

CCANZ CP 01:2022

Code of Practice for Weathertight Concrete and Concrete Masonry Construction



Concrete New Zealand

October 2022



CCANZ CP 01:2022 - Code of Practice for Weathertight Concrete and Concrete Masonry Construction

Weathertightness solutions for:

- **Concrete slab on ground**
- **Concrete and concrete masonry wall systems**
- **Concrete flat roofs and decks, and**
- **Concrete to timber construction junctions.**

PREFACE

It has been eight years since the CCANZ CP 01 Code of Practice for Weathertight Concrete and Concrete Masonry Construction was last updated. While there have been some additions to reflect changing construction practices, other edits have been revisions to some of the detailed drawings to allow for improved thermal performance.

We have now added thermal images of the details shown in the Code of Practice to enable better understanding of the risk of condensation at the internal surface areas and junctions. Some of the details will perform well in all NZ climate zones other in warmer NZ climate zones but potentially less so in the colder regions. A table with acceptable surface temperature factors will help to answer suitability of the details for the various climate zones. A new Appendix A describes the methodology that was used and provides further information regarding thermal performance considerations.

The previous ten years saw a range of new weathertightness systems entering New Zealand. Double glazing and all in all thicker thermal insulation to help addressing Climate Change is now the norm. Hence window details have been updated and thermal insulation is shown more advanced for some details. Even though this does not form part of weathertightness requirements, but it is an essential element of the building envelope.

Conductivity and thermal bridging should also be considered with guidance provided by section 8.

We hope that this Code of Practice will continue to be a helpful guide to solving your detail design for residential concrete buildings.

Ralf Kessel, Concrete NZ Architect (NZRAB, ARBUK), October 2022

ACKNOWLEDGEMENTS

This Code of Practice was prepared in 2011 by:

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Cement & Concrete Association of New Zealand (now Concrete NZ)

With the assistance of CCANZ CP 01 work group members:

Bannan Construction

Building Research Association of New Zealand

Department of Building and Housing

Firth Industries

New Zealand Concrete Masonry Association

Solid Concrete Solutions

Sto New Zealand

WILCO Precast Ltd.

Wilton Joubert Civil Engineers, and

Window Association of New Zealand.

It was updated in 2014 with the assistance of the Ministry of Business, Innovation and Employment and again in 2022 with the assistance of:

Bannan Construction

Building Research Association of New Zealand

Composite Insulation

Concrete NZ

Concrete NZ Readymix Sector Group (Firth Industries)

Concrete NZ Masonry Sector Group (Bowers Brothers Concrete)

Concrete NZ Precast Sector Group (Busck Prestressed Concrete)

Oculus Architectural Engineering Limited

Resene Group

Sika New Zealand

Sto New Zealand

Sustainable Engineering Ltd, and

Window & Glass Association NZ.

The contribution of time and expertise from all those involved is gratefully acknowledged.

Cover image: Point Chevalier House residential design by Ponting Fitzgerald Architects

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ISBN: 978-0-908956-98-2 (print)

ISBN: 978-0-908956-99-9 (online)

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Published October 2022 by Concrete NZ, PO Box 448, Wellington 6140, New Zealand

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Section 4.6 (Masonry Veneer) of this Code of Practice is based on content from **NZS 4229:2013** - *Concrete masonry buildings not requiring specific engineering design*, which has been provided by Standards New Zealand under licence 001006.

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DOCUMENT HISTORY

Version	Date	Key changes
CCANZ CP 01:2011	June, 2011	n/a
CCANZ CP 01:2014	January, 2014	4.5 weathertight concrete, minimum strength requirement revised
(Errata 1)	January, 2015	Editorial revisions
CCANZ CP01:2022	October, 2022	3.0: Updated 4.5: Updated with extended comments 4.6: Lintel dimensions updated 8.3: Comments regarding thermal breaks included 9.0: Detailed drawings updated Appendix A (informative): Thermal performance, modelling method, internal insulation and mould growth, thermal images of junctions to support detailed drawings (new)

Foreword by Jason Quinn

This new edition of the Code of Practice for Weathertight Concrete and Concrete Masonry Construction demonstrates admirable leadership from Concrete NZ, establishing new standard practices in advance of New Zealand Building Code minima. This positions the industry extremely well given MBIE has announced that the Building Code's thermal performance requirements will continue to increase to help meet climate change targets.

Sustainable Engineering Ltd provided input into the previous edition of this manual, and my team was very pleased to again offer our expertise. One new focus in CCANZ CP01 is on thermal performance, and we calculated the thermal bridging and surface temperature factors (mould index) for the various details.

These calculations help architects and designers to understand the risk of mould growth and underpin comprehensive changes to the detailed drawings of this document. The temperature plots clearly show the performance gains that can be made by using these updated details, but it's also useful to think about the qualitative benefits:

- Concrete that is better insulated and transfers less energy via thermal bridges saves on heating and cooling bills for the life of the building.
- Comfortable temperatures in buildings are easier to maintain, and that's good for the wellbeing of the people that occupy them.
- Comfortable temperatures are also good for the environment, as heating and cooling buildings account for a significant proportion of New Zealand energy use and resultant greenhouse gas emissions.
- Finally, there is a financial benefit for the owner, occupier or lessee — whoever is paying utility bills.

Preventing cold spots caused by thermal bridging also means reducing or removing the risk of mould. This means better building durability and it's also very important for the health of those who live and work and learn in these buildings. Mould is a significant health hazard, especially for people with respiratory illnesses (and sadly, New Zealand is a world leader in rates of asthma and other lung conditions).

When we build better, everybody benefits.

Jason Quinn
Director
Sustainable Engineering Ltd

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2	Wall/ Footing - Slab on Ground	insitu, precast	external (EIFS)
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4	Wall/ Footing - Slab on Ground	insitu, precast	internal
5	Wall/ Footing - Slab on Ground	insitu, precast	integral
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7	Wall/ Upper Floor Slab	masonry, insitu, precast	external (EIFS)
8	Wall/ Upper Floor Slab	masonry, insitu, precast	internal
9	Wall/ Upper Floor Slab	insitu, precast	integral
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21	Wall/ Pitched Roof - Apron	masonry	cavity
22	Wall/ Pitched Roof - Eaves	masonry, insitu, precast	external (EIFS)
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References

For the purposes of New Zealand Building Code (NZBC) compliance, the Standards and documents referenced in this Code of Practice shall be the editions, along with their specific amendments, listed below. Where these primary reference documents refer to other Standards or documents (secondary reference documents), which in turn may also refer to other Standards or documents, and so on (lower-order reference documents), then the version in effect at the date of publication of this document shall be used.

Standards New Zealand		Where quoted in CCANZ CP 01: 2022
AS/NZS 1170: 2011	Structural Design Actions	1.1.1, 1.1.4, 1.3, 3.3.1, 3.4.1, 4.1 6.2, 6.4, 7.1, 7.6
AS/NZS 2311: 2017	Guide to the painting of buildings	3.3.3, 3.4.3
AS/NZS 2699.1: 2000	Built in components for masonry construction wall ties	4.6.3, 4.6.4, 4.6.4.1
AS/NZS 2699.3: 2000	Built-in components for masonry construction - Lintels and shelf angles (durability requirements)	4.6.5
AS/NZS 2728: 2013	Prefinished/ prepainted sheet metal products for interior/ exterior building applications - Performance requirements	5.1.2
NZS 3101: 2006	Concrete Structures Standard	1.1.4, 2.1, 2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.5 6.2, 7.1, 7.6
NZS 3104: 2006	Specification for Concrete Production	2.2, 3.3.2, 3.4.2, 4.5
NZS 3109: 1997	Concrete Construction	1.1.4, 3.3.1, 3.4.1, 6.2, 7.1
NZS 3112: 2017	Tests relating to the determination of strength of concrete	4.5.1
NZS 3114: 1987	Specification for Concrete Surface Finishes	3.3.3, 3.4.3, 6.3
NZS 3602: 2003	Timber & wood-based products for use in buildings	6.11.2
NZS 3604: 2011	Timber framed buildings	3.2.5, 3.2.9.6, 4.6.1, 4.6.4, 4.6.5, 5.1.2, 7.1
AS/NZS 4201:1994	Pliable building membranes and underlays - Methods of test	3.1.5.4
NZS 4210: 2001	Masonry construction: materials & workmanship	2.2, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6, 4.6.2, 6.2
NZS 4211: 2008	Specification for performance of windows Amend: 1, 2, 3	3.1.5
NZS 4229: 2013	Concrete masonry buildings not requiring specific engineering design	1.1.1, 1.1.3, 1.2.2, 3.2.1, 3.2.6, 4.6.4.1, 4.6.5, 6.2, 7.1, 7.3, 7.4, 7.6
NZS 4230: 2004	Design of reinforced concrete masonry structures	6.2
SNZ HB 4236: 2002	Masonry Veneer Wall Cladding	3.2.9.3, 3.2.9.6
NZS 4251	Solid plastering	4.2.1
Part 1: 2007	Cement plasters for walls, ceilings and soffits	
AS/NZS 4256: 2006	Plastic roof and wall cladding materials	5.2.1
	Unplasticized polyvinyl chloride (uPVC) building Sheet	
AS/NZS 4284:2008	Testing of building facades	3.1.8

Where quoted in CCANZ CP 01: 2022

AS/NZS 4455.1: 2008	Masonry units, pavers, flags and segmental retaining wall units - Masonry units	3.2.2, 4.6.2
AS/NZS 4456.16: 2003	Masonry units, segmental pavers and flags - Methods of test	4.4.1
AS/NZS 4671: 2019	Steel reinforcing materials	3.3.2, 3.4.2
AS/NZS 4858: 2004	Wet area membranes	3.1.5.3, 3.1.5.4, 4.2.3

Australian Standards

AS 1478.1:2000	Chemical admixtures for concrete, mortar and grout	4.5
Part 1	Admixtures for concrete	
AS 1366.3:1992	Rigid cellular plastics sheets for thermal insulation	4.1.3.1
(R2018)	Rigid cellular polystyrene – Moulded (RC/PS-M)	
AS 1366.4:1989	Rigid cellular plastics sheets for thermal insulation	4.1.3.1
(R2018)	Rigid cellular polystyrene – Extruded (RC/PS-E)	

American Society for Testing and Materials

ASTM C1330: 2018	Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants	3.1.1, 3.1.2
ASTM C1549: 2014	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer	4.1.3.4
ASTM C755-10	Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation	6.4.1
ASTM D412:2021	Tensile Testing of Elastomers	3.1.9
ASTM D642:2020	Standard Test Method for Determining Compressive Resistance of Shipping Containers, Components, and Unit Loads	3.1.9
ASTM D882: 2018	Standard Test Method for Tensile Properties of Thin Plastic Sheeting	3.1.2
ASTM D903: 2017	Standard Test Method for Peel or Stripping Strength of Adhesive Bonds	6.5.1, 6.5.2
ASTM D2240:2010	Standard Test Method for Shore Hardness	3.1.9
ASTM D2842-06	Standard Test Method for Water Absorption of Rigid Cellular Plastics	3.2.9.2
ASTM D6134: 2019	Standard Specification for Vulcanised Rubber Sheets Used in Waterproofing Systems	6.5.1
ASTM D7105: 2019	Standard Test Method for Determining the Adhesive and Cohesive Strength Between Materials in Roofing or Waterproofing Membranes and Systems	6.4, 6.5.1, 6.5.2
ASTM E96: 2017	Standard Test Methods for Water Vapour Transmission of Materials	3.1.2, 3.1.5.4
ASTM E104: 2020	Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions	8.2
ASTM E903: 2020	Standard Test Method for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres	4.1.3.4

Where quoted in CCANZ CP 01: 2022

ASTM E2098: 2018	Standard Test Method for Determining Tensile Breaking Strength of Glass Fibre Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to a Sodium Hydroxide Solution	4.1.3.2
ASTM E2134-14:2018	Standard Test Method for Evaluating the Tensile Adhesion Performance of an Exterior Insulation and Finish System (EIFS)	4.1.3.1, 4.1.3.3, 4.1.3.6
ASTM E2357:2018	Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies Adhesion Performance of an Exterior Insulation	3.1.2
ASTM G53-84	Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials	3.1.8

Building Research Association of New Zealand

BRANZ EM 5: 2005	Evaluation method for adhesives and seam tapes for butyl and EPDM rubber membranes	6.5.1, 6.5.2
BRANZ Bulletin 424	Measuring moisture on building sites	8.2

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NZCMM	New Zealand Concrete Masonry Manual: 1999	3.2.9.4
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Other organisations and references

EN 1504-2:2004	Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Part 2: Surface protection systems for concrete	4.4.3
Waterproofing Membrane Association Inc.:	Code of Practice for Reinforced Modified Bitumen Membrane Systems for Roofs and Decks, 4th edition	6.5.1, 6.5.2
New Zealand Metal Roofing Manufacturers Inc:	New Zealand Metal Roof and Wall Cladding Code of Practice: 2008	5.2
EIMA 101.91: 1992	EIFS Industry Members Association: Standard Guide for resin of resin coated glass fibre mesh in exterior insulation and finish systems (EIFS), Class PB.	4.1.3.2
ISO 10077-2:2017	Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 2: Numerical method for frames	Appendix A
ISO 10211:2007	Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations	Appendix A

Where quoted in CCANZ CP 01: 2022

ISO 11600: 2002	Building Construction – Jointing products Classification and requirements for sealants	3.1.1, 3.1.2, 3.1.4.1
ISO 6946:2017	Building components and building elements - Thermal resistance and thermal transmittance - Calculation methods	Appendix A
Federal Specification Standard TT-S-00230C	Elastomeric type, cold applied single component for caulking, sealing, and glazing in buildings, building areas (plazas, decks, pavements), and other structures	3.1.1, 3.1.2, 3.1.4.1
ICC Evaluation	International Code Council, Acceptance criteria for flashing materials Services Inc AC148	3.1.5.4

Additional key resources**Standards New Zealand**

NZS 3151:1974	Precast lightweight concrete panels and slabs (withdrawn)
AS/NZS 2904: 1995	Damp-proof courses and flashings
AS/NZS 4284: 2008	Testing of building facades
AS/NZS 4680: 2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

Australian Standards

AS 3706: 2012	Geotextiles - Methods of test (13 parts)
AS 3730: 2006	Guide to the properties of paints for buildings

British Standards Institution

BS 6538: 1987	Air permeance of paper and board
Part 3: 1987	Method for determination of air permeance using the Garley apparatus
BS 6925: 1988	Specification for mastic asphalt for building and civil engineering (limestone aggregate)
BS EN 988: 1997	Zinc and zinc alloys. Specification for rolled flat products for building

Building Research Association of New Zealand

BRANZ Bulletin 330: 1995	Thin flooring materials – 2 – preparation and laying: Appendix 1
BRANZ Weathertight Solutions Volume 4:	Section 2

Other organisations and references

National Precast Concrete Association of Australia and Concrete Institute of Australia: Precast Concrete Handbook (2002), republished in 2004 with a commentary for New Zealand users by CCANZ and Precast New Zealand Inc

ISO 9223: 2012	Corrosion of metals and alloys; corrosivity of atmospheres; classification
ISO/TS 15510: 2003	Stainless steels – chemical composition
ASTM C981 –05	Standard Guide for Design of Built-Up Bituminous Membrane Waterproofing Systems for Building Decks

ANSI/ASHRAE 160-2016	Criteria for Moisture-Control Design Analysis in Buildings
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Definitions

This is an abbreviated list of definitions for words or terms particularly relevant to this Code of Practice.

Air seal	A continuous water resistant seal fitted between a window or door reveal and the surrounding wall framing to prevent the flow of air into the interior of the building.
AOV	Automatic opening vent.
Apron flashing	A near flat or sloping flashing with a vertical upstand, used at junctions between roofs and walls.
Balustrade	A barrier to prevent people from falling over the edge of a roof/ deck. Balustrades may be formed from concrete or masonry wall around a roof/ deck or from a handrail and stanchions fixed to a parapet. See also Parapet .
Building	A building has the meaning given to it by Sections 8 and 9 of the Building Act 2004.
Building element	Any structural and non-structural component and assembly incorporated into or associated with a building. Included are fixtures, services, drains, permanent mechanical installations for access, glazing, partitions, ceilings and temporary supports.
Capping	A flashing formed to cover the exposed top of a balustrade or parapet. Also known as a coping.
Cladding	An exterior weathertight system used to prevent water entry into the building. COMMENT: Includes any supporting substrate and, if applicable, weathertight coatings or membranes.
Cladding system	The weathertight enclosure of a building, including claddings and their fixings, windows, doors and all penetrations, flashings, seals, joints and junctions.
Concrete	A combination of graded aggregates, cement, water, sand and admixtures manufactured in accordance with NZS 3104.
Concrete masonry	Construction using concrete masonry blocks manufactured using cement and aggregates in accordance with AS/NZS 4455, which are reinforced and either fully or partially filled with grout in accordance with NZS 4210. This definition excludes aerated concrete blocks.
Composite precast panel	A precast panel where insulation is placed integrally within the thickness of the panel.
Control joint	A joint designed to prevent damage by accommodating movement. See also Expansion joint .
Damp-proof course (DPC)	A strip of durable vapour barrier placed between building elements to prevent the passage of moisture from one element to another.
Damp-proof membrane (DPM)	A sheet material or coating, as specified in section 7.4, used to prevent water ingress from the ground into the concrete.
Deck	A near flat roof designed for pedestrian traffic. COMMENT: This definition of 'deck' has a narrower scope than is commonly used, e.g. cantilevered balconies are not part of this definition.
Drip edge	Horizontal edge formed from plaster, metal profile or PVC profile to deflect water away from the cladding system.
Durable	Resistant to wear and decay.

Eaves	That part of the roof construction, including cladding, fascia and gutter, that extends beyond the exterior face of the wall.
EIFS (Exterior Insulation and Finish System)	A polystyrene sheet-based weatherproof finish system that uses mesh reinforced polymer modified cement-based or polymer-based plaster base coats and a protective top coating.
Expansion joint	A joint designed to prevent damage by accommodating movement. See also Control joint .
External wall	Any exterior face of a building within 30° of vertical, consisting of primary and/or secondary elements intended to provide protection against the outdoor environment, but which may also contain unprotected areas. COMMENT: A roof is an external wall if within 30° of the vertical.
Flashing	A component, formed from a rigid or flexible waterproof material, that drains or deflects water away from the cladding system and from junctions.
Footing	Those parts of a building transmitting and distributing loads to the ground.
fRsi	Internal surface temperature factor (factor, resistance surface internal) The temperature factor fRsi is a dimensionless quantity for the assessment of thermal bridges. The higher the temperature factor, the better the thermal insulation in this area and the lower the risk of condensation. The fRsi requirements vary with climate zone locations.
Good ground	Soil that has an ultimate bearing pressure of 300 kPa and: - foundations of adjacent buildings show no signs of settlement or inadequate bearing, - there is no evidence of landslides in the vicinity, - there is no evidence of buried services, and - there is no organic soil, peat or soft clay present.
Insitu concrete construction	Construction where concrete is cast into formwork on site into its final position.
Integral insulation	Insulation placed integrally within the thickness of a precast panel, insitu concrete or masonry element.
Lining	The rigid sheet covering for a wall, ceiling or other interior surface.
Masonry veneer	A skin of concrete masonry or burned clay masonry or natural stone of a maximum mass of 220 kg/m ² , which is attached to and laterally supported by a structural wall.
Membrane	A pliable sheet like waterproofing layer, applied as a fluid or as a sheet.
Mortar	A material in which masonry units are bedded.
Concrete NZ Plant Audit Scheme	An independent verification that concrete complies with NZS 3104.
Outlet (drainage)	A proprietary downpipe cover to secure a deck or roof membrane transition.
Parapet	The exposed top of a concrete or concrete masonry wall that extends above the level of the roof or deck. See also Balustrade .
PEF rod	Closed cell polyethylene foam in accordance with ASTM C1330 used as joint backing material in conjunction with elastomeric sealant.
Plaster	Mixture of dry mineral materials including cement and polymers as required that when mixed with water sets hard.
Polymer plaster	Mixture of wet mineral and polymer material that sets hard on exposure to air.
Poorly drained site	Ground where a hole of size 0.3 m/ 0.3 m/ 0.3 m (length/ width/ depth) filled with water takes more than six hours to drain.
Precast concrete construction	Construction where prefabricated concrete elements are assembled on site. COMMENT: PRECAST CONCRETE IS TYPICALLY CAST OFFSITE BUT CAN SOMETIMES BE CAST ONSITE; FOR EXAMPLE, AS TILT-UP PANELS CAST ADJACENT TO THEIR FINAL POSITION.

Proprietary	A product or system manufactured or distributed by one owner of the patent, formula, brand name or trade mark associated with the product.
Rebate	A recess in a wall joint, opening or floor slab to restrict water entry.
Render	A term synonymous with exterior plaster.
Roof	That part of a building having its upper surface exposed to the outside and at an angle of 60 degrees or less to the horizontal.
Roof underlay	An absorbent permeable building paper that absorbs or collects condensation or water that may penetrate the roof cladding or metal wall cladding.
Saddle flashing	A flashing used to make a weathertight junction between the horizontal top of a wall and the vertical face.
Sandwich panel construction	See Composite precast panel construction .
Screed	A layer of thin plaster or concrete as a floor topping.
Specific design	Design and detailing of a proposed building, or parts of a building, which is outside the scope of this Code of Practice.
Stanchion	A pole or other connecting device, fixed into the structure of a building, which provides support for handrails, aerials and similar structures.
Storey	That portion of a building included between the upper surface of any floor and the upper surface of the floor immediately above, except the top storey shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above.
Thermal bridge	Also called cold bridge, is an area or component of the building envelope which has higher thermal conductivity than the surrounding materials, creating a path of least resistance for heat transfer. Thermal bridges can be avoided by covering the building envelope with a continuous layer of thermal insulation.
Wall	A vertical structure closing in part of the building, or dividing the internal space.
Waterproof and waterproofing	The complete and total resistance of a building element to the ingress of any water in either liquid or vapour state.
Waterproof membrane	A membrane impervious to water which is placed to prevent the passage of water and water vapour through a concrete, concrete masonry element or other building element.
Weathertightness and weathertight	<p>Terms used to describe the resistance of a building to the weather. Weathertightness is a state where water is prevented from entering and accumulating behind the cladding in amounts that can cause undue dampness or damage to the building elements.</p> <p>COMMENT:</p> <p>A weathertight building, even under severe weather conditions, is expected to limit moisture ingress to inconsequential amounts, insufficient to cause undue dampness inside buildings or damage to building elements. Moisture that may occasionally enter is able to harmlessly escape or evaporate.</p>
Weatherproof	A term synonymous with weathertight and usually referring to a component of a weathertight system. In general, this document uses the terms 'weathertight' and 'weathertightness' in preference.
Weathertight coating	A multi-coat liquid applied coating system applied to exterior walls to make them weathertight.

1 Scope

This Code of Practice is intended as a means of generic guidance for compliance with the New Zealand Building Code (NZBC) Clause E2 External Moisture for residential buildings as per NZS 4229 scope for residential buildings.

It covers the weathertightness of the building envelope for:

- Concrete slab on ground,
- Concrete and concrete masonry wall systems,
- Concrete flat roofs and decks, and
- Concrete to timber construction junctions.

COMMENT:

Details of the junctions between concrete walls and timber walls, and of the junctions between concrete walls and timber roofs are provided in Section 3.

Weathertightness details for timber roofs and timber walls are not covered by this Code of Practice. Weathertightness details for timber roofs can be found in NZBC E2/AS1.

1.0.1 Interpretation

Instructions or specifications that must be followed to achieve compliance with this Code of Practice are given in the main text of this document. Verbs such “shall” and “require” are used to help make this clear.

‘NOTES’ throughout this document form part of mandatory requirements of this Code of Practice.

‘COMMENTS’ throughout this document are for guidance purposes only and do not form part of mandatory requirements of this Code of Practice. Verbs such as “should”, “may” and “recommend” are used to indicate that these are recommended practices or advice rather than compliance requirements.

1.1 Construction included

The scope of this Code of Practice is limited to the materials, and processes contained herein, for *buildings* within the scope of section 1.1.1.

1.1.1 Building type

The building type shall be as per the following limitations:

- a) Building use - residential, (housing, communal residential, outbuildings as specified under NZBC Clause A1 Classified uses) with the geometrical limitations of NZS 4229, 1 Scope and Interpretation.
- b) Buildings shall comply with importance levels 1 & 2 of AS/NZS 1170 - Structural Design Actions,
- c) Buildings shall be built on good ground as defined in NZS 4229, but with “liquefaction and lateral spread” added to the list of excluded ground,
- d) The building configuration shall comply with NZS 4229, 1.1.3 except that the total floor area for single storey buildings can be up to 1000m², and
- e) The slope of the finished concrete roof and deck membrane shall be no less than 1.5°.

1.1.2 Walls

This Code of Practice covers three types of concrete walls:

- A. Concrete masonry construction as specified in section 3.2,
- B. Insitu concrete construction as specified in section 3.3, and
- C. Precast concrete construction as specified in section 3.4.

Weathertightness requirements for walls shall be as specified in Table 1 and in section 4.

This Code of Practice also provides weathertightness details for four alternative positions for the wall insulation:

1. On the inner face of the wall, or
2. On the outside face of the wall (EIFS systems), or
3. Integral within the wall itself, or
4. Within a ventilated cavity.

Only the EIFS insulation forms part of the weathertightness system. Insulation in other positions (ie, internal, integral or cavity) is shown for illustrative purposes only and is not part of the weathertightness system.

Thermal insulation is determined from the requirements of NZBC Clause H1 Energy efficiency and Clause E3 Internal moisture, which are outside the scope of this Code of Practice.

The wall construction types shall be designated as:

A1 -	Concrete masonry -	Internal insulation
A2 -	Concrete masonry -	EIFS
A3 -	Concrete masonry -	Integral insulation
A4 -	Concrete masonry -	Masonry veneer
B1 -	Insitu concrete -	Internal insulation
B2 -	Insitu concrete -	EIFS
B3 -	Insitu concrete -	Integral insulation
C1 -	Precast concrete -	Internal insulation
C2 -	Precast concrete -	EIFS, and
C3 -	Precast concrete -	Integral insulation

COMMENT

The word 'system' is used in this Code of Practice to indicate the location of insulation.

Junction details for these wall construction types shall be as specified in section 3 for:

- a) Concrete walls to flat concrete roofs/ decks,
- b) Concrete walls to concrete slab on ground,
- c) Openings and penetrations in concrete walls,
- d) Concrete walls to timber walls, and
- e) Concrete walls to timber roofs.

COMMENT:

Junction details for concrete slab on ground to timber walls are given in NZBC E2/AS1.

1.1.2.1 Wall weathertightness systems

Exterior finishes for wall construction types as specified in section 1.1.2 shall be as shown in Table 1.

Table 1	Section references of acceptable wall weathertightness systems								
Wall type	Weathertightness system								
	EIFS	Plaster systems			Masonry veneer ¹	Coating systems			Weather-tight concrete ³
		Polymer based plaster	Polymer modified cement plaster	3 coat solid plaster		Pigmented standard or elastomeric high build acrylic (≥180µm)	Pigmented acrylic (≥80µm)	Clear coating and/ or impregnation ²	
Masonry Wall Construction Type	4.1	4.2	4.2	4.2	3.2.9 & 4.6	4.3.2	n/a ⁴	4.4	n/a
	A2	A1/ A3	A1/ A3	A1/ A3	A4	A1/ A3		A1/ A3	
Insitu Wall Construction Type	4.1	4.2	4.2	n/a	n/a	4.3	4.3	4.4	4.5
	B2	B1/ B3	B1/ B3			B1/ B3	B1/ B3	B1/ B3	B1/ B3
Precast Wall Construction Type	4.1	4.2	4.2	n/a	n/a	4.3	4.3	4.4	4.5
	C2	C1/ C3	C1/ C3			C1/ C3	C1/ C3	C1/ C3	C1/ C3
NOTES: <ol style="list-style-type: none"> 1. Masonry veneer on concrete masonry construction requires a clear cavity of at least 40 mm. 2. Acceptability of clear coatings and impregnations is specified in section 4.4.2. 3. Weathertight concrete, as specified in section 4.5, will meet NZBC Clause E2 without the need for a coating. 4. n/a stands for not acceptable. 									

1.1.3 Floors

The scope of this Code of Practice limits floors to those that are concrete slabs on ground.

Footings and footing walls and concrete slabs on ground shall comply with NZS 4229 Sections 6 and 7, or be specifically designed by a chartered professional structural engineer.

Weathertightness details for slabs on ground and footings shall be as specified in section 7.

COMMENT:

Suspended floors do not influence the weathertightness system, provided the external wall surface is continuous.

1.1.4 Roofs and decks

The scope of this Code of Practice limits concrete flat roofs and decks to those specified in section 6.

Concrete roofs and decks shall be designed in accordance with AS/NZS 1170 - Structural Design Actions and NZS 3101 - Concrete Structures Standard and constructed in accordance with NZS 3109 - Concrete Construction.

Weathertightness details shall be as specified in section 6.0. Openings and penetrations through concrete roofs (roof exits, gullies) shall be completed in accordance with section 6.10.

NZBC E2/AS1 provides weathertight details for timber roof constructions. These can be used with the wall construction covered by this Code of Practice. Roof junction details at the eaves and verge connections to concrete walls are specified in section 3.0.

1.2 Construction excluded

Further limitations which are specific to construction systems are given in the relevant sections that follow.

1.2.1 Outbuildings

Outbuildings, such as detached garages, are outside the scope of this Code of Practice.

COMMENT:

An attached garage that is integral within the weathertightness envelope of the building is included within the scope of this Code of Practice.

While details contained in this Code of Practice may be used for outbuildings, the requirements may be in excess of the minimum required by the New Zealand Building Code.

1.2.2 Retaining walls

Retaining walls, including those used in a basement, are not covered in this Code of Practice.

COMMENT:

Such walls are subject to a solution based on NZS 4229 or to specific design.

1.3 Provisions for snow

This Code of Practice does not allow for excessive build-up of snow melt water when the open ground snow load S_g , as defined in AS/NZS 1170, exceeds 1.0 kPa.

COMMENT:

Such a situation requires specific design. Hidden gutters, parapets and skylights are examples of features within a roof design that are likely to cause a build-up of snow.

1.4 Qualifications

COMMENT:

An understanding of the proper methods of design and installation and the importance of the correct construction sequence is essential if an NZBC-compliant building is to be achieved. Adequate training of those installing particular products and claddings should be appropriately qualified.

The design, installation and alteration of claddings is 'restricted building work' under the licensed building practitioner's scheme, which took effect in 2012. It is important that product suppliers, manufacturers and New Zealand agents (for imported products) ensure that those handling and applying their products are adequately qualified to do so, and that site managers oversee the correct integration of adjoining building elements to achieve a complete weathertight system.

2 General

2.1 Specific design criteria for weathertightness

Concrete requires weathertight protection comprising either an EIFS, a plaster system, a coating system, a veneer, membranes or to be made of weathertight concrete.

Concrete shall be designed to prevent cracking in service in accordance with NZS 3101 Part 1 section 2.4.4.1(c) and section 2.4.4.8 and NZS 3101 Part 2 section C2.4.4.

COMMENT:

Weathertightness issues will involve not only the concrete and concrete masonry system itself, but also joints and connections with other cladding materials. Acceptable details are shown in this Code of Practice. However, where specialist fixings and flashings form part of the weathertightness envelope, these need supporting documentation or testing to demonstrate compliance with NZBC E2 and are therefore outside the scope of this document.

2.2 Materials

Materials used to construct the building envelope shall:

- a) For concrete and concrete masonry, comply with the durability provisions of NZS 3101 and NZS 4210 respectively, and
- b) Comply with NZBC E2/AS1 Table 20 in respect of their end use, location and environment, and comply with NZBC E2/AS1 Tables 21 and 22 in respect of their compatibility with adjoining materials.
- c) must comply with NZBC B2.
- d) Comply with NZS 3104 - Specification for concrete production

2.3 Maintenance

Maintenance shall be carried out as necessary to achieve the required durability of materials, connections, flashings and other components; particularly at junctions.

COMMENT:

Concrete and plaster are generally regarded as long-life materials traditionally requiring less maintenance than other cladding materials. Nevertheless, regular inspection and maintenance of associated flashings and fixings, weathertight coatings and waterproof membranes needs to be carried out.

2.3.1 Regular maintenance

Regular maintenance of a building shall entail:

- a) Washing exterior surfaces to remove dirt and mould at least once every 365 days to prevent staining,
- b) Inspecting surfaces and junctions at least once every 365 days, and repairing or replacing items as necessary,
- c) Repairing cracks and surface defects, and recoating as necessary,
- d) Inspecting sealants at least once every 365 days for loss of integrity or adhesion with the joint surfaces and replacing sealants as necessary,
- e) Maintaining paint coatings by recoating at least every 10 years,
- f) Inspecting clear sealers at least once every 365 days. Recoat, if necessary, but at least every 5 years, and
- g) Maintaining required clearances (as shown in the details in section 9) between wall claddings and:
 - i) ground surface,

- ii) paving surface,
- iii) deck membranes, and
- iv) roof membranes.

COMMENT:

The frequency of regular maintenance depends on the degree of exposure and the robustness of the building facade system including the integrity of any coating. The maintenance interval for concrete or concrete masonry systems can range from three months to one year.

Washing by rain removes most accumulated atmospheric contaminants, but sheltered areas, such as walls directly below eaves, are protected from the direct effects of rain and require regular manual washing.

Some heavily textured surfaces will not be as effectively washed by rain as smoother surfaces, so may require more regular manual washing. However, it is important that high pressure water is not directed at sensitive junctions such as joinery, window surrounds and flashings. Great care should be taken to avoid water being driven into joints and potentially dislodging seals.

The repair of cracks to concrete and plaster may require specialist advice to ascertain the cause of cracking and the appropriate repair methodology.

3 Wall construction

3.1 General

This Code of Practice is subject to the limitations of section 1.1.2. Wall construction shall comply with the provisions of sections 3.1.1 to 3.1.7 and, depending on the wall type, either section 3.2 or 3.3 or 3.4.

Insitu and precast concrete walls require weathertight protection comprising either an EIFS, a plaster system, a coating system, a cavity veneer system or to be made of weathertight concrete.

Concrete masonry walls require weathertight protection comprising an EIFS, a plaster system, a coating system or a masonry veneer.

A weathertightness system as specified in section 4 shall be used, subject to the limitations of section 1.1.2.1.

The external wall shall be inspected (e.g. visual and touch tests) to ensure concrete surfaces are clean and free of contaminants, eg curing agents, before applying the weathertightness system.

COMMENT:

The detailed drawings (section 9) show alternative positions for insulation, which reflects the different details used in the industry. Only EIFS insulation forms part of the weathertightness system and must be used as specified in section 4.1. Insulation in other positions (i.e. internal, integral or cavity) is shown for illustrative purposes only and is not part of the weathertightness system. The details and associated materials common to all systems which contribute to weathertight performance of the cladding system as a whole are given. Specific floor, wall, window, door, and roof details are also given for each of the three wall construction types.

3.1.1 External seals

COMMENT:

Sealants have an important role in preventing moisture ingress at joints and wall penetrations and openings.

External seals shall have a 2:1 width to depth ratio and shall be:

- a) Compliant with Type F, Class 20LM or 25LM of ISO 11600, or
- b) Low modulus Type II Class A of Federal Specification TT-S-00230C.

The sealant shall be chosen based on:

- i) Suitability for the particular application and environmental exposure,
- ii) The differential movement in the adjoining materials under the extremes of thermal and moisture movement, and
- iii) Compatibility with adjacent materials to which it adheres.

COMMENT:

There are a number of generic types of sealants, and advice should be sought from the manufacturer on the best type for a particular application.

Some sealant types such as acid-cure silicones are not suitable for cement-based alkaline substrates.

Sealants also function as a flexible gap filler for flashings and joinery.

As some sealants have a limited life (typically 15 years maximum) good joint detailing allowing free drainage to the exterior, for instance, will provide some additional back-up protection against water entry.

There shall be no internal air pockets or gaps in the sealant and it shall contact both sides of the joint. The contact surfaces shall be free of contaminants.

PEF backing rods complying with ASTM C1330 are required in addition where specified in the detailed drawings in section 9.

For compression foam tapes see 3.1.8. For baffle joint strips see 3.1.9.

3.1.2 Air seals

Window, door and service penetrations through walls shall be provided with flexible water resistant air seals to minimise the risk of airflows carrying water into the building wall.

The air seal shall be:

- a) Provided between the concrete or concrete masonry opening and the window frame.
and either
- b) Installed over a closed cell polyethylene foam (PEF) backing rod complying with ASTM C1330, and
Made of:
 - i) self-expanding polyurethane foam, or
 - ii) sealant complying with:
 - a. Type F, Class 20LM or 25LM of ISO 11600, or
 - b. Low modulus Type II Class A of Federal Specification TT-S-00230C.
- or
- c) Self-adhesive tape with the following properties:
 - i) Dry Tensile Strength when tested to ASTM D882, $\geq 1.5 \text{ N/m}$
 - ii) Elongation when tested to ASTM D882, $\geq 250\%$
 - iii) Water Vapor Transmission when tested to ASTM E96, $\leq 0.4 \text{ g/24 hr} \times \text{m}^2$
 - iiii) adhesion to last for at least 15 years
 - iv) Air Leakage when tested at 57 Pascal to ASTM E2357, $\leq 0.05 \text{ l/s} \times \text{m}^2$

COMMENT:

Care should be taken when using self-expanding polyurethane foam as there is a danger of over-filling due to the foam expanding by up to 20 times its original volume.

3.1.3 Control joints

This Code of Practice does not allow for horizontal control joints, except for a precast construction joint at eaves level on a gable end, as shown in Details 69d (undrained joint) and Detail 71. Detail 71 shows a drained, horizontal construction joint for precast panel construction.

Vertical control joints shall be provided at a maximum of 6 m centres for all construction types and to the requirements as specified in NZS 4229, section 12.

Control joints shall be positioned and designed to accommodate differential movements in the substrate whilst ensuring that the wall remains weathertight. Joints in the substrate shall be reflected through into the EIFS, plaster or coating.

Control joints shall be detailed as shown in Details 69a to 69f.

Junction Details 18 to 29 and 61a to 68 shall be used where concrete or concrete masonry abuts light-weight construction (i.e. timber frame or steel frame).

