Ultrapanel®
Building Technologies

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Revision J 03 February 2021

System Manual

Contents

1.0	Scope and Limitations of the System	Page 2-5
2.0	Specification of key components	Page 6
3.0	Design Details	Page 9-37
4.0	Evaluation of Critical Performance	Page 38 -69
5.0	Quality Management systems and Factory Production Control	Page 70-73
	Appendices 1-14	

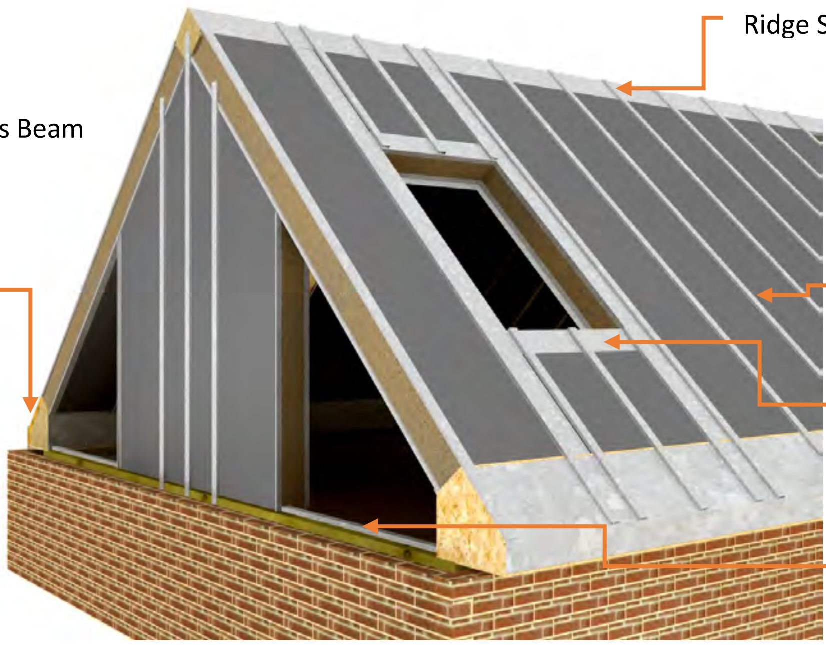
1.0 Scope and Limitations of the System

1.1 Introduction/overview

The essence of the Ultraroof system is that it is a quick and easy way of creating a 'room in the roof'. Volume house builders are using 'room in the roof' typically on 4-bed semi-detached homes and 5 bed detached.

Ultraframe has created an offsite constructed 'flat packed' room in the roof kit that arrives on site and is lifted into position by a telehandler ready for 2-3 joiners to install over the course of a day.

Ultraroof uses structural insulated panels which are supported by a structural 450mm wide insulated box eaves beam. The beam is tied at intervals and allows the panels to be propped without any extra structure. Where the panels meet there is a ridge and/or hip component.



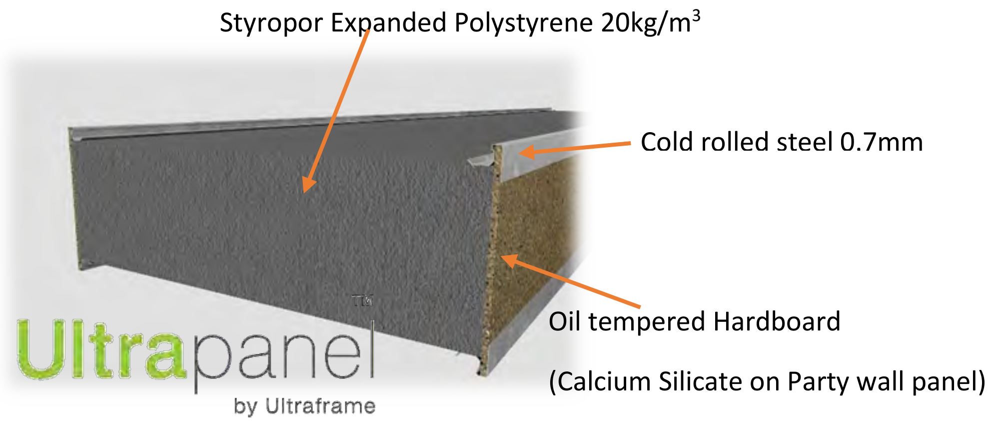
Section through Roof Structure

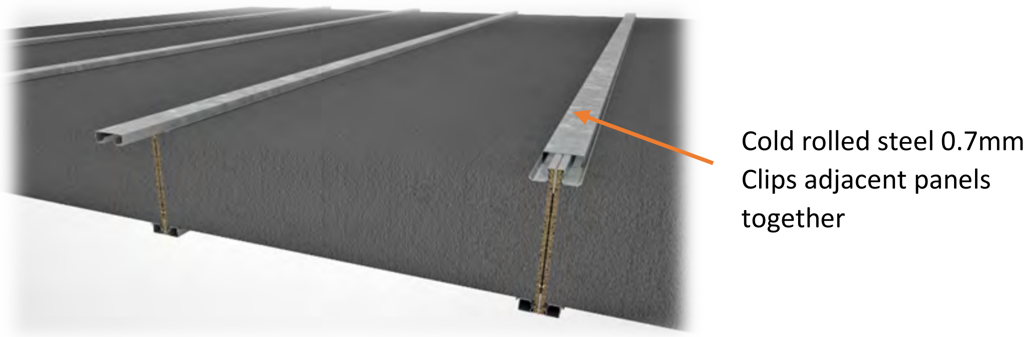
The roof is supplied without finishes on either the internal or external surfaces. The following are supplied with the roof:-

- Structure
- Insulation
- Structural connections
- Fixings
- Vapour permeable external membrane

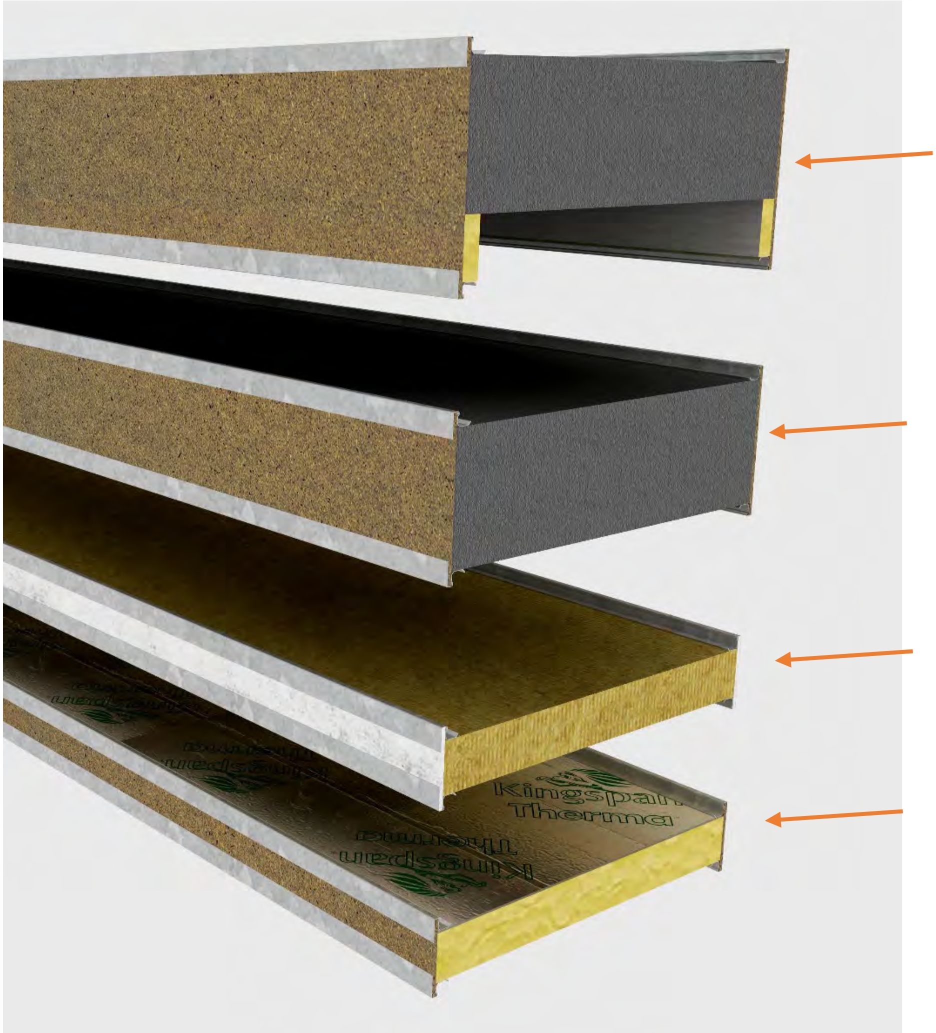
1.1 System Elements

Panel

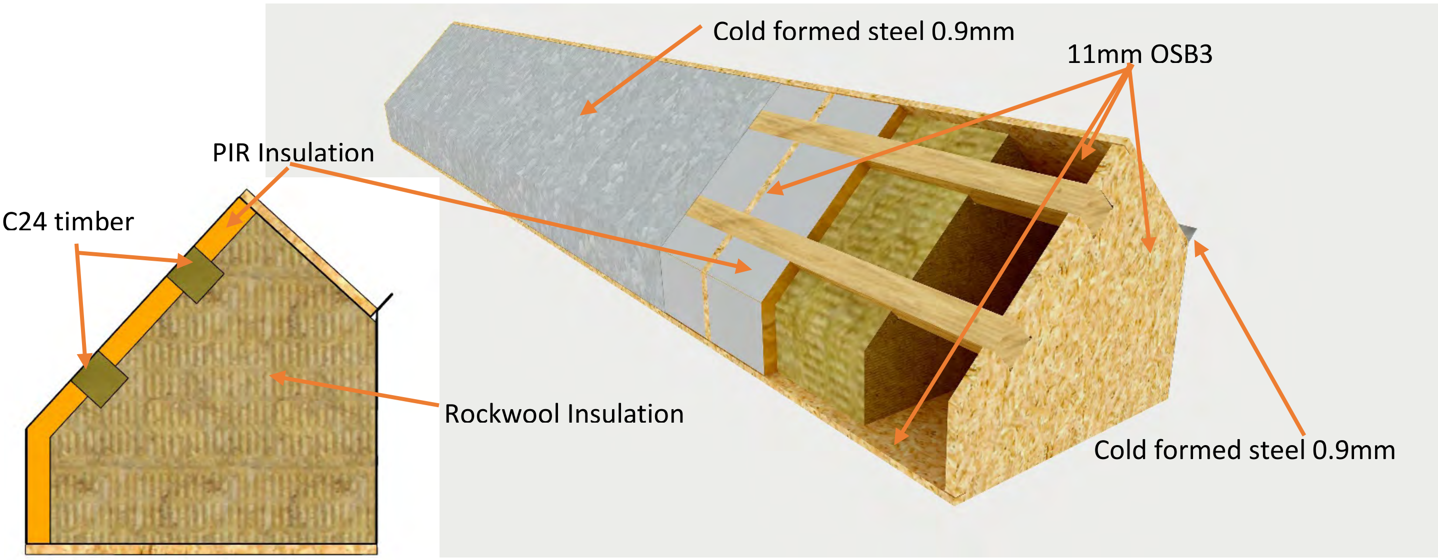




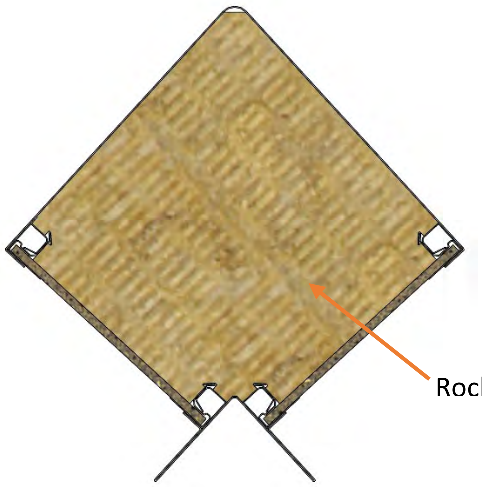
The panel is used both as part of the roof structure and as the spandrel wal. The panel thickness below is for the panel allone the assembled thickness includes the clips top and bottow so the overall thickness is 2mm greater. The BBA certificate refers to the assembled thickness.l

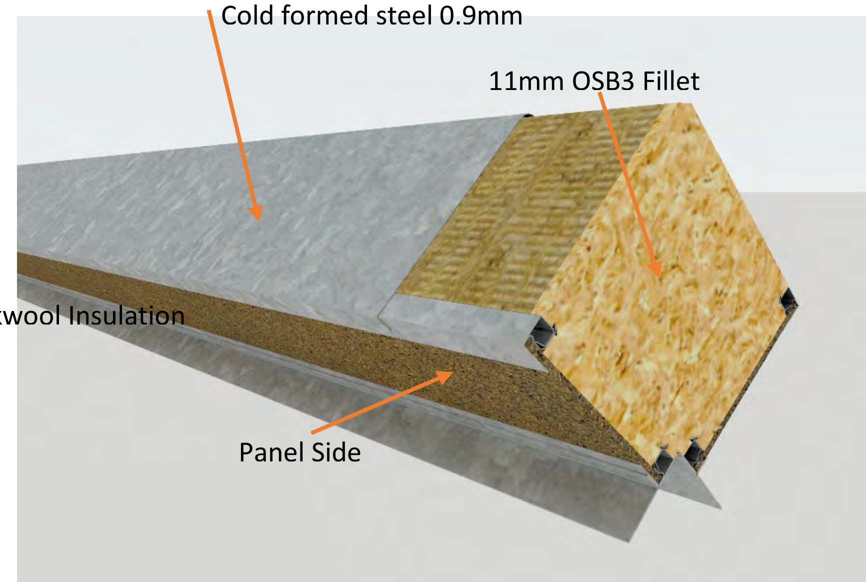

285mm panel 175mm EPS insulation – roof panel
213mm panel 175mm EPS insulation – roof and wall panel
113mm panel 75mm Rockwool Insulation – party wall panel
113mm panel 75mm PIR insulation – external gable wall panel

Eaves Beam

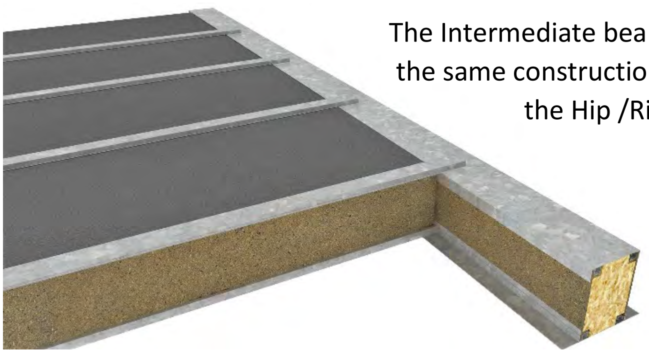

Cold formed steel 0.9mm
11mm OSB3
PIR Insulation
C24 timber
Rockwool Insulation
Cold formed steel 0.9mm

Hip / Ridge





Intermediate trimmer beam

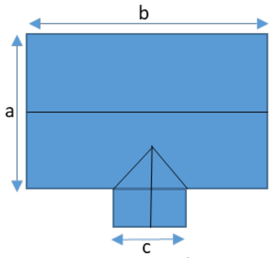


1.3 Intended use and limits of application

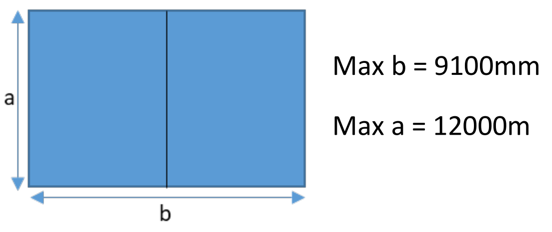
- The intended use for the roof is as part of a domestic dwelling.
- The roof is sat on masonry cavity wall.(other wall structures are possible but not part of this scope)
- The height of the wall, which the roof's eaves sits on, above floor level is not limited however its deflection is limited to height/300 or 6mm whichever is the smaller.
- The eaves is tied at either end to prevent spread. Where the eaves length exceeds the design limit an intermediate tie is required. The tie can be run in the

ceiling/floor. Where there is a dwarf wall the angle restraint (image page 6) is required this practically limits the Dwarf to 1200mm.

- The eaves height across the roof can differ. There is a separate tie bar for the stepped eaves. The limitation on height difference is the tension in the tie or where the eaves length exceeds the maximum and the angle restraint is required the maximum difference is 1200mm.
- The building on which the roof is used is limited to 5 stories or 14m to top of ridge.
- The main roof section is rectangular with gable ends
- The maximum span across the roof pitch is 9100mm (inside wall to inside wall)
- The maximum eaves/ridge length is 12000mm.
- Roof Pitch from 37.5deg to 50 deg
- All types of tiles finish are applicable weights to be assess per job.
- A Pike (a smaller roof at 90 deg to the main roof where there are 2 valleys where the two roofs meet) are also possible as long as the ridge of the main roof is above the ridge of the smaller roof.
- The roof can have openings for roof lights such as Velux or for the addition of a prefabricated dormer window.



GABLE ROOF with PIKE



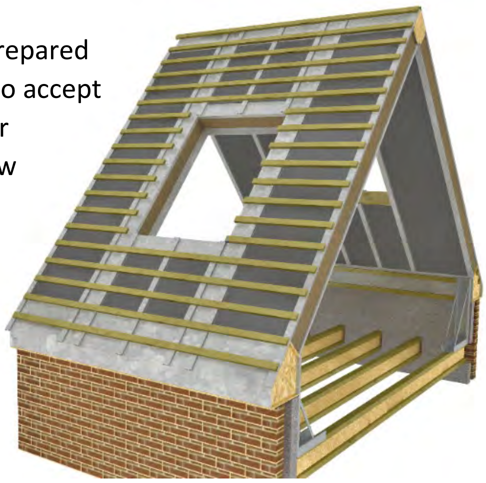
GABLE ROOF

1.4 Responsibilities

- The design of the system and the configuration of the components for each job is the responsibility of Ultraframe.
- Ensuring the structural integrity for the particular site location is the responsibility of Ultraframe.
- Preparation of the house to wall plate level is the responsibility of the builder.
- The installation of the system will be by an Ultraframe approved contractor, whether employed by Ultraframe or by the building contractor.
- The responsibility for the completed home remains with the builder.

The roof can be factory prepared to accept standard roof window and dormer windows (supplied by others). These items are proprietary and so the associated fixing/flashing kits are by others.

Roof prepared ready to accept Dormer Window



Roof with Dormer Fitted

2.0 Specification of key components

2.1 Plasterboard Linings.

- The underside of the roof requires :-
  - FR30 15 mm Gyproc Wallboard Duplex fixed to internal steel clip
  - FR60 two layers of 15mm mm fire-resistant plasterboard Gyproc FireLine, fixed to internal steel clip

2.2 Thermal insulation

- EPS 70 supplied by SPI is used in the construction of the panel (APPENDIX 4)
- Knauf Earthwool Building Slab RT45; used in the beam (APPENDIX 7.1)
- Knauf Earthwool Loft Roll 44; used in the beam, ridge and intermediate beam (APPENDIX 7.2)
- Rockwool MECH SL GR2 used in party wall gable panel (APPENDIX 7.4)
- Kingspan TP10 75mm used in external gable wall panel (APPENDIX 8.2)

2.3 Vapour control Layer

- The roof has been assessed by the BBA on the basis of Foil faced plasterboard (APPENDIX10.3). Assessments have been carried out showing no interstitial condensation even when the VCL is removed. Further preventative measures are also applied in the factory with Proctor Procheck 300 applied to the OSB face of both the beam and the ridge.

2.4 External Breathable membrane

- Daltex RoofTX (or equivalent) (not supplied) (APPENDIX 10.2)
- Proctor Frameshield 100 applied to the external spandrel panel (APPENDIX 10.1)

2.5 Fasteners

- Steel screw of grade ASTM A510, grade 1022 (equivalent EN grade 4.6) with zinc coating of Electropolyseal V (1000 hr) grade and thickness of coating 20-25 microns, head diameter 8.94 mm and length 38 mm, used externally in the systems eg clip fixings, soffits, gable ladder (APPENDIX 6.1)
- Steel screw of grade ASTM A510, grade 1022 (equivalent EN grade 4.6) with zinc coating of clear zinc (Fe/Zn 3A per ASTM F1941) grade and thickness of 2.5 microns, head diameter 8.23 mm and length 19 mm, for internal use eg clip (APPENDIX 6.2)

2.6 Fire stop

- ARC Building Solutions (APPENDIX 7.3)
  - Cavity Stop Sock CSS100
  - Party wall cavity stop sock PWCSS 100
  - Soffit Sock SSL 600/450

2.7 Integrated Elements

- In line roof windows (supplied by Builder)
- Prefabricated dormer.(supplied by Builder)

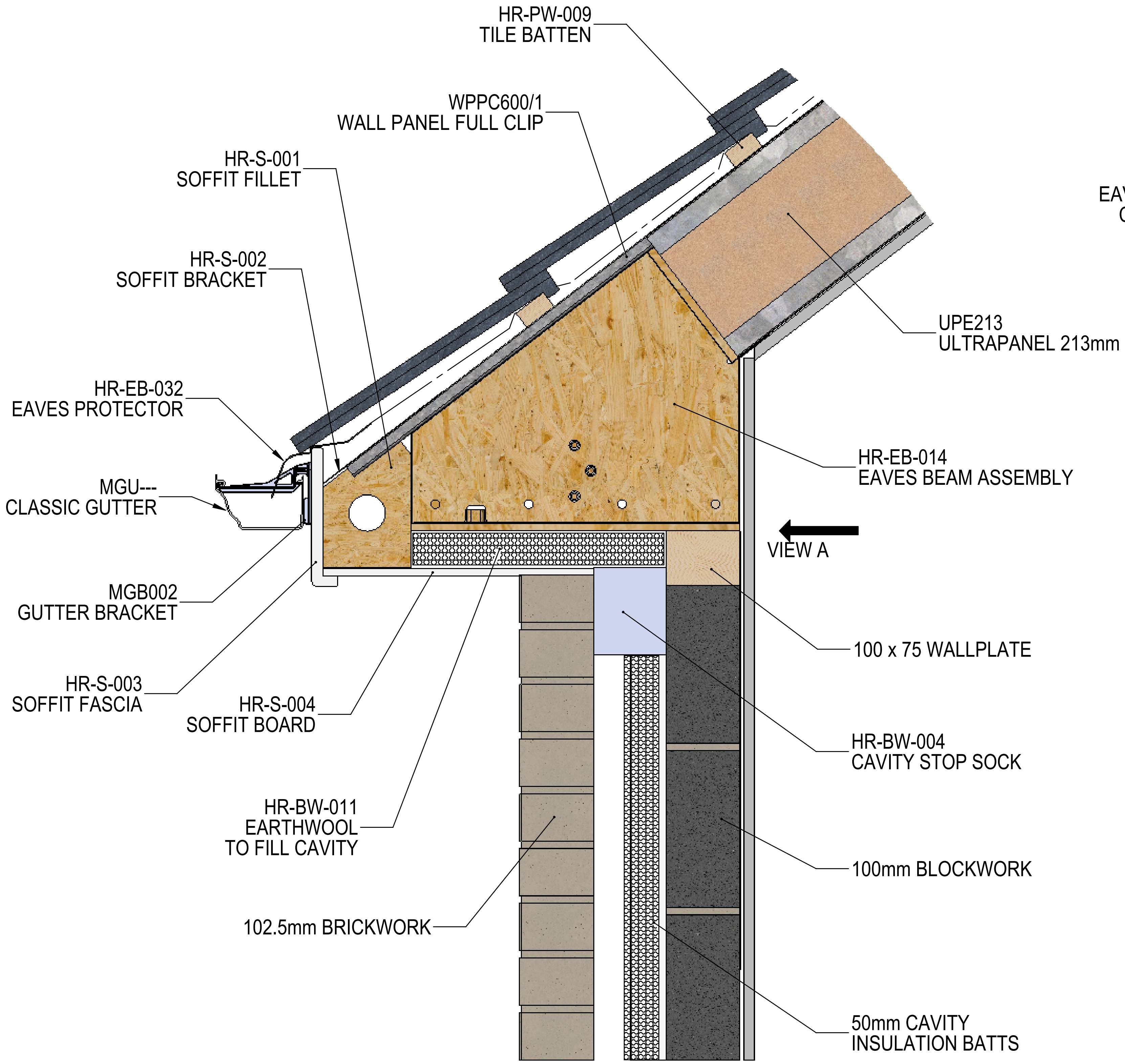
Drawing Issue Register

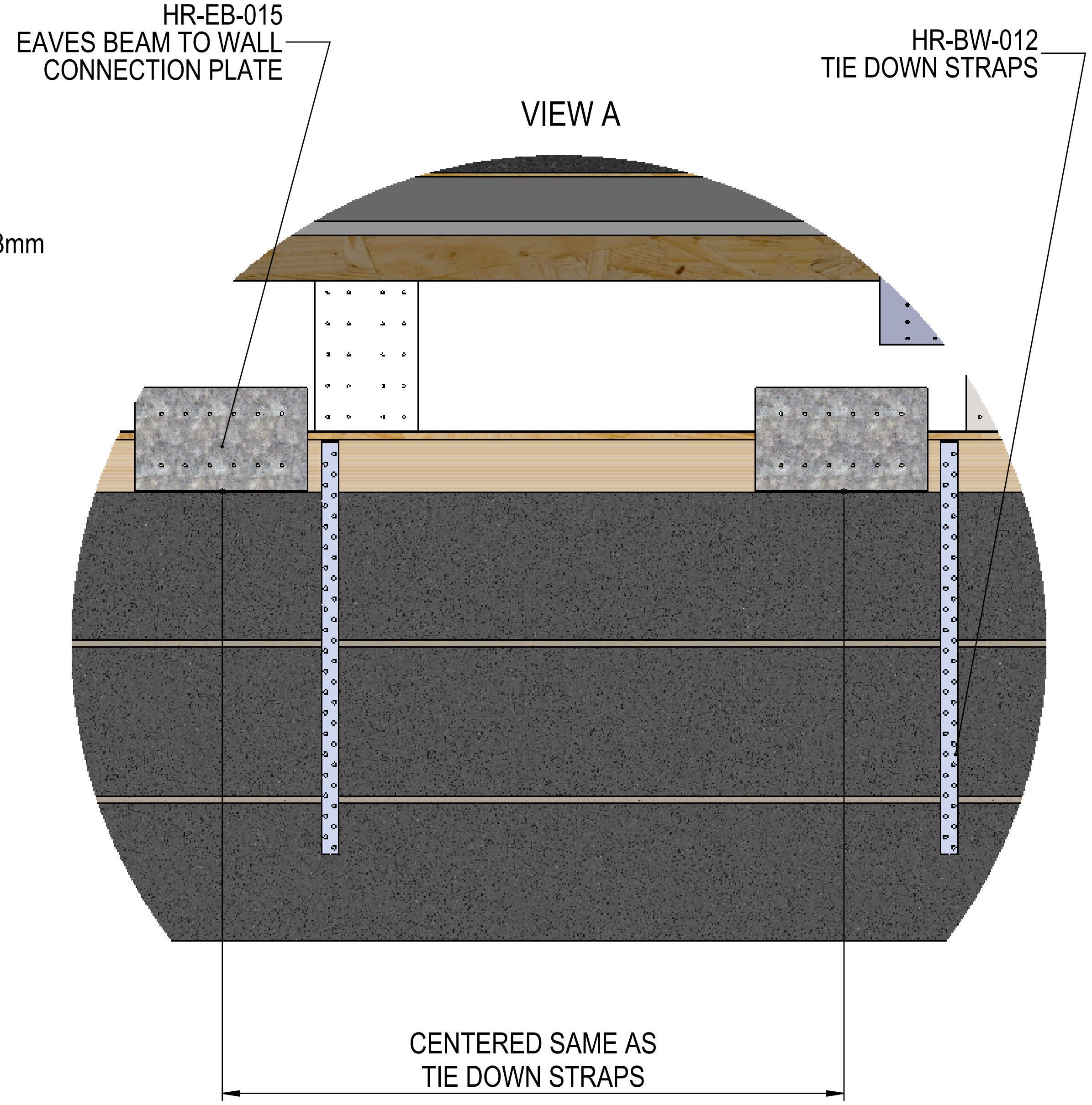
DRAWING NUMBER	REVISION	DATE	DRAWING TITLE	System Guide Page
HR-EB-016	6	15/01/2021	Eaves Assembly Detail	10/11
HR-EB-017	5	15/12/2020	Eaves Split & Tie Bar Detail	12
HR-EB-020	2	27/10/2020	Stepped Height Tie Bar Detail	13
HR-EB-024	1	11/09/2020	Eaves Beam Steel Add-on Detail	14
HR-EB-030	2	01/12/2020	Gable Wall Tie Plate Detail	15/16
HR-ES-001	4	04/01/2021	Electrical Socket Detail	17/18
HR-GW-001	7	15/01/2021	Gable Wall Assembly Detail	19/21
HR-PC-001	1	04/12/2020	Pre-fab Chimney Detail	22
HR-PW-001	5	15/12/2020	Party Wall Assemly Detail	23/24
HR-RB-009	2	22/09/2020	Ridge Assembly Detail	25/26
HR-RB-011	4	07/12/2020	Ridge Beam Split Detail	27
HR-RL-001	1	21/08/2020	Roof Light Assembly Detail	28
HR-SR-001	6	15/12/2020	Stepped Roof Assembly Detail	29/30
HR-UP-012	2	01/12/2020	Ultrapanel Service Vent	31/32
HR-UP-014	2	04/01/2021	Tile Batten Fixing Detail	33
HR-W-001	5	25/09/2020	Gable Window Detail	34/35
HR-VD-001	1	19/01/2021	Valley Detail	36
HR-GD-005	2	19/01/2021	Dormer detail	37

Last Updated: 22/01/2021

CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER





QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 05/08/2020
SCALE: 1:7	STATUS: DEV

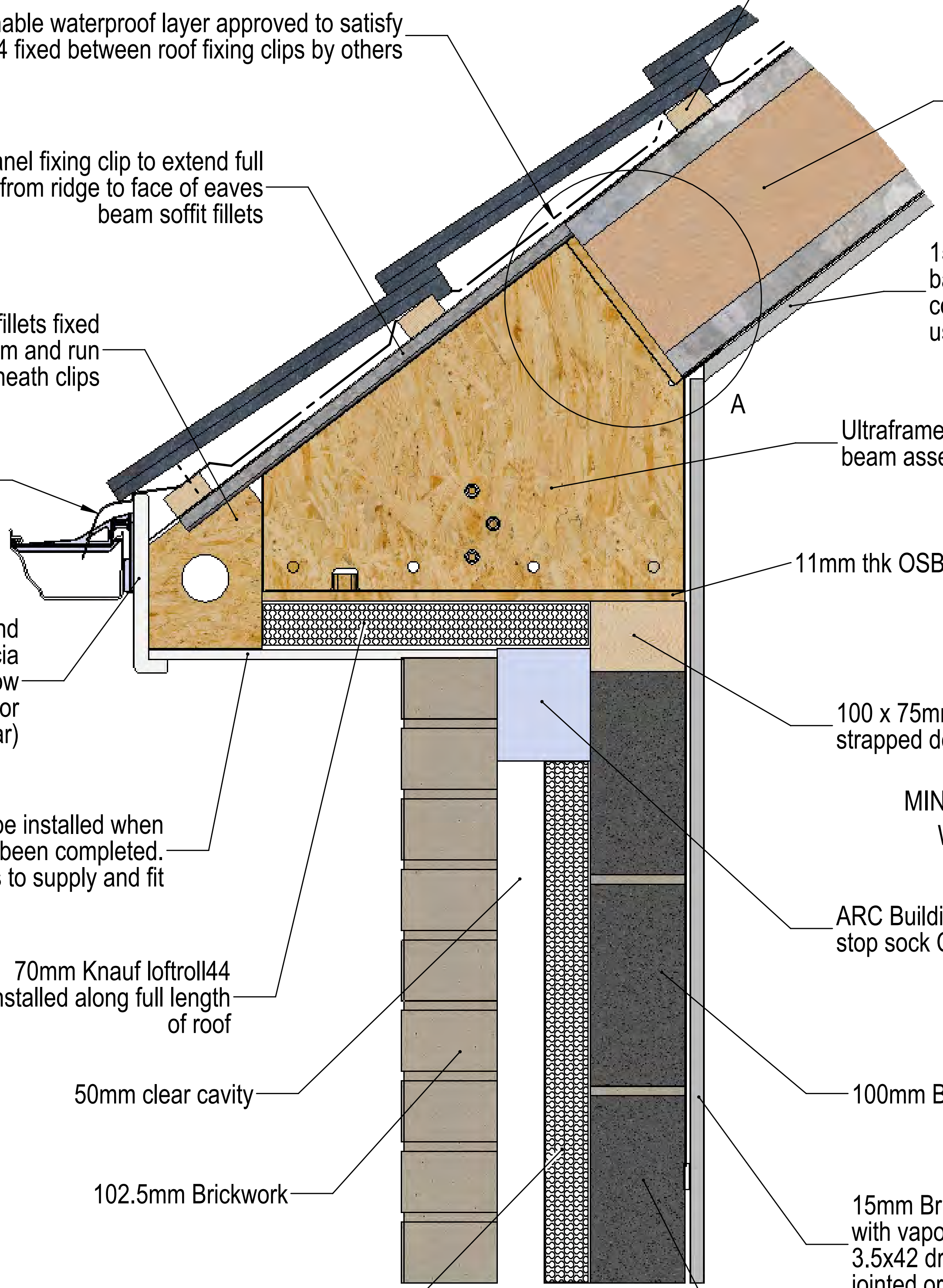
DESCRIPTION:
HOUSE ROOF EAVES DETAIL (INTERNAL)

