cw}^* = 7.43kN < \phi N_{cw} = 28.28kN$	OK (0.26)
Bending:	$M(dl)^* = 0.17kNm < \phi M(dl) = 1.64kNm$, $M^* = 0.23kNm < \phi M = 2.31kNm$	OK (0.10,0.10)
	$M_{wi}^* = 0.44kNm < \phi M_{wi} = 2.89kNm$, $M_{w.out}^* = 0.57kNm < \phi M_{wo} = 2.89kNm$	OK (0.15,0.20)
Combined:	Refer table below	OK (0.62)
Deflection:	$\delta_{in} = L/377$ (8mm), $\delta_{out} = L/406$ (8mm)	OK
Reactions:	(Each end) $R_{.in}^* = 0.6kN$, (Each end) $R_{.out}^* = 0.5kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category =	1 (1) House, (2) Primary building elements, (3) Important
House =	Y (Y)es,(N)o
Length (L) =	3100 mm
Centres (cts) =	600 mm

Strong axis eff. length (Lax) =	3100 mm	Edge restrained =	B (O)uter,(I)nnner,(B)oth
Weak axis eff. length (Lay) =	1350 mm, (C)ontinuous	Bending (Layb) =	3100 mm
Effective length factor (g13) =	0.9 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2		

Loadings Wind area reduction not applied

Compression

Dead load (Ndl) =	4.76 kN	Eccentricity (ecc) =	22.5 mm (+ve increases out)
Live load (Nll) =	2.86 kN	D/2 =	45 mm
Wind load (Nwl*) =	kN (Comp.)		

Live load duration =	Floor
Duration (k1) =	0.80 Table 2.3
Long term LL factor (Ψ_{lp}) =	0.40 AS/NZS 1170.0 Table 4.1
Combination factor (Ψ_{cp}) =	0.40 AS/NZS 1170.0 Table 4.1

$\phi . 9K_a * \phi . 7C_{pe}$
 $\phi . 9K_a * \phi . 65C_{pe}$

Bending

Wall area =	1.9 m ²	Apply wind reduction =	N (N)one,(S)ide,(W)ind,(L)ee
Ws/Wu =	0.68	Area reduction (ka) =	1.00 AS/NZS 1170.2 Table 5.4

Ult. wind load in (Wu.in) =	0.96 kPa	cpi =	0	w.in* =	0.36 kN/m
cpe =	0.63				

Ult. wind load out (Wu.out) =	0.96 kPa	cpi =	0	w.out* =	0.34 kN/m
cpe =	0.585				

$N_{dl}^* = 1.2 * N_{dl} + 1.5 * \Psi_{lp} * N_{ll}$ =	7.43 kN	$M_{(dl)}^* =$	0.17 kNm
$N_c^* = 1.2 * N_{dl} + 1.5 * N_{ll}$ =	10.00 kN	$M^* =$	0.23 kNm
$N_{cw}^* = 1.2 * N_{dl} + N_{wl}^* + 1.5 * \Psi_{cp} * N_{ll}$ =	7.43 kN	$M_{wi}^* =$	0.00 kNm
		$M_{wo}^* =$	0.17 kNm

Horz. Point loads

Wind load (pwl.in*) =	kN	Position =	1550 mm from bottom
Wind load (pwl.out*) =	kN		

w.in* =	0.36 kN/m	w.out* =	0.34 kN/m	R.in* =	0.6 kN
p.in* =	0.00 kN	p.out* =	0.00 kN	R.out* =	0.5 kN
Mw.in* =	0.44 kNm	Mw.out* =	0.57 kNm		

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Proposed Residential Development
418 Esplanade, Moana SA

Page:
Project No.: 24261
Designed: JS

Ground level wall studs 3.1m high supporting floor trusses

TIMBER MULLION V5.08

HWC Engineers

CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

Axial Capacity - Cl 3.3

Member = 90mm x 45mm Smart LVL13
Description = LVL13 seasoned softwood
Design depth (dD) = 90 mm
Design width (dW) = 45 mm

Area (A) = 4050 mm²
Section modulus (Zx) = 60.8 x10³ mm³
Section modulus (Zy) = 30.4 x10³ mm³
Stiffness (Ix) = 2.73 x10⁶ mm⁴
Stiffness (Iy) = 0.68 x10⁶ mm⁴
Modulus of elasticity (E) = 13200 MPa - Cl 8.3

S3x = min(g13*L/dD & Lax/dD) = 31.00
S4y = min(g13*L/dW & Lay/dW) = 30.00
Critical S = 31.00

k12cx = 0.154 for pc*S3x ≥ 20 - Cl 3.3.3
k12cy = 0.165 for pc*S4y ≥ 20 - Cl 3.3.3
k12c = 0.154 for pc*S ≥ 20 - Cl 3.3.3
k12cd = 0.143 for pcd*S ≥ 20 - Cl 3.3.3
k12cw = 0.175 for pcw*S ≥ 20 - Cl 3.3.3

Strength reduction factor (φ) = 0.95 Table 2.1
φNc(dl) = φ*0.57*k4*k6*k12cd*f*c*A = 13.1 kN
φNc = φ*k1*k4*k6*k12c*f*c*A = 20.0 kN
φNcw = φ*(k1=1)*k4*k6*k12cw*f*c*A = 28.3 kN

f'c = 42.0 MPa
f't = 22.0 MPa
Material constant (pcd) = 1.21 (rcd=0.25)
Material constant (pc) = 1.16 (rc=0.43)
Material constant (pcw) = 1.09 (rcw=1.00)
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Size modifier (mod.c) = 1.00

Bending Capacity - Cl 3.2

S1i = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 6.18 for tension edge restrained - Cl 3.2.3.2
S1o = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 6.18 for tension edge restrained - Cl 3.2.3.2

k12di = 1.000 for pbd*S1i ≤ 10 - Cl 3.2.4
k12i = 1.000 for pb*S1i ≤ 10 - Cl 3.2.4
k12wi = 1.000 for pbi*S1i ≤ 10 - Cl 3.2.4
k12do = 1.000 for pbd*S1o ≤ 10 - Cl 3.2.4
k12o = 1.000 for pb*S1o ≤ 10 - Cl 3.2.4
k12wo = 1.000 for pbo*S1o ≤ 10 - Cl 3.2.4

Strength reduction factor (φ) = 0.95 Table 2.1
φM(dl) = φ*(k1=0.57)*k4*k6*k9*min(k12di,k12do)*f'b*Zx = 1.64 kNm
φM = φ*k1*k4*k6*k9*min(k12i,k12o)*f'b*Zx = 2.31 kNm
φMwi = φ*(k1=1)*k4*k6*k9*k12wi*f'b*Zx = 2.89 kNm
φMwo = φ*(k1=1)*k4*k6*k9*k12wo*f'b*Zx = 2.89 kNm

f'b = 50.0 MPa
Material constant (pbd) = 1.10 (rbd=0.25)
Material constant (pb) = 1.01 (rb=1.00)
Material constant (pbi) = 1.01 (rbi=1.00)
Stress reversal (pbo) = 1.01 (rbo=1.00)
Duration factor (k1) = 0.80
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Sharing factor (k9) = 1.00
Size modifier (mod.b) = 1.00

Combined - Cl 3.5.1 & Appendix E5

Comp/Bend	Nc(dl)*	Nc*	Ncw*
Minor buckling	0.50	0.48	0.32
Major buckling	0.62	0.60	0.50

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Member:	(Upper level wall studs 3.3m high) 90mm x 45mm Smart LVL13 (Varies)	
Comp:	$N_c(dl)^* = 2.20kN < \phi N_c(dl) = 11.59kN$, $N_c^* = 3.49kN < \phi N_c = 20.77kN$	OK (0.19,0.17)
	$N_{cw}^* = 1.96kN < \phi N_{cw} = 24.96kN$	OK (0.08)
Bending:	$M(dl)^* = 0.10kNm < \phi M(dl) = 1.64kNm$, $M^* = 0.16kNm < \phi M = 2.71kNm$	OK (0.06,0.06)
	$M_{wi}^* = 0.49kNm < \phi M_{wi} = 2.89kNm$, $M_{w.out}^* = 0.55kNm < \phi M_{wo} = 2.89kNm$	OK (0.17,0.19)
Combined:	Refer table below	OK (0.28)
Deflection:	$\delta_{in} = L/313$ (11mm), $\delta_{out} = L/337$ (10mm)	OK
Reactions:	(Each end) $R_{.in}^* = 0.6kN$, (Each end) $R_{.out}^* = 0.6kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category = 1 (1) House, (2) Primary building elements, (3) Important

Length (L) = 3300 mm
Centres (cts) = 600 mm

Strong axis eff. length (Lax) = 3300 mm Edge restrained = B (O)uter,(I)inner,(B)oth
Weak axis eff. length (Lay) = 1350 mm, (C)ontinuous Bending (Layb) = 3300 mm
Effective length factor (g13) = 0.9 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2

Loadings Wind area reduction not applied

Compression

Dead load (Ndl) = 1.63 kN Eccentricity (ecc) = 45 mm (+ve increases out)
Live load (Nll) = 1.02 kN D/2 = 45 mm
Wind load (Nwl*) = kN (Comp.)

Live load duration = Roof
Duration (k1) = 0.94 Table 2.3
Long term LL factor (Ψ_{lp}) = 0.00 AS/NZS 1170.0 Table 4.1
Combination factor (Ψ_{cp}) = 0.00 AS/NZS 1170.0 Table 4.1

$\phi . 9K_a * \phi . 7C_{pe}$
 $\phi . 9K_a * \phi . 65C_{pe}$

Bending

Wall area = 2.0 m² Apply wind reduction = N (N)one,(S)ide,(W)ind,(L)ee
 $W_s/W_u = 0.68$ Area reduction (k_a) = 1.00 AS/NZS 1170.2 Table 5.4

Ult. wind load in ($W_{u.in}$) = 0.96 kPa
cpe = 0.63 cpi = 0 $w_{.in}^* = 0.36$ kN/m

Ult. wind load out ($W_{u.out}$) = 0.96 kPa
cpe = 0.585 cpi = 0 $w_{.out}^* = 0.34$ kN/m

$N_{dl}^* = 1.35 * N_{dl} = 2.20$ kN $M_{(dl)}^* = 0.10$ kNm
 $N_c^* = 1.2 * N_{dl} + 1.5 * N_{ll} = 3.49$ kN $M^* = 0.16$ kNm
 $N_{cw}^* = 1.2 * N_{dl} + N_{wl}^* + 1.5 * \Psi_{cp} * N_{ll} = 1.96$ kN $M_{wi}^* = 0.00$ kNm
 $M_{wo}^* = 0.09$ kNm

Horz. Point loads

Wind load ($p_{wl.in}^*$) = kN Position = 1650 mm from bottom
Wind load ($p_{wl.out}^*$) = kN

$w_{.in}^* = 0.36$ kN/m $w_{.out}^* = 0.34$ kN/m $R_{.in}^* = 0.6$ kN
 $p_{.in}^* = 0.00$ kN $p_{.out}^* = 0.00$ kN $R_{.out}^* = 0.6$ kN
 $M_{w.in}^* = 0.49$ kNm $M_{w.out}^* = 0.55$ kNm

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Axial Capacity - Cl 3.3

Member = 90mm x 45mm Smart LVL13
Description = LVL13 seasoned softwood
Design depth (dD) = 90 mm
Design width (dW) = 45 mm

Area (A) = 4050 mm²
Section modulus (Zx) = 60.8 x10³ mm³
Section modulus (Zy) = 30.4 x10³ mm³
Stiffness (Ix) = 2.73 x10⁶ mm⁴
Stiffness (Iy) = 0.68 x10⁶ mm⁴
Modulus of elasticity (E) = 13200 MPa - Cl 8.3

S3x = min(g13*L/dD & Lax/dD) = 33.00
S4y = min(g13*L/dW & Lay/dW) = 30.00
Critical S = 33.00

k12cx = 0.137 for pc*S3x ≥ 20 - Cl 3.3.3
k12cy = 0.165 for pc*S4y ≥ 20 - Cl 3.3.3
k12c = 0.137 for pc*S ≥ 20 - Cl 3.3.3
k12cd = 0.126 for pcd*S ≥ 20 - Cl 3.3.3
k12cw = 0.154 for pcw*S ≥ 20 - Cl 3.3.3

Strength reduction factor (φ) = 0.95 Table 2.1
φNc(dl) = φ*0.57*k4*k6*k12cd*f*c*A = 11.6 kN
φNc = φ*k1*k4*k6*k12c*f*c*A = 20.8 kN
φNcw = φ*(k1=1)*k4*k6*k12cw*f*c*A = 25.0 kN

f'c = 42.0 MPa
f't = 22.0 MPa
Material constant (pcd) = 1.21 (rcd=0.25)
Material constant (pc) = 1.16 (rc=0.44)
Material constant (pcw) = 1.09 (rcw=1.00)
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Size modifier (mod.c) = 1.00

Bending Capacity - Cl 3.2

S1i = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 6.27 for tension edge restrained - Cl 3.2.3.2
S1o = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 6.27 for tension edge restrained - Cl 3.2.3.2

k12di = 1.000 for pbd*S1i ≤ 10 - Cl 3.2.4
k12i = 1.000 for pb*S1i ≤ 10 - Cl 3.2.4
k12wi = 1.000 for pbi*S1i ≤ 10 - Cl 3.2.4
k12do = 1.000 for pbd*S1o ≤ 10 - Cl 3.2.4
k12o = 1.000 for pb*S1o ≤ 10 - Cl 3.2.4
k12wo = 1.000 for pbo*S1o ≤ 10 - Cl 3.2.4

Strength reduction factor (φ) = 0.95 Table 2.1
φM(dl) = φ*(k1=0.57)*k4*k6*k9*min(k12di,k12do)*f'b*Zx = 1.64 kNm
φM = φ*k1*k4*k6*k9*min(k12i,k12o)*f'b*Zx = 2.71 kNm
φMwi = φ*(k1=1)*k4*k6*k9*k12wi*f'b*Zx = 2.89 kNm
φMwo = φ*(k1=1)*k4*k6*k9*k12wo*f'b*Zx = 2.89 kNm

f'b = 50.0 MPa
Material constant (pbd) = 1.10 (rbd=0.25)
Material constant (pb) = 1.01 (rb=1.00)
Material constant (pbi) = 1.01 (rbi=1.00)
Stress reversal (pbo) = 1.01 (rbo=1.00)
Duration factor (k1) = 0.94
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Sharing factor (k9) = 1.00
Size modifier (mod.b) = 1.00

Combined - Cl 3.5.1 & Appendix E5

Comp/Bend	Nc(dl)*	Nc*	Ncw*
Minor buckling	0.15	0.14	0.11
Major buckling	0.24	0.23	0.28

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Member:	(Upper level wall studs 3.8m high) 90mm x 63mm Smart LVL13 (Varies)	
Comp:	$N_c(dl)^* = 2.20kN < \phi N_c(dl) = 12.23kN$, $N_c^* = 3.49kN < \phi N_c = 21.93kN$	OK (0.18,0.16)
	$N_{cw}^* = 1.96kN < \phi N_{cw} = 26.35kN$	OK (0.07)
Bending:	$M(dl)^* = 0.10kNm < \phi M(dl) = 2.30kNm$, $M^* = 0.16kN < \phi M = 3.80kNm$	OK (0.04,0.04)
	$M_{wi}^* = 0.65kNm < \phi M_{wi} = 4.04kNm$, $M_{w.out}^* = 0.70kN < \phi M_{wo} = 4.04kNm$	OK (0.16,0.17)
Combined:	Refer table below	OK (0.26)
Deflection:	$\delta_{in} = L/287$ (13mm), $\delta_{out} = L/309$ (12mm)	OK
Reactions:	(Each end) $R_{.in}^* = 0.7kN$, (Each end) $R_{.out}^* = 0.6kN$	

Geometry (House member affecting $\leq 25m^2$ or secondary building member)

Category = 1 (1) House, (2) Primary building elements, (3) Important

Length (L) = 3800 mm
Centres (cts) = 600 mm

Strong axis eff. length (Lax) = 3800 mm Edge restrained = B (O)uter,(I)inner,(B)oth
Weak axis eff. length (Lay) = 1350 mm, (C)ontinuous Bending (Layb) = 3800 mm
Effective length factor (g13) = 0.9 Studs in framing=0.9, Restrained both ends in pos.=1.0, Other cases - Table 3.2

Loadings Wind area reduction not applied

Compression

Dead load (Ndl) = 1.63 kN Eccentricity (ecc) = 45 mm (+ve increases out)
Live load (Nll) = 1.02 kN D/2 = 45 mm
Wind load (Nwl*) = kN (Comp.)

Live load duration = Roof
Duration (k1) = 0.94 Table 2.3
Long term LL factor (Ψ_{lp}) = 0.00 AS/NZS 1170.0 Table 4.1
Combination factor (Ψ_{cp}) = 0.00 AS/NZS 1170.0 Table 4.1

$0.9k_a * 0.7C_{pe}$
 $0.9k_a * 0.65C_{pe}$

Bending

Wall area = 2.3 m² Apply wind reduction = N (N)one,(S)ide,(W)ind,(L)ee
 $W_s/W_u = 0.68$ Area reduction (k_a) = 1.00 AS/NZS 1170.2 Table 5.4

Ult. wind load in ($W_{u.in}$) = 0.96 kPa
cpe = 0.63 cpi = 0 $w_{.in}^* = 0.36$ kN/m

Ult. wind load out ($W_{u.out}$) = 0.96 kPa
cpe = 0.585 cpi = 0 $w_{.out}^* = 0.34$ kN/m

$N_{dl}^* = 1.35 * N_{dl} = 2.20$ kN $M(dl)^* = 0.10$ kNm
 $N_c^* = 1.2 * N_{dl} + 1.5 * N_{ll} = 3.49$ kN $M^* = 0.16$ kNm
 $N_{cw}^* = 1.2 * N_{dl} + N_{wl}^* + 1.5 * \Psi_{cp} * N_{ll} = 1.96$ kN $M_{wi}^* = 0.00$ kNm
 $M_{wo}^* = 0.09$ kNm

Horz. Point loads

Wind load (pwl.in*) = kN Position = 1900 mm from bottom
Wind load (pwl.out*) = kN

$w_{.in}^* = 0.36$ kN/m $w_{.out}^* = 0.34$ kN/m $R_{.in}^* = 0.7$ kN
 $p_{.in}^* = 0.00$ kN $p_{.out}^* = 0.00$ kN $R_{.out}^* = 0.6$ kN
 $M_{w.in}^* = 0.65$ kNm $M_{w.out}^* = 0.70$ kNm

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Proposed Residential Development
418 Esplanade, Moana SA

Page:
Project No.: 24261
Designed: JS

Upper level wall studs 3.8m high

TIMBER MULLION V5.08

HWC Engineers

CITY OF ONKAPARINGA
Development Approval
Approval date 10.02.2026
Endorsed pursuant to the
PDI Act 2016 and Regulations

Axial Capacity - Cl 3.3

Member = 90mm x 63mm Smart LVL13
Description = LVL13 seasoned softwood
Design depth (dD) = 90 mm
Design width (dW) = 63 mm

Area (A) = 5670 mm²
Section modulus (Zx) = 85.1 x10³ mm³
Section modulus (Zy) = 59.5 x10³ mm³
Stiffness (Ix) = 3.83 x10⁶ mm⁴
Stiffness (Iy) = 1.88 x10⁶ mm⁴
Modulus of elasticity (E) = 13200 MPa - Cl 8.3

S3x = min(g13*L/dD & Lax/dD) = 38.00
S4y = min(g13*L/dW & Lay/dW) = 21.43
Critical S = 38.00

k12cx = 0.103 for pc*S3x ≥ 20 - Cl 3.3.3
k12cy = 0.324 for pc*S4y ≥ 20 - Cl 3.3.3
k12c = 0.103 for pc*S ≥ 20 - Cl 3.3.3
k12cd = 0.095 for pcd*S ≥ 20 - Cl 3.3.3
k12cw = 0.116 for pcw*S ≥ 20 - Cl 3.3.3

Strength reduction factor (φ) = 0.95 Table 2.1
φNc(dl) = φ*0.57*k4*k6*k12cd*f*c*A = 12.2 kN
φNc = φ*k1*k4*k6*k12c*f*c*A = 21.9 kN
φNcw = φ*(k1=1)*k4*k6*k12cw*f*c*A = 26.4 kN

f'c = 42.0 MPa
f't = 22.0 MPa
Material constant (pcd) = 1.21 (rcd=0.25)
Material constant (pc) = 1.16 (rc=0.44)
Material constant (pcw) = 1.09 (rcw=1.00)
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Size modifier (mod.c) = 1.00

Bending Capacity - Cl 3.2

S1i = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 4.13 for tension edge restrained - Cl 3.2.3.2
S1o = (dD/dW)^{1.35}*(Lay/dD)^{0.25} = 4.13 for tension edge restrained - Cl 3.2.3.2

k12di = 1.000 for pbd*S1i ≤ 10 - Cl 3.2.4
k12i = 1.000 for pb*S1i ≤ 10 - Cl 3.2.4
k12wi = 1.000 for pbi*S1i ≤ 10 - Cl 3.2.4
k12do = 1.000 for pbd*S1o ≤ 10 - Cl 3.2.4
k12o = 1.000 for pb*S1o ≤ 10 - Cl 3.2.4
k12wo = 1.000 for pbo*S1o ≤ 10 - Cl 3.2.4

Strength reduction factor (φ) = 0.95 Table 2.1
φM(dl) = φ*(k1=0.57)*k4*k6*k9*min(k12di,k12do)*f'b*Zx = 2.30 kNm
φM = φ*k1*k4*k6*k9*min(k12i,k12o)*f'b*Zx = 3.80 kNm
φMwi = φ*(k1=1)*k4*k6*k9*k12wi*f'b*Zx = 4.04 kNm
φMwo = φ*(k1=1)*k4*k6*k9*k12wo*f'b*Zx = 4.04 kNm

f'b = 50.0 MPa
Material constant (pbd) = 1.10 (rbd=0.25)
Material constant (pb) = 1.01 (rb=1.00)
Material constant (pbi) = 1.01 (rbi=1.00)
Stress reversal (pbo) = 1.01 (rbo=1.00)
Duration factor (k1) = 0.94
Moisture factor (k4) = 1.00
Temp. factor (k6) = 1.00
Sharing factor (k9) = 1.00
Size modifier (mod.b) = 1.00

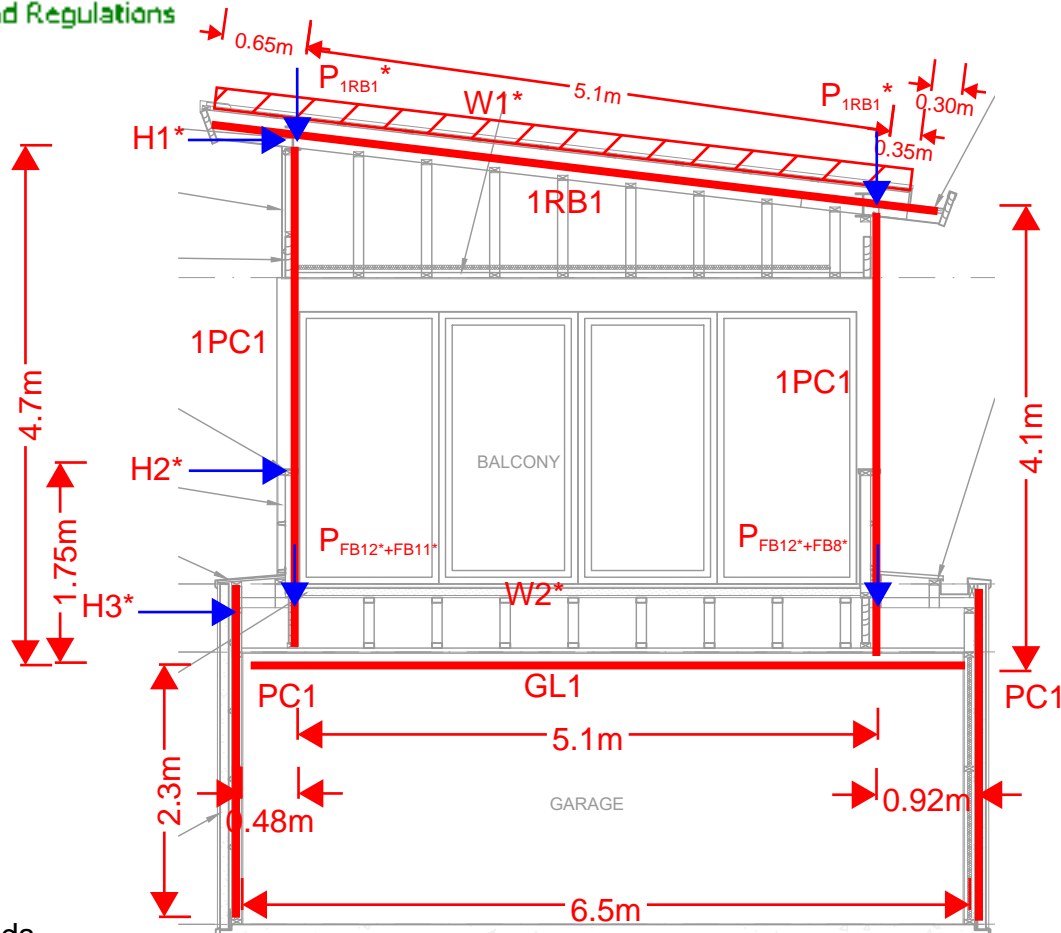
Combined - Cl 3.5.1 & Appendix E5

Comp/Bend	Nc(dl)*	Nc*	Ncw*
Minor buckling	0.05	0.05	0.06
Major buckling	0.21	0.20	0.26

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PORTAL FRAME 1RB1 + GL1 + 1PC1 + PC1



Loads

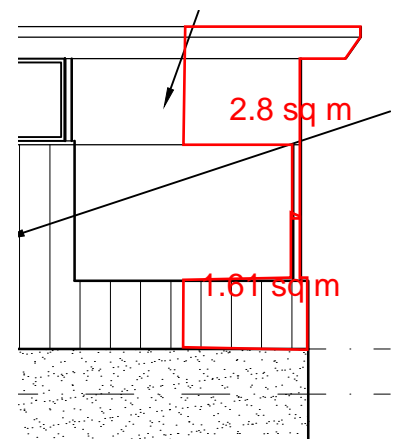
$W1*G = 0.4kPa*0.6m = 0.24kN/m$
 $W1*Q = 0.25kPa*0.6m = 0.15kN/m$
 $W1*wind = 2.2kPa*(0.9+0.2)cpe*0.6m = 1.45kN/m \text{ up}$

$W2*G = 1kPa*0.9m = 0.9kN/m$

$PFB12+FB11,G = 8.5 + 16.3 = 24.8kN$
 $PFB12+FB11,Q = 2.2 + 9.5 = 11.7kN$

$P1RB1,G = 4.8kN$
 $P1RB1,Q = 2.1kN$
 $P1RB1,Wu = 15kN \text{ up}$

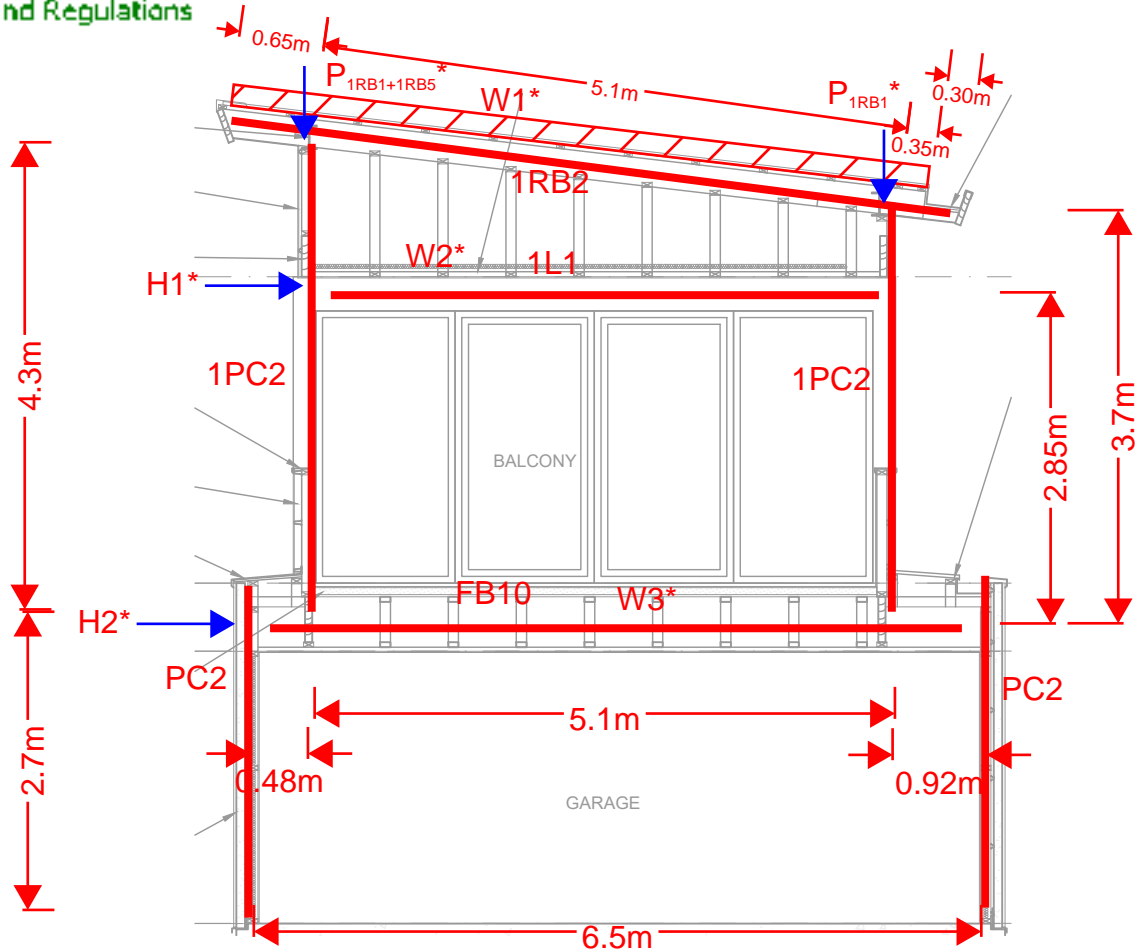
$N2 \text{ wind class, Table 5.1A AS4055, WIND PRESSURE} = 0.92kPa$
 $H1*ult = 0.92kPa*2.8sqm = 2.8kN$
 $H2*ult = 0.92kPa*1.7sqm = 1.6kN$
 $H3*ult = 0.92kPa*1.6m*(0.6+1.2)m = 2.65kN$