3.1.4 Pipes and service penetrations

3.1.4.1 Pipes and cables

Pipes and service penetrations shall be made weathertight by using a sealant on the exterior and interior that is either:

- a) Type F, Class 20LM or 25LM of ISO 11600, or
- b) Low modulus Type II Class A of Federal Specification TT-S-00230C.

Pipes shall slope down to the exterior to facilitate drainage to the outside. Details for flashing pipe services shall be as shown in Details 53 to 56.

Where cables penetrate the weathertightness system, a sleeve or conduit shall be provided and all wires that pass through a conduit shall be sealed into position inside the conduit.

COMMENT:

Service penetrations through the wall should be kept to a minimum. Where practical, service pipes should be taken through the floor.

3.1.5 Windows and doors

Windows and doors shall comply with the requirements of NZS 4211. Window and door openings shall be made weathertight with a waterproof membrane bonded to the concrete before installation. For concrete masonry construction, rebated blocks for heads and jambs and rebated sloped sill blocks for windows shall be used.

Window details specific to particular wall constructions shall be as given in Details 11 to 15. Door details shall be as given in Details 16 and 17.

Windows shall be mechanically fixed. After installation, the flange forming the window or door facing shall have a minimum 10 mm overlap over the surrounding weathertightness system. However, a minimum of 8 mm effective overlap on the sill shall be permitted where necessary to allow for on-site tolerances.

Windows and door openings shall:

- a) Deflect water away from the window/ door to wall joint by overhangs and drip edges in plaster or mouldings,
- b) Allow any water that does get into the window/ door frame to drain back out, generally through the open sill joint along the bottom edge,
- c) Allow air through this unsealed joint to aid drying and equalise air pressures thus minimising water entry, and
- d) Be provided with air seals on the inside edges of openings to restrict the passage of air and moisture through joints.

3.1.5.1 Scope

This Code of Practice limits windows and doors to:

- a) Windows that are fixed hinged (i.e. hinges are fixed to an immovable frame, as compared to a bi-fold or sliding window) or stayed and that have frame sizes of no more than 5000 mm x 5000 mm, and
- b) Doors that are fixed hinged and that have frame sizes of no more than 5000 mm x 5000 mm.

COMMENT:

Certain aluminium joinery sections (bi-fold and sliding doors and windows) will not be able to use the sill details included in this Code of Practice and achieve the required window facing cover and sill support with a sill tray. The sill details in these cases should be subject to specific design.

3.1.5.2 Weathertight treatment of openings

A waterproof membrane as specified in section 3.1.5.3 shall be applied around the head and the jambs of the window opening as shown in Details 11a to 15b.

A waterproof membrane as specified in section 3.1.5.4 shall be applied across the entire sill and shall be extended up the jambs for at least 40 mm or to manufacturer's requirements, whichever is greater.

COMMENT:

The waterproof membrane and weatherproof coatings carry out a critical role in preventing the entry of moisture through the opening into the building.

3.1.5.3 Jamb/ head membrane

The head and jamb membrane shall consist of a liquid membrane or elastomeric paint that complies with AS/NZS 4858.

3.1.5.4 Sill membrane

The sill membrane shall consist either of:

- a) A liquid membrane that complies with AS/NZS 4858 or test methods of AS/NZS 4201 or ASTM E96, or
- b) A bonded sheet membrane that complies with AS/NZS 4858 or test methods of AS/NZS 4201 or ASTM E96, or
- c) A flashing tape which complies with ICC Acceptance Criteria AC148 sections 3.2 and 4, which is compatible with the concrete substrate and finish, and which is applied to primed concrete surfaces.

Sills shall be made weathertight by applying the sill membrane continuously across the concrete sill for the entire opening width of the window.

3.1.5.5 Integrated sills

If the sill forms an integral part of the window manufacturer's system installation shall be in accordance with the manufacturer's instructions. The window and window sill system used, must be certified under the CodeMark New Zealand product certification scheme.

3.1.6 Flashings

Flashings shall comply with section 5.0.

Profiled metal roof flashings shall be provided at the apron on a sloped roof as shown in Details 18 to 21 and shall run up beneath the metal over-flashing or compression seal. Over-flashings shall be chased and sealed into the wall with a sealant complying with section 3.1.1.

COMMENT:

A metal capping may be used to cap a parapet (see Details 31, 34a & b, 36a & b and 38) and should be clipped to a proprietary metal bracket.

3.1.7 Fixings

The attachment of fixings shall be designed so as not to compromise the integrity of the weathertightness system. Attachment of fixings into horizontal or inclined surfaces shall be avoided. The use of a metal over-flashing will provide additional weathertightness protection.

3.1.8 Compression foam tapes

Compression foam tapes shall comply with AS/NZS 4284:2008 Testing of building facades and with the test method to ASTM G53-84 - Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials. The tested material shall pass the accelerated QUV weatherometer aging test for a period of 3,000 hours in accordance with the ASTM G53-84.

3.1.9 Baffle seal strips

Baffle seal strips for drained precast concrete panel joints shall be at least 85 mm wide and consist of neoprene rubber. The material's tensile strength shall be ≥ 7 MPa and elongation at break ≥ 300 % when tested to ASTM D412 with a tear propagation resistance of ≥ 20 N/mm when tested to ASTM D642 and Shore A hardness of 65 ± 5 when tested to ASTM D2240.

3.2 Concrete masonry wall construction

3.2.1 Design criteria

Concrete masonry walls shall be fully or partially filled.

Concrete masonry walls, including concrete masonry veneer walls, shall comply with NZS 4229 and NZS 4210. Cover requirements for reinforcement shall be as specified in NZS 4210 Appendix 2E.

3.2.2 Materials

Concrete masonry materials including blocks, grout and mortar shall comply with NZS 4210 and AS/NZS 4455.1.

3.2.3 Substrate finish

All maximum tolerances shall be in strict accordance with NZS 4210, 2.7.1.4 Table 2.2; i.e. no more than 3 mm surface alignment deviation over a 1200 mm radius.

The inter-storey floors should be poured within the block structure, leaving the outer block shell continuous (i.e. over the concrete slab edge) to avoid cracking in the exterior face of the wall.

The moisture content of the wall including joints shall be below 70% relative humidity before applying the weathertight system. If the product manufacturer specifies a lower maximum relative humidity percentage than this is to ensure their product fulfills the weathertightness requirements, the moisture content of the wall including joints shall be equal or below that lower percentage.

COMMENT:

The concrete block installation, including reinforcement and concrete infill, must follow the project specifications and the block manufacturer's technical data. In particular, the blocks must be laid true in both vertical and horizontal planes with all joinery and service openings correctly formed and waterproofed.

3.2.4 Mortar joints

COMMENT:

The mortar quality and workmanship are important to the weathertight performance of concrete masonry.

Mortar depth of horizontal and vertical joints shall be the full thickness of the face shell.

COMMENT:

Face shell describes the thickness of the shell of the masonry block.

Mortar shall meet the requirements of NZS 4210 and shall achieve a compressive strength of 12.5 MPa. Mortar joints shall be compressed by tooling in accordance with NZS 4210 and Detail 70. The mortar joint shall be tooled after the initial water loss, once the mortar is thumbnail hard. The depth of the vertical mortar joint shall match that of the horizontal joints.

COMMENT:

Flush joints may be used where plaster or EIFS is to be applied to the concrete masonry, but they should still be tooled first.

3.2.5 Grouting

The masonry block cells and cavities shall be cleaned to remove mortar droppings and debris from the joints before grouting.

Grouting shall comply with the requirements of NZS 4210.

Grout filling shall be in accordance with NZS 4210 clause 2.11.6(b) using one of the three methods described.

COMMENT:

NZS 4210 requires the grout to have a spread of 450 mm to 530 mm and a minimum specified strength of either:

- a) 25 MPa at 28 days for buildings located in the NZS 3604 Zone D (exposure zone), or
- b) 17.5 MPa at 28 days in all other cases.

3.2.6 Control joints

Vertical control joints in concrete masonry shall comply with NZS 4229 section 12.

COMMENT:

Typical weatherproofing details of control joints are shown in Detail 69a & b.

NZS 4229, section 12 requires control joints to be spaced no further apart than 6 m.

The use of horizontal control joints is outside the scope of this Code of Practice.

3.2.7 Construction type A1 and A3 - Concrete masonry wall construction - internal insulation and integral insulation

Details in sections 3.2.7.1 to 3.2.7.3 shall be used for concrete masonry wall construction types A1 and A3.

COMMENT:

The details referred to in the following text have been drawn based on concrete masonry wall construction with internal insulation. The details for concrete masonry wall construction with integral insulation are similar except that the position of the insulation is moved into the masonry block wall.

3.2.7.1 Footing detail

Footings shall be constructed as shown in Detail 3a, b, c and d: Wall/ Footing Junction - Slab on ground. These details include a 45 mm – 100 mm deep rebate (100 mm represents a half-block height) below finished floor concrete slab level to take the base block of the wall. Rebates shall be provided as specified in Table 2.

COMMENT:

The inclusion of a rebate is as an additional weatherproofing measure to reduce the risk of water entry to floor level.

Table 2	Concrete masonry ground floor rebate requirement				
Building type	Concrete masonry weathertightness systems				
	EIFS (section 4.1)	Plaster system (section 4.2)	Masonry veneer (section 4.6)	Clear sealer (section 4.4)	Pigmented standard or elastomeric high build acrylic ($\geq 180\mu\text{m}$) (section 4.3.2)
Non-residential	NR	NR	NR	NR	NR
Residential: Fully filled block wall	NR	NR	NR	R	NR
Residential: Partially filled block wall	NR	R	NR	R	R
KEY: R = Rebate required NR = No rebate required					

COMMENT: It is acceptable to provide a rebate also where Table 2 says NR (no rebate): it is just not mandatory.

3.2.7.2 Wall details

Detail 8	-	Masonry Wall/ Upper Floor Slab Junction
Detail 13	-	Window - Head, Sill, Jamb
Detail 44	-	Roof/Deck at Wall Junction
Detail 54	-	Wall Penetration
Detail 62a & b	-	Masonry Wall adjoining other Wall Type
Detail 66	-	Masonry Wall/ Timber Wall Upper Floor Junction
Detail 70	-	Mortar Joints

3.2.7.3 Roof details

Detail 19	-	Wall/ Pitched Roof - Apron Junction
Detail 23	-	Wall/ Pitched Roof - Eaves Junction
Detail 27	-	Wall/ Pitched Roof - Verge Detail
Details 34a	-	Parapet

3.2.8 Construction type A2 - Concrete masonry wall construction - external insulation - EIFS

Details in sections 3.2.8.1 to 3.2.8.3 shall be used for concrete masonry wall construction type A2.

COMMENT:

A description of EIFS is given in section 4.1.

3.2.8.1 Footing detail

Details 1a, 1b	-	Wall/ Footing Junction - Slab on Ground
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3.2.8.2 Wall details

Detail 7	-	Wall/ Upper Floor Slab Junction
Detail 11	-	Window - Head, Sill, Jamb
Details 43, 47	-	Roof/Deck at Wall Junction
Detail 53	-	Wall Penetration
Detail 61a & b	-	Masonry Wall adjoining other Wall Type
Detail 65	-	Masonry Wall/ Timber Wall Upper Floor Junction

3.2.8.3 Roof details

Detail 18	-	Wall/ Pitched Roof - Apron Junction
Detail 22	-	Wall/ Pitched Roof - Eaves Junction
Detail 26	-	Wall/ Pitched Roof - Verge Junction
Details 31, 33	-	Parapet

3.2.9 Construction type A4 - Masonry veneer on drained cavity concrete masonry wall construction

Details in sections 3.2.9.7 to 3.2.9.9 shall be used for concrete masonry wall construction type A4.

3.2.9.1 Limitations

This Code of Practice limits veneer construction to masonry veneer tied to concrete masonry construction with a minimum clear ventilated cavity of 40 mm.

COMMENT:

The use of natural stone bricks or blocks as a masonry veneer is outside the scope of this Code of Practice and may require specific design.

3.2.9.2 General

Masonry veneer construction with a minimum 40 mm clear ventilated cavity is deemed to be weathertight when constructed in accordance with SNZ HB 4236. Insulation used in a drained cavity shall resist absorbing moisture. The water absorption, measured in accordance with ASTM D2842, shall be equal to or less than 2.5% by volume.

COMMENT:

Brick or block-layers recognised under the licensed building practitioners scheme are required for the installation of masonry veneer.

3.2.9.3 Installation

Masonry veneer on concrete masonry walls, of the types specified in section 3.2.9.1, shall:

- Be installed in accordance with SNZ HB 4236,
- Have masonry veneer cavities that are ventilated at both the top and the bottom and drained from the bottom as detailed in SNZ HB 4236,
- Have control joints in accordance with section 3.2.9.4, and
- Comply with section 4.6

COMMENT:

A waterproofing membrane applied to the cavity side of the structural wall may enhance the lifetime of the building; however, it is not required to achieving a weathertight envelope.

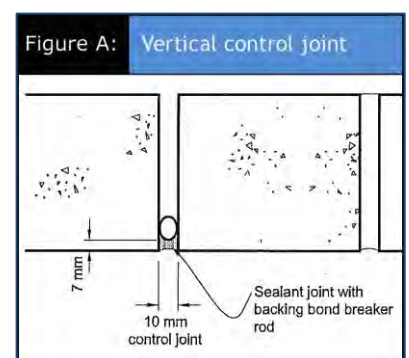
3.2.9.4 Control joints

Control joints shall be formed as shown in Figure A and using an external seal as specified in section 3.1.1.

Control joints in clay brick veneers shall be included at locations specified by the brick manufacturer. Control joints in concrete brick veneers shall be included as specified in the New Zealand Concrete Masonry Manual and in any other locations specified by the manufacturer.

COMMENT:

Cracks are cosmetic and not likely to cause a moisture problem because of the presence of the cavity. Manufacturers can provide additional information on control joints.



3.2.9.5 Windows and doors

Window details for masonry veneer shall be constructed as shown in Detail 15. Openings shall be as specified in section 3.1.5.2.

3.2.9.6 Ground clearances, ventilation and drainage of veneer

Clearances to ground levels at the bottom of masonry veneer shall be in accordance with Detail 6.

Vents shall be installed at the top, and drain holes provided at 1000 mm²/m through the bottom bed joint of the masonry veneer in accordance with SNZ HB 4236 and NZS 3604.

3.2.9.7 Footing detail

Detail 6 - Masonry Veneer Wall/ Footing Junction - Slab on ground

3.2.9.8 Wall details

Detail 10 - Masonry Veneer Wall/ Upper Floor Slab
 Detail 15b - Window - Head, Sill, Jamb
 Details 46, 50 - Roof/Deck at Masonry Veneer Wall Junction
 Detail 56 - Masonry Veneer Wall Penetration
 Detail 64 - Masonry Veneer Wall adjoining other Wall Type
 Detail 68 - Masonry Veneer Wall/ Timber Wall Upper Floor Junction

3.2.9.9 Roof details

Detail 21 - Masonry Veneer Wall/ Pitched Roof - Apron Junction
 Detail 25 - Masonry Veneer Wall/ Pitched Roof - Eaves Junction
 Detail 29 - Masonry Veneer Wall/ Pitched Roof - Verge Junction
 Detail 38 - Parapet

3.3 Insitu concrete wall construction

3.3.1 Design criteria

Insitu concrete construction shall be designed in accordance with AS/NZS 1170, NZS 3101 and section 2.1 of this Code of Practice, and constructed in accordance with NZS 3109.

3.3.2 Materials

All concrete shall be produced in accordance with NZS 3104 and:

- a) Weathertight concrete shall comply with section 4.5, and
- b) All other concrete shall comply with NZS 3104 for 'normal concrete' and shall have a minimum specified 28 day concrete strength of 25 MPa.

Concrete shall either be certified by the Concrete New Zealand Plant Audit Scheme or by a Chartered Professional Engineer confirming the concrete complies with NZS 3104.

Reinforcement shall comply with AS/NZS 4671. The reinforcement cover shall comply with NZS 3101 section 3 to meet NZBC B2 durability provisions.

3.3.3 Substrate finish

The exterior face of the concrete wall shall:

- a) For EIFS and plaster systems as specified in sections 4.1 and 4.2, be finished to a minimum F4 standard in accordance with NZS 3114, and
- b) For coating and clear sealer systems as specified in sections 4.3 and 4.4, be finished to a minimum F5 standard in accordance with NZS 3114.

At least 28 days shall be allowed after concrete placement as per AS/NZS 2311 for curing and stabilisation to take place before commencing the weathertight system. The moisture content of the wall shall be below 70% relative humidity before applying the weathertight system. If the product manufacturer specifies a lower maximum relative humidity percentage than this is to ensure their product fulfills the weathertightness requirements, the moisture content of the wall including joints shall be equal or below that lower percentage.

The substrate design needs to detail adequate reinforcement to prevent cracking in service.

COMMENT:

Particular attention should be paid to vibration and curing in and around edges of the wall.
A comprehensive reference guide, New Zealand Guide to Concrete Construction, is available from www.cnz.org.nz.
It is important that all insitu concrete work has close quality control.

3.3.4 Control joints

Vertical control joints shall be placed at a maximum of 6 m centres as shown in Details 69e & 69f.

3.3.5 Construction type B1 - Insitu concrete wall construction - internal insulation

Details in sections 3.3.5.1 to 3.3.5.3 shall be used for insitu concrete wall construction type B1.

3.3.5.1 Footing detail

Detail 4 - Wall/ Footing Junction - Slab on ground

3.3.5.2 Wall details

Detail 8 - Wall/ Upper Floor Slab
 Detail 13 - Window - Head, Sill, Jamb
 Details 44, 48 - Roof/Deck at Wall Junction
 Detail 54 - Wall Penetration
 Detail 62a & b - Concrete Wall adjoining other Wall Type
 Detail 66 - Concrete Wall/Timber Wall Upper Floor Junction

3.3.5.3 Roof details

Detail 19 - Wall/ Pitched Roof - Apron Junction
 Detail 23 - Wall/ Pitched Roof - Eaves Junction
 Detail 27 - Wall/ Pitched Roof - Verge Junction
 Details 34a - Parapet

3.3.6 Construction type B2 - Insitu concrete wall construction - external insulation - EIFS

Details in sections 3.3.6.1 to 3.3.6.3 shall be used for insitu concrete wall construction type B2.

3.3.6.1 Footing detail

Details 1a, 1b and 2 - Wall/ Footing Junction - Slab on ground

3.3.6.2 Wall details

Detail 7 - Wall/ Upper Floor Slab Junction
 Detail 11a - Window - Head, Sill, Jamb
 Details 43, 47 - Roof/Deck at Wall Junction
 Detail 53 - Wall Penetration
 Detail 61a & b - Concrete Wall adjoining other Wall junction
 Detail 65 - Concrete Wall/ Timber Wall Upper Floor Junction

3.3.6.3 Roof details

Detail 18 - Wall/ Pitched Roof - Apron Junction
 Detail 22 - Wall/ Pitched Roof - Eaves Junction
 Detail 26 - Wall/ Pitched Roof - Verge Junction
 Details 31, 33 - Parapet

3.3.7 Construction type B3 - Insitu concrete wall construction - integral insulation

Details in sections 3.3.7.1 to 3.3.7.3 shall be used for insitu concrete wall construction type B3.

3.3.7.1 Footing detail

Detail 5 - Wall/ Footing Junction - Slab on ground

3.3.7.2 Wall details

Detail 9 - Wall/ Upper Floor Slab Junction
 Detail 14 - Window - Head, Sill, Jamb
 Details 45, 49 - Roof/Deck at Wall Junction
 Detail 55 - Wall Penetration
 Detail 63 - Concrete Wall adjoining other Wall Type
 Detail 67 - Concrete Wall/ Timber Wall Upper Floor Junction

3.3.7.3 Roof details

Detail 20 - Wall/ Pitched Roof - Apron Junction
 Detail 24 - Wall/ Pitched Roof - Eaves Junction
 Detail 28 - Wall/ Pitched Roof - Verge Junction
 Details 36a - Parapet

3.4 Precast concrete wall construction

COMMENT:

Panels with integral insulation may also be called composite panel construction or sandwich panel construction.

3.4.1 Design criteria

Precast concrete walls shall be designed in accordance with AS/NZS 1170, NZS 3101 and section 2.1 of this Code of Practice, and constructed in accordance with NZS 3109.

COMMENT:

The construction of concrete walls to provide weathertightness requires close quality control. Particular attention should be paid to vibration and curing in and around edges of the panel, to ensure that the joints are sound for adherence of the sealant.

3.4.2 Materials

All concrete shall be produced in accordance with NZS 3104 and:

- a) Weathertight concrete shall comply with section 4.5
- b) All other concrete shall comply with NZS 3104 for 'normal concrete' and shall have a minimum specified 28 day concrete strength of 25 MPa.

Concrete shall either be certified by the Concrete New Zealand Plant Audit Scheme or by a Chartered Professional Engineer confirming the concrete complies with NZS 3104.

Reinforcement shall comply with AS/NZS 4671. The reinforcement cover shall comply with NZS 3101 section 3 to meet NZBC B2 durability provisions.

3.4.3 Substrate finish

The exterior face of the concrete wall shall:

- a) For EIFS and plaster systems as specified in sections 4.1 and 4.2, be finished to a minimum F4 standard in accordance with NZS 3114, and
- b) For coating and clear sealer systems as specified in sections 4.3 and 4.4, be finished to a minimum F5 standard in accordance with NZS 3114.

At least 28 days shall be allowed after concrete placement as per AS/NZS 2311 for curing and stabilization to take place before commencing the weathertight system. The moisture content of the wall shall be below 70% relative humidity before applying the weathertight system.

The substrate design needs to detail adequate reinforcement to prevent cracking in service.

3.4.4 Control joints

Control joints shall be placed at a maximum of 6 m centres as shown in Details 69a, c & d.

3.4.5 Construction type C1 - Precast concrete wall construction - internal insulation

Details in sections 3.4.5.1 to 3.4.5.4 shall be used for precast concrete wall construction type C1.

3.4.5.1 Footing detail

Detail 4 - Wall/ Footing Junction - Slab on ground

3.4.5.2 Wall details

Detail 8 - Wall/ Upper Floor Slab Junction
 Detail 13 - Window - Head, Sill, Jamb
 Detail 44 - Roof/Deck at Wall Junction
 Detail 54 - Wall Penetration
 Detail 62a & b - Concrete Wall adjoining other Wall Type
 Detail 66 - Concrete Wall/ Timber Wall Upper Floor Junction

3.4.5.3 Roof details

Detail 19 - Wall/ Pitched Roof - Apron Junction
 Detail 23 - Wall/ Pitched Roof - Eaves junction
 Detail 27 - Wall/ Pitched Roof - Verge Junction
 Details 34 - Parapet

3.4.5.4 Precast panel to panel joints

Detail 69b - Vertical control joint; plastered wall, horizontal section
 Detail 69c - Vertical control joint; precast wall, horizontal section
 Detail 69d - Horizontal panel joint; precast wall, vertical section
 Detail 71 - Horizontal panel joint; precast wall, vertical section

3.4.6 Construction type C2 - Precast concrete wall construction - external insulation - EIFS

Details in sections 3.4.6.1 to 3.4.6.3 shall be used for precast concrete wall construction type C2.

3.4.6.1 Footing detail

Detail 2 - Wall/ Footing Junction - Slab on ground

3.4.6.2 Wall details

Detail 7 - Wall/ Upper Floor Slab Junction
 Detail 11a - Window - Head, Sill, Jamb
 Details 43, 47 - Roof/Deck at Wall Junction
 Detail 53 - Wall Penetration
 Detail 61a & b - Concrete Wall adjoining other Wall Type
 Detail 65 - Wall/ Timber Wall Upper Floor Junction

3.4.6.3 Roof details

Detail 18 - Wall/ Pitched Roof - Apron Junction
 Detail 22 - Wall/ Pitched Roof - Eaves Junction
 Detail 26 - Wall/ Pitched Roof - Verge Junction
 Details 31, 33 - Parapet

3.4.7 Construction type C3 - Precast concrete wall construction - integral insulation

Details in sections 3.4.7.1 to 3.4.7.3 shall be used for precast concrete wall construction type C3.

3.4.7.1 Footing detail

Detail 5 - Wall/ Footing Junction - Slab on ground

3.4.7.2 Wall details

Detail 9 - Wall/ Upper Floor Slab
 Detail 14 - Window - Head, Sill, Jamb
 Details 45, 49 - Roof/Deck at Wall Junction
 Detail 55 - Wall Penetration
 Detail 63 - Wall adjoining other Wall Type
 Detail 67 - Wall/ Timber Wall Upper Floor Junction

3.4.7.3 Roof details

Detail 20 - Wall/ Pitched Roof - Apron Junction
 Detail 24 - Wall/ Pitched Roof - Eaves Junction
 Detail 28 - Wall/ Pitched Roof - Verge Junction
 Details 36a, 36b - Parapet

4 Wall weathertightness systems

This section provides specifications for the following weathertightness systems:

1. EIFS (Exterior Insulation and Finish System) (section 4.1),
2. Plaster system (section 4.2),
3. Pigmented coating system (section 4.3),
4. Clear coating and clear impregnation systems (section 4.4),
5. Weathertight concrete (section 4.5), and
6. Masonry veneer (section 4.6).

4.1 EIFS system – external insulation

This section specifies Exterior Insulation and Finish Systems (EIFS) applied directly to either:

- a) A Concrete Masonry Wall type A2, or
- b) An Insitu Concrete Wall type B2, or
- c) A Precast Concrete Wall type C2.

4.1.1 Limitations

EIFS shall be:

- a) The EIFS system supplier is to have supporting documentation, a BRANZ Appraisal or a Code Mark certificate to demonstrate that the system meets the requirements of NZBC E2
- b) Supplied by a single supplier who takes responsibility for the system as a whole encompassing the durability, weathertight detailing and overall weathertightness, and
- c) Not fixed:
 - i) so as to form a horizontal surface, or
 - ii) in such a way as to allow water to pond.

4.1.2 General

Installation and finishing of EIFS must be carried out by a licensed building practitioner and shall be approved by the New Zealand supplier of the system.:

4.1.3 Materials

EIFS shall comprise:

- a) A polystyrene rigid insulation board complying with 4.1.3.1,
- b) A polymer-modified cement-based base plaster or a polymer-based base plaster complying with 4.1.3.3, reinforced with fibreglass mesh complying with 4.1.3.2, and
- c) A polymer-modified cement finishing plaster system or polymer-based finishing plaster system in one or more coats complying with 4.1.3.4.

4.1.3.1 Polystyrene board

Polystyrene boards shall be either:

- a) Expanded polystyrene (EPS) complying with AS 1366: Part 3, Class H or Class S, or
- b) Extruded polystyrene (XPS) that complies with AS 1366: Part 4

COMMENT:

The minimum board thickness will be determined by structural and thermal requirements.
For some EIFS, polystyrene boards are available with the base coat plaster factory-applied.

The polystyrene boards shall be mechanically fixed to the requirements of the system at no greater than 600 mm centres and adhered to the wall using a cement-based mineral adhesive coat, achieving 100 kPa when tested for bond strength between polystyrene and concrete or masonry substrate, in accordance with ASTM E2134-01(2006).

The concrete or masonry wall shall be free of contaminants prior to application of the adhesive.

4.1.3.2 Fibreglass reinforcing mesh

The entire exterior surface of the polystyrene sheet (including corners) shall be continuously reinforced with an alkali-resistant fibreglass mesh, which shall:

- a) Weigh no less than 150 grams per m²,
- b) Have an aperture size from a minimum 3 mm x 3 mm to a maximum of 6 mm x 6 mm square,
- c) Comply with the requirements of EIMA 101.91 test No. 6.3 and ASTM E2098,
- d) Be tested for alkali resistance by 28 days immersion in 5% sodium hydroxide with no visual degradation at the end of the test, and
- e) Overlap at mesh to mesh joints for at least 75 mm.

4.1.3.3 Base coat plaster

The base coat plaster shall:

- a) Be at least 3 mm thick and form a flat plane surface and be either:
 - i) polymer-modified cement-based plaster, or
 - ii) polymer based plaster,
- b) Be reinforced with an alkali-resistant fibreglass mesh as specified in section 4.1.3.2,
- c) Cover the mesh by at least 1.0 mm,
- d) Be applied out of direct sunlight at temperatures between 5°C and 30°C, and with the expectation that the temperature will be within that range for the following 24 hours, or as required by the product manufacturer and
- e) Have bond strength with the polystyrene board tested in accordance with ASTM E2134-01.

4.1.3.4 Finish coat

The finish coat shall comprise either:

- a) A polymer-modified cement-based plaster or a polymer-based plaster, finished in both cases with a paint coating, or
- b) Either a pre-coloured, polymer-modified, cement-based plaster, or a pre-coloured, polymer-based plaster with the top coat applied as a decorative plaster that is sealed or glazed.

Finish colours for EIFS shall have a reflectivity of 25% or more when measured in accordance with ASTM C1549 or ASTM E903.

COMMENT:

Dark colours cause finishes to reach higher temperatures, which results in more thermal expansion and a greater risk of cracking. Coating manufacturers can supply reflectance values.

4.1.3.5 Openings and penetrations

- a) All window/ door openings shall have waterproof membranes as specified in section 3.1.5.2,
- b) All wall recesses shall have waterproof membranes as specified in section 3.1.5.2,
- c) All window/ door openings, wall recesses and penetrations shall have sealant, or air seals as detailed in sections 3.1.1 to 3.1.2, and
- d) Openings and penetrations in EIFS shall be completed as shown in Details 11, 53, 57a & 57b.

COMMENT:

This is the minimum standard. Additional elements required by the system supplier should not be excluded on the basis of this Code of Practice.

4.1.3.6 Decorative mouldings

Decorative mouldings formed from polystyrene shall be glued onto the base coat plaster and, in addition, meshed on at the top edge. The adhesive bond strength shall be tested in accordance with ASTM E2134-01(2006). Control joints shall be reflected through the mouldings.

COMMENT:

Decorative mouldings formed from other materials are available. However, due to the unknown weight and rigidity of these mouldings, specific design of the fixing is required.

4.1.4 Movement joints

Movement joints shall be provided to coincide with the control joints in the masonry or concrete substrate. The joint shall be 8 mm to 15 mm wide as shown in Detail 69a.

The front of the joint shall use either a sealant as specified in section 3.1.1 or an EIFS joint profile as per Detail 69a. The sealant shall have a width to depth ratio of 2:1.

At junctions between concrete walls and timber or metal frame walls, a control joint and back flashing as shown in Details 61a to 64 shall be provided.

4.1.5 EIFS/ floor slab junction

The bottom of the EIFS shall run at least 100 mm into ground as shown in Details 1 and 2 and shall incorporate a waterproofing capillary break in the insulation.

The capillary break shall be formed by a continuous cut through the insulation board. The bottom section of the insulation board shall be made watertight by applying a membrane as specified in section 4.2.3 and as shown in Details 1 and 2.

4.1.6 Parapets and balustrades

Parapets and balustrades shall comply with section 6.11.

Balustrades shall use the same weathertightness details and specifications as for parapets.

4.1.7 Fixings

Fixings of downpipes brackets, garden taps and other outside fittings shall be in accordance with NZBC E2/AS1 Paragraph 9.9.4.4.

Designs of fixing brackets for connecting items carrying substantial loads such as stringers for decks are outside the scope of this Code of Practice and will require specific design.

4.2 Plaster system

This section specifies plaster systems applied directly to either:

- a) A Concrete Masonry Wall type A1 or A3 (internal or integral insulation), or
- b) An Insitu Concrete Wall type B1 or B3 (internal or integral insulation), or
- c) A Precast Concrete Wall type C1 or C3 (internal or integral insulation).

The exterior plaster system shall comprise a combination of plaster layers as specified in Table 3 and as detailed in section 4.2.1. All layers specified for a given option shall be used.

The substrate shall be free of contaminants prior to the application of the base coat. Plaster shall be applied out of direct sunlight at temperatures between 5°C and 30°C, with the expectation that the temperature will be within that range for the following 24 hours.

Table 3	Acceptable weathertight plaster systems								
Wall type	Plaster type								
	A	B	C	D	E	F	G	H	I
B1, B3, C1, C3	•			•					
B1, B3, C1, C3	•					•			
B1, B3, C1, C3		•			•				
B1, B3, C1, C3		•					•		
B1, B3, C1, C3			•					•	
A1, A3	•			•					
A1, A3	•					•			
A1, A3		•			•				
A1, A3		•					•		
A1, A3			•					•	
A1, A3									•

4.2.1 Plaster types

The plaster types to be used as specified in section 4.2 and the associated Table 3 shall be as follows.

Type A:

Polymer based plaster base coat comprising:

- i) Plaster of at least 3 mm thickness to form a flat plane surface,
- ii) Reinforcing with an alkali-resistant fibreglass mesh as specified in section 4.1.3.2,
- iii) Cover to the mesh of at least 1.0 mm of plaster, and
- iv) A minimum bond strength of 0.1 MPa to the concrete or concrete masonry substrate.

Type B:

Polymer modified cement-based plaster base coat comprising:

- i) Plaster of at least 3 mm thickness to form a flat plane surface,
- ii) Reinforcing with an alkali-resistant fibreglass mesh as specified in section 4.1.3.2,
- iii) Cover to the mesh of at least 1.0 mm of plaster, and
- iv) A minimum bond strength of 0.1 MPa to the concrete or concrete masonry substrate.

Type C:

Solid plaster base coat comprising:

- i) Bond or scratch coat 3 mm to 4 mm thick, reinforced with an alkali-resistant fibreglass mesh as specified in section 4.1.3.2, and
- ii) Flanking coat 9 mm to 15 mm thick in accordance with NZS 4251.

Type D:

Polymer based plaster finish coat with a standard acrylic coating of no less than 80 µm Dry Film Thickness.

Type E:

Polymer modified cement-based plaster finish coat with a standard acrylic coating of no less than 80 µm Dry Film Thickness.

Type F:

Pre-coloured polymer based plaster finish coat with a clear coat as specified in section 4.4 and with a permeability of less than 3 mm/hr.

Type G:

Pre-coloured polymer modified cement-based plaster finish coat with a clear coat as specified in section 4.4 and with a permeability of less than 3 mm/hr.

Type H:

Solid plaster finish coat, 2 mm to 3 mm thick, applied and finished in accordance with NZS 4251.

Type I:

Three coat cement-based solid plaster in accordance with NZS 4251 Section 3: Plaster system for concrete masonry walls applied and finished in accordance with NZS 4251.

4.2.2 Movement control joints

Control joints shall be provided to coincide with the control joints in the masonry or concrete substrate. The joint shall be 8 mm to 20 mm wide as shown in Detail 69b. The sealant, as specified in section 3.1.1, shall have a width: depth ratio of 2:1.

4.2.3 Membrane for plaster

An additional layer of waterproofing shall be applied to:

- a) Window and door openings as per Details 11 and 12,
- b) Footings and wall to ground junctions as per Details 1, 2, 3a, 3b, 3c, 3d, 4, and 5, and
- c) Parapets as per Details 32 and 33.

The waterproofing membrane for plaster shall consist of a reinforced liquid membrane that complies with AS/NZS 4858 and which is suitable for the application of plaster.

4.3 Pigmented coating system

This section specifies pigmented coating systems applied directly to either:

- a) A Concrete Masonry Wall type A1 or A3, or
- b) An Insitu Concrete Wall type B1 or B3, or
- c) A Precast Concrete Wall type C1 or C3.

Concrete walls shall be sufficiently dry to give a relative humidity reading of less than 70% at the time of coating application.

The substrate shall be free of contaminants prior to the application of the coating system.

COMMENT:

If a release agent has been used, make sure that no contaminants remain on the concrete surface.

Coating shall be applied out of direct sunlight and at temperatures between 5°C and 30°C, with the expectation that the temperature will be in that range for the following 12 hours. Coating shall not be applied in damp conditions.

4.3.1 Pigmented acrylic coating

Pigmented acrylic coatings for exterior use shall have a dry film thickness (DFT) of at least 80 µm. No less than two coats at 40 µm DFT per coat shall be applied.

Pigmented acrylic coatings shall not be applied to concrete masonry walls.

COMMENT:

Pigmented acrylic coatings are suitable for concrete precast and concrete insitu walls.

4.3.2 Pigmented standard or elastomeric acrylic coating

Pigmented standard or elastomeric acrylic coatings for exterior use shall have a dry film thickness (DFT) of at least 180 µm. No less than two coats at 90 µm DFT per coat shall be applied.

COMMENT:

Pigmented standard or elastomeric acrylic coatings are suitable for concrete masonry walls, concrete precast and concrete insitu walls.

4.4 Clear coating and clear impregnation systems

This section specifies clear coating and clear impregnation systems applied directly to either:

- a) A Concrete Masonry Wall type A1 or A3, or
- b) An Insitu Concrete Wall type B1 or B3, or
- c) A Precast Concrete Wall type C1 or C3.

Clear coating and clear impregnation systems complying with section 4.4.2 or 4.4.3 are weathertight.

The system shall be supplied by a single, responsibility for the system as a whole, encompassing the weathertight application shall be taken by the applicator.

Clear coating and clear impregnation systems are to be reapplied every five years at a minimum or in accordance with the manufacturer's specifications.

The clear coating or clear impregnation system shall be designed to prevent water ingress into the pores of the concrete or masonry. The system shall allow the passage of water vapour from the interior to the exterior.

COMMENT:

Clear weathertightness applications do not always have the flexible film-forming ability that acrylic coatings have. Therefore they require a strict maintenance regime and need recoating at shorter intervals. For a clear coating system the re coating times could be set by the coating supplier as some systems may be designed to have a performance varying from the 5 year requirement.

4.4.1 Permeability test

Clear coating and clear impregnation systems shall be tested for permeability in accordance with AS/NZS 4456.16 except as modified in the following requirements:

- a) Standard masonry blocks shall be received and stored for 48 hours in a $20 \pm 3^{\circ}\text{C}$ protected environment prior to the coating or impregnation being applied.
- b) The moisture content using a humidity meter shall be measured and recorded and shall be less than 75% before applying the coating.
- c) The coating or impregnation shall be applied to the masonry block in a vertical position in accordance with the manufacturer's specifications and methods and allowed to cure.
- d) On completion of curing, the block shall be directly placed in the AS/NZS 4456.16 test rig and testing shall then proceed as stipulated by the test method.

The minimum test period shall be two hours.

4.4.2 Acceptable clear coatings

Clear coatings for insitu and precast concrete walls shall have a permeability of 3 mm/hr or less when tested in accordance with section 4.4.1.