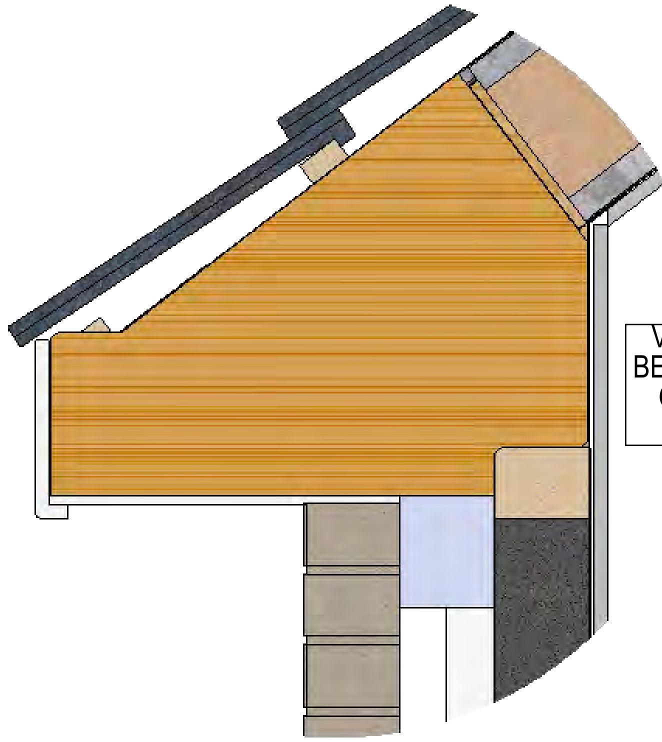
DRAWING No:	STOCK CODE:	REV:
HR-EB-016		-.06

MODEL NAME: House Roof Assembly / CONFIG. NAME: Default

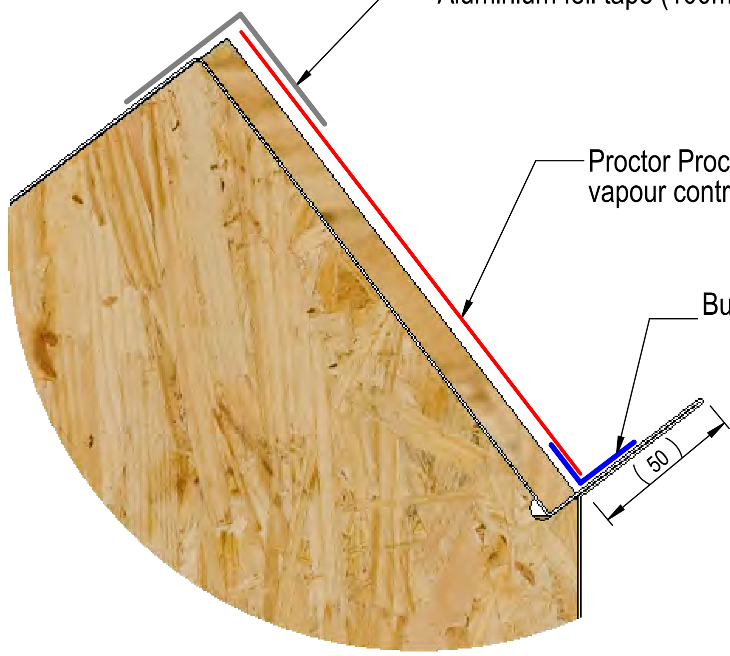
SHEET 1 OF 2, SIZE A3 | 25/01/2021

CHANGE No.	REV.	AUTHOR





VIEW FROM END OF EAVES BEAM SHOWING CUT PROFILE OF ARC INSULATION SLAB SSL600/450



DETAIL A
(WITH ULTRAPANEL REMOVED FOR CLARITY)

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

PREVIOUSLY SD-01

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 05/08/2020
SCALE: 1:7	STATUS: DEV

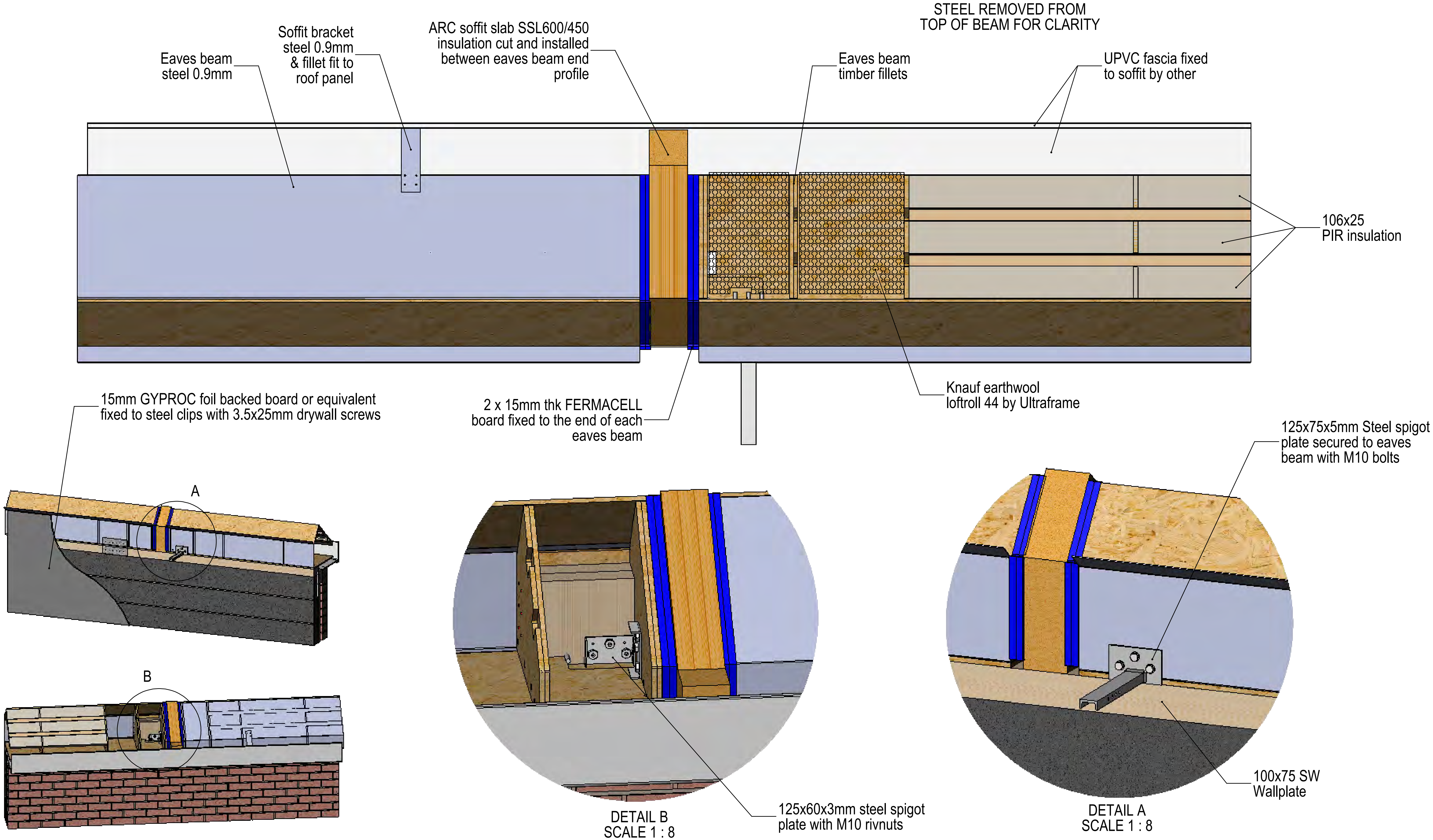
DESCRIPTION:
HOUSE ROOF EAVES DETAIL (EXTERNAL)

MODEL NAME: House Roof Assembly / CONFIG. NAME: Default

DRAWING No:	STOCK CODE:	REV:
HR-EB-016		-.06
SHEET 2 OF 2, SIZE A3		22/01/2021

CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

PREVIOUSLY SD-01

CRITICAL DIMENSIONS CIRCLED
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ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 20/08/2020
SCALE: 1:10	STATUS: DEV

DESCRIPTION:
EAVES BEAM SPLIT/TIE BAR DETAIL

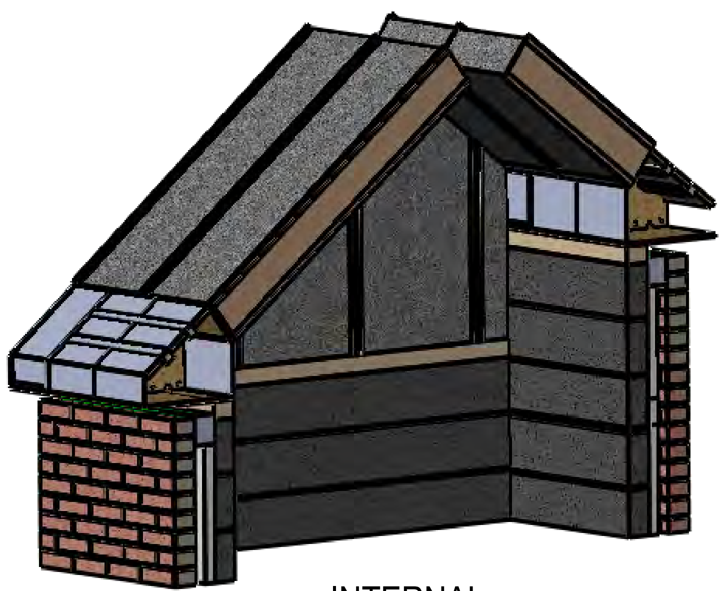
DRAWING No:	STOCK CODE:	REV:
HR-EB-017		-.05

MODEL NAME: HR-EB-017 / CONFIG. NAME: Default

SHEET 1 OF 2, SIZE A3 15/12/2020

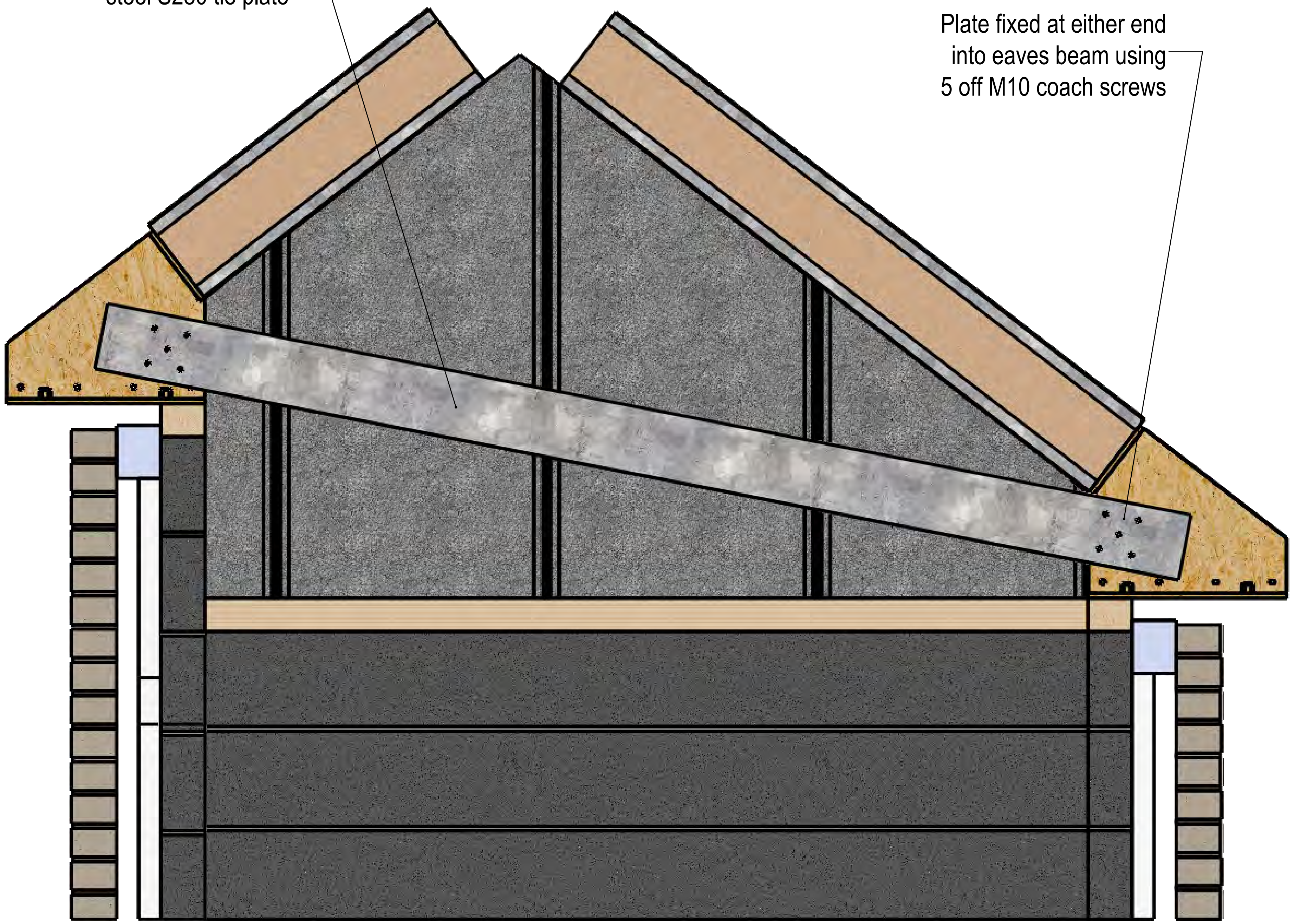
CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER



INTERNAL
ISOMETRIC VIEW
FOR REFERENCE

EXTERNAL
ISOMETRIC VIEW
FOR REFERENCE



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

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ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

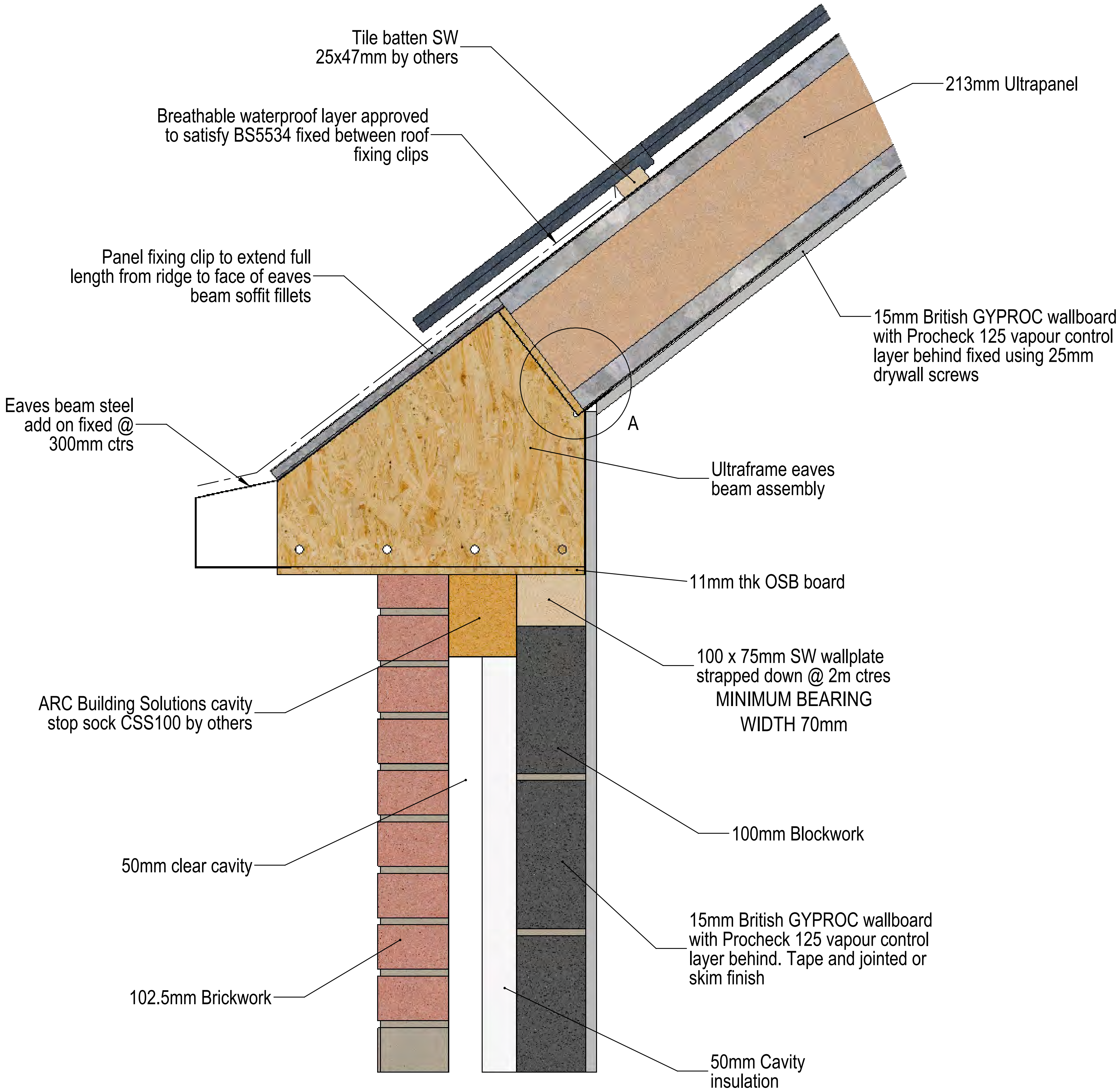
DRAWN BY: DM
DATE CREATED: 10/09/2020
SCALE: 1:12
STATUS: DEV

DESCRIPTION:
STEPPED HEIGHT EAVES/TIE BAR DETAIL

DRAWING No: HR-EB-020
STOCK CODE:
REV: -.02

MODEL NAME: HR-EB-020.SLDPRT / CONFIG. NAME: Default
SHEET 1 OF 1, SIZE A3
27/10/2020

CHANGE No.	REV.	AUTHOR



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ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
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DRAWN BY: DM	DATE CREATED: 05/08/2020
SCALE: 1:7	STATUS: DEV
DRAWING No: HR-EB-024	STOCK CODE:
REV: -.01	

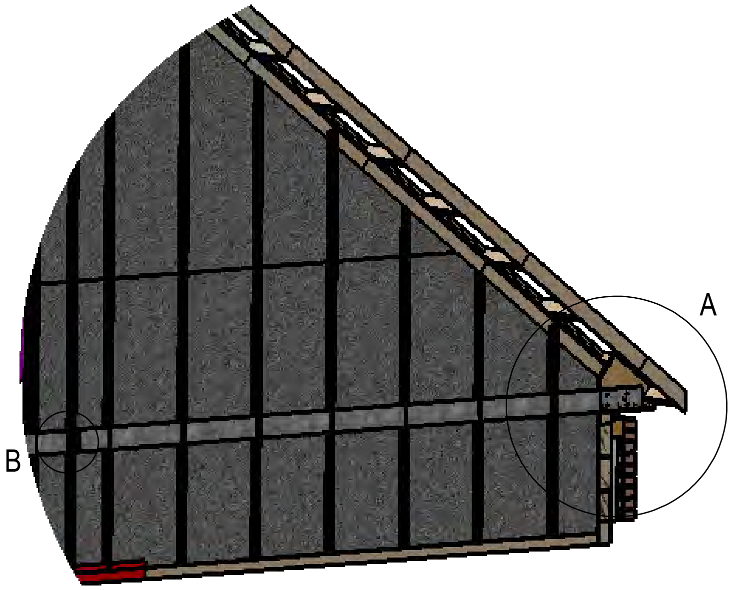
DESCRIPTION:

EAVES BEAM STEEL ADD ON ASSEMBLY

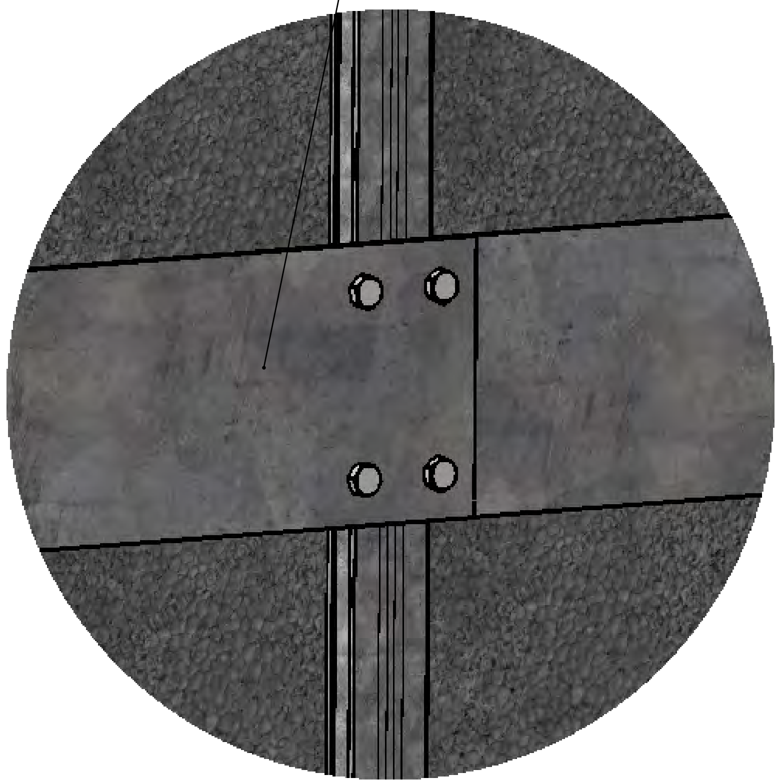
MODEL NAME: House Roof Assembly / CONFIG. NAME: With Eaves Beam Add On

CHANGE No.	REV.	AUTHOR

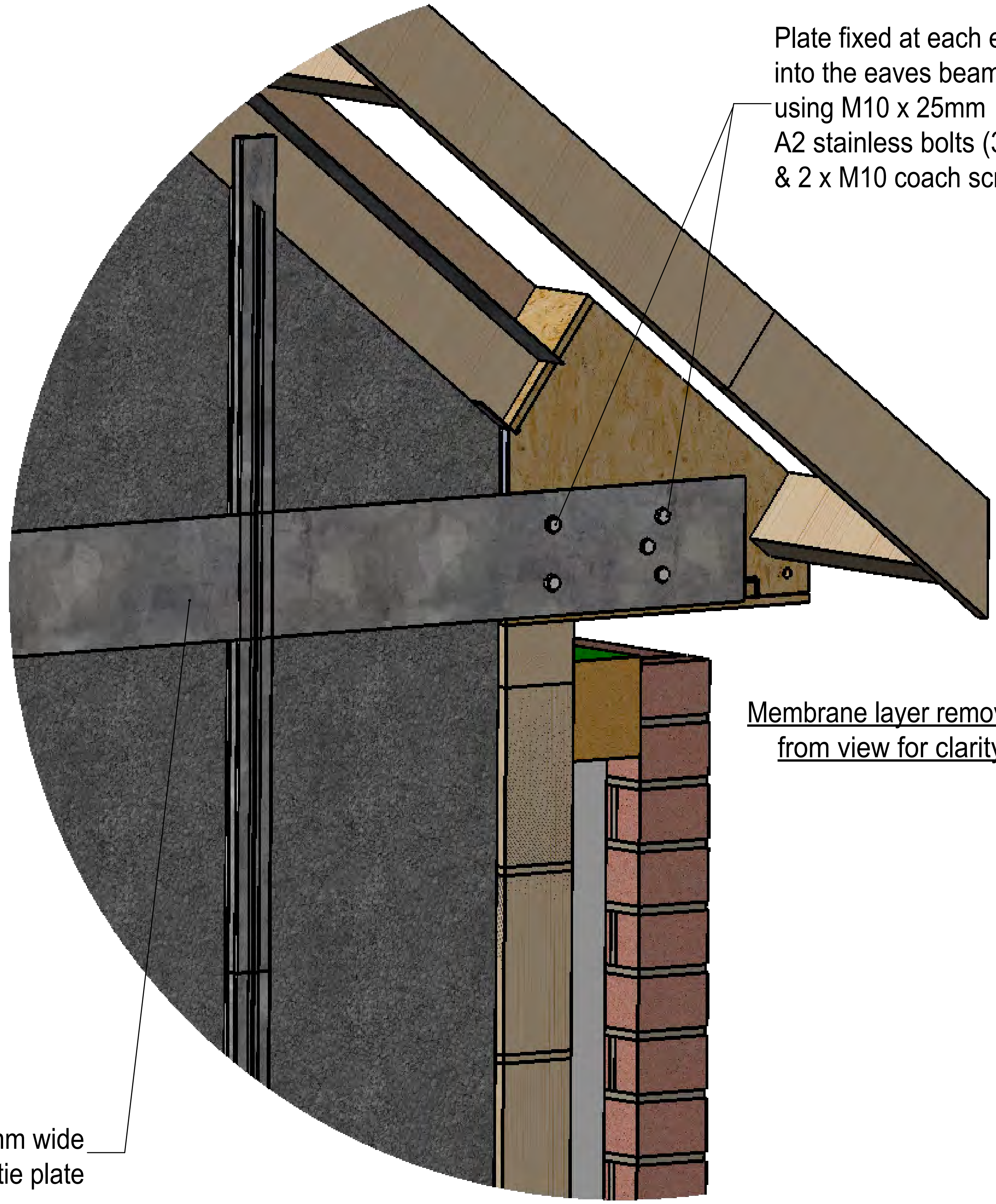
CAD MODEL IS MASTER



EXTERNAL ISOMETRIC VIEW



DETAIL B



DETAIL A

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

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1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
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DRAWN BY: DM		DATE CREATED: 19/11/2020	
SCALE: NTS		STATUS: DEV	
DRAWING No: HR-EB-030	STOCK CODE:		REV: -.02
	SHEET 1 OF 2, SIZE A3		01/12/2020

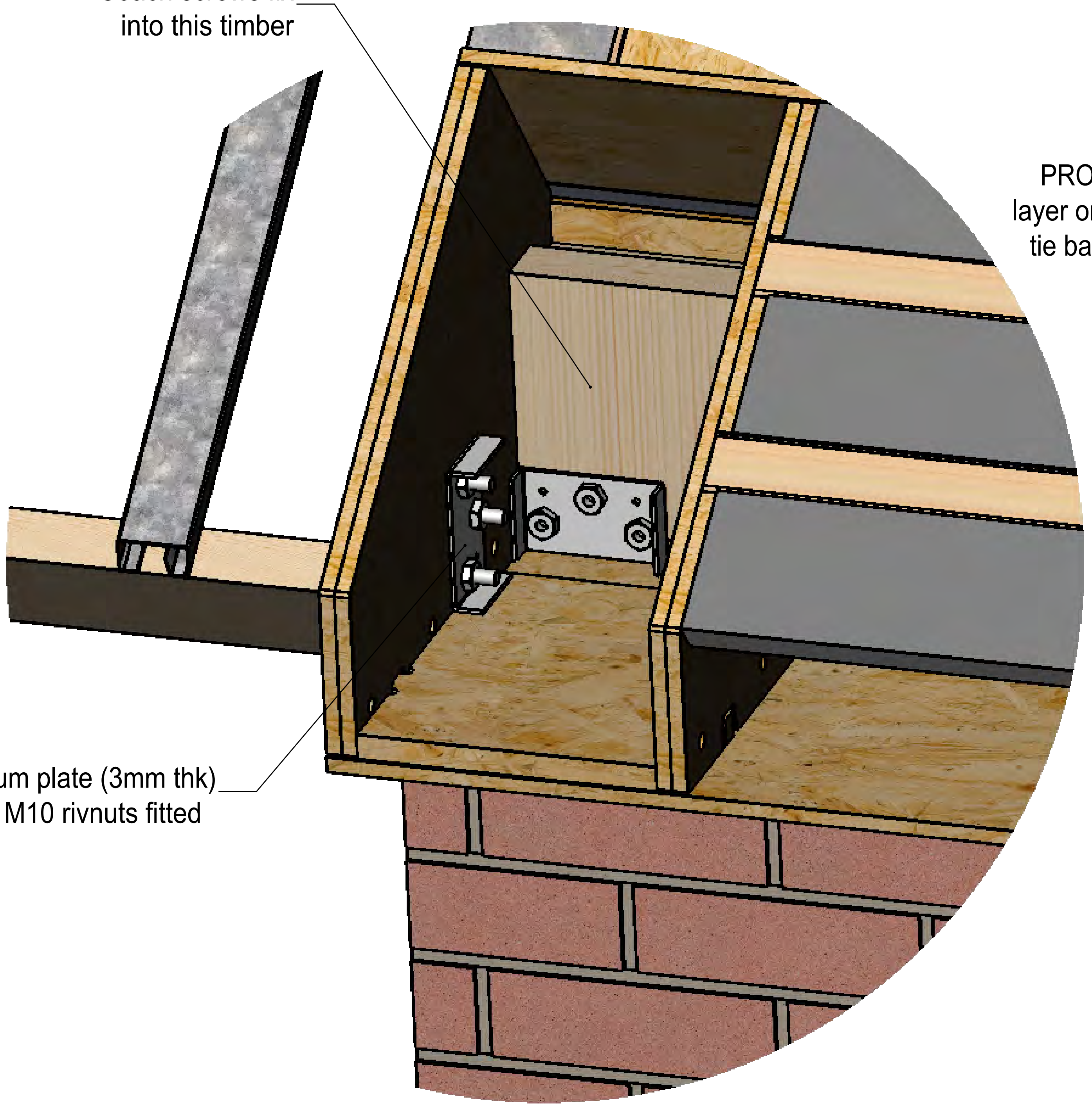
DESCRIPTION:
GABLE WALL TIE PLATE DETAIL

MODEL NAME: Norbury Roof Assembly / CONFIG. NAME: Default

CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER

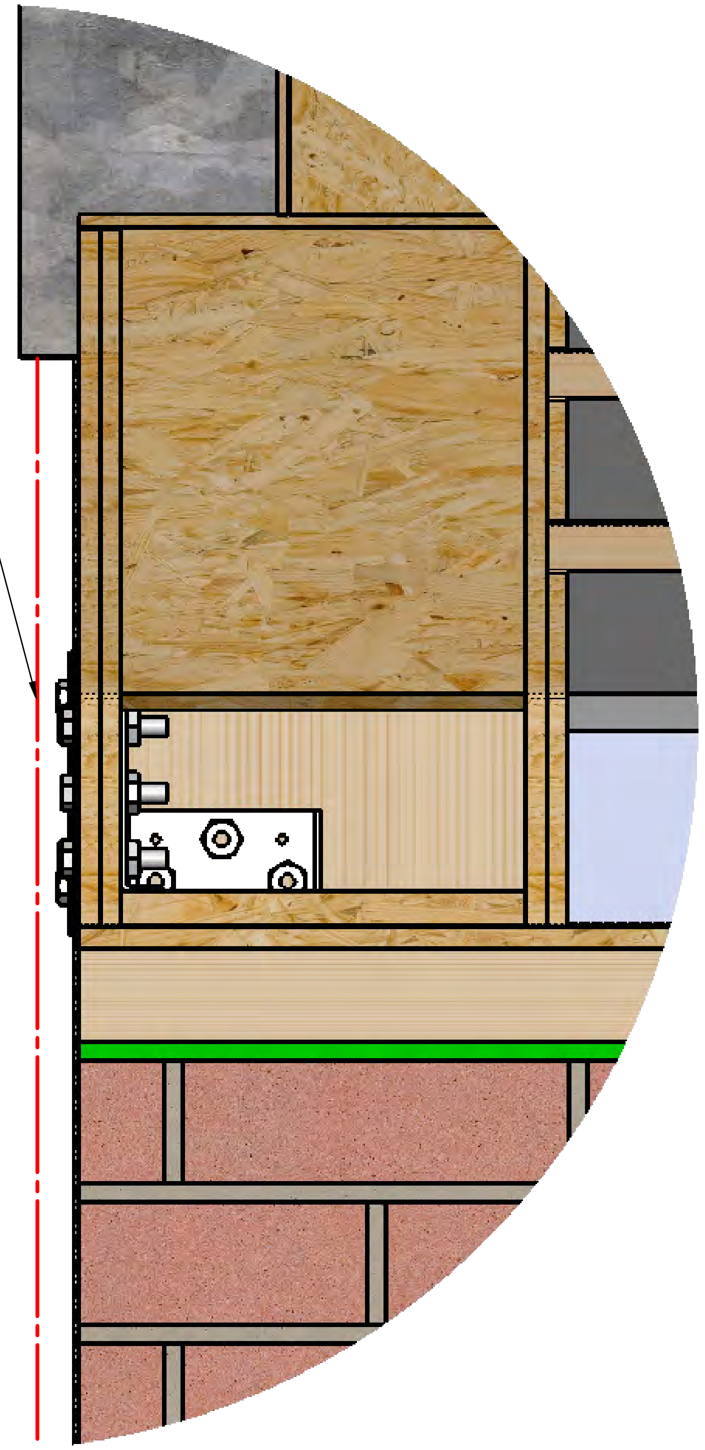
Coach screws fix into this timber



Aluminium plate (3mm thk) with 3 x M10 rivnuts fitted

PROCTOR framesheild 100 waterproof layer or equal fixed over and lapped over tie bar strap and held in place by A2 SS wafer head fixings @ 450 ctrs

INSIDE VIEW OF EAVES CORBEL



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1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DESCRIPTION: GABLE WALL TIE PLATE DETAIL