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PORTAL FRAME 1RB2 + 1L1 + 1PC2



Loads

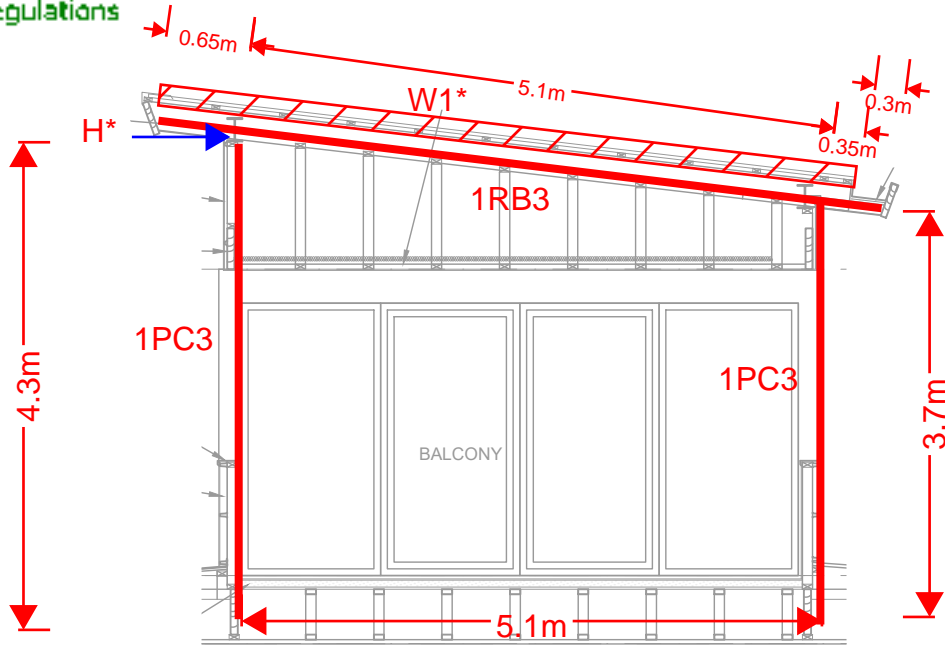
- $W1^*G = 0.4\text{kPa} \cdot 0.6\text{m} = 0.24\text{kN/m}$
- $W1^*Q = 0.25\text{kPa} \cdot 0.6\text{m} = 0.15\text{kN/m}$
- $W1^*\text{wind} = 2.2\text{kPa} \cdot (0.9+0.2)\text{cpe} \cdot 0.6\text{m} = 1.45\text{kN/m up}$
- $W2^*G = 1\text{kPa} \cdot 0.9\text{m} = 0.9\text{kN/m}$
- $W3^*G = 1\text{kPa} \cdot 2.4\text{m} = 2.4\text{kN/m}$
- $P1RB1,G = 4.8\text{kN}$
- $P1RB1,Q = 2.1\text{kN}$
- $P1RB1,Wu = 15\text{kN up}$
- $P1RB5,G = 3.2\text{kN}$
- $P1RB5,Q = 1.7\text{kN}$
- $P1RB5,Wu = 13.3\text{kN up}$

N2 wind class, Table 5.1A AS4055, WIND PRESSURE = 0.92kPa
 $H1^*\text{ult} = 0.92\text{kPa} \cdot (1.5+1.35)\text{m} \cdot 3.6\text{m} = 9.5\text{kN}$
 $H1^*\text{ser} = 0.68 \cdot 9.5\text{kN} = 6.5\text{kN}$
 $H2^*\text{ult} = 0.92\text{kPa} \cdot 3.6\text{m} \cdot 2.85\text{m} = 9.5\text{kN}$

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PORTAL FRAME 1RB3 + 1PC3



Loads

$W1 * G = 0.4kPa * 0.6m = 0.24kN/m$

$W1 * Q = 0.25kPa * 0.6m = 0.15kN/m$

$W1 * wind = 2.2kPa * (0.9 + 0.2) * 0.6m = 1.45kN/m \text{ up}$

N2 wind class, Table 5.1A AS4055, WIND PRESSURE = 0.92kPa

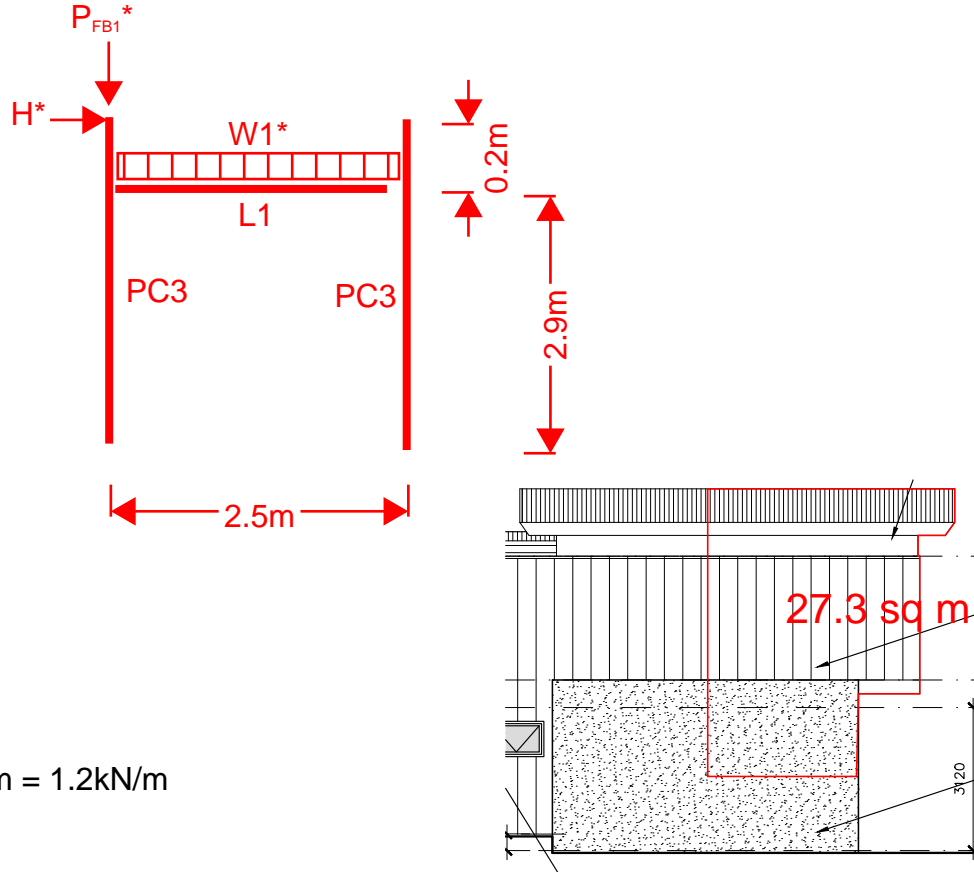
$H^*_{ult} = 0.92kPa * (1.5 + 1.35)m * 3.6m = 9.4kN$

$H^*_{ser} = 0.68 * 9.4kN = 6.4kN$

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PORTAL FRAME L1 + PC3



Loads

$W1 * G = 1 \text{ kPa} * 1.2 \text{ m} = 1.2 \text{ kN/m}$

$PFB1, G^* = 4.2 \text{ kN}$

$PFB1, Q^* = 1.8 \text{ kN}$

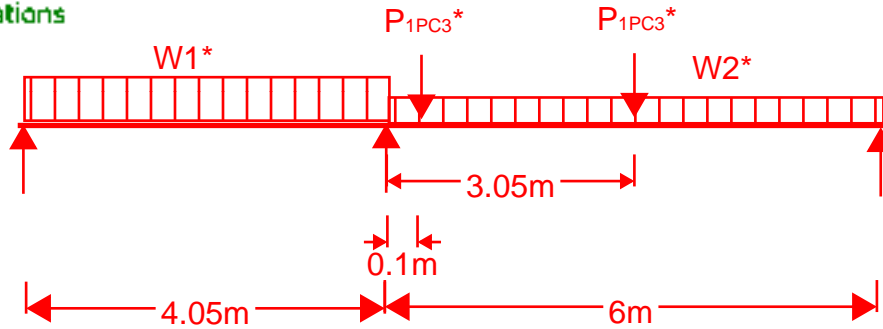
N2 wind class, Table 5.1A AS4055, WIND PRESSURE = 0.92kPa

$H^*_{ult} = 0.92 \text{ kPa} * 27.3 \text{ sqm} - 0.9 * 6 \text{ kN/m} * (1.5 + 1.6) \text{ m} = 8.5 \text{ kN}$

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FLOOR BEAM FB8+FB13



Loads

$$W1^*G = 1\text{kPa} \cdot 2.5\text{m} + 1\text{kPa} \cdot 3.2\text{m} + 0.4\text{kPa} \cdot 3.5\text{m} = 7.1\text{kN/m}$$

$$W1^*Q = 1.5\text{kPa} \cdot 2.5\text{m} + 0.25\text{kPa} \cdot 3.5\text{m} = 4.63\text{kN/m}$$

$$W2^*G = 1\text{kPa} \cdot 2.5\text{m} + 0.4\text{kPa} \cdot 3.5\text{m} = 3.9\text{kN/m}$$

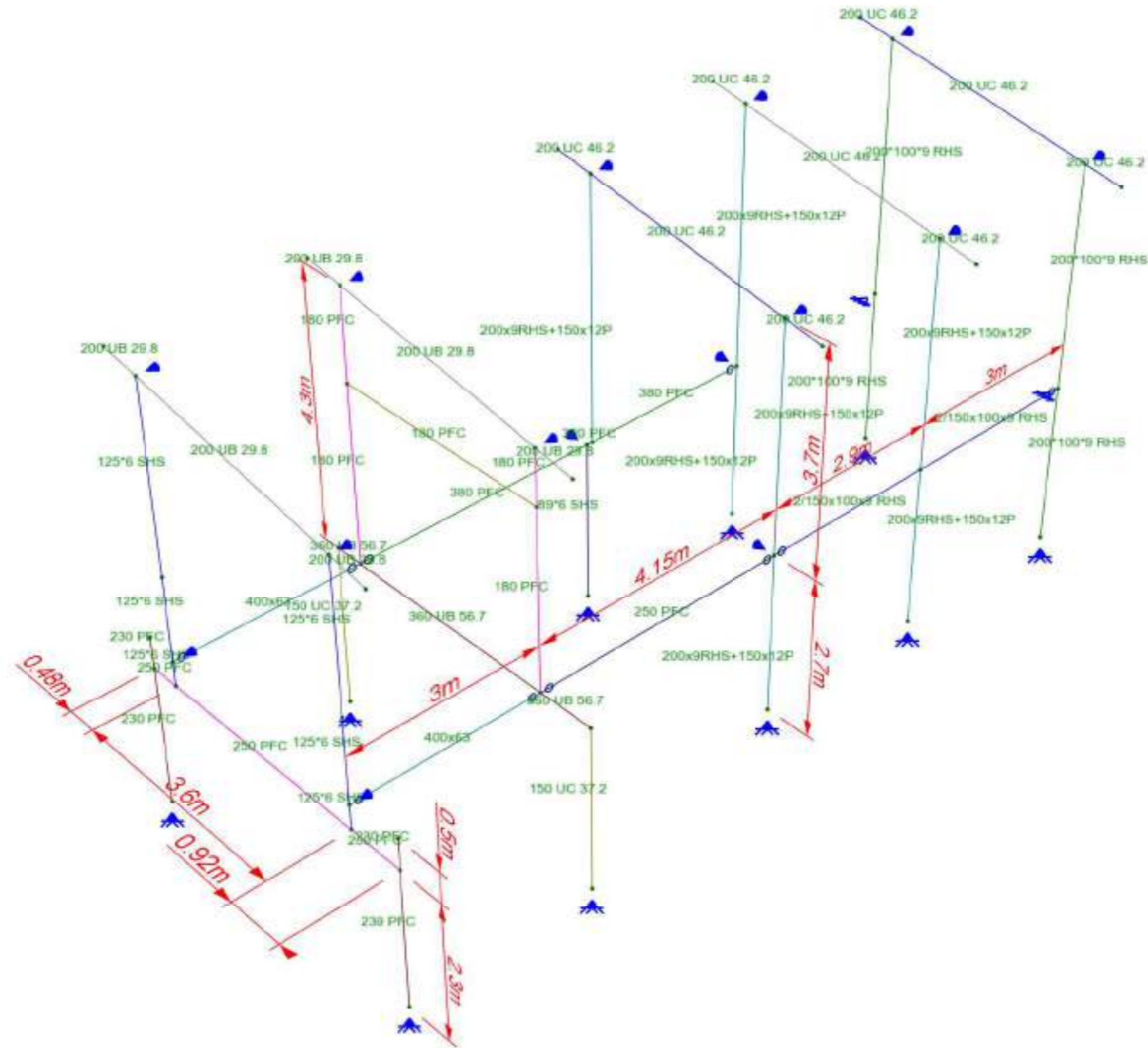
$$W2^*Q = 0.25\text{kPa} \cdot 3.5\text{m} = 0.88\text{kN/m}$$

$$P_{ol}^* = 1.1\text{kN}$$

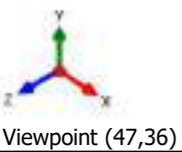
$$W^*_{ult} = 0.96\text{kPa} \cdot 0.8\text{Ka} \cdot 0.7\text{Cpe} \cdot 3.1\text{m} = 1.67\text{kN/m}$$

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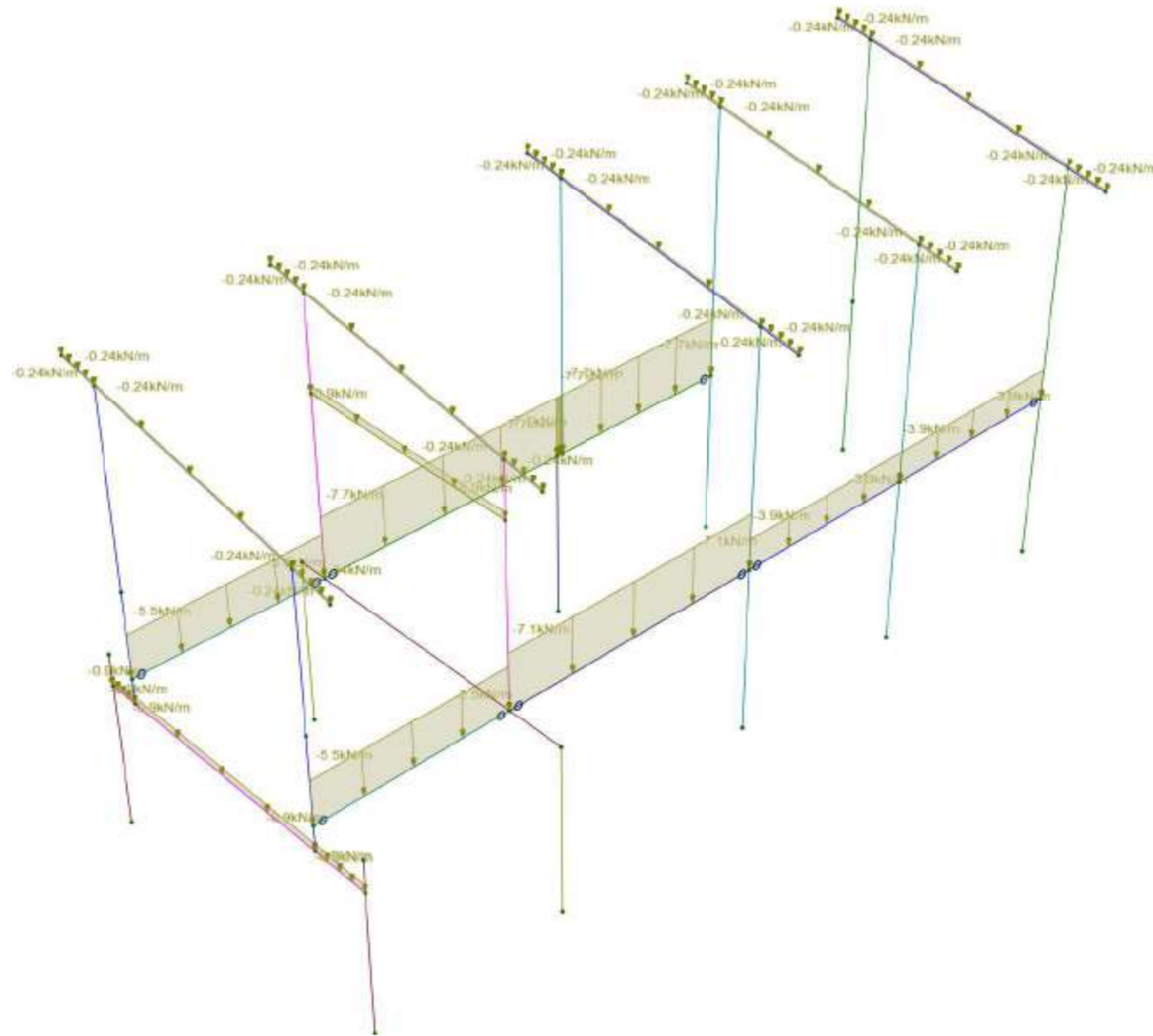


- Sections:
- 1 200 UB 29.8
 - 2 200 UC 46.2
 - 3 250 PFC
 - 4 360 UB 56.7
 - 5 180 PFC
 - 6 380 PFC
 - 7 250 PFC
 - 8 400x63
 - 10 200 UC 46.2
 - 11 2/150x100x9 RHS
 - 20 125*6 SHS
 - 21 180 PFC
 - 22 230 PFC
 - 23 150 UC 37.2
 - 24 200*100*9 RHS
 - 25 89*6 SHS
 - 26 200x9RHS+150x12PL
- Materials:
- 1 STEEL
 - 2 Smart LVL 13



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1 (SW) G



Viewpoint (47,36), Loads

Sections:

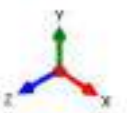
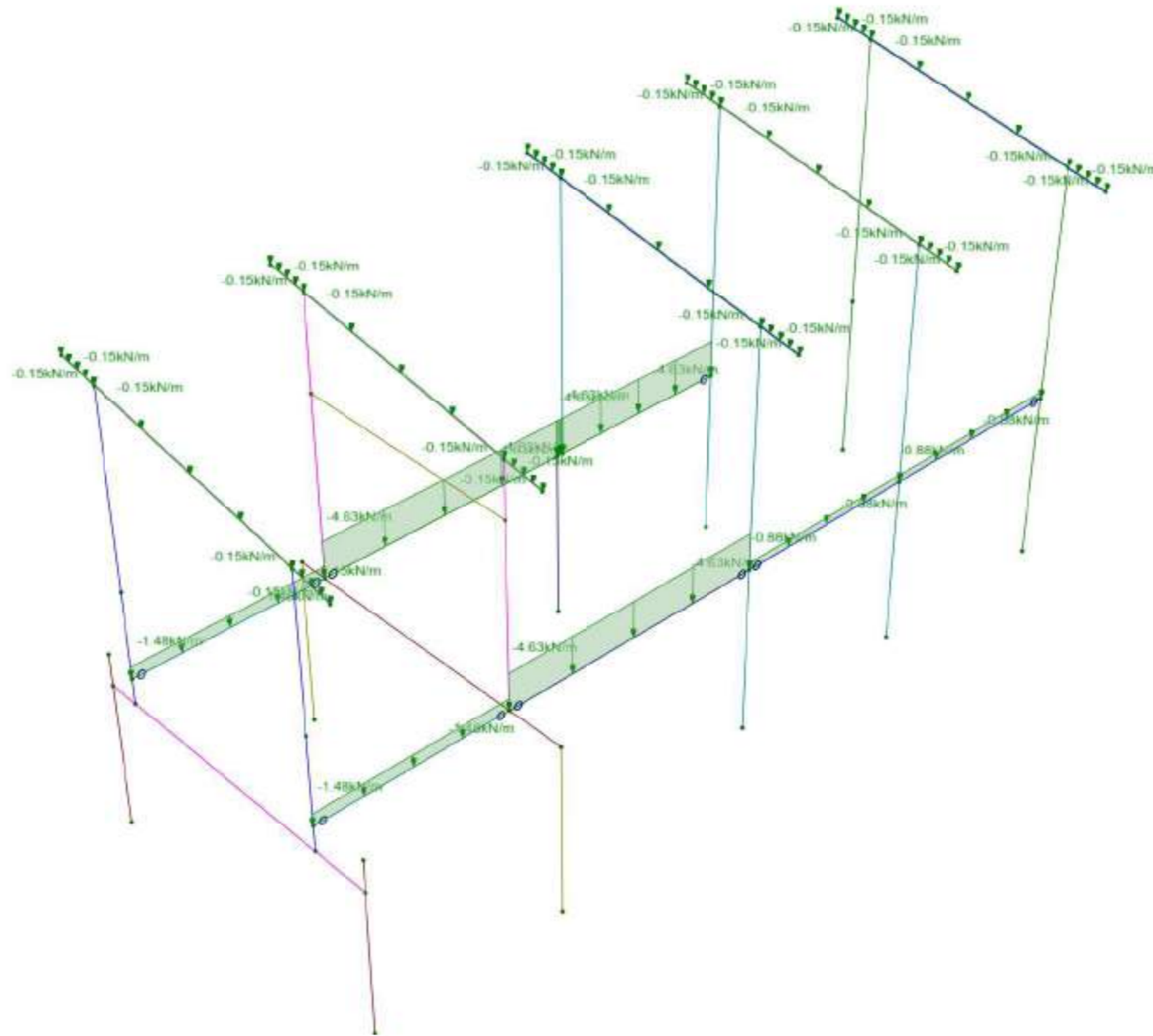
- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
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- 11 2/150x100x9 RHS
- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

- 1 STEEL
- 2 Smart LVL 13



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Viewpoint (47,36), Loads

Sections:

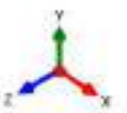
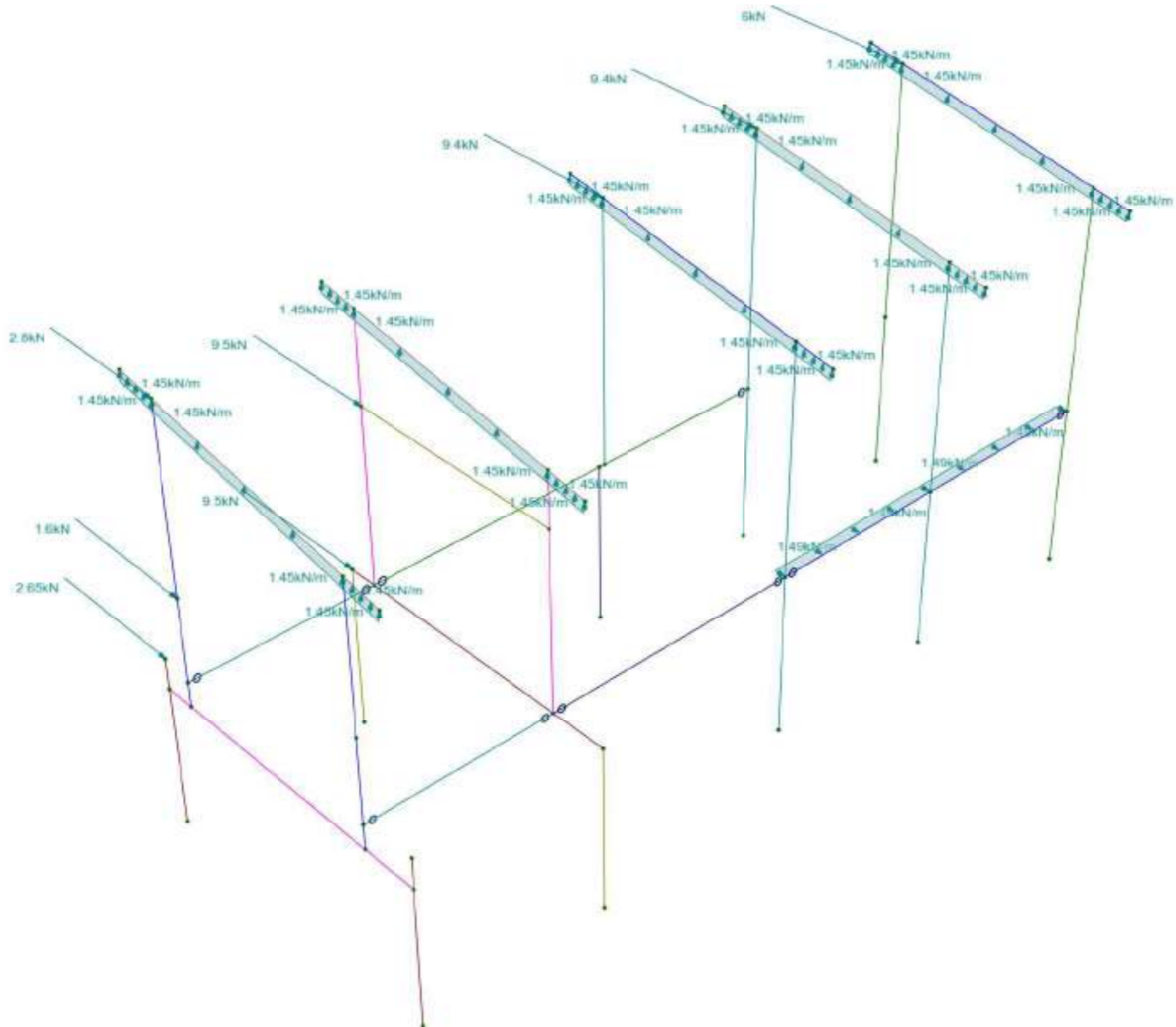
- 1 200 UB 29.8
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- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
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- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
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- 25 89*6 SHS
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Materials:

- 1 STEEL
- 2 Smart LVL 13

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3 WUI



Viewpoint (47,36), Loads

Sections:

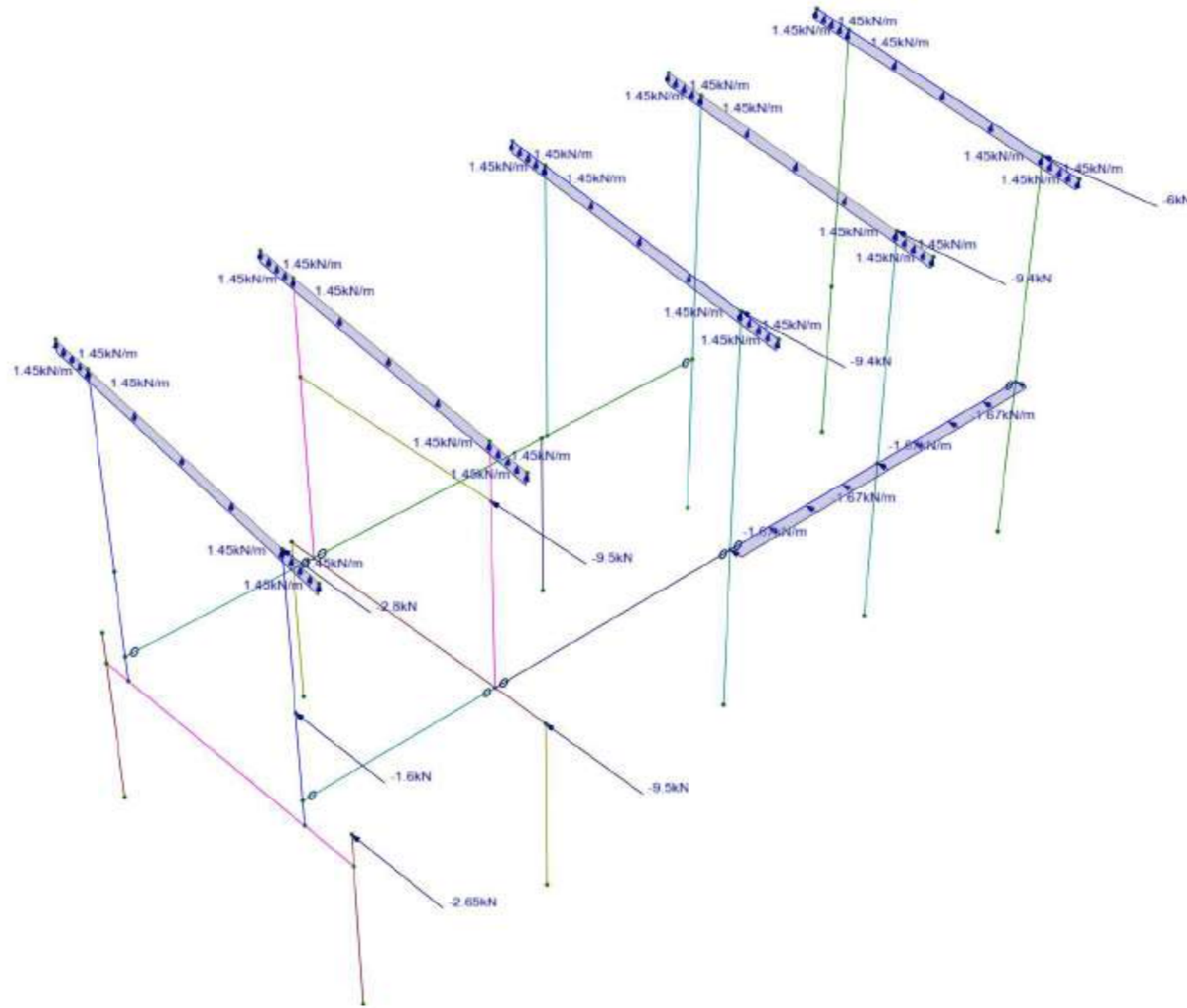
- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
- 11 2/150x100x9 RHS
- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