Clear coatings for concrete masonry walls shall have:

- a) A permeability of 1 mm/hr or less when tested in accordance with section 4.4.1, or
- b) A permeability of 3 mm/hr or less when tested in accordance with section 4.4.1 if the wall is constructed of low permeability blocks. Low permeability blocks shall have a permeability of less than 10 mm/hr when tested in accordance with section 4.4.1.

If the block permeability is unknown, the worst-case scenario shall be considered.

4.4.3 Acceptable clear impregnations

Clear impregnations for insitu and precast concrete walls shall comply with EN 1504 Part 2.

4.5 Weathertight concrete

This section specifies weathertight concrete used to construct either:

- i) An Insitu Concrete Wall type B1 or B3, or
- ii) A Precast Concrete Wall type C1 or C3.

The use of weathertight concrete will provide weathertightness without the need for exterior plaster or coating. Weathertight concrete limits moisture ingress to inconsequential amounts insufficient to cause undue dampness inside the building or damage to building elements.

Weathertight concrete shall:

- a) Have a minimum specified 28 day concrete strength of 30 MPa,
- b) Have a water/cementitious (w/c) ratio (by weight) no greater than 0.50,
- c) Be designed and constructed in accordance with section 2.1, 3.3 and 3.4.c

COMMENT 1:

Weathertight concrete will not prevent the passage of water vapour.

Silane or siloxane sealers or systems increase the water repellent properties of the concrete surface where a concrete aesthetic is required, however these are usually non-film forming, hence only have the ability to repel liquid water from micro cracks.

Crystalline admixtures increase the watertightness properties of concrete and can span cracks of up to 0.3 mm. Where it is intended to apply other surface coatings it is recommended to check for compatibility before proceeding.

AS 1478.1 Appendix F covers permeability reducing admixtures.

Where a painted aesthetic is acceptable, acrylic coatings such as pigmented standard or elastomeric high build coatings can be used to achieve an advanced weathertight finish. These coatings and in particular elastomeric high build coatings can span cracks of up to 2.0 mm. The maximum crack span width is typically defined by a factor of the total film thickness.

Repair of larger cracks typically involves specialist injection or routing and grouting. The filler will depend upon the crack dimensions.

COMMENT 2:

The requirements of 4.5, c) are to ensure that weathertight concrete is designed and constructed correctly:

- Properly compacted concrete from a well-designed mix will be weathertight, but areas of poor compaction, large cracks or poor joints will compromise weathertightness of otherwise sound construction.
- Precast concrete wall panels must be designed to withstand handling and erection without cracking.
- In situ wall construction requires consideration of shrinkage and flexural cracks.

Also refer to section 2.1 of this Code of Practise: 'Concrete shall be designed to prevent cracking in service in accordance with NZS 3101 Part 1 section 2.4.4.1(c) and section 2.4.4.8 and NZS 3101 Part 2 section C2.4.4.'

4.6 Masonry veneer

This section specifies masonry veneer wall coverings to construct:

- a) Concrete Masonry Wall type A4 as per section 1.1.2.

4.6.1 Scope

- a) The maximum height of veneer shall be 6 m measured from the top of a footing or a supporting slab edge, except at a gable end where the height at the peak can be increased to 10 m.

COMMENT:

Where a timber-framed upper storey has been used, then the maximum height above the masonry substructure shall be determined in accordance with NZS 3604.

- b) All masonry veneers shall be constructed in running (or stretcher) bond pattern.
- c) The maximum mass of veneer shall be 220 kg/m².

4.6.2 General

- a) Requirements for the materials and workmanship of masonry veneer shall comply with NZS 4210.
- b) The minimum length of a veneer wall or return shall be 230 mm, measured from the external face of the veneer.
- c) The minimum nominal work width of masonry units shall be 70 mm as determined by AS/NZS 4455.1.
- d) The maximum overhang of the veneer over the supporting footing shall be 20 mm.
- e) Longitudinal shrinkage stresses in concrete masonry veneer shall be controlled by providing vertical control joints at not more than 8 m centres.

COMMENT:

A Water Resistive Barrier applied to the cavity side of the concrete/ masonry surface can help to improve the systems performance.

4.6.3 Cavities

The minimum width of the cavity between masonry veneer and the exterior face of the masonry structure shall be 40 mm and the maximum width shall be 70 mm.

COMMENT:

It is important to maintain the minimum cavity width of 40 mm as cumulative construction tolerances could reduce the cavity width below 40 mm, which is unacceptable.

All brick ties must comply with the requirements of AS/NZS 2699.1. The maximum cavity width of 70 mm may be increased if brick ties are used which comply with the requirements of AS/NZS 2699.1.

Pipes and services shall not be placed in the cavity other than passing directly through the cavity to the exterior.

Cavities must allow for drainage and ventilation.

For drainage a weep hole of 75mm x 10mm is required to be placed every 800mm along the base or alternatively 1000mm/linear meter of wall.

For ventilation one of the two methods below shall be provided:

- Vertical vents installed as per the earlier weep holes; or
- Leaving a 5mm gap around the top of the veneer.

4.6.4 Wall ties

Masonry veneer shall be attached to a structural backing by wall ties. The ties may be dry bedded and of such a length that:

- a) They have an embedment length of at least half the width of the veneer, and
- b) They have an end cover in the bed joint of not less than 15 mm.

Mortar less than 24 hours old shall not be subject to vibration.

Type B ties as specified in AS/NZS 2699.1 shall be used and:

- a) shall be tested and comply with the provisions of AS/NZS 2699.1 for the specific cavity width,
- b) shall comply with the durability provisions of Table 4.

Table 4	Protection for masonry veneer ties supporting masonry veneer using AS/NZS 2699.1	
Exposure zone (NZS 3604)	Grades 316, 316L or 304 stainless steel	470 g/m ² galvanising on mild steel
Zone B	Yes	Yes
Zone C	Yes	Yes
Zone D	Yes	No
NOTE: The exposure zones are as defined in section 4 of NZS 3604.		

COMMENT:

Brick ties that comply with the requirements of AS/NZS 2699.1 shall be used for cavities wider than 75 mm.

4.6.4.1 Tie spacing

Masonry veneer ties shall be:

- Spaced horizontally and vertically so that the area of masonry veneer attached to each tie does not exceed the area (in m^2) as specified in Table 5 for the tie duty, earthquake zone, and veneer mass, or
- Selected directly from Table 6.
- Fixed to an edge distance of between 60 mm and 110 mm.

Table 5	Masonry veneer area/tie					
Earthquake zone	Area of masonry veneer attached to each Type B veneer tie of the duty specified (m^2)					
	Veneer less than 180 kg/m^2			Veneer $180 \text{ kg/m}^2 - 220 \text{ kg/m}^2$		
	EL	EM	EH	EL	EM	EH
1	0.24	0.24	0.24	0.20	0.24	0.24
2	0.16	0.24	0.24	0.13	0.20	0.24
3	0.11	0.16	0.24	0.09	0.13	0.24
4	0.08*	0.12	0.23	0.07*	0.11	0.22

* Some small veneer areas may be impracticable.

NOTES:

- The earthquake zones are as defined in NZS 4229, section 4.2.
- Type B veneer ties are specified in AS/ NZS 2699.1, section 1.4.15.2.
- EL, EM, EH = Earthquake classification of Type B ties in accordance with AS/ NZS 2699.1, section 2.7.3.
- Minimum strengths for tie fixings to blockwork are: 0.5 kN (EL), 0.75 kN (EM), and 1.5 kN (EH).
- The horizontal tie spacing multiplied by the vertical tie spacing selected shall be equal or less than the area of masonry veneer given for the earthquake zone and the veneer mass. The maximum spacing of ties shall be 600 mm horizontal and 400 mm vertical.
- Using higher strength ties does not permit the maximum spacing of ties to be increased.
- Ties shall be face fixed to blockwork or fully embedded in the structural masonry wall joint.

Table 6	Tie duty schedule	
Earthquake zone	Masonry veneer attached by Type B veneer ties of the duty and spacing specified	
	Veneer less than 180 kg/m ² requires tie spacing of 600 mm horizontal x 400 mm vertical	Veneer 180 kg/m ² – 220 kg/m ² requires tie spacing of 500 mm horizontal x 400 mm vertical
1	EL	EL
2	EM	EM
3	EH*	EH*
4	SED*	EH

* The veneer area/ tie table (Table 5) allows for different tie spacing.

NOTES:

- a) The earthquake zones are as defined in NZS 4229, section 4.2.
- b) The tie spacing for veneer less than 180 kg/m² that is calculated using SED (specific engineering design) shall not be greater than 600 mm horizontally and 400 mm vertically.
- c) EL, EM, EH = Earthquake classification of Type B ties in accordance with AS/ NZS 2699.1, section 2.7.3.
- d) Minimum strengths for tie fixings to blockwork are: 0.5 kN (EL), 0.75 kN (EM), and 1.5 kN (EH).
- e) Using higher strength ties does not permit the maximum spacing of ties to be increased.
- f) Ties shall be face fixed to blockwork or fully embedded in the structural masonry wall joint.

4.6.5 Openings

Openings in masonry veneer shall be spanned by steel lintel angles with the structural sizes specified in Table 7 and protected against corrosion to the provisions of Table 8.

Steel lintel angles shall have a minimum seating of 100 mm for spans up to and including 2 m, and a minimum seating of 200 mm for spans over 2 m.

Table 7	Veneer lintel table - steel angles					
Maximum lintel span (mm)	Veneer thickness 70 mm			Veneer thickness 90 mm		
	Maximum veneer height supported			Maximum veneer height supported		
	350 mm	700 mm	2000 mm	350 mm	700 mm	2000 mm
2000	80 x 80 x 8	80 x 80 x 8	80 x 80 x 8	90 x 90 x 8	90 x 90 x 8	90 x 90 x 8
2500	80 x 80 x 8	80 x 80 x 8	90 x 90 x 8	90 x 90 x 8	90 x 90 x 8	90 x 90 x 10
3000	90 x 90 x 8	90 x 90 x 8	125 x 75 x 8	90 x 90 x 8	90 x 90 x 8	90 x 90 x 10
3500	90 x 90 x 8	90 x 90 x 8	125 x 75 x 8	90 x 90 x 8	90 x 90 x 10	125 x 75 x 10
4000	90 x 90 x 8	125 x 75 x 8	125 x 75 x 10	90 x 90 x 10	125 x 75 x 8	150 x 90 x 10
4500	125 x 75 x 8	125 x 75 x 10	–	125 x 75 x 8	125 x 75 x 10	–
4800	125 x 75 x 8	125 x 75 x 10	–	125 x 75 x 8	125 x 75 x 10	–

NOTES:

- a) All sections are steel angles.
- b) Stainless steel sections of equivalent section modulus are a permitted alternative.
- c) A minimum dimension of 80 mm x 80 mm x 8 mm is regarded New Zealand common practice.
- d) Propping of lintels for 28 days is recommended to allow for sufficient curing and setting time.

Table 8	Protection for masonry veneer lintels supporting masonry veneer using AS/NZS 2699.3	
Exposure zone (NZS 3604)	Grades 316, 316L or 304 stainless steel or 600 g/m² galvanising on mild steel plus duplex coating	600 g/m² galvanising on mild steel or 300 g/m² galvanising on mild steel plus duplex coating
Zone B	Yes	Yes
Zone C	Yes	Yes
Zone D	Yes	No

5 Flashings

5.1 Required properties of flashing materials

5.1.1 Durability requirements

All flashings shall comply with the requirements of NZBC B2 Durability.

COMMENT:

The durability requirements for flashings specified in NZBC B2 are:

- a) 50 years, where flashings are:
 - i) completely hidden behind claddings or
 - ii) not accessible, or
- b) 15 years, where flashings are:
 - i) exposed, or
 - ii) accessible.

5.1.2 Environmental requirements

Flashing materials shall be selected according to the relevant exposure conditions as defined in either:

- a) AS/NZS 2728, or
- b) NZBC E2/AS1 Table 20.

COMMENT:

The exposure zone in which a building is located can affect the durability of flashings.

Exposure zones for flashing materials are defined in NZS 3604 section 4, based on the likely exposure to wind-driven sea-salt.

Exposure due to geothermal or industrial gases, as defined in NZS 3604, is outside the scope of this Code of Practice and will require specific design.

5.1.3 Specific conditions of use

Flashing materials shall be selected according to the specific conditions of their use from NZBC E2/AS1 Table 20 to minimise the effects of corrosion.

COMMENT:

The specific location of a material on a building can substantially affect the durability of that material.

In particular, many metals can undergo accelerated corrosion if they are exposed to wind-driven sea-salt in sheltered locations, where they are not exposed to being washed by rainwater.

5.1.4 Surrounding materials

Flashings which are in contact with or subject to run-off to or from other materials shall be selected in accordance with NZBC E2/AS1 Tables 21 and 22.

Uncoated metals shall not be used where carbon deposits or chemical contaminants may accumulate.

COMMENT:

Undesirable effects can occur when some materials are in contact with each other. Examples are corrosion of metals, stress cracking of plastics and staining of glass. Carbon deposits such as soot can cause accelerated corrosion of damp, uncoated metal.

5.2 Acceptable flashing materials

COMMENT:

Additional guidance on flashing materials can be found in the New Zealand Metal Roofing Manufacturers' Roof and Wall Cladding Code of Practice.

5.2.1 uPVC flashings

uPVC flashings shall be a minimum of 0.75 mm thick and shall comply with the requirements of the following Clauses of AS/NZS 4256: Part 2:

- a) Clause 9.2 Impact resistance,
- b) Clause 9.3 Tensile strength, and
- c) Clause 9.4 Colourfastness and impact resistance following ultraviolet light exposure.

Where uPVC flashings are exposed to the weather, they shall also comply with Section 8 of AS/NZS 4256: Part 2. uPVC flashings shall have a finish colour with a reflectance of 40% or more.

COMMENT:

Manufacturers of uPVC flashings which have a proven performance in use may be able to show compliance with NZBC B2 Durability as detailed in NZBC B2/VM1.

5.2.2 Metallic flashings

Metallic flashings (aluminium flashings, galvanised steel flashings, aluminium-zinc magnesium coated steel flashings, stainless steel flashings, copper flashings, lead sheet flashings and zinc sheet flashings) shall be as specified in NZBC E2/AS1 Paragraphs 4.3.2 to 4.3.8 respectively, except that aluminium flashings shall not be used in contact with fresh cement plaster or green concrete (i.e. concrete which has cured for less than 28 days).

5.3 Fixings

Fixings of metal flashings shall comply with NZBC E2/AS1 Tables 20, 21 and 22.

Where fixings penetrate flashings, self-tapping nails or screws provided with a watertight underlay disc shall be used.

COMMENT:

Fixings that penetrate flashings should be avoided wherever possible.

6 Concrete roofs and decks

Concrete roofs and decks shall be made weathertight by applying a roof membrane as specified in section 6.5.

The following details, as shown in section 9, shall be used for concrete roof and deck construction:

Detail 16	-	Door/ Threshold at Deck, external roof insulation
Detail 17	-	Door/ Threshold at Deck, internal roof insulation
Detail 30a	-	Flat Roof, general built up, internal roof insulation
Detail 30b	-	Flat Roof, general built up, external roof insulation
Detail 39	-	Roof Gully, external roof insulation
Detail 40	-	Roof Gully, internal roof insulation
Detail 41	-	Roof Exit, AOV, external roof insulation
Detail 42	-	Roof Exit, AOV, internal roof insulation
Detail 51	-	Decking Options, external roof insulation
Detail 52	-	Decking Options, internal roof insulation

Junctions of roofs or decks to walls shall be as specified in section 6.9. Parapets and balustrades shall be as specified in section 6.11.

COMMENT:

Sections through a typical insulated flat roof showing the arrangement of the vapour barrier, insulation and membrane are shown in Detail 30a (internal or under- slab insulation) and Detail 30b (external insulation).

In Detail 30a, either a single torch on membrane or an adhesive membrane could be used.

In Detail 30b, the vapour barrier below the insulation keeps the insulation dry from vapour arising from the inside of the building. A double membrane could be used directly over the insulation where the lower membrane is adhesive fixed to the insulation and the top membrane is being torched on.

Concrete used for roof and deck construction shall either be certified by the Concrete New Zealand Plant Audit Scheme or by a Chartered Professional Engineer confirming the concrete complies with NZS 3104.

6.1 Limitations

This Code of Practice limits concrete flat roofs and decks to those with:

- a) Parapets at all edges,
- b) Bituminous or butyl and EDPM sheet roof membranes installed over concrete or insulation board,
- c) A fall of between 1.5° (1:40) and 5° (1:11),
- d) No integral roof gardens,
- e) No downpipe directly discharging to the roof or deck,
- f) No cantilevering in their construction, and
- g) Decks with removable raised surfaces to protect the roof membrane, as shown in Details 16, 17, 51 and 52.

COMMENT:

Discharging gutters directly onto decks increases the chances of water entry into sensitive areas. Direct discharge may be allowed into gutters calculated to have sufficient water-carrying capacity, but this is outside the scope of this Code of Practice.

6.2 Design criteria

Concrete roofs and decks shall be designed in accordance with AS/NZS 1170, NZS 3101 and section 2.1 of this Code of Practice, and constructed in accordance with NZS 3109.

Parapets and balustrades form part of the roof or deck design and construction. Parapets and balustrades formed of concrete masonry shall be designed in accordance with NZS 4230 and constructed in accordance with NZS 4210.

The slab shall be formed from insitu concrete, or precast concrete with an insitu concrete topping. Drainage falls shall be provided by either a sloped screed or by sloped thermal insulation boards.

COMMENT:

Concrete used to construct roofs and decks shall be designed as a suspended concrete floor in accordance with NZS 3101 and NZS 3109.

Suspended concrete floors used as a diaphragm shall meet the requirements of NZS 4229 for horizontal loads.

If they perform other structural functions, they shall be subject to specific design in accordance with NZS 3101.

In all cases, the dead load of suspended concrete floors shall not exceed 6.0 kPa.

6.3 Substrate finish

The finish of the concrete surface to take the roof membrane shall be a light broom or a U2 wood float to NZS 3114 or U3 steel trowel.

At the time of laying the roof membrane, the concrete shall be either:

- a) More than 28 days old, or
- b) Sufficiently dry so as to give a relative humidity reading of less than 75%.

The concrete shall be cleaned and any contaminants such as curing compound or release agents shall be removed.

COMMENT:

Curing compounds should not be used unless necessary.

The contractor is responsible for ensuring that moisture content of the substrate comes within the membrane supplier's requirements. Substrate ventilation of the membrane to substrate interface may be required where there is excess moisture present in building materials at the time of laying the membrane.

6.4 External roof insulation

The external roof insulation functions as substrate for the bituminous roof membrane and shall be a rigid type of either:

- a) Extruded polystyrene foam (XPS), or
- b) Polyurethane foam, or
- c) Cellular foamed glass.

The specification of the external roof insulation shall be specifically designed to support the loads from the decking system as specified in section 6.7 plus the live loads as specified in AS/NZS 1170.

The external roof insulation shall be adhered to the substrate over a vapour control layer by:

- a) Cold adhered with bond strength of 4 kPa when tested in accordance with ASTM D7105, or
- b) Bedded in, melted down, or
- c) Self- adhesive vapour barrier sheet, or
- d) Mechanical fixing.

The insulation board shall be installed in dry weather.

6.4.1 Vapour control layer

A vapour control layer shall be installed under the external roof insulation to prevent the entrapment of moisture. The vapour control layer shall be specified in accordance with ASTM C755.

The vapour control layer shall be installed in dry weather.

6.5 Roof membrane

Roof and deck membranes shall be either:

- a) an EPDM or butyl rubber membrane as specified in section 6.5.1, or
- b) a bituminous membrane as specified in section 6.5.2.

6.5.1 EPDM and butyl rubber roof membranes

The membrane shall:

- a) Be a minimum thickness of:
 - i) 1 mm for roofing, or
 - ii) 1.5 mm for decks,
- b) Comply with the following parts of Table 1 in ASTM D6134:
 - i) tensile strength,
 - ii) elongation,
 - iii) water absorption, water vapour permeance,
 - iv) and heat aging followed by:
 - a. tensile strength, and
 - b. elongation,
- c) Have adhesives, primers and seam tapes that:
 - i) comply with BRANZ EM 5 section 3.1, and
 - ii) have bond strength of 4 kPa when tested in accordance with ASTM D903 and ASTM D7105, and
 - iii) are part of a complete system approved by the manufacturer or supplier of the membrane, and
- d) Be UV resistant unless the membrane is protected from sunlight, and
- e) Have a membrane colour with a light reflectance greater than 40%.

COMMENT:

If non UV-resistant membranes are used, the recommended methods of protection from sunlight include:

- 1) Embedded mineral granules - selecting mineral membranes which comply with the technical requirements of the Waterproofing Membrane Association's Code of Practice for Reinforced Modified Bitumen Membrane Systems for Roofs and Decks will ensure the mineral is well embedded (rolled-in) into the membrane to ensure non-shedding of mineral, with can result in bald patches, and
- 2) Using a high-performance reflective coating system as part of the membrane system to provide long-term protection.

For installation, adhesives shall be applied to both the membrane and the substrate. When tack-dry, the membrane shall be rolled into the substrate. Seam tapes shall be used on all joints. Seams should be aligned parallel to the fall of the deck to minimise ponding.

COMMENT:

It is recommended that installation of membrane roofs and decks be carried out by trained installers, approved by the manufacturer or the New Zealand agent (in the case of imported membrane).

Membrane adhesives should be selected for the applicable substrate, concrete or rigid insulation.

Penetrations made through the membrane subsequent to laying require specific design.

6.5.2 Bituminous roof membranes

The membrane shall:

- a) Meet the performance requirements of the Code of Practice for Reinforced Modified Bitumen Membrane Systems for Roofs and Decks, 4th edition, sections 2.2 and 2.3,
- b) Have adhesives, primers and seam tapes that:
 - i) comply with BRANZ EM 5 section 3.1, and
 - ii) have bond strength of 4 kPa when tested in accordance with ASTM D903 and ASTM D7105, and
 - iii) are part of a complete system approved by the manufacturer or supplier of the membrane, and
- c) Be UV resistant unless the membrane is protected from sunlight.

The membrane installation shall follow the Code of Practice for Reinforced Modified Bitumen Membrane Systems for Roofs and Decks, 4th edition, section 6.

For externally insulated roofs and decks, a double layer waterproofing membrane on top of the insulation shall be used. The first layer shall be a self adhesive or cold-fixed layer to avoid damage from torching flame, and the second layer (top layer) shall be torched on. All laps shall be heat welded on the second layer.

Additionally a vapour barrier, either liquid or self adhesive, shall be applied between the concrete roof/ deck and the insulation boards to prevent vapour from inside the building diffusing into the insulation.

6.6 Roof and deck drainage

Roofs and decks shall be constructed so that:

- a) The highest point of the waterproofing membrane on a roof or deck shall be at least 100 mm below an adjoining interior floor,
- b) A minimum clear drainage gap of 12 mm shall be provided between the decking edge and the wall or parapet or balustrade cladding,
- c) A minimum 150 mm upstand of the roof/deck membrane shall be provided at all roof/ deck to wall and parapet junctions, except at thresholds where this can be reduced to 100 mm. No penetrations shall be made through this membrane upstand.
- d) Water discharges directly into roof outlets with a minimum diameter of 75 mm as shown in Detail 39 and 40,
- e) External corner upstands in the membrane are formed in accordance with NZBC E2/AS1 Figure 57,
- f) Allowance for additional run-off shall be provided by an extra outlet, with both outlets sized to take the full required capacity, and
- g) The number of rainwater outlets is no less than two.

6.7 Additional deck requirements

In addition to the requirements of section 6.5, a deck shall have:

- a) A raised removable decking system of tiles or timber slats in accordance with Details 16, 17, 43 to 52 or E2/AS1 Figure 17A, A minimum clear drainage gap of 12 mm shall be provided between the decking edge and the wall or parapet or balustrade cladding, or
- b) Paving on a rounded pebble drainage layer (that can be removed for maintenance) in accordance with Details 51 and 52.

Doors for level access shall be constructed in accordance with Detail 16 or 17 or E2/AS1, Figure 17A and:

- a) Have a minimum clear drainage gap of 12 mm between the decking edge and the door sill or the door frame, or
- b) Have an external linear drainage grille along the length of the door opening.

6.8 Control joints

The design of control joints for membrane roofs and decks is subject to specific design and is outside the scope of this Code of Practice. All control joints in the substrate shall be accommodated in the membrane.

6.9 Junctions

All junctions of roofs or decks to walls and doors shall be constructed in accordance with the following details and figures where relevant:

Detail 16	-	Door/Threshold at Deck, external deck insulation
Detail 17	-	Door/Threshold at Deck, internal deck insulation
Detail 43	-	Roof/ Deck at Wall, masonry, insitu or precast walls, external roof insulation, external wall insulation (EIFS)
Detail 44	-	Roof/ Deck at Wall, masonry, insitu or precast walls, external roof insulation, internal wall insulation
Detail 45	-	Roof/ Deck at Wall, insitu or precast walls, external roof insulation, integral wall insulation
Detail 46	-	Roof/ Deck at Wall, masonry walls, external roof insulation, cavity wall insulation
Detail 47	-	Roof/ Deck at Wall, masonry, insitu or precast walls, internal roof insulation, external wall insulation (EIFS)
Detail 48	-	Roof/ Deck at Wall, masonry, insitu or precast walls, internal roof insulation, internal wall insulation
Detail 49	-	Roof/ Deck at Wall, insitu or precast walls, internal roof insulation, integral wall insulation
Detail 50	-	Roof/ Deck at Wall, masonry walls, internal roof insulation, cavity wall insulation

NZBC E2/AS1, Figure 62.

COMMENT:

Adding wearing surfaces over the membrane effectively reduces clearances and should be allowed for when setting membrane levels.

6.10 Penetrations

Penetrations for external and internal insulation options shall be constructed in accordance with Details 39 to 42.

No fixing shall penetrate the exposed horizontal roof membrane or any exposed non vertical applied roof membrane.

6.10.1 Handrails

Connections of stanchions for handrails and other fixtures (such as TV aerials or satellite dishes) shall be side-fixed to a vertical surface and shall have the junction with the exterior wall made weathertight by using the connections shown in Details 31 to 38.

Fixing of posts through non-vertical roof membrane areas shall be avoided.

COMMENT:

Any fixings of posts through roof or deck membranes require specific design.

6.11 Parapets

Parapets shall be constructed in accordance with the following Details:

Detail 31	-	Parapet, profiled capping, external roof insulation, masonry, insitu or precast walls, EIFS
Detail 33	-	Parapet, integral capping, Option B, external roof insulation, masonry, insitu or precast, walls, EIFS
Detail 34a	-	Parapet, profiled capping, Option A, internal roof insulation, masonry, insitu or precast walls, internal insulation
Detail 36a	-	Parapet of composite insitu or precast wall, Option A, external roof insulation, integral wall insulation
Detail 36b	-	Parapet of composite insitu or precast wall, Option B, external roof insulation, integral wall insulation
Detail 38	-	Parapet with profiled capping for masonry wall.

6.11.1 Capping materials

Cappings for concrete parapets shall be formed either:

- a) As an integral capping by continuing the weathertight system up and over the parapet top, or
- b) By using a metal capping.

Capping materials shall be selected in accordance with section 5.0.

Integral cappings for EIFS and plaster weathertight systems shall incorporate an additional waterproof membrane, as specified in section 4.2.3, beneath the plaster and as shown in Details 32, 33, 35.

Cappings for parapets constructed from concrete masonry shall use a metal capping system only.

6.11.2 Metal cappings

Metal cappings shall either be clipped to steel brackets, bolted to the top of the parapet or fixed with self tapping screws to the sides of the parapet as shown in Details 31, 34a, and 38.

Metal cappings shall also comply with all the following requirements:

- a) Tops of cappings shall be free of any penetrations,
- b) Slope of top shall be 5° (1:12) minimum and sloped packers under cappings shall be timber treated to NZS 3602 or 9 mm H3 plywood on packers,
- c) All cappings shall have drip edges, with minimum drip edges the same as those specified in Details 31, 34a, 36a, 36b and 38,
- d) Lengths of capping shall be joined in accordance with NZBC E2/AS1 Figure 9 (b) or Figure 9 (d),
- e) External corners of cappings shall be in accordance with NZBC E2/AS1 Figure 9 (e),
- f) Expansion joints shall be provided for joined cappings with a combined length exceeding either:
 - i) 12 m for light coloured steel and stainless steel, or
 - ii) 8 m for dark coloured steel, or
 - iii) 8 m for copper, or
 - iv) 8 m for aluminium,
- g) Where both ends of a capping are constrained, allowance shall be made for expansion,
- h) Where necessary, expansion joints shall be formed as shown in NZBC E2/AS1 Figure 9 (g) and with:

- i) minimum 200 mm laps, and
- ii) sliding clips at both sides of the lap, and
- i) Where a capping finishes against a wall, a saddle flashing with a 100 mm overlap extending 50 mm up the wall shall be provided as shown in NZBC E2/AS1 Figure 12 (a).

Joints and corners of metal cappings shall be constructed in accordance with NZBC E2/AS1 Figure 9.

7 Concrete slab-on-ground and footings

7.1 Design criteria

Concrete slab on ground and wall footings shall:

- a) Comply with NZS 4229 section 6 and 7 and NZS 4210, or
- b) Be designed in accordance with AS/NZS 1170, NZS 3101 and section 2.1 of this Code of Practice, and constructed in accordance with NZS 3109.

The minimum acceptable ground floor level for the concrete floor shall be in accordance with NZBC E1/AS1 Section 2.0.

COMMENT:

Concrete curing requirements in NZS 4229 specify a minimum 28 day concrete strength in accordance with NZS 3604 exposure zones as follows:

- (a) 17.5 MPa for reinforced concrete either not exposed to weather or exposed to the weather in Zone B, or
- (b) 20.0 MPa for reinforced concrete exposed to weather in Zone C, or
- (c) 25.0 MPa for reinforced concrete exposed to weather in Zone D.

NZS 4229 specifies slab thicknesses in Clause 7.8 and requires slabs to be reinforced with 665 mesh.

Concrete used for footing and floor construction shall either be certified by the Concrete New Zealand Plant Audit Scheme or by a Chartered Professional Engineer confirming the concrete complies with NZS 3104.

7.2 Wall footing details

The wall/floor junction shall be constructed in accordance with Details 1 to 6.

7.3 Finished floor level

The ground directly adjacent to the building shall be sloped no less than 1:25 for at least 1 m to carry water away from the building.

The height of the finished floor level above adjacent final landscaped ground levels shall comply with NZS 4229 Clause 7.2.1 and be no less than 100 mm if the ground is permanently paved, or 150 mm if the ground is unpaved.

COMMENT:

It is important that ground clearances are maintained after completion and occupation of the building. The likely final landscaped ground levels should be taken into account when planning footings and earthworks to avoid reductions in minimum ground levels in the finished building.

It is recommended that the building platform be formed at a level of at least 300 mm below the finished floor level, with the exterior ground sloped to carry water away from the exterior walls. This allows landscaping and paving to be built up while still maintaining the required clearances.

7.4 Damp-proof membranes (DPM)

Every concrete floor slab cast on the ground shall have a damp-proof membrane (DPM), which shall be either:

- i) Laid between the ground and the slab as shown in Details 1 to 6, or
- ii) Laid between the top of the slab and a concrete floor topping that is no less than 50 mm thick.

The DPM shall:

- a) Be in accordance with NZS 4229, sections 7.4 to 7.7,
- b) Continue to remain waterproof for a minimum of 50 years, and
- c) Be continuous over the whole slab area or under a concrete floor topping.

To avoid damage to the damp-proof membrane, a granular base in accordance with NZS 4229 Section 7.3.3 shall be placed.

7.4.1 Wall footings in poorly drained sites

For poorly drained sites, the DPM shall be extended vertically up the external face of the footings as specified in Details 1 to 6. In this case a sheet applied self adhesive DPM shall be used. The DPM shall be overlapped with the wall weathertightness system for at least 50 mm as shown in Details 1 to 6.

7.5 Protection of timber

Timber shall be separated from the concrete slab by a damp-proof course (DPC).

7.6 Control joints

Control joints shall be placed in accordance with NZS 4229 section 7.8.5 or as specified by specific design in accordance with AS/NZS 1170 and NZS 3101.

8 Construction moisture

Moisture in the building structure at completion of construction shall be limited to avoid damage to the building elements.

COMMENT:

Excessive moisture content in concrete floors may inhibit bonding of subsequent floor coatings.

Construction moisture includes the moisture contained in:

- a) Timber products as a result of a treatment or manufacturing process,
- b) Timber or other materials as a result of exposure to the weather, and
- c) Concrete, mortar or plaster that is not completely cured.

8.1 Maximum acceptable moisture

The maximum moisture contents shall:

- a) For concrete floors, have a relative humidity of less than 75% at the time of applying membranes, sealants, weathertightness systems or fixed floor coverings, and
- b) For concrete walls, have a relative humidity reading of less than 70% at the time of applying wall membranes, sealants or weathertightness systems.

8.2 Measuring moisture content in concrete

Measurement of moisture content shall be made in accordance with BRANZ Bulletin 515 "Measuring moisture on building sites" using hygrometers calibrated to ASTM E104: 2002 "Standard practice for maintaining constant relative humidity by means of aqueous solutions".

COMMENT: Measurement of moisture content in timber should be made in accordance with NZBC E2/AS1, Pgrph 10.3.

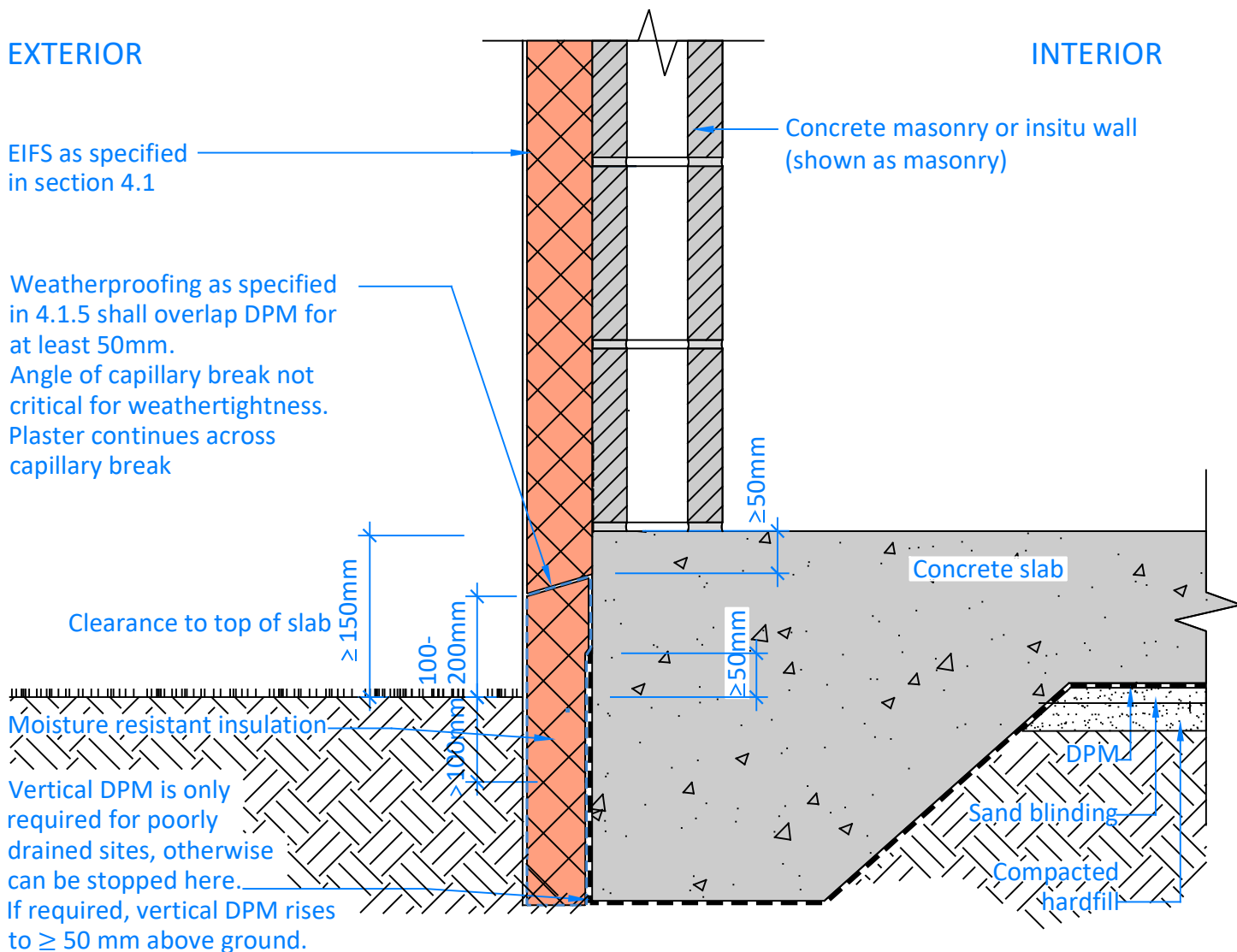
8.3 Condensation moisture

COMMENT: This code of practice relates to external moisture, it is however advised to conduct careful planning regarding thermal performance, not alone for compliance with NZBC H1, reducing energy requirements and associated costs, but as well for compliance with NZBC E3, Internal Moisture, preventing mould growth and building damage. Internal moisture is generated by the occupants, by having showers, cooking, washing and breathing. If the interior air temperature is 'warm', it can absorb moisture generated in average households.

However, surface condensation occurs, once the air is saturated which happens faster at lower temperatures. In the average New Zealand condition, the air is saturated at about 12°C. Condensation shows first at the weakest points, at so called 'thermal bridges'. Thermal bridges are created when materials high in conductivity are uninsulated, creating a funnel of unobstructed heat flow towards the colder area, so the cold exterior air. Thermal bridges can be avoided with insulation, ideally externally, since it is much easier for moisture to escape from the external envelope part than from the internal side, where is a risk of moisture being trapped, supporting mould growth.

An efficient solution is to cover the entire envelope with a continuous layer of externally applied, thermal insulation. There are several alternatives available in New Zealand.

9 Detail drawings



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: The above weathertightness detail shall be used for either concrete or concrete masonry footings.