MODEL NAME: Norbury Roof Assembly / CONFIG. NAME: Default

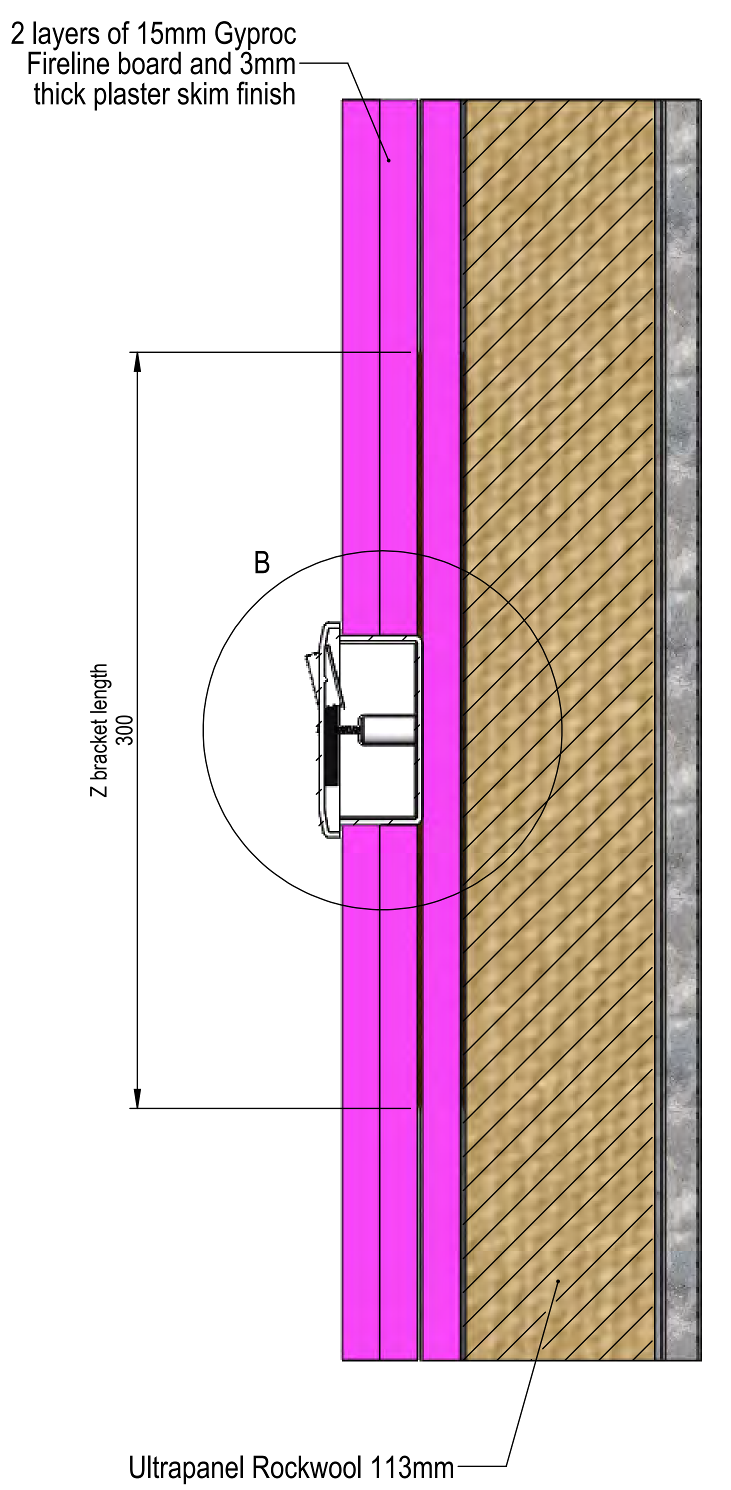
DRAWN BY: DM	DATE CREATED: 19/11/2020
SCALE: NTS	STATUS: DEV

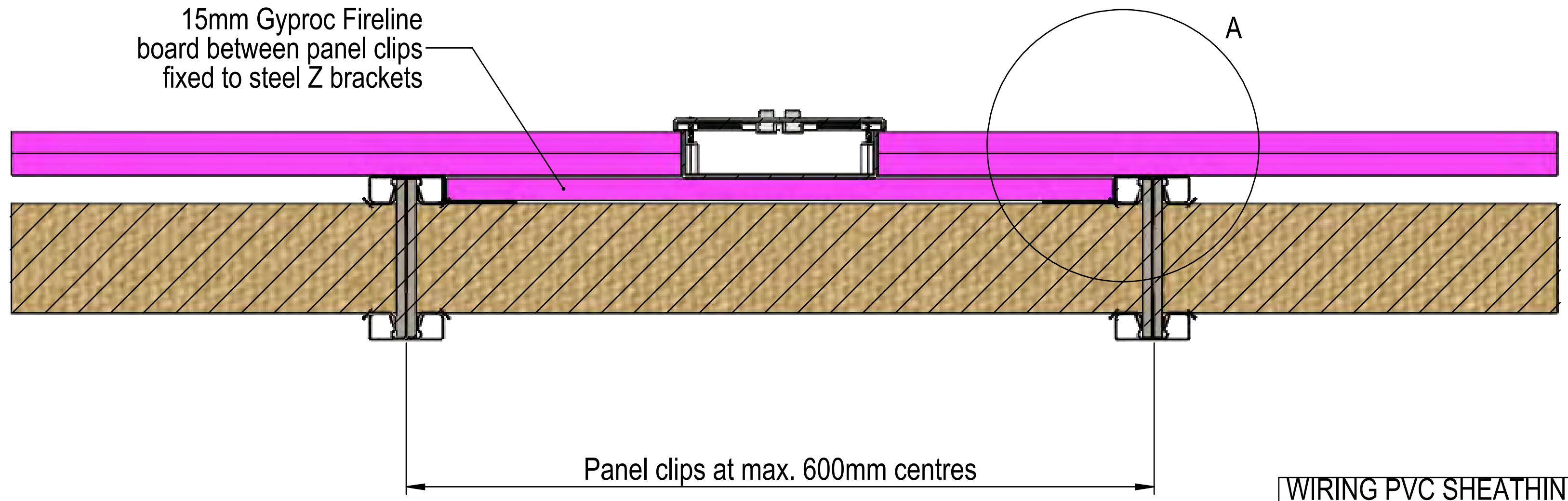
DRAWING No:	STOCK CODE:	REV:
HR-EB-030		-.02
	SHEET 2 OF 2, SIZE A3	01/12/2020

CAD MODEL IS MASTER

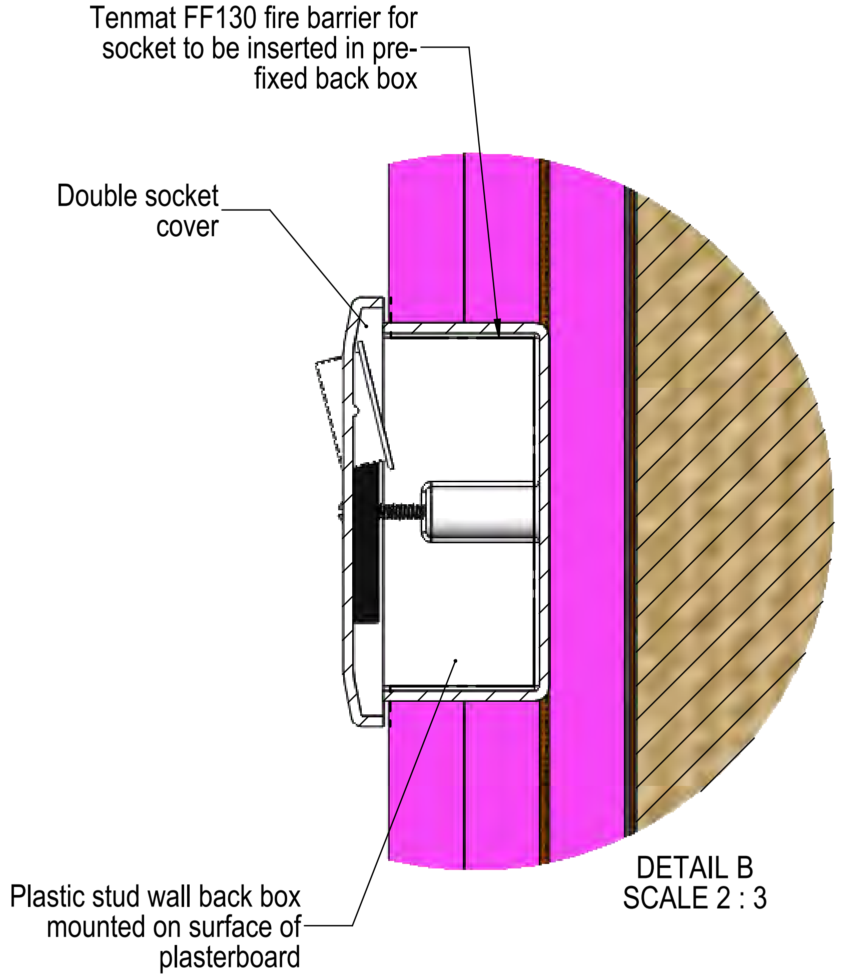
CHANGE No.	REV.	AUTHOR

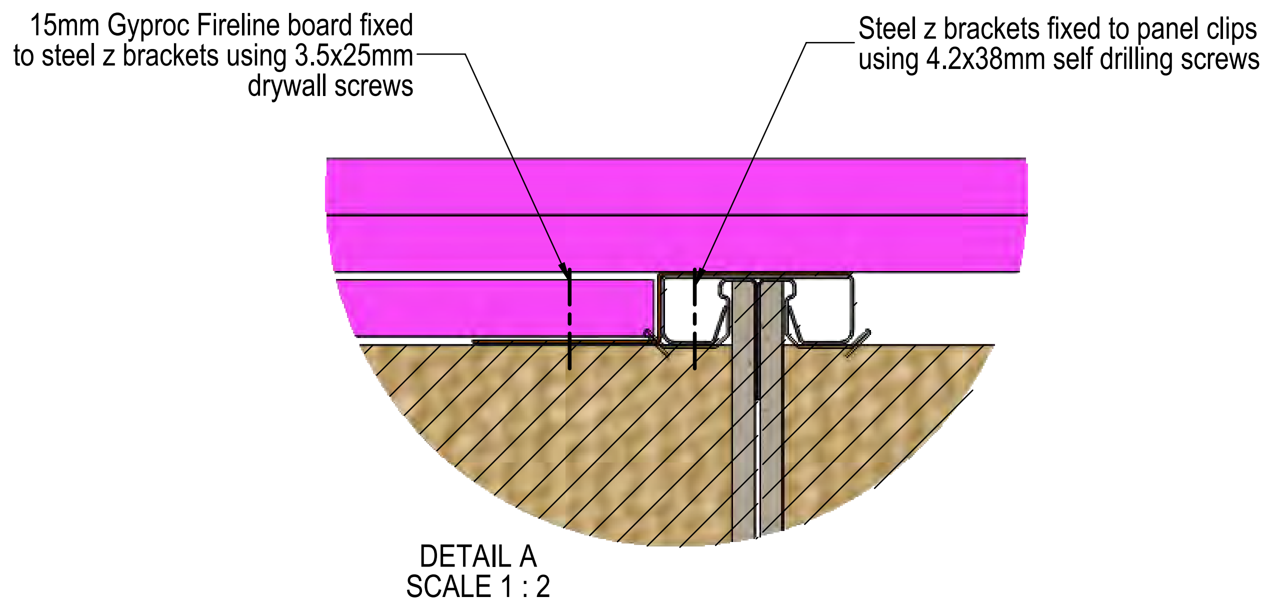
SOCKET SPEC FOR 60 MIN FIRE TESTED PARTY WALL

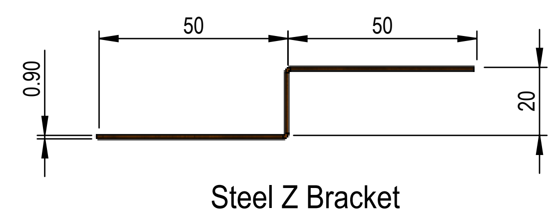




WIRING PVC SHEATHING SHOULD NOT COME INTO CONTACT WITH THE EPS. RUN WIRING INSIDE CONDUIT TO PREVENT CONTACT







QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

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ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM		DATE CREATED: 02/09/2020	
SCALE: 1:3		STATUS: DEV	
DRAWING No: HR-ES-001	STOCK CODE:		REV: -.04
	SHEET 1 OF 2, SIZE A3		04/01/2021

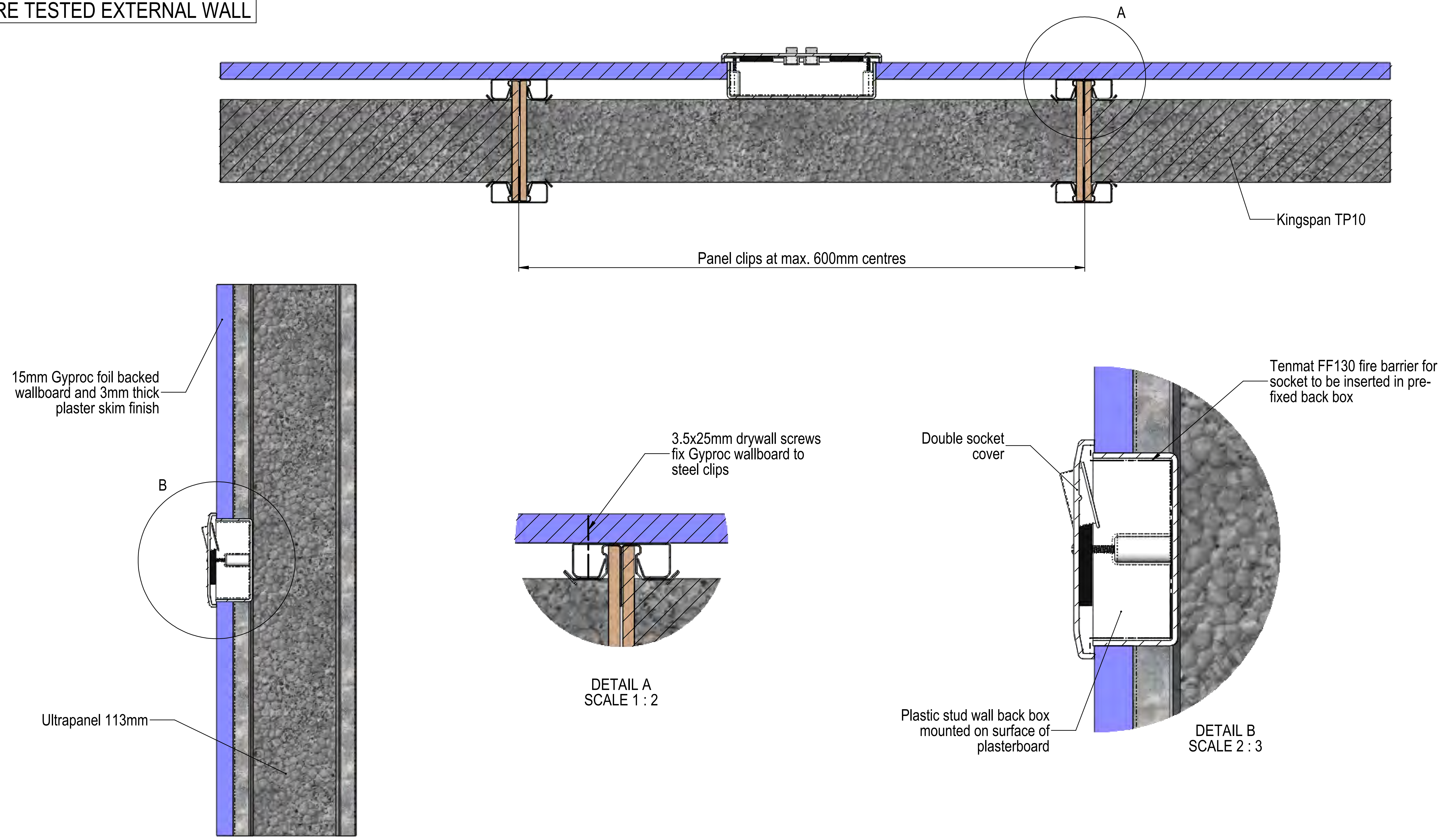
DESCRIPTION:
ELECTRICAL SOCKET DETAILS (party wall)

MODEL NAME: HR-ES-001 / CONFIG. NAME: Default

CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER

SOCKET SPEC FOR 30 MIN
FIRE TESTED EXTERNAL WALL



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

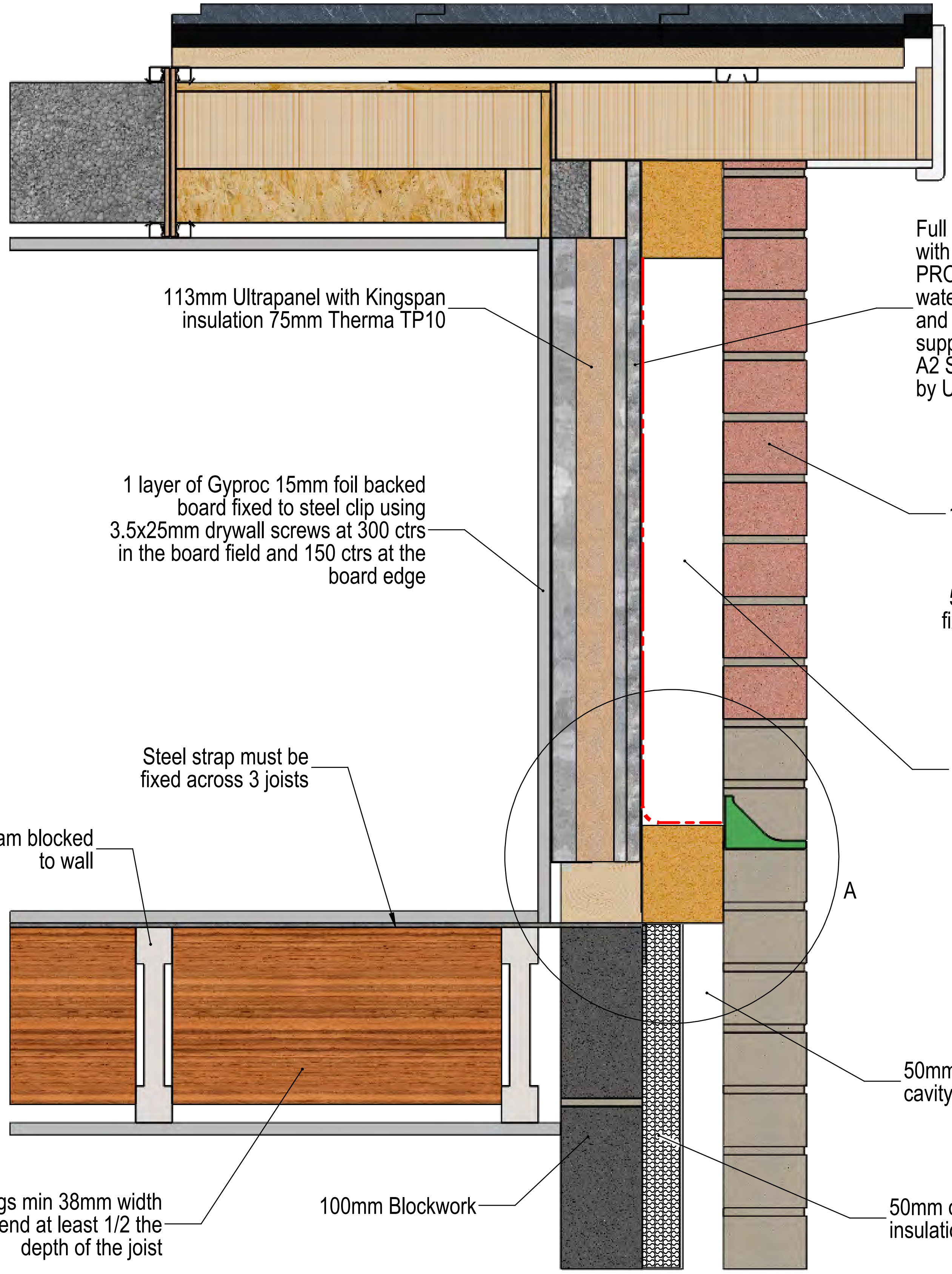
ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

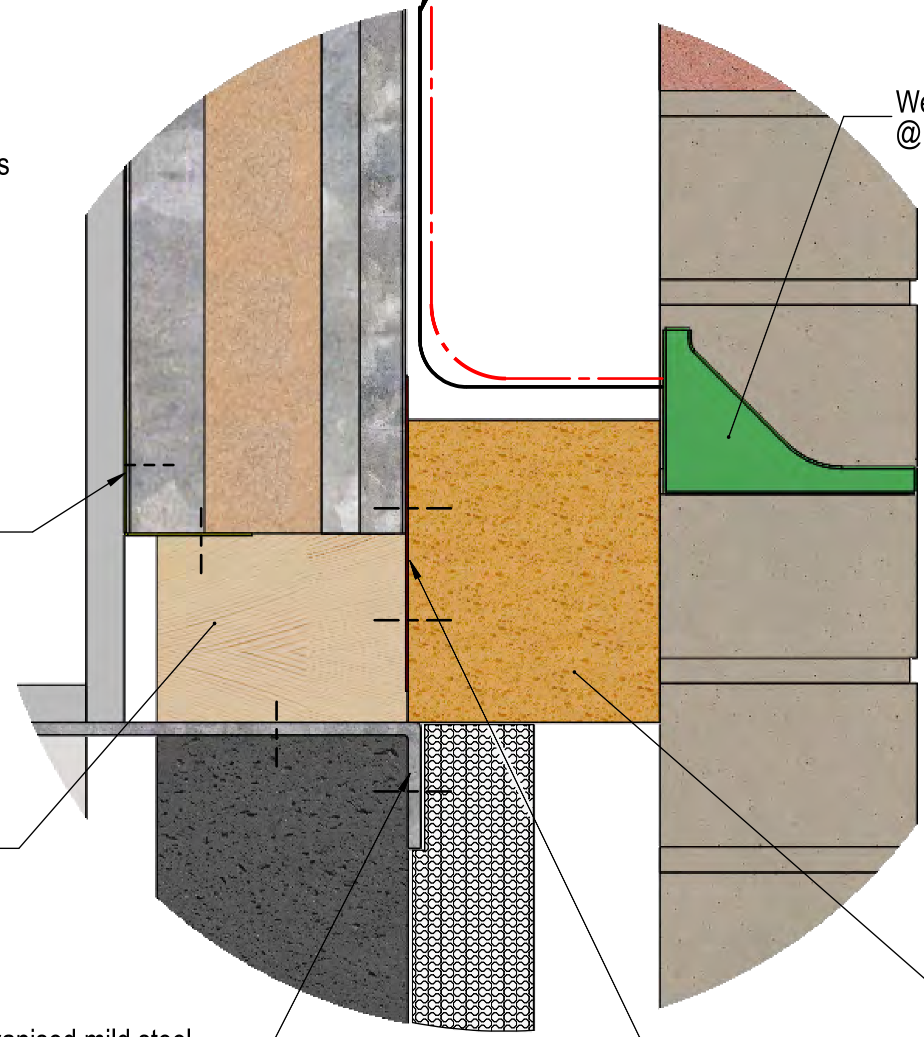
1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 02/09/2020		
SCALE: 1:3	STATUS: DEV		
DESCRIPTION: ELECTRICAL SOCKET DETAILS (external wall)	DRAWING No: HR-ES-001	STOCK CODE:	REV: -.04
MODEL NAME: HR-ES-001 / CONFIG. NAME: Default		SHEET 2 OF 2, SIZE A3	04/01/2021

CHANGE No.	REV.	AUTHOR

GABLE WALL BASE DETAIL





DETAIL A
SCALE 1 : 3

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 26/08/2020
SCALE: 1:7	STATUS: DEV

DESCRIPTION: GABLE WALL ASSEMBLY DETAIL

DRAWING No:	STOCK CODE:	REV:
HR-GW-001		-.07

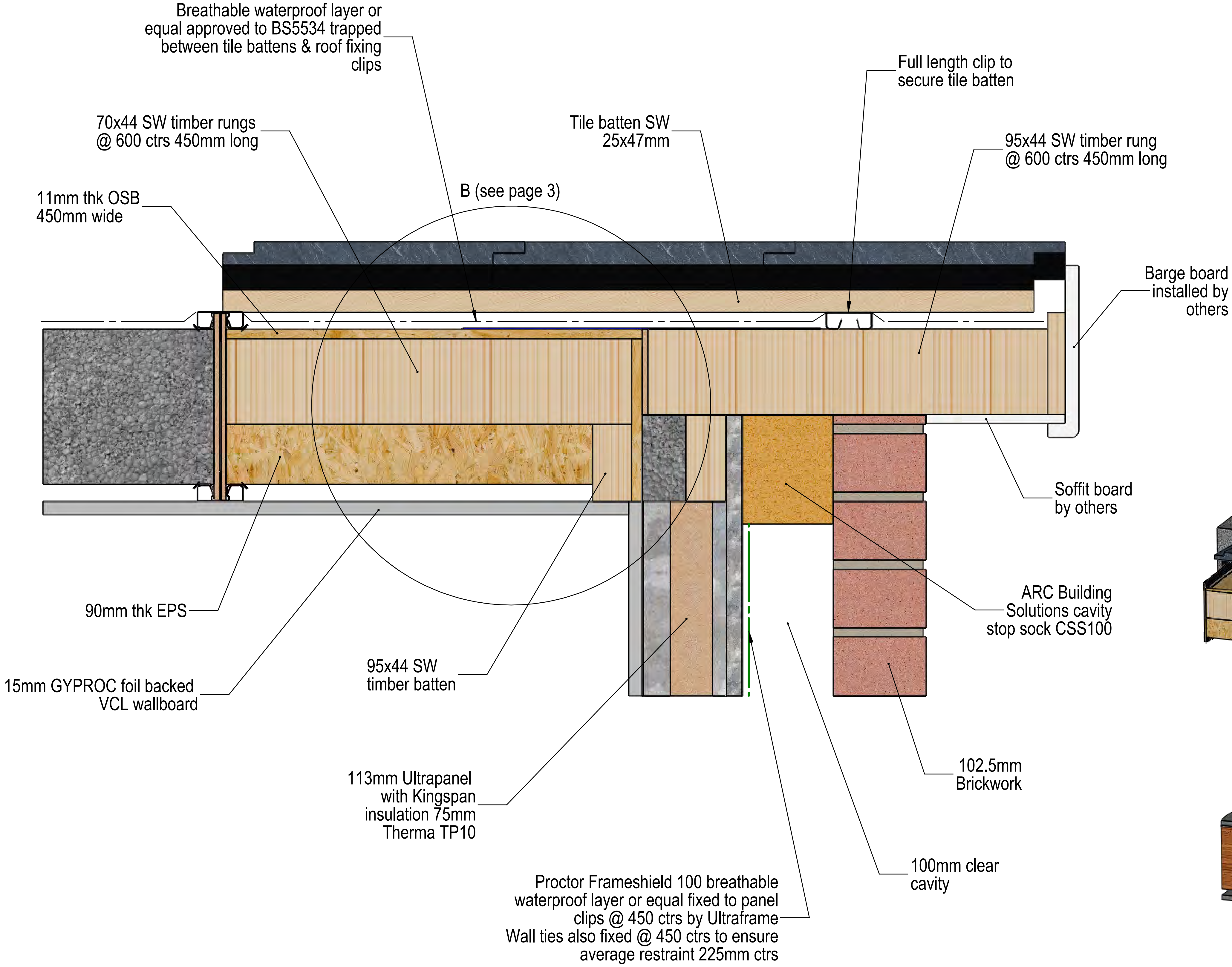
MODEL NAME: HR-GW-001 / CONFIG. NAME: Default

SHEET 1 OF 3, SIZE A3 | 22/01/2021

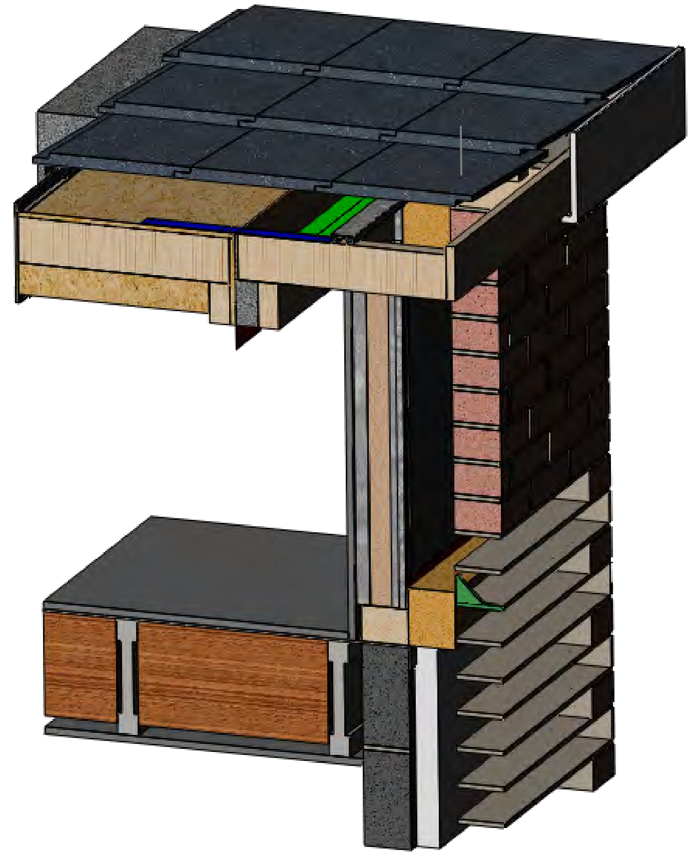
CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER

GABLE WALL HEAD DETAIL



ISOMETRIC VIEW FOR REFERENCE



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED

(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

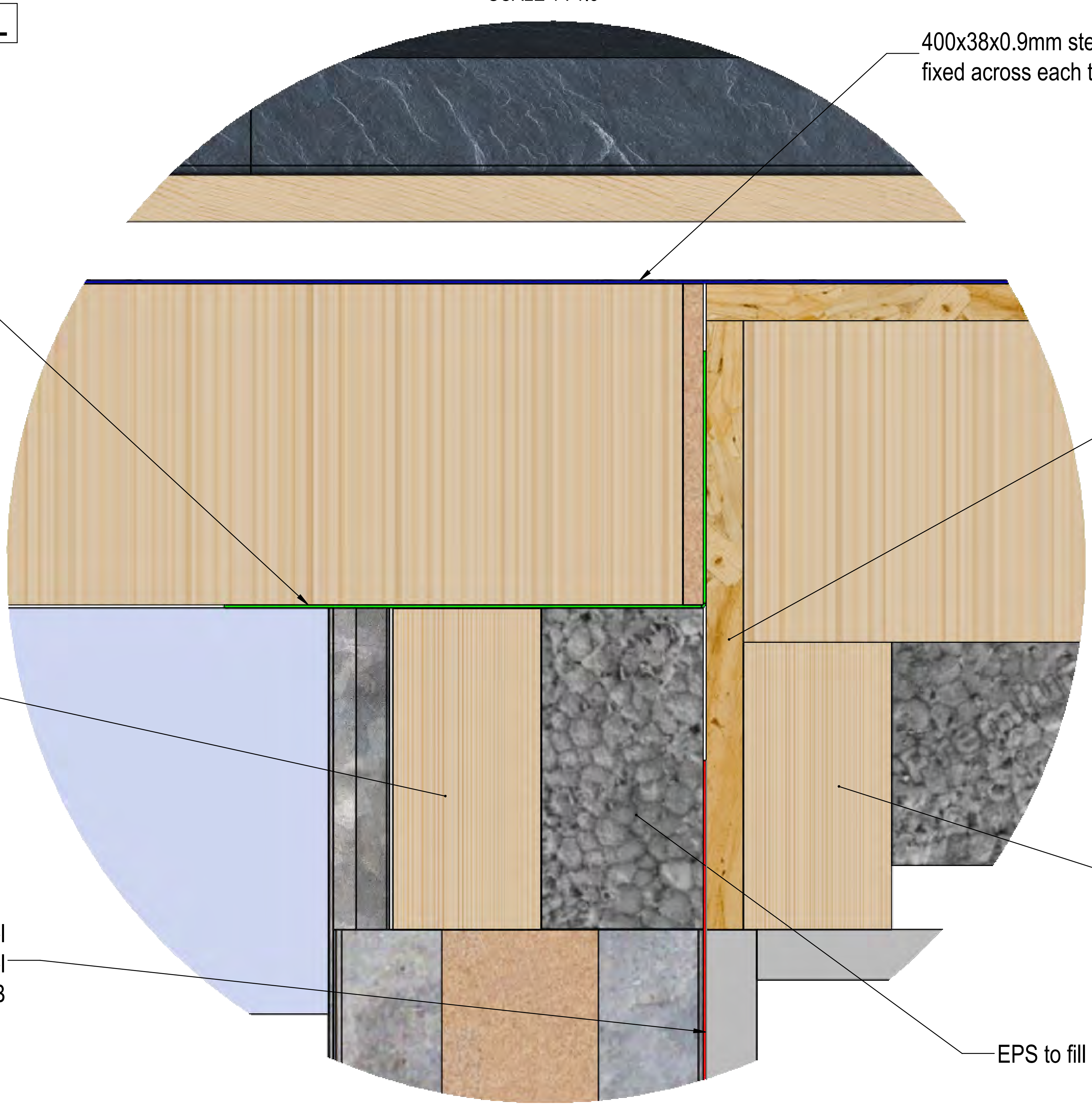
ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM
DATE CREATED: 26/08/2020
SCALE: 1:20
STATUS: DEV
DESCRIPTION: GABLE WALL ASSEMBLY DETAIL
DRAWING No: HR-GW-001
STOCK CODE:
REV: -.07
MODEL NAME: HR-GW-001 / CONFIG. NAME: Default
SHEET 2 OF 3, SIZE A3
22/01/2021

GABLE WALL HEAD DETAIL

DETAIL B (see page 3)
SCALE 1 : 1.5



CHANGE No.	REV.	AUTHOR

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DESCRIPTION:
GABLE WALL ASSEMBLY DETAIL

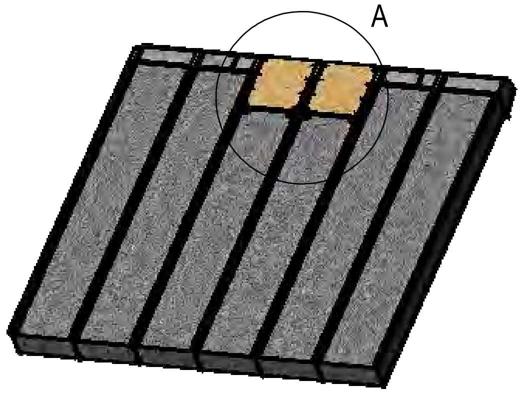
MODEL NAME: HR-GW-001 / CONFIG. NAME: Default