- 1 STEEL
- 2 Smart LVL 13

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4 WUZ



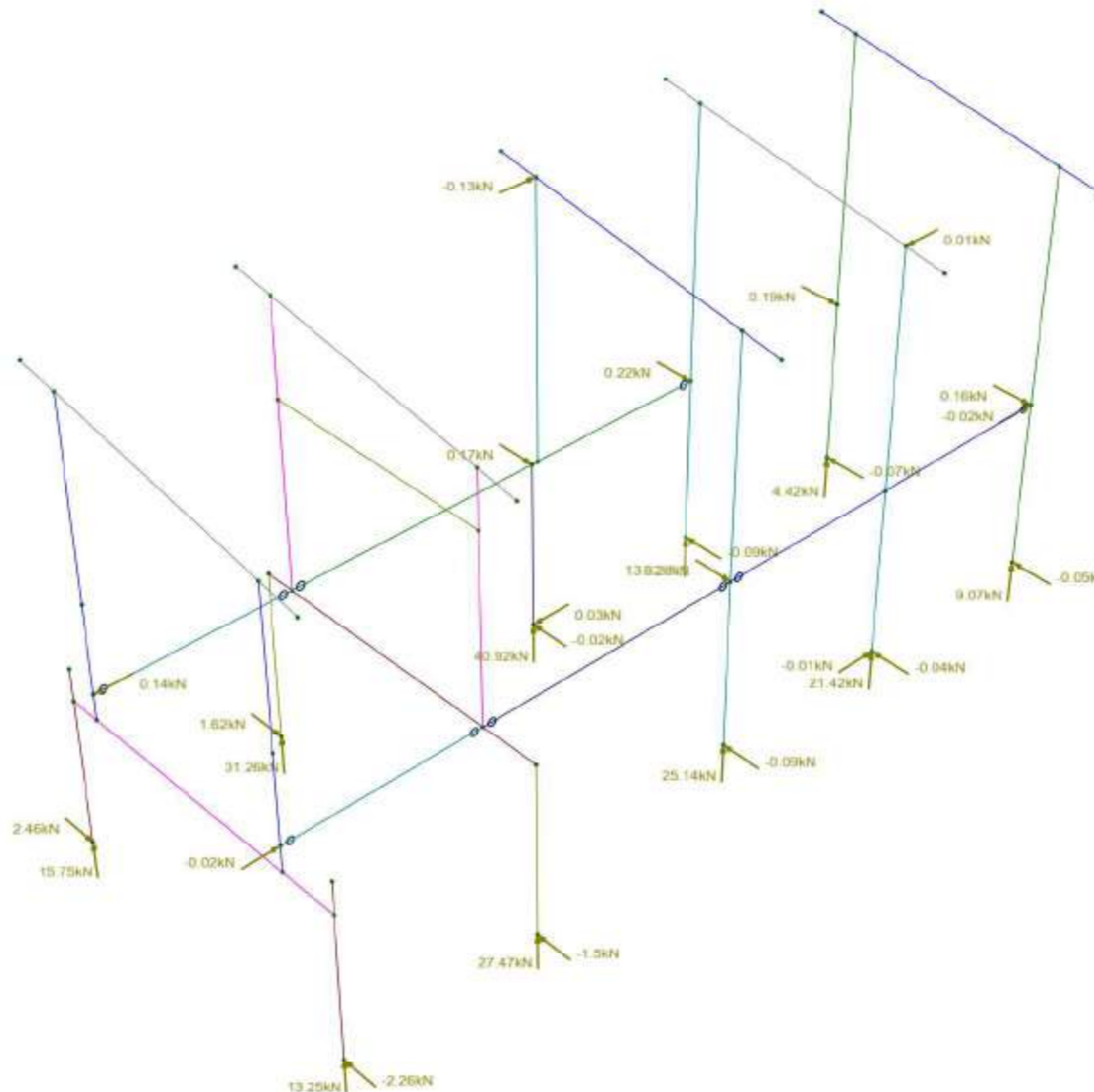
- Sections:
- 1 200 UB 29.8
 - 2 200 UC 46.2
 - 3 250 PFC
 - 4 360 UB 56.7
 - 5 180 PFC
 - 6 380 PFC
 - 7 250 PFC
 - 8 400x63
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 - 11 2/150x100x9 RHS
 - 20 125*6 SHS
 - 21 180 PFC
 - 22 230 PFC
 - 23 150 UC 37.2
 - 24 200*100*9 RHS
 - 25 89*6 SHS
 - 26 200x9RHS+150x12PL
- Materials:
- 1 STEEL
 - 2 Smart LVL 13



Viewpoint (47,36), Loads

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1 (SW) G



Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
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- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

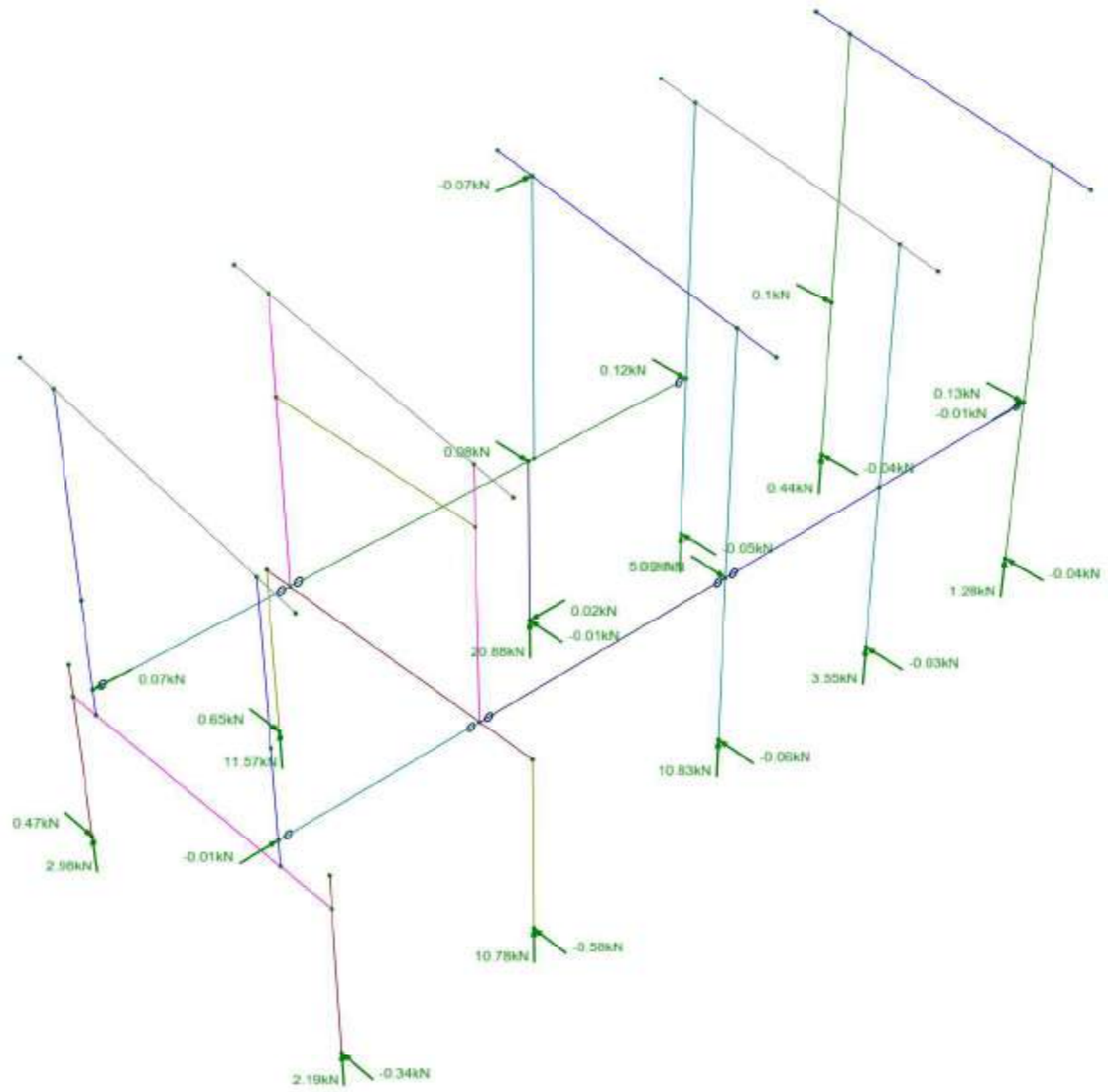
- 1 STEEL
- 2 Smart LVL 13



Viewpoint (47,36), Reactions

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2 Q

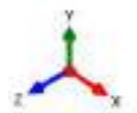


Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
- 11 2/150x100x9 RHS
- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

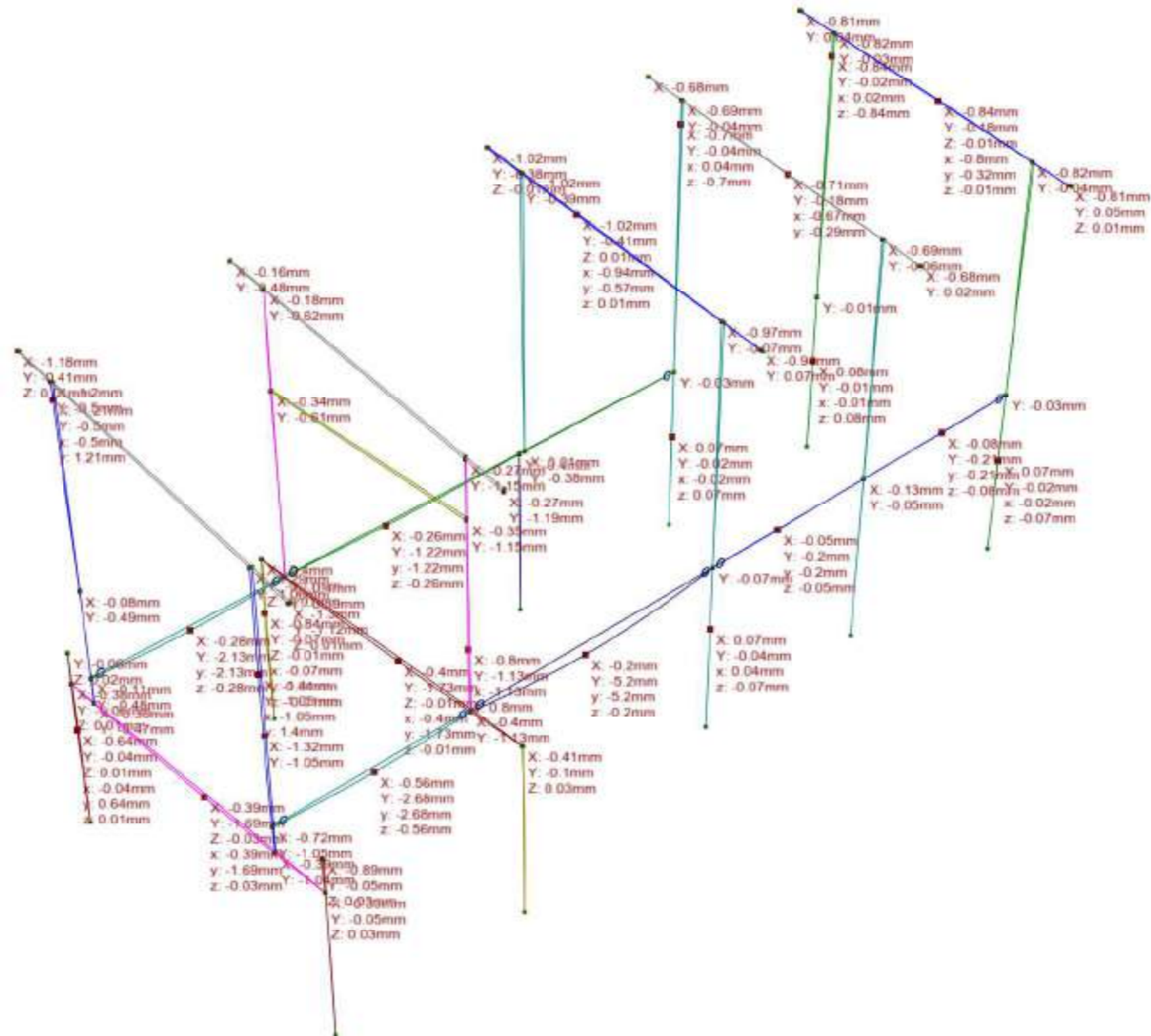
- 1 STEEL
- 2 Smart LVL 13



Viewpoint (47,36), Reactions

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10 (SW) G+0.7Q

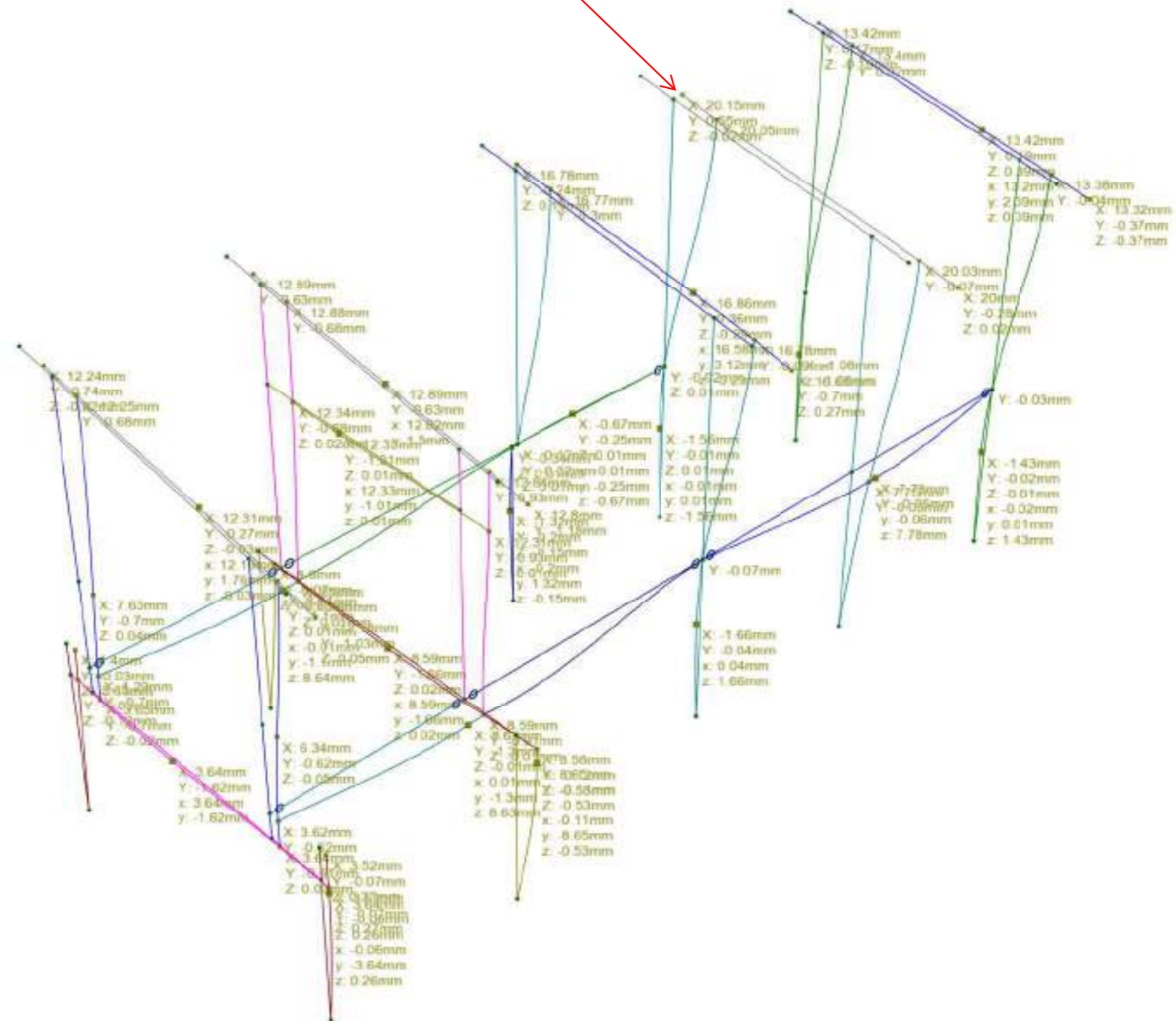


Viewpoint (47,36), Displacements

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11 (SW) G+0.7Q+Wsl

D/H = 1/213 < 1/200 OK

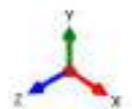


Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
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- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

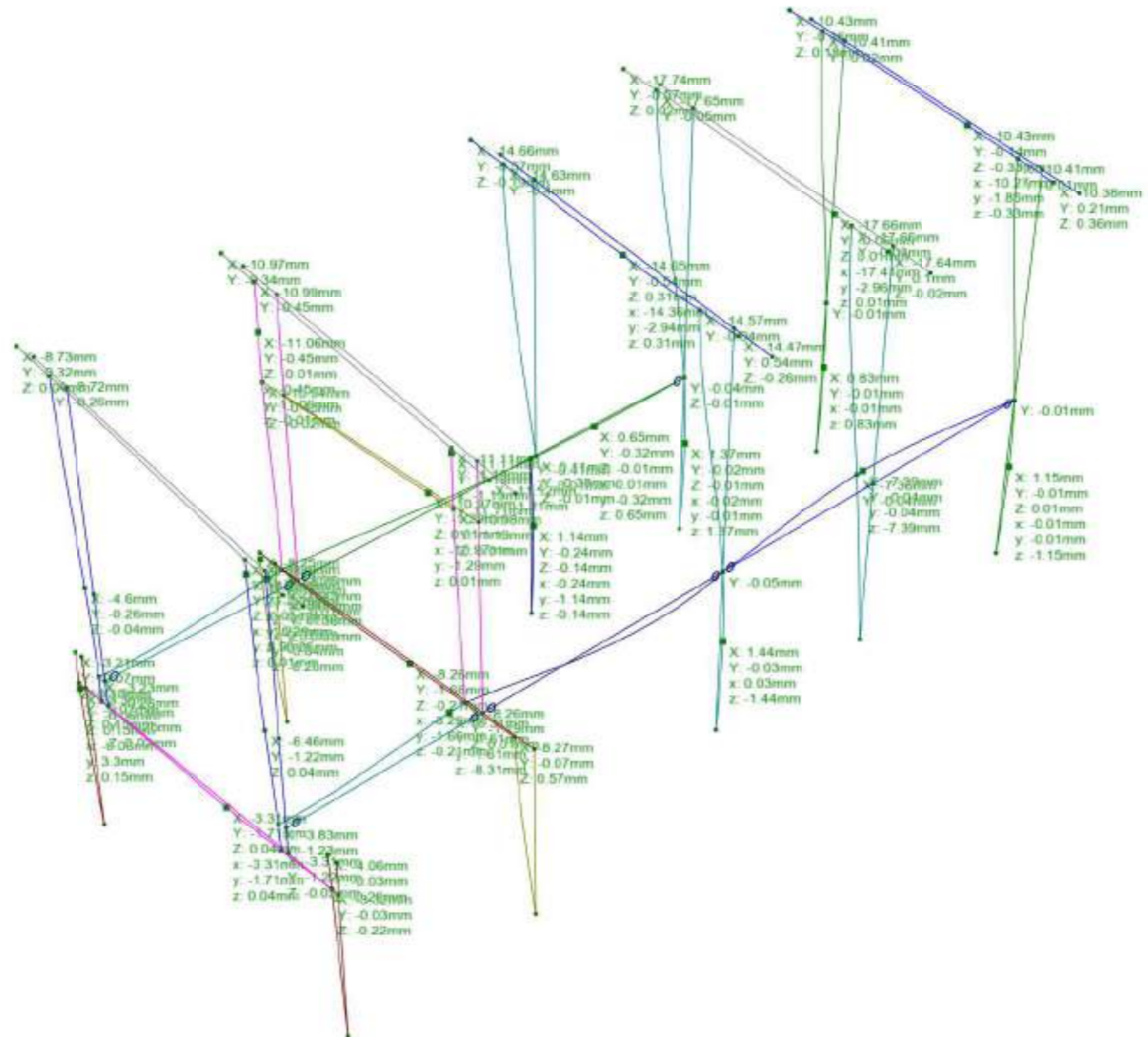
- 1 STEEL
- 2 Smart LVL 13



Viewpoint (47,36), Displacements

12 (SW) G+0.7Q+Ws2

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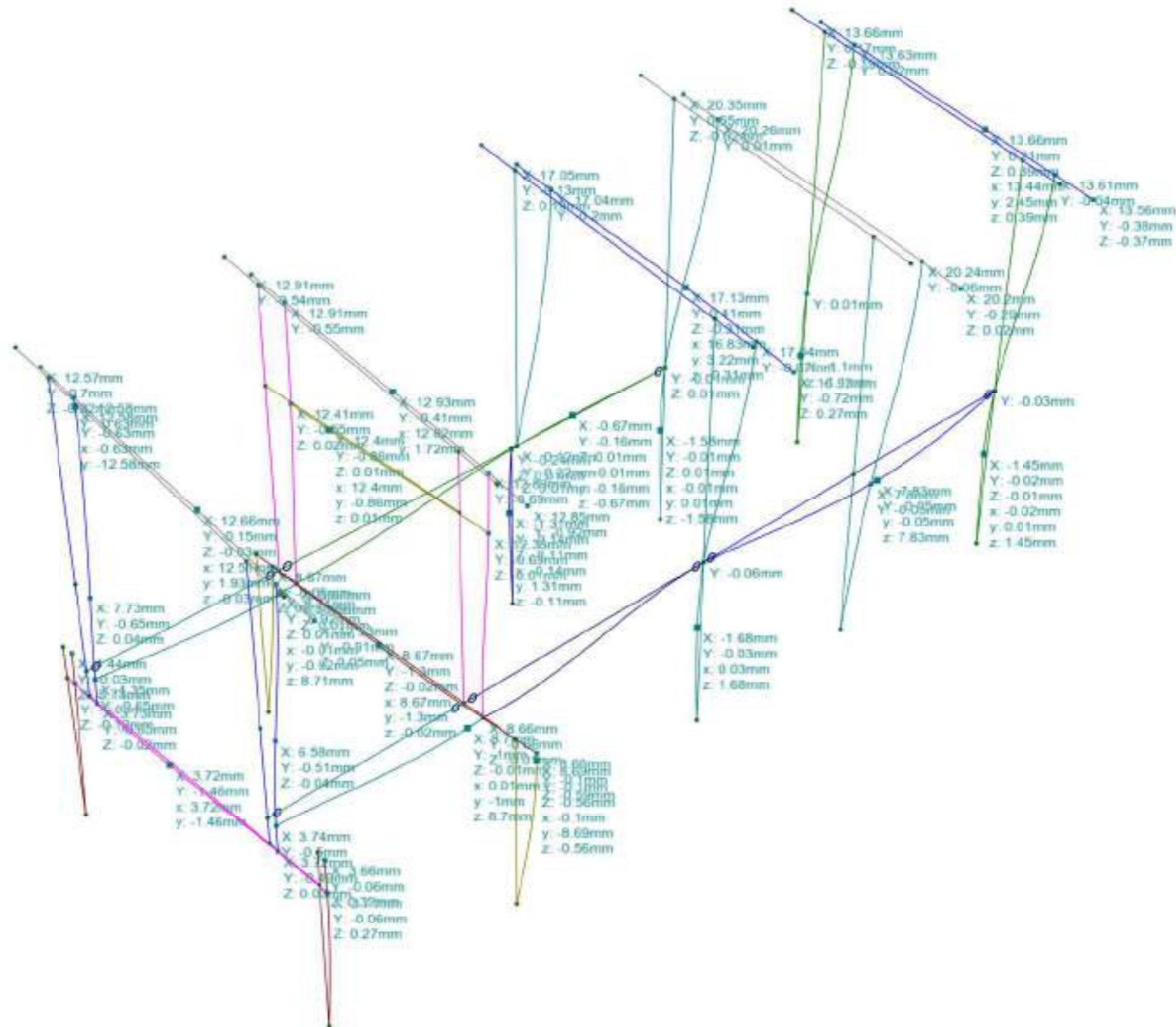


- Sections:
- 1 200 UB 29.8
 - 2 200 UC 46.2
 - 3 250 PFC
 - 4 360 UB 56.7
 - 5 180 PFC
 - 6 380 PFC
 - 7 250 PFC
 - 8 400x63
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 - 21 180 PFC
 - 22 230 PFC
 - 23 150 UC 37.2
 - 24 200*100*9 RHS
 - 25 89*6 SHS
 - 26 200x9RHS+150x12PL
- Materials:
- 1 STEEL
 - 2 Smart LVL 13

Viewpoint (47,36), Displacements

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13 (SW) G+WS1



Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
- 11 2/150x100x9 RHS
- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

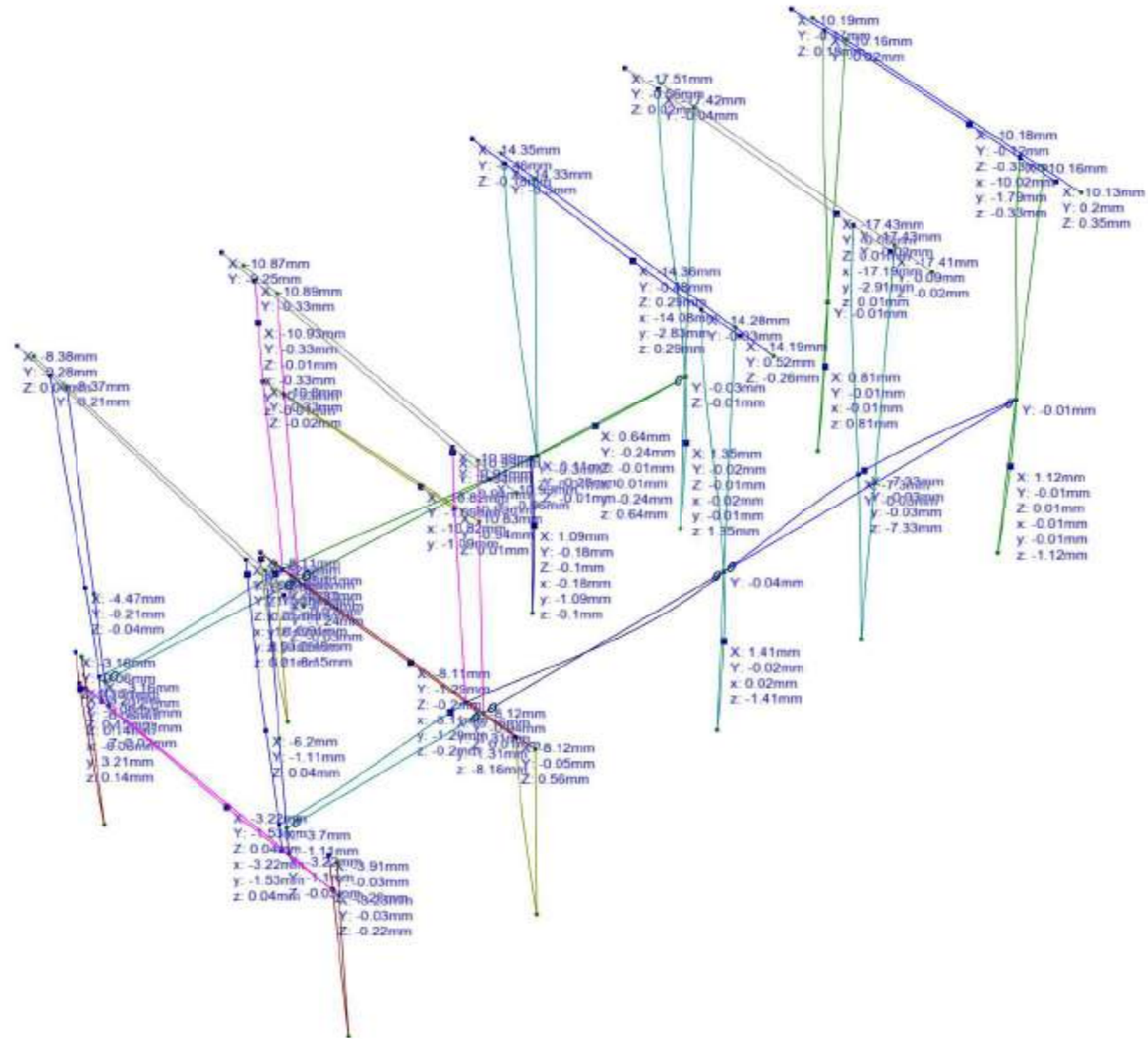
- 1 STEEL
- 2 Smart LVL 13



Viewpoint (47,36), Displacements

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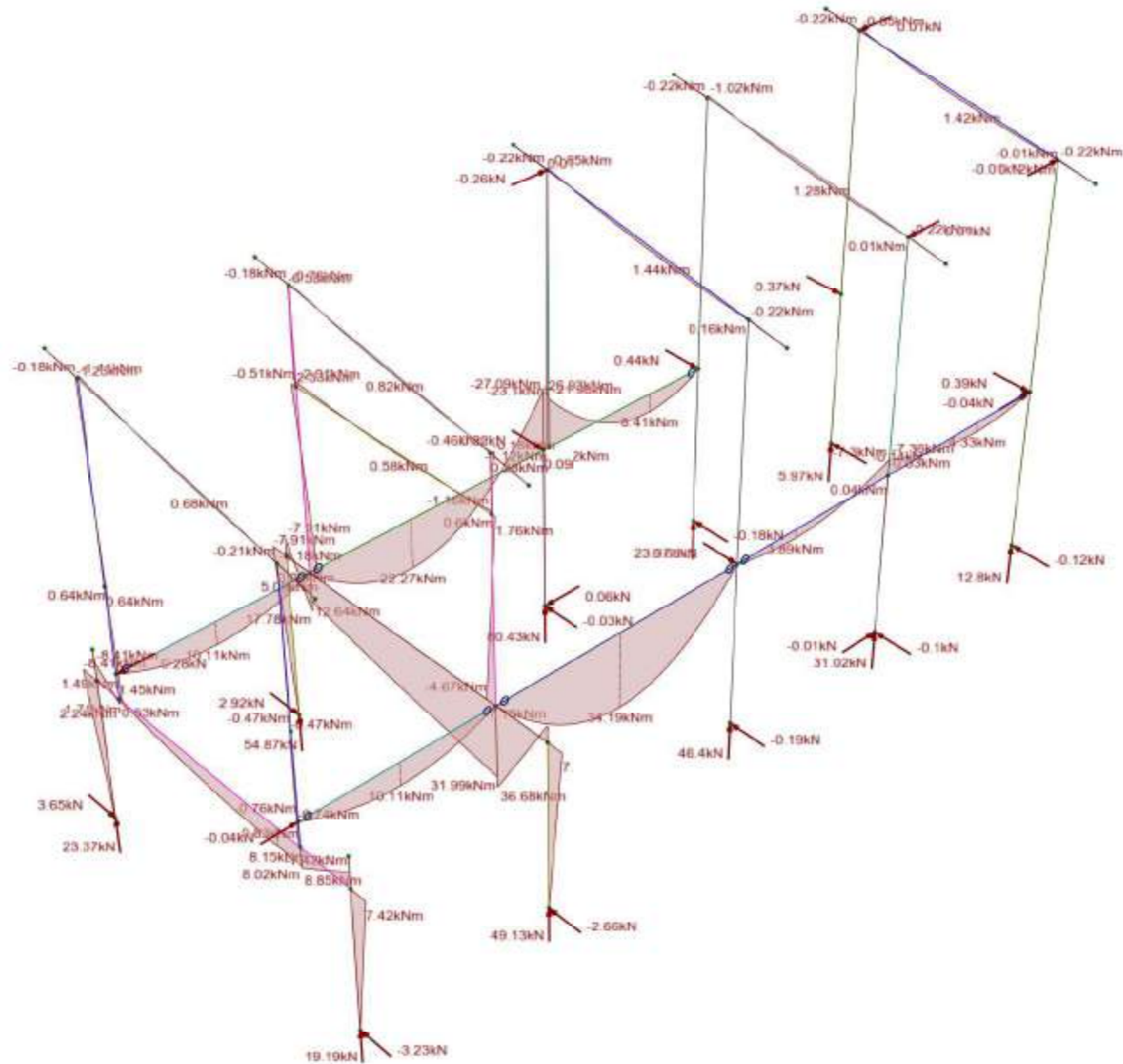
14 (SW) G+WS2