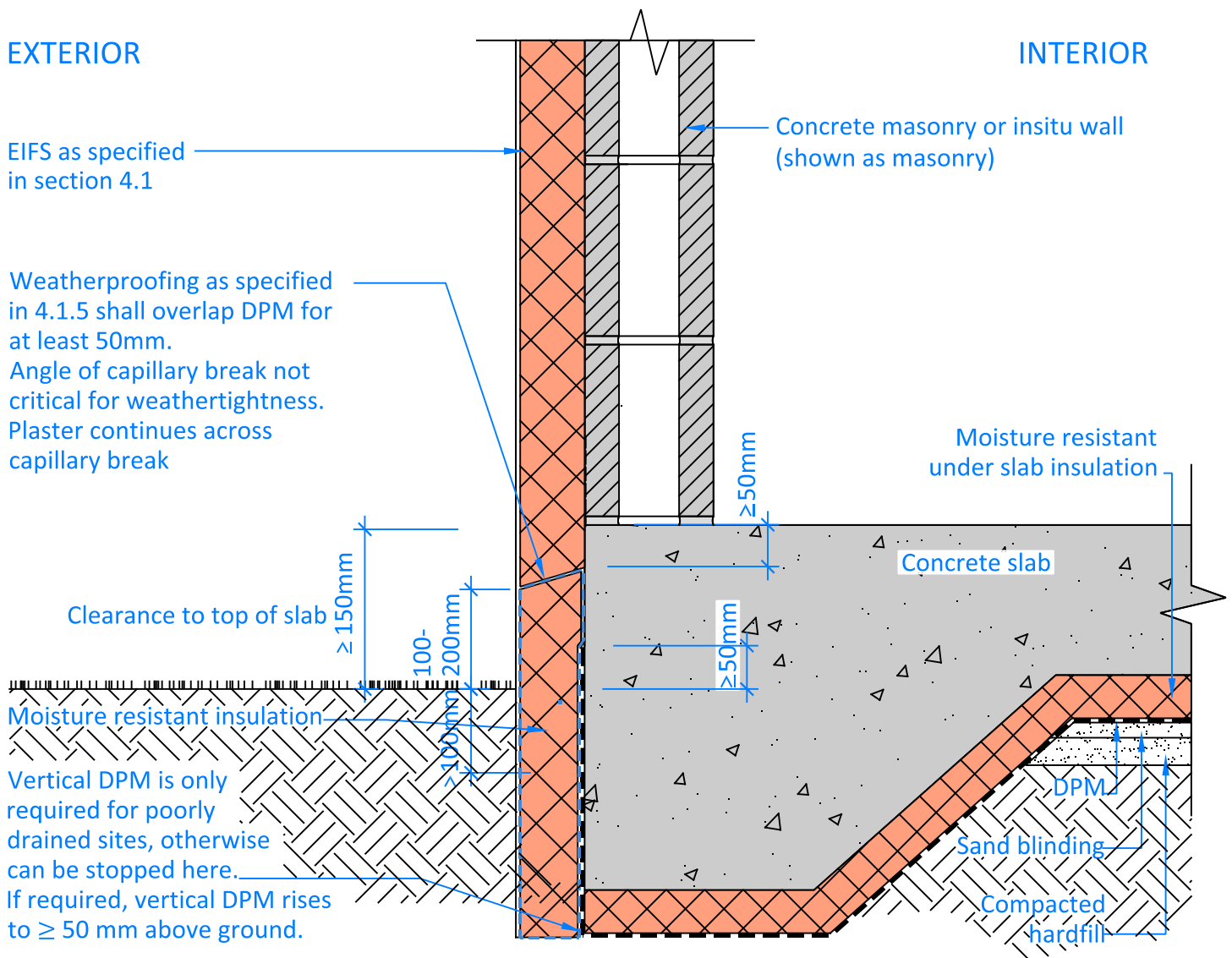
Detail 1a

(not to scale)

Wall/ Footing Junction: Slab on Ground

Concrete Masonry or Insitu Wall: EIFS

Wall type: A2, B2



Comment 1: Underfloor insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

Comment 2: Structural layout is indicative only and subject to individual project design.

Comment 3: The above weathertightness detail shall be used for either concrete or concrete masonry footings.

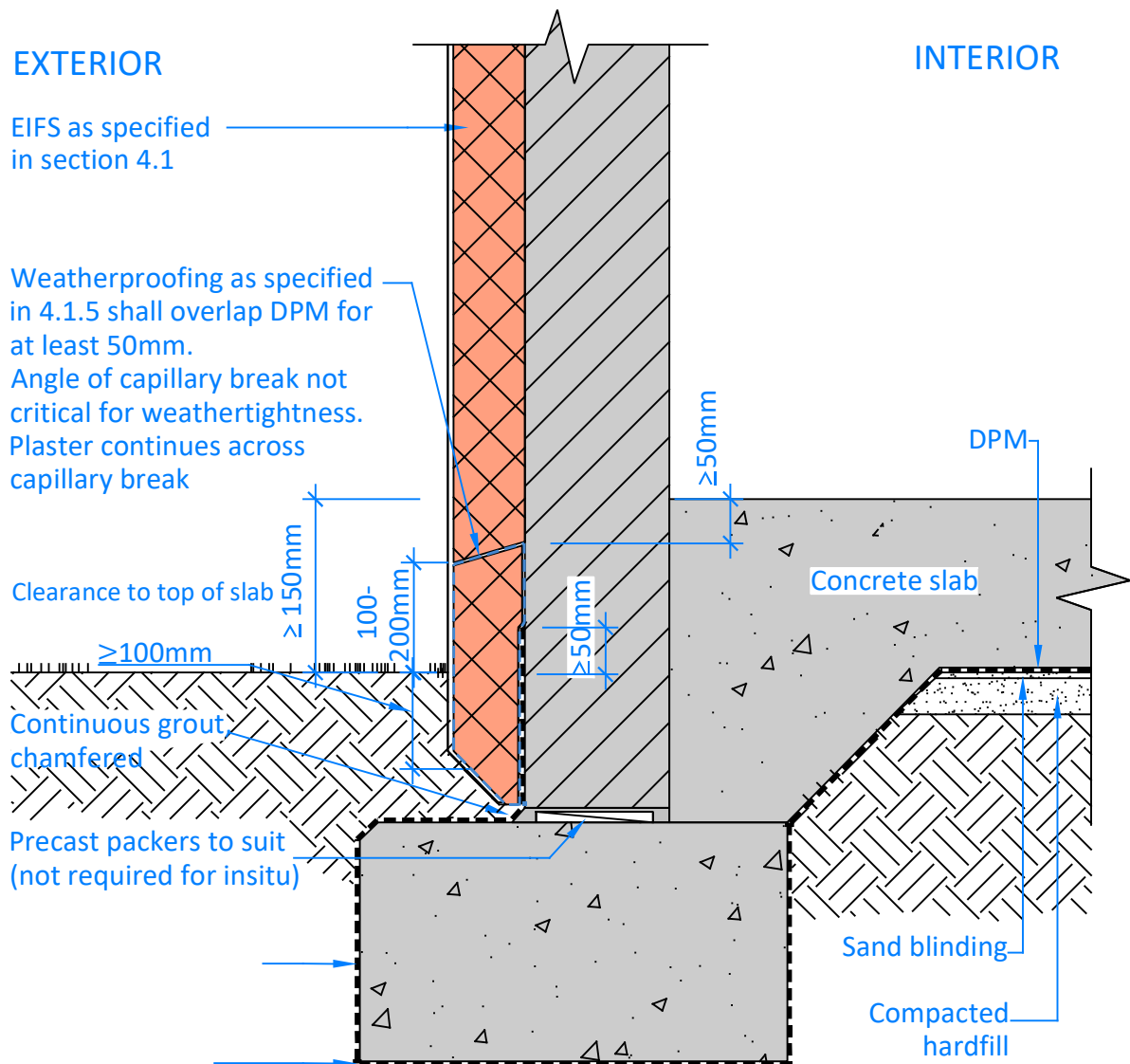
Detail 1b (underfloor insulation)

(not to scale)

Wall/ Footing Junction: Slab on Ground

Concrete Masonry or Insitu Wall: EIFS

Wall type: A2, B2



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

Comment 2: Structural layout is indicative only and subject to individual project design.

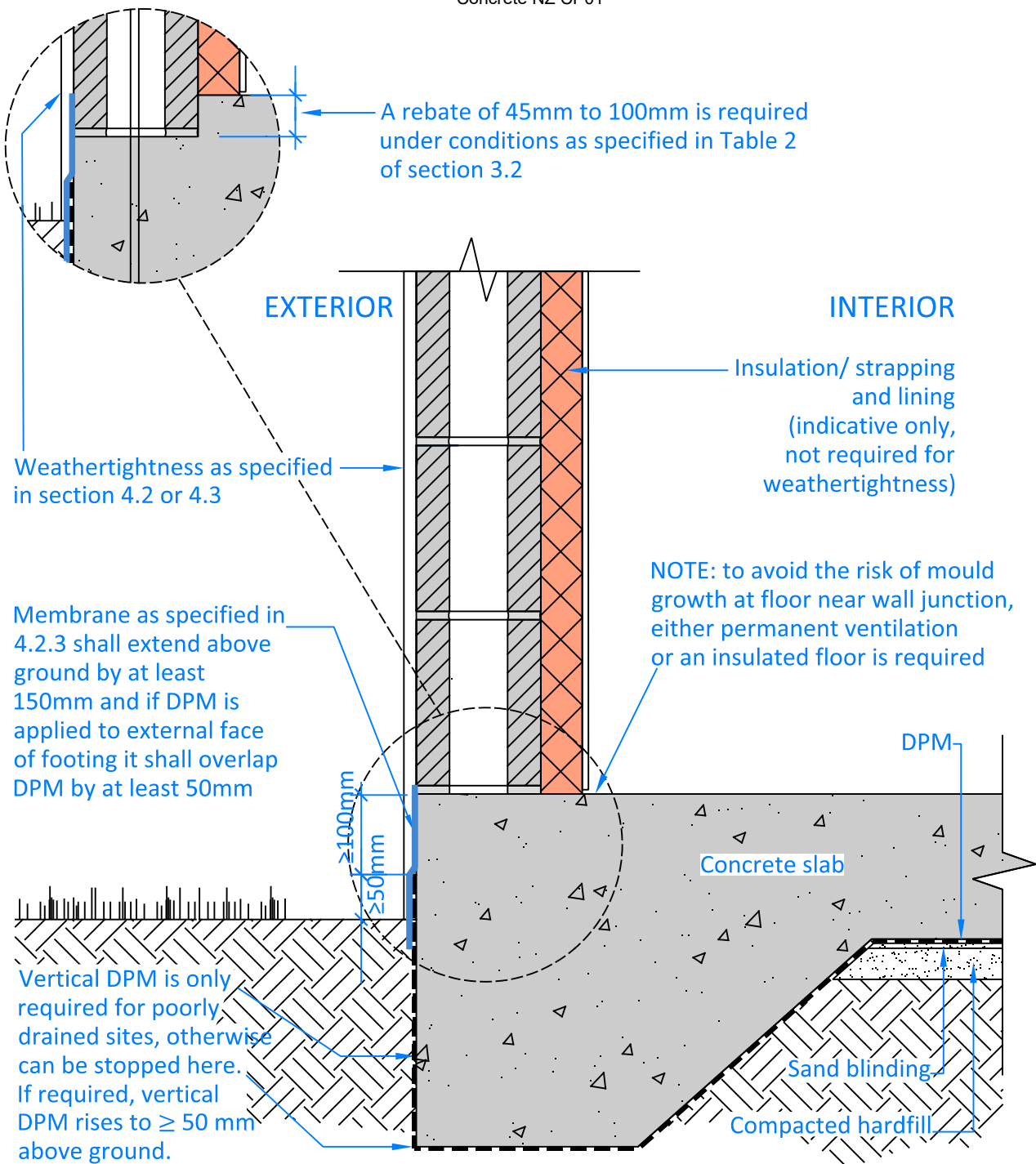
Detail 2

(not to scale)

Wall/ Footing Junction: Slab on Ground

Insitu or Precast Wall: EIFS

Wall type: B2, C2



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

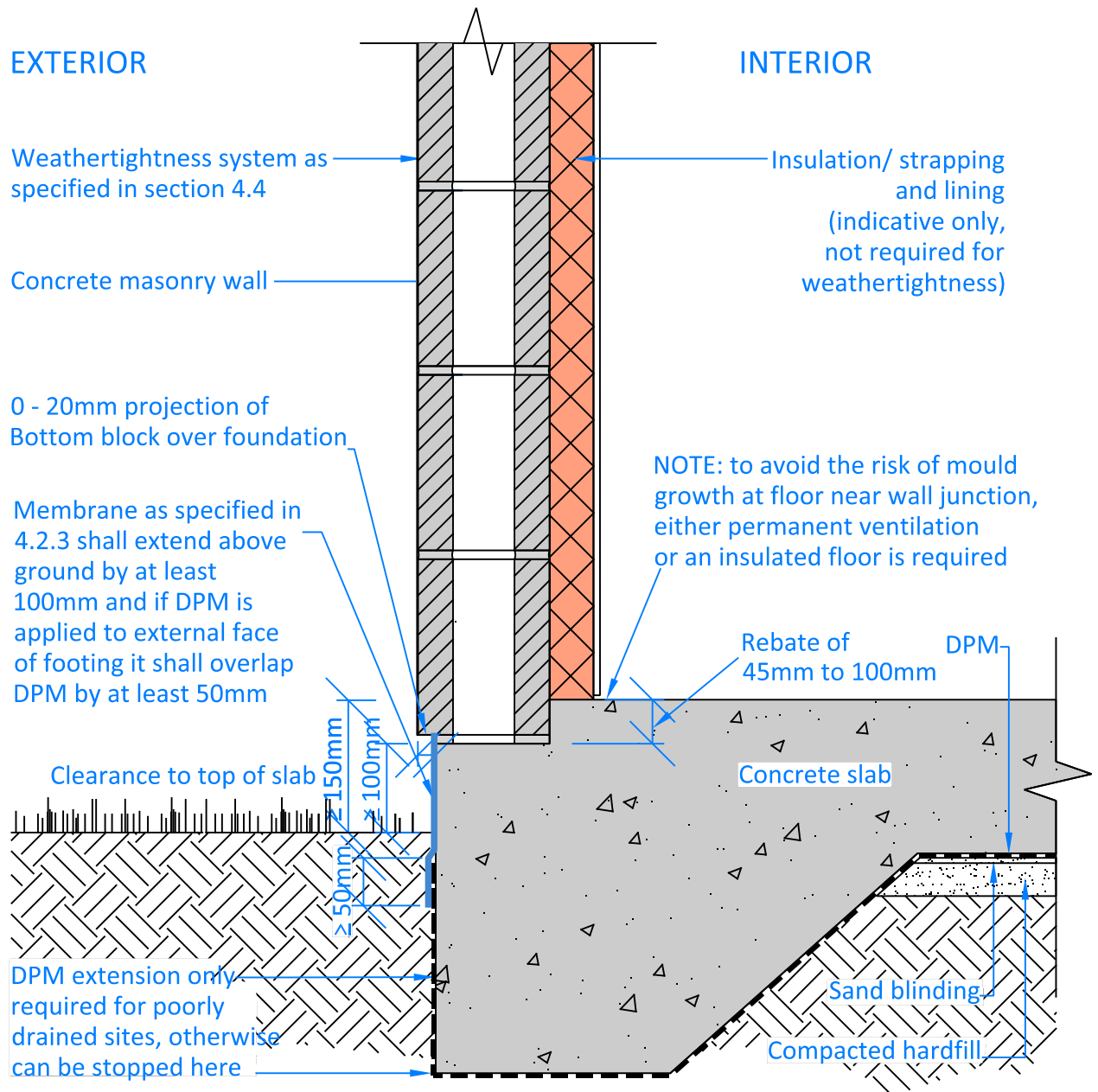
Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Comment 3: Structural layout is indicative only and subject to individual project design.

Detail 3a (for weathertightness system 4.2 and 4.3)

(not to scale)

Wall/ Footing Junction: Slab on Ground (no rebate)
 Insitu and Masonry Wall: internal & integral insulation
 Wall with external plaster or coating



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Comment 3: Structural layout is indicative only and subject to individual project design.

Detail 3b (for weathertightness system 4.4)

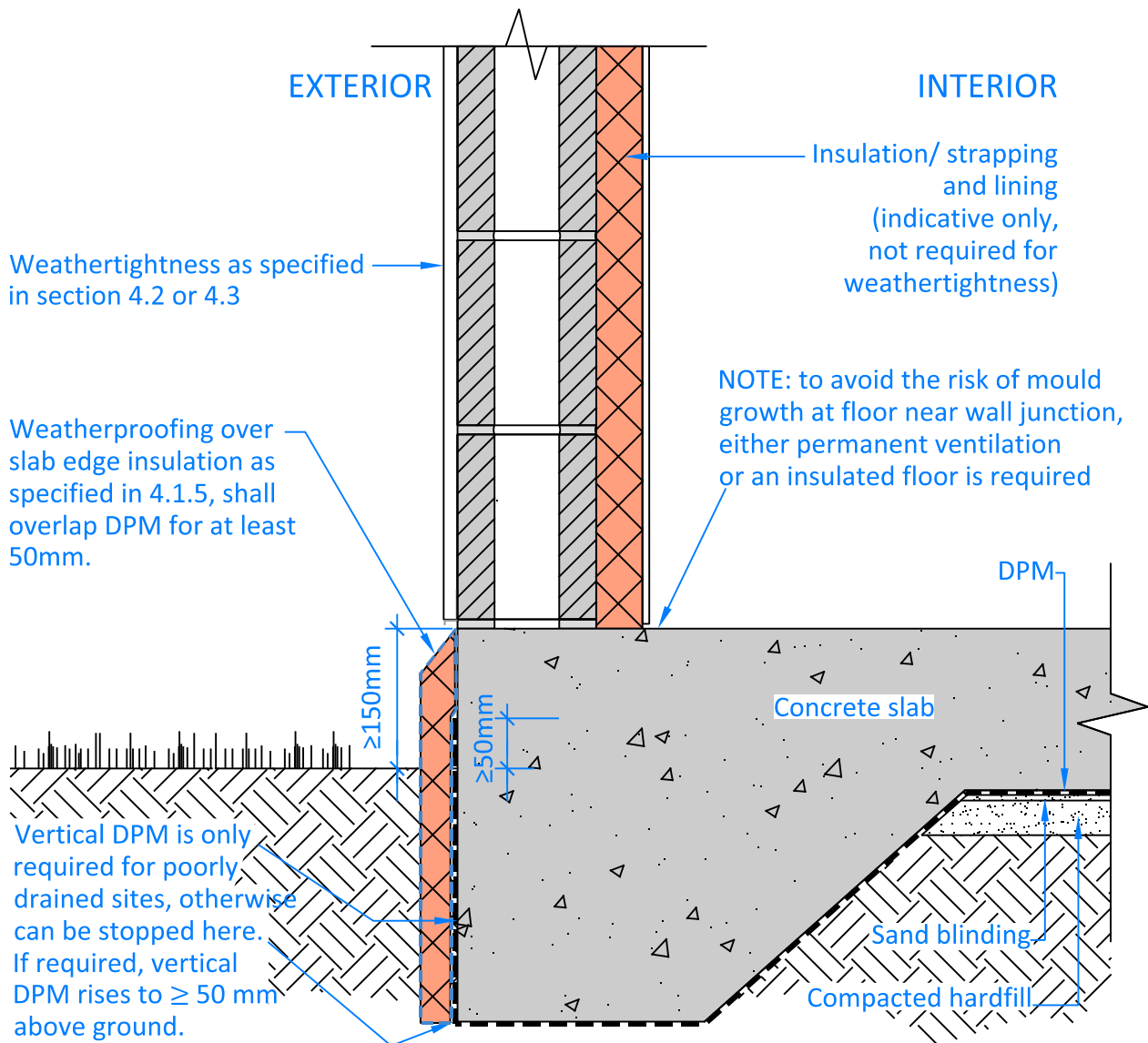
(not to scale)

Wall/ Footing Junction: Slab on Ground

Concrete Masonry Wall: internal & integral insulation

Wall with external clear coating

Wall type: A1, A3



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Comment 3: Structural layout is indicative only and subject to individual project design.

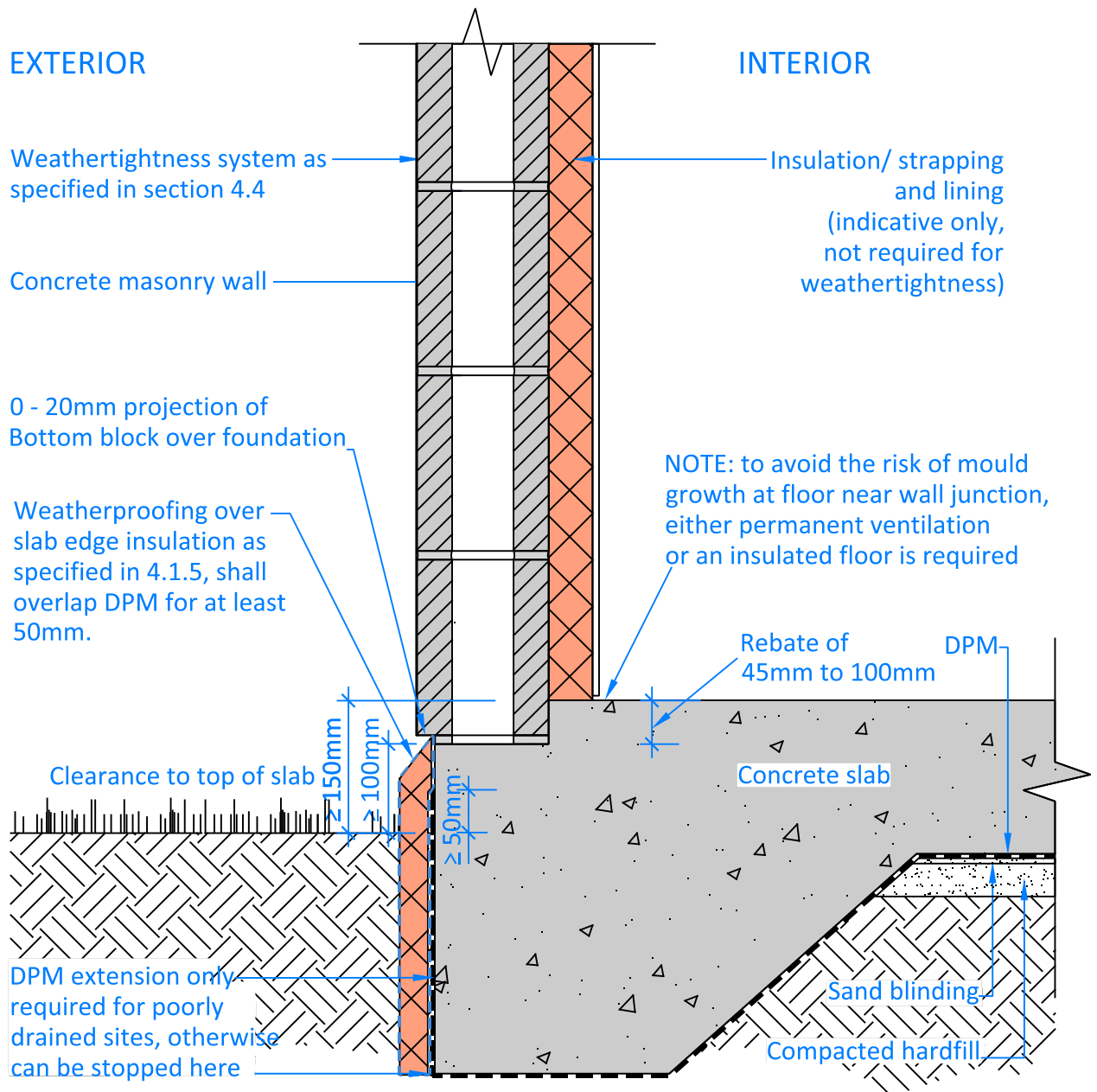
Detail 3c (for weathertightness system 4.2 and 4.3)

(not to scale)

Wall/ Footing Junction: Slab on Ground (no rebate)

Insitu and Masonry Wall: internal & integral insulation

Wall with slab edge insulation



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Comment 3: Structural layout is indicative only and subject to individual project design.

Detail 3d (for weathertightness system 4.4)

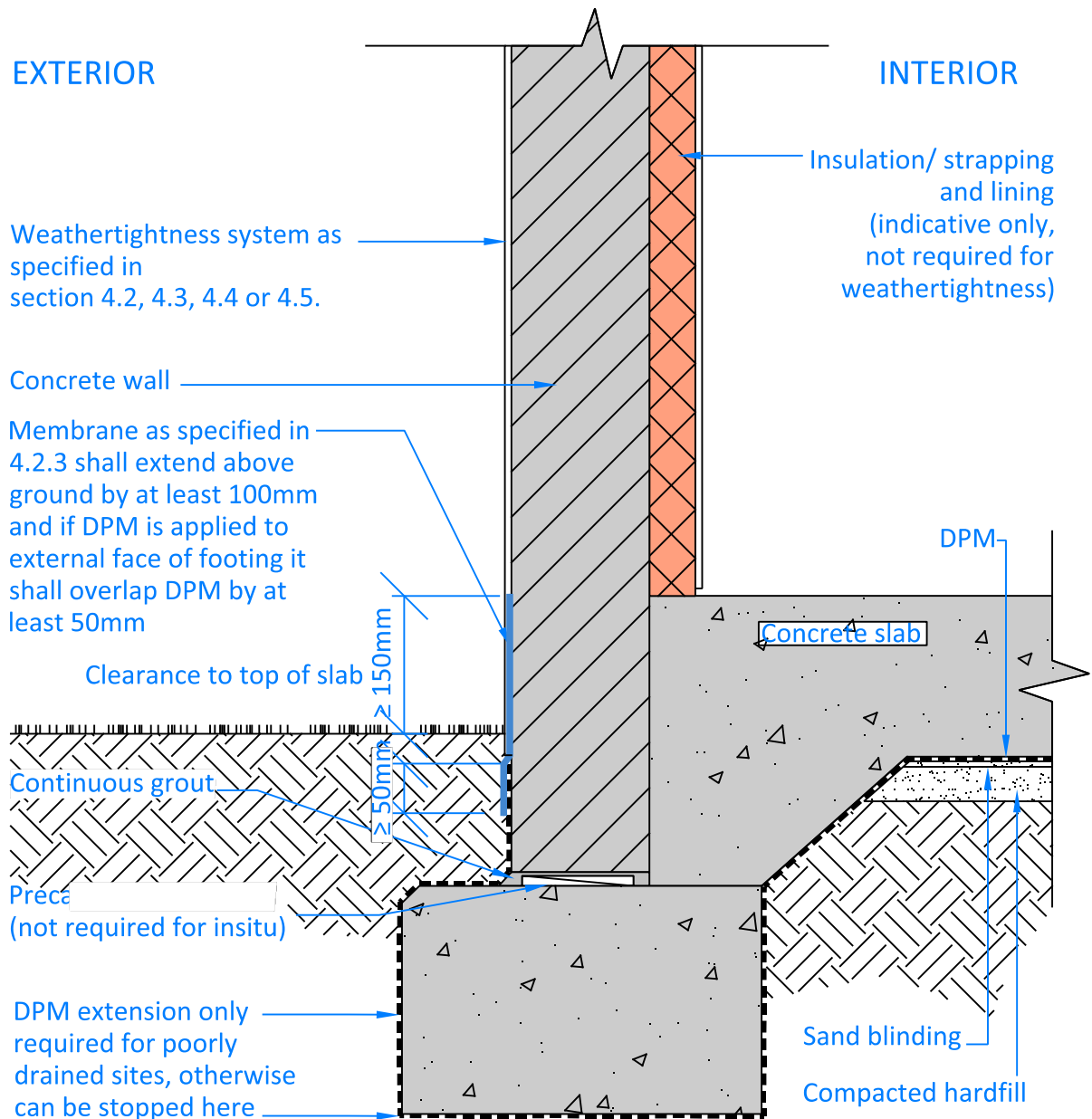
(not to scale)

Wall/ Footing Junction: Slab on Ground

Concrete Masonry Wall: internal & integral insulation

Wall with rebate and slab edge insulation

Wall type: A1, A3



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

Comment 2: Structural layout is indicative only and subject to individual project design.

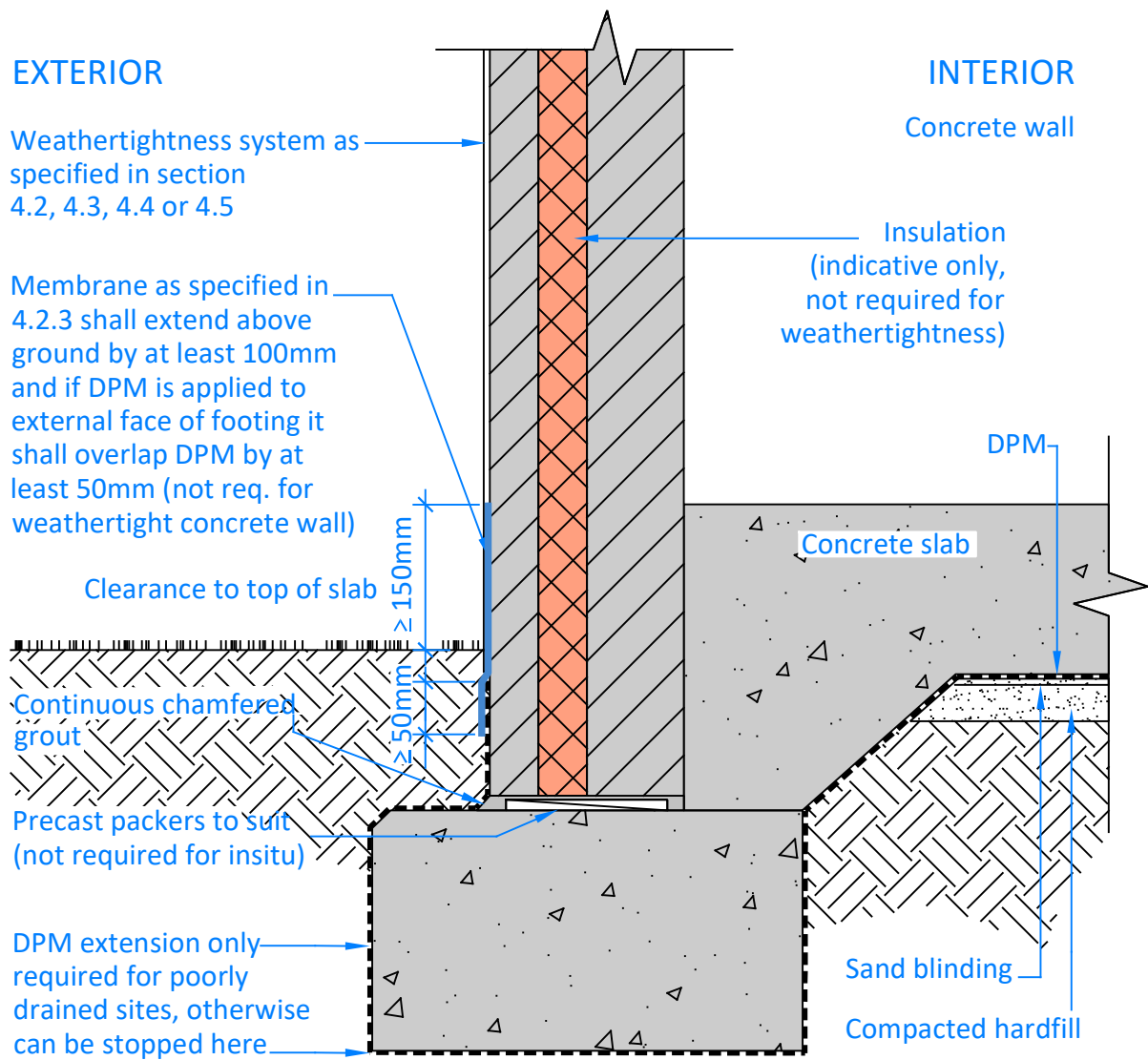
Detail 4

(not to scale)

Wall/ Footing Junction: Slab on Ground

Precast Wall: internal insulation

Wall type: C1



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

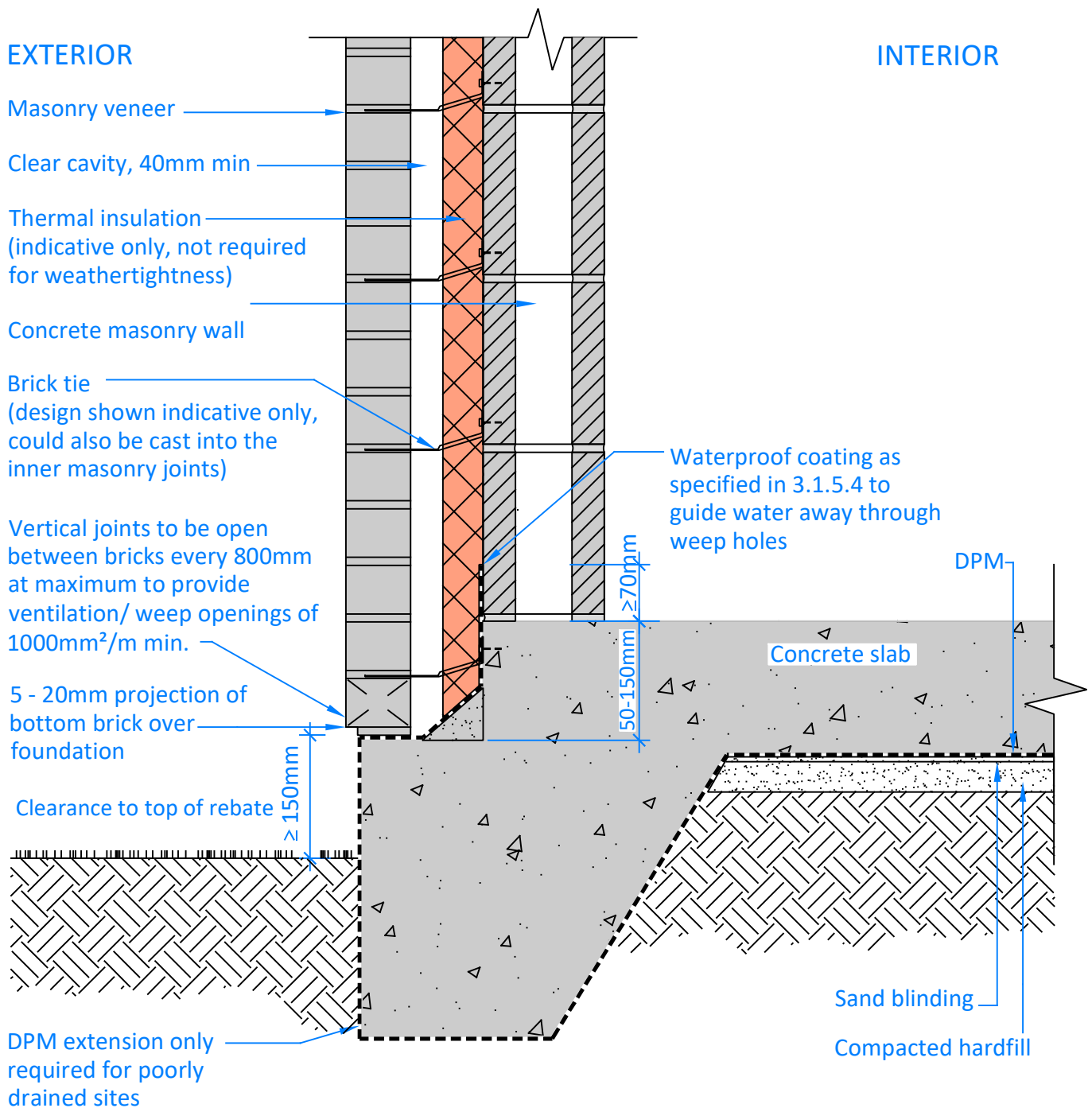
Comment 2: Structural layout is indicative only and subject to individual project design.

Detail 5

(not to scale)

Wall/ Footing Junction: Slab on Ground Insitu or Precast Wall: Integral Insulation

Wall type: B3, C3



Comment 1: Underfloor and/ or edge insulation not required for weathertightness, but may be required for NZBC/H1 compliance.

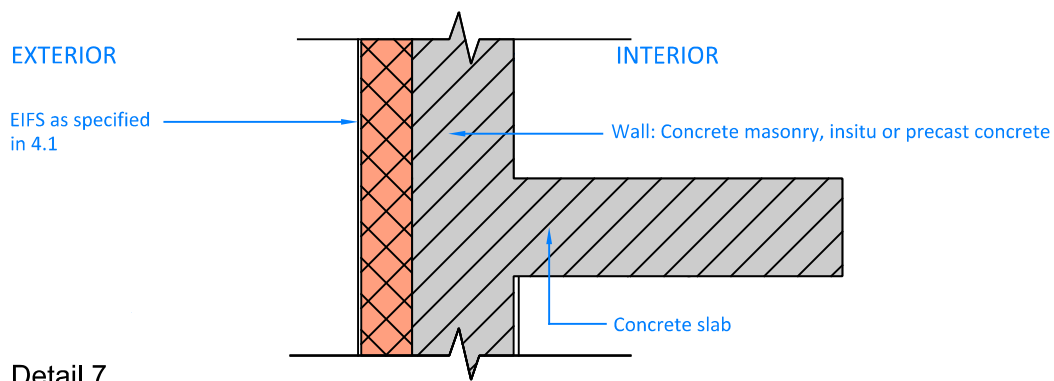
Comment 2: Structural layout is indicative only and subject to individual project design.