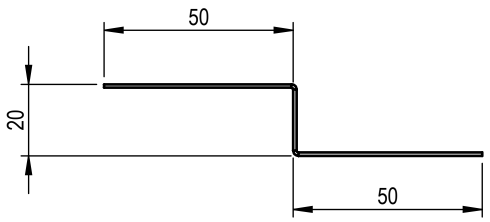
DRAWN BY: DM	DATE CREATED: 26/08/2020
SCALE: 1:20	STATUS: DEV

DRAWING No:	STOCK CODE:	REV:
HR-GW-001		-.07
	SHEET 3 OF 3, SIZE A3	22/01/2021

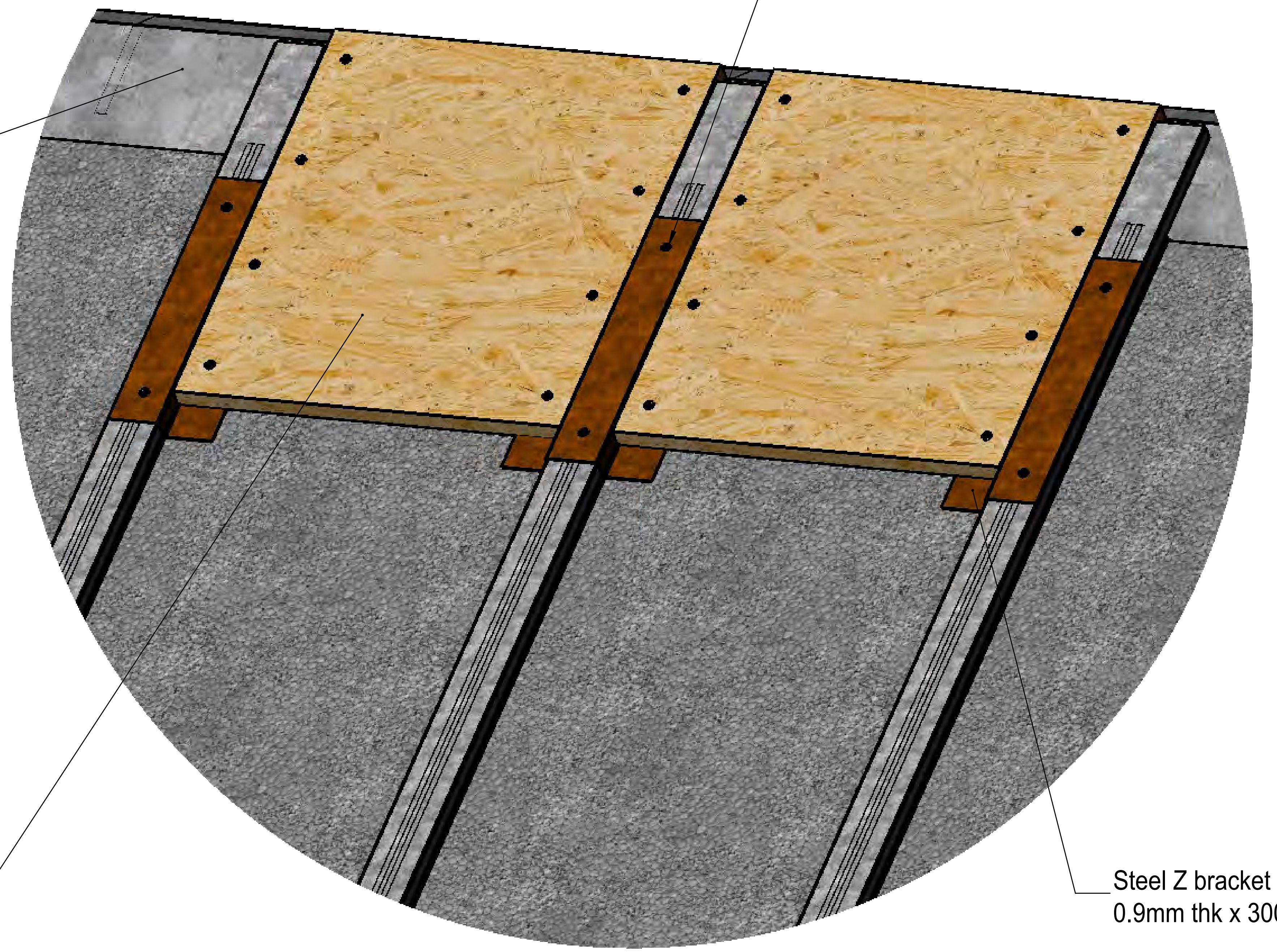
CAD MODEL IS MASTER

CHANGE No.	REV.	AUTHOR





Steel Z Bracket



DETAIL A
SCALE 1 : 5

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

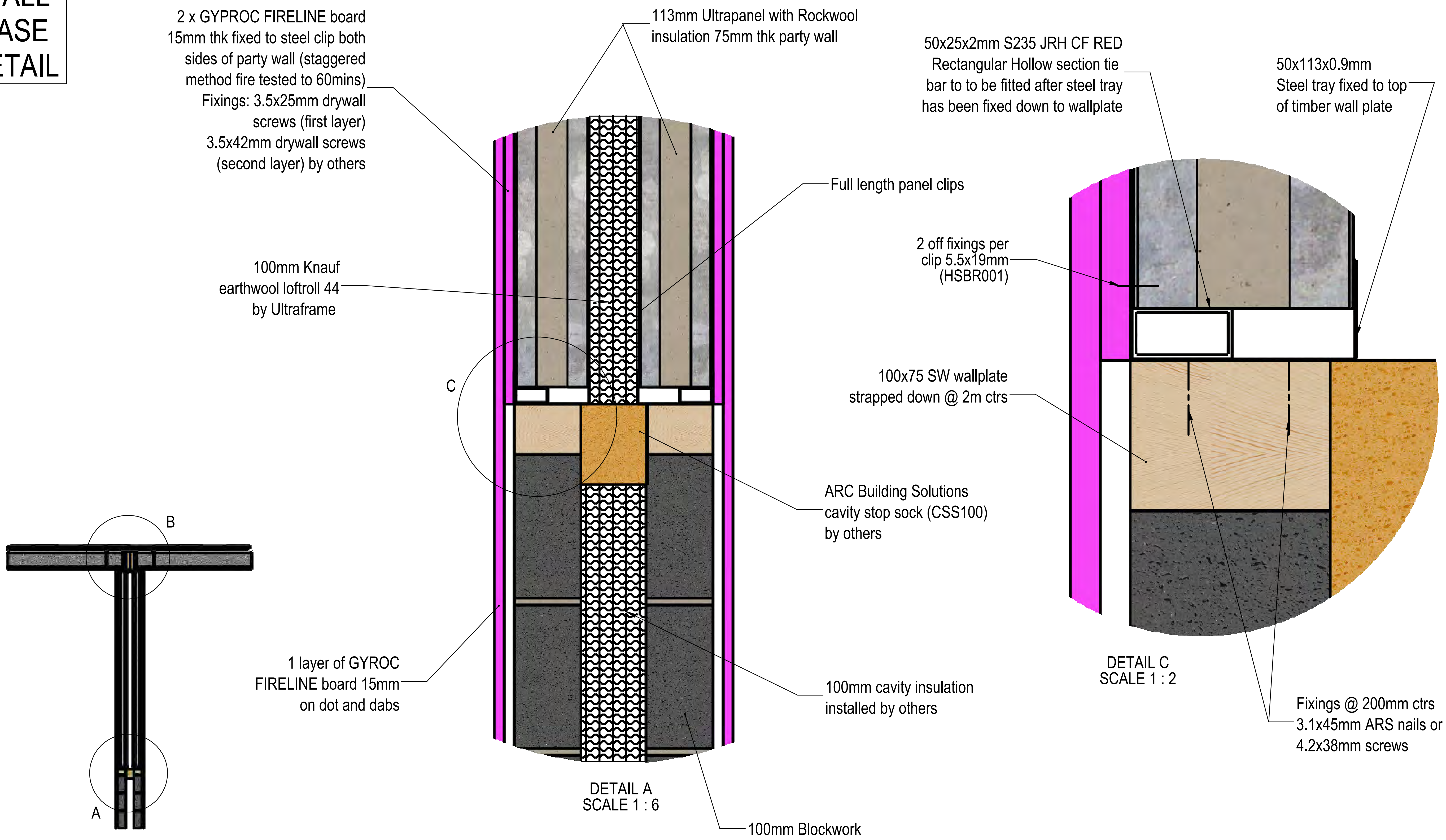
1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM		DATE CREATED: 21/08/2020	
SCALE: 1:5		STATUS: DEV	
DESCRIPTION: PREFAB CHIMNEY DETAIL	DRAWING No: HR-PC-001	STOCK CODE:	REV: -.01
MODEL NAME: HR-PC-001 / CONFIG. NAME: Default		SHEET 1 OF 1, SIZE A3	04/12/2020

CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER

PARTY WALL BASE DETAIL



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

WALLPLATE STRAPS & CAVITY STOP FITTED BY OTHERS BEFORE ROOF COMES TO SITE

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 14/08/2020
SCALE: 1:6	STATUS: DEV

DESCRIPTION:
PARTY WALL ASSEMBLY DETAIL (EXTERNAL)

DRAWING No:	STOCK CODE:	REV:
HR-PW-001		-.05

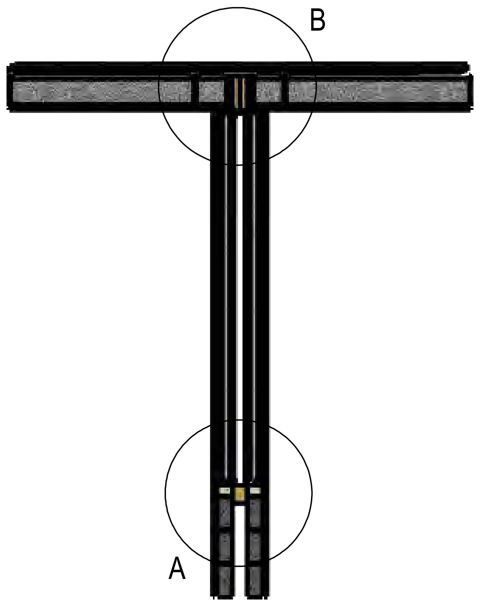
MODEL NAME: HR-PW-001 / CONFIG. NAME: Default

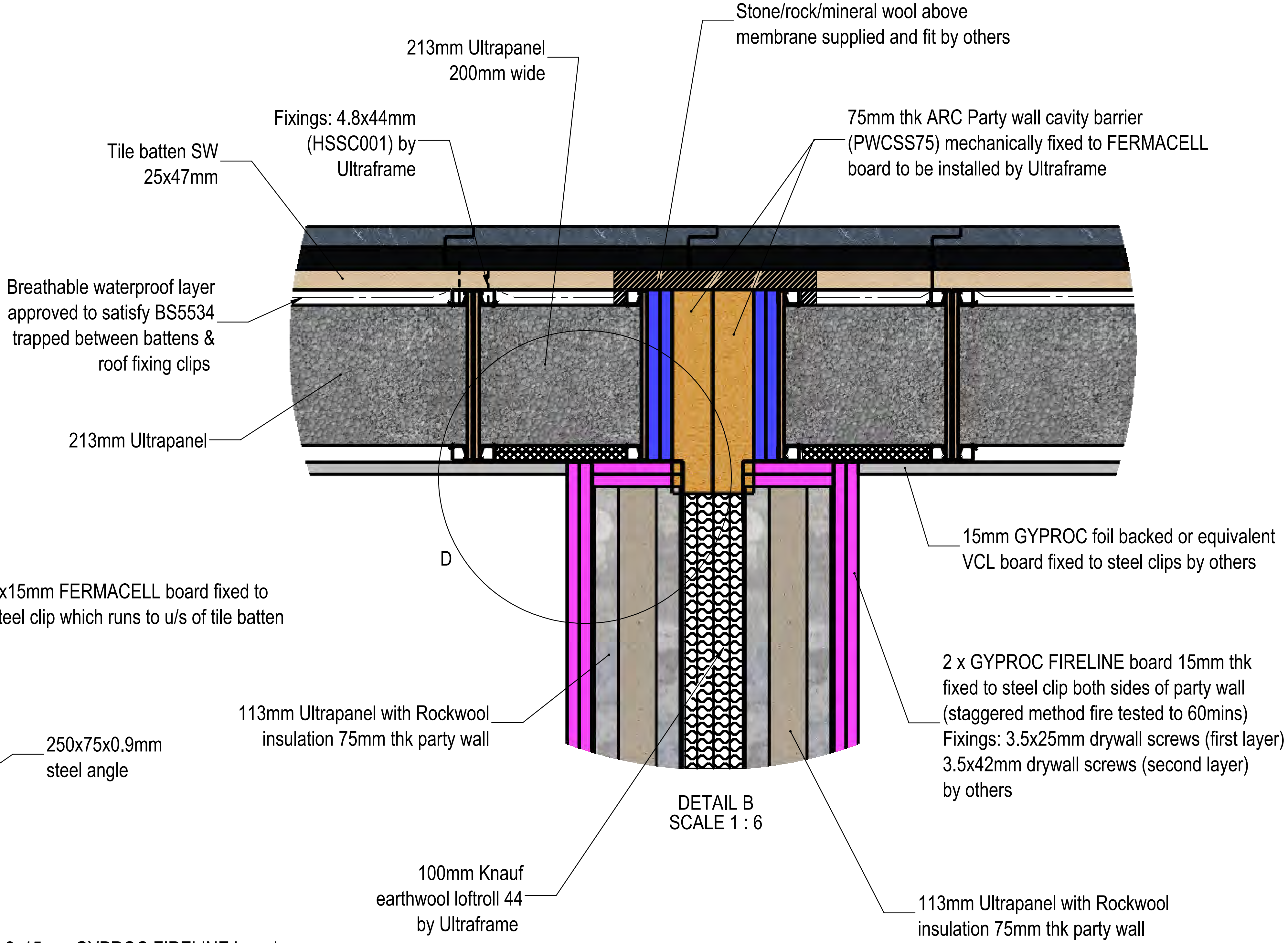
SHEET 1 OF 2, SIZE A3 15/12/2020

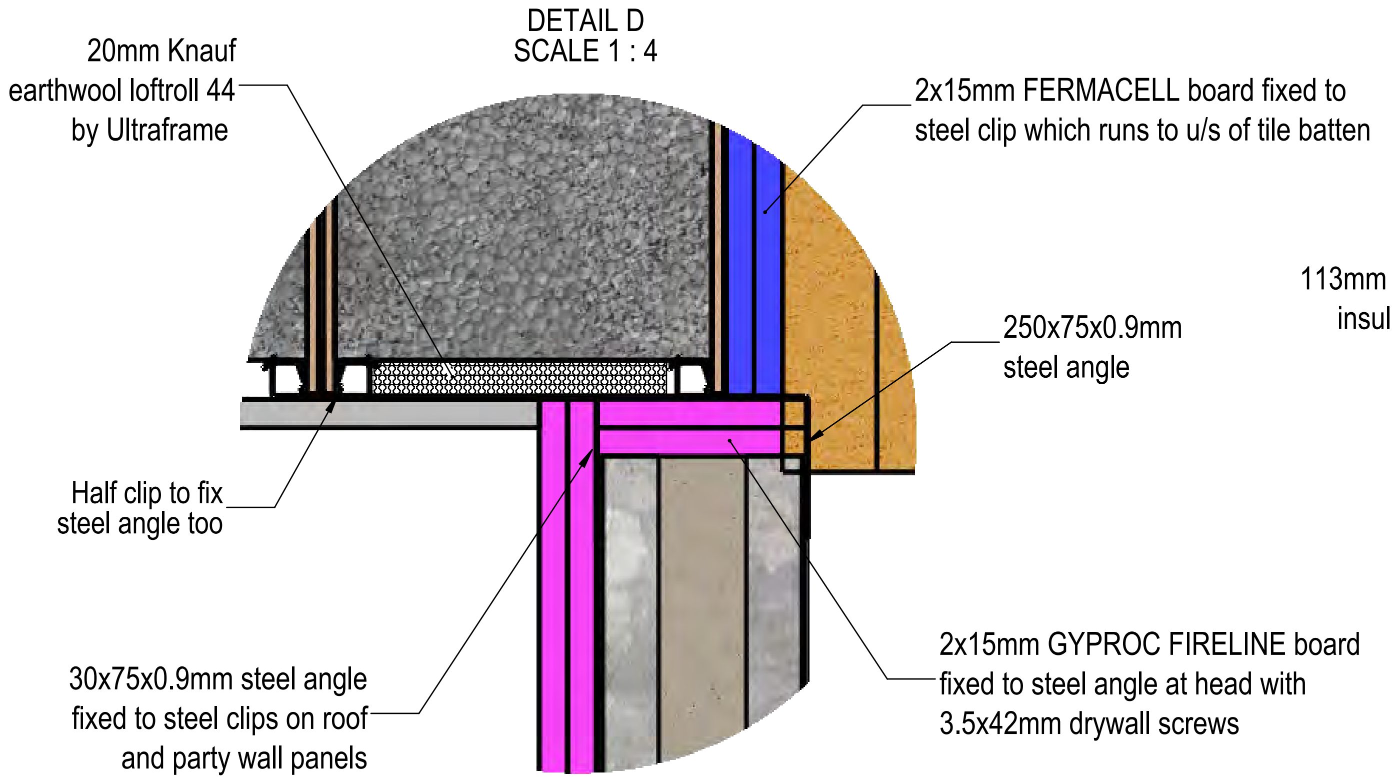
PARTY WALL HEAD DETAIL

CAD MODEL IS MASTER

CHANGE No.	REV.	AUTHOR







QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

WALLPLATE STRAPS & CAVITY STOP FITTED BY OTHERS BEFORE ROOF COMES TO SITE

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 14/08/2020
SCALE: 1:6	STATUS: DEV

DESCRIPTION: PARTY WALL ASSEMBLY DETAIL (EXTERNAL)

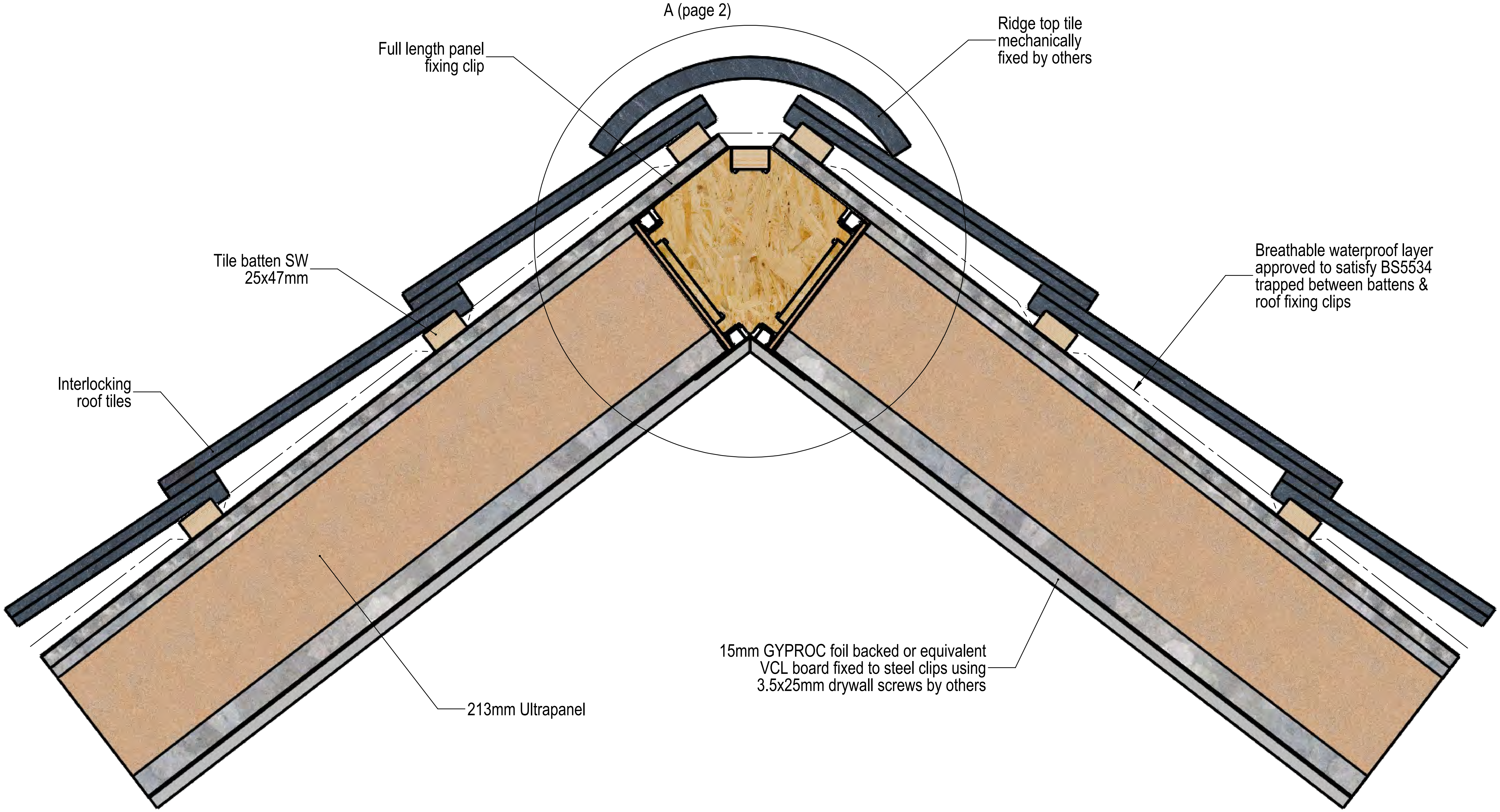
DRAWING No:	STOCK CODE:	REV:
HR-PW-001		-.05

MODEL NAME: HR-PW-001 / CONFIG. NAME: Default

SHEET 2 OF 2, SIZE A3 15/12/2020

CAD MODEL IS MASTER

CHANGE No.	REV.	AUTHOR



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM		DATE CREATED: 25/08/2020	
SCALE: 1:5		STATUS: DEV	
DRAWING No: HR-RB-009	STOCK CODE:		REV: -.02

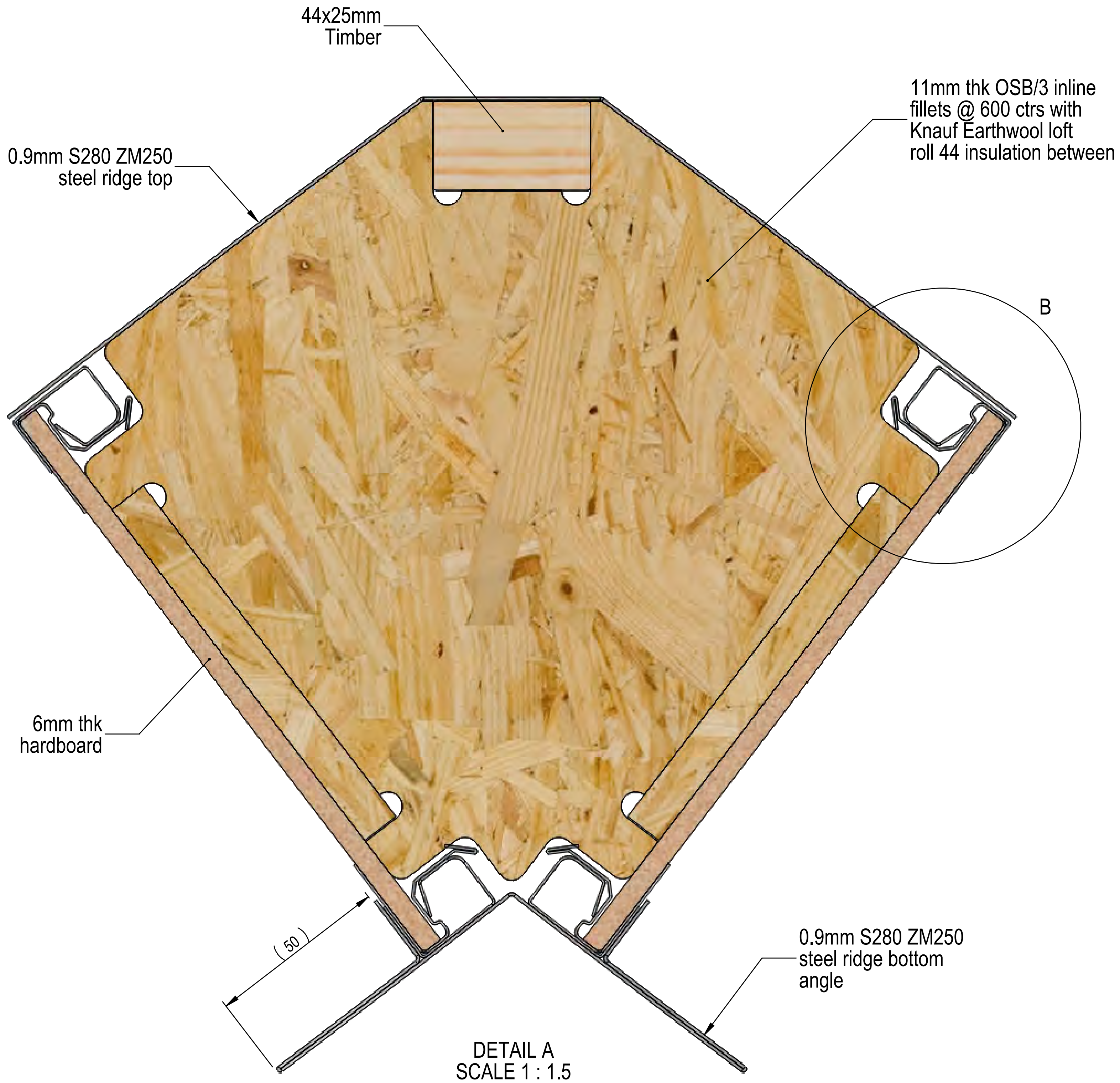
DESCRIPTION:
RIDGE BEAM DETAIL

MODEL NAME: HR-RB-009 / CONFIG. NAME: Default

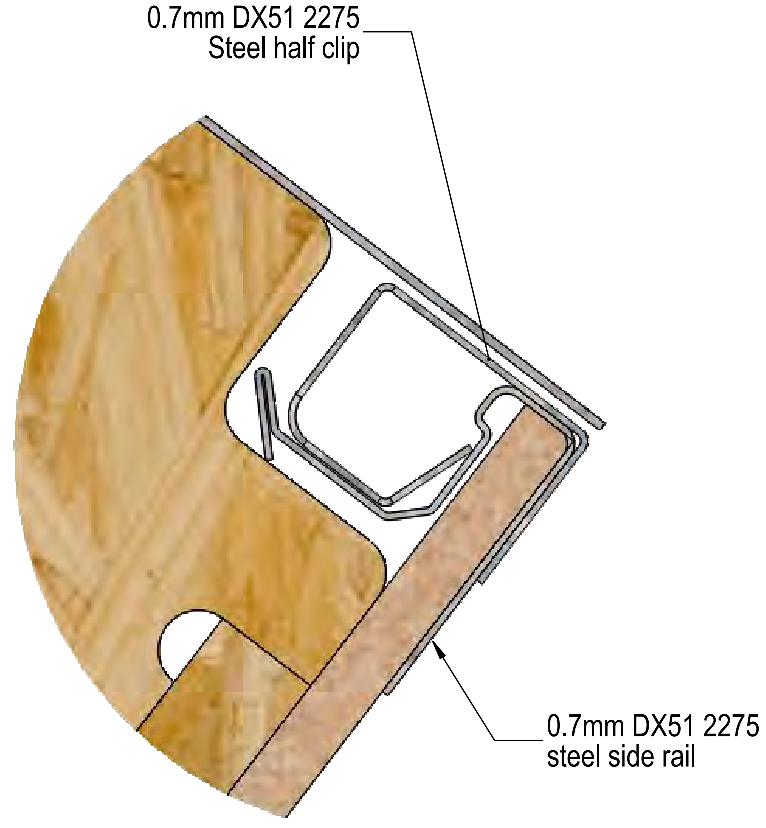
SHEET 1 OF 2, SIZE A3

22/09/2020

CAD MODEL IS MASTER



DETAIL A
SCALE 1 : 1.5



DETAIL B
SCALE 2 : 1.5

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

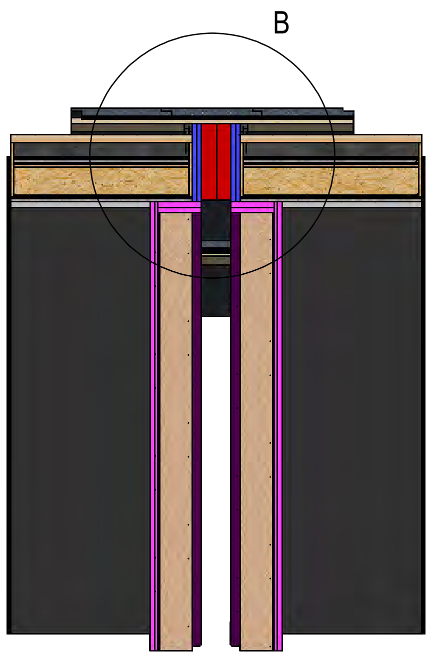
DRAWN BY: DM	DATE CREATED: 25/08/2020	
SCALE: 1:5	STATUS: DEV	
DRAWING No: HR-RB-009	STOCK CODE:	REV: -.02

DESCRIPTION:
RIDGE BEAM DETAIL

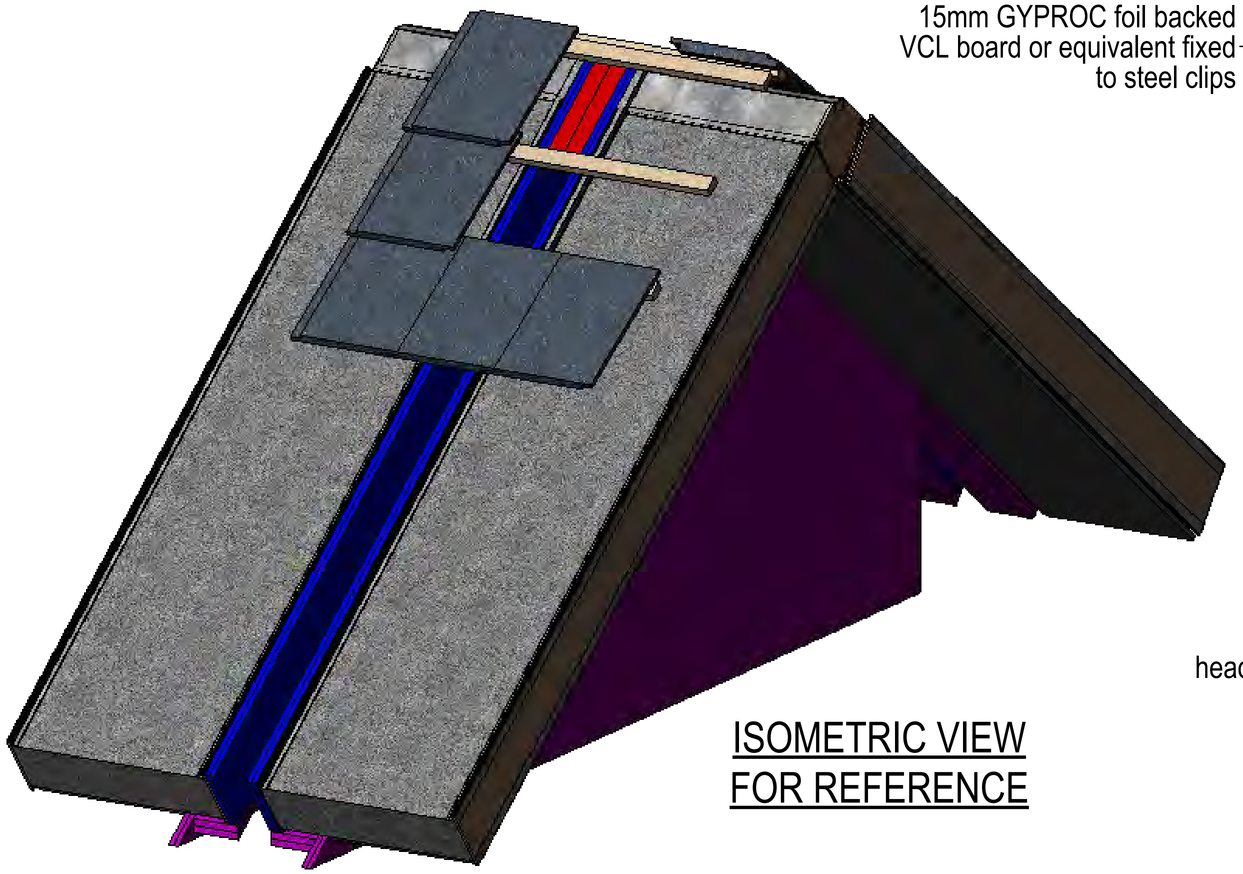
MODEL NAME: HR-RB-009 / CONFIG. NAME: Default