Viewpoint (47,36), Displacements

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20 (SW) 1.2G+1.5Q

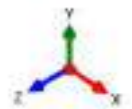


Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
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- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

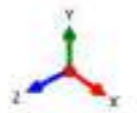
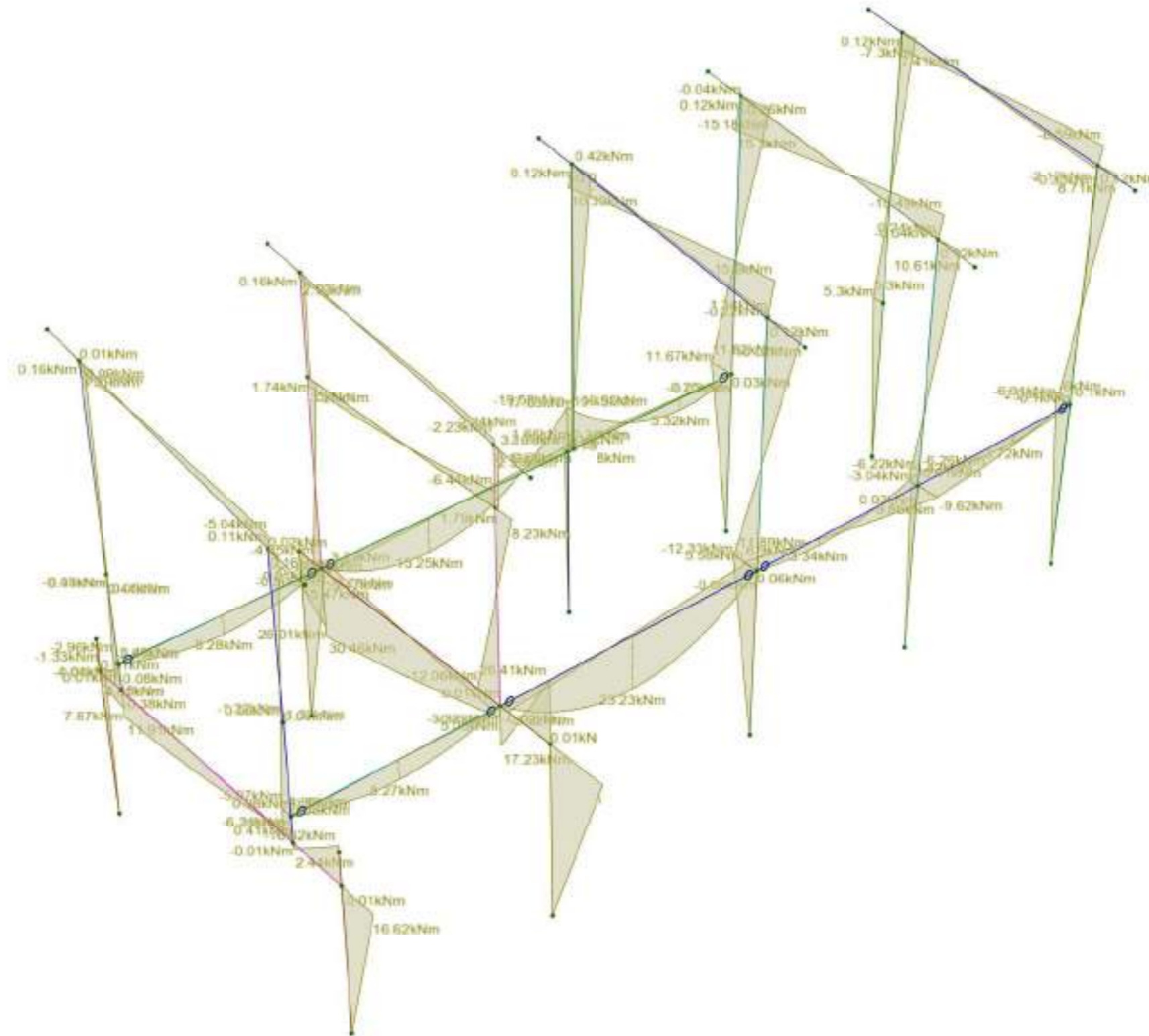
- 1 STEEL
- 2 Smart LVL 13



Viewpoint (47,36), Moments, Reactions

21 (SW) 1.2G+0.4Q+Wu1

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Viewpoint (50,35), Moments

Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
- 11 2/150x100x9 RHS
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- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

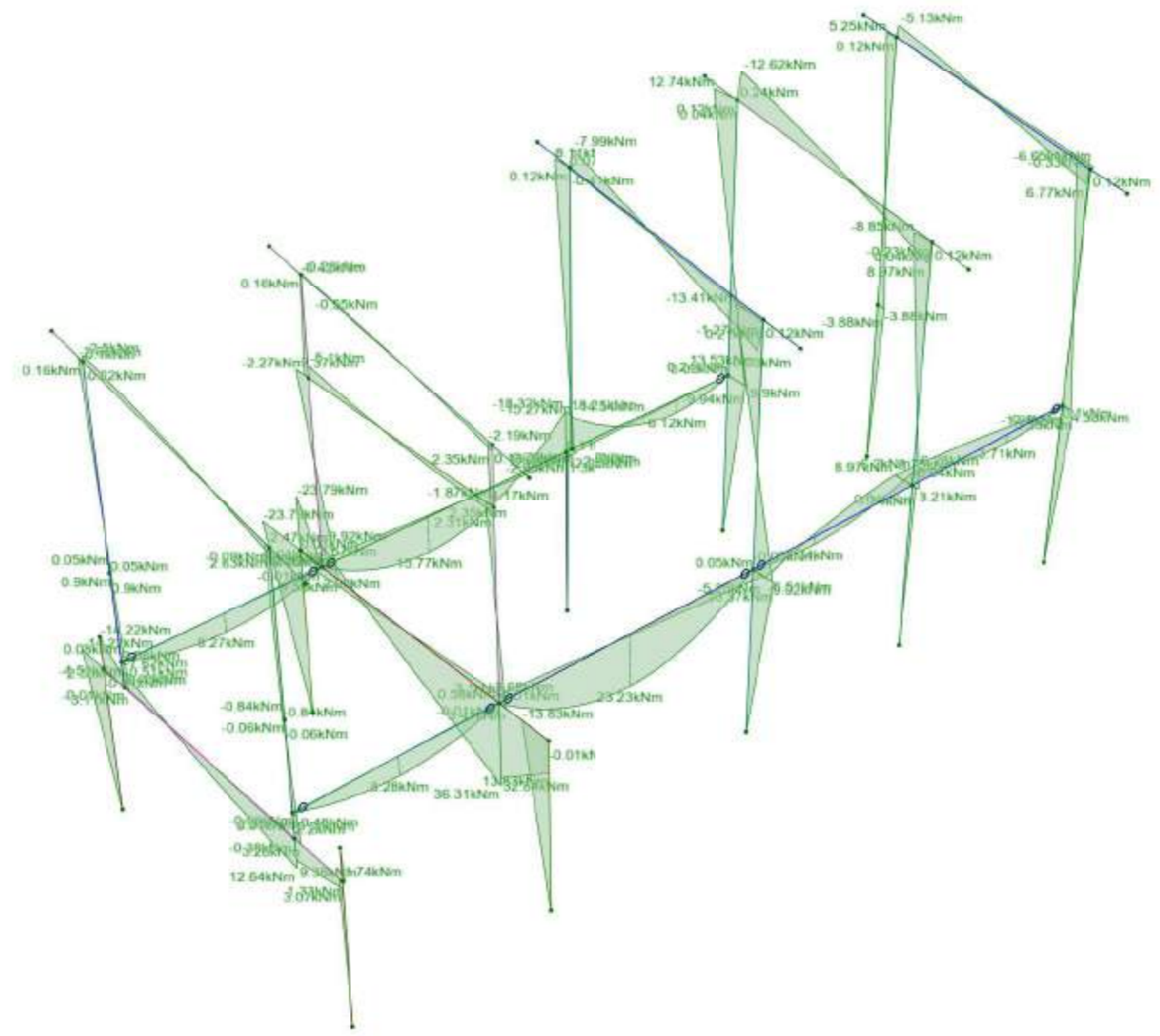
Materials:

- 1 STEEL
- 2 Smart LVL 13

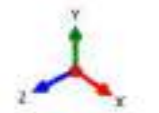


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22 (SW) 1.2G+0.4Q+Wu2



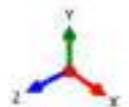
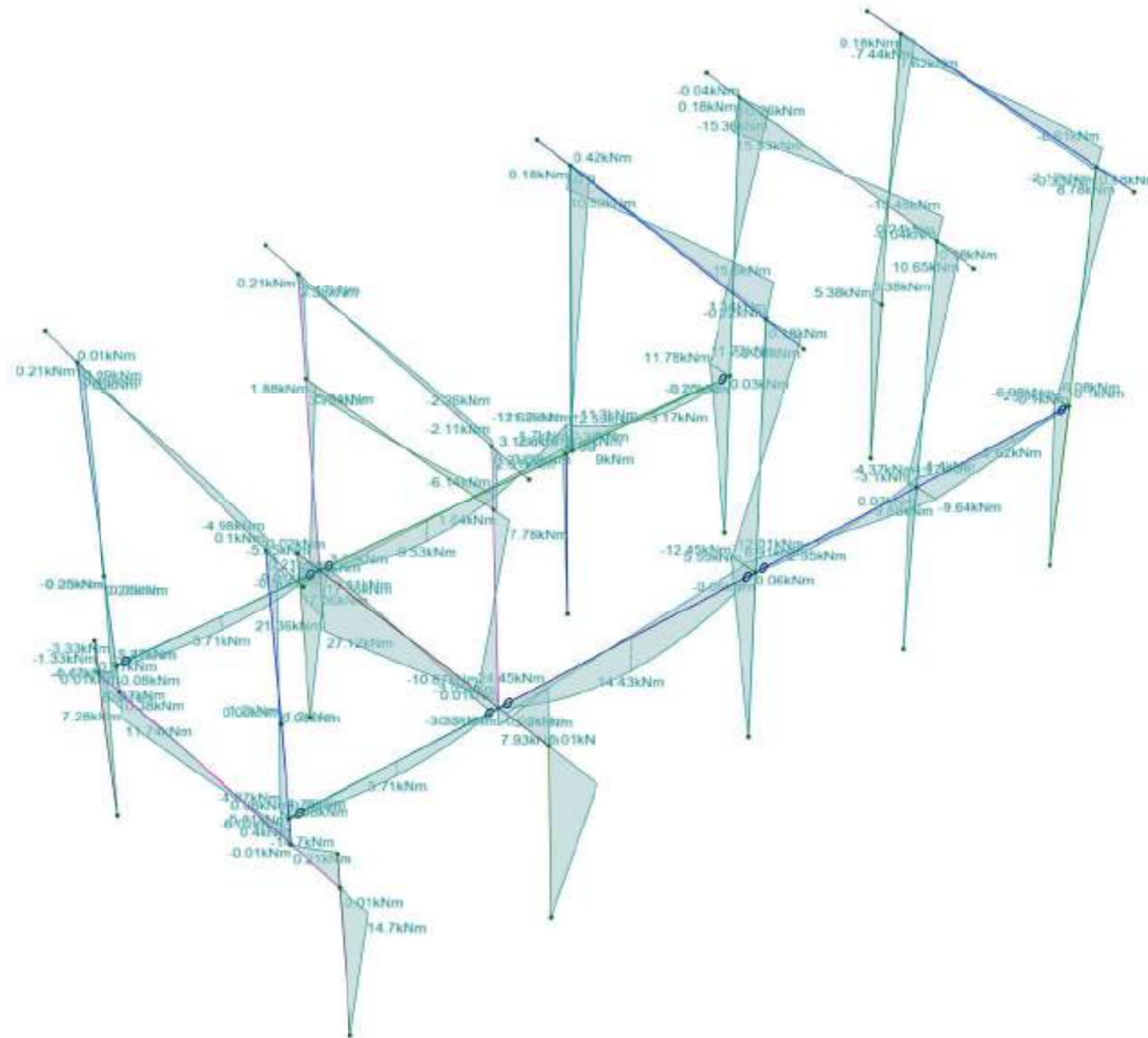
- Sections:
- 1 200 UB 29.8
 - 2 200 UC 46.2
 - 3 250 PFC
 - 4 360 UB 56.7
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 - 7 250 PFC
 - 8 400x63
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 - 21 180 PFC
 - 22 230 PFC
 - 23 150 UC 37.2
 - 24 200*100*9 RHS
 - 25 89*6 SHS
 - 26 200x9RHS+150x12PL
- Materials:
- 1 STEEL
 - 2 Smart LVL 13



Viewpoint (50,35), Moments

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23 (SW) 0.9G+Wu1



Viewpoint (50,35), Moments

Sections:

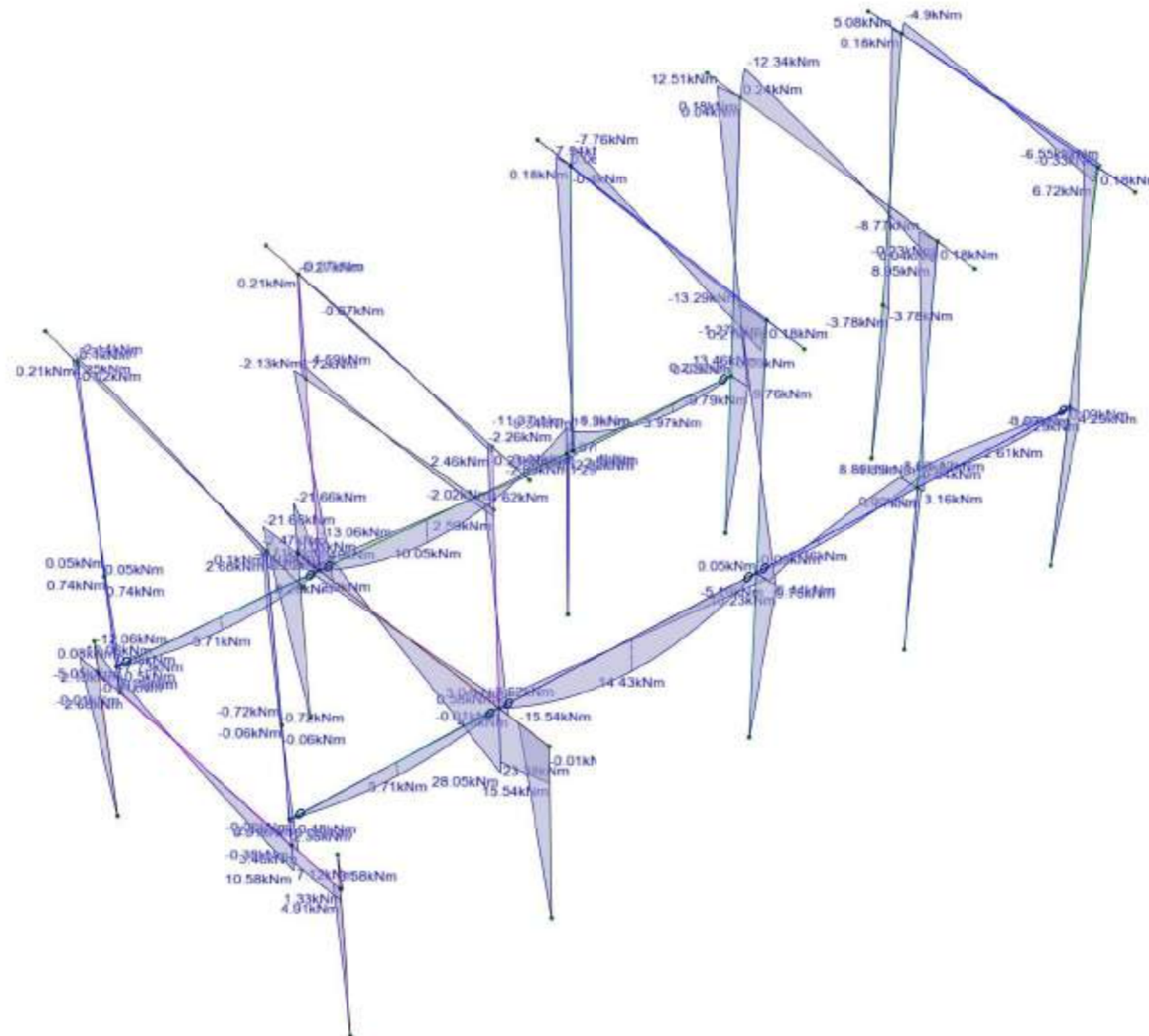
- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
- 11 2/150x100x9 RHS
- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

- 1 STEEL
- 2 Smart LVL 13

24 (SW) 0.9G+Wu2

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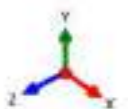


Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
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- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

- 1 STEEL
- 2 Smart LVL 13



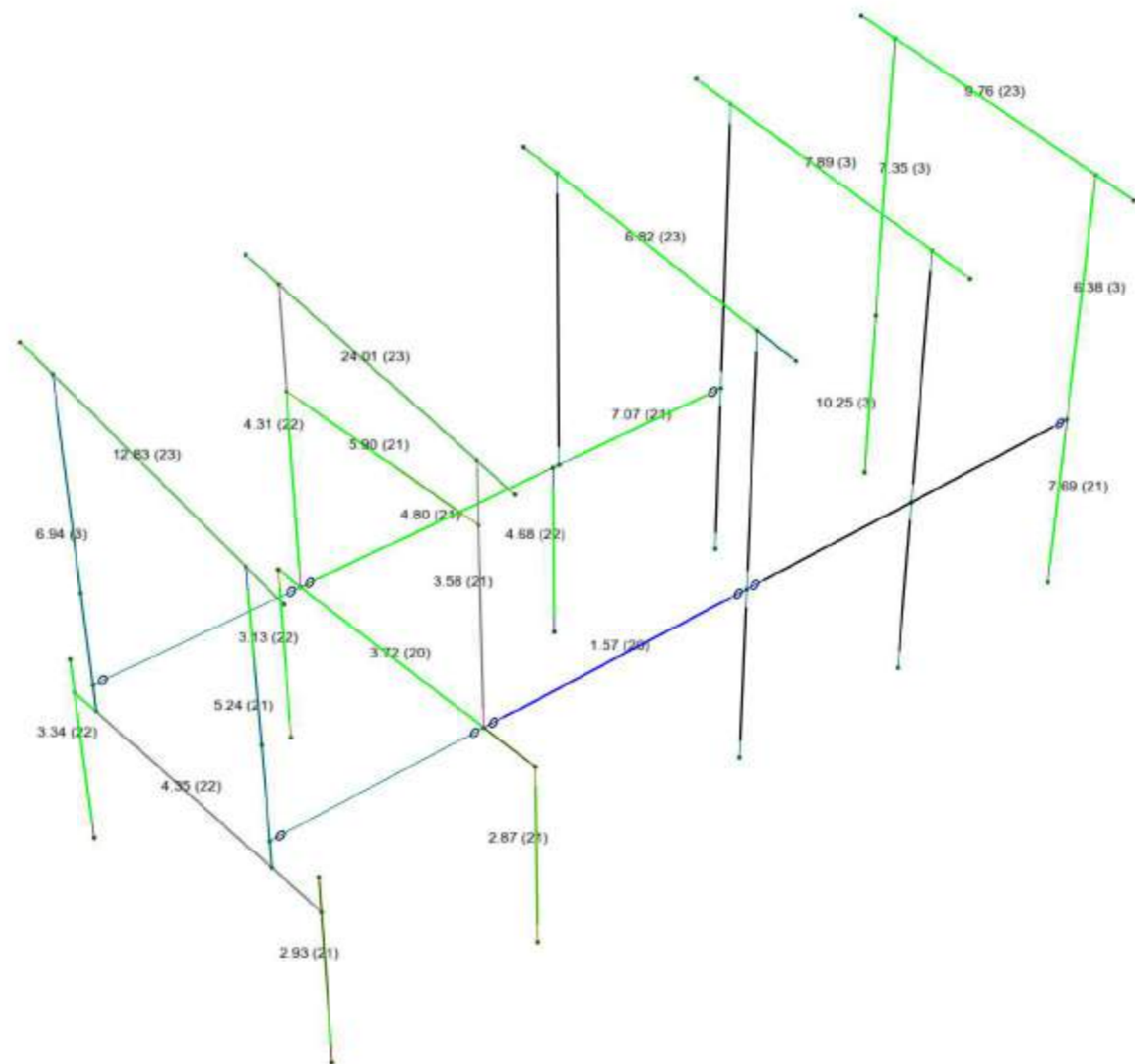
Viewpoint (50,35), Moments



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Development Approval
Approval date: 03/03/2025
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PDI Act 2016 and Regulations

29/10/2025 2020 Load Factors:

- >= 2.00 (Pass)
- >= 1.10 (Pass)
- >= 1.00 (Pass)
- < 1.00 (Fail)
- < 0.90 (Fail)
- < 0.50 (Fail)
- Design error
- L/r failure
- Design error
- Not Designed



Sections:

- 1 200 UB 29.8
- 2 200 UC 46.2
- 3 250 PFC
- 4 360 UB 56.7
- 5 180 PFC
- 6 380 PFC
- 7 250 PFC
- 8 400x63
- 10 200 UC 46.2
- 11 2/150x100x9 RHS
- 20 125*6 SHS
- 21 180 PFC
- 22 230 PFC
- 23 150 UC 37.2
- 24 200*100*9 RHS
- 25 89*6 SHS
- 26 200x9RHS+150x12PL

Materials:

- 1 STEEL
- 2 Smart LVL 13



Viewpoint (50,35)



STEEL MEMBER V5.17

HWC Engineers

Doubly symmetric and compact

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Section:	(Column 1PC3) 200 x 100 x 9.0 RHS (G350)	
Bending:	No major bending	
	$M_y^* = 16.1 \text{ kNm} < \phi M_{sy} = 56.7 \text{ kNm}$	OK (0.28)
Shear:	$V_x^* = 7.50 \text{ kN} < \phi V_{vm} = 589.7 \text{ kN}$ (Web area full depth)	OK (0.01)
	No minor shear	
Compression:	$N_c^* = 40.0 \text{ kN} < \phi N_c = 1031.7 \text{ kN}$	OK (0.04)
Combined:	In-plane = 0.32, Out-of-plane = 0.04, Biaxial = 0.31	OK (0.32)
Tension:	No tension	
Torsion:	No torsion	

Bending & Shear - Section 5

Max. restraint (2.5% flange force) = - kN

(M* to include first order amplification as required - Cl 4.4.2)

Analysis values = M (M)anual, (L)eft, Position (X) from analysis, (R)ight, (C)ritical
Transverse load = N (Y)es, (N)o

Major bending (Mx*) =	0.000 kNm	Major bending (Mx*) =	0 kNm
Minor bending (My*) =	16.1 kNm	Minor bending (My*) =	16.1 kNm
Shear Force (Vx*) =	7.50 kN	Torsion (Mz*) =	0 kNm
Shear Force (Vy*) =	0.000 kN	Shear Force (Vx*) =	7.5 kN
		Shear Force (Vy*) =	0 kN

Effective length factor (ke) =	Calc		
Restraint code =	FF From [Restraint] Tab	Max. length for Cl 5.3.2.3 =	4697 mm
ke = (kt=1.00)*(kl=1.00)*(kr=1.00) =	1.00 From [Restraint] Tab	Span / Segment Length (L) =	3200 mm
Effective length (Le = L*ke) =	3200 mm	Moment modification factor (αm) =	1.00 kN
φ =	0.9 Table 3.4		
φMsx =	92.3 kNm		
φMbx(αm=1) =	92.3 kNm	Bending (y) =	OK (0.28)
φMbx =	92.3 kNm	Shear =	OK (0.01)
φMsy =	56.7 kNm		
φVvx =	589.7 kN	φVvy =	279.0 kN
φVvm =	589.7 kN	lx =	22.8 x10 ⁶ mm ⁴
φMz =	51.4 kNm	S.Wt =	0.377 kN/m

Compression - Section 6

Axial compression (Nc*) =	40.0 kN	Axial compression (Nc*) =	40 kN
Major axis length (Lx) =	3000 mm	Eff. X length factor (kex) =	1.00
Minor axis length (Ly) =	3000 mm	Eff. Y length factor (key) =	1.00
Braced or Sway member =	B (B)raced, (S)way		
φNs =	1512.0 kN	Major axis effective length (Lex) =	3000 mm
φNcx(kex=1.00) =	1359.9 kN	Minor axis effective length (Ley) =	3000 mm
In-Plane φNcx(kex=1.00) =	1359.9 kN		
φNcy(key=1.00) =	1031.7 kN	Compression =	OK (0.04)
In-Plane φNcy(key=1.00) =	1031.7 kN	Bending & Comp. =	OK (0.32)
φNc =	1031.7 kN		

Tension - Section 7 (No tension)

Axial tension (Nt*) =	0.0 kN	Axial tension (Nt*) =	0 kN
kt =	1.00 Table 7.3.2		
φNt =	1512.0 kN		

Combined

φMrxt =	92.3 kNm	φMixt =	92.3 kNm	φMoxt =	92.3 kNm
φMrxc =	89.9 kNm	φMixc =	89.6 kNm	φMoxc =	88.7 kNm
φMryt =	56.7 kNm	φMiyt =	54.5 kNm	φMtx =	92.3 kNm
φMryc =	55.2 kNm			φMxc =	88.7 kNm

Licensee: HWC Engineers



STEEL MEMBER V5.17

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Section: (Floor Beam FB13) 150 x 100 x 9.0 RHS (G350)
Bending: $M_x^* = 6.20 \text{ kNm} < \phi M_{bx} = \phi M_{sx} = 58.3 \text{ kNm}$
 $M_y^* = 9.00 \text{ kNm} < \phi M_{sy} = 44.1 \text{ kNm}$ (Biaxial = 0.31)
Shear: $V_x^* = 3.60 \text{ kN} < \phi V_{vx} = 434.6 \text{ kN}$ (Web area full depth)
 $V_y^* = 10.5 \text{ kN} < \phi V_{vy} = 279.0 \text{ kN}$
Compression: No compression

OK (0.11)
OK (0.20,0.31)
OK (0.01)
OK (0.04)

Tension: No tension

Torsion: No torsion

Bending & Shear - Section 5

Max. restraint (2.5% flange force) = - kN

(M* to include first order amplification as required - Cl 4.4.2)

Analysis values = M (M)annual, (L)eft, (P)osition (X) from analysis, (R)ight, (C)ritical
Transverse load = N (Y)es, (N)o

Major bending (M_x^*) =	6.20 kNm	Major bending (M_x^*) =	6.2 kNm
Minor bending (M_y^*) =	9.00 kNm	Minor bending (M_y^*) =	9 kNm
Shear Force (V_x^*) =	3.60 kN	Torsion (M_z^*) =	0 kNm
Shear Force (V_y^*) =	10.5 kN	Shear Force (V_x^*) =	3.6 kN
		Shear Force (V_y^*) =	10.5 kN

Effective length factor (k_e) = Calc

Restraint code = FF From [Restraint] Tab
 $k_e = (k_t=1.00) * (k_l=1.00) * (k_r=1.00) = 1.00$ From [Restraint] Tab
Effective length ($L_e = L * k_e$) = 5900 mm

Max. length for Cl 5.3.2.3 = 6244 mm
Span / Segment Length (L) = 5900 mm
Moment modification factor (α_m) = 1.13 kN

$\phi = 0.9$ Table 3.4

$\phi M_{sx} = 58.3 \text{ kNm}$

Bending (x) = OK (0.11)

$\phi M_{bx}(\alpha_m=1) = 56.8 \text{ kNm}$

Bending (y) = OK (0.20)

$\phi M_{bx} = 58.3 \text{ kNm}$

Shear = OK (0.01)