Detail 6

(not to scale)

Wall/ Footing Junction: Slab on Ground Concrete Masonry Wall With Drained Cavity

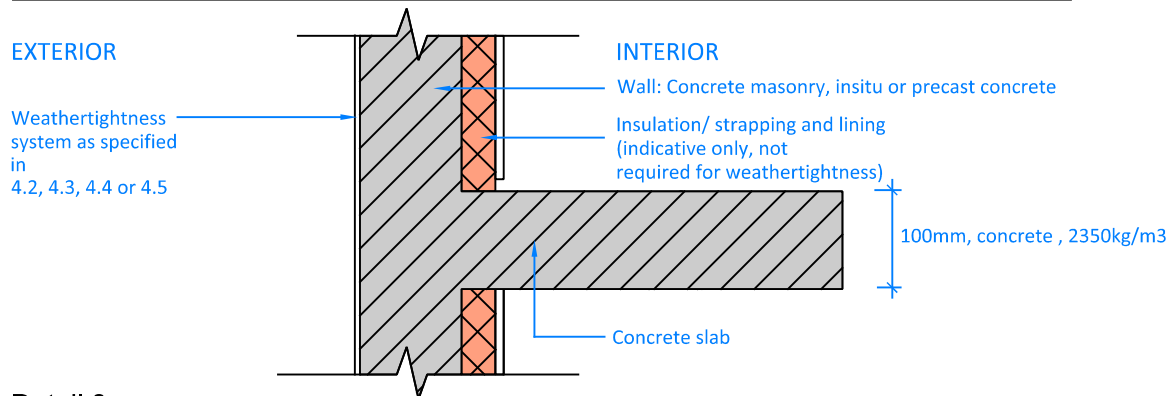
Wall type: A4



Detail 7

Wall/ Upper Floor Slab Junction

Concrete Masonry, Precast or Insitu: External Insulation Wall type: A2, B2, C2 (not to scale)

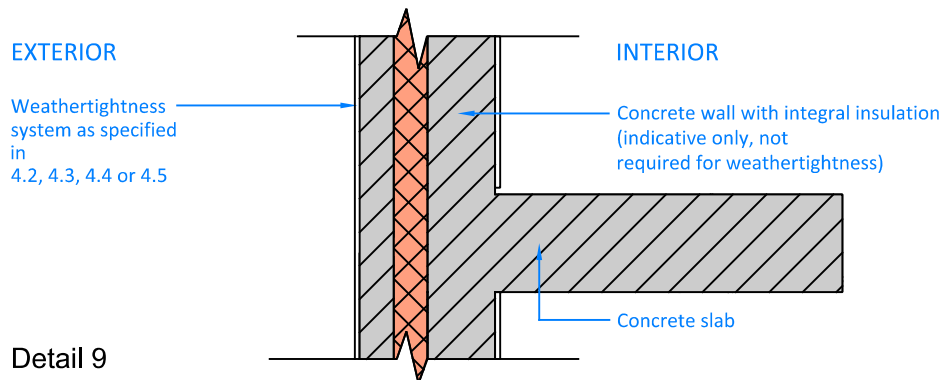


Detail 8

Wall/ Upper Floor Slab Junction

Concrete Masonry, Precast or Insitu: Internal Insulation Wall type: A1, B1, C1 (not to scale)

Comment: If masonry block with integral insulation applies, internal insulation may be ignored depending on required wall R value

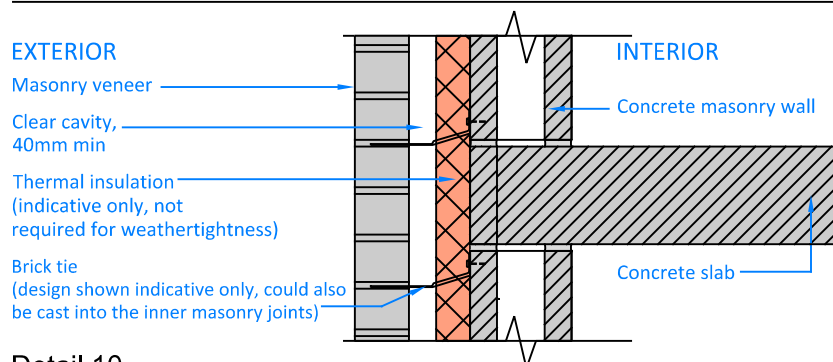


Detail 9

Wall/ Upper Floor Slab Junction

Precast or Insitu Wall: Integral Insulation

Wall type: A3, B3, C3 (not to scale)



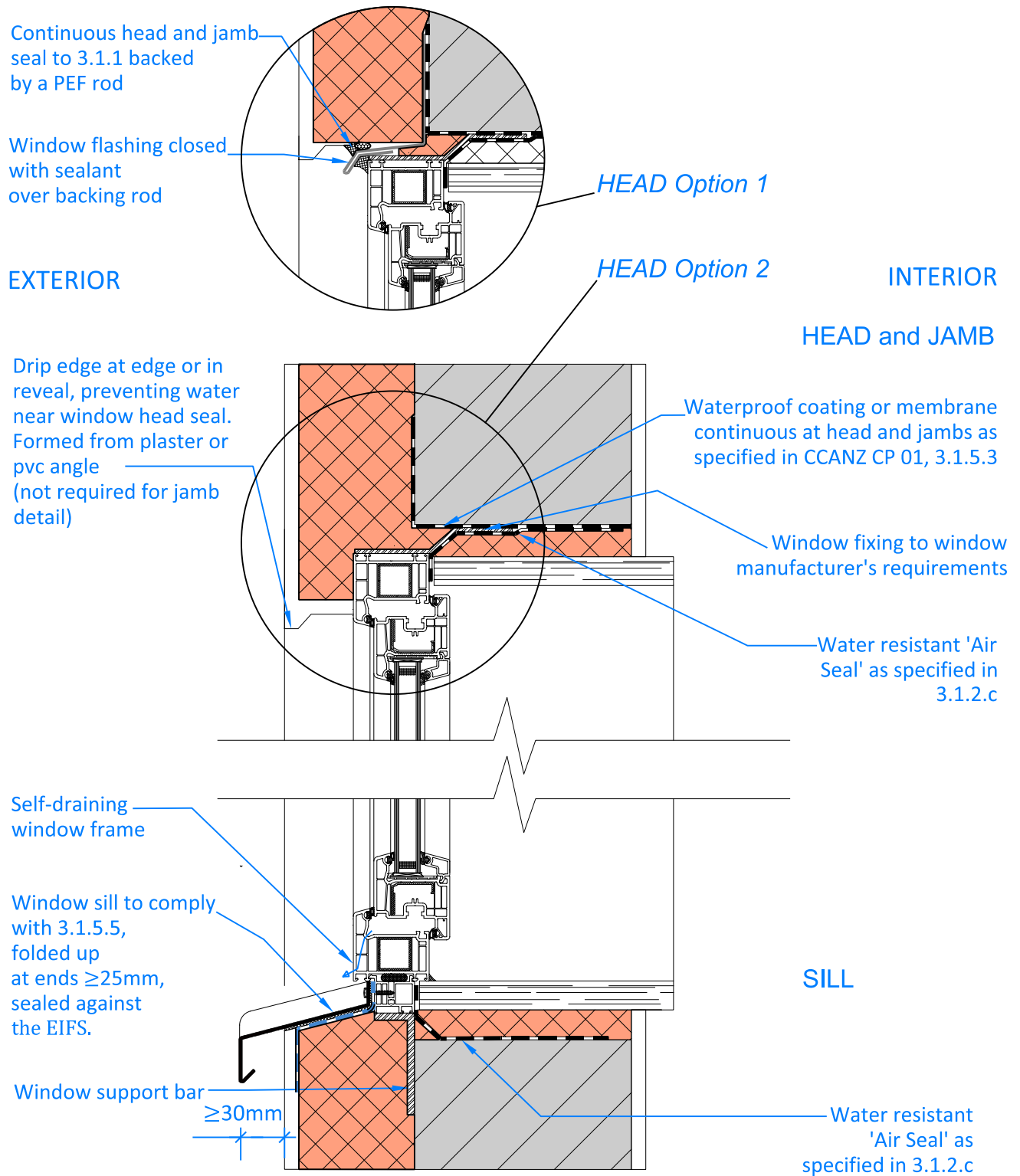
Detail 10

Wall/ Upper Floor Slab Junction

Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4 (not to scale)

Note 1: Structural layout is indicative only and subject to individual project design.



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: Window system shown is one of various options available to New Zealand.

Detail 11a

(not to scale)

Window - Head, Sill and Jamb Insitu or Precast Wall: EIFS

Wall type: A2, B2, C2

EXTERIOR

INTERIOR

Waterproof coating or membrane continuous at head and jambs as specified in CCANZ CP 01, 3.1.5.3

Drip edge at edge or in reveal, preventing water near window head seal. Formed from plaster or pvc angle (not required for jamb detail)

Membrane for plaster as specified in CCANZ CP 01, 4.2.3

Insulation wraps into recess

Continuous head and jamb seal to CCANZ CP 01, 3.1.1 backed by a PEF rod

Self-draining window frame

Frame to provide min. 10mm overhang, with 5mm min drainage clearance (vertical and horizontal)

EIFS plaster as specified in CCANZ CP 01, 4.2 over concrete sill sloping at least 15°

Membrane for plaster as specified in CCANZ CP 01, 4.2.3 across sill

EIFS as specified in CCANZ CP 01, 4.1

HEAD and JAMB

Water resistant 'Air Seal' as specified under 3.1.2.b, backed by a PEF rod to perimeter of trim cavity

≥50mm
≥5mm
applies also to jamb and sill

SILL

Window frame fixed to blockwork, and packed as required.

Sill membrane as specified in CCANZ CP 01, 3.1.5.4 beneath window/door to run along the entire sill, down the face and on external slope and also min. 40mm up jambs

Water resistant 'Air Seal' as specified in CCANZ CP 01, 3.1.2.b backed by a PEF rod to perimeter of trim cavity

Comment 1: Structural layout is indicative only and subject to individual project design.
Comment 2: Window system shown is one of various options available to New Zealand.

Detail 11b

(not to scale)

Window - Head, Sill and Jamb Concrete Masonry Wall: EIFS

EXTERIOR

INTERIOR

Waterproof coating or membrane continuous at head and jambs as specified in 3.1.5.3

Plaster or coating finish as specified in 4.2, 4.3, 4.4, 4.5

Plaster membrane as specified in 4.2.3
(not required for weathertightness system 4.3 and 4.4)

Drip edge formed from plaster or pvc angle

Continuous head and jamb seal as specified in 3.1.2 backed by a PEF rod

Window frame fixed to blockwork, and packed as required.

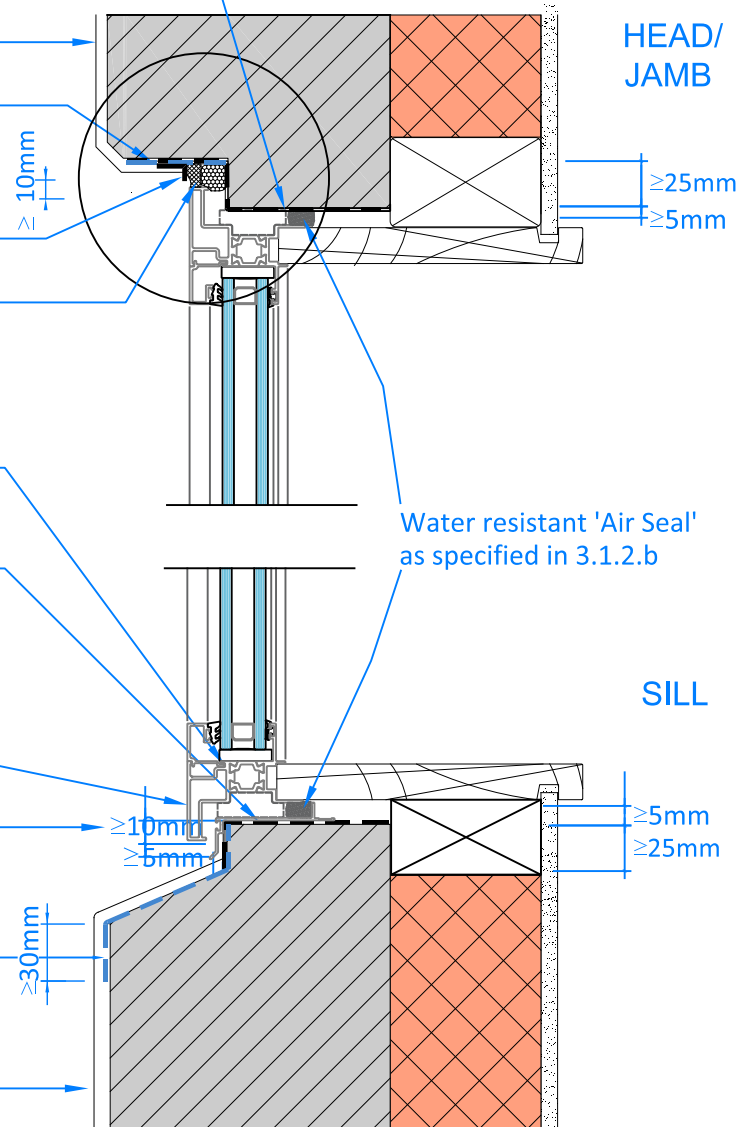
Sill membrane as specified in 3.1.5.4 beneath window/ door to run along the entire sill and down the external face of the sill and min. 40mm up jambs

Self-draining window frame

Sill profile to provide min. 10mm overhang, with 5mm drainage clearance (vertical and horizontal)

Plaster membrane as specified in 4.2.3
(not required for weathertightness system 4.3 and 4.4)

Weathertightness system as specified in 4.2, 4.3, 4.4 or 4.5



Comment 1: Window system shown is one of various options available to New Zealand.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Comment 3: Structural layout is indicative only and subject to individual project design.

Detail 13

(not to scale)

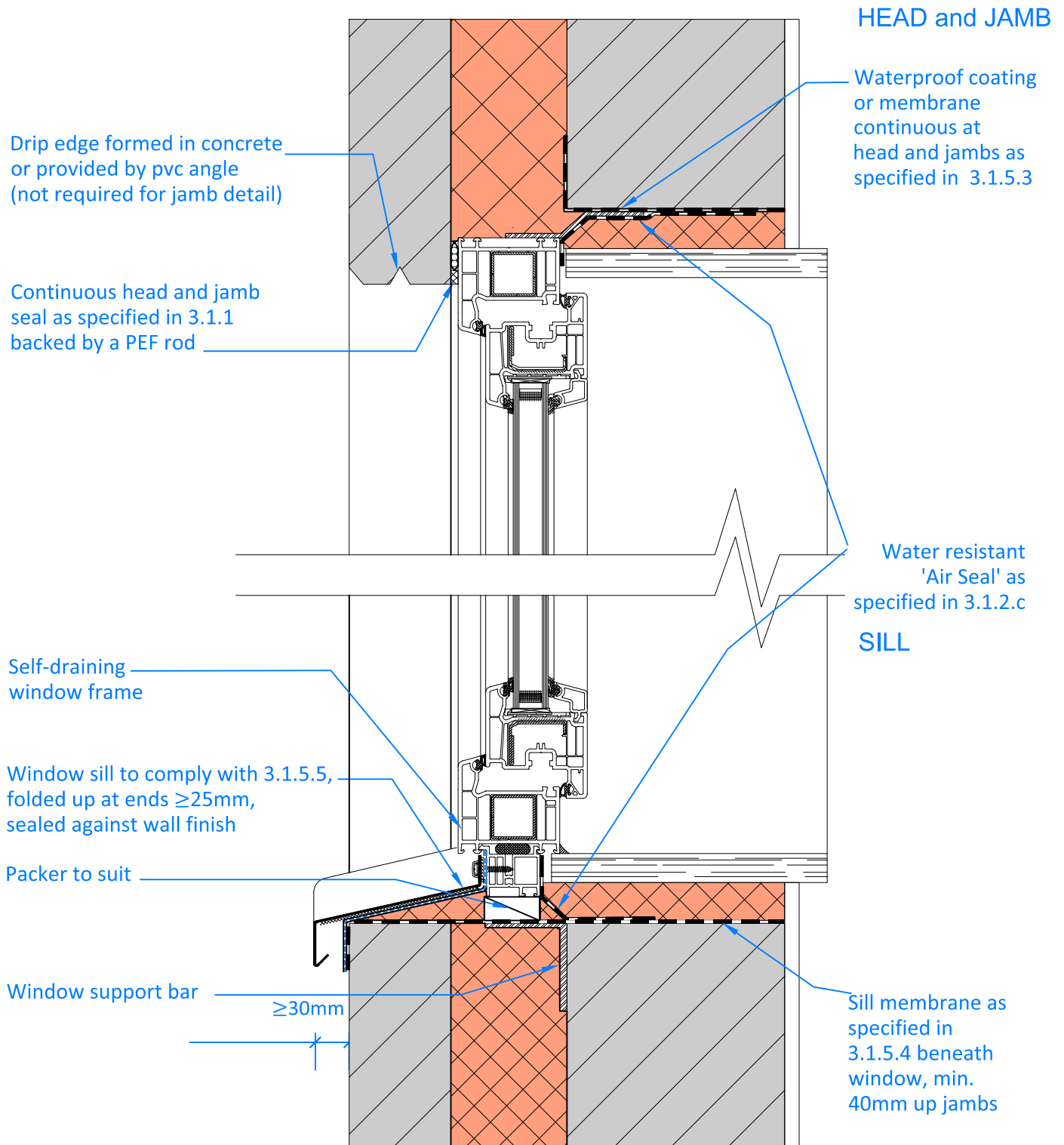
Window - Head, Sill and Jamb

Insitu, Precast, Masonry Wall: Internal or integral Insulation

Wall type: A1, B1, C1

EXTERIOR

INTERIOR



Comment 1: Structural layout is indicative only and subject to individual project design.

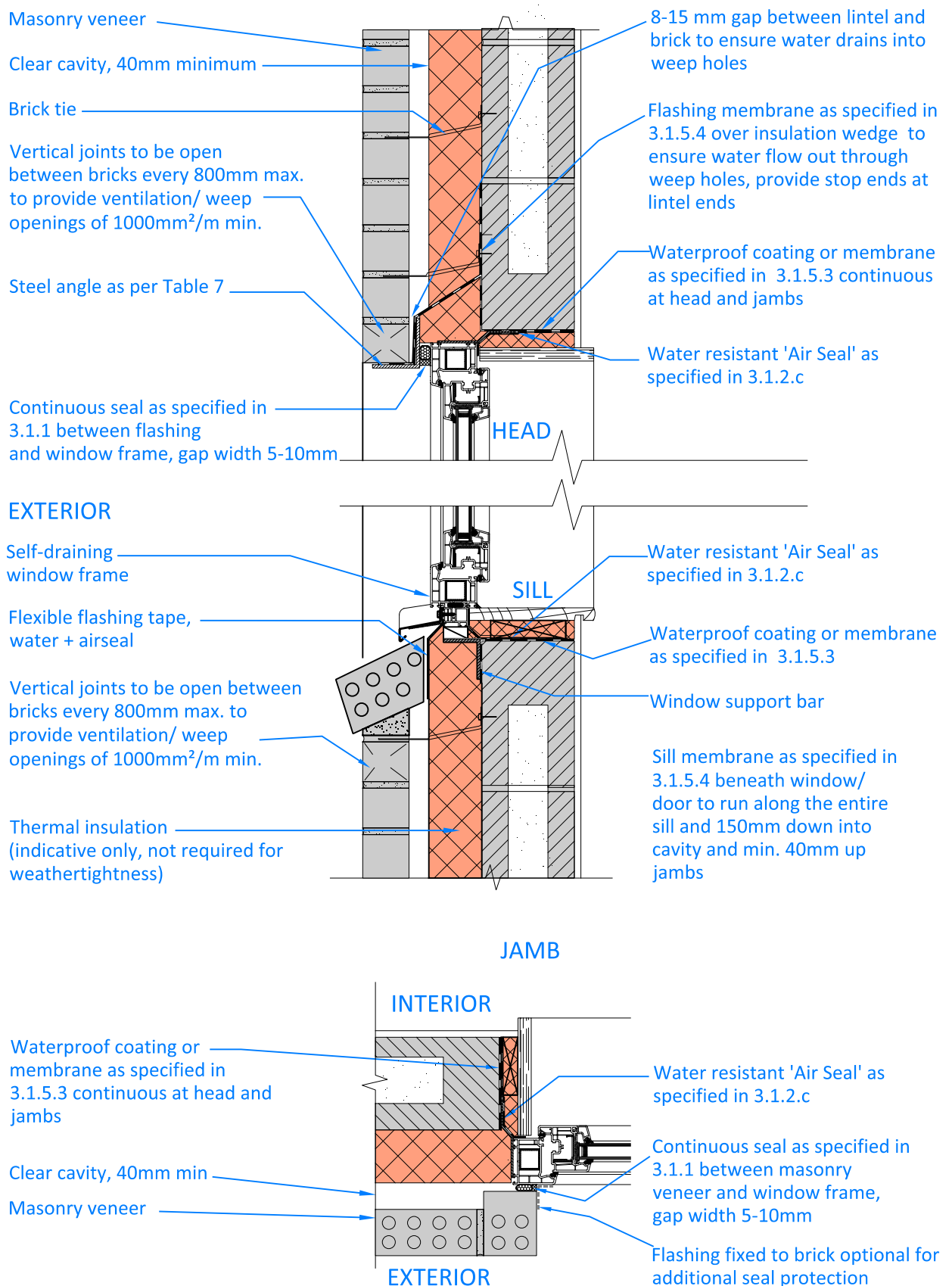
Comment 2: Window system shown is one of various options available to New Zealand.

Detail 14

(not to scale)

Window - Head, Sill and Jamb Insitu or Precast Wall: EIFS

Wall type: A2, B2, C2



Comment 1: Structural layout is indicative only and subject to individual project design.

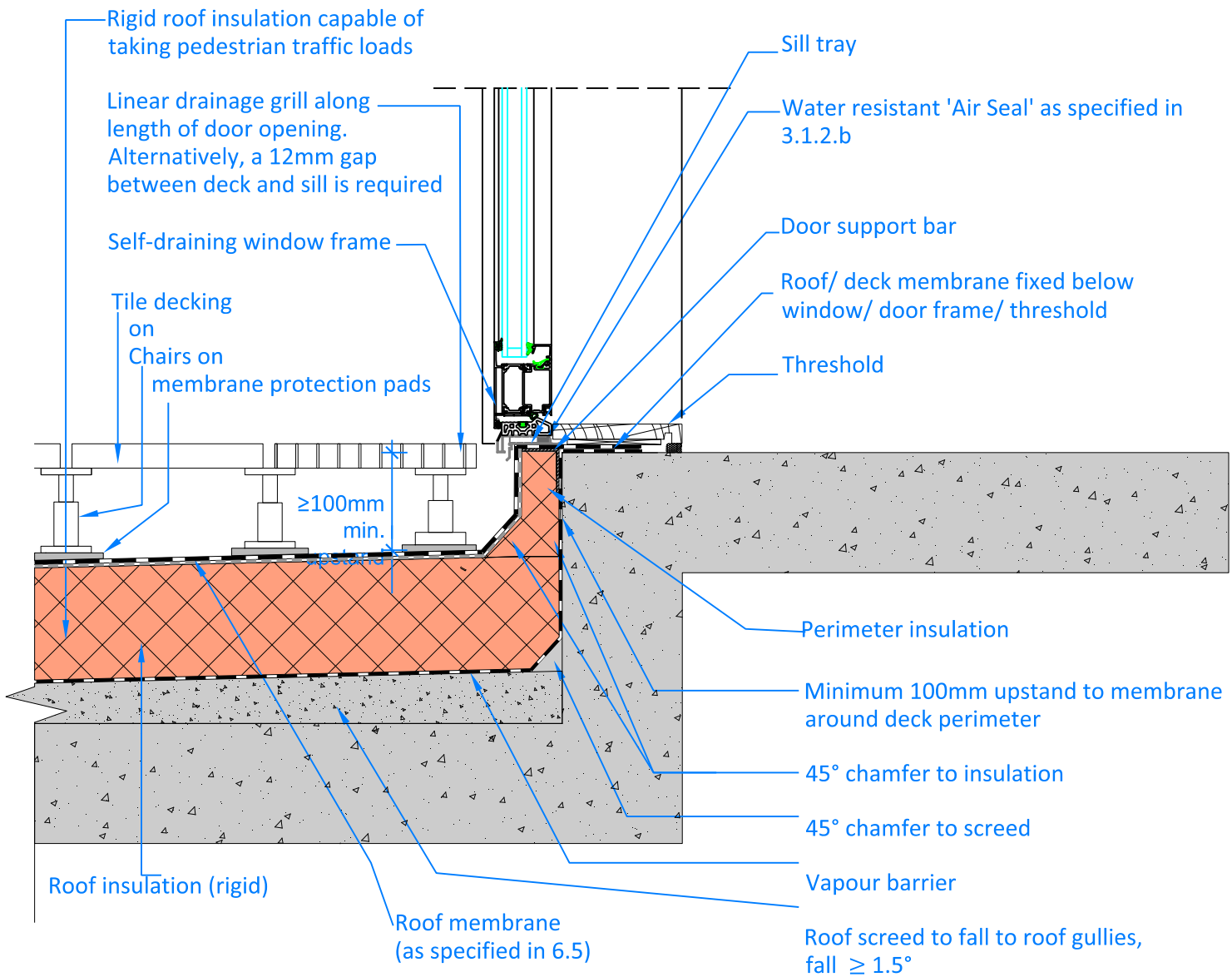
Comment 2: Thermal insulation is not required for weathertightness.

Detail 15b Window - Head, Sill and Jamb Concrete Masonry Wall With Drained Cavity Wall type: A4

(not to scale)

EXTERIOR

INTERIOR



Comment 1: Refer to detail 52 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

Comment 3: Window system shown is one of various options available to New Zealand.

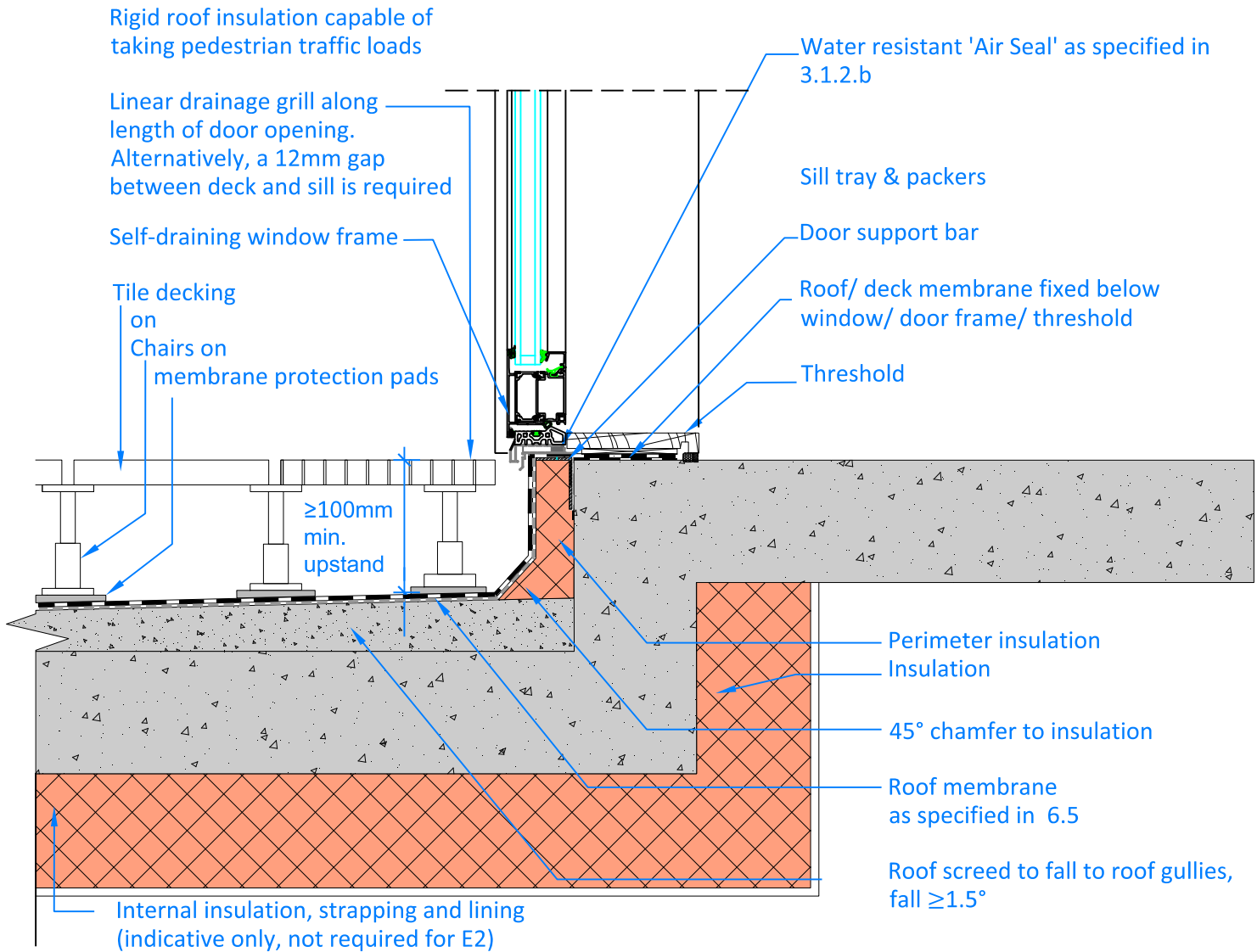
Detail 16

(not to scale)

Door Threshold at Deck, External Deck Insulation

EXTERIOR

INTERIOR



Comment 1: Refer to detail 52 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

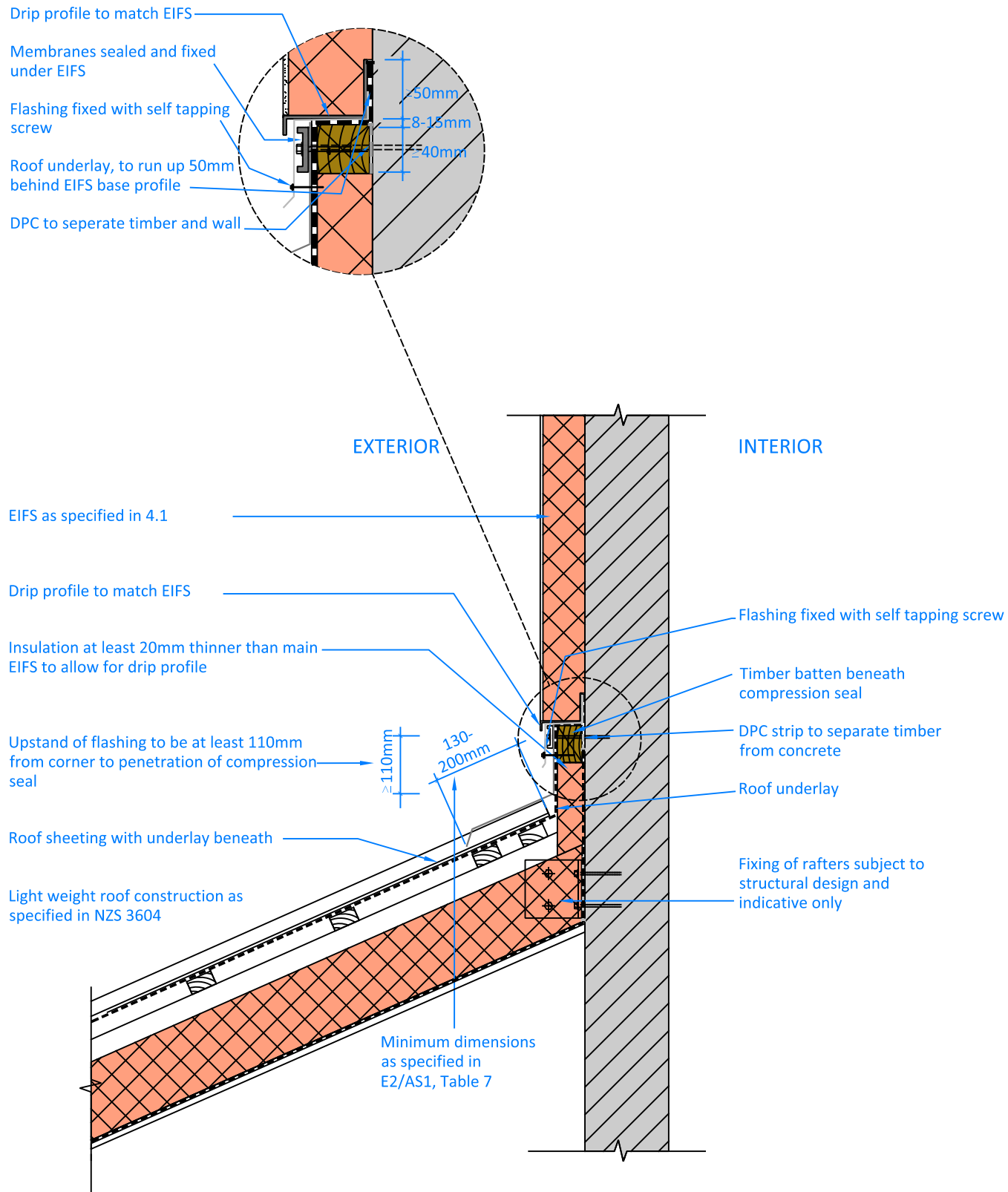
Comment 3: Window system shown is one of various options available to New Zealand.

Comment 4: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 17

(not to scale)

Door Threshold at Deck, Internal Deck Insulation



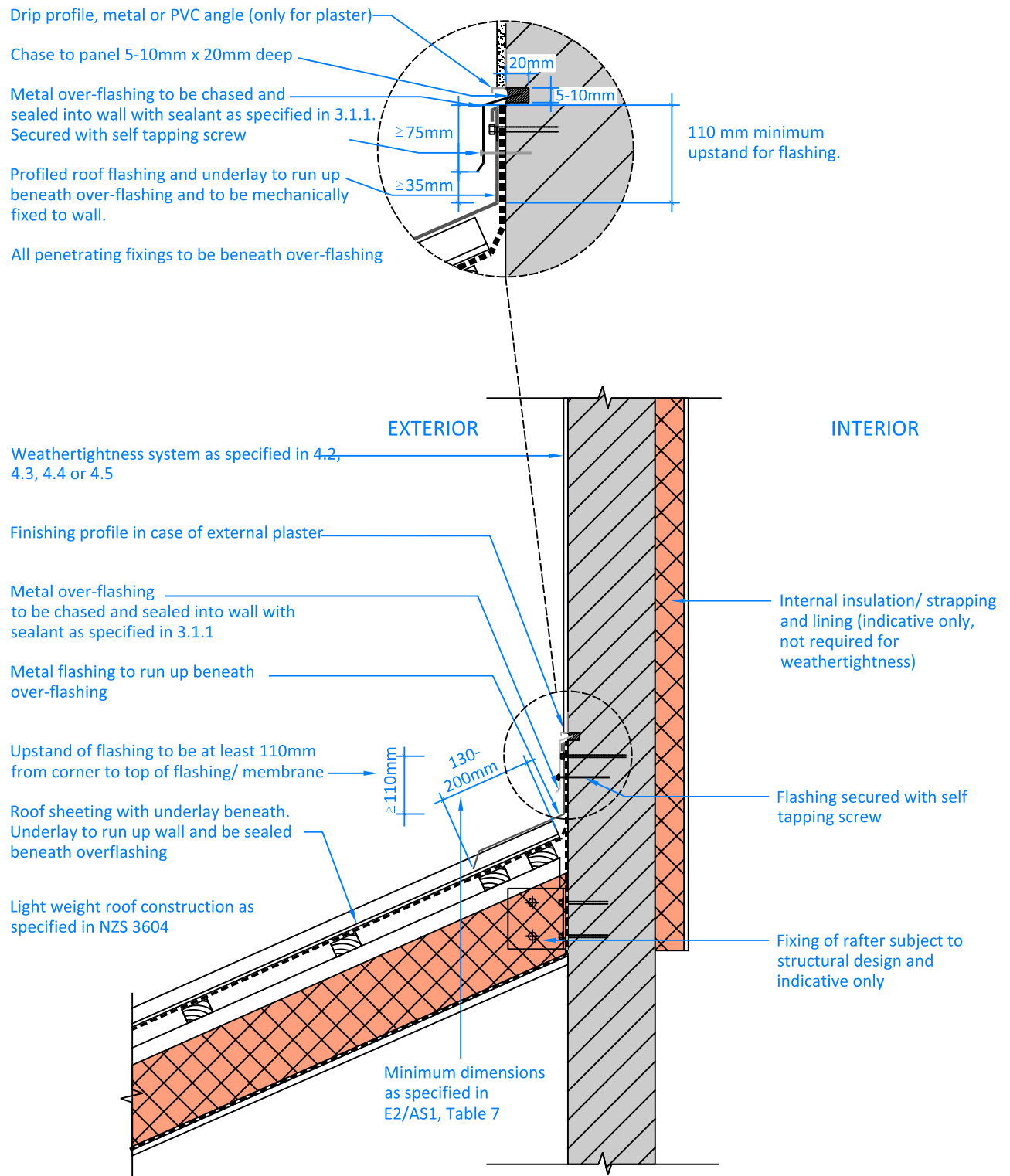
Comment: Structural layout is indicative only and subject to individual project design.