CAD MODEL IS MASTER

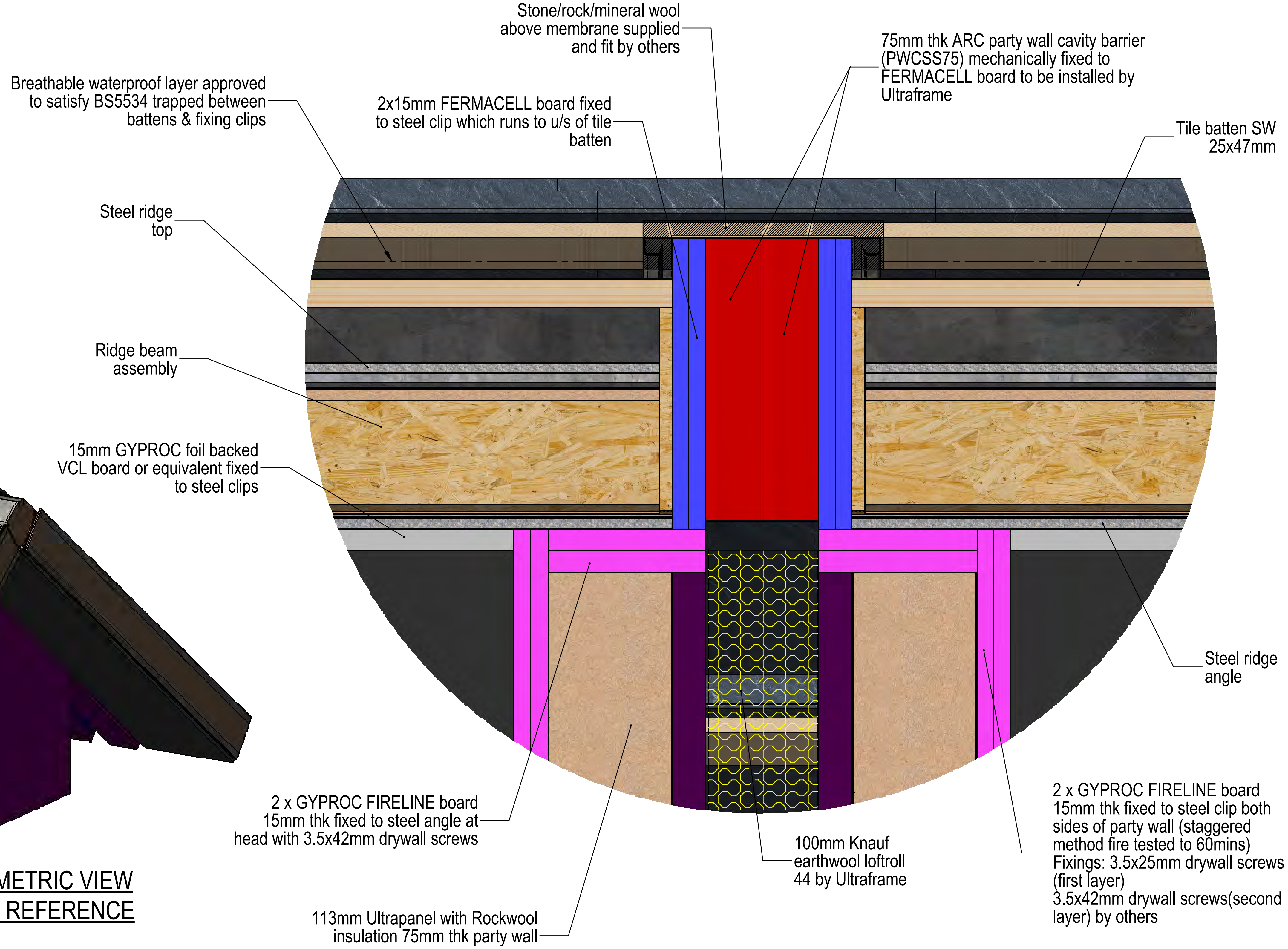
CHANGE No.	REV.	AUTHOR



SECTION A-A
SCALE 1 : 25



ISOMETRIC VIEW
FOR REFERENCE



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 26/08/2020
SCALE: 1:4	STATUS: DEV

DESCRIPTION: RIDGE BEAM SPLIT DETAIL

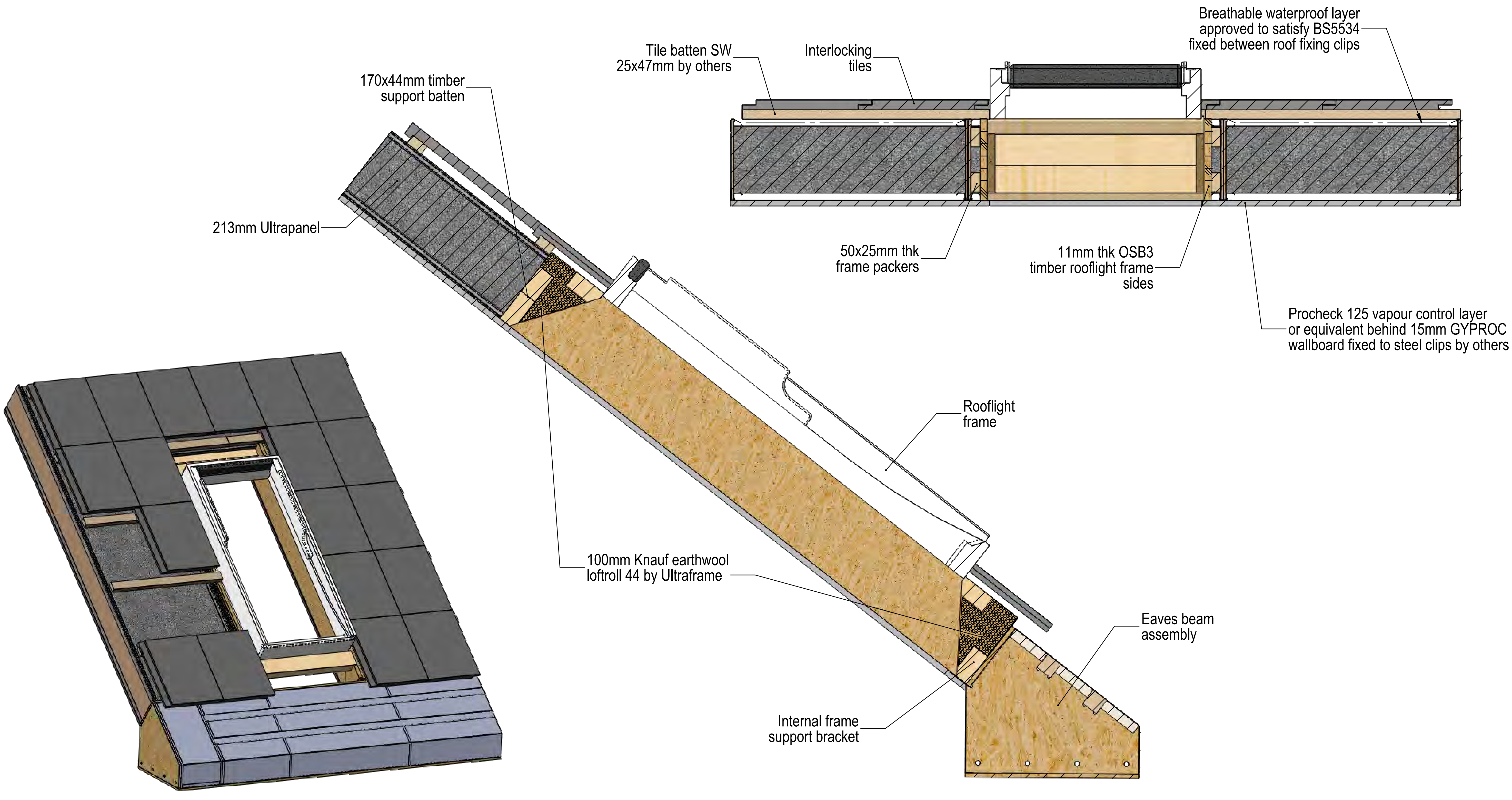
DRAWING No:	STOCK CODE:	REV:
HR-RB-011		-.04

MODEL NAME: HR-RB-011 / CONFIG. NAME: Default

SHEET 1 OF 1, SIZE A3 07/12/2020

CAD MODEL IS MASTER

CHANGE No.	REV.	AUTHOR



ISOMETRIC VIEW FOR REFERENCE

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED

(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

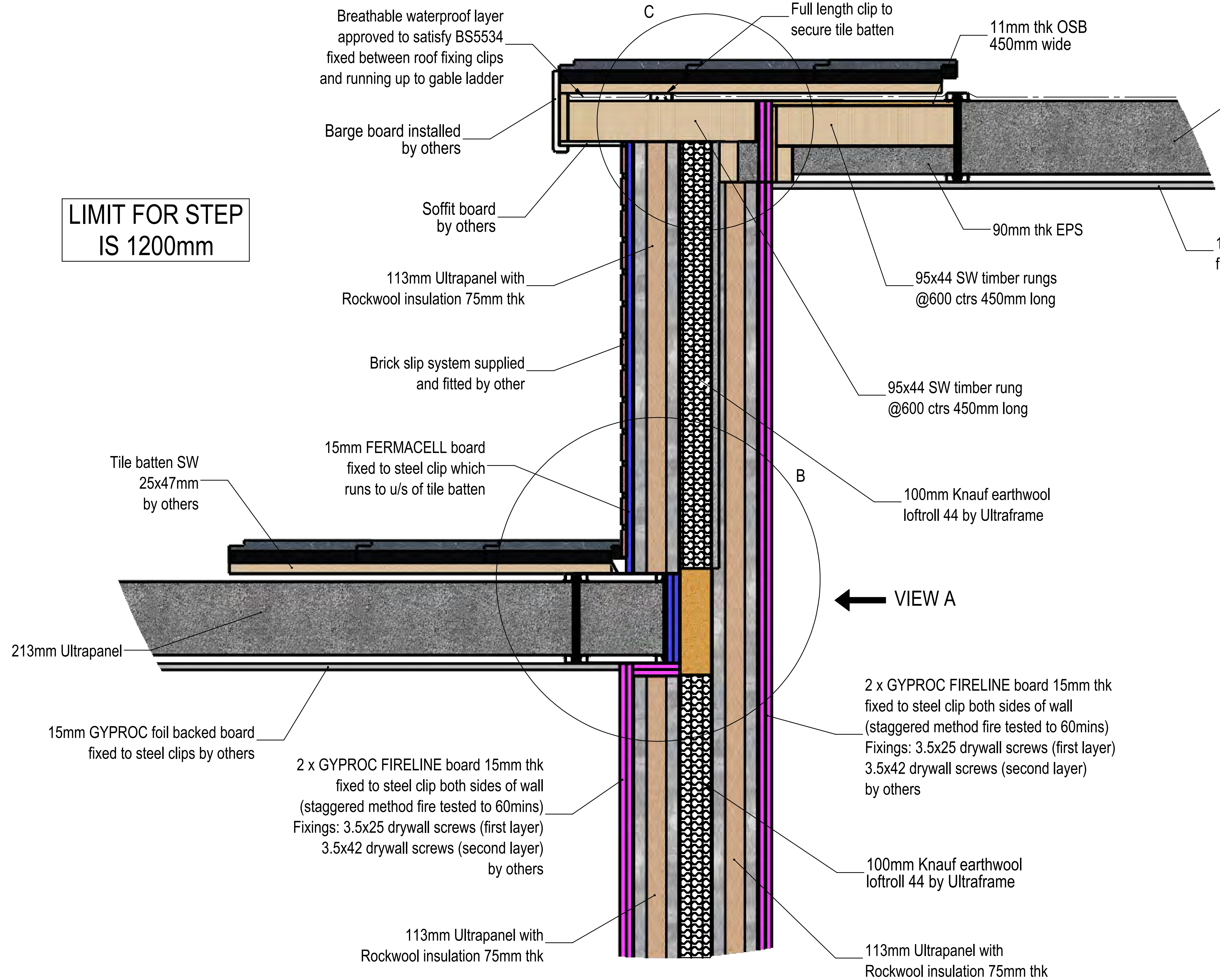
DRAWN BY: DM	DATE CREATED: 21/08/2020		
SCALE: 1:10	STATUS: DEV		
DRAWING No: HR-RL-001	STOCK CODE:	REV: -.01	
	SHEET 1 OF 1, SIZE A3	21/08/2020	

DESCRIPTION:

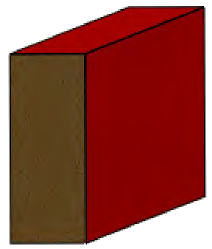
ROOF LIGHT ASSEMBLY

MODEL NAME: HR-RL-001 / CONFIG. NAME: WORKS INSTRUCTION

CHANGE No.	REV.	AUTHOR



Cavity in EPS is filled with 100mm thk ARC party wall cavity barrier PWCSS100 (pictured below)



VIEW A
(with board removed)

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

WALLPLATE STRAPS & CAVITY STOPS FITTED BY OTHERS BEFORE ROOF COMES TO SITE

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

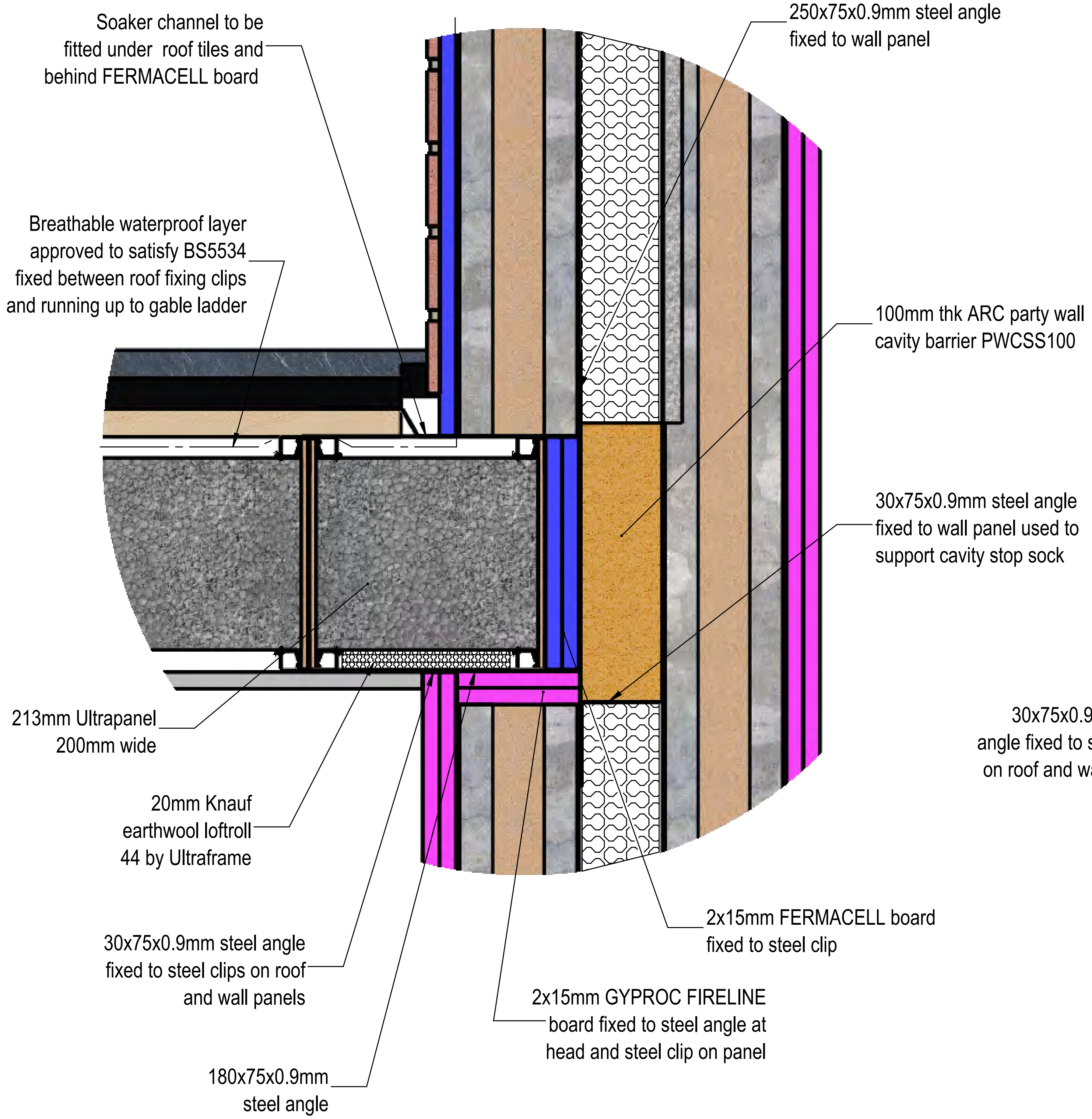
DRAWN BY: DM	DATE CREATED: 11/08/2020	
SCALE: 1:10	STATUS: DEV	
DRAWING No: HR-SR-001	STOCK CODE:	REV: -.06

DESCRIPTION:
STEPPED ROOF ASSEMBLY (EXTERNAL)

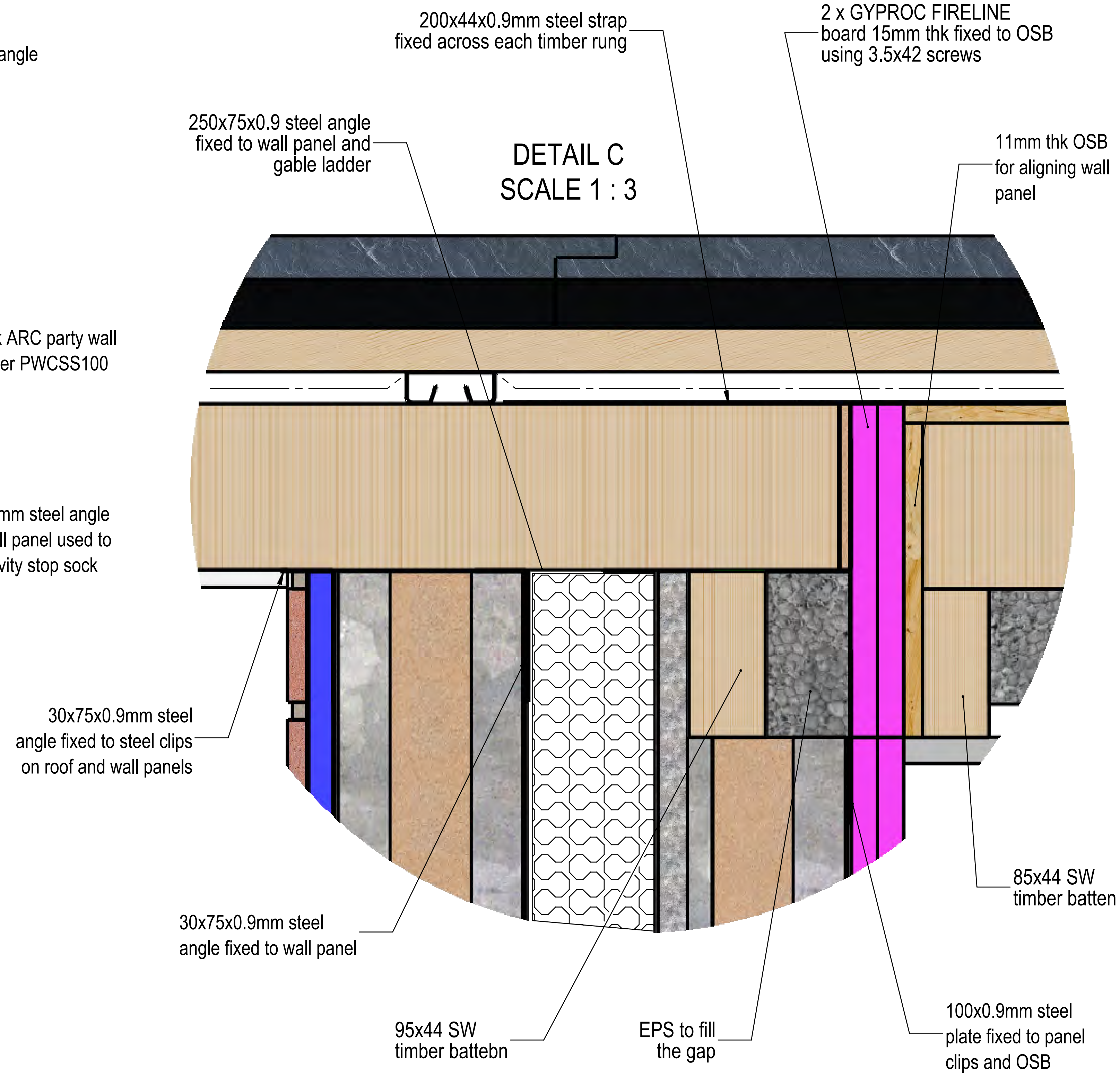
MODEL NAME: HR-SR-001 / CONFIG. NAME: Default

SHEET 1 OF 2, SIZE A3 15/12/2020

DETAIL B
SCALE 1 : 5



DETAIL C
SCALE 1 : 3



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

WALLPLATE STRAPS & CAVITY STOPS FITTED BY OTHERS BEFORE ROOF COMES TO SITE

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 11/08/2020
SCALE: 1:10	STATUS: DEV

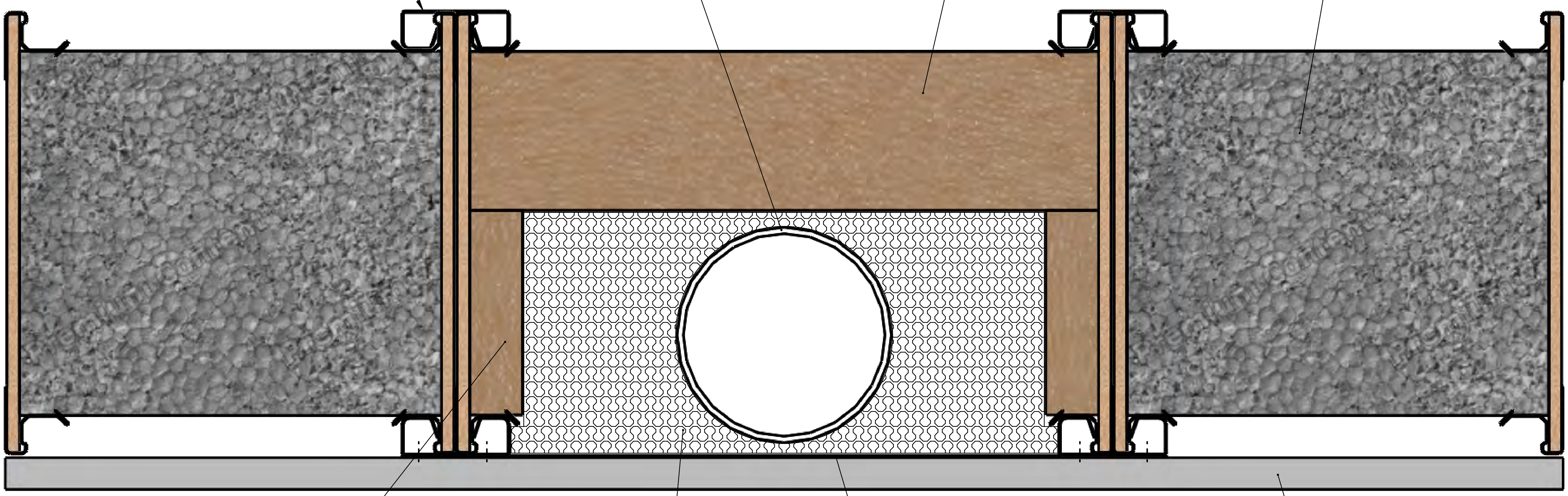
DESCRIPTION:
STEPPED ROOF ASSEMBLY (EXTERNAL)

DRAWING No:	STOCK CODE:	REV:
HR-SR-001		-.06

MODEL NAME: HR-SR-001 / CONFIG. NAME: Default

CHANGE No. | REV. | AUTHOR

CAD MODEL IS MASTER



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED
(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm | DO NOT SCALE IF IN DOUBT ~ ASK | THIRD ANGLE PROJECTION

ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM
DATE CREATED: 30/11/2020
SCALE: 1:2
STATUS: DEV

DESCRIPTION:
ULTRAPANEL SERVICE VENT

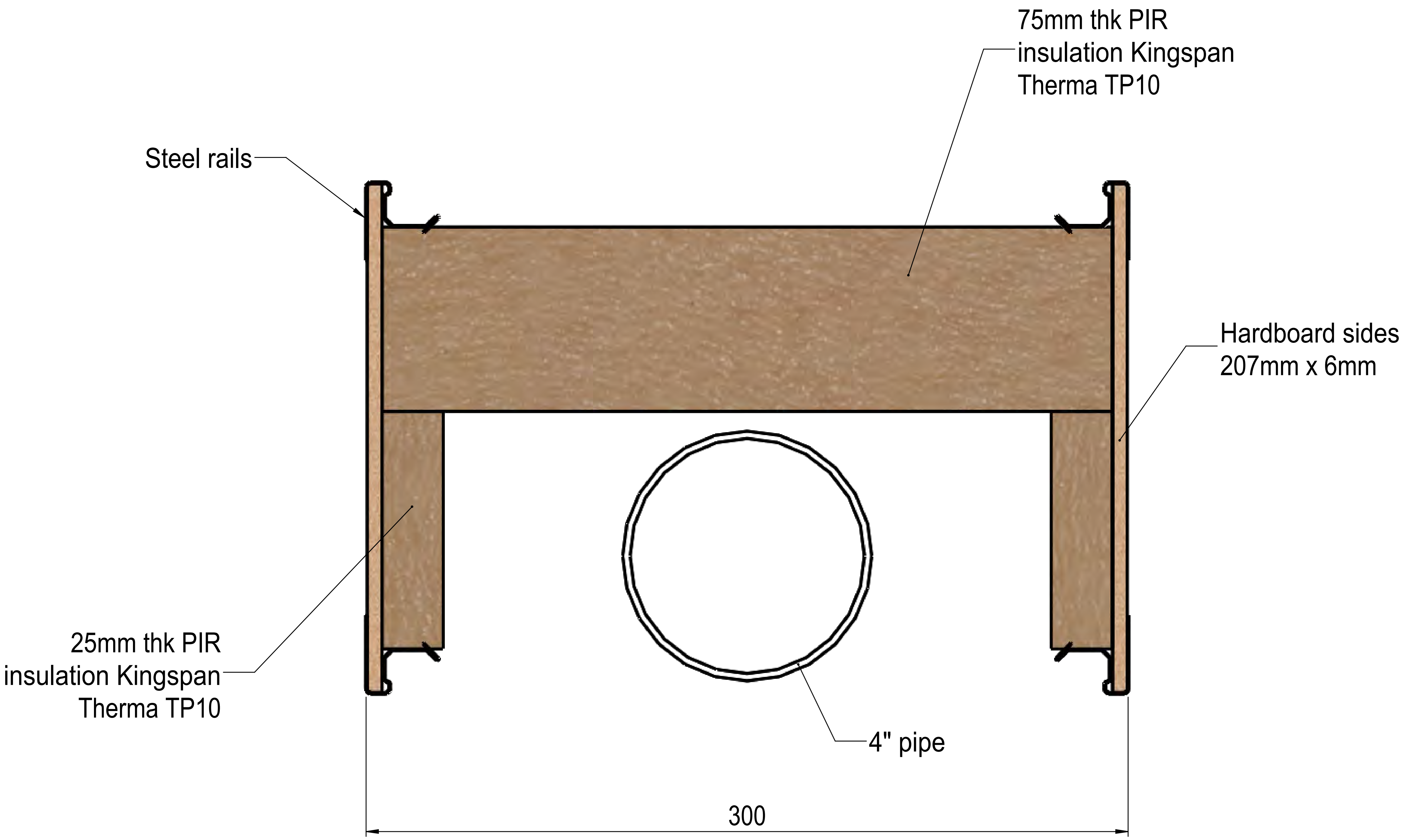
DRAWING No: HR-UP-012
STOCK CODE:
REV: -.02

MODEL NAME: HR-UP-012 / CONFIG. NAME: 298mm

SHEET 1 OF 2, SIZE A3 01/12/2020

CHANGE No.	REV.	AUTHOR

CAD MODEL IS MASTER



QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

NOTES:

CRITICAL DIMENSIONS CIRCLED

(REFERENCE DIMENSIONS IN PARENTHESES)

ALL DIMENSIONS IN mm	DO NOT SCALE IF IN DOUBT ~ ASK	THIRD ANGLE PROJECTION

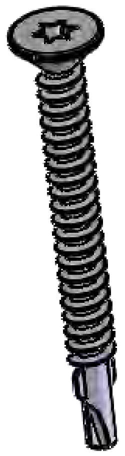
ultraframe
Transforming light and space
ENTERPRISE WORKS, SALTHILL Rd, CLITHEROE, LANCASHIRE, BB7 1PE

1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

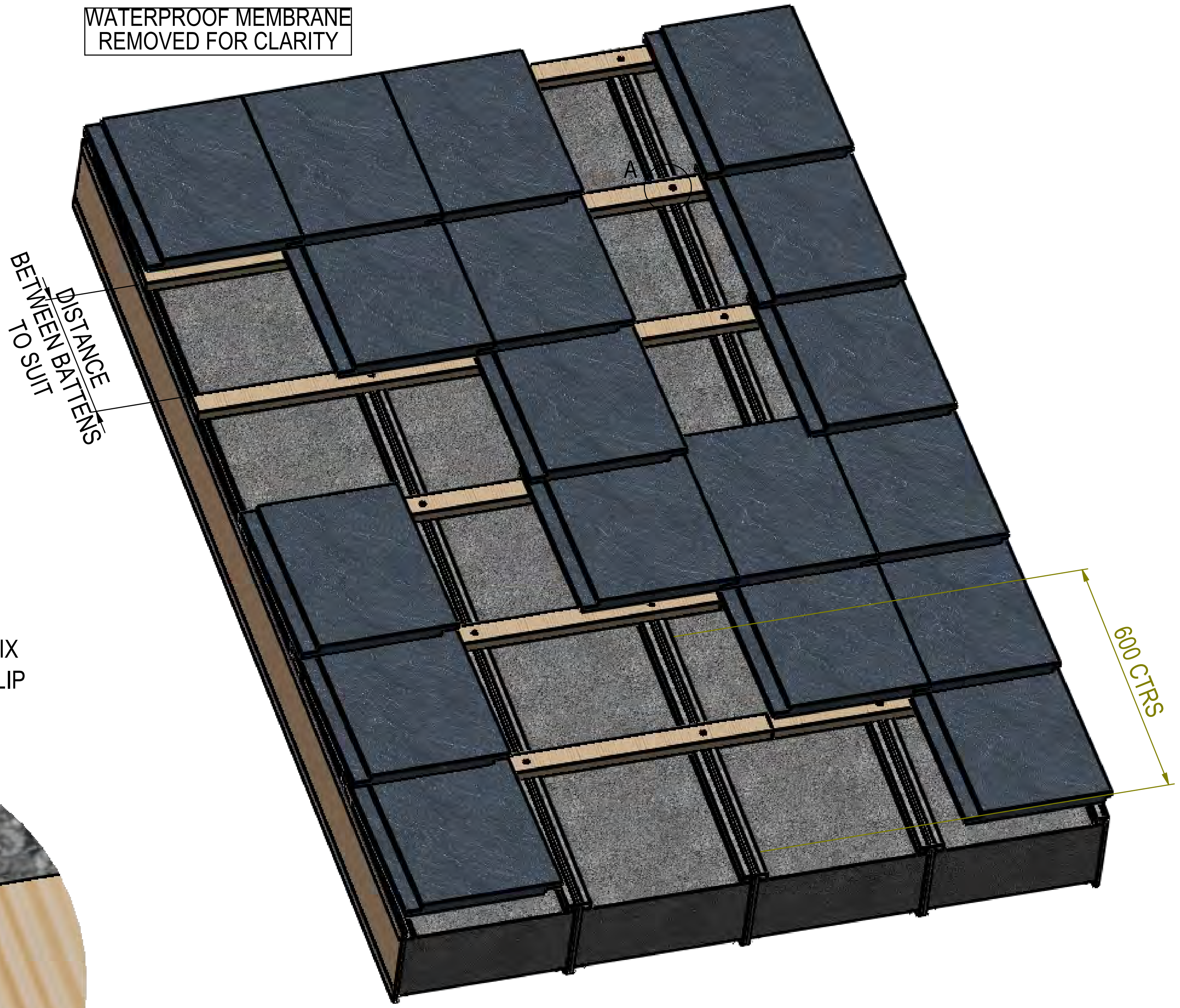
DRAWN BY: DM	DATE CREATED: 30/11/2020
SCALE: 1:2	STATUS: DEV
DESCRIPTION: ULTRAPANEL SERVICE VENT	
DRAWING No: HR-UP-012	STOCK CODE:
REV: -.02	
MODEL NAME: HR-UP-012 / CONFIG. NAME: 298mm	SHEET 2 OF 2, SIZE A3
01/12/2020	

CHANGE No.	REV.	AUTHOR

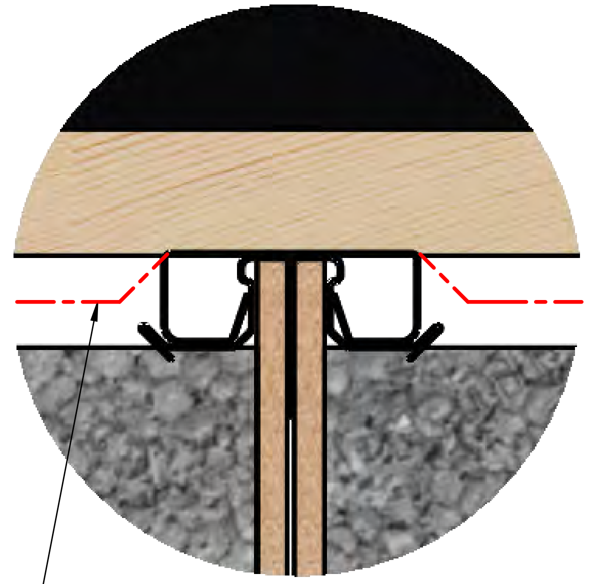
HSSC001
∅4.8 x 44mm c/sunk
TX25 torx head screw
stainless/Bi-metal