$\phi M_{sy} = 44.1 \text{ kNm}$

$\phi V_{vx} = 434.6 \text{ kN}$

$\phi V_{vy} = 279.0 \text{ kN}$

$\phi V_{vm} = 434.6 \text{ kN}$

$I_x = 10.9 \times 10^6 \text{ mm}^4$

$\phi M_z = 37.3 \text{ kNm}$

S.Wt = 0.307 kN/m

Compression - Section 6 (No compression)

Axial compression (N_c^*) = 0.0 kN
Major axis length (L_x) = 6000 mm
Minor axis length (L_y) = 6000 mm
Braced or Sway member = B (B)raced, (S)way

Axial compression (N_c^*) = 0 kN
Eff. X length factor (k_{ex}) = 1.00
Eff. Y length factor (k_{ey}) = 1.00

$\phi N_s = 1228.5 \text{ kN}$
 $\phi N_{cx}(k_{ex}=1.00) = 472.2 \text{ kN}$
In-Plane $\phi N_{cx}(k_{ex}=1.00) = 472.2 \text{ kN}$
 $\phi N_{cy}(k_{ey}=1.00) = 264.1 \text{ kN}$
In-Plane $\phi N_{cy}(k_{ey}=1.00) = 264.1 \text{ kN}$
 $\phi N_c = 264.1 \text{ kN}$

Major axis effective length (L_{ex}) = 6000 mm
Minor axis effective length (L_{ey}) = 6000 mm

Tension - Section 7 (No tension)

Axial tension (N_t^*) = 0.0 kN
 $k_t = 1.00$ Table 7.3.2

Axial tension (N_t^*) = 0 kN

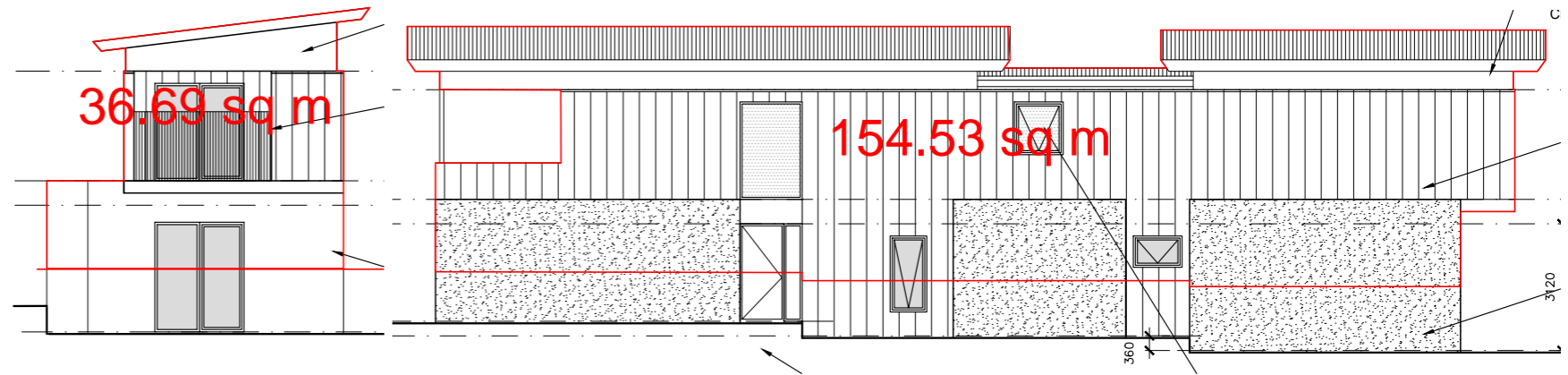
$\phi N_t = 1228.5 \text{ kN}$

Combined

$\phi M_{rxt} = 58.3 \text{ kNm}$	$\phi M_{mixt} = 58.3 \text{ kNm}$	$\phi M_{oxt} = 58.3 \text{ kNm}$
$\phi M_{rxc} = 58.3 \text{ kNm}$	$\phi M_{mixc} = 58.3 \text{ kNm}$	$\phi M_{oxc} = 58.3 \text{ kNm}$
$\phi M_{ryt} = 44.1 \text{ kNm}$	$\phi M_{miyc} = 44.1 \text{ kNm}$	$\phi M_{tx} = 58.3 \text{ kNm}$
$\phi M_{ryc} = 44.1 \text{ kNm}$		$\phi M_{cx} = 58.3 \text{ kNm}$

GROUND LEVEL BRACING

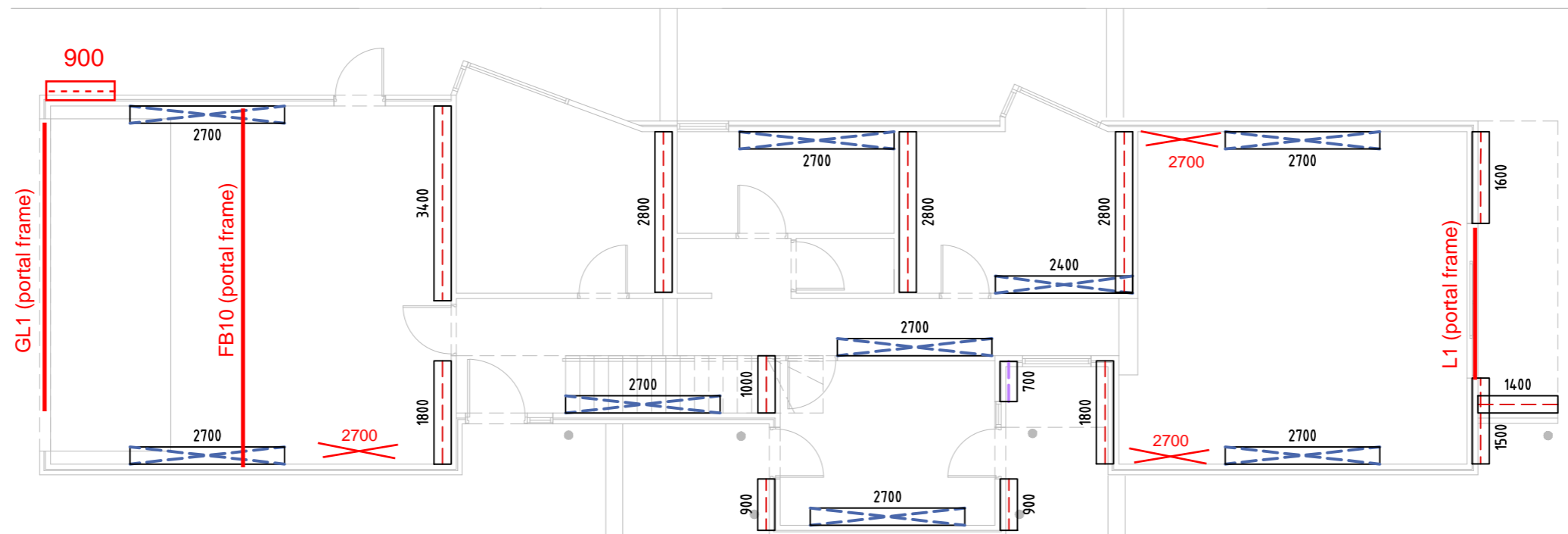
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WIND PRESSURE ON SIDE = 0.92kPa Table 5.2(A), N2 AS 4055
 WIND PRESSURE ON END = 2.14kPa Table 5.2(A), N4 AS 4055

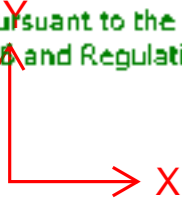
RACKING FORCE RX = 2.14kPa*36.7sqm = 78.5kN
 BRACING CAPACITY = 3kN/m*(2.7*7+2.4+4*0.9*2.7)m + 6kN/m*(0.9+1.4)m = 106.9kN > RX. OK

RACKING FORCE RY = 0.92kPa*154.5sqm = 142.1kN
 TIMBER BRACING CAPACITY = 6kN/m*(3.4+1.8+2.8+1+0.9+2.8+0.9+0.9*1.8+0.9*2.8)m + 0.9*3.4*0.7 = 108.6kN
 PORTAL FRAME BRACING CAPACITY = 7.05 + 19 + 8.5 = 34.55kN
 TOTAL BRACING CAPACITY = 108.6+34.55 = 143.15kN > RY. OK



UPPER LEVEL BRACING

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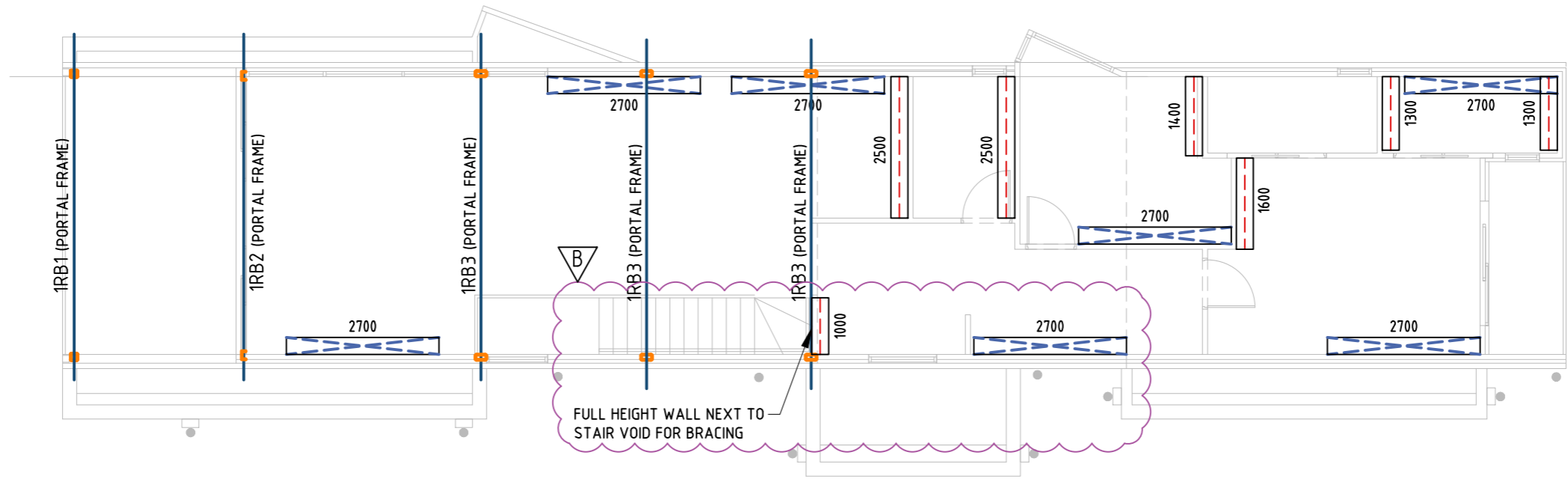
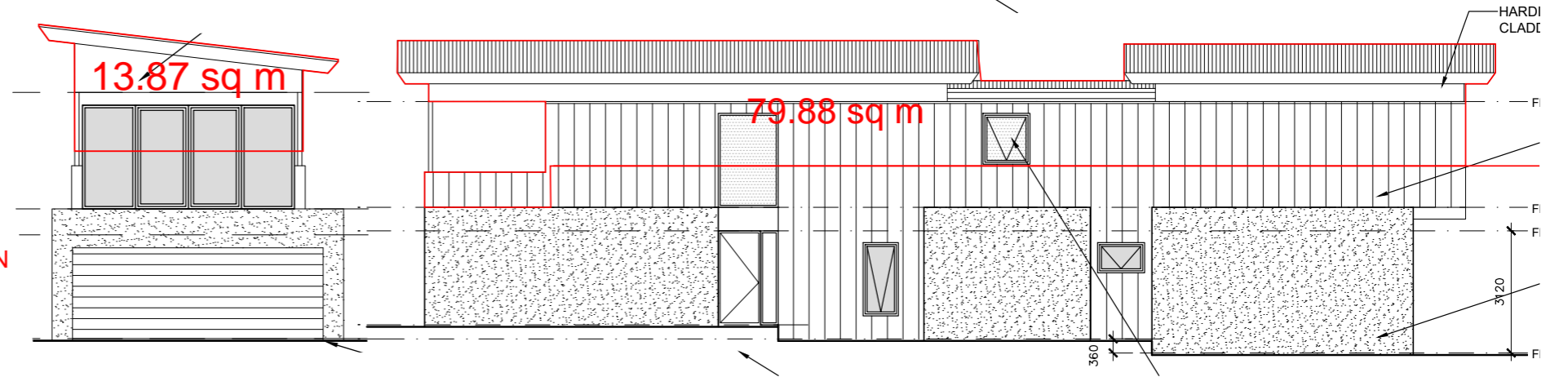
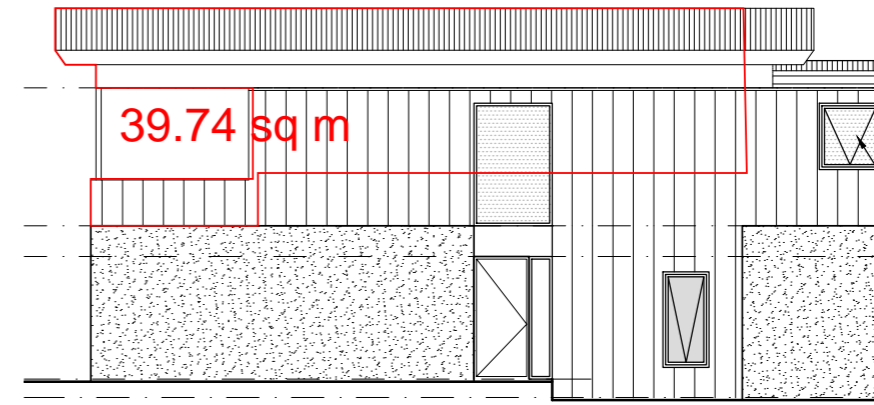


WIND PRESSURE ON SIDE = 0.92kPa Table 5.2(A), N2 AS 4055
 WIND PRESSURE ON END = 2.14kPa Table 5.2(A), N4 AS 4055

RACKING FORCE RX = 2.14kPa*13.9sqm = 29.75kN
 BRACING CAPACITY = 0.7*3kN/m*(2.7*7)m = 39.7kN > RX. OK

RACKING FORCE RY = 0.92kPa*80sqm = 73.6kN
 TIMBER BRACING CAPACITY = 0.7*6kN/m*(2.4*2+1.4+1.5+1.3*2+1)m = 47.5kN
 PORTAL FRAME BRACING CAPACITY = 1RB1 + 1RB2 + 1RB3*2 + 1RB3
 = 4.4 + 9.5 + 9.4*2 + 6 = 38.7kN
 TOTAL BRACING CAPACITY = 47.5+38.7= 89.2kN > RY. OK

RACKING FORCE RY TO BACK HALF OF DWELLING WHERE PORTAL
 FRAMES 1RB1 + 1RB2 AND 1RB3'S ARE RESISTING THE WIND FORCE:
 RY = 0.92kPa*39.7sqm = 33.7kN
 PORTAL FRAME BRACING CAPACITY = 1RB1 + 1RB2 + 1RB3*2 + 1RB3
 = 4.4 + 9.5 + 9.4*2 + 6 = 38.7kN > RY TO BACK HALF. OK





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Government of South Australia
SA Housing Authority

Construction Specification

NATSPEC Simple Domestic

2020 Compliant

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Use the current edition

This specification is published annually and is aligned with BCA Volume 2 of the NCC for Class 1 and Class 10 Buildings.

NATSPEC SIMPLE DOMESTIC SPECIFICATION is a reference specification and does not require editing or amendment. It is intended for inclusion, along with other documents such as drawings and schedules, as a condition of contract for the building works. It assumes all project specific design information is shown on the drawings or in schedules, including the specific requirements of the South Australian Housing Trust (SAHT). The Preliminaries worksection provides for the requirements of the drawings and schedules to override conflicting requirements of this reference specification.

National Construction Code

The National Construction Code (NCC), including state and territory variations, is enforced by local authorities and controls domestic construction in Australia, along with the requirements of statutory authorities (e.g. electricity and water supply). This specification has been aligned with BCA Volume 2 of the NCC but any local requirements must take precedence. NATSPEC recommends that the users of this document have ready access to BCA Volume 2 for Class 1 and Class 10 Buildings. It is available online. Go to <https://ncc.abcb.gov.au/> to register.

Work Health and Safety (WHS)

Everyone at a workplace is responsible for complying with stringent Occupational Health and Safety legislation. However, the accountable person has primary control over the workplace and therefore the greatest WHS responsibility. A builder engaged to manage a project and organise the relevant sub-contractors is the accountable person and must make sure that they, their employees and sub-contractors work in a safe manner. An owner builder, engaging independent tradespeople as required, is the accountable person responsible for ensuring the tradespeople comply with safety standards. WHS legislation in some States and Territories also includes statutory obligations on designers in relation to WHS issues arising out of their designs during and after construction. It is important to note that WHS obligations differ in each State and Territory. Go to www.safeworkaustralia.gov.au to see WHS legislation for each.

Standards and tolerances

Check that the building work conforms to requirements of the drawings, schedules and this specification. *Guide to Standards and Tolerances* is a reference document of best construction practice available on the web.

Dispute resolution

Many building contracts include dispute resolution provisions and in most states there are dispute resolution services provided and/or mandated under State legislation

SAHT specific requirements

The SAHT has specific building requirements which are additional to this specification. These requirements are included as separate documents titled *South Australian Housing Trust (SAHT) construction requirements for class 1A buildings* and SAHT fixtures and fitting schedule – Class 1A buildings.

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Make sure all subcontractors are aware of the requirements within 0180 *Common Requirements*.



BUILDING CONSENT GRANTED
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1 GENERAL

1.1 THE SITE

Occupied premises

General: For the parts of the site designated as occupied premises:

- Allow occupants to continue in secure possession and occupancy of the premises for the required period.
- Maintain safe access for occupants.
- Arrange work to minimise nuisance to occupants and for their safety.
- Protect occupants against weather, dust, dirt, water or other nuisance.

Proposals: Submit details of proposed methods.

- Purpose of submission: Information only.

Protection of persons and property

Temporary works: Provide and maintain required barricades, guards, fencing, shoring, temporary roadways, footpaths, signs, lighting and traffic management.

Accessways and services: Do not obstruct or damage roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Determine the location of such services.

Property: Do not interfere with or damage trees and property which are to remain on or adjacent to the site, including adjoining property encroaching onto the site.

Rectification

Accessways and services: Rectify immediately any obstruction or damage to roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Provide temporary services whilst repairs are carried out.

Property: Rectify immediately any interference or damage to trees and property which are to remain on or adjacent to the site, including adjoining property encroaching onto the site.

Existing services

Service to be continued: Repair, divert or relocate, as documented.

Trenches: If the existing service crosses the line of a required trench, or will lose support when the trench is excavated, provide permanent support for the existing service.

Redundant services: Remove redundant parts and make safe.

Interruptions to services: Minimise the number and duration of interruptions.

Signs

General: Provide a signboard displaying the lot number, the builder's name, address and licence number, and the BCA accreditation authority, address and contact details, if required.

1.2 BUILDING THE WORKS

Order of precedence of documents

Precedence: Requirements of the schedules and drawings override conflicting requirements in this reference specification.

Survey marks

Definition: A survey peg, bench mark, reference mark, signal, alignment, level mark or any other mark used or intended to be used for the purpose of setting out, checking or measuring the work.

Care of survey marks: Preserve and maintain the principal's survey marks in their true positions.

Rectification: If the survey marks are disturbed or obliterated, immediately rectify.

Items supplied by owner

General: Materials and other items supplied free of charge to the contractor for installation in the execution of the works, as documented.

Unload and take delivery, inspect for defects and take care of the items. If defects are found, advise. Return unused items to the principal.

1.3 MISCELLANEOUS

Contractor and owner to observe confidentiality

Publicity: Do not issue information concerning the project for publication in the media without prior written approval of the owner.

0180 COMMON REQUIREMENTS

1 GENERAL

1.1 APPLICABILITY

General

Requirement: Conform to 0171 General requirements, as appropriate, in all worksections.

1.2 STANDARDS

Current editions

General: Use referenced Australian or other standards (including amendments), and the NCC including state and territory variations which are current three months before the date of the contract except where other editions or amendments are required by statutory authorities. Any local authority requirements take precedence.

1.3 INTERPRETATION

Abbreviations

General: For the purpose of this document the following abbreviations apply:

- BCA: National Construction Code Series Volume 2: Building code of Australia Class 1 and Class 10 Buildings.
- NCC: National Construction Code.

Definitions

General: For the purposes of this specification, the following definitions apply:

- Contractor: Means the same as builder.
- Documented: Documented, as documented and similar terms mean contained in the contract documents.
- Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy via a continuous hot-dip process.
- Owner: Owner has the same meaning as client, principal or proprietor and is the party to whom the contractor is legally bound to construct the works.
- Professional engineer: As defined by the NCC.
- Proprietary: Identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: Provide and similar expressions mean supply and install and include development of the design beyond that documented.

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- Required: Means required by the contract documents, the local council or statutory authorities.

Supply: Supply, furnish and similar expressions mean supply only.

1.4 BUSHFIRE PROTECTION

General

Conformance: In areas designated as bushfire prone, comply with statutory and local authority requirements.

Standard: To AS 3959.

2 PRODUCTS

2.1 GENERAL

Manufacturers' or suppliers' recommendations

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items to the manufacturers' or suppliers' recommendations.

Proprietary items/systems/assemblies: Assemble, install or fix to substrate to the manufacturers' or suppliers' recommendations.

Substitution

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the identified item, but indicates the necessary properties of the item.

Natural and treated timber durability table

Exposure	Natural timber	Treated timber	Remarks
	Required durability class to AS 5604	Required hazard class to the AS 1604 series	
Inside, above ground. Completely protected from the weather. Well ventilated	Class 4	H1	Treated timber resistant to lyctids. Untreated timber must be protected from termites
Inside, above ground. Protected from wetting with nil leaching. Well ventilated	Class 3	H2	Treated timber resistant to borers and termites. Untreated timber must be protected with a finish
Above ground, exposed to weather. Periodic moderate wetting and leaching	Class 2	H3	Treated timber resistant to borers, termites and moderate decay. Applicable to weatherboards, fascias, pergolas (above ground), window joinery, framing and decking
In-ground	Class 1	H4 (Severe wetting and leaching)	Treated timber resistant to borers, termites and severe decay. Applicable to fence posts, greenhouses, pergolas (in-ground) and landscaping timbers
		H5 (Extreme wetting and leaching and/or critical uses)	Applicable to retaining walls, piling, house stumps, building poles, cooling tower fill

2.3 STEEL

Durability

General: Provide steel products protected from corrosion to suit the conditions of use.

Internal engineer designed steel members: Remove mill scale, rust, moisture and oil. Coat with a zinc phosphate primer to the manufacturer's instructions.

Built-in products below damp-proof course: Stainless steel 316 or engineered polymer.

Corrosion resistance

Atmospheric corrosivity category: To AS 4312 and the AS/NZS 2312 series.

Minimum external corrosion protection requirements for corrosive environments: Conform to BCA Volume 2.

Preparation and pre-treatment

Standard: To the AS 1627 series.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives.

2.2 TIMBER

Acclimatisation

General: Acclimatise timber fitouts by stacking them for two weeks in the in-service conditions with air circulation to all surfaces after the following are complete:

- Air conditioning operational.
- Lighting operational.
- Site drainage and stormwater works are complete.
- Space fully enclosed and secure.
- Wet work complete and dry.

Unseasoned timber

General: If unseasoned timber is provided, or variation in moisture content is likely, make allowance for shrinkage, swelling and differential movement.

Durability

General: Provide timbers with natural durability appropriate to the conditions of use or preservative-treated timbers of equivalent durability.

Natural durability class of heartwood: To AS 5604.

Preservative treatment: To the AS 1604 series.

Minimum requirement: To the **Natural and treated timber durability table**.

Galvanizing

General: Galvanize mild steel components (including fasteners) to AS/NZS 1214, AS 1397 or AS/NZS 4680, as appropriate, and in the following conditions:

- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind external leaves of masonry walls.
- In contact with chemically treated timber.

2.4 PROTECTIVE COATINGS

General

Environment: To AS 2312.1 clause 2.3.

Coating designation: To AS 2312.1 Table 6.3.

CCA (copper chrome arsenic) treated timber

Greasing: Before placing bolts or other metal components in contact with CCA-treated timber, paint contact surfaces or coat in grease or a bituminous coating.

Unseasoned timber

General: Do not fix in contact with steel framing without fully painting the contact surfaces of timber and steel.

2.5 FASTENERS

Self-drilling screws

Standard: To AS 3566.1.

2.6 VAPOUR BARRIER

General

Vapour barrier to slabs: To AS 2870 clause 5.3.3.

Minimum thickness: 0.2 mm.

2.7 DAMP-PROOF MEMBRANES

General (Damp-proof)

Damp-proof membrane: To AS 2870 clause 5.3.3.

Type: High impact resistant polyethylene film, minimum 0.2 mm thick, which has been pigmented and branded by the manufacturer.

3 EXECUTION

3.1 WALL CHASING

Holes and chases

General: Make holes and chases required in masonry walls so that the structural integrity of the wall is maintained. Do not chase walls with a fire-resistance level or an acoustic rating.

Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

Chasing blockwork: Only chase core-filled hollow blocks or solid blocks not documented as structural.

Concrete blockwork chasing table

Block thickness (mm)	Maximum depth of chase (mm)
190	35
140	25
90	20

3.2 MOISTURE CONTENT

Alignment of flooring and subfloor

Concrete subfloor: Do not start installation of the flooring until the moisture content of the concrete subfloor conforms to AS 1884 clause 3.1.

Timber, plywood or particleboard flooring subfloors: Do not start installation of the flooring until the moisture content of the subfloor conforms to the following:

- Dry in-service environment (air conditioned buildings): 8 to 10%
- Normal in-service environment (intermittently heated buildings): To 12.5%
- Moist in-service environment (unheated buildings): 12.5 to 15%

3.3 FIXING

General

Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

Fasteners

Sufficiency: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient for the rigidity of the assembly.

3.4 FOOTPATH CROSSING

General

Requirement: Provide a footpath and kerb crossing to local authority requirements.

3.5 COMPLETION

General

Removal of temporary work, services and plant: Remove temporary work services and construction plant within 10 working days after occupation of the works.

Final cleaning: Remove rubbish and surplus material from the site and clean the works throughout including interior and exterior surfaces exposed to view. Vacuum clean carpeted and soft surfaces. Clean debris from the site, roofs, gutters, downpipes and drainage systems.

Samples: Remove non-incorporated samples, sample panels and prototypes.

Warranties: Register with manufacturers, as necessary, and provide copies of manufacturers' warranties.

Instruction manuals: Provide the manufacturers' instruction manuals.

Operation: Make sure moving parts operate safely and smoothly.

Surveyor's certificate: Provide a certificate which confirms that the work, including boundary fences, has been correctly located.

Services layout: Provide a plan which shows the location of underground services.

Authorities' approvals: Provide evidence of approval of the local authority or principal accredited certifier and statutory authorities whose requirements apply to the work.

Keys: Provide two keys for each set of locks keyed alike and two keys for each lock keyed to differ.

0184 TERMITE MANAGEMENT

1 GENERAL

1.1 STANDARDS

General

Standard: To AS 3660.1.

Termite management system notice

Requirement: Permanently fix a durable notice in a prominent location to BCA 3.1.4.4.

Certification

Requirement: Submit installation certificate to AS 3660.1 Appendix A3.

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1 GENERAL

1.1 STANDARDS

Demolition

Standard: To AS 2601.

1.2 SUBMISSIONS

Records

Dilapidation record:

- Before demolition: Submit to each owner of each adjacent property, a copy of the part of the record relating to that property and obtain their written agreement to the contents.
- Rectification work: Submit written acceptance of rectification works from the owner of each adjoining property affected.

2 EXECUTION

2.1 SUPPORT

Temporary support

Existing buildings: Until permanent support is provided, provide temporary support for sections of existing buildings which are to be altered and which rely for support on work to be demolished.

2.2 PROTECTION

Encroachment

General: Prevent the encroachment of demolished materials onto adjoining property, including public places.

Weather protection

General: If walls or roofs are opened for alterations and additions, or the surfaces of adjoining buildings are exposed, provide temporary covers to prevent water penetration. Provide covers to protect existing plant equipment and materials intended for re-use.

Security

General: If walls or roofs are opened for alterations or additions, provide security against unauthorised entry to the building.

2.3 DEMOLITION

Asbestos removal

Method: Use wet removal methods recommended in the Safe Work Australia Code of Practice - How to safely remove asbestos.

Notice of completion

General: Give at least 5 working days' notice of completion of demolition so that adjacent structures may be inspected following completion of demolition.

Reinstatement

Assessment of damage: Use the dilapidation record to assess the damage and rectification work arising from the demolition work.

Rectification: Repair damage arising out of demolition work. Obtain written acceptance from the owner of each adjoining property of the completeness and standard of the rectification work.

1 EXECUTION

1.1 CONTROL AND PROTECTION

Erosion control

General: Plan and carry out the work so as to avoid erosion, contamination, and sedimentation of the site, surrounding areas, and drainage systems.

Dewatering

Requirement: Keep earthworks free of water. Prevent water flow over freshly laid work.

1.2 TREE PROTECTION

General

Protection: Protect from damage trees which are required to be retained. Provide a temporary fence or safety barrier if required by the local authority. Comply with local authority requirements for protection of trees.

Work near trees

Harmful materials: Keep the area within the dripline free of sheds and paths, construction material and debris.

Work under trees: Do not remove topsoil from, or add topsoil to, the area within the dripline of the trees.

1.3 SITE CLEARING

Extent

Requirement: Clear only areas to be occupied by works such as structures, paving, excavation, regrading and landscaping or other areas designated to be cleared.

Clearing and grubbing

Clearing: Remove everything on or above the site surface, including rubbish, scrap, grass, vegetable matter and organic debris, scrub, trees, timber, stumps, boulders and rubble.

Turf: Remove turf to a depth just sufficient to include the root zone.

Grubbing: Grub out stumps and roots over 75 mm diameter to a minimum depth of 500 mm below subgrade under buildings, embankments or paving, and 300 mm below the finished surface in unpaved areas. Backfill holes remaining after grubbing with sand material to prevent ponding of water. Compact the material to the relative density of the existing adjacent ground material.

Surplus material

Removal: Take possession of surplus material and removal it from the site.