Detail 18

Wall/ Pitched Roof Junction: Apron Flashing
Concrete Masonry, Insitu or Precast: EIFS

Wall type: A2, B2, C2

(not to scale)



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

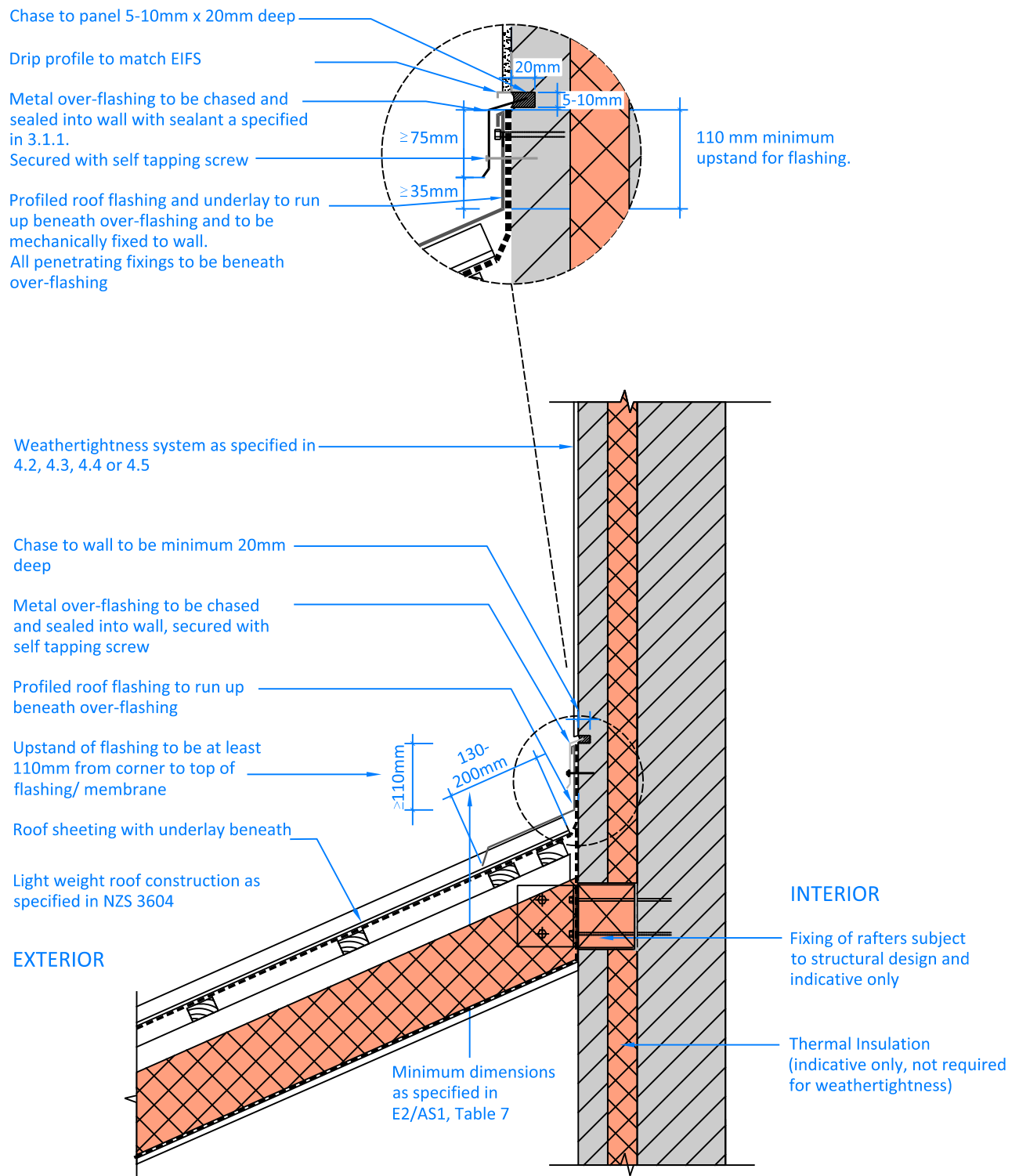
Detail 19

(not to scale)

Wall/ Pitched Roof Junction: Apron Flashing

Concrete Masonry, Insitu or Precast: Internal Insulation

Wall type: A1, A3, B1, C1



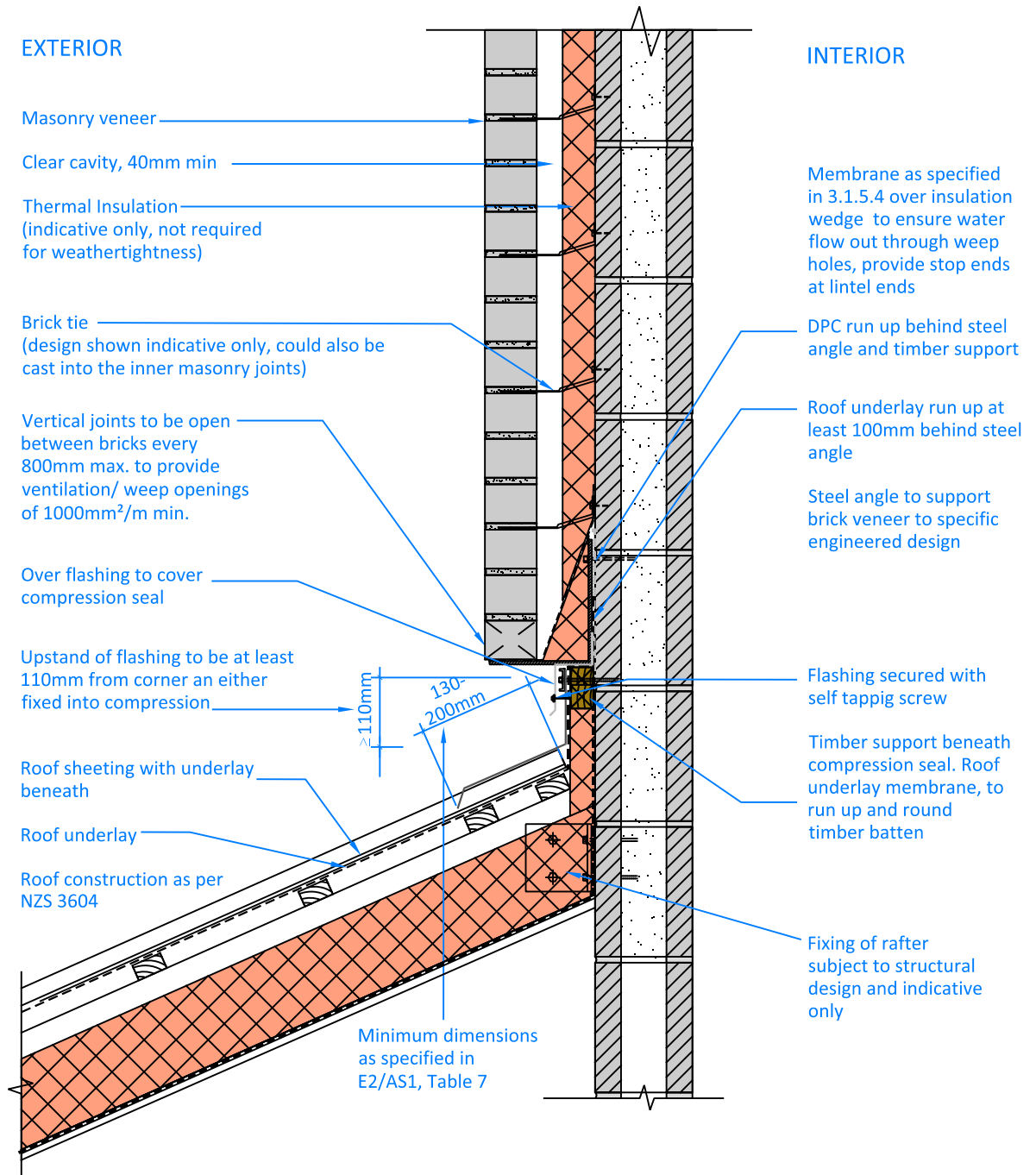
Comment: Structural layout is indicative only and subject to individual project design.

Detail 20

Wall/ Pitched Roof Junction: Apron Flashing Insitu or Precast Walls: Integral Insulation

Wall type: B3, C3

(not to scale)



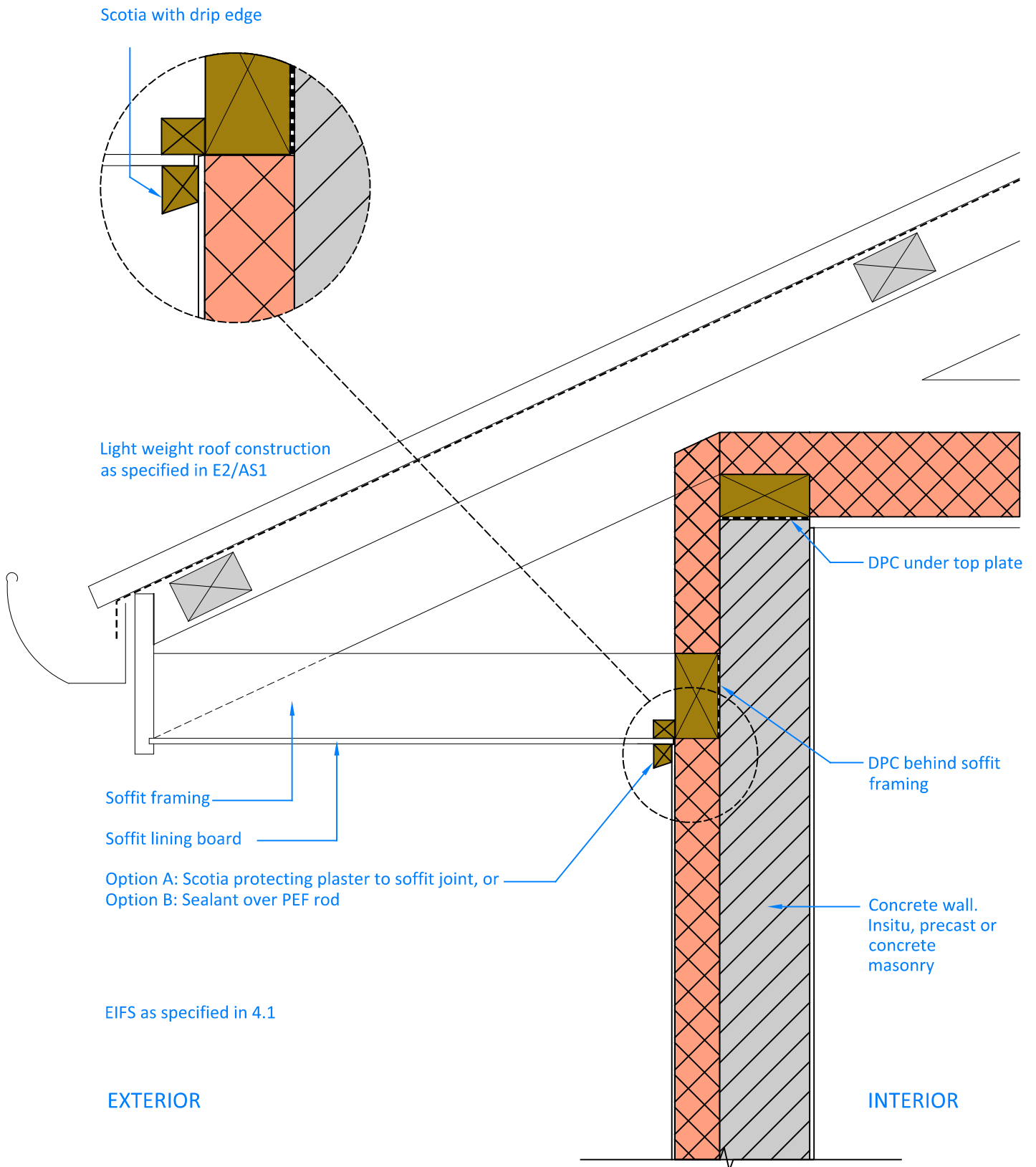
Comment: Structural layout is indicative only and subject to individual project design.

Detail 21

(not to scale)

Wall/ Pitched Roof Junction: Apron Flashing Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



Comment: Structural layout is indicative only and subject to individual project design.

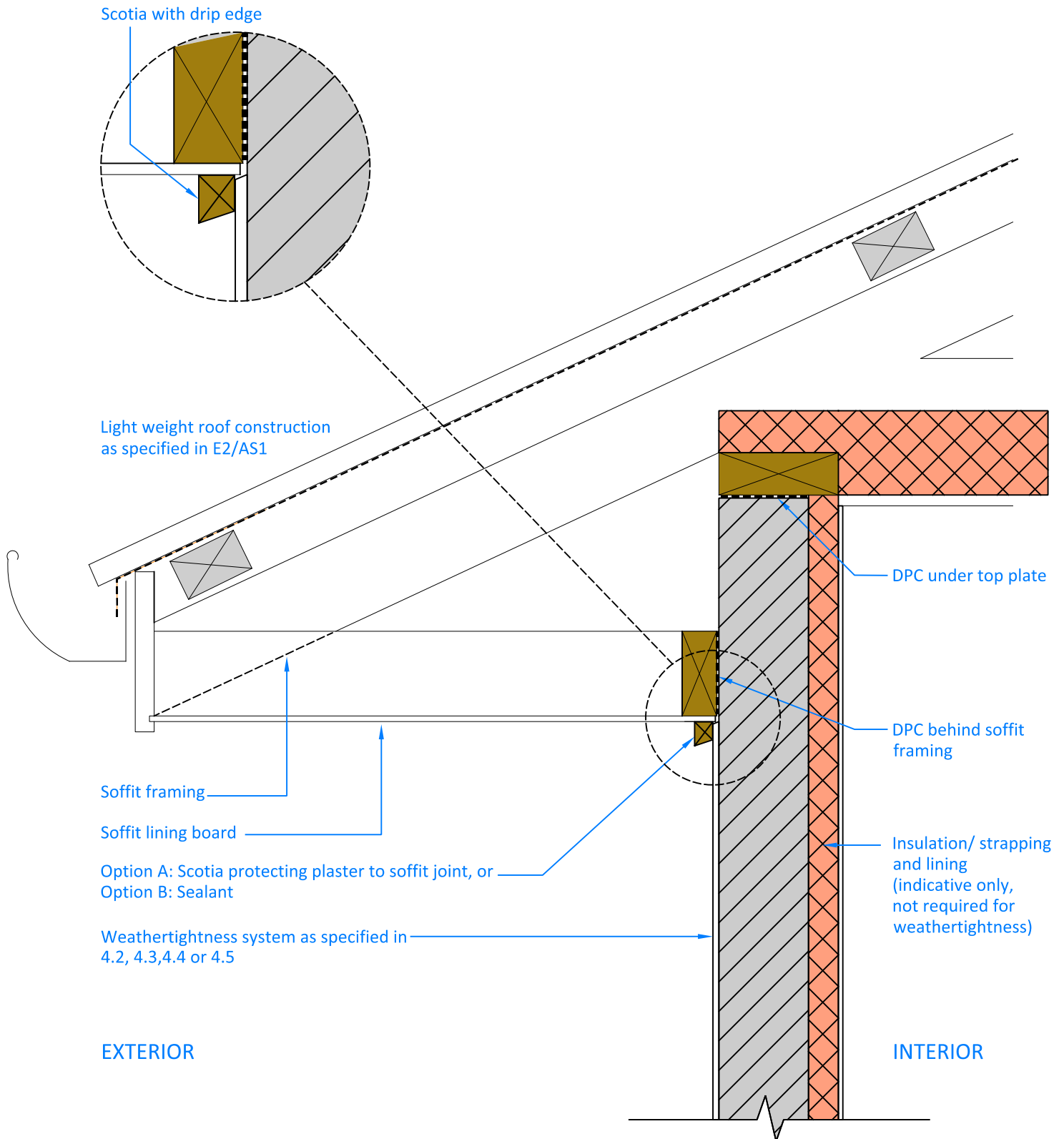
Detail 22

Wall/ Pitched Roof: Eaves Junction

Concrete Masonry, Precast or Insitu: EIFS

Wall type: A2, B2, C2

(not to scale)



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

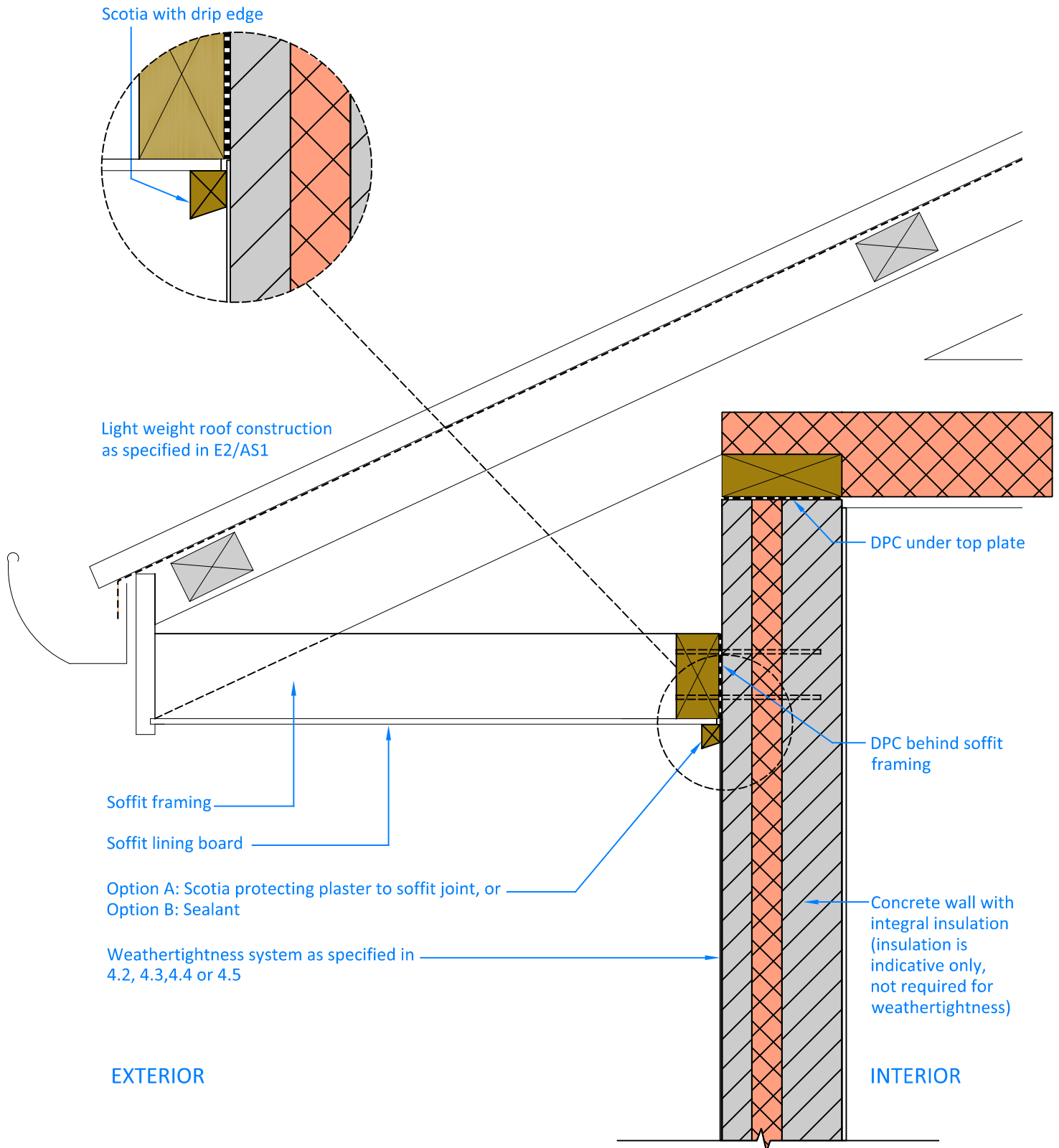
Detail 23

(not to scale)

Wall/ Pitched Roof: Eaves Junction

Concrete Masonry, Precast or Insitu: Internal Insulation

Wall type: A1, A3, B1, C1



Comment: Structural layout is indicative only and subject to individual project design.

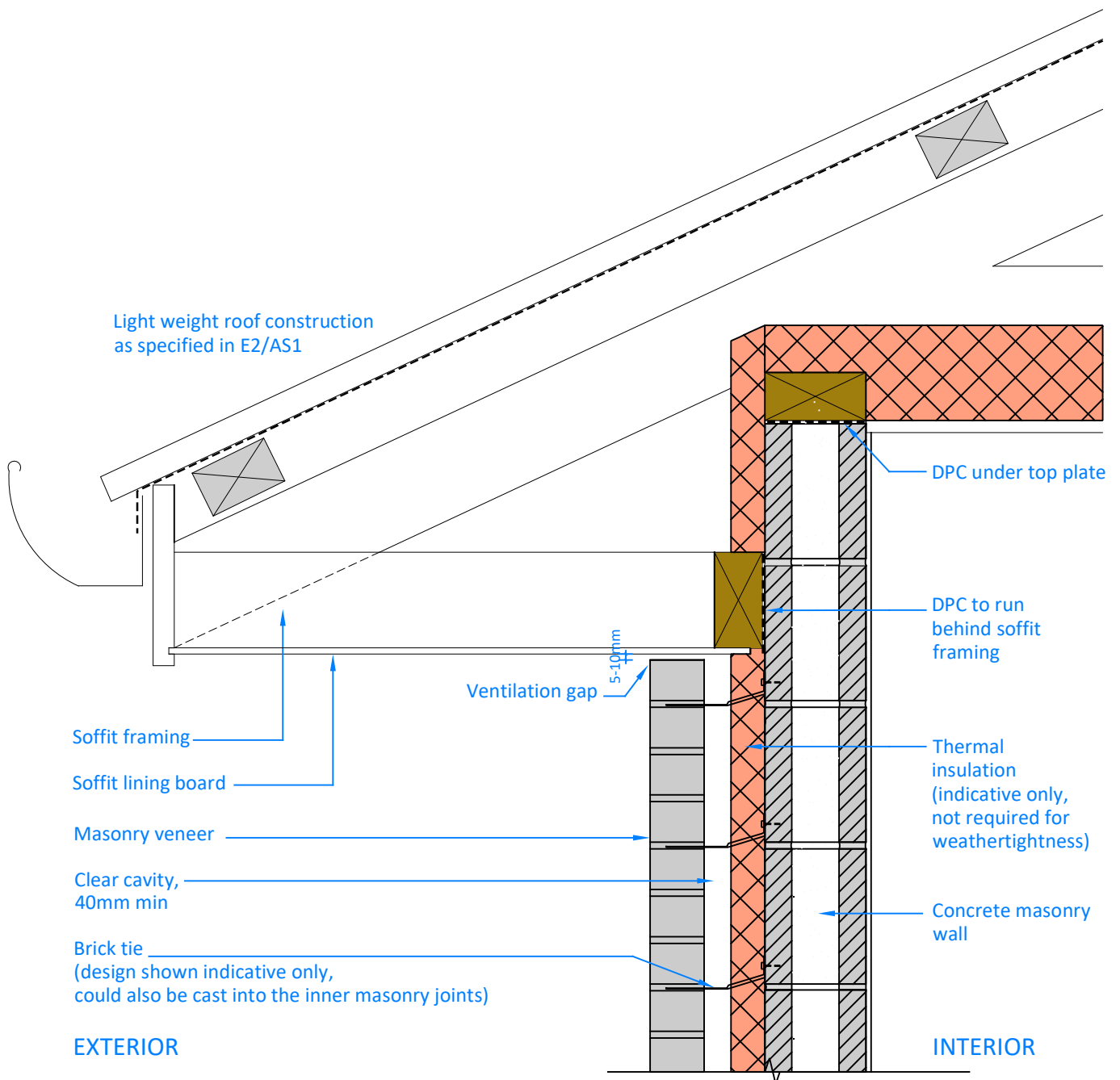
Detail 24

Wall/ Pitched Roof: Eaves Junction

Precast or Insitu Wall: Integral Insulation

Wall type: B3, C3

(not to scale)



Comment: Structural layout is indicative only and subject to individual project design.

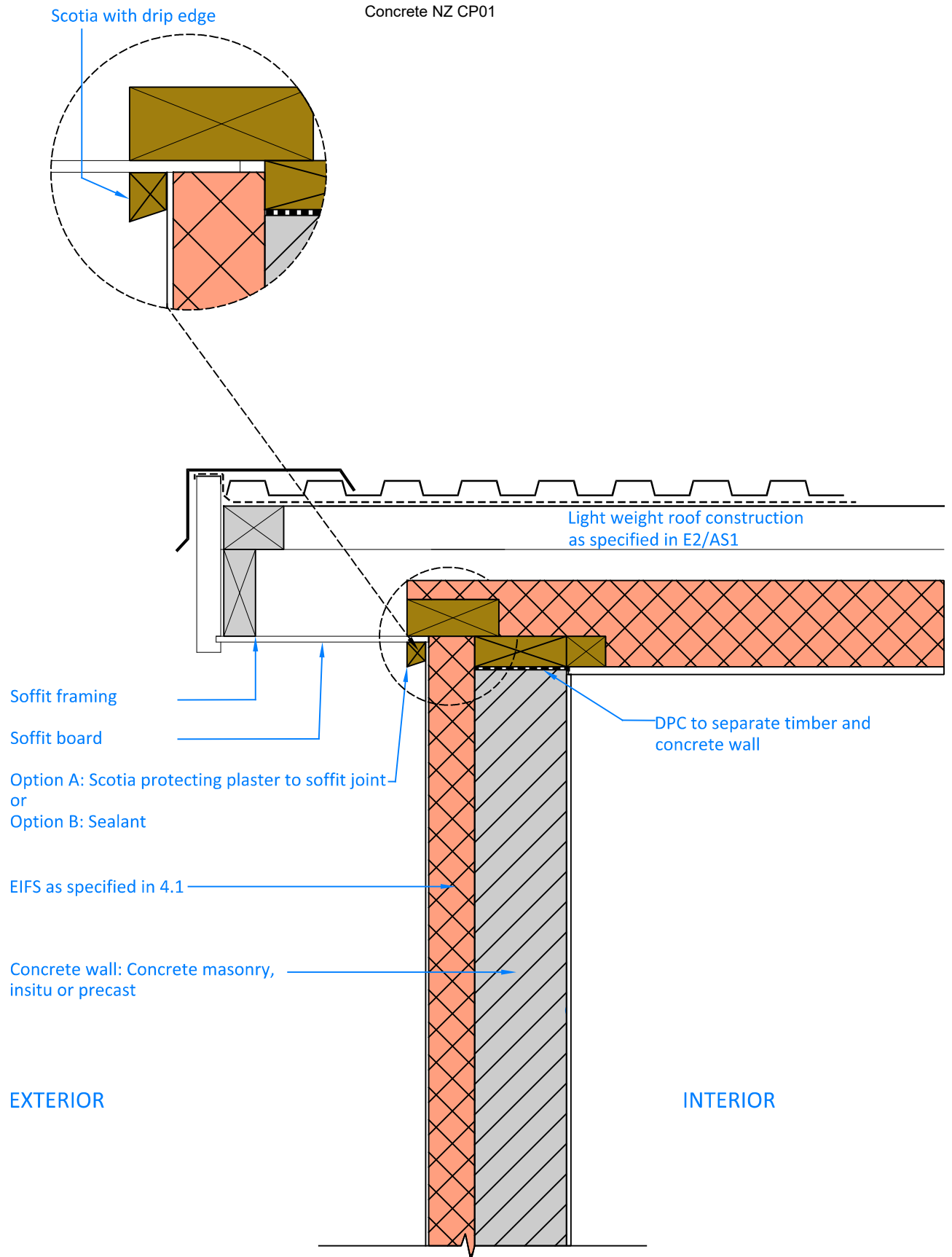
Detail 25

(not to scale)

Wall/ Pitched Roof: Eaves Junction

Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



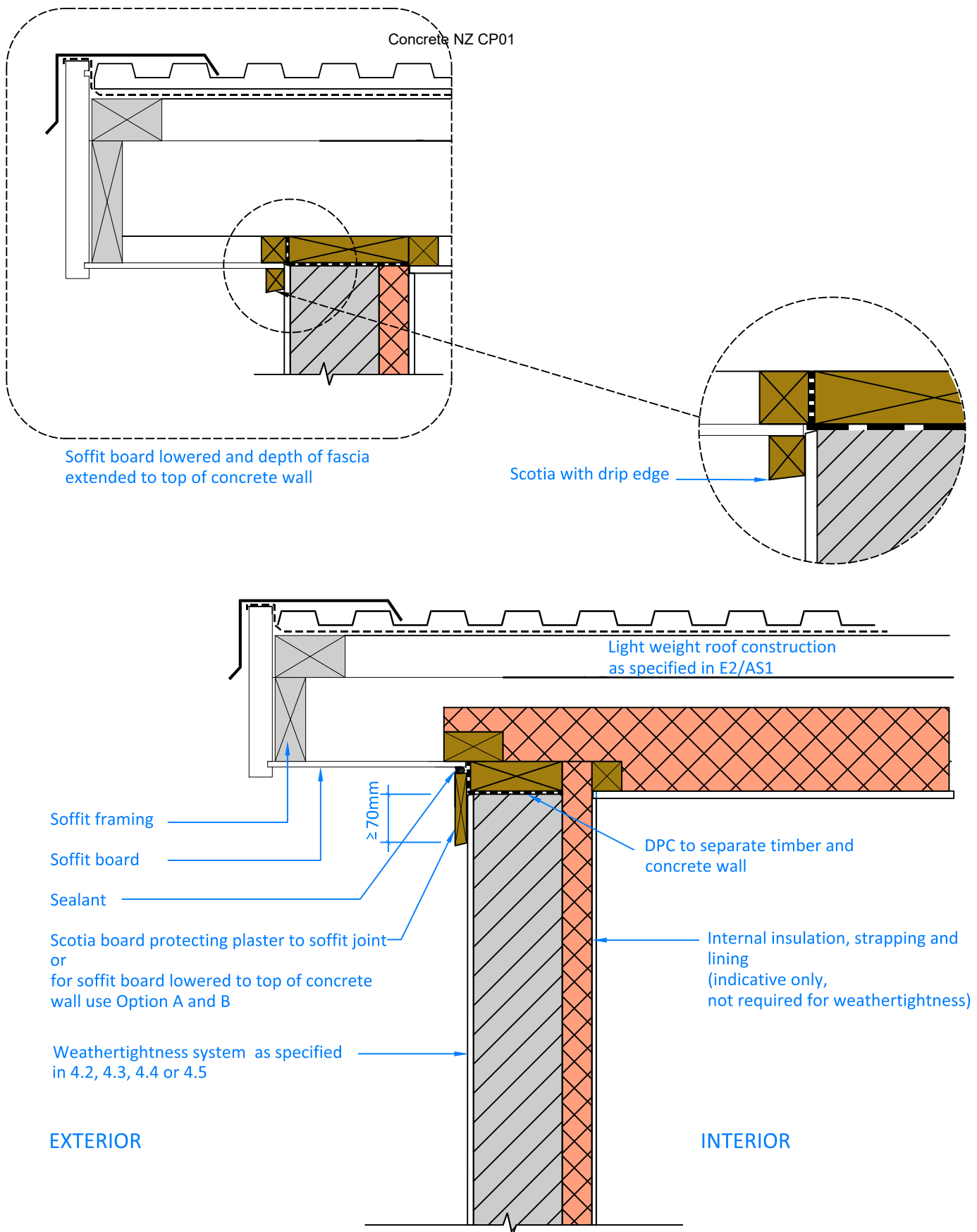
Comment: Structural layout is indicative only and subject to individual project design.

Detail 26

(not to scale)

Wall/ Pitched Roof Junction: Verge Detail
Concrete Masonry, Precast or Insitu: EIFS

Wall type: A2, B2, C2



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

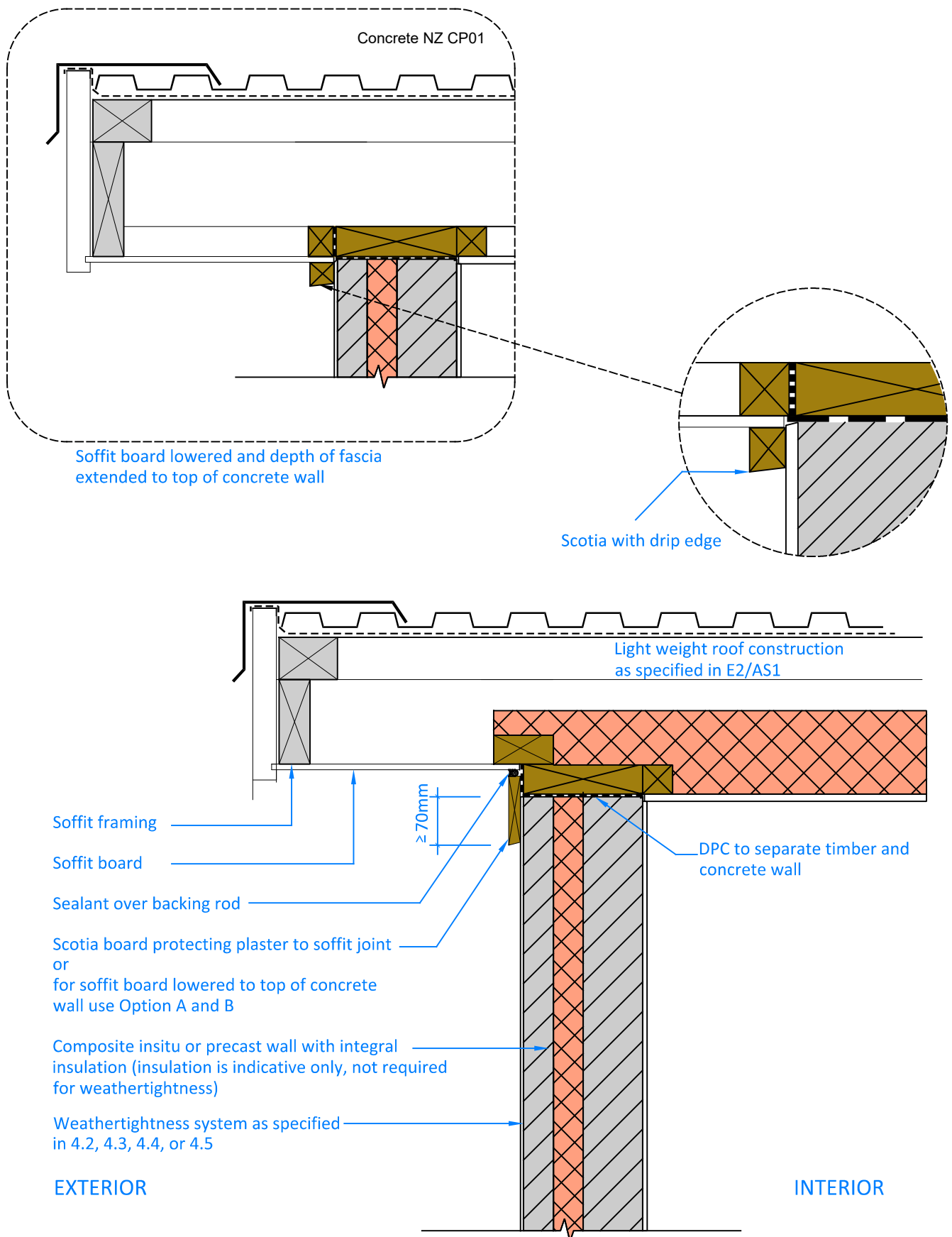
Detail 27

(not to scale)

Wall/ Pitched Roof Junction: Verge Detail

Concrete Masonry, Precast or Insitu: Internal Insulation

Wall type: A1, A3, B1, C1



Comment: Structural layout is indicative only and subject to individual project design.

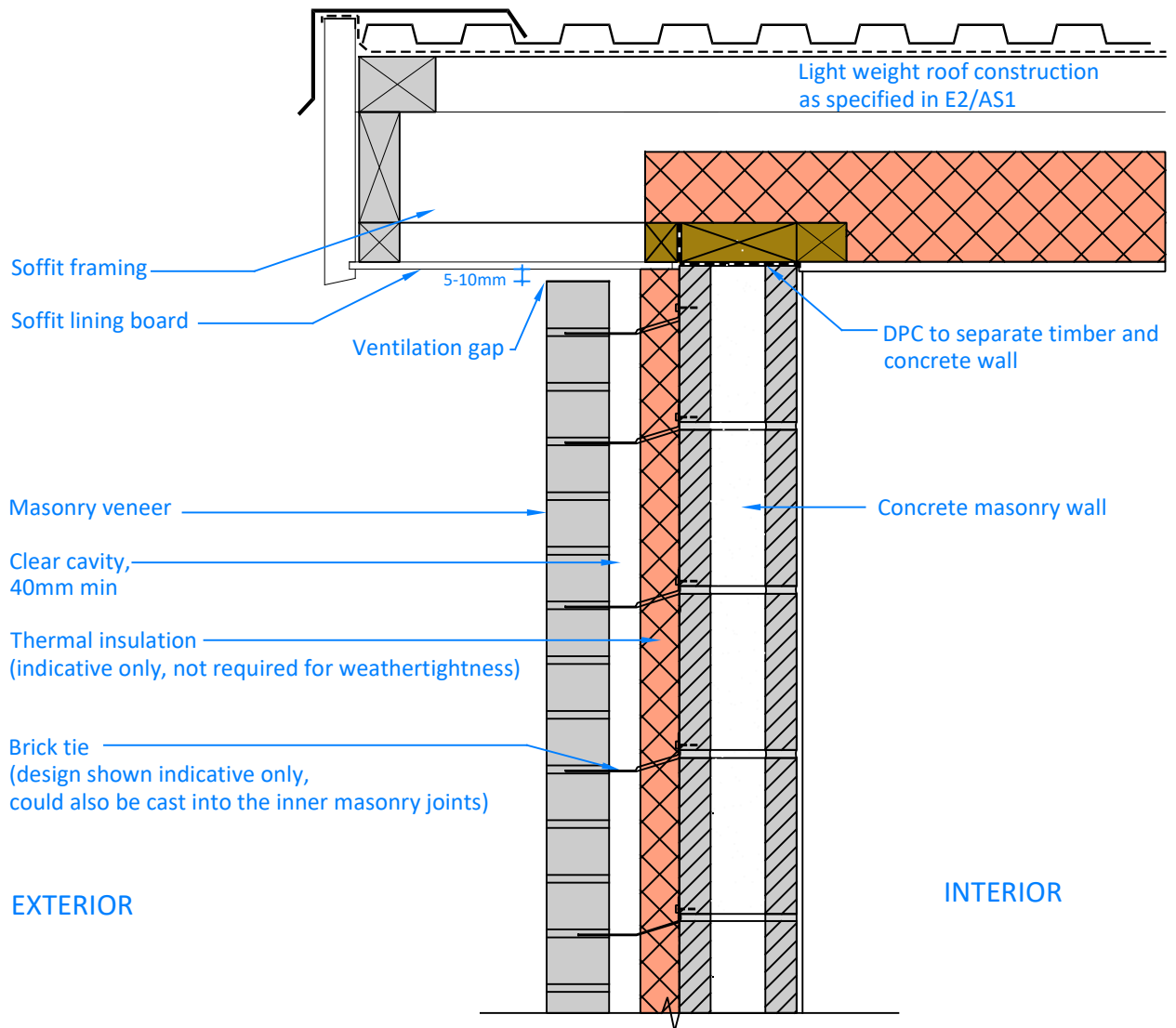
Detail 28

(not to scale)

Wall/ Pitched Roof Junction: Verge Detail

Insitu or Precast: Integral Insulation

Wall type: B3, C3



Comment: Structural layout is indicative only and subject to individual project design.