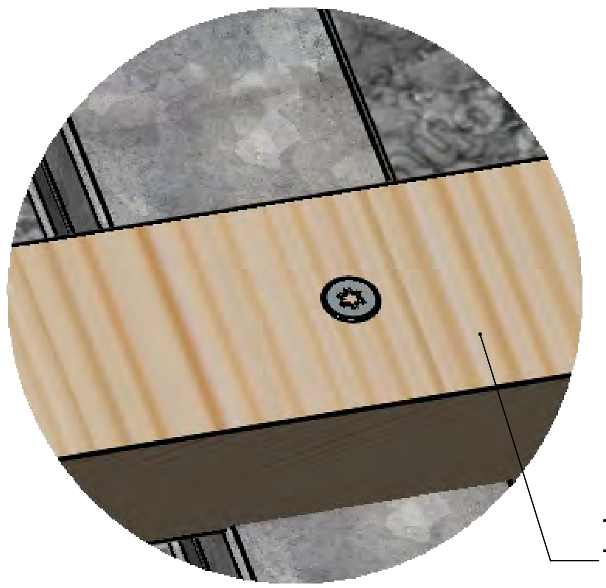
USE 1 x HSSC001 @ EVERY CLIP TO FIX THE TIMBER BATTEN TO THE FULL CLIP



DETAIL B

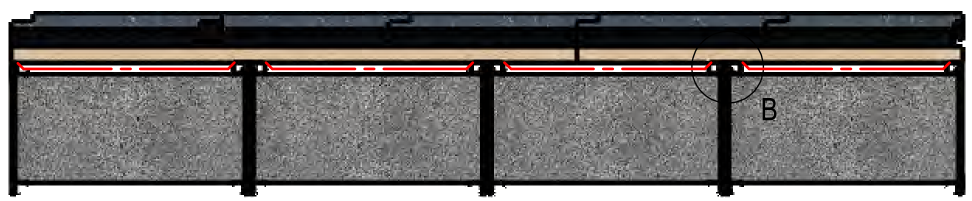


BREATHABLE WATERPROOF LAYER OR EQUAL APPROVED TO BS5534 TRAPPED BETWEEN TILE BATTENS & ROOF FIXING CLIPS



TIMBER BATTEN
TO BS5534
47mm x 25mm

DETAIL A



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NOTES:

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1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
2. INSPECTION & QUALITY REQUIREMENTS IN ACCORDANCE WITH QM 756

DRAWN BY: DM	DATE CREATED: 09/12/2020
SCALE: 1:10	STATUS: DEV

DESCRIPTION:
TILE BATTEN FIXING DETAIL

MODEL NAME: HR-UP-014 / CONFIG. NAME: Default

DRAWING No:	STOCK CODE:	REV:
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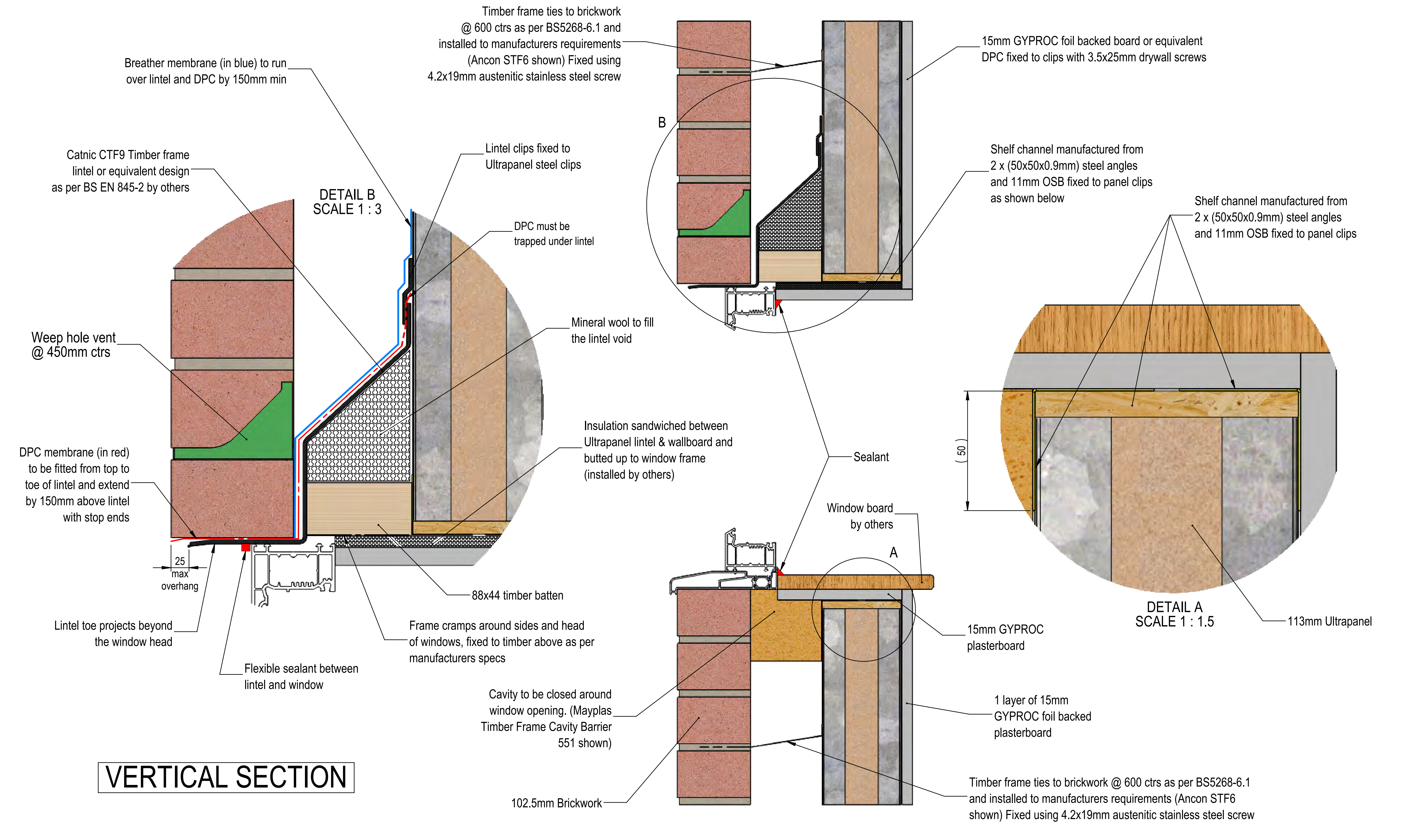
	SHEET 1 OF 1, SIZE A3	04/01/2021



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1. PACKAGING, PROTECTION & IDENTIFICATION IN ACCORDANCE WITH QM 755
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DRAWN BY: DM
DATE CREATED: 03/09/2020
SCALE: 1:6
STATUS: DEV

DESCRIPTION:
GABLE WINDOW DETAILS

DRAWING No: HR-W-001
STOCK CODE:
REV: -.05

MODEL NAME: HR-W-001 / CONFIG. NAME: Default
SHEET 1 OF 2, SIZE A3
22/01/2021

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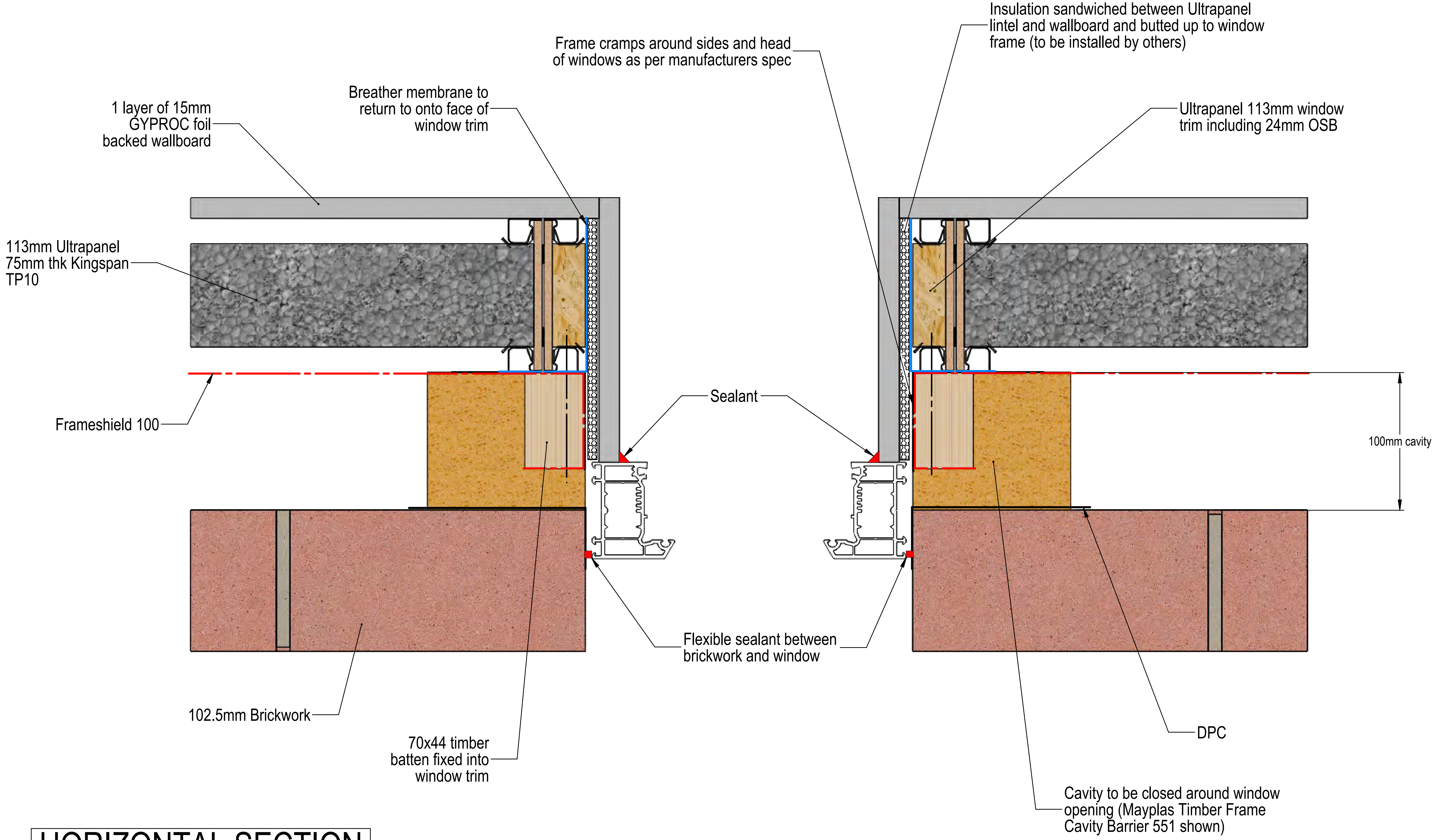

HORIZONTAL SECTION

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DRAWN BY: DM	DATE CREATED: 03/09/2020
SCALE: 1:50	STATUS: DEV

DESCRIPTION: GABLE WINDOW DETAILS

DRAWING No:	STOCK CODE:	REV:
HR-W-001		-.05

MODEL NAME: HR-W-001 / CONFIG. NAME: Default

SHEET 2 OF 2, SIZE A3 22/01/2021

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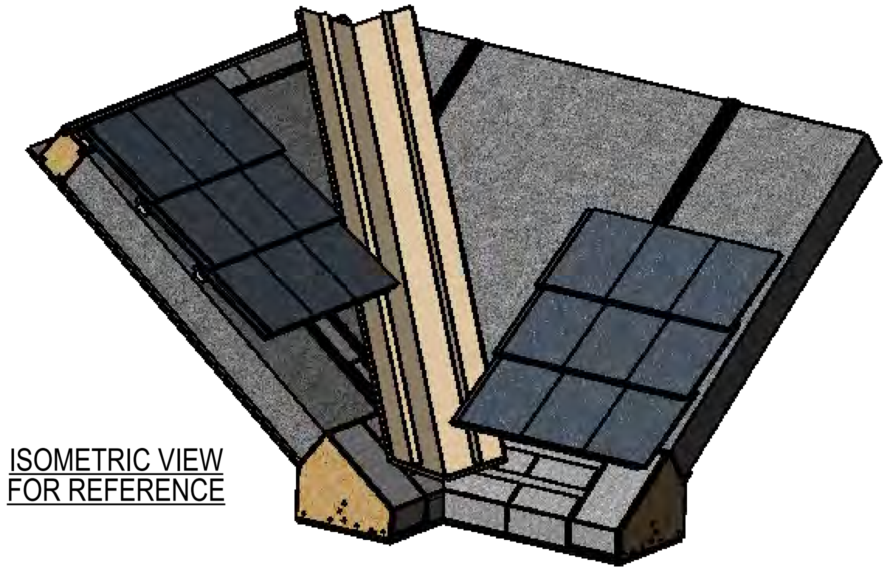
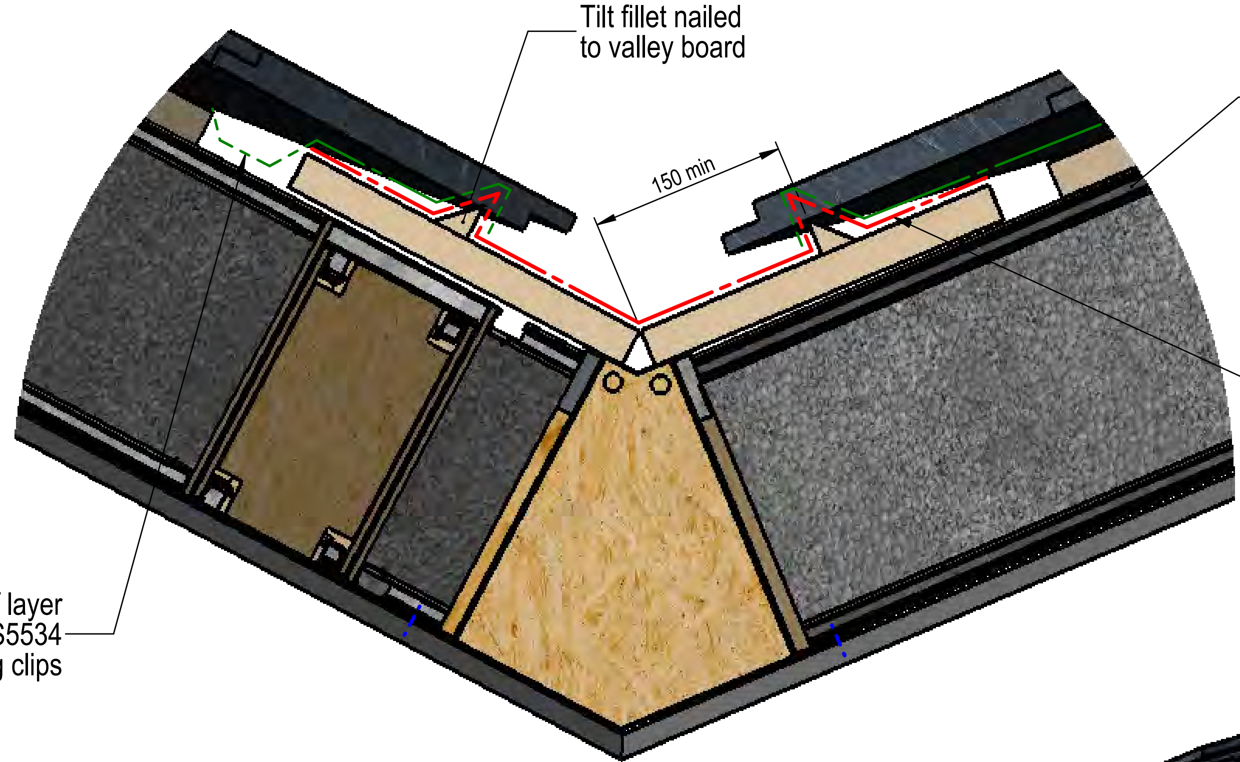
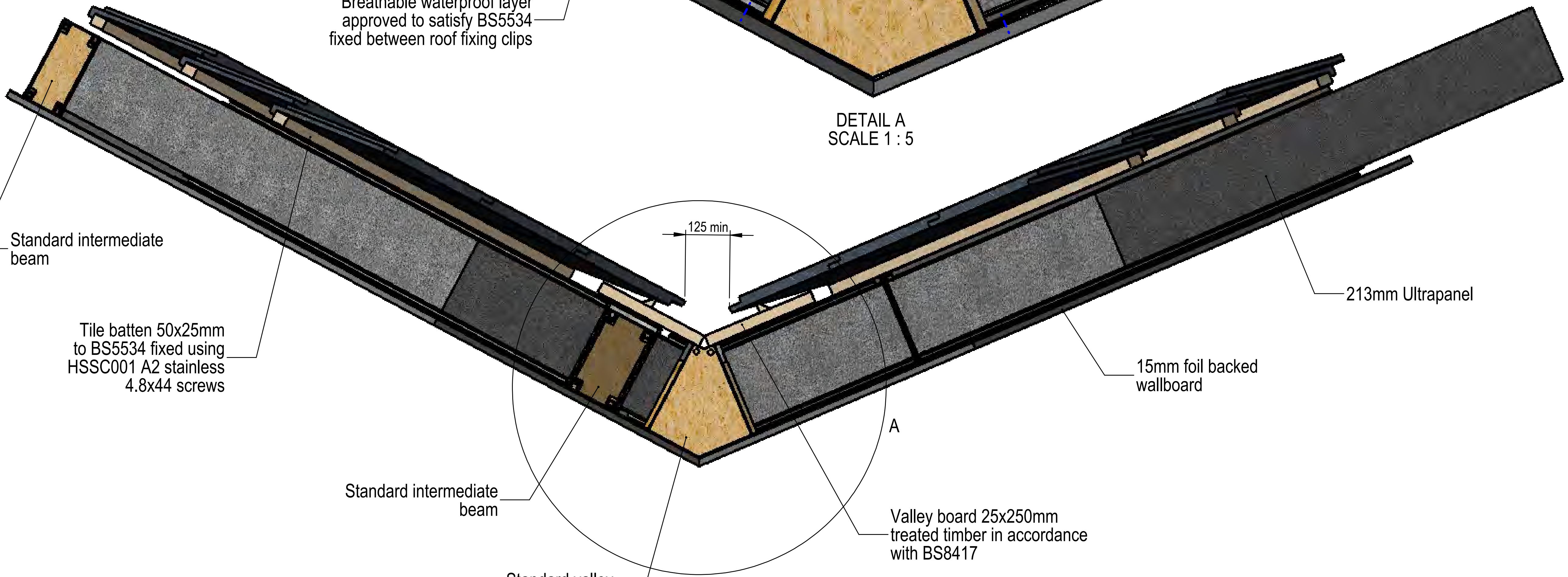


ISOMETRIC VIEW
FOR REFERENCE



DETAIL A
SCALE 1 : 5



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DM	19/01/2021
SCALE: 1:10	STATUS: DEV

DESCRIPTION:
HOUSE ROOF VALLEY DETAIL

DRAWING No:	STOCK CODE:	REV:
HR-VD-001		-.01

MODEL NAME: HR-VD-001 / CONFIG. NAME: Default

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CHANGE No.	REV.	AUTHOR

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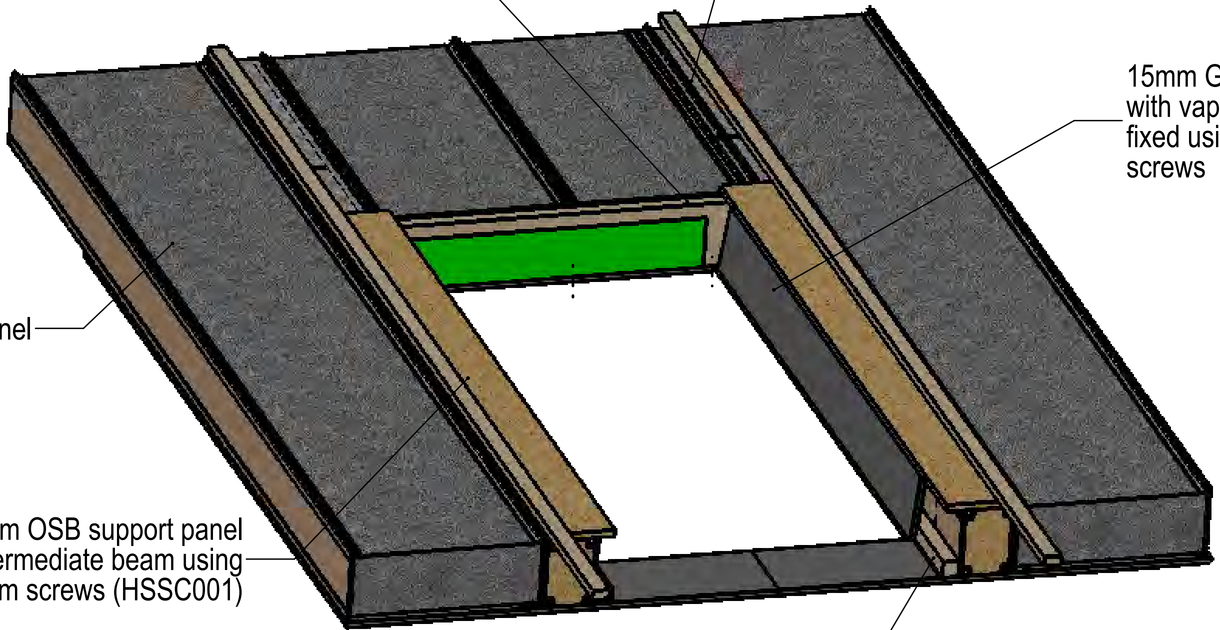

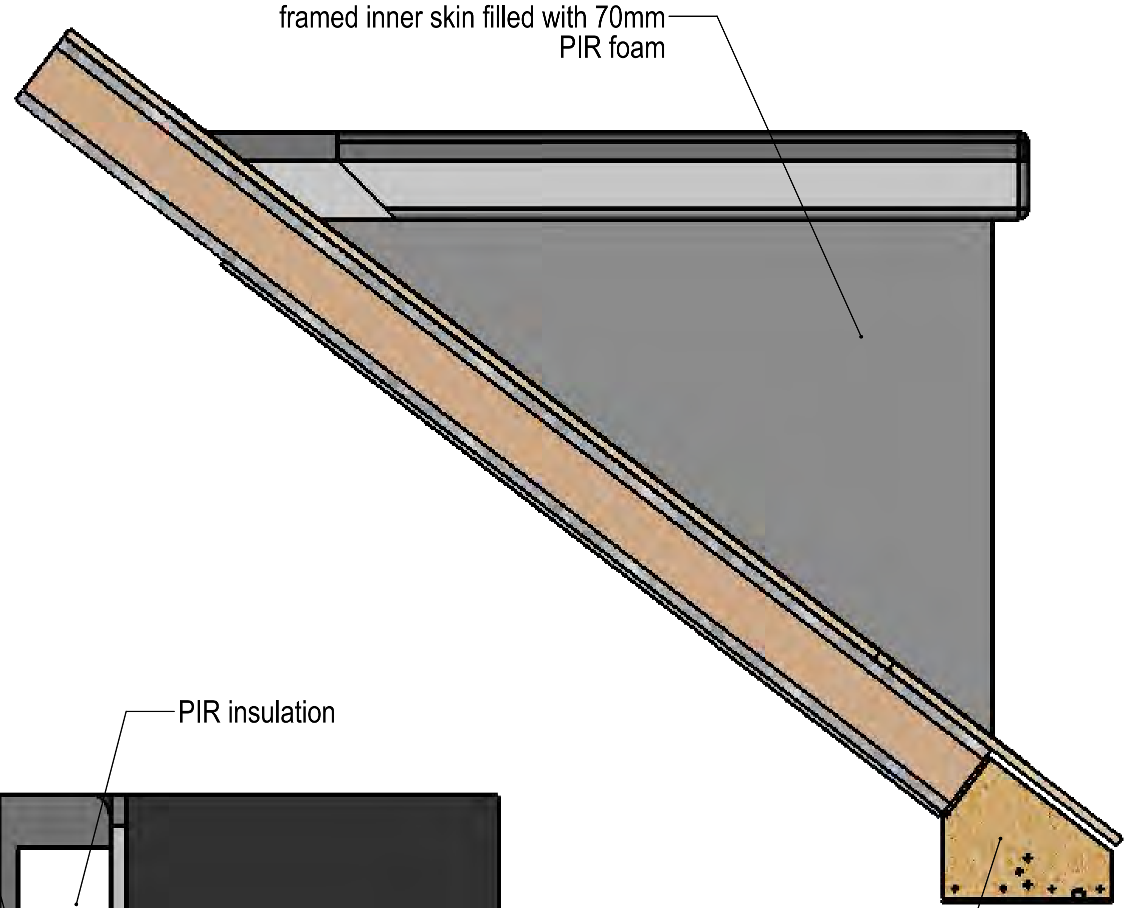

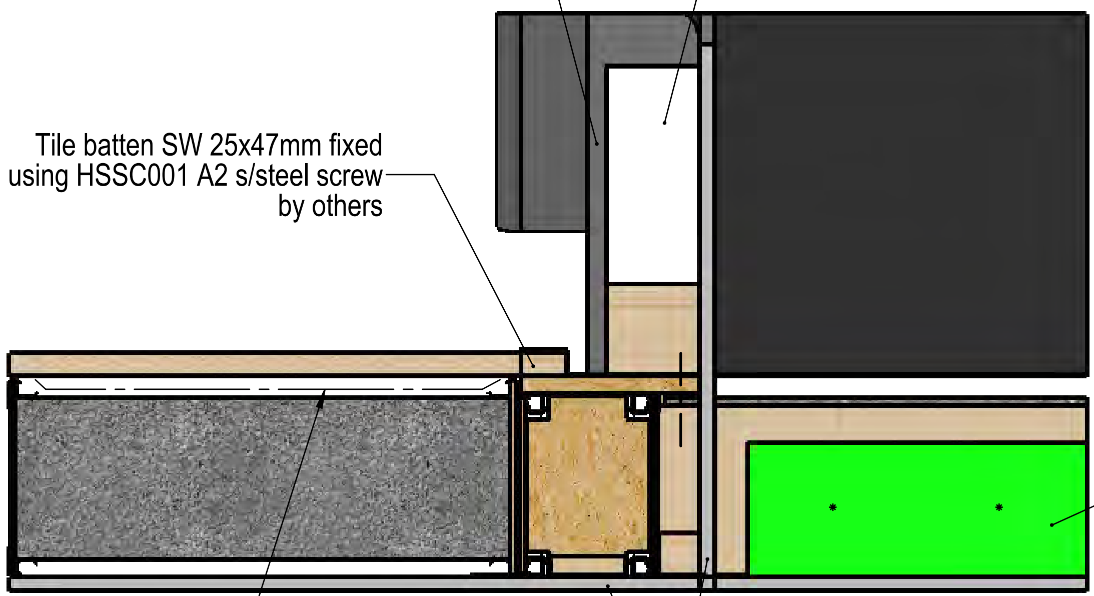

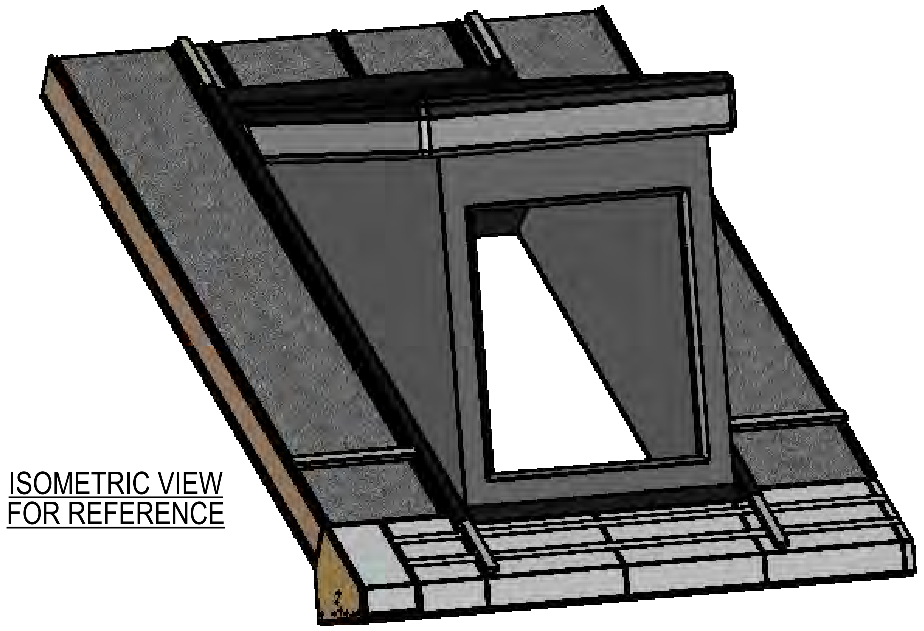

ISOMETRIC VIEW FOR REFERENCE

QM (?), COMPONENT ASSEMBLY DATA TABLE, ISSUE 1 (DETAILS UNLESS OTHERWISE SPECIFIED)

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DRAWN BY:	DM
DATE CREATED:	20/01/2021
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STOCK CODE:	
REV:	-.02
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Ultraframe House Roof System Structural Guide

Rev F February 2021

Author: Tansy Sabben M.Eng., C.Eng., M.I.Struct.E. Senior Structural Engineer, Ultraframe UK
Approved by: Andrew Thomson B.Eng., M.Des.,D.I.C. Design and Development Director, Ultraframe UK

Design philosophy statement for the hybrid system created by Ultraframe UK to be used on house roofs to comply with NHBC and UK Building Regulations.

02/02/2021

Contents

1.0 Introduction ... 4
2.0 Design Philosophy ... 5
2.1 Overall concept design ... 5
2.2 Individual Members ... 5
2.2.1 Panels ... 6
2.2.2 Ridge ... 7
2.2.3 Eaves ... 7
2.2.4 Intermediate Beam ... 8
2.2.5 Valley ... 8
2.2.6 Tie member ... 9
2.2.7 Gable Wall Design ... 12
2.2.7.1 Lateral restraint of the Gable wall into the Roof system ... 15
2.2.7.2 Lateral restraint of the Gable wall at base ... 16
2.2.8 Fixings to resist Uplift on Roof Panels ... 17
2.2.9 Possible Diagonal Bracing in Spandrel Walls. ... 21
2.2.10 Compression Resistance of Panels ... 22
2.2.11 Proof of minimum vertical support width for Eaves ... 23
2.3 Permanent and Variable Loading ... 24
3.0 Roles and responsibilities ... 25
Appendix A: Example Member Structural Calculations ... 26
A.1 Panel Design ... 27
A.2 Eaves Beam Design ... 27
A.3 Valley Beam Design ... 28
A.4 Intermediate Beam Design ... 28
Appendix B: Steel Construction Institute Reports. ... 29
RT 1797 V03 ... 29
RT 1826 V04 ... 30
RT 1828 V03 ... 31
APPENDIX C Screw Information ... 32
08X_CKADDS ... 32
10M075CKNFDP ... 33

ICC-ES Evaluation Report ESR-3558 34

DWG 13515 REV01 FASTNER POSITIONS FOR 37.5 DEGREE ROOF 35

Author: Tansy Sabben M.Eng., C.Eng., M.I.Struct.E. Senior Structural Engineer, Ultraframe UK

Signed and dated:____ 01/02/21

Approved by: Andrew Thomson B.Eng., M.Des.,D.I.C. Design and Development Director, Ultraframe UK

Signed and dated:____02/02/21

Rev C: re-written 2.1

Updated table 1

Added more dimensions to some members

Added alternative tie bar section

2.2.6 clarified horizontal deflection limit and inserted bolstered eaves (corrected T equation)

2.2.7 changed title. Included shear capacity, local axial capacity, wall tie fixing check

2.2.7.1 added

2.2.7.2 added

2.2.11 added

Appendix B:RT1797 V03 and RT1828 V03 replace RT1797 V02 and RT1828 V02

Rev D:updated 2.2.7 to include dwarf wall height to gable panel.

Rev E: Angle bracket added to 2.2.6

2.2.7 updated for additional wall height due different house levels.

Rev F: Section 2.2.7 revised to suit new deflection limit.

1.0 Introduction

This is a hybrid lightweight panel system that encompasses structural integrity and robustness, thermal insulation and overall stability with easy and quick installation. Compliance with other relevant building regulation requirements, such as durability and specific U-values will be discussed in another document. The bespoke members will be discussed throughout this report with regards to performance, design responsibility and site-specific responsibilities. This document demonstrates compliance with the Technical Requirements of NHBC Standards Chapter 2.1 and the Performance Standards of NHBC Standards Chapter 7.2.

☐ Chapter 2.1 is “The Standards and Technical Requirements”.

☐ Chapter 7.2 is “Pitched roofs”.

The Ultraframe system is targeted at ‘room-in-roof’ applications, therefore additional NHBC chapters will be considered for wall applications. These are:

☐ Chapter 6.2 - External timber framed walls.

☐ Chapter 6.10 - Light steel framed walls and floors.

However, presently the walling system is only being used as the gable spandrel panel and it is not acting as load bearing and flooring is provided by others.

The structure has also been implemented considering the Building Regulations Approved Document A.

All design calculations are in accordance with:

BS EN 1990:2002+A1:2005, Eurocode 0– Basis of structural design
NA to BS EN 1990:2002+A1:2005, UK National Annex for Eurocode – Basis of structural design.

BS EN 1991-1-1:2002, Eurocode 1: Actions on structures; Part 1-1: General actions – Densities, self-weight, imposed loads for buildings
NA to BS EN 1991-1-1:2002:2005, UK National Annex to Eurocode 1: Actions on structures; Part 1-1: General actions – Densities, self-weight, imposed loads for buildings

BS EN 1991-1-3:2003, Eurocode 1: Actions on structures; Part 1-3: General actions – Snow Loads
NA to BS EN 1991-1-3:2003, UK National Annex to Eurocode 1: Actions on structures; Part 1-3: General actions – Snow Loads

BS EN 1991-1-4:2005, Eurocode 1: Actions on structures; Part 1-4: General actions – Wind Loads
NA to BS EN 1991-1-4:2005+A1:2010, UK National Annex to Eurocode 1: Actions on structures; Part 1-4: General actions – Wind Loads

BS EN 1991-1-7:2006, Eurocode 1: Actions on structures; Part 1-7: General actions – Accidental Actions.
NA to BS EN 1991-1-7:2006, UK National Annex to Eurocode 1: Actions on structures; Part 1-7: General actions – Accidental Actions

2.0 Design Philosophy

2.1 Overall concept design

This report is focused on the design of gable shape roofs. Other shapes will be covered in subsequent revisions. The roof is designed to arch and therefore the ridge acts as the apex, the panels transfer load to the eaves beam, which in turn translate the load vertically into the load-bearing wall below and horizontally through the eaves beam into tie-members.

Lateral stability is provided (i.e. the prevention of racking) between the gable walls with a combination of elements working together. The tightly packed EPS and the bespoke I-beams create a diaphragm panel that spans between a continuous ridge and continuous eaves beam. The lateral forces are transferred through the gable wall panels into either the attic floor via the wallplate, and restraint angles or into the gable panel beam at the edge of the roof. This gable panel beam then transfer the force through the roof panelling into the ridge and eaves. The lateral force through the panels is restrained by the fixings of the top clip into the ridge and the eaves. No assumption has been taken in the calculations that the internal plasterboard skin provides additional diaphragm action.