0222 EARTHWORK

1 GENERAL

1.1 STANDARDS

General

Earthwork: To the recommendations of AS 3798.

1.2 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Bad ground: Ground unsuitable for the works, including fill liable to subsidence, ground containing cavities, faults

or fissures, ground contaminated by harmful substances and ground that is, or becomes, soft, wet or unstable.

Rock: Monolithic material with volume greater than 0.3 m³ that cannot be removed until broken up by rippers or percussion tools.

Site classification: To AS 2870 and BCA 3.2.4.

Subgrade: The trimmed or prepared earth material on which the pavement, footing or slab is constructed. Generally taken to relate to the upper line of the earth material.

- Zone of influence: A foundation zone bounded by planes extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

2 EXECUTION

2.1 REMOVAL OF TOPSOIL

General

Extent: Areas of cut or fill and areas occupied by structures, pavements and embankments.

Maximum depth: 200 mm.

Disposal: Remove topsoil unsuitable for re-use from the site to AS 3798 clause 6.1.8.

2.2 EXCAVATION

Extent

Site surface: Excavate the site to the levels and profiles required for the documented structures, pavements, filling and landscaping. Make allowance for compaction, settlement or heaving.

Footings: Excavate to the required sizes and depths. Confirm that the foundation conditions meet the design bearing capacity.

Crawl space: Provide a clear space under timber or steel bearers:

- Minimum clearance: 400 mm.

Existing footings

Requirement: If excavation is required within the zone of influence of an existing footing, provide supports to the footing sufficient to prevent damage arising from the works. Use methods including temporary shoring or underpinning.

Existing services

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

Bearing surfaces

Requirement: Provide even plane bearing surfaces for loadbearing elements including footings. Step to accommodate level changes. If supporting masonry, make the steps appropriate to the courses.

Grading

External areas: Grade to give falls away from buildings, minimum 1:100.

Subfloor areas: Grade the ground surface under suspended floors to drain ground or surface water away from buildings without ponding.

2.3 PREPARATION FOR FILLING

Preparation

Stripping: Prepare the ground surface before placing fill (including topsoil fill), ground slabs or load bearing elements to AS 3798 clause 6.1.5. Remove material that inhibits or prevents satisfactory placement of fill layers, loose material, debris and organic matter.

2.4 PLACING FILL

Placing fill

Placement: To BCA 3.2.2.

Layers: Place fill in near-horizontal layers of uniform thickness no greater than 150 mm after compaction, deposited systematically across the fill area.

Moisture content: Adjust the moisture content of fill during compaction to achieve the required density.

Base preparation underground slab vapour barrier or damp-proof membrane: Blind the surface with sufficient sand to cover any hard projections. Dampen the sand just before placing the vapour barrier.

0223 SERVICE TRENCHING

1 PRODUCTS

1.1 FILL MATERIALS

General

Backfill material: To AS 3798 clause 4.4, free from stones larger than 100 mm maximum dimension and as follows:

- Next to services: Do not place any particles greater in size than 25 mm within 150 mm of services.
- Under paved areas and within 4 m of structures: Coarse sand, controlled low strength material or fine crushed rock.
- In reactive clay: In sites classified M, M-D, H1, H1-D, H2, H2-D, E or E-D to AS 2870, re-use excavated site material at a moisture content within $\pm 1\%$ of that of the adjoining in situ clay.

2 EXECUTION

2.1 EXCAVATING

Excavation

Requirement: Excavate for underground services in conformance with the following:

- To required lines and levels, with uniform grades.
- Straight between access chambers, inspection points and junctions.
- With stable sides.

2.2 TRENCH BACKFILL

General

Place fill: To AS 3798 clause 6.2.2 and 6.2.6.

Timing: Backfill service trenches as soon as possible after laying and bedding the service, if possible on the same working day.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness. Compact each layer to the relative compaction specified before the next layer is commenced.

2.3 SURFACE RESTORATION

General

Reinstatement: Reinstatement existing surfaces removed or disturbed by trench excavation to match existing and adjacent work.

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PRODUCTS

1.1 TIMBER

Posts and rails

Hardwood: To AS 2082.

Softwood: To AS 2858.

Pickets and palings

Hardwood: To AS 2796.1, Section 8.

- Grade to AS 2796.2: Select.

Softwood: To AS 4785.1, Section 7.

Seasoned cypress pine: To AS 1810, Section 5.

Preservative treatment

Timber type: Provide only timbers with preservative treatment appropriate to the Hazard class.

Cut surfaces: Provide supplementary preservative treatment to all cut and damaged surfaces.

CCA treated timber: If proposed to be used, provide details. Test

1.2 STEEL

Steel tubes

Posts, rails, stays and pickets: To AS/NZS 1163.

- Grade: C350L0.

Post and rail finish: Hot-dip galvanized.

1.3 COMPONENTS

Steel panel fencing

Steel framing: Zinc-coated or aluminium/zinc alloy coated steel to AS 1397.

Steel sheeting: Prepainted to AS/NZS 2728.

Timber fencing

General: Conform to the timber members in the **Timber fencing sizes table**.

Timber fencing sizes table

Member	Preservative treated soft wood picket (mm)	Preservative treated soft wood paling/lap and cap (mm)	Hardwood or cypress pine paling/lap and cap (mm)
Maximum height	1200	1800	1800
End/corner gate posts	90 x 90	100 x 100	125 x 125 or 100 x 100
Intermediate posts	90 x 90	140 x 45 or 100 x 75	125 x 50 or 100 x 75
Maximum post spacing	2400	2400/2700*	2700*
Rails	70 x 40	75 x 50 or 100x 38	75 x 50 or 100x 38
Picket/paling size	70 x 19	75, 100 or 150* x 15	100 or 150* x 13
Capping	-	125 x 35	100 x 50
Footing type	Earth	Earth	Earth
Footing size (diameter x depth)	200 x 600	250 x 600	250 x 600

* Three rail fences only

Gates

General: As documented.

Fencing for swimming pools

Design, construction and performance: To AS 1926.1.

Location of fencing for private swimming pools: To AS 1926.2.

2 EXECUTION

2.1 GENERAL

Installation

Requirement: Adopt local industry practices for set-out, clearing of vegetation, excavation, minimum footing size materials, components and erection.

0250 LANDSCAPE – GARDENING

1 GENERAL

1.1 STANDARDS

Soils

Site and imported topsoil: To AS 4419.

Potting mixes: To AS 3743.

Composts, soil conditioners and mulches: To AS 4454.

2 PRODUCTS

2.1 MATERIAL

Topsoil

Requirement: Topsoil containing organic matter, able to support plant life and free from stones, contaminants and weeds.

Source: If the topsoil of documented quality cannot be provided from material recovered from site, provide imported topsoil.

Turf

Description: Cultivated turf of even thickness, free from weeds and other foreign matter.

Supplier: A specialist grower of cultivated turf.

Plants

General: Provide plants in conformance with the local authority approval requirements.

3 EXECUTION

3.1 GENERAL

Weed eradication

Herbicide: Eradicate weeds with a non-residual glyphosate herbicide in any of its registered formulae, at the recommended maximum application rate.

Watering

General: Comply with local restrictions.

Turf: Water immediately after laying turf until the topsoil is moistened to its full depth. Maintain moisture to this depth.

Planting: Water as required to maintain planting to the completion of the contract.

0271 PAVEMENT BASE AND SUBBASE

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1 PRODUCTS

1.1 BASE AND SUBBASE MATERIAL

Granular material

Requirement: Provide unbound granular materials, including blends of two or more different materials which when compacted develop structural stability and are uniform in grading and physical characteristics.

Crushed rock

Requirement: Provide crushed rock as follows:

- Base: 20 mm nominal.
- Subbase: 40 mm nominal.

Natural gravel

Provide unbound natural gravel as follows:

- Base: 20 mm nominal.
- Subbase: 40 mm nominal.

2 EXECUTION

2.1 SUBGRADE PREPARATION

General

Requirement: Prepare the subgrade to 0222 Earthwork.

2.2 PLACING BASE AND SUBBASE

General

Weak surfaces: Do not place material on a surface that is weakened by moisture and is unable to support, without damage, the construction plant required to perform the works.

Spreading: Spread material in uniform layers without segregation.

Moisture content: Maintain wet mixed materials at the required moisture content before and during spreading. Add water to dry mixed materials through fine sprays to the entire surface of the layer after spreading, to bring the material to the required moisture content.

Compacted layer thickness: 200 mm maximum and 100 mm minimum. Provide layers of equal thickness in multilayer courses.

2.3 TOLERANCES

Surface level

General: Provide a finished surface level which is free draining and evenly graded between level points.

2.4 BASE AND SUBBASE COMPACTION

General

Construction operation: Compact each layer of fill to the required depth and density, as a systematic construction operation.

Minimum relative compaction table

Item description	Minimum dry density ratio (modified compaction) to AS 1289.5.2.1
Subbase	95%
Base	98%

Compaction requirements

General: Apply uniform compactive effort, over the whole area to be compacted, until the required density is achieved or until failure is acknowledged.

Equipment: Use rollers appropriate to the materials and compaction requirements documented.

0274 CONCRETE PAVEMENT

1 GENERAL

1.1 STANDARDS

General

Specification and supply: To AS 1379.

Materials and construction: To AS 3600.

Residential pavements: To AS 3727.1.

Vapour barrier

Requirement: To AS 2870 clause 5.3.3.

Grading

General: Grade paving to even falls to drain away from buildings to drainage outlets without ponding.

Minimum fall for drainage:

- Vehicle traffic pavements: 1:40.
- Other pavements: 1:100.

0276 PAVING – SAND BED

1 PRODUCTS

1.1 MATERIALS

Sand

Bedding and joint filling: Well-graded and free of deleterious materials such as soluble salts which may cause efflorescence.

Mortar

Mix proportions (cement:sand): 1:3.

2 EXECUTION

2.1 GENERAL

Preparation

General: Trim the subgrade to the required profile and to suit the thickness of pavers and sand bed. Compact to a firm, even surface.

Base course

General: Conform to 0271 Pavement base and subbase.

Edge restraint

Perimeter: If not provided by other structures, provide edge restraints to bedding and units.

Type: Bed units in mortar at least 40 mm thick.

Drainage: Position the edge restraint and pavers so that the top of the pavers is slightly above the front edge of the edge restraint.

Bedding course

Preparation: Remove all loose material from the prepared base.

Geotextile: Place fabric between the base course and the bedding sand.

Bedding sand: Screed uncompacted sand over prepared base uniformly to achieve a 30 mm thick layer. Maintain sand at a uniform loose density and moisture content.

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General: Grade paving to even falls to drain away from buildings to drainage outlets without ponding.

Minimum fall for drainage: 1:100.

Laying

General: Lay paving units on the screeded sand bedding to the nominated pattern, as documented.

Joints: 2 to 5 mm gap.

Cut courses: 50 mm minimum plan dimension. On footpaths and other linear elements, use at least two cut courses and maintain symmetry.

Compaction: Compact the sand bedding after laying paving units using a vibrating plate compactor and appropriate hand methods, and continue until lipping between adjoining units is eliminated.

Joint filling: Spread dry sand over the paving units and fill the joints by brooming. Carry out one or more passes with the vibrating plate compactor and refill the joints with sand. Repeat the process until the joints are completely filled.

0310 CONCRETE

1 GENERAL

1.1 STANDARDS

General

Formwork design and construction: To AS 3610.1.

Plywood formwork: To AS 6669.

Reinforced concrete construction: To AS 3600.

Specification and supply of concrete: To AS 1379.

Residential ground slabs and footings: To AS 2870.

Design

Formwork: The design of the formwork is the contractor's responsibility.

Vapour barrier or damp-proof membrane

Requirement: Conform to *0180 Common requirements*.

0331 BRICK AND BLOCK CONSTRUCTION

1 GENERAL

1.1 STANDARD

General

Materials and construction: To AS 4773.1 and AS 4773.2.

2 PRODUCTS

2.1 DURABILITY

General

Exposure environment: To AS 4773.1 clause 4.3.

Exposure locations: To AS 4773.1 clause 4.4.

2.2 MATERIALS

Bricks and blocks

Standard: To AS/NZS 4455.1 and AS/NZS 4455.3.

Salt attack resistance grade: To AS 4773.2 Table 2.1.

Mortar materials

Sand: Fine aggregate with a low clay content and free from efflorescing salts, selected for colour and grading.

Proportions: To AS 4773.1 Table 3.1.

2.3 BUILT-IN COMPONENTS

General

Durability class of built-in components: To AS 4773.1 Table 4.1.

Steel lintels

Angles and flats: Sizes to AS 4773.1 Table 12.2.

Cold-formed lintels: Designed to AS/NZS 4600.

Corrosion protection: To AS/NZS 2699.3.

Galvanizing: Do not cut after galvanizing.

Wall ties

Standard: To AS/NZS 2699.1.

Type: A.

Corrosion protection: To AS/NZS 2699.1.

Flashings and damp-proof courses

Standard: To AS/NZS 2904.

3 EXECUTION

3.1 GENERAL

Mortar mixing

General: Measure volumes accurately to the documented proportions. Machine mix for at least six minutes.

Protection from contamination

Masonry materials and components: Protect from ground moisture and contamination.

Bond

Type: Stretcher bond.

Clearance for timber frame shrinkage

General: In timber frame brick veneer construction, leave clearances between window frames and brick sill and between roof frames and the brick veneer as follows:

- Single storey frames and ground floor windows (not for slab on ground): 10 mm.
- Two storey frames and upper floor windows: 20 mm.
- Additional clearance: Accommodate additional shrinkage of unseasoned floor timbers.

Joining to existing

General: Provide a control joint where joining to existing structures. Do not tooth new masonry into existing work unless approved by a professional engineer.

Mortar joints

Joint thickness: 10 mm.

Finish: Conform to the following:

- Externally: Tool to give a dense water-shedding finish.
- Internally: If wall is to be plastered, do not rake more than 10 mm to give a key.

3.2 FACEWORK

Cleaning

General: Clean progressively as the work proceeds to remove mortar smears, stains and discolouration. Do not erode joints if using pressure spraying.

Acid solution: Do not use.

Colour mixing

Distribution: In facework, distribute the colour range of units evenly to prevent colour concentrations and banding.

Sills and thresholds

General: Solidly bed sills and thresholds and lay them with the top surfaces to drain away from the building.

Minimum size of unit: Three quarters full width.

Access openings

General: In internal walls, leave door-width openings beneath doorways to give access to underfloor areas.

Air vent location

General: Provide air vents to give adequate cross ventilation to the space under suspended ground floors.

3.4 **CAVITY WORK**

Cavity width

General: Construct minimum cavity widths in conformance with the following:

- Masonry walls: 50 mm.
- Masonry veneer walls: 40 mm between the masonry leaf and the loadbearing frame and 25 mm minimum between the masonry leaf and sheet bracing.

3.5 **DAMP-PROOF COURSES**

Location

General: To AS 4773.2 clause 9.6 and clause 10.5.

Installation

General: Lay in long lengths. Lap the full width of angles and intersections and 150 mm at joints. Step as necessary, but not more than 2 courses per step for brickwork and 1 course per step for blockwork. Sandwich damp-proof courses between mortar.

3.6 **FLASHINGS**

Location

General: To AS 4773.2 clause 9.6 and clause 10.5.

Installation

General: Sandwich flashings between mortar except where on lintels.

Pointing: Point up joints around flashings to fill voids.

Weepholes

Location: Provide weepholes to external leaves of cavity walls in the course immediately above flashings, and cavity fill, and at the bottoms of unfilled cavities.

Form: Open perpend.

Maximum spacing: 1200 mm.

0342 LIGHT STEEL FRAMING

1 GENERAL

1.1 STANDARDS

General

Design, materials and protection: To AS/NZS 4600.

Residential and low-rise steel framing: To NASH-1 (National Association of Steel Housing) and NASH-2 Standard.

2 EXECUTION

2.1 GENERAL

Fabrication

Length: Cut members accurately to length so that they fit firmly against abutting members.

Service holes: Form holes by drilling or punching.

Bushes: Provide plastic bushes or grommets to site cut holes.

Swarf: Immediately remove swarf and other debris from cold-formed steel framing.

Prefabricated wall frames and trusses

Assembly: Factory assemble wall frames and trusses.

Bracing: Provide details of bracing.

Certification: Obtain certification from a professional engineer for the erected frames.

Protection: Protect from damage or distortion during storage, transport and erection. Provide temporary protection for members until permanent covering is in place

Site work

Requirement: On-site welded connections are not permitted.

Metal separation

General: Install lagging to separate non-ferrous service pipes and accessories from the framing.

Unseasoned or CCA treated timber

General: Do not fix in contact with framing without fully painting the timber and/or the steel.

Earthing

Permanent earthing: Required.

Protection

General: Restore coatings which have been damaged by welding or other causes. Thoroughly clean affected areas back to base metal and coat with a zinc rich organic primer.

Grommets: Provide grommets to isolate piping and wiring from cold-formed steel framing.

Decks and balconies

Attachment to external walls: To BCA 3.10.6.

Vermin barriers

Requirement: Provide vermin barriers as follows:

- Brick veneer barrier: Fix 10 mm steel galvanized wire mesh to the underside of the bottom plate of external stud walls, extending across the cavity for building into brickwork.

Anti-ponding boards

Standard: To AS 4200.2.

Fascia, valley and barge boards

Requirement: Fix fascia, valley gutter boards and barge boards in conformance with the manufacturer's recommendations.

0382 LIGHT TIMBER FRAMING

1 GENERAL

1.1 STANDARDS

General

Residential timber framed construction: To AS 1684.2, AS 1684.3 or AS 1684.4, as appropriate.

Nailplated roof trusses: To AS 1720.5.

2 EXECUTION

2.1 GENERAL

Fabrication

Length: Cut members accurately to length so that they fit firmly against abutting members.

Service holes: Form holes by drilling.

Prefabricated wall frames and trusses

Assembly: Factory assemble wall frames and trusses.

Bracing: Provide details of bracing.

29/10/2025

Certification: Obtain certification from a professional engineer for the erected frames.

Protection: Protect from damage or distortion during storage, transport and erection. Provide temporary protection for members until permanent covering is in place.

Timber fasteners

Metal washers: Provide washers to the heads and nuts of all bolts and coach screws.

Connectors: Press connector plates fully into the frame members. Knots not permitted in plate area.

Joints

General: No gaps greater than 2 mm.

Priming

Steel: Before fixing, prime steel which is not galvanized or metallic-coated.

Decks and balconies

Attachment to external walls: To BCA 3.10.6.

Vermin barriers

Requirement: Provide vermin barriers as follows:

- Brick veneer barrier: Close nail 10 mm galvanized steel wire mesh to the underside of the bottom plate of external stud walls, extending across the cavity for building into brickwork.

Anti-ponding boards

Standard: To AS 4200.2.

Fascia, valley and barge boards

Requirement: Fix fascia, valley gutter boards and barge boards.

Damp-proof course

Requirement: Provide damp-proof courses under the bottom plate of stud walls built off slabs or masonry dwarf walls, as documented and as follows:

- External walls (not masonry veneer): Turn up at least 75 mm on the inside and tack. Project 10 mm beyond the external slab edge or dwarf wall and turn down at 45°.
- Walls of bathrooms, shower rooms and laundries: Turn up at least 150 mm on the wet side and tack to studs.

Flashings

Location: Provide flashings to external openings sufficient to prevent the entry of moisture. Form trays at the ends of sill flashings.

Masonry veneer construction: Extend flashing across cavities and build into brickwork.

0383 SHEET FLOORING AND DECKING

1 GENERAL

1.1 STANDARDS

General

Flooring and decking: To AS 1684.2, AS 1684.3 or AS 1684.4, as appropriate.

2 PRODUCTS

2.1 DECKING

New timber decking

Standard:

- Treated softwood to AS 4785.1 Section 4.
- Hardwood to AS 2796.1 Section 4.

2.2 SHEET FLOORING

Plywood

Standard: To AS/NZS 2269.0.

Bond: Type A to AS/NZS 2754.1.

Particleboard

Particleboard: To AS 1860.1, Class 1.

Compressed fibre cement sheeting

Standard: To AS/NZS 2908.2.

Category: Minimum 4.

3 EXECUTION

3.1 GENERAL

Decking on steel joists

General: Screw fix seasoned timber battens to the steel joists so that their top surfaces are aligned.

3.2 FIXING SHEET FLOORING

Particleboard flooring

Installation: To AS 1860.2.

Plywood flooring

Installation: To AS 1684.2, AS 1684.3 or AS 1684.4, as appropriate.

Compressed fibre cement flooring

Installation: Lay the length of the sheets at right angles to the joists. Stagger the end joints and locate centrally over joists. Apply adhesive to edges of sheets and firmly butt join together.

Minimum number of spans across support: 2.

Fixing: Pre-drill screw holes with 1 mm clearance over screw diameter and countersink. Fix with corrosion resistant countersunk screws.

Spacing of fasteners:

- Sheet edge and intermediate: Less than 450 mm.
- Corners and sheet edges: At least 12 mm from sheet edges and 50 mm from corners.

Wet area flooring: Stop screw heads with sealant.

3.3 FIXING DECKING

Timber decking

Installation: Lay in long lengths with the ends of each board firmly butted to the next and firmly in contact with the joists. Stagger joints and make over joists.

Gap between edges of seasoned boards: 4 mm.

Minimum number of spans across support: 3.

Nailing:

- General: Make sure the boards are in contact with the joists at the time of nailing, particularly where boards are machine nailed. If nails are to be less than 10 mm from ends of boards, pre-drill nail holes 0 to 1 mm undersize.
- Top nailing: Double nail at each bearing with nails driven flush. Offset nails at intermediate fixings or skew nail 10° in opposite directions.

Sealing: Apply 1 coat of water repellent preservative and 1 coat of finish coat to top surface of joists and all surfaces of boards before fixing.

1 PRODUCTS

1.1 COMPONENTS

Fasteners

Prefinished exposed fasteners: Finish with an oven baked polymer coating to match the roofing material.

Insulation spacers

Description: Proprietary spacer system to prevent excessive compression of insulation between roof sheeting and framing.

1.2 MATERIALS

Sheet metal roofing

Standard: To AS 1562.1.

Corrosion protection: To BCA Table 3.5.1.1.

Roof tiling

Standard: To AS 2049.

Accessories: Compatible with the tiles and necessary to complete the tiling.

Plastic sheet roofing

Unplasticised polyvinyl chloride (PVC-U) sheet: To AS 4256.2.

Glass fibre reinforced polyester (GRP) sheet: To AS 4256.3.

Polycarbonate: To AS 4256.5.

Skylights

Standard: To AS 4285.

Skylights (roof lights) in bushfire prone areas: To AS 3959.

Roof windows

Standard: To AS 4285.

Type: A proprietary window system for non-vertical installation in roofs pitched between 15° and 85°.

Roof windows (roof lights) in bushfire prone areas: To AS 3959.

Roof ventilators

General: A proprietary roof ventilator system, including framing, fixing, trim, seals, accessories and flashings.

Finish: Match adjacent roofing.

Roof plumbing

General: Flashings, cappings, gutters, rainwater heads, outlets, downpipes and accessories necessary to complete the roof systems.

Roof draining: To AS/NZS 3500.3.

Metal rainwater goods: To AS/NZS 2179.1.

Flashing and capping: To AS/NZS 2904.

2 EXECUTION

2.1 GENERAL

Installation

General: To the manufacturer's recommendations.

Sheet metal roofing: To AS 1562.1.

Roof tiling: To AS 2050.

Plastic sheet roofing: To AS 1562.3.

Ventilation of roof space

General: To BCA 3.8.7.4.

2.2 ROOF PLUMBING

Jointing sheet metal rainwater goods

Sealing: Seal fasteners and mechanically fastened joints. Fill the holes of blind rivets with silicone sealant.

Flashings and cappings

Upstands: Flash projections above or through the roof with two part flashings consisting of an apron flashing and an over-flashing, with at least 100 mm vertical overlap. Provide for independent movement between the roof and the projection.

Wall abutments: Provide overflashings where roofs abut walls, stepped to the roof slope in masonry and planked cladding, otherwise raking and as follows:

- In masonry: Build into the full width of the outer leaf. Turn up within cavity, sloping inward across the cavity and fixed to or built in to the inner leaf at least 75 mm above.

Gutters

Minimum slope of eaves gutters: 1:200.

Minimum width overall of valley gutters: 400 mm.

Eaves gutter overflow measures: To BCA 3.5.3.4.

Downpipes

General: Prefabricate downpipes to the required section and shape where possible. Connect heads to gutter outlets and, if applicable, connect feet to rainwater drains.

Downpipe support: Provide supports and fixings for downpipes.

0431 CLADDING

1 PRODUCTS

1.1 MATERIALS

Hardboard planks

Requirement: Proprietary wet process fibreboard planks.

Standard: To AS/NZS 1859.4.

Classification: Exterior.

Plank thickness: 9.5 mm.

Joints and edges: PVC-U extrusions.

External corners: Preformed metal joining pieces.

Internal corners: Scribe.

Fibre cement planks

Requirement: Proprietary system of single faced fibre cement building planks.

Standard: To AS/NZS 2908.2. Type A Category 3.

Plank thickness: 7.5 mm.

Joints and edges: PVC-U extrusion.

Corners: Preformed metal joining pieces.

Profiled sheet metal

Standard: To AS 1562.1.

Fibre cement sheet

Standard: To AS/NZS 2908.2.

Cladding, eaves and soffit linings: Type A Category 3.

Compressed cladding: Type A Category 5.

Sheet cladding: A proprietary system of single faced fibre cement sheets:

- Arrangement: Set out in even panels with joints coinciding with framing.
 - Sheet thickness: 6 mm.
 - Joints, corners and edges: PVC-U extrusion.
- Eaves lining: Single faced fibre cement:

- Sheet thickness: 4.5 mm.

- Joints: PVC-U extrusion.

Plastic sheets

Requirement: Proprietary plastic sheets.

Unplasticised polyvinyl chloride (PVC-U) sheet: To AS 4256.4.

Glass fibre reinforced polyester (GRP) sheet: To AS 4256.3.

Polycarbonate: To AS 4256.5.

1.2 COMPONENTS

Flashing material

Standard: To AS/NZS 2904.

2 EXECUTION

2.1 GENERAL

Cladding

Installation: To the manufacturer's recommendations.

0451 WINDOWS AND GLAZED DOORS

1 GENERAL

1.1 STANDARDS

General

Selection and installation: To AS 2047.

Glazing

Glass type and thickness: To AS 1288, if no glass type or thickness is nominated.

2 PRODUCTS

2.1 GENERAL

Glass

Safety glass: To AS/NZS 2208.

Aluminium frame finishes

Powder coating: To AS 3715.

Anodising: To AS 1231:

- Thickness: ≥ 15 to 20 microns.

Flashings

Standard: To AS/NZS 2904.

Window labelling and certification

Requirement: To AS 2047 Section 8.

Protection of openable windows

Fall prevention: To BCA 3.9.2.6 and BCA 3.9.2.7.

Testing: To AS 5203.

2.2 COMPONENTS

Insect screens

Aluminium framed insect screens: Provide aluminium extruded or folded box frame sections with mesh fixing channel, mitred, staked and screwed at corners. Provide an extended frame section where necessary to adapt to window opening gear.

- Mesh: Bead the mesh into the frame channel with a continuous resilient gasket, so that the mesh is taut and free of distortion.

Bushfire screens and seals

Protection: Protect glazed windows and doors from the ingress of embers.

Standard: AS 3959.

Security screens

Security grilles and screen doors: To AS 5039.

Installation: To AS 5040.

2.3 HARDWARE

Hardware documented generically

General: Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use, compatible with associated hardware, and fabricated with fixed parts firmly joined.

3 EXECUTION

3.1 INSTALLATION

Preglazing

Window assemblies and glazed doors: Supply inclusive of glazing, shop preglazed.

Weatherproofing

Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, joint sealant and pointing to prevent water from penetrating the building between frames and the building structure under prevailing service conditions, including normal structural movement of the building.

Fixing

Packing: Pack behind fixing points with durable full width packing.

Prepared masonry openings: If fixing of timber windows to prepared anchorages is by fastening from the frame face, conceal the fasteners by sinking the heads below the surface and filling the sinking flush with a material compatible with the surface finish.

Trim

General: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the window frames. Install to make neat and clean junctions between frames and the adjoining building surfaces.

0453 DOORS AND ACCESS PANELS

1 GENERAL

1.1 STANDARDS

General

Timber and composite doors: To AS 2688.

2 PRODUCTS

2.1 DOOR FRAMES

Aluminium frames

Construction: Assembled from aluminium sections, including accessories such as buffers, pile strips, strike plates, fixing ties or brackets and cavity flashing, with provision for fixing documented hardware.

Timber frames

Hardwood: To AS 2796.1.

- Grade: Select.

Softwood: To AS 4785.1.

- Grade: Select.

Joints:

- Morticed head and through tenons.

- Trenched head:

. Bare faced tenons on jambs.

2.2 DOORS

General

Doors: Proprietary products manufactured for interior or exterior applications and for the finish required.

Flush panel doors

General: Provide flush panel doors of balanced construction.

Construction

Standard: To AS 2688 clause 4.1 and 5.3.

Tolerances

Standard: To AS 2688 clauses 4.1 and 5.3.

Security screen doors

Standard: To AS 5039.

Bushfire screens and seals

Protection: Protect glazed windows and doors from the ingress of embers.

Standard: AS 3959.

2.3 SLIDING INTERNAL DOORS

Face mounted

General: Provide overhead track supports and head and jamb linings appropriate to the arrangement of the door, and removable pelmets at the head to allow access to the wheel carriages for adjustment.

Wheel carriages: Fully adjustable precision ball race type providing smooth, quiet operation.

Cavity sliding

Door assemblies: Proprietary product comprising steel and timber frame construction with rigid steel top, base and rear supporting members and incorporating the overhead door track, ball race type wheel carriages, guides, stops, split jamb linings and removable pelmet.

2.4 ANCILLARY MATERIALS

Flashings

Standard: To AS/NZS 2904.

3 EXECUTION

3.1 GENERAL

Security screen doors

Installation: To AS 5040.