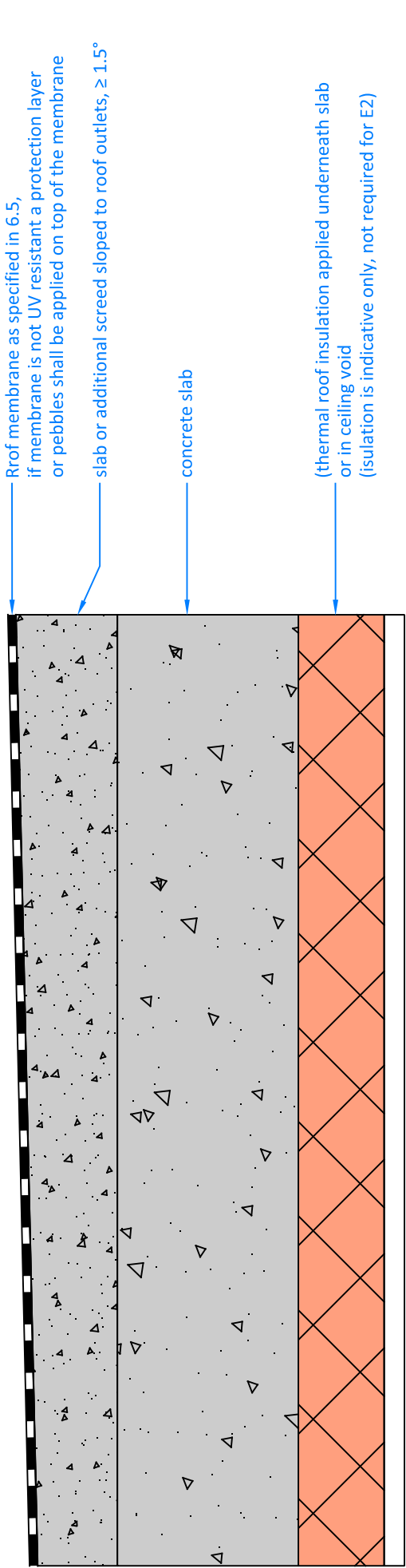
Detail 29

(not to scale)

Wall/ Pitched Roof Junction: Verge Detail

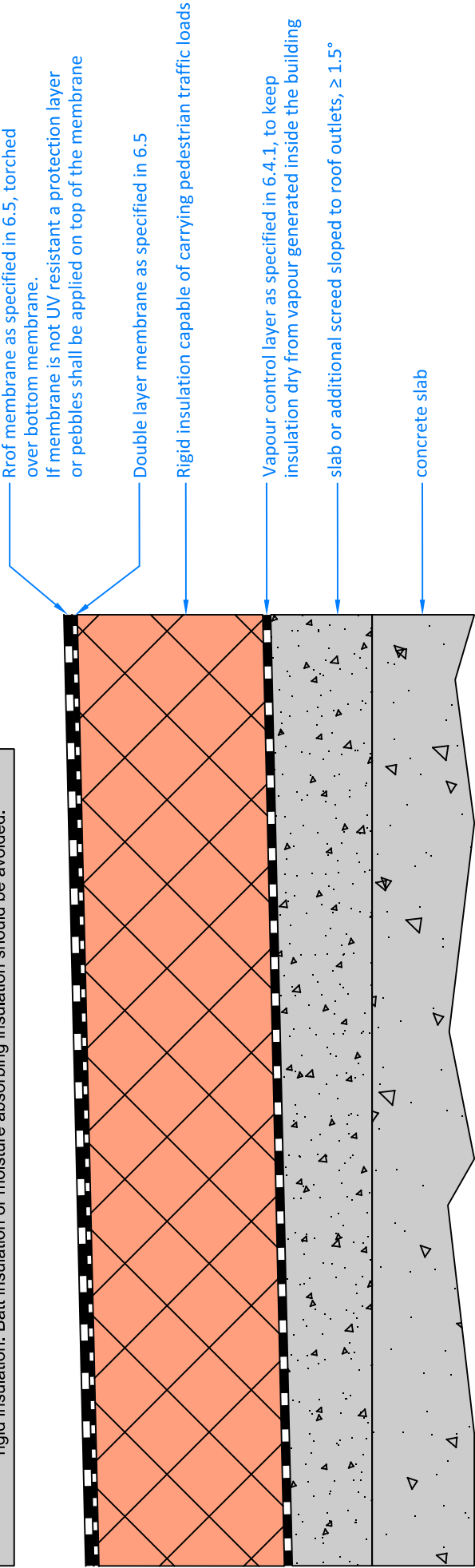
Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



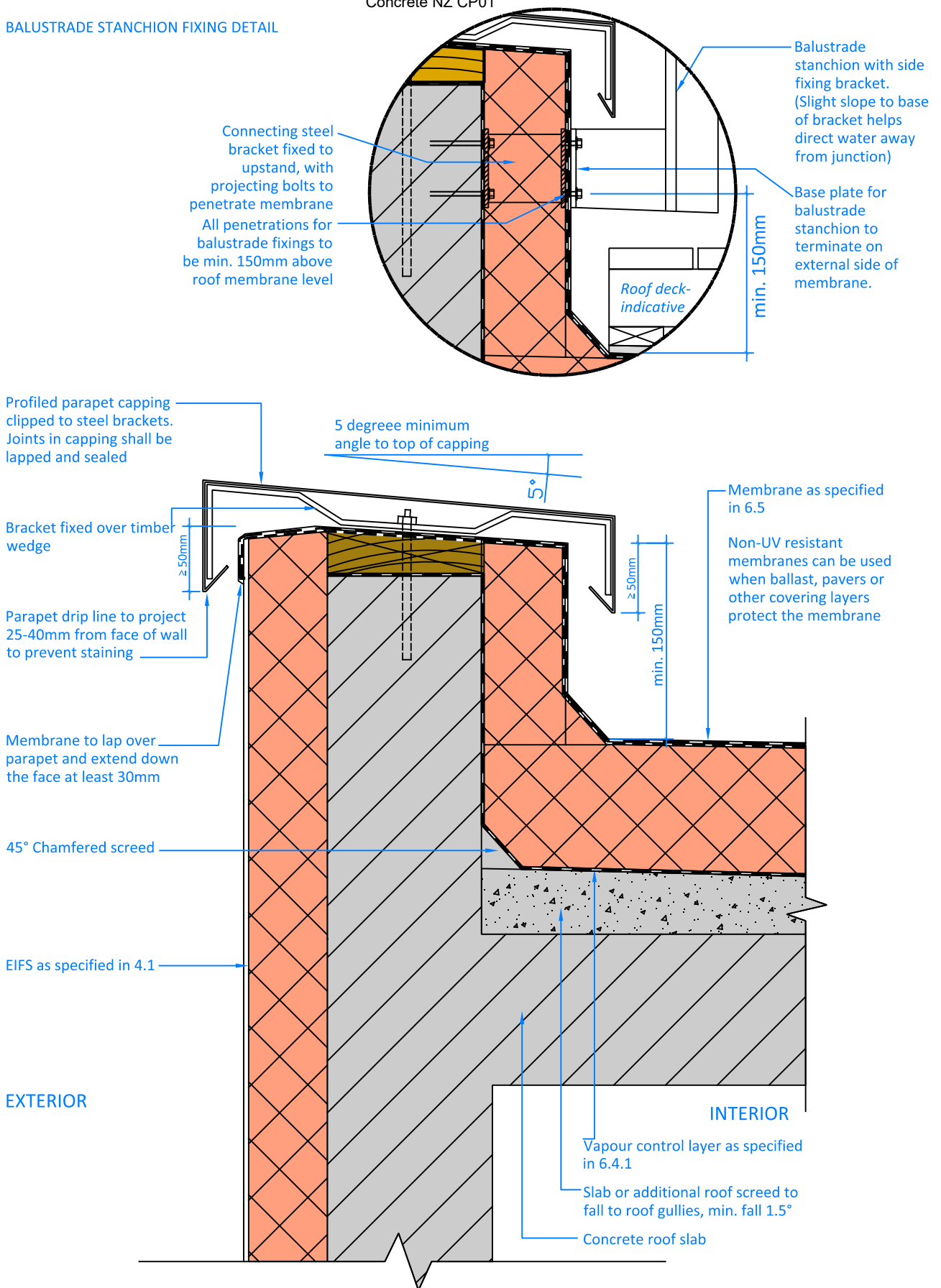
Detail 30 a. Flat roof general built up, internal insulation (not to scale)

Comment 1: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.



Detail 30 b. Flat roof general built up, external insulation (not to scale)

BALUSTRADE STANCHION FIXING DETAIL



Comment: Structural layout is indicative only and subject to individual project design.

Detail 31

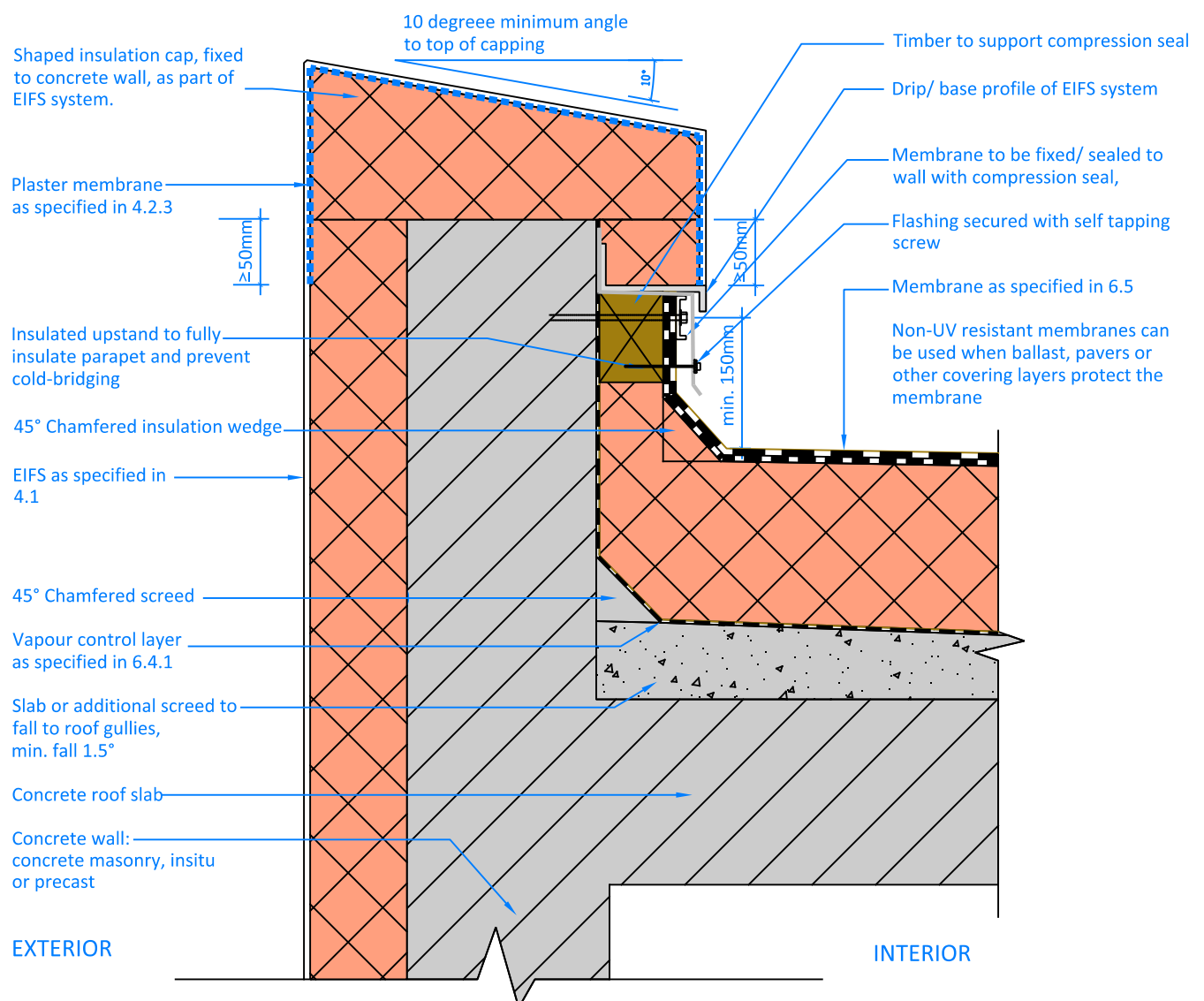
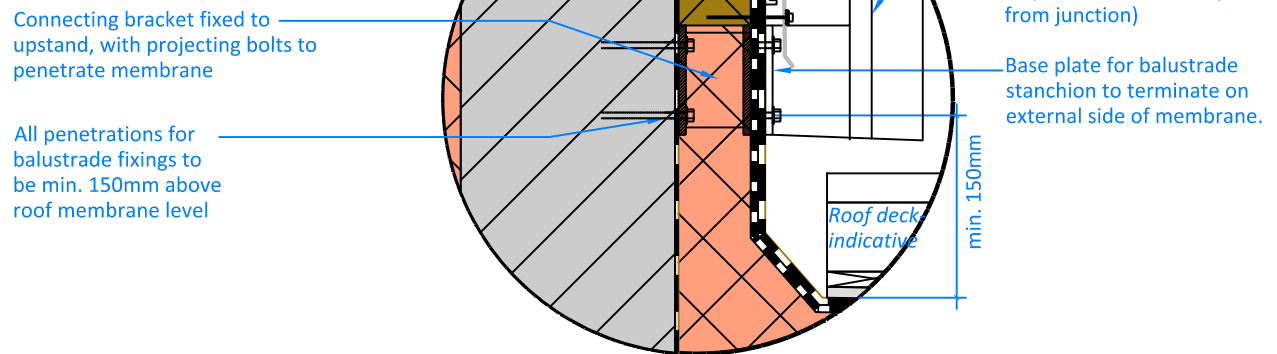
Parapet with Profiled Capping

Concrete masonry, insitu or precast with external insulation

Wall type: A2, B2, C2

(not to scale)

BALUSTRADE STANCHION FIXING DETAIL



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: It is recommended to undertake regular maintenance and removing lichen and other potentials which may reduce the waterproofing performance of the parapet capping.

Detail 33

(not to scale)

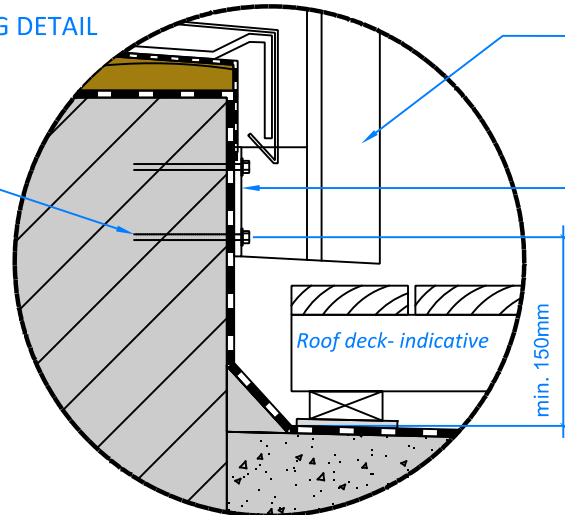
Parapet with Integral Capping, Option B

Concrete Masonry, Insitu or Precast: External Insulation

Wall type: A2, B2, C2

BALUSTRADE STANCHION FIXING DETAIL

All penetrations for balustrade fixings to be min. 150mm above roof membrane level



Balustrade stanchion with side fixing bracket. (Slight slope to base of bracket helps direct water away from junction)

Base plate for balustrade stanchion to terminate on external side of membrane.

min. 150mm

Roof deck- indicative

Profiled parapet capping clipped to steel brackets. Joints in capping shall be lapped and sealed

5 degree minimum angle to top of capping

Bracket fixed over timber wedge to provide slope to roof

DPC to separate steel and timber

Parapet drip line to project 25-40mm from face of wall

Roof membrane to lap over parapet and extend down the face at least 30mm

45° Chamfered screed at internal corner

Roof screed to fall to roof gullies, min fall 1.5°

Concrete roof slab

Concrete wall: concrete masonry, insitu or precast

Weathertightness system as specified in 4.2, 4.3, 4.4 or 4.5.

Roof membrane as specified in 6.5

Non-UV resistant membranes can be used when ballast, pavers or other covering layers protect the membrane

min. 150mm

EXTERIOR

INTERIOR

Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 34a

(not to scale)

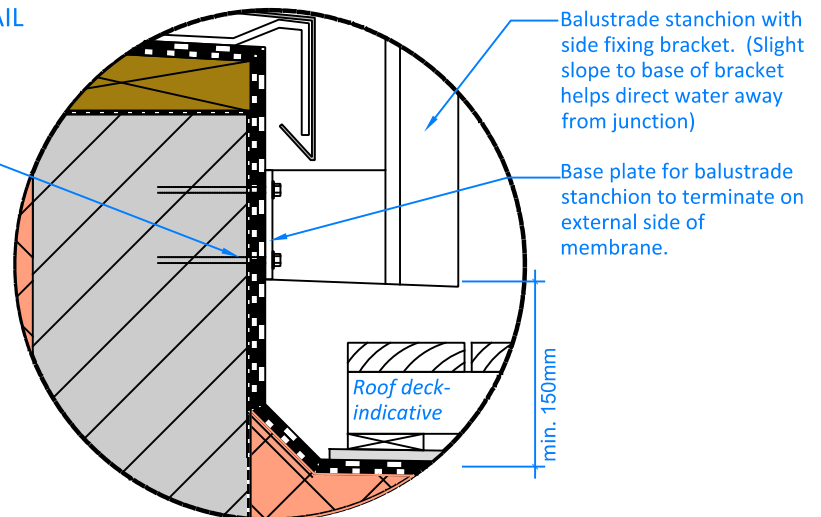
Parapet with Profiled Capping, Option A

Concrete Masonry, Insitu or Precast: Internal Insulation

Wall type: A1, A3, B1, C1

BALUSTRADE STANCHION FIXING DETAIL

All penetrations for balustrade fixings to be min. 150mm above roof membrane level



Profiled parapet capping clipped to steel brackets

Joints in capping shall be lapped and sealed

5 degree minimum angle to top of capping

Bracket fixed over timber wedge to provide slope down to roof

Membrane to lap over parapet and extend down the face at least 30mm

Parapet drip line to project 25-40mm from face of wall to prevent staining

DPC or extended roof vapour barrier to separate concrete wall and timber wedge

45° Chamfered insulation

45° Chamfered screed

Vapour control layer as specified in 6.4.1

Slab or screed to fall to roof gullies, min. fall 1.5°

Concrete roof slab

Composite insitu or precast wall with integral insulation (insulation is indicative only, not required for E2)

Watertightness system as specified in 4.2, 4.3, 4.4 or 4.5.

Membrane as specified in 6.5

Non-UV resistant membranes can be used when ballast, pavers or other covering layers protect the membrane

EXTERIOR

INTERIOR

Comment: Structural layout is indicative only and subject to individual project design.

Detail 36a

Parapet with Profiled Capping, Option A
Insitu or Precast Wall: Integral Insulation

Wall type: B3, C3

(not to scale)

BALUSTRADE STANCHION FIXING DETAIL

All penetrations for balustrade fixings to be min. 150mm above roof membrane level

Timber wedge to provide slope down to roof. Optional without timber if slope can be provided by top of wall

Continuous profiled parapet capping.

Capping secured with self tapping screw

Membrane to seal over parapet beneath capping, and feed out to external wall face

DPC to separate concrete wall and timber wedge

45° Chamfered insulation wedge

45° Chamfered screed

Vapour control layer as specified in 6.4.1

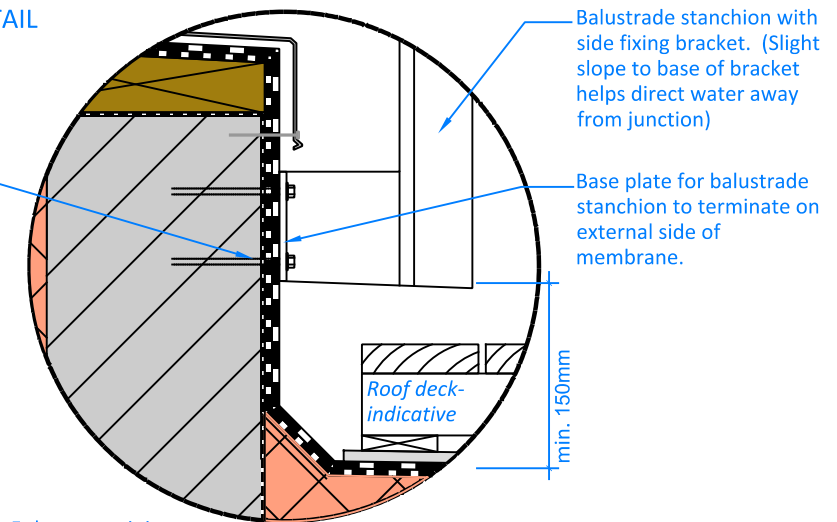
Slab or screed to fall to roof gullies, min. fall 1.5°

Concrete roof slab

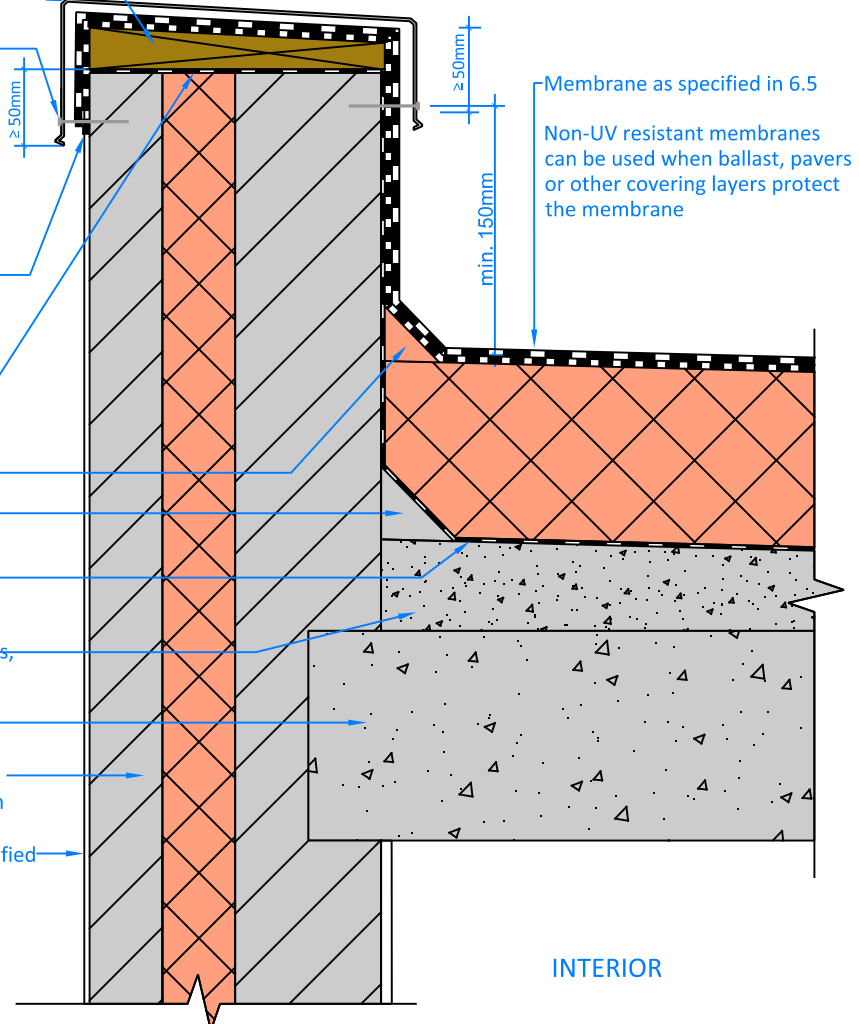
Composite insitu or precast wall with integral insulation (insulation is indicative only, not required for weather-tightness system as specified in 4.2, 4.3, 4.4 or 4.5.

EXTERIOR

INTERIOR



5 degree minimum angle to top of capping



Membrane as specified in 6.5

Non-UV resistant membranes can be used when ballast, pavers or other covering layers protect the membrane

Comment: Structural layout is indicative only and subject to individual project design.

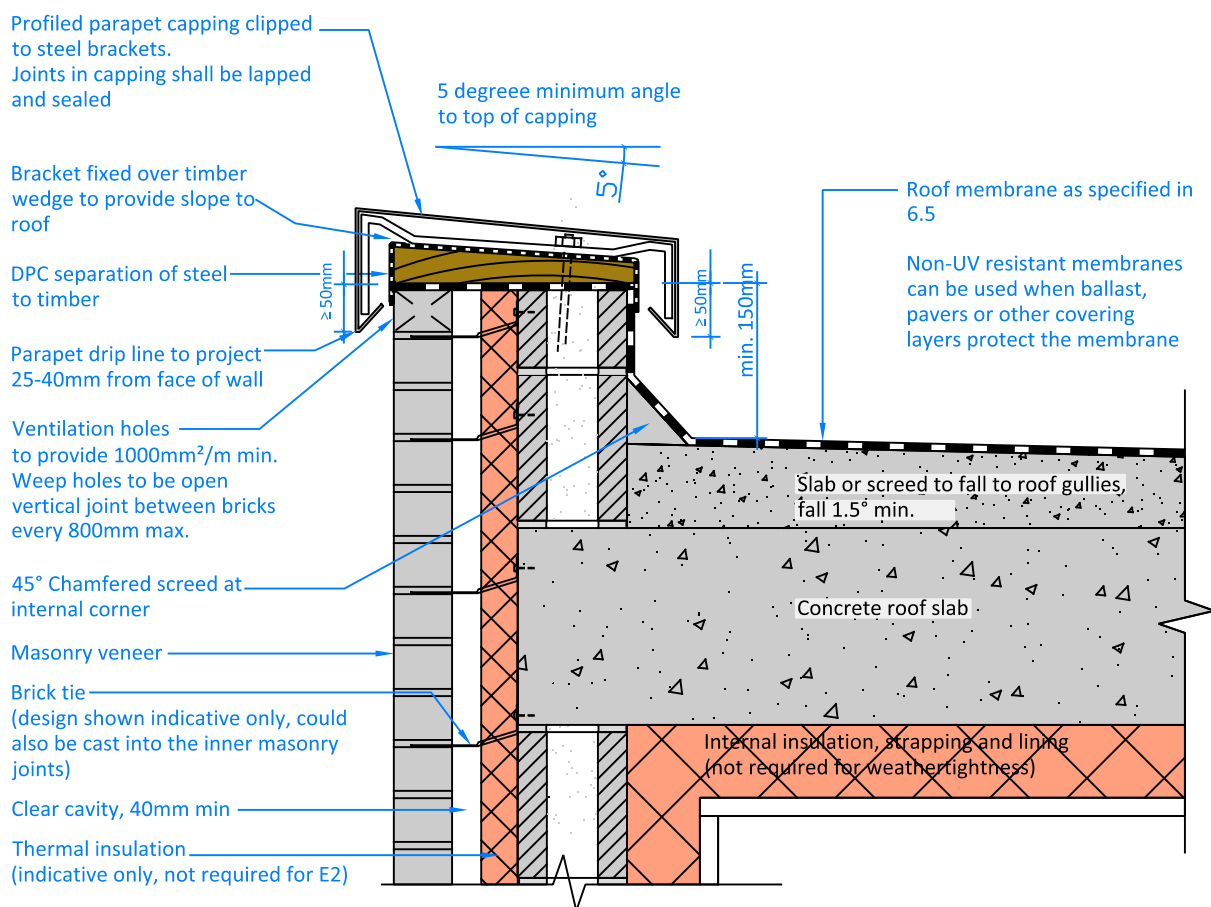
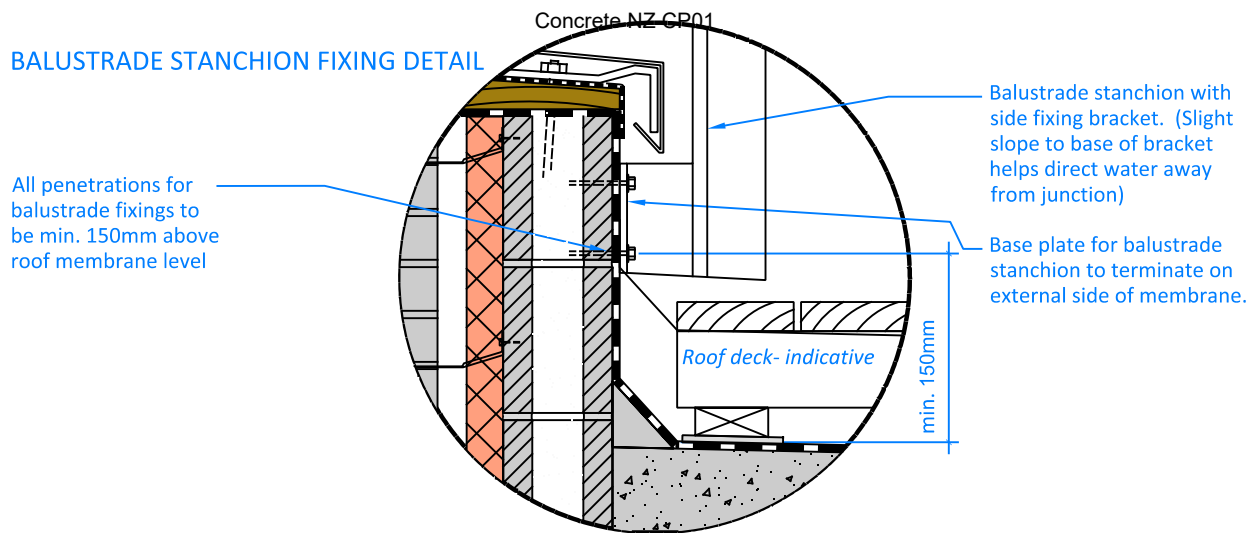
Detail 36b

(not to scale)

Parapet with Profiled Capping, Option B
Insitu or Precast Wall: Integral Insulation

Wall type: B3, C3

BALUSTRADE STANCHION FIXING DETAIL



EXTERIOR

INTERIOR

Comment 1: Structural layout is indicative only and subject to individual project design.
 Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

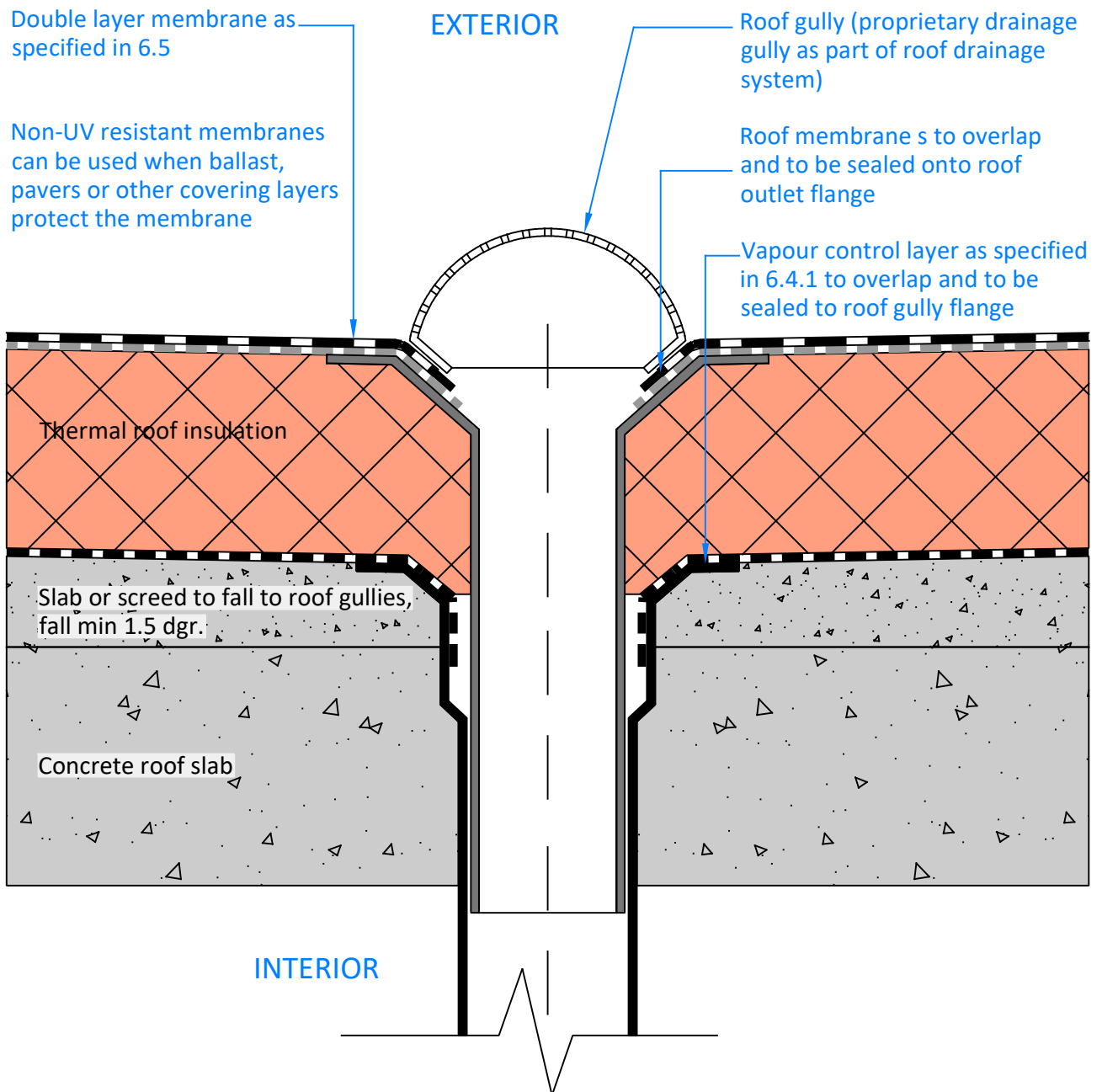
Detail 38

(not to scale)

Parapet with Profiled Capping

Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



Comment 1: Roof gullies to be located at lowest points of roof

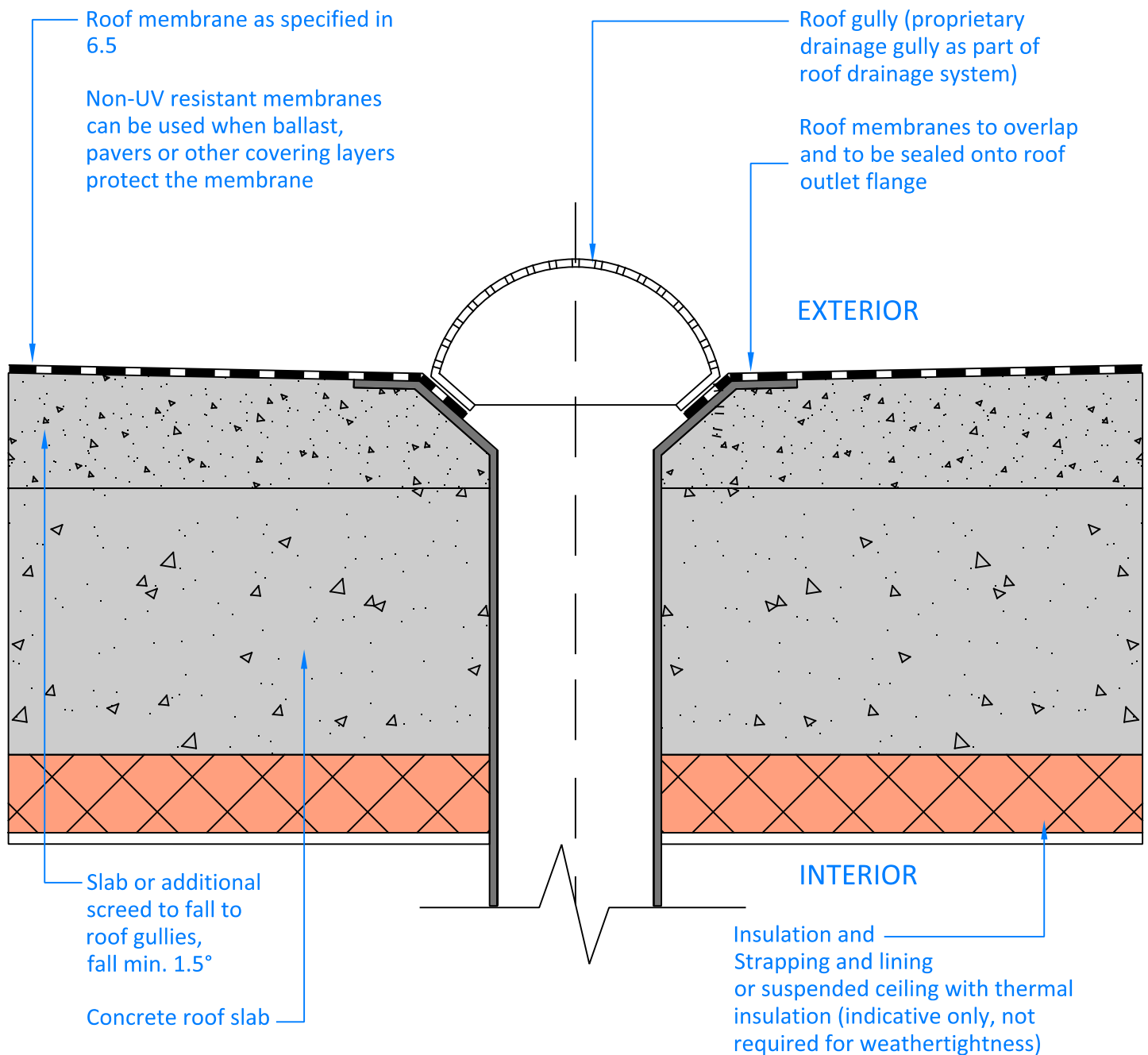
Comment 2: At least two roof outlets required for each flat roof section

Comment 3: Structural layout is indicative only and subject to individual project design

Detail 39 Roof Gully

Concrete Roof/ Deck with External Insulation

(not to scale)



Comment 1: Roof gullies to be located at lowest points of roof

Comment 2: At least two roof outlets required for each flat roof section

Comment 3: Structural layout is indicative only and subject to individual project design.