2.2 Individual Members

The following table summarizes the members considered, their properties and references which SCI report states the properties ascertained:

Member Name	Stiffness EI (Nmm^2)	SCI Report Ref	Ultimate Bending Resistance (KNm)	SCI Report Ref	Ultimate Shear Capacity (kN)	SCI Report Ref	Ultimate Axial Capacity (kN/m)	SCI Report Ref
213 panel	5.40E+11	RT 1797 V03	8.27	RT 1797 V03	20	RT 1828 V03	103	RT 1828 V03
285 panel	9.80E+11	RT 1826 V04	9.4	RT 1826 V04	26	RT 1828 V03	103+*	
113 wall panel	9.00E+10	RT 1828 V03	3.2	RT 1828 V03	10*		76	RT 1828 V03
450 Eaves beam (horiz)	8.50E+12	RT 1797 V03	15.6	RT 1797 V03	NA		NA	
213 Intermediate Beam	5.20E+11	RT 1826 V04	6.4	RT 1826 V04	20	RT 1828 V03	NA	
285 Intermediate Beam	9.30E+11	RT 1826 V04	10.4	RT 1826 V04	26	RT 1828 V03	NA	
213 Valley	7.80E+11	RT 1826 V04	7.1	RT 1826 V04	NA		NA	
					*estimated			

Table 1 Member properties

2.2.1 Panels

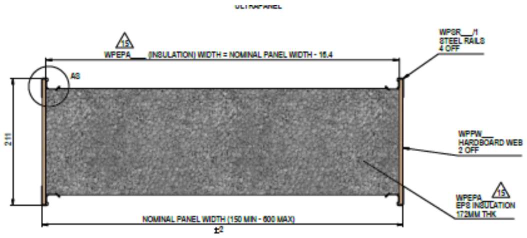


Figure 1 standard panel (no clips shown)

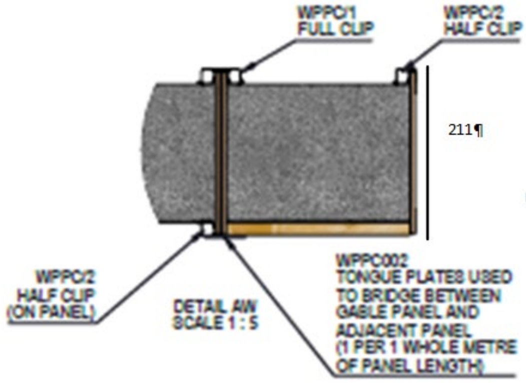


Figure 3 standard panel with clips

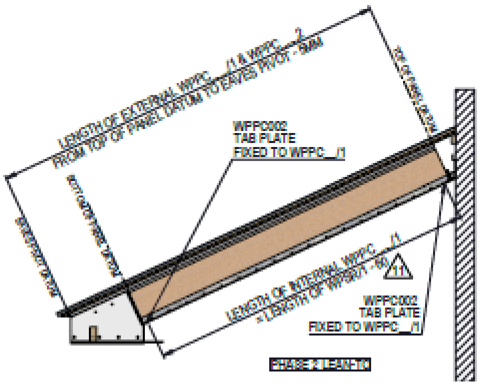


Figure 2 panel length and clip overhang

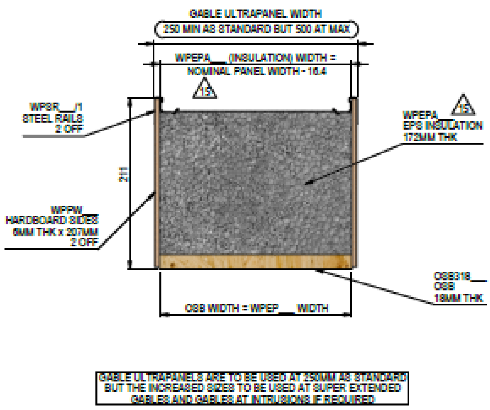


Figure 4 standard gable panel

The panel comprises of 0.7mm cold formed steel 'flanges' and a 6mm hardboard web. The elements are clinched together to form a beam member. Back to back sections are clipped together, with insulation supported between beam elements (as shown in Figure 1-4). 213mm,standard and 285mm, deep panel are used for roof panelling. 113mm, small and 213mm, standard are used for spandrel non-load bearing wall panels.

To determine the maximum span we use a deflection limit of span/240mm or 20mm for total unfactored loading (SLS). For plastered finish the requirement is span/360 this would refer to unfactored variable (live load only). The calculation using span over 240 or 20mm is the more onerous and the one used for the tables below.

2.2.2 Ridge

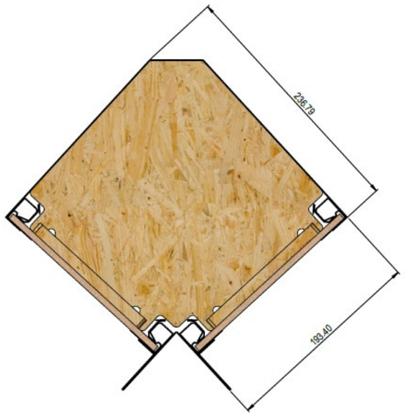


Figure 5 Ridge cross section

The ridge is another hybrid member that is formed from 0.9mm steel cold formed clips and plates clinched to 6mm hardboard and has 11mm OSB fillets at 600mm c/c and corbels at the ends.

2.2.3 Eaves

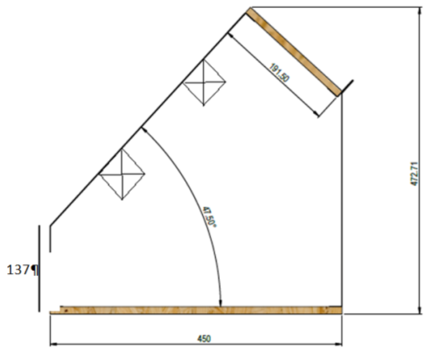


Figure 6 Eaves beam cross section

The eaves are built to suit each individual roof pitch, i.e based on pitch and standard and deep roof panel. The 0.9mm steel plates are bonded and screwed to 11mm OSB3. There are also OSB3 fillets at 600mm c/c and corbels at the ends.

2.2.4 Intermediate Beam

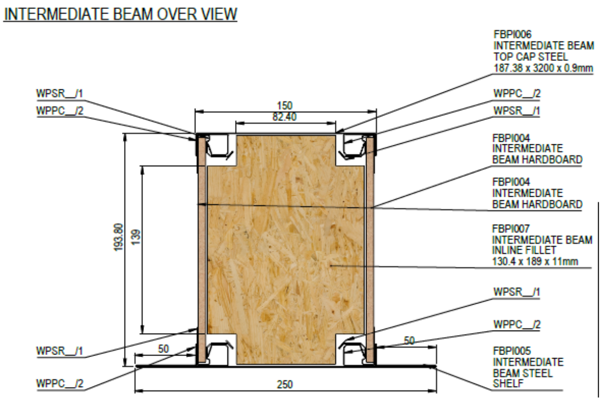


Figure 7 Intermediate Beam cross section

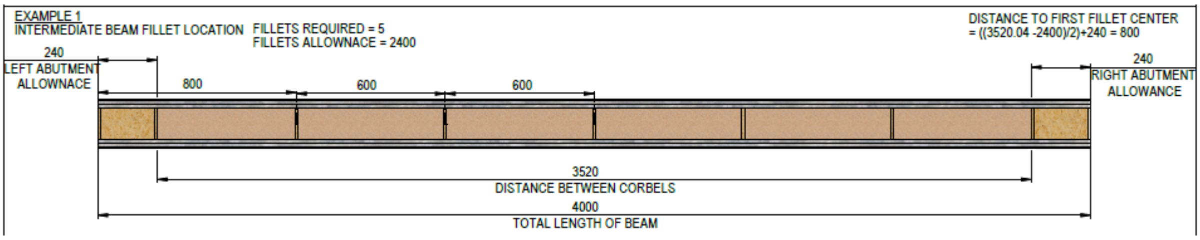


Figure 8 Intermediate Beam length section

The Intermediate beam is constructed in a similar method with 0.9mm steel flanges clinched to 6mm hardboard to form a box section with shelf angles which can be utilised to support incoming panels or intermediate beam. There are also 11mm OSB3 fillets at 600mm centres and corbels at the ends. There is a standard and deep version of the intermediate beam.

2.2.5 Valley

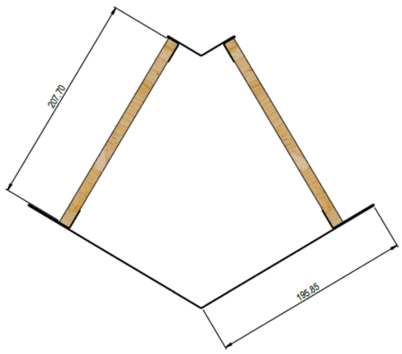


Figure 9 Valley cross section

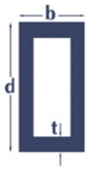
The valley is formed of 0.9mm steel folded plate clinched to 11mm OSB. This also has fillets at 600mm c/c and corbels at the ends.

2.2.6 Tie member

The tie bar is now 50x25x2 S235JRH CF RED fixed to a spigot channel 40x20x5 S275 which is welded to 4mm S275 steel plate.

Tension capacity of 50x25x2 S235JRH CF RED

d	50	Depth d mm
b	25	Width b mm
t	2	Thickness t mm
	2.74	Area of Section cm²
	465	Approx. Metres Per Tonne
	2.15	Kg/m



The Area A=274mm^2

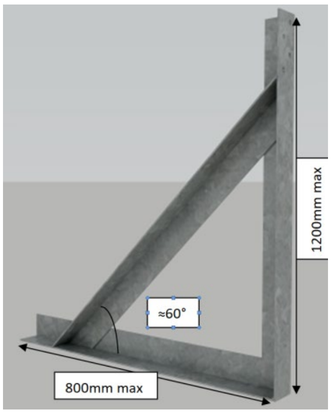
Therefore $N_{Rd} = \frac{A*f_y}{\gamma_{M0}}$ $N_{Rd} = \frac{274*235}{1.0}$ = **64kN**

f_y=235N/mm^2 (BS EN 1993-1-1:2005 table 3.1)

$\gamma_{M0} = 1.0$ (BS EN 1993-1-1:2005 Section 6.1 Note 2B)

Alternative Tie Bar Detail: 150x2 S280 Flat:

$N_{Rd} = \frac{200*275}{1.0}$ = **82kN**



Alternative 50x50x4 RSA S275
The bracket is formed of 50x50x4 RSA. The diagonal has the ultimate tension capacity of 98kN. Therefore the bracket can withstand an ultimate tie tension (horizontally) from eaves of **49kN**>37kN. This also means that the fixing of this to the floor and the floor construction needs to be able to withstand horizontal tension.

The following table summarises the maximum tension required in the tie bar whether in a spandrel/separation panel (mid tie) or in a gable panel (end tie). The roof loading has been calculated using a permanent load of 0.85kN/m^2 and variable load of 0.6kN/m^2.

The maximum slope length of the panel is determined over a range of pitches. This is then used confirm the maximum overall roof span (a). Then the maximum horizontal span of the eaves beam is calculated to determine the maximum possible tie bar spacing.

However each project will be checked on an individual basis to determine the required the tension, based on house dimensions and pitch, variable loading (calculated on worst case scenario of; wind, snow or maintenance/access) and spacing of the tie bars will be determined by spacing of the separation walls.

(Please note that values have varied slightly from the original statement for the max tie spacing (and therefore max tension required) and also the deep panel slope length since the stiffness, EI of the deep panel has been confirmed by SCI testing to be 9.8E11. An ULS column has also been added to calculate the accurate ULS loading for the tie bar)

Standard Panel

pitch/°	SLS Roof load/kN/m^2	ULS Roof load/kN/m^2	max plan span of panel/mm	slope length of panel/mm	max b, Roof span /mm	max tie spacing/ mm	ULS mid tie tension T/kN	ULS end tie tension T/kN	ULS P/kN
37.5	1.33	1.86	4500	5672	9000	4610	32	16	49
40	1.31	1.84	4360	5692	8720	4700	29	15	49
42.5	1.29	1.81	4210	5710	8420	4790	27	14	50
45	1.27	1.78	4050	5728	8100	4880	25	12	50
47.5	1.26	1.76	3890	5758	7780	4980	23	12	50
50	1.24	1.73	3710	5772	7420	5090	21	11	51

Table 2 Standard Panel Roof Max Spans and Tie bar tension

Deep Panel

pitch/°	SLS Roof load/kN/m^2	ULS Roof load/kN/m^2	max plan span/mm	slope length of panel/mm	max b, Roof span /mm	max tie spacing/ mm	ULS mid tie tension T/kN	ULS end tie tension T/kN	ULS P/kN
37.5	1.33	1.86	5230	6592	10460	4630	37	19	57
40	1.31	1.84	5060	6605	10120	4710	34	17	57
42.5	1.29	1.81	4890	6633	9780	4800	31	16	58
45	1.27	1.78	4710	6661	9420	4850	29	14	58
47.5	1.26	1.76	4510	6676	9020	5000	27	13	59
50	1.24	1.73	4310	6705	8620	5100	25	12	59

Table 3 Deep Panel Roof Max Spans and Tie bar tension

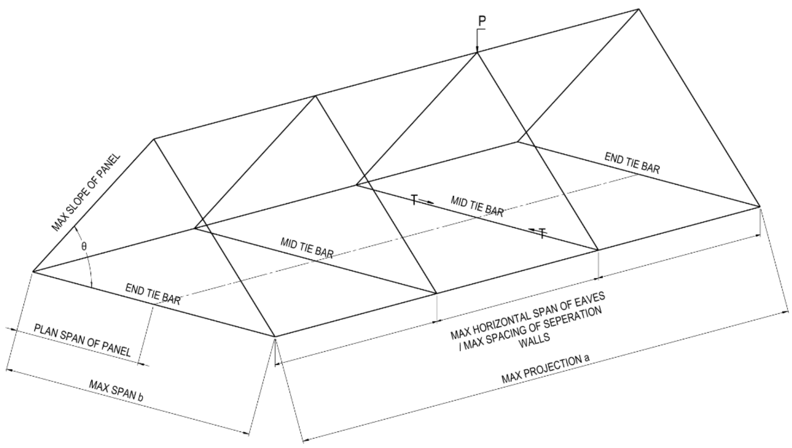


Figure 10 3-D Max Roof Spans and Tie bar positions

<u>Calculation example of 45° Standard Panel (Refer to diag above):</u>

(values in tables vary slightly due to rounding errors etc)

G=0.85kN/m2 Q=0.6kN/m^2.

Calculate the maximum slope length of the panel to establish the maximum house span b:

SLS Roof Load =0.85+0.6cos45=1.27 kN/m^2.

ULS=0.85*1.35+ (0.6cos45)*1.5=1.78 kN/m^2

Panels @600mm c/c therefore SLS UDL(w)=1.27*0.6=0.76kN/m

EI standard panel=5.4E11

Lmax (assuming 20mm max deflection (advised for platerboard)=$\sqrt[4]{\frac{20*384*EI}{5*w}}$=

Lmax=5747mm is max slope length.

Therefore max plan length =max slope length*cos45=4064mm

Therefore max house span, b=max plan length*2=8128mm

Now calculate the maximum span of the eaves beam based on max slope length of panel onto eaves:

The deflection limit (horizontal) is H/300 or 6mm whichever is smaller. (H being the height of the wall below) In this example we will use 4.5mm.

Roof load taken down slope to eaves,

therefore SLS horizontal UDL(w)=Roof load on slope*plan span=1.27*4.064=5.16kN/m

EI horizontal 45deg eaves beam=8.5E12

Lmax=$\sqrt[4]{\frac{4.5*384*EI}{5*w}}$=4884mm is the maximum horizontal span of the eaves beam. Therefore the tie bar will be placed at this spacing or less as the tie bar is to be placed within the separation walls.

Now calculate the tension in the horizontal tie bar (now in ULS):

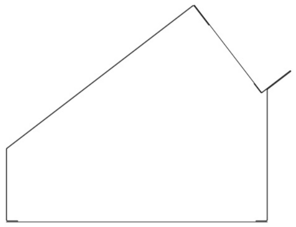
P=ULS Roof load*max slope length*max tie spacing=1.78*5.747*4.884=50kN

T=P/ (2*tanθ) =50/ (2*tan45) =25kN...This is the maximum tension in a mid tie at a separation wall. (In most instances 2no. tie bars will be provided (one in each side of the party wall) and therefore require maximum tie force will be half this value)

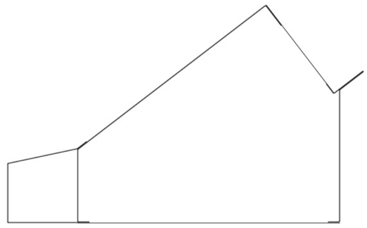
The max tension ULS end (i.e. in the gable wall) will be T/2=12.5kN.

From the tables above the expected maximum ULS Tension=37kN< **64kN** Therefore OK.

Provision of bolstered Eaves.



Original Eaves Horizontal EI=8.5E12



Bolstered Eaves Horizontal EI=1.46E13

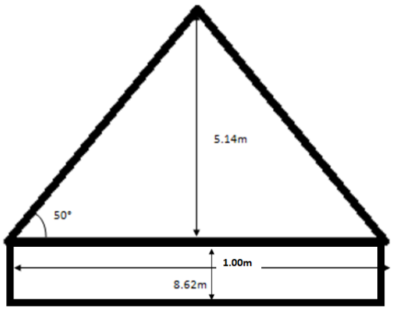
In some cases the deflection limit (of low dwarf walls) or the tie bar spacing needing be increased to suit separation wall layout or house overall projections may require a bolstered version of the eaves. The bolstered part has an individual Iyy of 727277mm^4 and amends the position of the centroid. This has increased the Horizontal EI by 72% enabling an enhanced performance.

Looking a certain roof type: (e.g. Norbury for Barratts):
Pitch =37.5°. Roof span (b) =8.7m<9m (from standard table above)
Separation walls are spaced at 4.4m<4.6m (from standard table above)

2.2.7 Gable Wall Design

Assuming the largest possible gable is (refer to Table 3)

Includes an extra 1m allowance to match dwarf walls if necessary.



Permanent Vertical Loading:

The gable wall is only taking its self weight = 0.24kN/m^2 (0.14 kN/m^2 for panel plus 0.1 kN/m^2 for plasterboard).

Ultimate load = 0.24*1.35=0.33 kN/m^2

UDL at bottom UDL=0.33*6.14/2=1.01kN/m<<Ultimate Axial Capacity of either standard 213mm wall (103kN/m) or small 113mm wall (76kN/m) Therefore OK.

Consider additional height due to different house levels: therefore max wall height of 6.14m plus a maximum of 2.4m height extra over=8.54m total.
Therefore the total udl from self weight is 0.34*1.35*8.54=3.9kN/m
Plus udl from the propping affect of the roof 25/8.62=2.9kN/m (see next page)
Therefore total ultimate udl required is 7kN/m<76kN/m (axial capacity of 113mm wall)

Demonstrating the axial capacity of the gable walls as props for local effect from ridge:

Consider the maximum roof size as before: 8.62m span@50°.

Ultimate load on the roof=1.35*0.85+1.5*0.6=2.05kN/m^2

UDL on ridge=$\frac{8.62}{2cos50} * 2.05$=13.7kN/m

Allow 3panels, i.e.1800mm to be locally taken by the gable wall. Load=13.7*1.8=25kN

113mm wall has axial capacity of 76kN/m, therefore 45kN/panel beam >25kN. Therefore Ok

(Therefore 213mm also OK with axial capacity of 103kN/m.)

Demonstrating the shear resistance of the gable walls:

The ultimate shear capacity of the 213mm panel is 20kN and therefore the ultimate shear capacity of the 113mm panel is 10kN.

Following on from the gable wall design:

The 4.11m high 113mm gable wall. Maximum shear required=0.66*1.5*4.11/2=2.0kN<10kN therefore OK.

The 6.14m high 213mm gable wall. Maximum shear required=0.66*1.5*6.14/2=3.0kN<20kN therefore OK.

Horizontal Loading:

Assuming a wind load of 1.1 kN/m^2 (An accepted conservative scheme value for most buildings within UK. In reality, each individual location will be calculated for max net pressure according to BS EN 1991-1-4:2005)

Based on a horizontal deflection recommendation of height/350 (Pg 3 of SCI Technical Information Sheet P408 “Light Steel Load-Bearing Walls” 2016)

Looking at the central panel, therefore 300mm wide. Deflection is limited to height/350.

113mm small wall panel:

The EI of 113mm panel is 9E10Nmm^2 w=1.1*0.3=0.33kN/m

Therefore the maximum height is:

$L_{max} = \sqrt[3]{\frac{384*EI}{350*5*w}}$=$\sqrt[3]{\frac{384*9E10}{350*5*0.33}}$=3.91m<6.14m (Therefore use 213mm wall panel for gable heights over 3.91m-see calculation below)

For panels at 600mm c/c w=1.1*0.6=0.66kN/m L_{max}=$\sqrt[3]{\frac{384*9E10}{350*5*0.66}}$=3.1m (Panels will be spaced appropriately for their capacity and height required)

Also check Ultimate Bending Resistance:

$$M_d = \frac{0.33 * 1.5 * 4.11^2}{8} = 1.05kNm < 3.2kNm\ (M_{RD})$$

<u>213mm small wall panel:</u>

The EI of 213mm panel is 5.4E11Nmm^2 w=1.1*0.3=0.33kN/m

Therefore the maximum height is:

$L_{max} = \sqrt[3]{\frac{384*EI}{350*5*w}}$=$\sqrt[3]{\frac{384*5.4E11}{350*5*0.33}}$=7.1m>6.14m

For panels at 600mm c/c w=1.1*0.6=0.66kN/m L_{max}=$\sqrt[3]{\frac{384*5.4E11}{350*5*0.66}}$=5.64m (Panels will be spaced appropriately for their capacity and height required)

Also check Ultimate Bending Resistance:

$$M_d = \frac{0.66 * 1.5 * 7.48^2}{8} = 6.92kNm < 8.27kNm\ (M_{RD})$$

Therefore generally gable heights up to 3.91m can use 113mm small wall panel and gable heights over 3.91m and up to the max required of 6.14m+ will use 213mm standard wall panel. (However each individual location will be calculated for max net pressure)

<u>Wall ties fixing check</u>

Wall ties are placed at the standard 450mm vertical centres and 600mm horizontal centres into clips (closer than the standard 900mm)

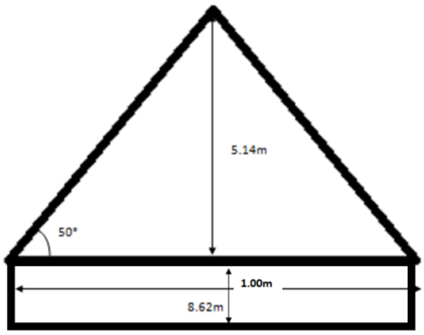
Using the worst case wind load attracted to our house gable wall (refer to Ultraframe House Roof System Structural Guide)

Each vertical clip resists a udl of 0.66kN/m and therefore each tie resists 0.3kN.

We are providing 2no 10M075CKNFDP Senco screws.

Each screw provides 0.6kN allowable pull-out, therefore ok.

2.2.7.1 Lateral restraint of the Gable wall into the Roof system

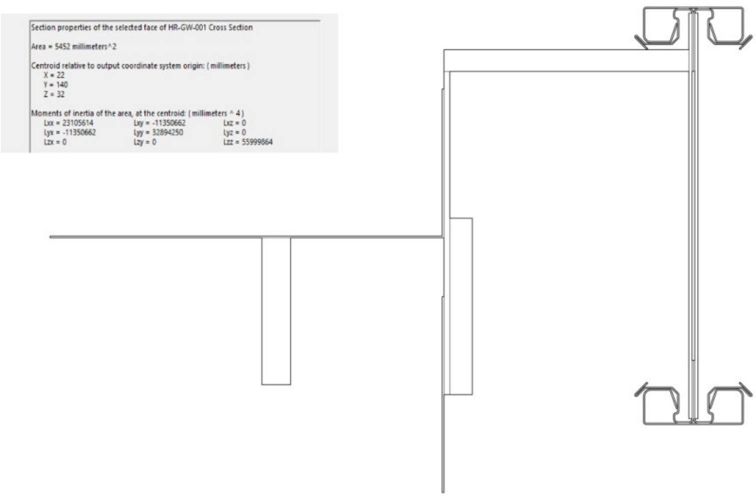


Consider largest possible roof

Consider the lateral loading from the gable wall. The 6.7m long panel is spanning between the ridge and the eaves. It attracts a approximate triangular load of quarter of gable area ($31m^2$/4)*1.1=W=8.5kN and *1.5=12.7kN (Ultimate)

The panel is fixed by 6no external screws through each top external clip at the eaves (over 640mm) and at the ridge (over 190mm). Therefore the actual span is 6.7-((0.64+0.19)/2)=6.3m between fixed connections.

This lateral triangular load is transferred through the gable panel beam. This has modelled to find the Iyy in the horizontal direction (OSB3, C24 timber and hardboard have all had their horizontal dimensions equated to steel E)



The panel is spanning 6.3m and deflection limited to H/300 or 6mm for the wall below. In this case the mid span deflection would be at 3.57m height of wall therefore 3570/300=11.9mm, therefore use 6mm limit.

$I_{yy\ required}=\frac{8500*6300^3}{60*210000*6}$=28,113,750$mm^4$ <$I_{yy\ provided}$=32,894,250mm^4 Therefore OK.

Due to the diaphragm action of the roof, the lateral load is transferred by the gable panel, through the diaphragm and this can be taken as pivoting either at the ridge or the eaves. I.e. the reaction along either would be 12.7kN.

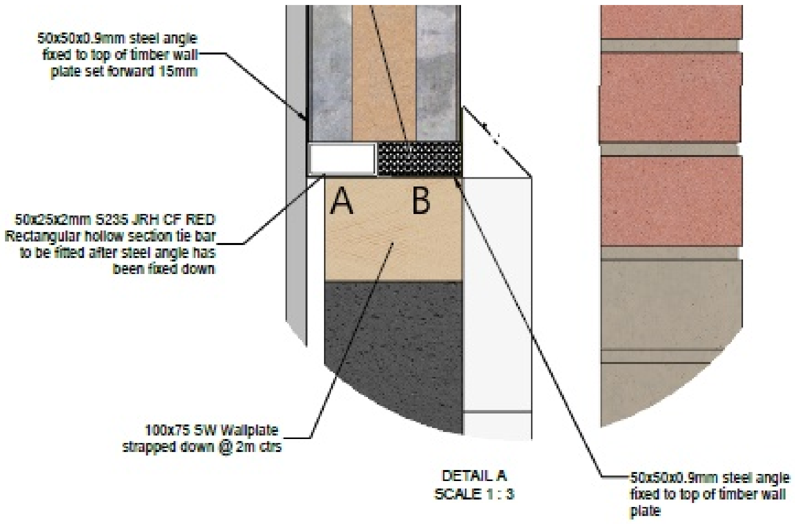
The minimum projection of roof is 4.2m and therefore there will be at least 6no panels across the roof. Therefore each top clip connection needs to take 2.1kN (12.7/6).

6no. external screws provide 6*0.97kN shear resistance=5.82kN>2.1kN. Therefore OK.

Also checking the horizontal shear of the top steel clip alone just before the fixings. Shear area, A=48mm^2.

$V_{Rd}=\frac{A*\frac{f_y}{\sqrt{3}}}{\gamma_{m0}}=\frac{48*\frac{275}{\sqrt{3}}}{1}$=7.6kN>2.1kN Therefore OK.

2.2.7.2 Lateral restraint of the Gable wall at base



This highlights the 2no. 50x50 continuous steel angles that is fixing the spandrel panel to the wall plate.

<u>Consider the vertical fixings into the wallplate (A and B)</u>

10M075CKNFP (SENCO) provide 1.5kN allowable shear capacity.

NHBC require an 8kN resistance at 2m centres.

Therefore we are providing 2no.@300mm c/c... which will provide 20kN every 2m. Therefore OK.

Considering our house roof design, the worst case resistance force required would be from a 213mm wall panel spanning the maximum height of 6.14m, giving 3.0kN (Ultimate) at 600mm c/c.

Therefore we are providing 2no.@300mm c/c which will provide 6kN every 600mm c/c. Therefore OK.

2.2.8 Fixings to resist Uplift on Roof Panels

Ultraframe have considered a reasonable approach to calculating the worst case uplift on a typical house roof within the UK using BS EN 1991-1-4:2005. This is a so typical fixing rules can be applied to the system, however each project will be considered on an individual basis and the loads and number of fixings considered.

The following were considered to calculate maximum$q_{p(ze)}$:

- England (and Wales) were taken as v_b=24m/s and Scotland v_b=28m/s.
- maximum house span of 10m
- Eaves height of 10m,
- considered Countryside and Town (all considered conservatively as with no shelter)
- Distance from sea 0km,10km,100km,
- Distance into town 10km,10km,100km
- Altitude 100m,200m,300m

Having worked through all the various combinations of the above, the worst case condition is: Town, 100km from sea, 0km into town and at 300m Altitude.

Therefore worst case $q_{p(ze)}$ for England is 1.4kN/m² and Scotland is 1.9 kN/m².

Calculating Uplift force/area (BS EN 1991-1-4:2005 section 5.3)

$$\frac{F_w}{A_{ref}} = c_s c_d * \sum c_f * q_{p(ze)}$$

$c_s c_d = 1.0$ (BS EN 1991-1-4:2005 section 6.2)

Using table NA7a and NA7b, considering duopitch ranging from 30°-60° use the worst cases of c_{pe}=-1.2 for edges and gables

and c_{pe}=-0.9 for rest of roof and

c_{pi}=+0.2 (BS EN 1991-1-4:2005 section 7.2.9 (6) note 2)

Therefore: Edge and Gable $\sum c_f = -(1.2 + 0.2) = -1.4$ Rest $\sum c_f = -(0.9 + 0.2) = -1.1$

	SLS Wind Force/Area kN/m²	
	Gable and Edge	Rest of Roof
ENGLAND	1.4*1.4=	1.4*1.1=
	1.96	1.54
SCOTLAND	1.9*1.4	1.9*1.1
	2.66	2.09

	ULS Wind Force/Area kN/m²	
	Gable and Edge	Rest of Roof
ENGLAND	2.18	1.55
SCOTLAND	3.23	2.37

(ULS =$1.5Q_k - 0.9G_k$) $G_k = 0.85\text{kN}/m^2$

<u>Calculate fixings for Gable clips (i.e. first 2 clips from edge of the gable at 600mm c/c)</u>

England: UDL on clip =2.18*0.6=1.3kN/m.

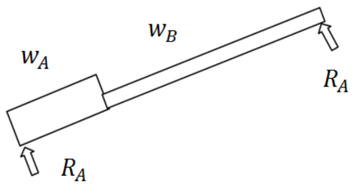
Use max possible slope length is 6.8m (see tie bar tension Table 3, 50° Deep Panel is 6.7m, so just over)

Therefore reaction at each end =1.3*6.8/2=**4.5kN**

Scotland: UDL on clip =3.23*0.6=1.94kN/m.

Max possible slope length is 6.8m, therefore reaction at each end =1.94*6.8/2=**6.6kN**

<u>Calculate fixings for rest of clips (at 600mm c/c)</u>



England: w_A=2.18*0.6=1.31kN/m

England: w_B=1.55*0.6=0.93kN/m

Scotland: w_A=3.23*0.6=1.94kN/m

Scotland: w_B=2.37*0.6=1.42kN/m

Therefore calculated from standard beam mechanics:
England: reaction at eaves = **3.6kN**, reaction at ridge=**3.2kN**
Scotland: reaction at eaves = **5.4kN**, reaction at ridge=**4.9kN**

The screws to be used Senco 10M075CKNFDP on the underside (inside) and 08X_CKADDS on the outside. Test date provided in ICC-ES Evaluation Report ESR-3558 (see appendix)

TABLE 2—ALLOWABLE TENSILE PULL-OUT LOADS (P_{NOT}/Ω), pounds-force[1,2,3,4]

SCREW DESIGNATION	NOMINAL DIAMETER (in.)	STEEL F_u=55 Ksi Ω = 3.0		STEEL F_u=65 Ksi Ω = 3.0		
		Design Thickness of Member Not in Contact with the Screw Head (in.)				
		0.041	0.050	0.062	0.075	0.104
#8-15 x Modified Truss (PMTH)	0.164	130	167	-	-	-
#8-18 x Modified Truss (PMTH)	0.164	85	100	-	-	-
#8-18 x Pan with Washer (SPWH)	0.164	91	128	183	237	382
#10-16 x Reduced Wafer (PWH)	0.190	90	105	198	232	341
#10-16 x Pan Framing (SPFH or RPFH)	0.190	99	126	191	267	371
#10-22 x Pan Framing (RPFH)	0.190	94	100	201	250	372
#12-18 x Pan Framing (RPFH)	0.216	96	125	195	240	368
#12-14 x Pan Framing (RPFH)	0.216	87	118	176	231	390

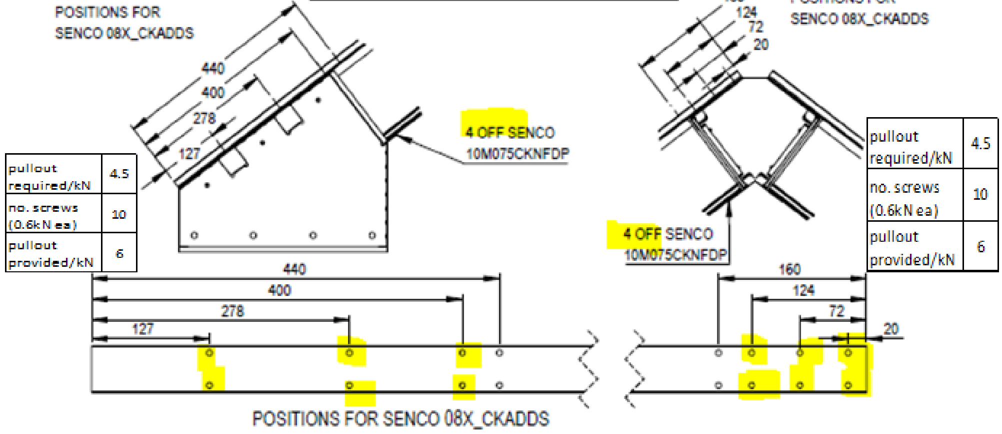
For SI: 1 inch = 25.4 mm, 1 pound-force = 4.4 N, 1 ksi = 6.89 MPa.