Ceiling access

General: Trim an opening and provide a loose access panel of minimum size 600 x 400 mm.

Under floor access

Requirements: Provide a frame and a door, minimum size 620 mm wide x 600 mm high, complete with padbolt.

Priming

General: Prime timber door leaves on top and bottom edges before installation.

3.2 FRAMES

Timber frames

Building into masonry: Screw galvanized steel brackets twice to jambs and build in.

Fixing to masonry openings: Build in seasoned timber plugs to masonry joints or use proprietary expansion anchors and screw twice through jambs at each fixing.

Fixing to stud frame openings: Back screw twice to jambs at each fixing.

Heads of fasteners: Conceal where possible, otherwise sink the head below the surface and fill the sinking flush with a material compatible with the surface finish.

Finishing

Trim: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the door frames. Install to make neat and clean junctions between the frame and the adjoining building surfaces.

Weatherproofing

Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing to prevent water from penetrating the building between the door frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

0454 OVERHEAD DOORS

1 GENERAL

1.1 STANDARD

General

Garage doors: To AS/NZS 4505.

0455 DOOR HARDWARE

1 PRODUCTS

1.1 COMPONENTS

Hinges

Requirement: Provide 3 hinges for external doors and door leaves over 2040 mm in height and 600 mm in width.

Conform to the **Hinges table**.

Hinges table

Size of door (mm x mm)	Number of hinges (per door leaf)	Size of hinges (steel)
2040 x 920	3	100 x 75 x 2.5 mm
2040/2400 x 1020	4	100 x 100 x 2.5 mm

Locksets

External doors: Push-button key and knob set and a double-cylinder dead bolt to each door.

Internal doors:

- Generally: Passage sets.
- Bathrooms, showers and toilets: Privacy sets.
- Sliding patio doors and windows: Key-lockable surface mounted bolts.

Keying

Requirement: Key doors (excluding garage doors) alike and key windows alike.

2 EXECUTION

2.1 INSTALLATION

Supply

Delivery: Deliver door hardware items, ready for installation, in individual complete sets for each door.

Mounting height

Door lockset mounting heights: 1000 mm above finished floor to centreline of spindle.

Locks

Cylinders: Fix vertically and with consistent key alignment.

Fixing: Fix on the floor, skirting or wall, as appropriate, to prevent the door or door furniture striking the wall or other surface.

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0467 GLASS COMPONENTS

1 GENERAL

1.1 SUBMISSIONS

Certification

Balustrade design: Submit a professional engineer's certificate confirming conformance with AS/NZS 1170.1 clause 3.6.

Sealant compatibility: Submit statements from all parties to the installation certifying the compatibility of sealants and glazing systems to all substrates.

2 PRODUCTS

2.1 MIRRORS

Reflective surface

Type: Silver layer deposited on the glass or glazing plastic.

Protective coatings: Electrolytic copper coating at least 5 microns thick, and 2 coats of mirror backing and edge sealing paint having a total dry film thickness of at least 50 microns.

Safety mirror

Type: Vinyl backed Grade A safety mirror.

Safety compliance: To AS/NZS 2208.

2.2 SHOWER SCREENS

Type

General: Proprietary system comprising frames of extruded aluminium, stainless steel, or PVC-U, assembled around safety glass to form fixed panels and sliding, hinged or pivoted doors.

Glass: To AS 1288 clause 5.8.

2.3 GLASS BALUSTRADES

Glass Balustrade system

Requirement: To AS 1288 Section 7.

Glass: Grade A safety glass.

0471 THERMAL INSULATION AND PLIABLE MEMBRANES

1 GENERAL

1.1 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definition applies:

- Pliable building membrane: To AS/NZS 4200.1 and equivalent to sarking-type material in the NCC.

2 PRODUCTS

2.1 MATERIALS

Insulation

Cellulosic fibre (loose fill): To AS/NZS 4859.1 Section 4.

Mineral wool blankets and cut pieces (compressible): To AS/NZS 4859.1 Section 7.

Polyester (compressible): To AS/NZS 4859.1 Section 6.

Rigid cellular foam insulation: To AS/NZS 4859.1 Section 8.

Polystyrene (extruded rigid cellular RC/PS-E): To AS 1366.4.

Polystyrene (moulded rigid cellular RC/PS-M): To AS 1366.3.

Reflective thermal insulation: To AS/NZS 4859.1, Section 9.

Wool: To AS/NZS 4859.1, Section 5.

Pliable building membrane

Standard: To AS/NZS 4200.1 and BCA 3.12.1.1.

3 EXECUTION

3.1 GENERAL

Bulk insulation

Standard: To AS 3999 and BCA 3.12.1.1.

Pliable building membrane

Standard: To AS 4200.2 and BCA 3.12.1.1.

3.2 FLOOR INSULATION

Under suspended framed floors - bulk insulation

Product type: Fibre batts.

Installation: Fit tightly between framing members. If other support is not provided, staple nylon twine to the framing and stretch tight.

Below concrete slab on ground

Product type: Rigid cellular extruded sheets.

Laying pattern: Stretcher bond, with edges tightly butted.

Damp-proof membrane: Lay over insulation.

3.3 WALLS

Framed walls – thermal break strips

Product type: Proprietary item.

Application: To steel framing with lightweight external cladding.

R-Value (m².K/W): ≥ 0.2.

Screw fixing: Button head screws at 1 m centres.

Adhesive fixing: Wallboard adhesive walnuts at 1 m centres.

Framed walls – bulk insulation

Product type: Fibre batts.

Installation: Friction fit between framing members. If other support is not provided, staple nylon twine to the framing and stretch tight.

Vapour permeable (breathable) membrane

Application: Provide a vapour permeable membrane behind the external facing material which does not provide permanent weatherproofing or may be subject to condensation forming on the internal face, including the following:

- Boards or planks fixed vertically or diagonally.
- Boards or planks fixed in exposed locations where wind driven rain can penetrate the joints.
- Unpainted or unsealed cladding.
- Masonry veneer.

Installation: Run the vapour permeable membrane horizontally on the outer face of external wall framing, over the flashing, from the bottom plate up. Pull taut over the framing and fix to framing members. Seal across the wall cavity at the top.

Horizontal laps: At least 150 mm wide, lapped to make sure water is shed to the outer face of the membrane.

3.4 ROOFS

Pliable building membranes

Sarking membrane:

- Location: Provide sarking under tile and shingle roofing.

Vapour barrier:

- Installation: Lay over the roof framing with sufficient sag to allow the bulk insulation to achieve its full thickness. Overlap all edges 150 mm and seal all joints with pressure sensitive adhesive tape.

Metal roofs – thermal break strips

Product type: Proprietary item.

Application: To steel framing supporting sheet metal roofing.

R-Value ($m^2.K/W$): ≥ 0.2 .

Metal roofs – bulk insulation

Product type: Fibre blankets or batts.

Installation:

- Batts: Fit tightly between framing members.
- Blanket for sound insulation: Install over the roof framing, reflective thermal insulation (if any), and mesh support, so that the blanket is in continuous contact with the underside of the metal roofing sheets.

Ceiling insulation – bulk insulation

Product type: Fibre batts.

Installation: Fit tightly between framing members.

0511 LINING

1 GENERAL

1.1 STANDARDS

Plasterboard

Standard: To AS/NZS 2588.

Fibre cement

Standard: To AS/NZS 2908.2.

Wall and ceiling linings: Type B, Category 2.

Minimum thickness: 4.5 mm.

2 EXECUTION

2.1 SHEET LINING

Installation

Gypsum plasterboard: To AS/NZS 2589.

Wet areas: To AS 3740.

- Fixing: Do not use adhesive fixing alone.

Supports

General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:

- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the plasterboard is not possible due to the arrangement or alignment of the framing or substrate.
- Where the lining is the substrate for tiled finishes.

- If required to support fixtures.

Joints

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

External corner joints: Make joints over metallic-coated steel corner beads.

Control joints: Provide purpose-made metallic-coated control joint beads at not more than 12 m centres in plasterboard linings or 7.2 m centres in fibre cement lining in walls and ceilings and to coincide with structural control joints.

Wet areas: Install additional supports, flashings, trim and sealants as required.

Joints in tiled areas: Do not apply a topping coat after bedding perforated paper tape in bedding compound.

0551 JOINERY

1 PRODUCTS

1.1 MATERIALS

Joinery timber

Hardwood for trim: To AS 2796.1.

Hardwood for furniture: To AS 2796.3.

Seasoned cypress pine: To AS 1810.

Softwood for trim: To AS 4785.1.

Softwood for furniture: To AS 4785.3.

Finished sizes for milled timber: Not less than the documented dimension unless qualified by a term such as nominal, out of or ex, to which industry standards for finished sizes apply.

Plywood

Interior use generally: To AS/NZS 2270.

Interior use, exposed to moisture: To AS/NZS 2271.

Wet process fibreboard (including hardboard)

Standard: To AS/NZS 1859.4.

Particleboard

Standard: To AS/NZS 1859.1.

Dry process fibreboard (including medium density fibreboard)

Standard: To AS/NZS 1859.2.

Decorative overlaid wood panels

Standard: To AS/NZS 1859.3.

Certification

Branding: Brand panels under the authority of a recognised certification scheme applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

Plywood certified formaldehyde emission class to AS/NZS 2270 and AS/NZS 2271: E₁.

Reconstituted wood-based panel certified formaldehyde emission class to AS/NZS 1859 series: E1.

High-pressure decorative laminate (HPDL) sheets

Standard: To AS/NZS 2924.1.

Minimum thickness: Conform to the following:

- For horizontal surfaces fixed to a continuous substrate: 1.2 mm.
- For vertical surfaces fixed to a continuous substrate: 0.8 mm.
- For post formed laminate fixed to a continuous substrate: 0.8 mm.

- For vertical surfaces fixed intermittently (e.g. to studs):
3.0 mm.

- For edge strips: 0.4 mm.

HPDL sheet application table

Class to AS/NZS 2924.1	Application
HGS or HGP	Kitchen work-tops
VGS or VGP	Kitchen front panels
MS	Other vertical locations

1.2 JOINERY ASSEMBLIES

General

Standard: To AS 4386.

1.3 WARDROBE, CUPBOARD AND DRAWER UNITS

Plinths, carcasses, drawer fronts, shelves and doors

Material: Select from the following:

- Overlaid high moisture resistant particleboard.
- Overlaid high moisture resistant medium density fibreboard.

Thickness: 16 mm.

Adjustable shelves: Support on proprietary pins in holes bored at equal 32 mm centres vertically.

Fasteners: Conceal with finish.

Drawer fronts: Rout for drawer bottoms.

Drawer and door hardware

Hinge types: Concealed metal hinges with the following features:

- Nickel plated.
- Adjustable for height, side and depth location of door.
- Integrated soft and self-closing action.
- Hold-open function.

Slides: Metal runners and plastic rollers with the following features:

- 30 kg loading capacity.
- Integrated soft and self-closing action.
- Closure retention.
- White thermoset powder coating or nickel plated.

Hardware

Requirement: Provide details of handles and locks.

1.4 WORKING SURFACES

Laminated benchtops

Material: High moisture-resistant particleboard or medium density fibreboard.

Finish: High pressure decorative laminate sheet.

Exposed edges: Extend laminate over shaped nosing, finishing more than 50 mm back on underside. Splay outside corners at 45°.

Minimum thickness: 32 mm.

Balance underside: Extend laminate to the undersides of benchtops if subject to excessive moisture from equipment such as dishwashers.

Stone benchtops

General: Provide stone or engineered stone slabs within the visual range of the approved samples. Repair mud veins or lines of separation that are integral to the selected pattern with resin fillers and back lining.

Splashbacks

Glass: 6 mm toughened colourback glass to AS/NZS 2208.

Stainless steel: Type 304, No. 4 finish.

2 EXECUTION

2.1 JOINERY

General

Joints: Provide materials in single lengths whenever possible. If joints are necessary, make them over supports.

Framing: Frame and trim where necessary for openings, including those required by other trades.

Fasteners

Installation: Secure plinths and carcasses to floors, walls, or both at not more than 600 mm centres.

Visibility: Do not provide visible fasteners except in the following locations:

- Inside cupboards and drawer units.
- Inside open units, in which case provide proprietary caps to conceal fixings.

Adhesives

General: Provide adhesives to transmit the loads imposed and for the rigidity of the assembly, without causing discolouration of finished surfaces.

Finishing

Junctions with structure: Scribe plinths, benchtops, splashbacks, ends of cupboards, kickboards and returns to follow the line of structure.

Benchtops

Installation: Fix to carcass at least twice per 600 mm length of benchtop.

Joint sealing: Fill joints with sealant matching the finish colour and clamp with proprietary mechanical connectors.

Edge sealing: Seal to walls and carcasses with a sealant, which matches the finish colour.

Glass splashbacks

Adhesive: Fix with non-acidic silicone adhesive. Apply at the rate recommended by the manufacturer.

Installation: Clean the back of the glass panel and apply walnuts of adhesive together with double sided adhesive tape for temporary support, and affix directly to the substrate.

2.2 TRIM

General

Requirement: Provide timber or medium density fibreboard trim, such as beads, skirtings, architraves, mouldings and stops to make neat junctions to openings and between components, finishes and adjacent surfaces.

Proprietary items: Provide complete with installation accessories.

Fixing

To masonry walls: Wall plugs at 600 mm centres, maximum.

To stud walls: Nail to plate or framing at 600 mm centres, maximum.

0572 MISCELLANEOUS FIXTURES AND APPLIANCES

1 PRODUCTS

1.1 COMPONENTS

General

Requirement: Provide kitchen and laundry appliances, and bathroom and other fixtures as documented.

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General

Materials design and construction: To BCA 3.9.1.

Handrails: To BCA 3.9.2.

Requirements: Provide details of stairs, including proposed finishes, before fabrication and/or construction.

0611 RENDERING AND PLASTERING

1 PRODUCTS

1.1 MATERIALS AND COMPONENTS

Aggregates

Sand: Fine, sharp, well-graded sand with a clay content between 1% and 5% and free from efflorescing salts.

Cement

Standard: To AS 3972.

Type: GP.

Lime

Limes for building: To AS 1672.1.

Mixes

General: Select a mix proportion to suit the conditions of application.

Measurement: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

Plaster mixing: Machine mix for 3 to 6 minutes.

Strength of successive coats: Make sure successive coats are no richer in binder than the coat to which they are applied.

Mix proportion table - Cement render, by volume

Mix type	Substrate		Upper and lower limits of proportions by volume		
			Cement	Lime	Sand
- Single or multi-coat systems with integral finishing treatments - Base coats in multi-coat systems with cement or gypsum finishes	CRS	Dense and smooth concrete and masonry	1 1	0 0.5	3 4.5
	CRM	Regular clay or concrete masonry	1 1	0.5 1	4.5 6
	CRW	Lightweight concrete masonry and other weak substrates	1 1	1 2	6 9
Second coat - internal	CRF	Cement render base coats	1 1	1 2	6 9
Second coat - external	CRF	Cement render base coats	1 1	1 2	5 6

Lath

General: Provide a proprietary product for use with plaster.

Internal: Expanded metal to AS 1397 coating class Z350, minimum.

External: Stainless steel or PVC-U.

Beads

General: Provide a proprietary product for use with plaster.

Internal: Metallic-coated sheet AZ 150, minimum.

External: Stainless steel or PVC-U.

Water

General: Clean and free from any deleterious matter.

2 EXECUTION

2.1 PREPARATION

Substrates

General: Provide substrates as follows:

- Clean and free from any deposit or finish which may impair adhesion of plaster.
- If framed or discontinuous, support members in full lengths without splicing.
- If solid or continuous, remove excessive projections and fill voids and hollows with plaster stronger than the first coat and not weaker than the substrate.

Untrue substrates: If the substrate is not sufficiently true for conformity with the thickness limits for the plaster system, or has excessively uneven suction resulting from variations in the composition of the substrate, apply additional coats without exceeding the thickness limits for the substrate or system.

Beads

Location: Fix beads as follows:

- Angle beads: At all external corners.
- Drip beads: At all lower terminations of external plaster.
- Beads for control of movement: At all control joints.
- Stop beads: At all terminations of plaster and junctions with other materials or plaster systems.

Joints in beads: Provide dowels to maintain alignment.

Mechanical fixing to substrate: ≤ 300 mm centres.

Bonding treatment

General: If bonding treatment is required, throw a wet mix onto the background of 1 part cement to 2 parts sand.

Curing: Keep continuously moist for 5 days or more and allow to dry before applying plaster coats.

Embedded items

General: If there are water pipes and other embedded items, sheath them to permit thermal movement.

Lath

Location: Provide lath as follows:

- Chases: If chases or recesses are 50 mm wide or greater, fix metal lath extending 75 mm or more beyond each side of the chase or recess.
- Metal and other non-porous backgrounds: Fix metal lath to provide a key.

Weepholes

Requirement: Keep opening free of plaster. Maintain consistent opening size.

2.2 APPLICATION

Control joints

General: Provide joints in the finish to coincide with control joints in the substrate. Make sure that the joint in the substrate is not bridged during plastering.

Tolerances

General: Finish plane surfaces within a tolerance of 6 mm in 2400 mm, determined using a 2400 mm straightedge placed anywhere in any direction. Finish corners, angles, edges and curved surfaces within equivalent tolerances.

Plaster thickness table

Substrate	Cement render, total thickness of single or multi-coat work (mm)
Brickwork and blockwork	12 min
Lightweight concrete and blocks	12 min
Metal lath measured from the face of the lath.	18 min

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Curing

General: Prevent premature or uneven drying out and protect from the sun and wind.

Keeping moist: If a proprietary curing agent is not used, keep the plaster moist as follows:

- Base coats and single coat systems: Keep continuously moist for 2 days and allow to dry for 5 days before applying further plaster coats.
- Finish coats: Keep continuously moist for 2 days.

0621 WATERPROOFING - WET AREAS

1 GENERAL

1.1 STANDARDS

Wet areas

Standard: To AS 3740.

2 PRODUCTS

2.1 PRODUCTS

Membranes

Standard: To AS/NZS 4858.

Membrane systems

Requirement: Provide a proprietary membrane system suitable for the intended internal waterproofing.

Shower tray

General: Purpose-made jointless shower tray, with wall upstands at least 50 mm higher than the hob upstands. Set hob masonry on the inside of the tray upstands.

3 EXECUTION

3.1 PREPARATION

Substrates

General: Provide substrates as follows:

- Clean and free of any deposit or finish which may impair adhesion of membranes.
- If walls or floors are framed or discontinuous, support members in full lengths without splicing.
- If floors are solid or continuous remove excessive projections and fill voids, hollows and cracks.

Concrete substrates: Cure for at least 28 days.

Bond breakers

Requirement: After the priming of surfaces, provide bond breakers at all wall/floor, hob/wall junctions and at control joints where the membrane is bonded to the substrate.

3.2 APPLICATION

Protection

Damage: Protect membrane from damage during installation and for the period after installation until the membrane achieves its service characteristics that resist damage.

Extent of waterproofing

Waterproof or water resistant surfaces: To requirements of BCA 3.8.1.2.

Vertical membrane terminations

Upstands: At least 150 mm above the finished tile level of the floor or 25 mm above the maximum retained water level, whichever is the greater.

Anchoring: Secure sheet membranes along the top edge.

Edge protection: Protect edges of the membrane.

Waterproofing above terminations: Waterproof the structure above the termination to prevent moisture entry behind the membrane using tiler's angle and finish overlaps.

Door jambs and architraves

Requirement: If the bottom of doorjamb and architraves do not finish above the floor tiling, waterproof their surfaces below tile level to provide a continuous seal between the perimeter flashing to the wall/floor junction and the water stop angle.

Drainage connections

Floor wastes: Turn membrane down 50 mm minimum into the floor waste drainage flanges and adhere to form a waterproof connection.

Enclosed showers with hobs

Internal membranes: Extend membrane over the hob and into the room at least 50 mm.

Unenclosed showers

Requirement: Extend membrane at least 1500 mm into the room from the shower rose outlet on the walls and floor.

Curing of liquid applied systems

General: To the manufacturer's instructions.

Curing: Allow membrane to fully cure before tiling.

Overlaying finishes on membranes

Requirement: Protect waterproof membranes with compatible water-resistant surface materials that do not cause damage to the membrane.

Bonded or partially bonded systems: If the topping or bedding mortar is required to be bonded to the membrane, provide sufficient control joints in the topping or bedding mortar to reduce the movement over the membrane.

3.3 COMPLETION

Protection

General: Keep traffic off membrane surfaces until bonding has set or for 24 hours after laying, whichever period is the longer.

Reinstatement: Repair or replace faulty or damaged work.

0631 CERAMIC TILING

1 GENERAL

1.1 STANDARDS

Tiling

General: Conform to the recommendations of AS 3958.1.

Slip resistance

Stair treads, ramps and landings: Classification to AS 4586.

2 PRODUCTS

2.1 MATERIALS

Adhesives

Standard: To AS ISO 13007.1.

PVA (polyvinyl acetate)-based adhesives: Do not use in wet areas or externally.

Mortar materials

Cement type to AS 3972: GP.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.

Bedding mortar

Mix Proportions (cement:sand), by volume: Select proportions from the range 1:3 to 1:4 for satisfactory adhesion. Provide minimum water.

Water

General: Clean and free from any deleterious matter.

Grout

Cement-based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Terracotta tiles: Provide proprietary polymer modified grout.

General purpose cement based grout: Mix with fine sand. Provide minimum water consistent with workability.

Pigments for coloured grout: Colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.

3 EXECUTION

3.1 APPLICATION

Preparation of substrate

General: Conform to the following:

- Clean off any deposit or finish which may impair adhesion or location of tiles.
- Compatible with all components of floor system.

Floor finish dividers

General: Finish tiled floors at junctions with differing floor finishes with a corrosion-resistant metal dividing strip fixed to the substrate. If changes of floor finish occur at doorways, make the junction directly below the closed door.

Bath ventilation

General: Ventilate the space below fully enclosed baths with at least 2 vermin proofed ventilating tiles.

Falls and levels

General: Grade floor tiling to even and correct falls generally and to floor wastes and elsewhere as required. Make level junctions with walls. If falls are not required, lay level.

Fall, general: 1:100 minimum.

Fall, in shower areas: 1:60 minimum.

Change of finish: Maintain finished floor level across changes of floor finish including carpet.

Sealant joints

General: Provide sealant joints filled with silicone sealant and finish flush with the tile surface where tiling joins sanitary fixtures and at internal corners of walls.

0651 RESILIENT FINISHES

1 GENERAL

1.1 STANDARDS

General

Installation: To AS 1884.

2 PRODUCTS

2.1 MATERIALS

Wet process fibreboard (hardboard) hard underlay

Standard: To AS/NZS 1859.4.

Classification: General purpose medium board, manufactured specifically as flooring underlay.

Thickness: 5.5 mm.

3 EXECUTION

3.1 PREPARATION

Substrates

General: To AS 1884 Section 3.

Concrete substrates

Substrate rectification: Conform to the following:

- Surface treatments: Mechanically remove any incompatible surface treatments, including the following:
 - . Sealers and hardeners.
 - . Curing compounds.
 - . Waterproofing additives.
 - . Surface coatings and contamination.
- Planeness, smoothness, projections: Remove projections and fill voids and hollows with a self-smoothing self-levelling compound compatible with the adhesive. Allow filling or levelling compound to dry to manufacturer's recommendations.

Cleaning: Remove loose materials or dust.

Timber, plywood and particleboard substrates

Substrate rectification: Remove projections. If conformance to a planeness tolerance of 4 mm in 2 m determined using a 2 m straightedge cannot be achieved, provide an underlay in brick pattern with joints avoiding substrate joints.

3.2 SHEET AND TILE INSTALLATION

General

Fixtures: Remove door stops and other fixtures, and refix in positions undamaged on completion of the installation.

Sheet set-out

General: Set out sheets to give the minimum number of joints. Position joints away from areas of high stress. Run sheet joints parallel with the long sides of floor areas, vertically on non-horizontal surfaces.

Tile set-out

General: Set out tiles from centre of room. If possible, cut tiles at margins only to give a cut dimension of at least 100 mm x full tile width. Match edges and align patterns. Arrange the cut tiles so that any variation in appearance is minimised.

Joints

Non-welded: Butt edges together to form tight neat joints showing no visible open seams.

Chemical welding: Apply seaming compound 100 mm wide to the substrate centrally under the seam. Roll the seam until the compound is forced up into the joint. Clean off flush using a damp cloth.

Junctions

General: Scribe neatly up to returns, edges, fixtures and fittings. Finish flush with adjoining surfaces.

3.3 COMPLETION

Protection of sheet materials

Finished floor surface: Keep traffic off floors for minimum 24 hours after laying or until bonding has set, whichever period is the longer. Avoid contact with water for minimum 7 days.

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Extent: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

Cleaning

General: Clean the finished surface. Buff and polish. Before the date for practical completion, mop and leave the finished surface clean and undamaged on completion.

0652 CARPETS

1 PRODUCTS

1.1 MATERIALS

Carpet

Minimum grade: Residential Medium Duty under the Australian Carpet Classification Scheme.

Total VOC emission tested to ISO 10580: < 0.5 mg/m²/h.

Wet process fibreboard (hardboard) hard underlay

Standard: To AS/NZS 1859.4.

Classification: General purpose medium board, manufactured specifically as flooring underlay.

Thickness: 5.5 mm.

Soft underlay

Standard: To AS 4288.

Hot-melt adhesive tapes

General: Glass fibre and cotton thermoplastic adhesive-coated tape 60 mm wide on a 90 mm wide metal foil base and backed with silicon-coated release paper.

Preformed carpet grippers

General: Architectural plywood carpet grippers with 3 rows of corrosion-resistant angled pins of length appropriate to the carpet type to AS 2455.1 clause 1.5.4.

Edge strips

Location: At exposed edges of the carpet, and at junctions with different floor finishes or finishes of a different thickness. Where edge strips occur at doorways, locate the junctions directly below the closed door.

2 EXECUTION

2.1 PREPARATION

Substrates

Cleaning concrete surfaces: Mechanically remove the following surface treatments:

- Sealers and hardeners.
- Curing compounds.

Cleaning timber surfaces: Remove oil, grease and traces of applied finishes.

Concrete substrate rectification: Remove projections and fill voids and hollows with a levelling compound compatible with the adhesive.

Timber substrate rectification: Remove projections. If conformance to a flatness tolerance of 6 mm in 3000 mm, determined using a 3000 mm straightedge placed anywhere in any direction cannot be achieved, fix a hardboard underlay in brick pattern with joints avoiding substrate joints.

Fixtures: Remove door stops and other fixtures, and refix in position undamaged on completion of the installation.

2.2 LAYING CARPET

Standard

General: To AS 2455.1.

0654 ENGINEERED PANEL FLOORING

1 PRODUCTS

1.1 MATERIALS

Flooring panels

General: Provide proprietary flooring system, as documented.

Floating floor underlay

Requirement: Proprietary closed cell foam sheeting, integral to the flooring system.

Acoustic underlay

General: Resilient underlay fixed with compatible adhesive.

Adhesive

Ventilation: Provide adequate ventilation appropriate for moisture curing.

2 EXECUTION

2.1 GENERAL

Storage and handling

General: Deliver panel flooring to site in unbroken wrapping or packs. Store in dry conditions, a minimum 100 mm above the subfloor. Do not store on the subfloor until the moisture content of the subfloor is suitable for the installation of the floor. Do not store in areas with wet plaster or paint.

Subfloor

Cleaning: Remove loose material and dust and any deposits or finishes that may impair adhesion or location and functioning of control joints.

Rectification: Conform to the following:

- Solid or continuous subfloors: Remove excessive projections and fill voids and hollows with a self-smoothing levelling compound compatible with the flooring including any adhesive.
- Plywood and particleboard subfloors: If required to achieve a smooth finish, sand joints between sheets.
- Existing timber flooring subfloors: Remove cupping, rough material and surface finishes by rough sanding.

2.2 INSTALLATION

Trial set-out

General: Prepare a trial panel set-out to each area as follows to:

- Maximise the size of equal margins of cut panels.
- Locate control joints.

Control joints

General: Provide control joints as follows:

- Against vertical building elements: 12 mm wide cork filled.
- To divide floors into maximum dimensions of 6 m: 4 mm wide silicone sealant filled.

0655 TIMBER FLOORING

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1 PRODUCTS

1.1 GENERAL

Storage and handling

General: Deliver timber flooring to site in unbroken wrapping or packs. Store in dry conditions a minimum 100 mm above the subfloor. Do not store on the subfloor until the moisture content of the subfloor is suitable for the installation of the floor. Do not store in areas of wet plaster or paint.

Adhesive

Ventilation: Provide ventilation appropriate for moisture curing.

1.2 STRIP FLOORING

New timber

General: Conform to the **Grading table**.

Grading table

Product	Standard	Grade
Hardwood	AS 2796.2	High Feature Grade if available for the species selected, otherwise Select Grade
Seasoned cypress pine	AS 1810	1
Softwood - pinus ssp	AS 4785.2	Appearance
Softwood - other	AS 4785.2	Select

Recycled timber

Standard: To FWPA PN06.1039.

- Grading: To Section 5.1.

2 EXECUTION

2.1 SUPPORT FIXING

Battens for strip flooring on steel joists

General: Screw fix seasoned battens along the steel joists with countersunk screws so that their top surfaces are aligned.

2.2 FIXING TIMBER FLOORING

Control joints

Perimeters: Provide 10 mm wide expansion joints against vertical building elements.

Strip flooring: For floors greater than 6 m wide select from the following:

- Partially cramp strip flooring to allow a 1 mm gap every 600 mm or 1.5 mm every metre.
- Divide floors into maximum widths of 6 m with expansion joints 12 mm wide filled with cork.

Adhesive fixing

Strip flooring: Use a polyurethane elastomer adhesive in addition to nails.

Mechanical fixing

General: Make sure boards are in contact with the subfloor at the time of fixing, particularly where boards are machine nailed. If nails are to be less than 12 mm from ends of boards, pre-drill nail holes 0.5 to 1 mm undersize.

Top nailing: For boards of 65 to 130 mm cover width, use two nails.

Secret fixing: Do not use boards of more than 85 mm cover width, and use one staple or cleat skewed at 45° through edges.

Sinking: Punch nails 3 mm below finished surfaces and fill the sinking flush with a material tinted to match the darker tone of the flooring which is compatible with the floor finish.

Strip flooring

General: Blend floor boards from more than one pack to distribute the colour range and grade features throughout the floor.

Installation: Lay in straight and parallel lines with each board firmly butted to the next and firmly in contact with the subfloor. If laid over joists or battens cramp sufficient only to bring the boards together and no more than 800 mm of flooring at any one time. With secret fixing do not cramp more than one board at a time.

Fixing to softwood joists or battens: Apply adhesive in addition to mechanical fixing.

2.3 COMPLETION

Protection

General: Provide protection as follows:

- Floors: With hardboard taped at all butt joints. Do not cover with sheet plastic.
- Stair treads: Full timber or plywood casing.

0656 FLOOR SANDING AND FINISHING

1 GENERAL

1.1 STANDARDS

Timber flooring - sanding and finishing:

General: To AS 4786.2.

0671 PAINTING

1 GENERAL

1.1 STANDARDS

Painting

General: To the recommendations of those parts of AS/NZS 2311 referenced in this worksection.

2 PRODUCTS

2.1 PAINTING MATERIAL

Low VOC emitting paints

VOC limits for low odour/low environmental impact paint types:

- Primers and undercoats: < 65 g/litre.
- Low gloss white or light coloured latex paints for wall areas: < 16 g/litre.
- Coloured low gloss latex paints: < 16 g/litre.
- Gloss latex paints for timber doors and trims: < 75 g/litre.

Combinations

General: Do not combine products from different manufacturers in a system.

Clear timber finish systems: Provide only the combinations of putty, stain and sealer recommended by the manufacturer of the top coats.

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Delivery: Deliver paints to the site in the manufacturer's labelled and unopened containers.

Putty and fillers

Material: To the recommendation of the paint system manufacturer as suitable for the substrate and compatible with the primer.

Tinting

General: Provide only products which are colour tinted by the manufacturer or supplier.

3 EXECUTION

3.1 PREPARATION

Order of work

Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for the installation of fittings, floor sanding and laying flooring materials.

Clear finishes: Complete clear timber finishes before commencing opaque paint finishes in the same area.

Protection

General: Before painting, clean the area and protect from dust contamination. Use drop sheets and masking agents to protect surfaces, including finished surfaces and adjacent surfaces during painting.

Fixtures and furniture: Remove door furniture, switch plates, light fittings and other fixtures before painting, and refix in position on completion of painting.

Wet paint warning

Notice: Place in a conspicuous location and do not remove until the paint is dry.

Substrate preparation - generally

General: Prepare substrates to receive the painting systems.

Cleaning: Clean down the substrate surface. Do not cause damage to the substrate or the surroundings.

Filling: Fill cracks and holes with fillers, sealants, putties or grouting cements as appropriate for the finishing system and substrate, and sand smooth.

- Clear finish: Provide filler tinted to match the substrate.

Clear timber finish systems: Prepare the surface so that its attributes will show through the clear finish without blemishes, using methods including the following:

- Removal of bruises.
- Removal of discolourations, including staining by oil, grease and nailheads.
- Bleaching where necessary to match the timber colour sample.
- Puttying.
- Fine sanding, with the last abrasive no coarser than 220 grit, so that there are no scratches across the grain.

Unpainted surfaces

Standard: To AS/NZS 2311 Section 3.

Previously painted surfaces

Standard: To AS/NZS 2311 Section 7.

3.2 PAINTING

Light levels

General: During preparation of surfaces, painting and inspection, maintain light levels to ≥ 400 lux to allow close examination of the entire process.

Paint application

Standard: To AS/NZS 2311 Section 6.

Timing: Apply the first coat immediately after substrate preparation and before contamination of the substrate can

occur. Apply subsequent coats after the manufacturer's recommended drying period has elapsed.

Priming before fixing

General: Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:

- External fascia boards.
- Timber door and window frames.
- Bottoms of external doors.
- Associated trims and glazing beads.
- Timber board cladding.

Spraying

General: If the paint application is by spraying, use conventional or airless equipment that conforms to the following:

- Satisfactorily atomises paint being applied.
- Does not require paint to be thinned beyond the maximum amount recommended by the manufacturer.
- Does not introduce oil, water or other contaminants into the applied paint.

Paint with known health hazards: Not permitted on site.

Sanding

Clear finishes: Sand the sealer, using abrasive no coarser than 320 grit, without cutting through the colour. Take special care with round surfaces and edges.

Repair

Requirement: Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up new damaged decorative paintwork or misses with the paint batch used in the original application.

Repair of galvanizing

Cleaning: For galvanized surfaces which have been subsequently welded, or which have been welded, prime the affected area.

Primer: Type 2 organic zinc rich coating for the protection of steel to AS/NZS 3750.9.

Services

General: Paint new services and equipment if not embedded, except chromium, anodised aluminium, GRP, PVC-U, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Repaint proprietary items only if damaged.

3.3 PAINT SYSTEMS

Paint system description

Generally: The paint system is referred to by its final coat.

Primers and undercoats: Provide primers and undercoats recommended by the manufacturer of the selected final coat as suitable for the substrate and the final coat.

Number of coats: Unless specified as one or two coat systems, each paint system consists of at least 3 coats.

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Final coat	Applicable Australian Standard
Interior	
Flat latex	AS 3730.1
Floor varnish - moisture cured	AS 3730.27
Floor varnish - two pack solvent borne	AS 3730.27
Low gloss latex	AS 3730.3
Semi-gloss latex	AS 3730.2
Gloss latex	AS 3730.12
Exterior	
Full gloss solvent-borne	AS 3730.6
Flat latex	AS 3730.7
Low gloss latex	AS 3730.8
Gloss latex	AS 3730.10
Stain, lightly pigmented	AS 3730.28
Latex stain, opaque	AS 3730.16
Semi-gloss latex	AS 3730.9
Paving	
Paving paint, semi-gloss	AS 3730.29
Paving paint, gloss	AS 3730.29

0702 MECHANICAL DESIGN AND INSTALL

1 GENERAL

1.1 AIR CONDITIONING DESIGN

Design criteria

Outside design conditions: Use outdoor design conditions listed in AIRAH DA09, Table 1 or Table 1A for the following:

- The location geographically closest to the site.
- Comfort (or non-critical process) conditions.

Inside design conditions:

- Summer: 24°C dry bulb, 50% relative humidity.
- Winter: 21°C dry bulb.

Temperature variation: Limit the temperature difference in air conditioned spaces served by the same zone or system to 2°C as follows:

- Between any 2 points in the space from floor level to 1500 mm above floor level.
- More than 2000 mm from cooking equipment and more than 1000 mm from any other appliance.
- When outside conditions are in the range specified above.
- After the plant has been operating for one hour.
- With the temperatures measured in the same 5 minute period.

Zoning: Divide the systems into temperature controlled zones to meet the specified permissible limits in temperature variation and the system divisions documented.

Fresh air: Supply fresh air to spaces with air conditioning systems via the air handling system.

Heating: Reverse cycle.

Windows, walls, floors and roofs: Refer to drawings for construction and insulation.

Ambient noise emitted: Lower than the level that can be heard within a habitable room in any neighbouring

residential premises, regardless of whether any door or window to that room is open.

2 PRODUCTS

2.1 AIR CONDITIONING EQUIPMENT

Standards

Ducted air conditioners: To AS/NZS 3823.1.2.

Non-ducted air conditioners: To AS/NZS 3823.1.1.

Controls

General: Provide the following functions:

- Temperature control for each zone located to accurately sense zone temperature.
- Fan speed selection for multi and variable speed fans.
- Day/night zone changeover if scheduled.
- Time switch for each system with ≥ 6 temperature programs per day, separate programs for each day of the week, manual set point over ride and Vacation temperature set back.

0802 HYDRAULIC DESIGN AND INSTALL

1 GENERAL

1.1 STANDARDS

General

Plumbing and drainage: To the AS/NZS 3500 series.

Authorised products: Listed in the WaterMark Product Database, unless otherwise required by the network utility operator.

2 EXECUTION

2.1 INSTALLATION

Connections to Network Utility Operator mains

General: Excavate to locate and expose the connection points and connect to the Network Utility Operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature strips.

Piping

Embedded pipes: Do not embed pipes that operate under pressure in concrete or surfacing material.

Concealment: If practicable, conceal piping and fittings requiring maintenance or servicing so that they are accessible within non-habitable enclosed spaces such as roof spaces, subfloor spaces and ducts. Keep pipelines in subfloor spaces at least 150 mm above ground and make sure access can be provided throughout for inspection. Provide at least 25 mm clearance between adjacent pipelines (measured from the piping insulation where applicable).

Cover plates: If exposed piping emerges from wall, floor or ceiling finishes, provide cover plates of non-ferrous metal, finished to match the piping, or of stainless steel.

Pipe support materials: The same as the piping, or galvanized or non-ferrous metals, with bonded PVC-U or glass fibre woven tape sleeves where needed to separate dissimilar metals.

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General

Requirement: Finish exposed piping, including fittings and supports as follows:

In internal locations such as toilet and kitchen areas:
Chrome plate copper piping to AS 1192 service condition 2, bright.

Externally: Prime steel piping or worn fittings internally:
Paint.

- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for required identification marking. Prime steel piping and iron fittings.
- Valves: Finish valves to match connected piping.

2.3 COLD AND HEATED WATER

Standards

General: To AS/NZS 3500.1 and AS/NZS 3500.4.

Water heaters

Location: Locate water heaters where they can be maintained or replaced without damaging adjacent structures, fixtures or finishes.

Types:

- Electric water heaters: To AS/NZS 4692.1.
 - . Energy performance: To AS/NZS 4692.2.
- Gas hot water heaters: To AS/NZS 5263.1.2. If a flue damper is available for the water heater supplied, provide one.
- Energy performance: To AS/NZS 4552.2.
- Solar water heaters: To AS/NZS 2712.
- Heat pump water heaters: To AS/NZS 2712.
- Gas instantaneous water heaters: To AS/NZS 5601.1.
- Electric instantaneous water heaters: To AS/NZS 60335.2.35.

Tariff: Install so that the heating system qualifies for the tariff concession or subsidy offered by the statutory authority.

Isolating valves: Provide isolation valves to water heaters.

Heated water temperature

Standard: To AS/NZS 3500.4.

2.4 STORMWATER

Standards

General: To AS/NZS 3500.3.

Downpipe connections

General: Turn up drain branch pipelines to finish 50 mm above finished ground or pavement level.

Subsoil drains

Connection: Connect subsoil drains to the stormwater drainage system.

Trench width: Minimum 450 mm.

Subsoil drains: Provide proprietary perforated plastic pipe.

Filter fabric: Provide a polymeric fabric formed from a plastic yarn containing stabilisers or inhibitors to make the filaments resistant to deterioration due to ultraviolet light.

Filter sock: Provide a polyester permeable sock capable of retaining particles of 0.25 mm size. Securely fit or join the sock at each joint.

Pits

Cover levels: Locate the top of covers or gratings, including frames as follows:

- In paved areas: Flush with the paving surface.
- In landscaped areas: 25 mm above finished surface.

- Gratings taking surface water runoff: Set to receive the runoff without ponding.

2.5 WASTEWATER

Standards

General: To AS/NZS 3500.2.

Cleaning

During construction: Use temporary covers to openings and keep the system free of debris.

On completion: Clean and flush the system.

Septic tanks

Standard: To AS/NZS 1546.1.

Vent pipes

Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide bird-proof vent cowls made of the same material and colour as the vent pipe.

2.6 RAINWATER TANKS

Standards

Metal tanks and rainwater goods: To AS/NZS 2179.1.

Design and installation: To the recommendations of SA HB 230.

2.7 GAS

Standard

Reticulated gas systems: To AS/NZS 5601.1.

Buried pipes

Warning tape: During backfilling, lay plastic warning tape 300 mm above and for the full length of buried gas pipes.

- Type: Minimum 100 mm wide, with GAS PIPE UNDER marked continuously.

Commissioning

General: On completion of installation and testing, turn on isolating and control valves and purge and charge the installation.

0902 ELECTRICAL DESIGN AND INSTALL

1 GENERAL

1.1 STANDARDS

General

Electrical installation: To AS/NZS 3000.

Electrical cable selection: To AS/NZS 3008.1.1.

Communications cable systems: To AS/CA S008, AS/CA S009, AS/NZS 11801.1 and SA/SNZ HB 252.

1.2 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- ED S&IR: The Electricity Distributor's Service and Installation Rules.
- RCD: Residual Current Device.

2 EXECUTION

2.1 GENERAL

Applications and compliance

General: Submit all necessary applications for electricity supply. Liaise with the electricity distributor and comply with the ED S&IR.

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Consumers mains and metering

General: Provide consumers mains and connect them to the electricity distributor mains.

Switchboards

Standard: To AS/NZS 61439.3.

Construction: Enclosed type with a hinged lid. Provide circuit breakers and RCDs.

Location: Verify that the location selected is compliant before proceeding.

Maximum demand and spare capacity

General: Calculate the maximum demand of the installation in accordance with AS/NZS 3000 and provide a copy of the calculations.

Spare capacity: Provide the following:

- > 10% spare capacity in mains and submains.
- > 25% spare capacity in final subcircuits.

Spare spaces: Provide switchboards with \geq 25% spare positions for future single phase circuit breakers.

Accessories

General: Provide accessories necessary for a complete installation including but not limited to switches, dimmers, socket outlets, and telecommunications outlets. Provide accessories located in close proximity of the same size and material and from the same manufacture.

Mounting: Flush mount accessories to the wall (or ceiling) unless noted otherwise. Provide proprietary wall boxes in masonry and wall brackets in stud walls.

Wiring

Sequence of work: Install conduits and cables before the installation of wall and ceiling linings, and before any external landscaping works.

Installation: Do not penetrate damp-proof courses. Arrange wiring such that it does not bridge the cavity in external masonry.

Minimum conduit diameter: 20 mm.

Conduits for future use: Provide a non-metallic drawstring having a breaking strain > 100 kg.

Luminaires

Standard: to AS/NZS 60598.1.

Non-specified luminaires: Provide a bayonet cap batten holder and lamp at each lighting point location where no luminaire is documented.

Minimum energy performance standards:

- General: To AS 4782.2 and AS/NZS 4783.2.
- Self-ballasted lamps: To AS 4847.2.
- Incandescent lamps: To AS 4934.2.

Appliances

General: Provide final subcircuits and terminate at fixed appliances, hot water units, packaged air conditioning and other plant and equipment.

Isolation switch: Provide isolating switch adjacent to equipment.

Telecommunications

General: Liaise with the telecommunication services carrier.

Installations requiring telephony only: To AS/CA S009.

Small office/home office installations: Category 6, to AS/CA S009 and AS 11801.4.

Television systems

General: Provide a digital television distribution system to AS/NZS 1367 and conforming to the recommendations of Broadcast Australia and ACMA.

Antennas: Provide and locate antennas to receive all locally available free-to-air television stations.

Network systems

General: Provide a coaxial cabling system suitable for satellite or cable network operator's services.

Intruder alarm system

Standard: To AS/NZS 2201.1.

Smoke detection system

General: Provide smoke alarms to the requirements of the BCA 3.7.5. Connect smoke alarms to mains power.

Labelling

General: Provide labels.

Telecommunications cables: Label telecommunications cables, cross connects and outlets in accordance with the requirements of AS/NZS 11801.1.

2.2 COMPLETION

Testing and certification

Electrical installations: Test to AS/NZS 3017. Provide a certificate showing test results, certifying compliance with AS/NZS 3000.

Communications cable systems: To AS 11801.4. Provide a certificate showing test results and certifying compliance with AS 11801.4.

Submission: Provide ACMA Telecommunications Cabling Advice (TCA1) form.

Television and audio systems: To AS/NZS 1367. Test the complete television and audio system. Provide a certificate showing test results and certifying compliance.

REFERENCED DOCUMENTS

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The following documents are incorporated into this worksection by reference:

AS/CA S008	2010	Requirements for customer cabling products
AS/CA S009	2013	Installation requirements for customer cabling (Wiring Rules)
AS/NZS 1163	2016	Cold-formed structural steel hollow sections
AS/NZS 1170		Structural design actions
AS/NZS 1170.1	2002	Permanent, imposed and other actions
AS 1192	2004	Electroplated coatings - Nickel and chromium
AS/NZS 1214	2016	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)
AS 1231	2000	Aluminium and aluminium alloys - Anodic oxidation coatings
AS 1288	2006	Glass in buildings - Selection and installation
AS 1289		Methods of testing soils for engineering purposes
AS 1289.5.2.1	2017	Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort
AS 1366		Rigid cellular plastics sheets for thermal insulation
AS 1366.3	1992	Rigid cellular polystyrene - Moulded (RC/PS - M)
AS 1366.4	1989	Rigid cellular polystyrene - Extruded (RC/PS-E)
AS/NZS 1367	2016	Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog signals in single and multiple dwelling installations
AS 1379	2007	Specification and supply of concrete
AS 1397	2011	Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium
AS/NZS 1546		On-site domestic wastewater treatment units
AS/NZS 1546.1	2008	Septic tanks
AS 1562		Design and installation of sheet roof and wall cladding
AS 1562.1	2018	Metal
AS 1562.3	2006	Plastics
AS 1604		Specification for preservative treatment
AS 1627		Metal finishing - Preparation and pretreatment of surfaces
AS 1627.1	2003	Removal of oil, grease and related contamination
AS 1672		Limes and limestones
AS 1672.1	1997	Limes for building
AS 1684		Residential timber-framed construction
AS 1684.2	2010	Non-cyclonic areas
AS 1684.3	2010	Cyclonic areas
AS 1684.4	2010	Simplified non-cyclonic areas
AS 1720		Timber structures
AS 1720.1	2010	Design methods
AS 1720.5	2015	Nailplated timber roof trusses
AS 1810	1995	Timber - Seasoned cypress pine - Milled products
AS/NZS 1859		Reconstituted wood-based panels - Specifications
AS/NZS 1859.1	2017	Particleboard
AS/NZS 1859.2	2017	Dry process fibreboard
AS/NZS 1859.3	2017	Decorative overlaid wood panels
AS/NZS 1859.4	2018	Wet process fibreboard
AS 1860		Particleboard flooring
AS/NZS 1860.1	2017	Specifications
AS 1860.2	2006	Installation
AS 1884	2012	Floor coverings - Resilient sheet and tiles - Installation practices
AS 1926		Swimming pool safety
AS 1926.1	2012	Safety barriers for swimming pools
AS 1926.2	2007	Location of safety barriers for swimming pools
AS 2047	2014	Windows and external glazed doors in buildings
AS 2049	2002	Roof tiles
AS 2050	2018	Installation of roof tiles
AS 2082	2007	Timber - Hardwood - Visually stress-graded for structural purposes
AS/NZS 2179		Specifications for rainwater goods, accessories and fasteners
AS/NZS 2179.1	2014	Metal shape or sheet rainwater goods, and metal accessories and fasteners
AS 2201		Intruder alarm systems
AS/NZS 2201.1	2007	Client's premises - Design, installation, commissioning and maintenance
AS/NZS 2208	1996	Safety glazing materials in buildings
AS/NZS 2269		Plywood - Structural
AS/NZS 2269.0	2012	Specifications
AS/NZS 2270	2006	Plywood and blockboard for interior use
AS/NZS 2271	2004	Plywood and blockboard for exterior use
AS/NZS 2311	2017	Guide to the painting of buildings
AS/NZS 2312		Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2312.1	2014	Paint coatings
AS 2455		Textile floor coverings - Installation practice

	2019	General
AS/NZS 2588	2018	Gypsum plasterboard
AS/NZS 2589	2017	Gypsum linings - Application and finishing
AS 2601	2001	The demolition of structures
AS 2688	2017	Timber and composite doors
AS/NZS 2699		Built-in components for masonry construction
AS/NZS 2699.1	2000	Wall ties
AS/NZS 2699.3	2002	Lintels and shelf angles (durability requirements)
AS/NZS 2712	2007	Solar and heat pump water heaters - Design and construction
AS/NZS 2728	2013	Prefinished/prepainted sheet metal products for interior/exterior building applications - Performance requirements
AS/NZS 2754		Adhesives for timber and timber products
AS/NZS 2754.1	2016	Adhesives for manufacture of plywood and laminated veneer lumber (LVL)
AS 2796		Timber - Hardwood - Sawn and milled products
AS 2796.1	1999	Product specification
AS 2796.2	2006	Grade description
AS 2796.3	1999	Timber for furniture components
AS 2858	2008	Timber - Softwood - Visually stress-graded for structural purposes
AS 2870	2011	Residential slabs and footings
AS/NZS 2904	1995	Damp-proof courses and flashings
AS/NZS 2908		Cellulose-cement products
AS/NZS 2908.2	2000	Flat sheets
AS/NZS 2924		High pressure decorative laminates - Sheets made from thermosetting resins
AS/NZS 2924.1	1998	Classification and specifications
AS/NZS 3000	2018	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3008		Electrical installations - Selection of cables
AS/NZS 3008.1.1	2017	Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
AS/NZS 3017	2007	Electrical installations - Verification guidelines
AS/NZS 3500		Plumbing and drainage
AS/NZS 3500.1	2018	Water services
AS/NZS 3500.2	2018	Sanitary plumbing and drainage
AS/NZS 3500.3	2018	Stormwater drainage
AS/NZS 3500.4	2018	Heated water services
AS 3566		Self-drilling screws for the building and construction industries
AS 3566.1	2002	General requirements and mechanical properties
AS 3600	2018	Concrete structures
AS 3610		Formwork for concrete
AS 3610.1	2018	Specifications
AS 3660		Termite management
AS 3660.1	2014	New building work
AS 3700	2018	Masonry structures
AS 3715	2002	Metal finishing - Thermoset powder coating for architectural applications of aluminium and aluminium alloys
AS 3727		Pavements
AS 3727.1	2016	Residential
AS 3730		Guide to the properties of paints for buildings
AS 3730.1	2006	Latex - Interior - Flat
AS 3730.2	2006	Latex - Interior - Semi-gloss
AS 3730.3	2006	Latex - Interior - Low-gloss
AS 3730.6	2006	Solvent-borne - Interior/exterior - Full gloss enamel
AS 3730.7	2006	Latex - Exterior - Flat
AS 3730.8	2006	Latex - Exterior - Low gloss
AS 3730.9	2006	Latex - Exterior - Semi-gloss
AS 3730.10	2006	Latex - Exterior - Gloss
AS 3730.12	2006	Latex - Interior - Gloss
AS 3730.16	2006	Latex - Self-priming timber finish - Exterior
AS 3730.27	2006	Clear coatings for interior timber floors
AS 3730.28	2006	Wood stain - Solvent-borne - Exterior
AS 3730.29	2006	Solvent-borne - Exterior/interior - Paving paint
AS 3740	2010	Waterproofing of domestic wet areas
AS 3743	2003	Potting mixes
AS/NZS 3750		Paints for steel structures
AS/NZS 3750.9	2009	Organic zinc-rich primer
AS 3798	2007	Guidelines on earthworks for commercial and residential developments
AS/NZS 3823		Performance of electrical appliances - Air conditioners and heat pumps
AS/NZS 3823.1.1	2012	Non-ducted airconditioners and heat pumps - Testing and rating for performance (ISO 5151:2010, MOD)
AS/NZS 3823.1.2	2012	Ducted airconditioners and air-to-air heat pumps - Testing and rating for performance (ISO 13253:2010, MOD)
AS 3958		Ceramic tiles
AS 3958.1	2007	Guide to the installation of ceramic tiles
AS 3959	2018	Construction of buildings in bushfire prone areas
AS 3972	2010	General purpose and blended cements
AS 3999	2015	Bulk thermal insulation - Installation
AS 4145		Locksets and hardware for doors and windows

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AS/NZS 4200	2008	Mechanical locksets for doors and windows in buildings
AS/NZS 4200.1	2017	Pliable building membranes and underlays
AS 4200.2	2017	Materials
AS 4250		Installation requirements
AS 4256.2	2006	Plastic roof and wall cladding materials
AS 4256.3	2006	Unplasticized polyvinyl chloride (uPVC) building sheets
AS 4256.4	2006	Glass fibre reinforced polyester (GRP)
AS 4256.5	2006	Unplasticized polyvinyl chloride (uPVC) wall cladding boards
AS 4285	2006	Polycarbonate
AS 4288	2019	Rooflights
AS 4312	2003	Soft underlays for textile floor coverings
AS 4386	2019	Atmospheric corrosivity zones in Australia
AS 4419	2018	Cabinetry in the built-in environment - Commercial and domestic
AS 4454	2018	Soils for landscaping and garden use
AS/NZS 4455	2012	Composts, soil conditioners and mulches
AS/NZS 4455.1	2008	Masonry units, pavers, flags and segmental retaining wall units
AS/NZS 4455.3	2008	Masonry units
AS/NZS 4505	2012	Segmental retaining wall units
AS 4552	2012	Garage doors and other large access doors
AS/NZS 4552.2	2005	Gas fired water heaters for hot water supply and/or central heating
AS 4586	2010	Minimum energy performance standards for gas water heaters
AS/NZS 4600	2013	Slip resistance classification of new pedestrian surface materials
AS/NZS 4680	2018	Cold-formed steel structures
AS/NZS 4692	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 4692.1		Electric water heaters
AS/NZS 4692.2	2005	Energy consumption, performance and general requirements
AS 4773	2005	Minimum Energy Performance Standard (MEPS) requirements and energy labelling
AS 4773.1		Masonry in small buildings
AS 4773.2	2015	Design
AS/NZS 4782	2015	Construction
AS 4782.2		Double-capped fluorescent lamps - Performance specifications
AS/NZS 4783	2019	Minimum Energy Performance Standard (MEPS)
AS/NZS 4783.2		Performance of electrical lighting equipment - Ballasts for fluorescent lamps
AS 4785	2002	Energy labelling and minimum energy performance standards requirements
AS 4785.1		Timber - Softwood - Sawn and milled products
AS 4785.2	2002	Product specification
AS 4785.3	2002	Grade description
AS 4786	2002	Timber for furniture components
AS 4786.2		Timber flooring
AS/NZS 4847	2005	Sanding and finishing
AS 4847.2		Self ballasted lamps for general lighting services
AS/NZS 4858	2019	Minimum energy performance standard (MEPS)
AS/NZS 4859	2004	Wet area membranes
AS/NZS 4859.1		Thermal insulation of buildings
AS 4934	2018	General criteria and technical provisions
AS 4934.2		Incandescent lamps for general lighting service - Test methods
AS 5039	2011	Minimum energy performance standards (MEPS) requirements
AS 5040	2008	Security screen doors and security window grilles
AS 5203	2003	Installation of security screen doors and window grilles
	2016	Protection of openable windows/ fall prevention – Test sequence and compliance method
AS/NZS 5263		Gas appliances
AS/NZS 5263.1.2	2020	Gas fired water heaters for hot water supply and/or central heating
AS/NZS 5601		Gas installations
AS/NZS 5601.1	2013	General installations
AS 5604	2005	Timber - Natural durability ratings
AS 6669	2016	Plywood - Formwork
AS 11801		Information technology - generic cabling for customer premises
AS/NZS 11801.1	2019	General requirements (ISO/IEC 11801-1:2017, MOD)
AS 11801.4	2019	Single-tenant homes (ISO/IEC 11801-4:2017,MOD)
AS ISO 13007		Ceramic tiles
AS ISO 13007.1	2013	Grouts and adhesives - Terms, definitions and specifications for adhesives
AS/NZS 60335		Household and similar electrical appliances - Safety
AS/NZS 60335.2.35	2013	Particular requirements for instantaneous water heaters
AS/NZS 60598		Luminaires
AS/NZS 60598.1	2017	General requirements and tests (IEC 60598-1, Ed. 8.0 (2014) MOD)
AS/NZS 61439		Low-voltage switchgear and controlgear assemblies
AS/NZS 61439.3	2016	Distribution boards intended to be operated by ordinary persons (DBO) (IEC 61439-3, Ed 1.0 (2012), MOD)
SA HB 230	2008	Rainwater tank design and installation handbook
SA/SNZ HB 252	2014	Communications Cabling Manual - Module 3: Residential communications cabling handbook
AIRAH DA09	1998	Air conditioning load estimation
BCA 3.1.4.4	2019	Acceptable construction - Site preparation - Termite risk management - Durable notices
BCA 3.2.2	2019	Acceptable construction - Footings and slabs - Preparation
BCA 3.2.4	2019	Acceptable construction - Footings and slabs - Site classification

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BCA 3.5.3.4

BCA 3.7.2.8

BCA 3.7.5

BCA 3.8.1.2

BCA 3.8.7.4

BCA 3.9.1

BCA 3.9.2.6

BCA 3.9.2.7

BCA 3.10.6

BCA 3.12.1.1

FWPA PN06.1039

NASH

NASH-1

NASH-2

ISO 10580

Safe Work Australia

2019	Acceptable construction - Roof and wall cladding - Sheet roofing - Acceptable corrosion protection for metal sheet roofing
2019	Acceptable construction - Roof and wall cladding - Gutters and downpipes - Installation of gutters
2019	Fire safety - Fire separation of external walls - Roof lights
2019	Acceptable construction - Fire safety - Smoke alarms and evacuation lighting
2019	Acceptable construction - Health and amenity - Wet areas and external weatherproofing - Wet areas
2019	Acceptable construction practice - Health and amenity - Condensation management - Ventilation of roof spaces
2019	Acceptable construction - Safe movement and access - Stairway and ramp construction
2019	Acceptable construction - Safe movement and access - Barriers and handrails - Protection of openable windows - bedrooms
2019	Acceptable construction - Safe movement and access - Barriers and handrails - Protection of openable windows - rooms other than bedrooms
2019	Attachment of decks and balconies to external walls of buildings
2019	Acceptable construction - Energy efficiency - Building fabric - Building fabric thermal insulation
2008	Interim industry standard – Recycled timber – Visually graded recycled decorative NASH Standard Residential and Low-rise Steel Framing
2005	Design criteria
2014	Design solutions
2010	Resilient, textile and laminate floor coverings - Test method for volatile organic compound (VOC) emissions
2018	Code of Practice: How to safely remove asbestos