[1]For tension connections, the least of the allowable pull-out, pullover, and fastener tension strength of screw found in Tables 2, 3, and 5, respectively must be used for design.
[2]Nominal load values are based upon laboratory testing in accordance with AISI S905.
[3]The allowable pull-out capacity for intermediate member thicknesses can be determined by interpolating within the values in the table for the applicable steel tensile strength.
[4]To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.

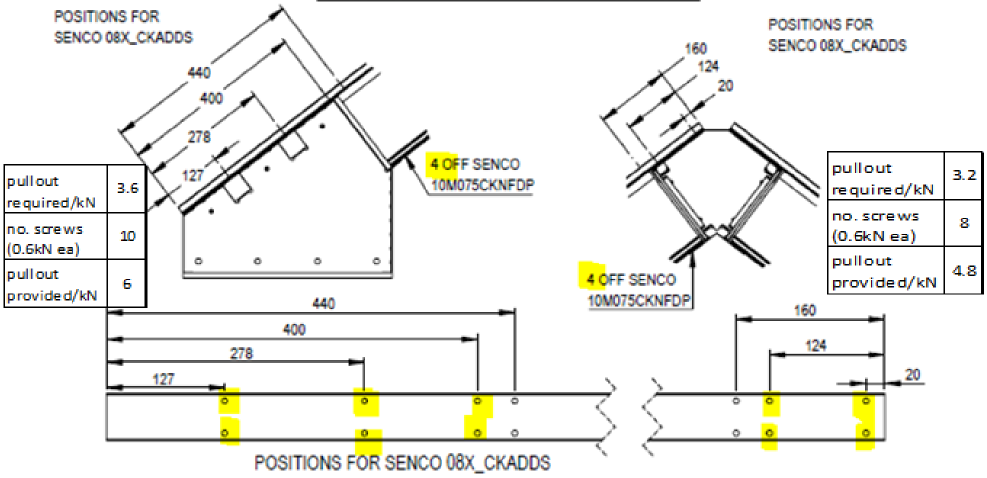
<u>The ultimate tensile pull out=90*3*0.5=135lbs=0.6kN</u>

Therefore the following fixings will be applied for England (Wales) and Scotland (unless the uplift is to be calculated significantly differently for the individual locations)

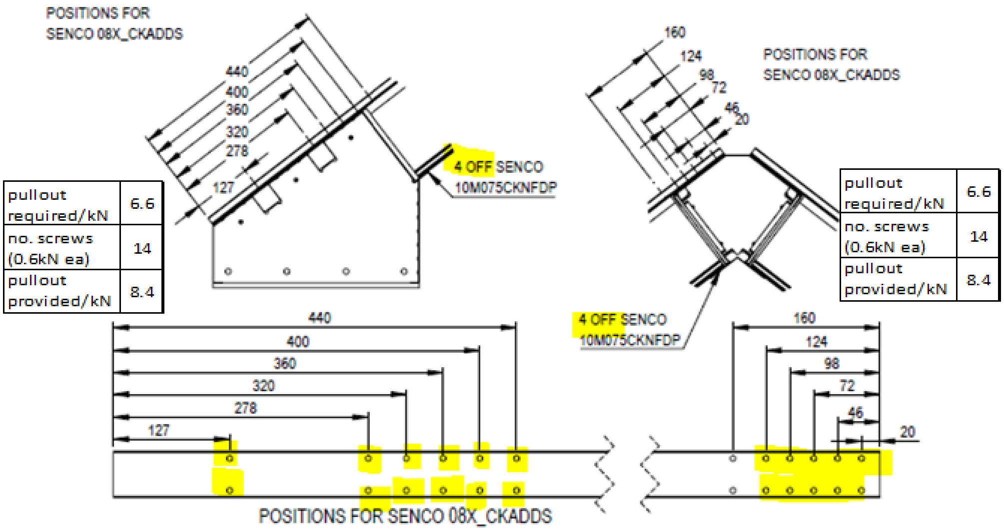
ENGLAND GABLE FASTENER POSITIONS



ENGLAND TYPICAL FASTENER POSITIONS



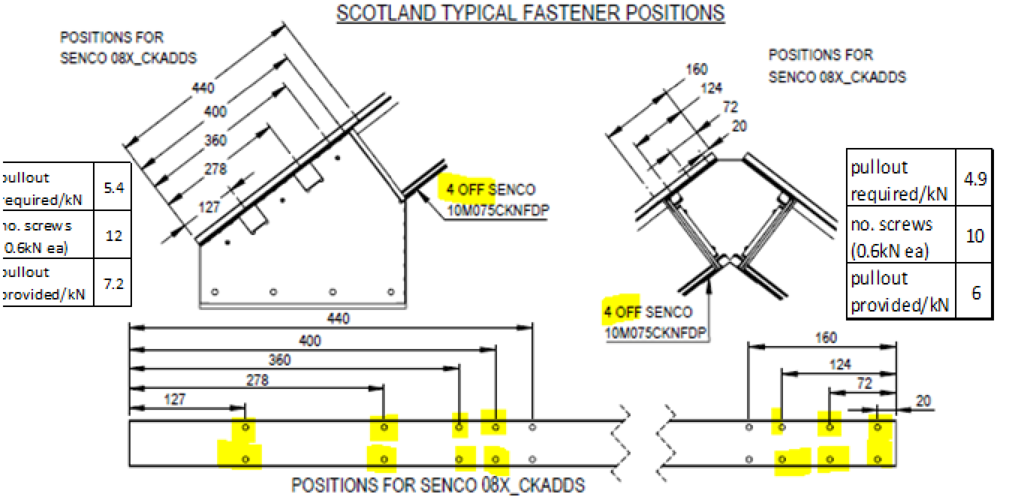
SCOTLAND GABLE FASTENER POSITIONS



pullout required/kN	6.6
no. screws (0.6kN ea)	14
pullout provided/kN	8.4

pullout required/kN	6.6
no. screws (0.6kN ea)	14
pullout provided/kN	8.4

SCOTLAND TYPICAL FASTENER POSITIONS



pullout required/kN	5.4
no. screws (0.6kN ea)	12
pullout provided/kN	7.2

pullout required/kN	4.9
no. screws (0.6kN ea)	10
pullout provided/kN	6

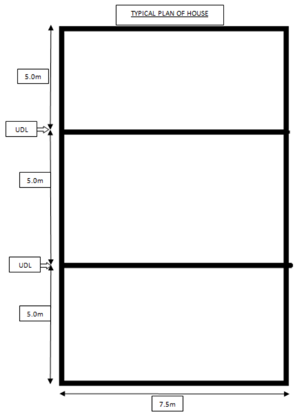
2.2.9 Possible Diagonal Bracing in Spandrel Walls.

Ultraframe have been asked to demonstrate the in-plane racking resistance of the panel when exposed to lateral forces. However within the roof spaces that we intend to use our walls, the panels will be triangular, will not directly take lateral load and therefore racking need not be considered.

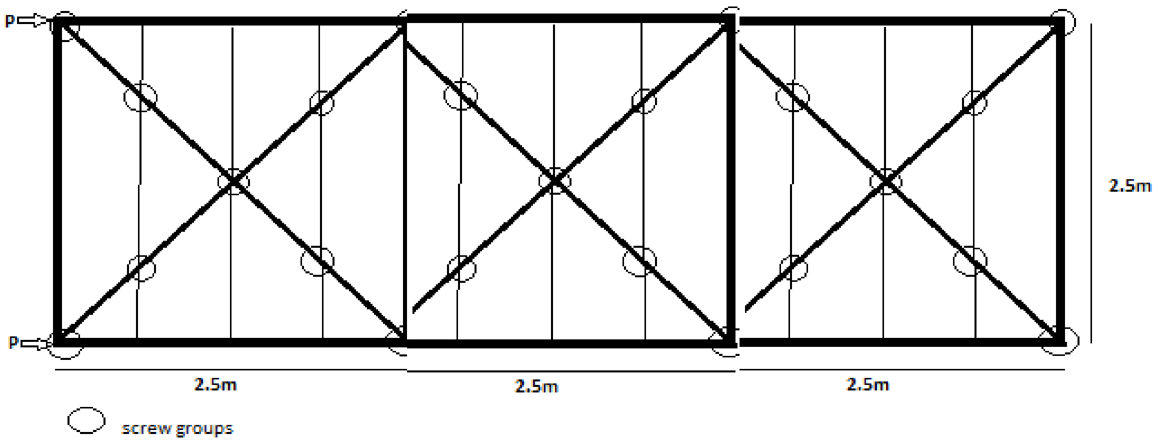
However to demonstrate that if the situation did arise we have considered a 3no.panels, 2.5m high by 2.5m wide and we would use 100mm wide 0.9mm steel strap cross-bracing. (See diagram below)

Assumptions:

a) Wind Load is 1.1kN/m^2 (An accepted conservative scheme value for most buildings within UK. In reality, each individual location will be calculated for max net pressure according to BS EN 1991-1-4:2005)



b) 3no.panels, each 2.5mx2.5m.
Assume the walls are at 5m spacing. (In reality the spacing would be taken to suit each house)
UDL on panel =1.1x5x1.5 = approx 8.25kN/m (Ultimate)
P=8.25x2.5/2=10.3kN `
Tension in each diagonal = 10.3/ (3*cos45) =4.9kN



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The cross bracing is 0.9x100 flat steel (S280GD+Z) bar.

The A=90mm^2

Therefore $N_{Rd} = \frac{A*f_y}{\gamma_{M0}}$ $N_{Rd} = \frac{90*280}{1.0}$ = **25 kN** (correctedf_y.)

Our S280GD+Z is provided by our supplier with specified minimum guaranteed yield strength of 280 kN/mm^2. Each delivery is in accordance with BS EN10346:2015 accompanied by required independent test data to prove minimum required strength)

$\gamma_{M0} = 1.0$ (BS EN 1993-1-1:2005 Section 6.1 Note 2B)

The maximum required force is 4.9kN (ultimate) < 25kN. Therefore OK.

Each fixing has shear capacity of 1.0kN (SENCO 55WS19MC through 1.0mm steel data sheet is 1.1kN)

Senco Shear Test Data

	Steel thickness Fu=55 Ksi		Steel thickness Steel Fu=65 Ksi		
Screw Designation	1.0mm	1.3mm	1.6mm	1.9mm	
#8-15 x mod Truss 4.2mm	1.3	1.5			kN
#8-18 x mod Truss 4.2mm	1.0	1.2	1.8	1.9	kN
#8-18 x Pan with washer 4.2mm	0.9	1.2	1.9	1.9	kN
#10-16 x Reduced wafer 4.8mm	1.0	1.2	2.0	2.2	kN
#10-16 Pan framing 4.8mm	1.0	1.2	2.3	2.3	kN
#10-22 x pan framing 4.8mm	1.1	1.2	2.1	2.4	kN
#12-19 Pan Framing 5.5mm	1.1	1.3	2.5	2.5	kN
#12-14 Pan framing 5.5mm	1.2	1.4	2.4	2.6	kN

Please refer to attached data sheet from SENCO in Appendix C

Therefore each corner has 5x1.0=5kN shear capacity>4.9kN. Therefore OK. (Again the number of screws will be calculated to suit each individual case)

5no. screws are used to fix strap to wall clip in each corner. However there are also screw groups where the strap crosses clips to distribute further and the connection of the continuous wall clip to the beams top and bottom with further screws provide a moment connection.

2.2.10 Compression Resistance of Panels

Using Tables 2 and 3: Maximum compressive load through panels will be the ULS Roof Load*Slope length for 50°.

Standard Panel

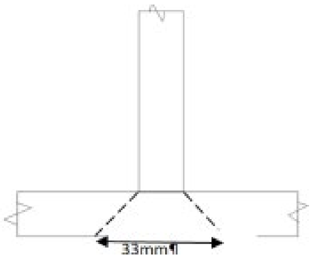
Maximum compression=1.73*5.8=10kN/m < 103kN/m Standard panel maximum Axial capacity.

Deep Panel

Maximum compression=1.73*6.8=12kN/m < 103+kN/m Deep panel maximum axial capacity.
The compressive resistance of the panels is OK.

2.2.11 Proof of minimum vertical support width for Eaves.

The limiting factor for this will be the crushing of the 11mm OSB fins@ 600mm c/c



Using same loading from previous maximum span of 8.128m 45° roof span. I.e. vertical load at eaves =7.74kN/m (Ultimate). Therefore there is 4.64kN/fillet vertical load. (Approximately 3.1kN permanent and 1.55kN variable)

Calculate minimum width required due to compressive strength of OSB3.

(Service Class 1, Υ_m=1.2, k_{mod}=0.4 permanent, k_{mod}=0.9 short term variable, $f_{c,k}$=12.7N/mm^2)

$f_{c,d}=k_{mod} * \frac{f_{c,k}}{\Upsilon_m}$ permanent: $f_{c,d}=0.4 * \frac{12.7}{1.2}$=4.23 N/mm^2 variable: $f_{c,d}=0.9 * \frac{12.7}{1.2}$=9.53 N/mm^2

Therefore minimum width required: permanent=$\frac{3100}{33*4.23}$=22mm variable=$\frac{1550}{33*9.53}$=5mm

Therefore a minimum total width of 70mm is OK.

2.3 Permanent and Variable Loading.

The following is used for the permanent load:

I-Beam panels	kg/m^2	
EPS	6	
Hardboard	2.33	
Steels	6.06	
Sub-total	**0.14**	**kN/m^2**
soffit and coverings	kg/m^2	
Plasterboard	10	
OSB	8	
Battens	0.7	
Marley tiles	54	
Sub-total	**0.71**	**kN/m^2**
TOTAL DEAD	**0.85**	**kN/m^2**

Table 4 Permanent Loading

Variable loads are obtained from UDesign software. UDesign uses location data (altitude and exposure factors) from BREVe based on the installation postcode to calculate the basic wind speed and ground level snow loadings. Then the following codes are used to calculate the variable loads further: BS EN 1991-1-3:2003, Eurocode 1: Actions on structures; Part 1-3: General actions – Snow Loads

NA to BS EN 1991-1-3:2003, UK National Annex to Eurocode 1: Actions on structures; Part 1-3: General actions – Snow Loads

BS EN 1991-1-4:2005, Eurocode 1: Actions on structures; Part 1-4: General actions – Wind Loads

NA to BS EN 1991-1-4:2005+A1:2010, UK National Annex to Eurocode 1: Actions on structures; Part 1-4: General actions – Wind Loads

The envelope of combinations is considered as per BS EN 1990:2002, Eurocode 0.

The members are then designed for the worst case loading criteria.

3.0 Roles and responsibilities

Ultraframe carried out in-house load tests to ascertain the member resistance (stiffness (EI)) of the members; panels, eaves beams, intermediate beam and valley.

We have then utilized the SCI (Steel Construction Institute) to provide accreditation for the design resistance of these members. To date they have carried out load tests in conjunction with Oxford Brookes University and confirmed the properties as summarised in Table 1.

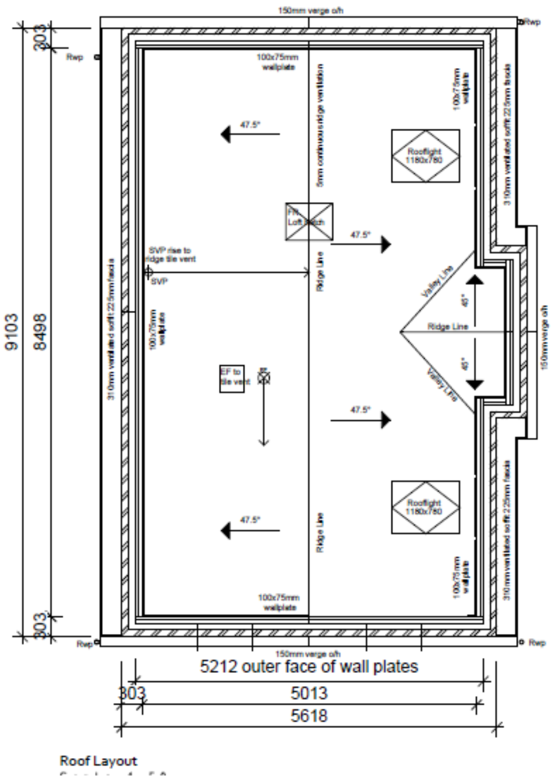
Therefore Ultraframe (using the results from SCI and in-house tests) are responsible for confirming the structural design for the following members: panels, eaves beam, intermediate beam, valley, tie member and their connection to each other. The connections are designed to ensure adequate load paths (in terms of shear and tension) and to provide robustness. The structural design is determined by stiffness and limited by span/240 or 20mm (recommended for plasterboard finishes) for total serviceability deflection. The bending and shear capacity have been considered but deflection is always the overriding limit with the lightweight structure, spans and imposed loads considered.

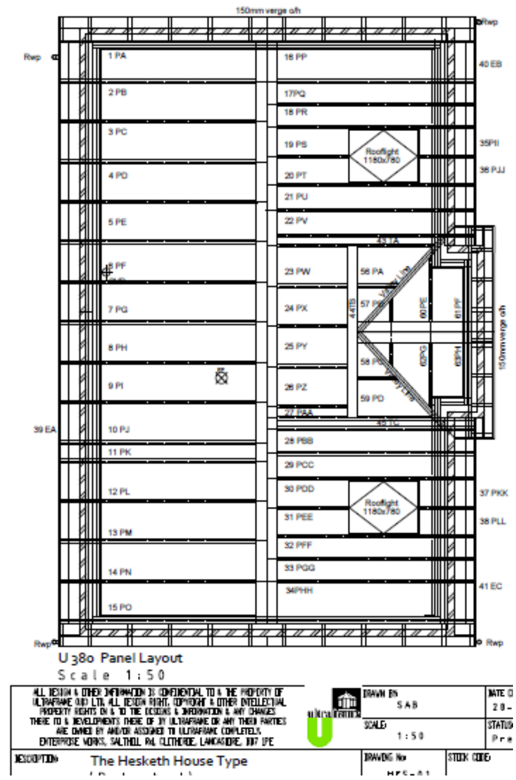
The following elements are not the responsibility of Ultraframe but highlight our expectation of how gravitational and lateral loadings are subsequently transferred to structure below.

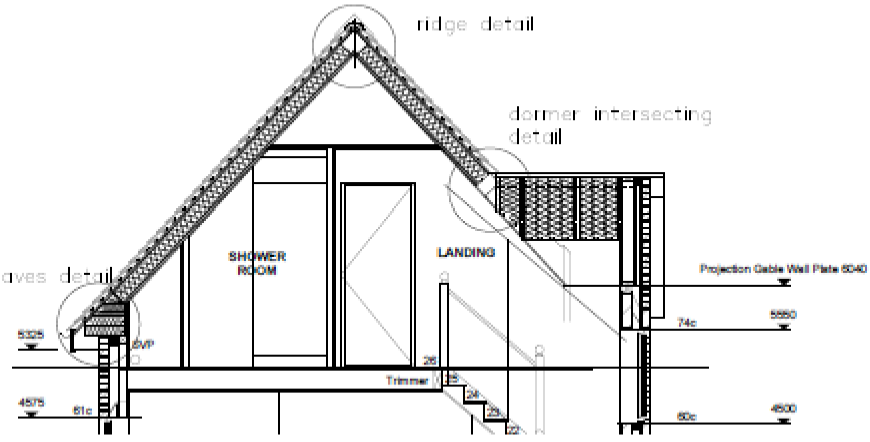
a) The load bearing walls below the level of the underside of the eaves beam. This is the design responsibility is with the house builder. The loadings transferred from the roof will be provided to enable evaluation of the structure below being suitable. Note the weight of the roof is less than the timber structure it replaces therefore if the structure has been designed for the timber roof the structure will be adequate.
b) Vertical ties securing the 100*50 wall plate should be installed as per standard construction details to prevent uplift and ensure robustness. The eaves beam is secured to the wall plate via a 2508150*0.9 steel plate.
c) The gable brickwork (outer leaf). Ultraframe are providing the spandrel panel on the inner leaf but this is to be tied to the brickwork with brick-ties as per standard construction details. Ties to be provided by others. Gable wall is to provide adequate stiffness to withstand the lateral movement transferred through the diaphragm action of the roof.
d) Floor construction. Design and detailed by others. The floor is required to withstand the tension transferred from the tie detail. Ultraframe have presumed that a Steico or similar timber joist floor is provided.
e) Horizontal ties from walls to floors to be installed as per standard construction details to enhance robustness and prevent disproportionate collapse.

Appendix A: Example Member Structural Calculations

These are based on the Hesketh House Type:







Section Detail

Pitch =47.5°
Assume snow load dominant and take minimum imposed of load of 0.6 kN/m^2
Permanent load=0.85 kN/m^2
Therefore Overall Roof Load =$0.6 * cos47.5 + 0.85 = 1.26$ kN/m^2

A.1 Panel Design

Worst case is panels at 600mm c/c. Therefore udl, $w = spacing * roofload$

$w = 0.6 * 1.26 = 0.76$ kN/m

Deflection limit is span/240 for spans <4800mm
Deflection limit is 20mm for spans >4800mm
In this case, panel slope length= 3700mm, therefore use span/240.
Therefore:
$EIrequired = 3.125 * w * L^3$
$EIrequired = 3.125 * 0.76 * 3700^3 = 1.20E11$
$EIprovided = 5.40E11$ (standard panel)
Therefore OK

A.2 Eaves Beam Design

The udl onto the eaves beam, $w = panel\ slope * roofload$

$w = 3.7 * 1.26 = 4.66$ kN/m

Deflection limit is height/300. Therefore is this case deflection limited to 2.5mm.

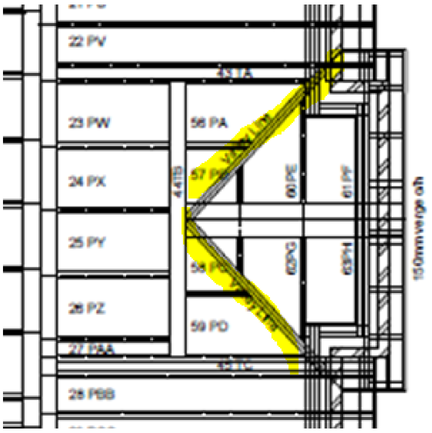
Aiming to place a tie at midpoint, therefore eaves length required is 4300mm.

$EI = \frac{5*w*L^4}{384*\delta}$ $\quad EI_{req} = \frac{5*4.66*4300^4}{384*2.5} = 8.3E12$

$EIrequired = 8.3E12$
$EIprovided = 8.5E12$

Therefore OK.

A.3 Valley Beam Design



Udl on valley taken conservatively.

$$w = 0.76 \text{ kN/m}$$

Deflection limit is span/240 for spans <4800mm

In this case, valley slope length= 2900mm,

Therefore:

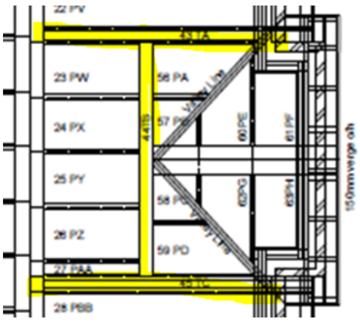
$EIrequired = 3.125 * w * L^3$

$EIrequired = 3.125 * 0.76 * 2900^3 = 5.79E10$

$EIprovided = 7.80E11$

Therefore OK

A.4 Intermediate Beam Design



Udl and point load on sloping beam.

$$w = \frac{0.6}{2} * 1.26 = 0.38 \text{ kN/m}$$

$$P = \frac{4.52}{2} * 1.26 * \frac{2.7}{2} = 3845\text{N}$$

Deflection limit is span/240 for spans <4800mm

In this case, slope length= 3850mm,

Therefore:

$EIrequired\ for\ w = 3.125 * w * L^3$

$EIrequired = 3.125 * 0.38 * 3850^3 = 6.78E10$

$EIrequired\ for\ P = (240 * P * L^2)/48$

$EIrequired = \dfrac{240 * 3845 * 3850^2}{48} = 2.85E11$

$EIrequiredtotal = 3.53E11$

$EIprovided = 5.2E11$

Therefore OK

4. b. Behaviour in relation to fire

The strategy adopted is for the fire protection which covers the structure to meet the building regulation requirements before the fire has penetrated the wall cavity.

The underside of the roof therefore used 1 layer of 15mm Gypsum wallboard to achieve the required 30 minutes.

Walls incorporating the wall panel systems can achieve a classification for resistance to fire of REI 30 and REI 60 when tested in accordance with BS EN 1365-1 : 2012 (in conjunction with BS EN 1363-1 : 2012) and classified in accordance with BS EN 13501-2 : 2016. The wall constructions required to achieve these classifications are described in **Appendix 9.1, 9.2, 9.4, 9.5, 9.6 and 9.7**

We have conducted Roof Penetration tests at Exova to BS 476-3 See **Appendix 9.3** This is a test using a polymer tile we use in the home improvements market. It therefore represents worst case in respect of the flammability of the external surface. In applications relating to House roofs the finish will be either concrete tile or clay tile. Despite this worst case test the roof achieved a B Roof fire rating.

The responsibility for fitting the cavity barriers and fire stops in all areas adjacent to the roof will be the responsibility of the building contractor and the roof tiling contractor. Details of the position and product codes are contained within the detailed drawings in section 3.

4. c. Resistance to moisture

The construction of the roof is to be protected on the underside by a continuous Vapour Control Layer. Foil faced plasterboard is used as the vapour control layer on the inside . On the external side of the roof on top of the panel and under the tile batten a breathable membrane is to be used such as Daltex RoofTX.

Condensation risk analysis has been completed by Evolusion and verified by the BBA. The full report is contained in Appendix 11

4. d. Resistance to the passage of sound

The sloped roof elements are not subject to a performance requirement and no data is provided.

The spandrel wall needs to achieve a sound reduction of 50dB. There has been a paperwork assessment of the spandrel wall design and there is a high level confidence that a reduction greater than 50dB will be achieved. Report **Appendix 15**

The proposal is to conduct an internal test on the roof constructed in our factory to confirm the performance and an addition test on the first trial roof when constructed on site.

We are planning to use RBA Acoustics for this field testing.

4. e Energy efficiency

The elemental thermal performance of the roof system has been evaluated by Evolusion Innovation and verified by the BBA. The full report is in **Appendix 11.1**

Flanking element	Panel option	U-value ($Wm^{-1}K^{-1}$)	Temperature factor, f_{Rsi}
Gable wall[1]	113 mm panel(EPS)	0.32	0.93
Gable wall[1]	113 mm panel(PIR)	0.23	0.92
Gable wall[1]	213 mm panel	0.17	0.96
Pitched roof[2]		0.18	0.97
Gable wall[1]	285 mm panel	0.16	0.98
Pitched roof[2]		0.18	0.98
Pitched roof[3]	Intermediate panel	0.29	0.96

Table 6 Junction psi values[1]

Junction	SAP reference	Flanking element description	Ψ-value ($Wm^{-1}K^{-1}$)	Temperature factor, f_{Rsi}
Ridge	R5	Pitched roof[2]	0.025	0.94
Eaves (insulation at rafter level)	E11	Pitched roof[2] External wall[3]	0.000	0.95
Gable (insulation at rafter level)	E13	Pitched roof[2] Gable wall[4]	0.029	0.93

4. f. Durability

The roof system has been assessed for risk of interstitial condensation and the analysis shows no condensation. The exterior of the roof structure is encased in a breathable membrane which keeps the structure dry and allow any construction related increase in moisture content to normalise over time. On the internal face of the roof there is a vapour control layer to prevent room humidity penetrating the roof structure.

The durability of the steel elements is out lined in the Steel Construction Institute Technical information guide ED022. Within this the predicted life for an uninsulated roof space is 100yrs where steel with a Z275 coating is used. This most closely represents the conditions of the steel on the external face of the roof. The Steel on the internal face will have a life expectancy of 250 yrs. The steel used as part of the beam construction has an Arceor Magnelis coating ZM250 the performance of this exceeds Z275.**(Appendix 1)**

The OSB used as part of the beam construction is considered to have a life equivalent to the attached structure ref Norboard Sterling Board OSB3 BBA certificate 01/3857.**(Appendix 3)**

The Oil tempered Hardboard is supplied by Lion Board and manufactured by Finishfibreboard. The declared Durability is Class 2 – Durable. EN13986:2004 i.e. a life of over 60 yrs. **(Appendix 2)**

EPS is supplied by Styrene Packaging and Insulation. Their BBA certificate,04/4102 states durability as : The products are rot-proof, dimensionally stable and, when installed with the overlays specified in this Certificate, will remain effective as an insulating material for the life of the building in which they are incorporated. **(Appendix 4)**

5.0 QMS and FPC measures

The Ultraframe factory in Clitheroe already has regular audits as part of our BBA certificate / ISO 9001 approval **(Appendix 21.1)**

- 3 monthly BSI (ISO 9001) audits
- BBA visit us every 6months in relation to different certificates of approval, including CE marking etc.
- Internally we conduct approximately 24 ISO 9001 specific audits. All internal auditors are qualified to (minimum of) ISO 9001:2015 'Internal Auditors' standard.

On site checks, packaging and delivery

5.1 Pre- start inspection.

Ultraframe's contracts manager will visit site once the developer agrees a new site will feature the roof system. The Ultraframe contracts manager will engage with the housebuilders site manager and/or delegated members of staff.

The meeting will discuss which plots are to feature the roof system, review access details for unloading and go through the accompanying Trades Manual that identifies what Ultraframe expect to find when arriving at site, what overlaps there are with other trades and the required finishes that the housebuilder will need to undertake to complete the installation. Risk assessments and method statements will be then tailored to suit that site/house types.

The Ultraframe contracts manager visits site a few days before the roof in installed to check the wall plate has been fitted correctly (all dimensions checked against published tolerances), the floor/deck has been laid as a safe working platform and the scaffold is as agreed.

5.2 Manufacturing

- Each component is labelled as the last step of the manufacturing process, each component or group of components (for example clips) are identified with a pack label, see example below.

- Each order is uniquely identified with an Ultraframe order number, in this example KJ120152, there is no reference to a design revision on the label but if the design revision was included on the customer order this would be traceable via the Ultraframe order number.
- There are 3 fields within the Customer Ref. field in the label below, these fields will be used to reference the Plot Number/Project Number.
- The label below indicates that there are 52 packs in total for this particular roof order, with this label being for pack number 15.

- Each panel is uniquely identified with a pack label as above and also a panel location label, see example below. The location label can be cross referenced against the roof location plan so that the installer knows where the panel should be located and installed on the roof.
  - The panel location label also includes the panel dimensions and Ultraframe order number.

- Each panel/component will be identified with the plot number in the Customer Ref. field in the pack label above. Panels will be grouped and palletised by plot number and the pallet identified with site and plot references.

- A damaged or defective panel should be reported to Ultraframe quoting the Ultraframe order number (taken from the pack label or panel location label) and the panel location reference. A customer service order will be generated and a replacement panel will be manufactured and delivered to site.

5.3 Delivery, handling and storage

Delivery will be on Ultraframe's own trailers/vehicles. These may be either a rigid, flat bed trailer or curtain sided vehicle – this will depend upon the size of the roof and more importantly the location on site of the plot (eg is the plot within reach of the crane) and selecting the best method of loading out the roof. The packaging will consist of the eaves beams on a pallet from which individual beams are lifted onto the wall plate. The ridge and intermediate beams will also be on a pallet. The insulating panels will be stacked on pallets, two wide and 6 panels high.

Pallets to be suitably wrapped to ensure protection during transport and temporary storage on site.

The preferred method of loading out the roof is a telescopic handler lifting the beams/pack onto the scaffold or the loft floor (subject to confirmation of point loads etc). If site conditions don't allow, a crane will be deployed to lift each panel/member into place.

5.4 Installation process

A detailed installation guide will be sent to site with each roof. The roof comes with a location plan to carefully point out where each element sits – this location plan correlates with pack labels to ensure the correct panels are picked and lifted into the right positions.

An Ultraframe supervisor is on site to ensure compliance and fitment in line with the guide. Installation sequence is as follows

(and is the same on all house types);

- The eaves is positioned on the wall plate and are connected using the tie bar. Once centralised temporary fix using support brackets provided
- Erect of central section of external spandrel wall and party wall–.
- Lift the ridge into position and temporary support on the spandrel

- Add gable roof panels, one each side of the ridge and at both ends of the ridge and fix into position - to steel sections on the spandrel panel and ridge.
- Position remainder of panels working from both gables towards the centre. Add any panels with cut outs/preps for roof windows and GRP dormers
- Knock on steel clips to 'zip' panels together and fasten with screws at the ridge and eaves positions.
- Fit remainder of Spandrel and Party wall panels.
- Add breathable membrane externally at the spandrel, fix cavity ties and complete external masonry bricklayers to ensure cavity barriers are fitted.
- Sub contract tilers fit tiles/battens and membrane in accordance with NHBC standards

5.5 Sign off of completed roof assembly

Ultraframe contracts manager goes through pre-agreed checklist before handover to site manager – special checks made of areas where other trades are following on such as bricklayers (external spandrel), dryliners (with special attention to fire protection measures/internal fire stops), roofers (including fire stops). Duplicate sign off sheet kept by Ultraframe in the project file at Ultraframe's HQ.

5.6 Remediation of damage caused during installation

If the membrane gets ripped on the spandrel, repair carefully by taping a new section of membrane over the ripped area. This detail is covered in the Technical Manual.

If a small section of EPS insulation is damaged, the damaged section may be replaced using expanding polyurethane foam to adhere the piece into place. Alternatively the foam maybe used to make up the missing section.