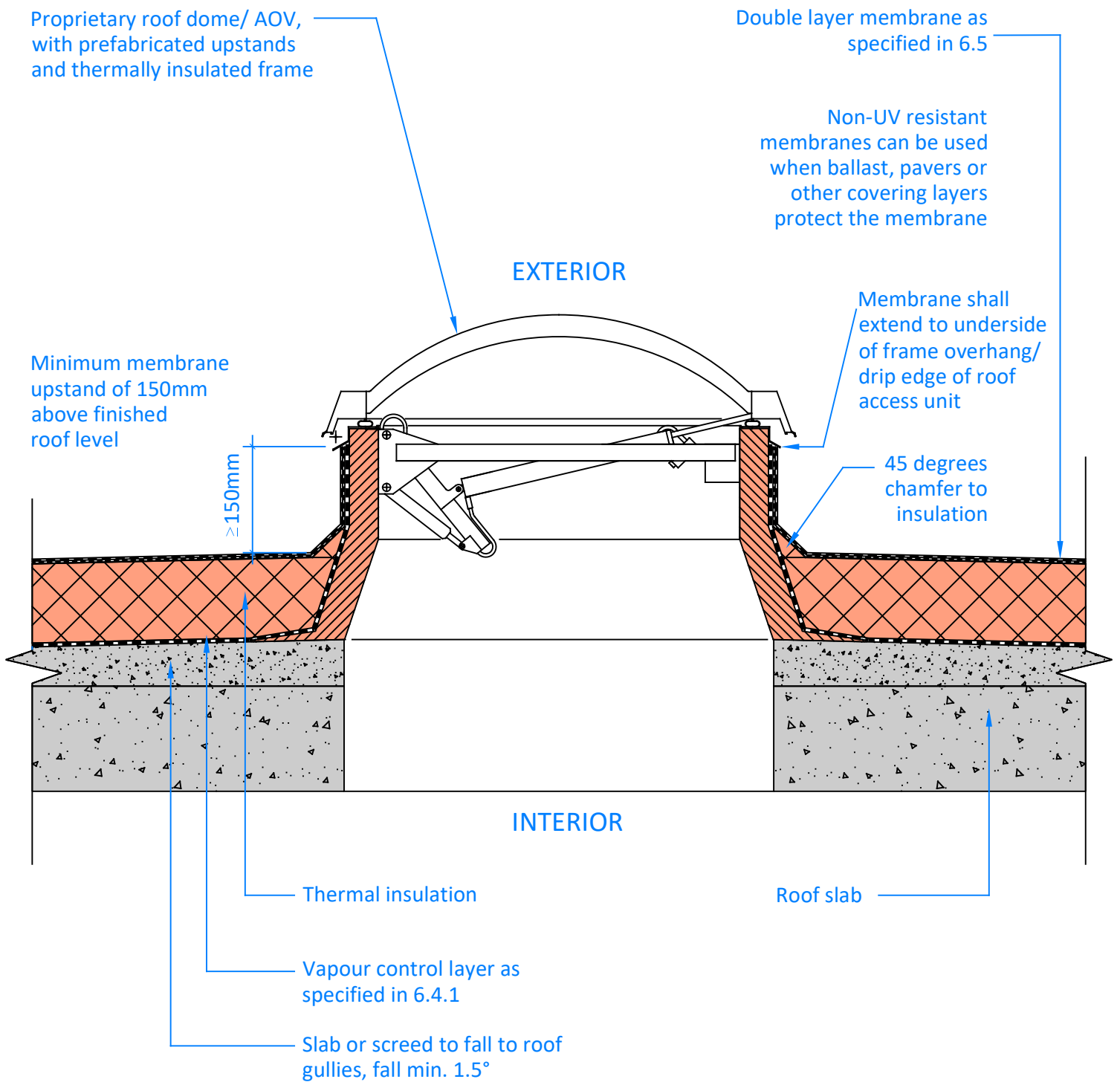
Comment 4: For internal insulation it is recommended using taped & sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 40

Roof Gully

Concrete Roof/ Deck with internal insulation

(not to scale)



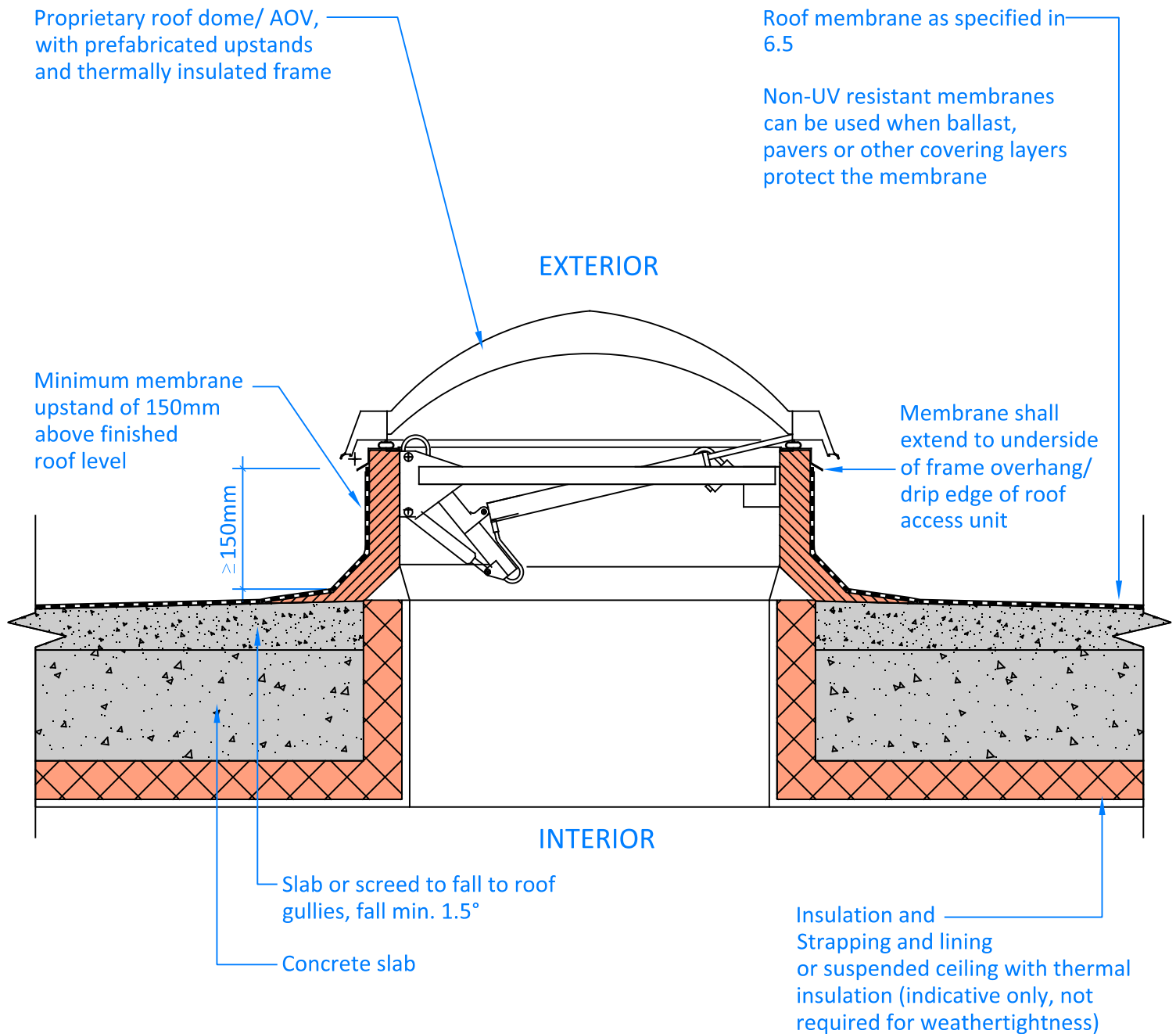
Comment: Structural layout is indicative only and subject to individual project design.

Detail 41

Roof Penetration (Light Dome/ AOV/ Hatch)

Concrete Roof/ Deck with External Insulation

(not to scale)



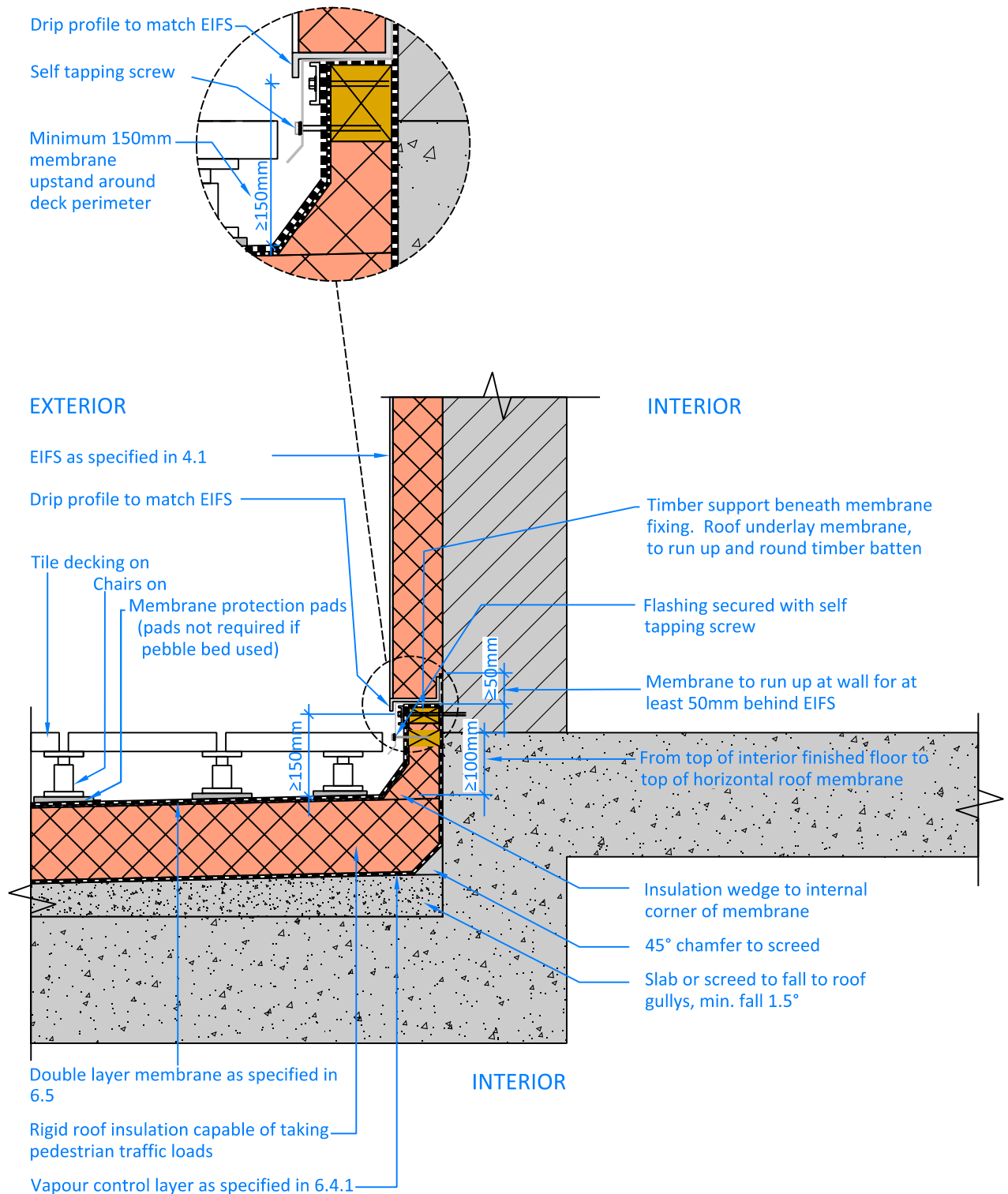
Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 42

(not to scale)

Roof Penetration (Light Dome/ AOV/ Hatch) Concrete Roof/ Deck with Internal Insulation



Comment 1: Refer to detail 51 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

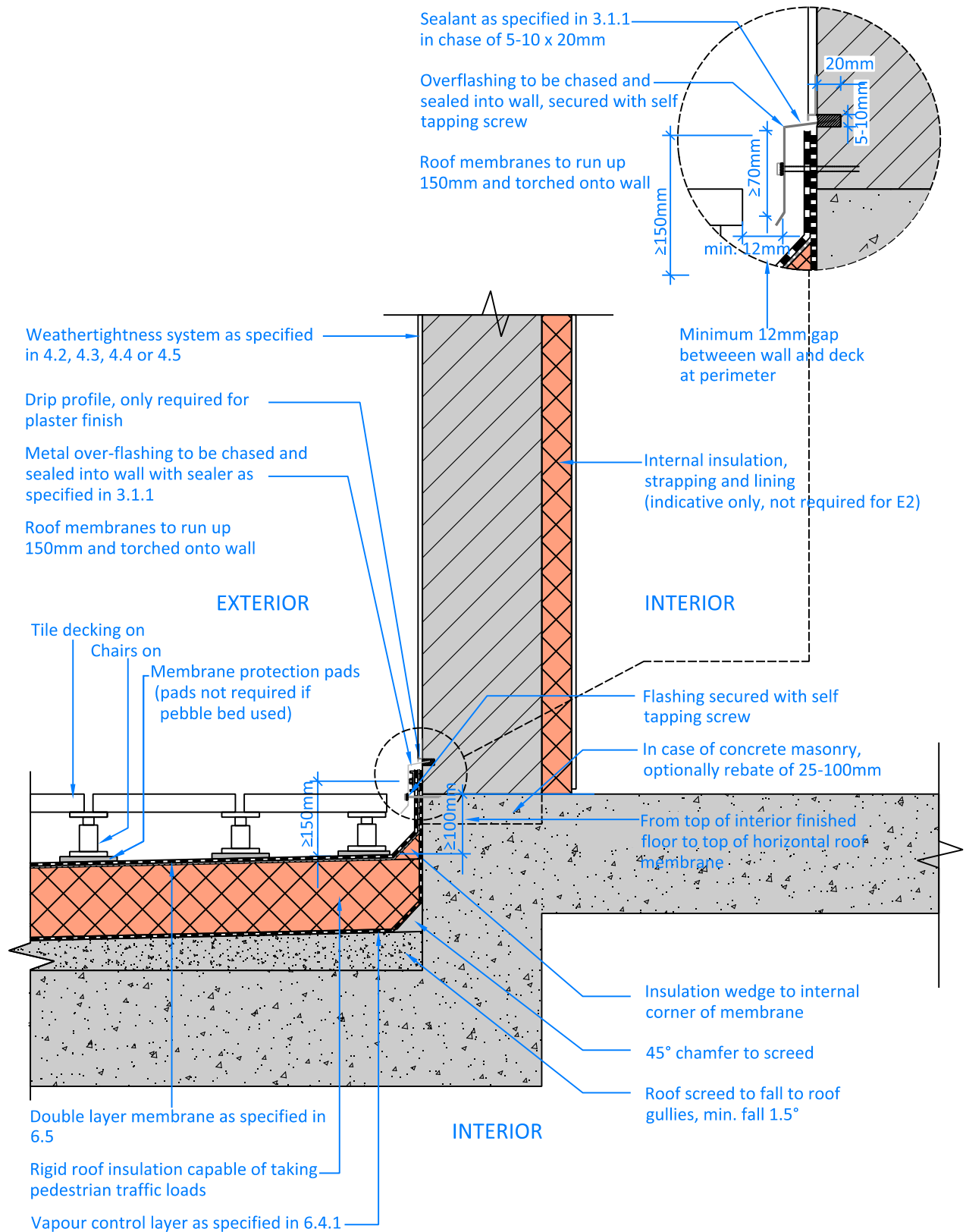
Detail 43

(not to scale)

Roof/ Deck at Wall: Externally Insulated Deck

Concrete Masonry, Precast or Insitu Wall: External Insulation

Wall type: A2, B2, C2



Comment 1: Refer to detail 51 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

Comment 3: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

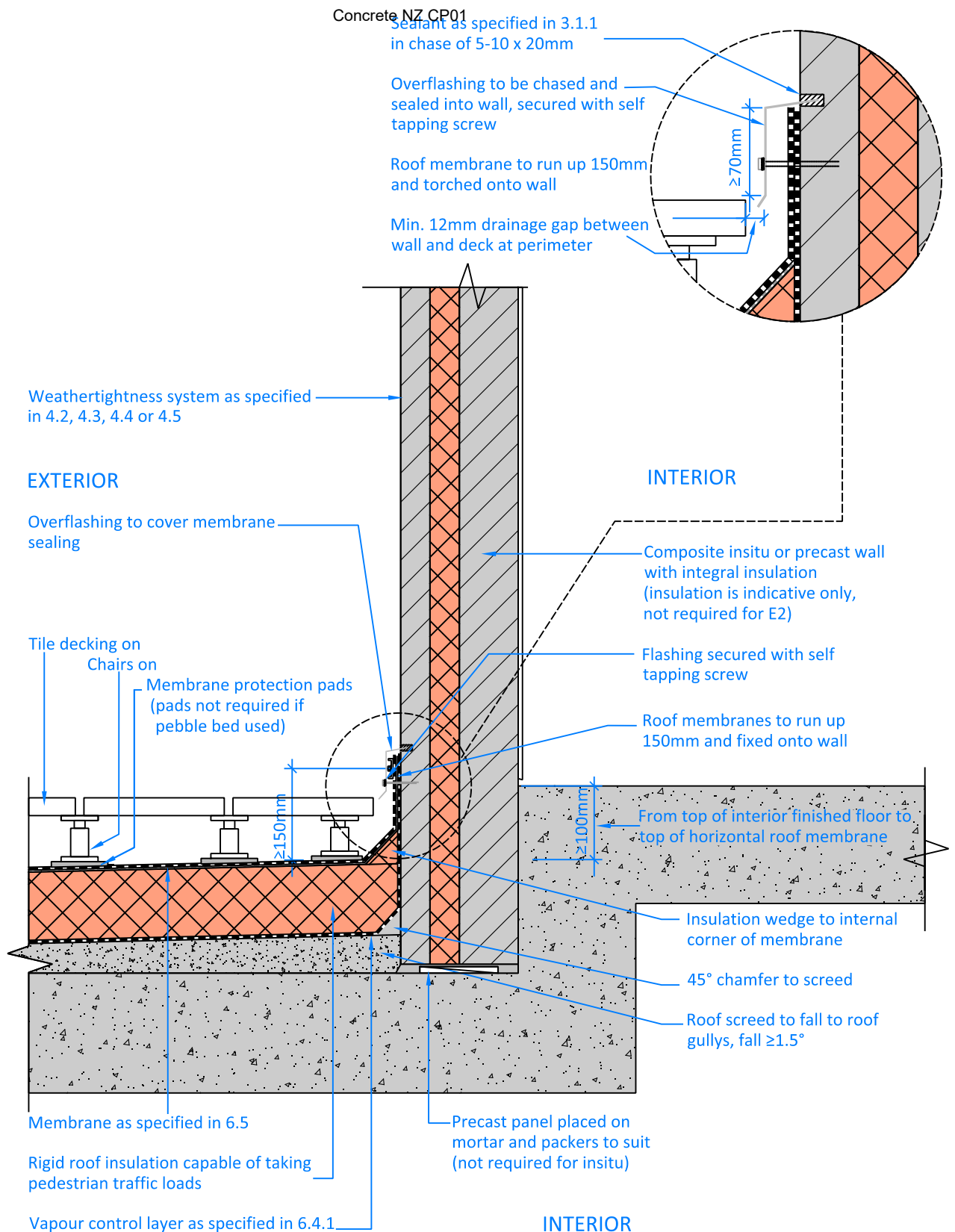
Detail 44

(not to scale)

Roof/ Deck at Wall: Externally Insulated Deck

Concrete Masonry, Precast or Insitu Wall: Internal Insulation

Wall type: A1, A3, B1, C1



Comment 1: Refer to detail 51 for deck types and setdown requirements.

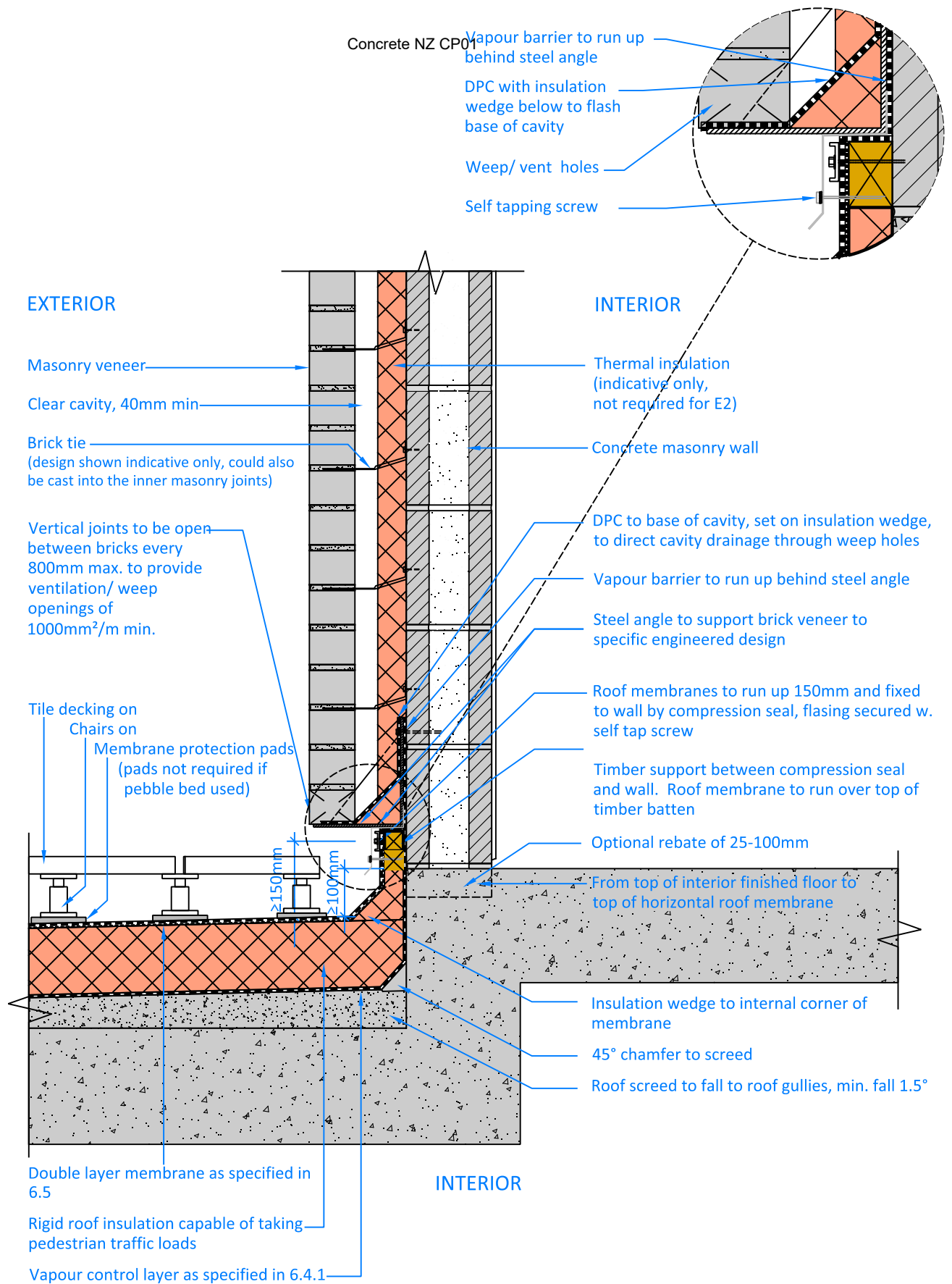
Comment 2: Structural layout is indicative only and subject to individual project design.

Detail 45

(not to scale)

Roof/ Deck at Wall: Externally Insulated Roof Precast or Insitu Wall: Integral Insulation

Wall type: B3, C3



Comment 1: Refer to detail 51 for deck types and setdown requirements.

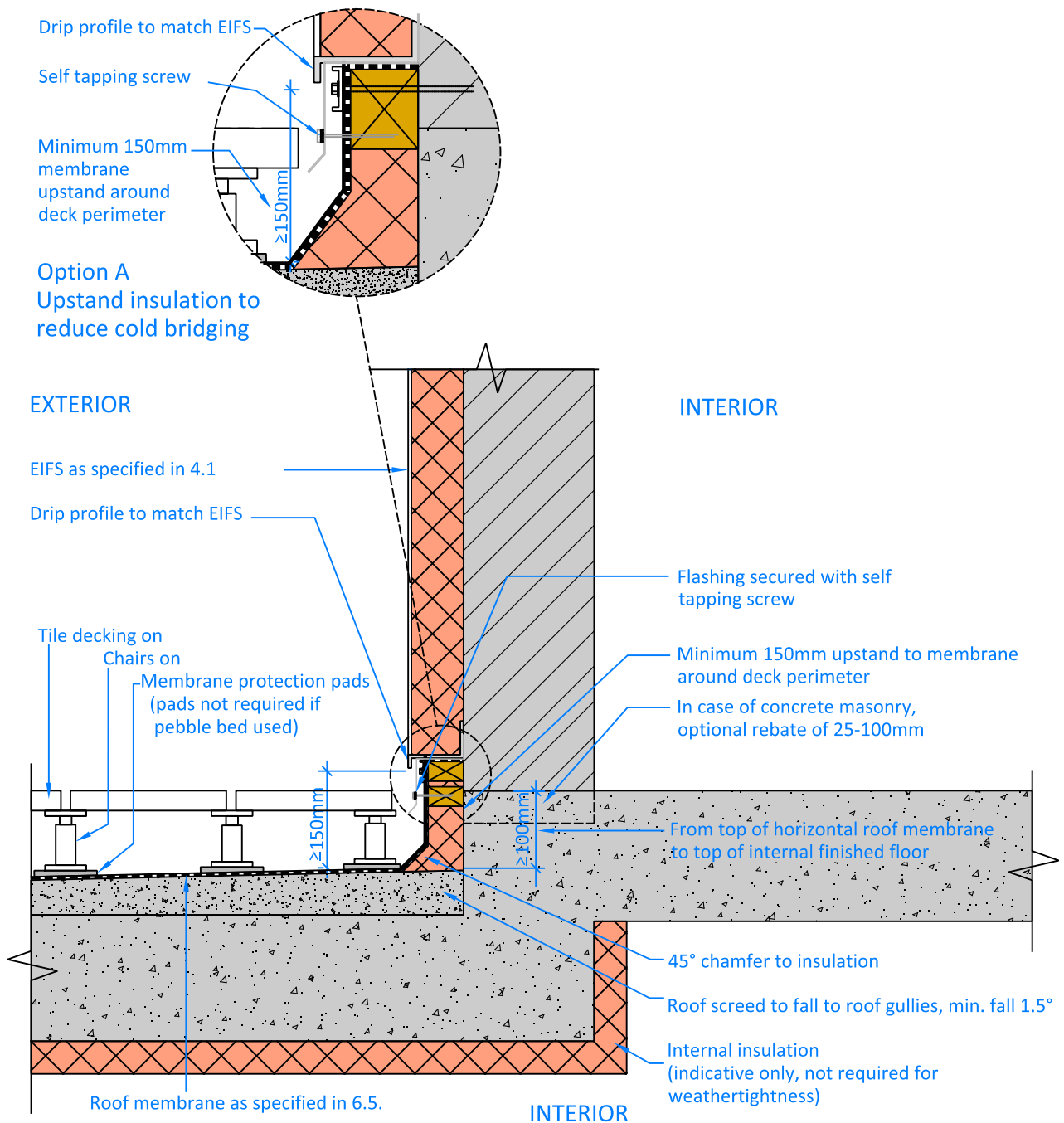
Comment 2: Structural layout is indicative only and subject to individual project design.

Detail 46

(not to scale)

Roof/ Deck at Wall: Externally Insulated Roof Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



Comment 1: Refer to detail 51 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

Comment 3: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

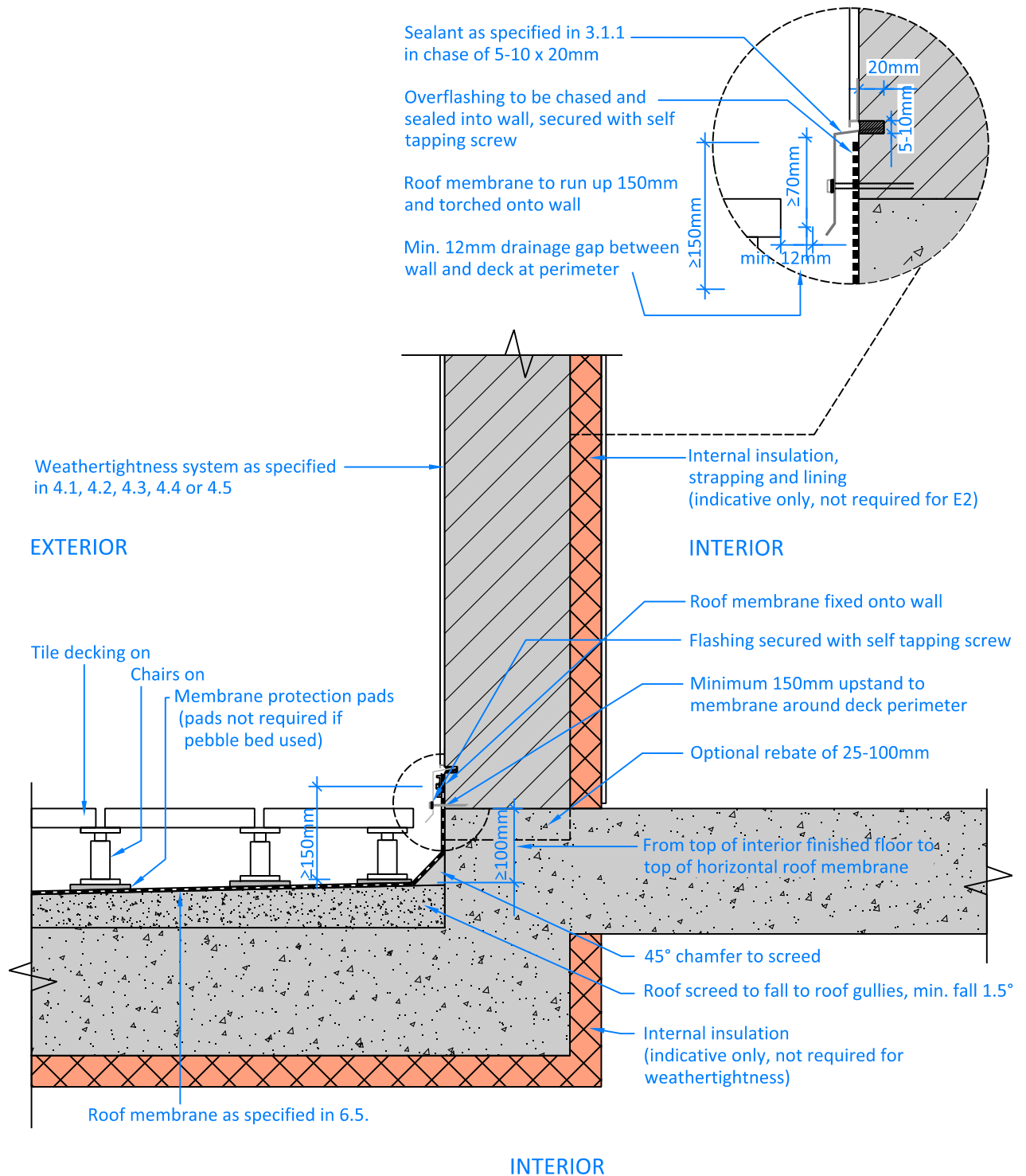
Detail 47

(not to scale)

Roof/ Deck at Wall: Internally Insulated Roof

Concrete Masonry, Precast or Insitu Wall: External Insulation

Wall type: A2, B2, C2



Comment 1: Refer to detail 51 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

Comment 3: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

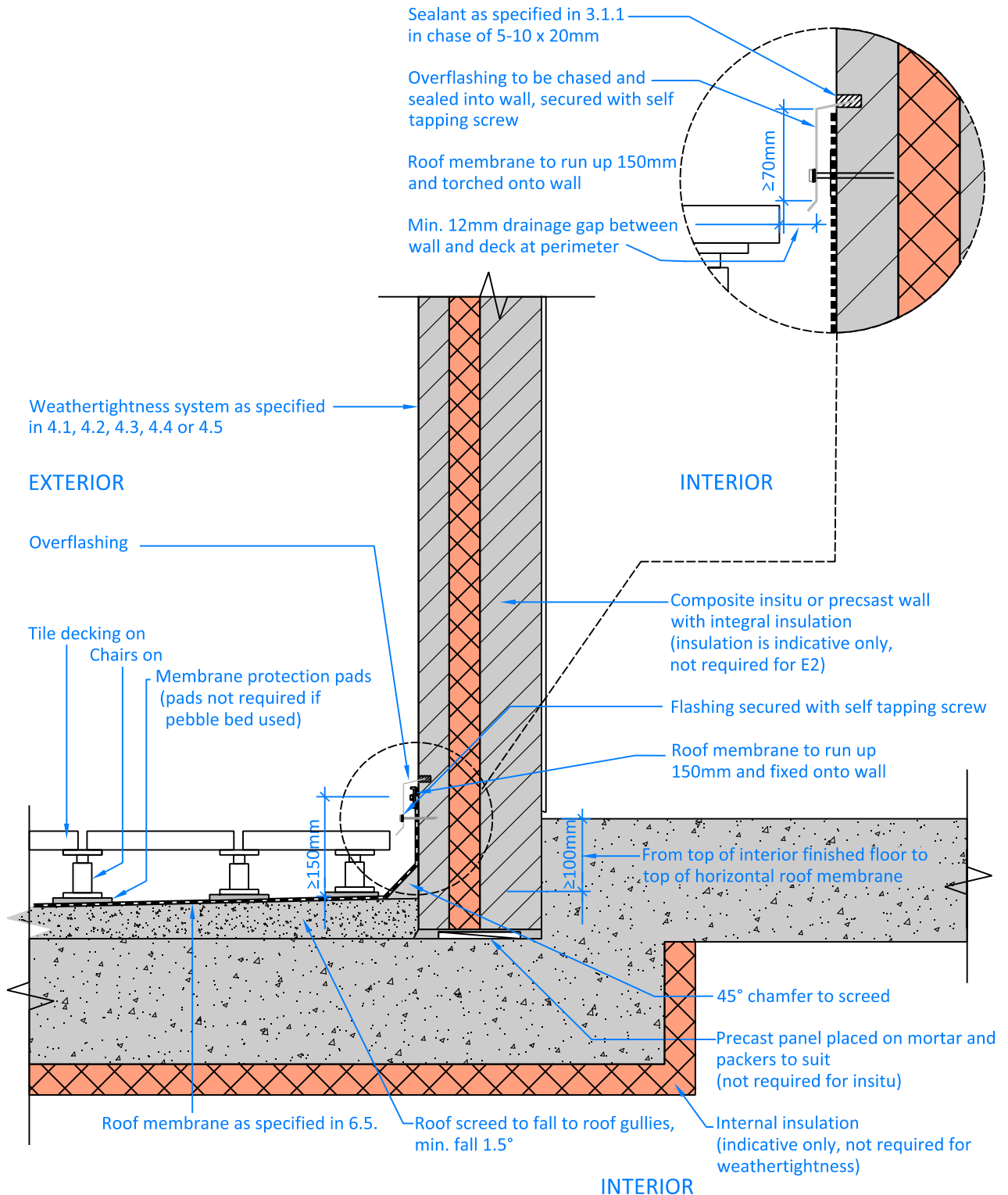
Detail 48

(not to scale)

Roof/ Deck at Wall: Internally Insulated Roof

Concrete Masonry, Precast or Insitu Wall: Internal Insulation

Wall type: A1, A3, B1, C1



Comment 1: Refer to detail 51 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

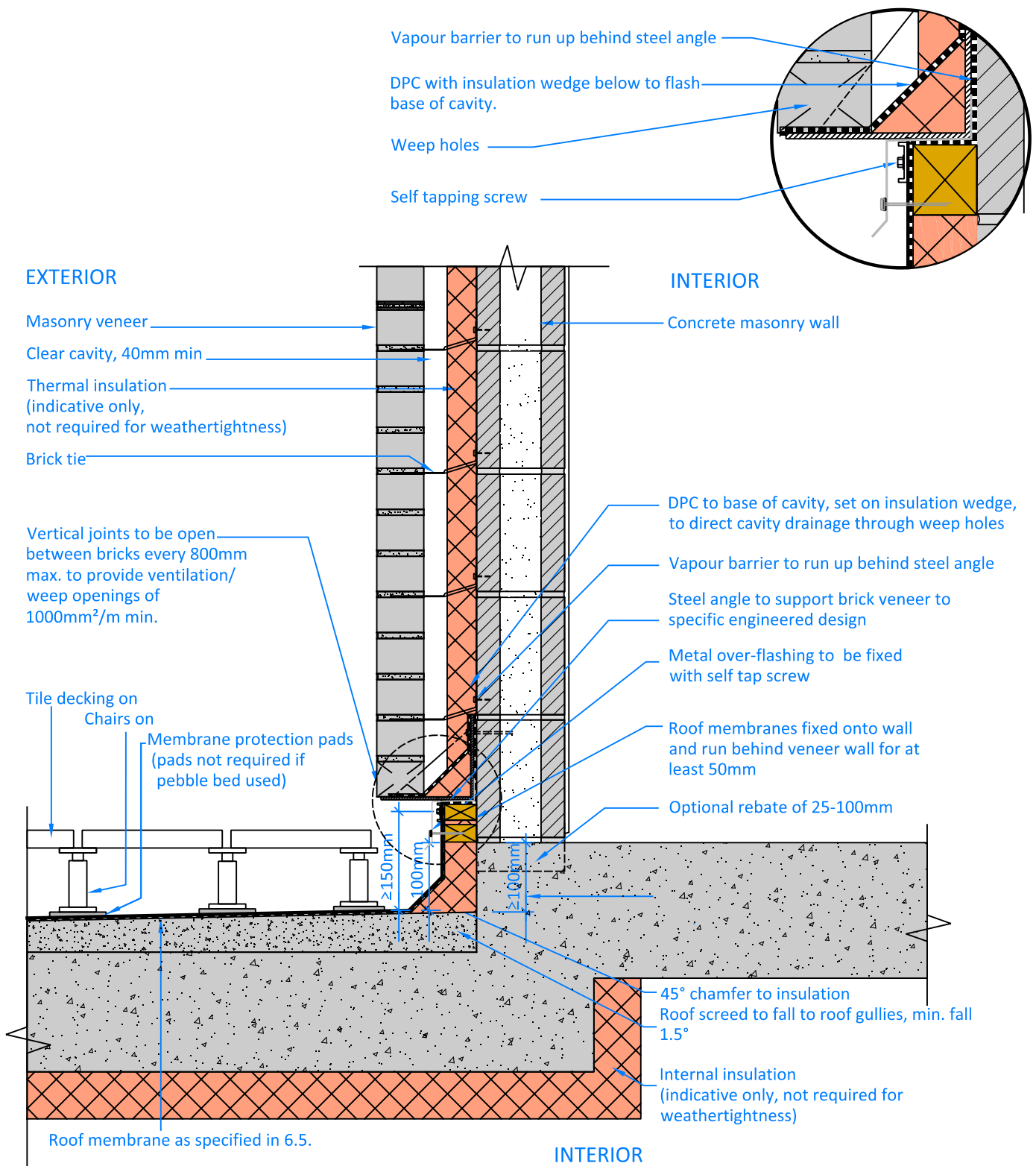
Comment 3: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 49

(not to scale)

Roof/ Deck at Wall: Internally Insulated Roof Precast or Insitu Wall: Integral Insulation

Wall type: B3, C3



Comment 1: Refer to detail 51 for deck types and setdown requirements.

Comment 2: Structural layout is indicative only and subject to individual project design.

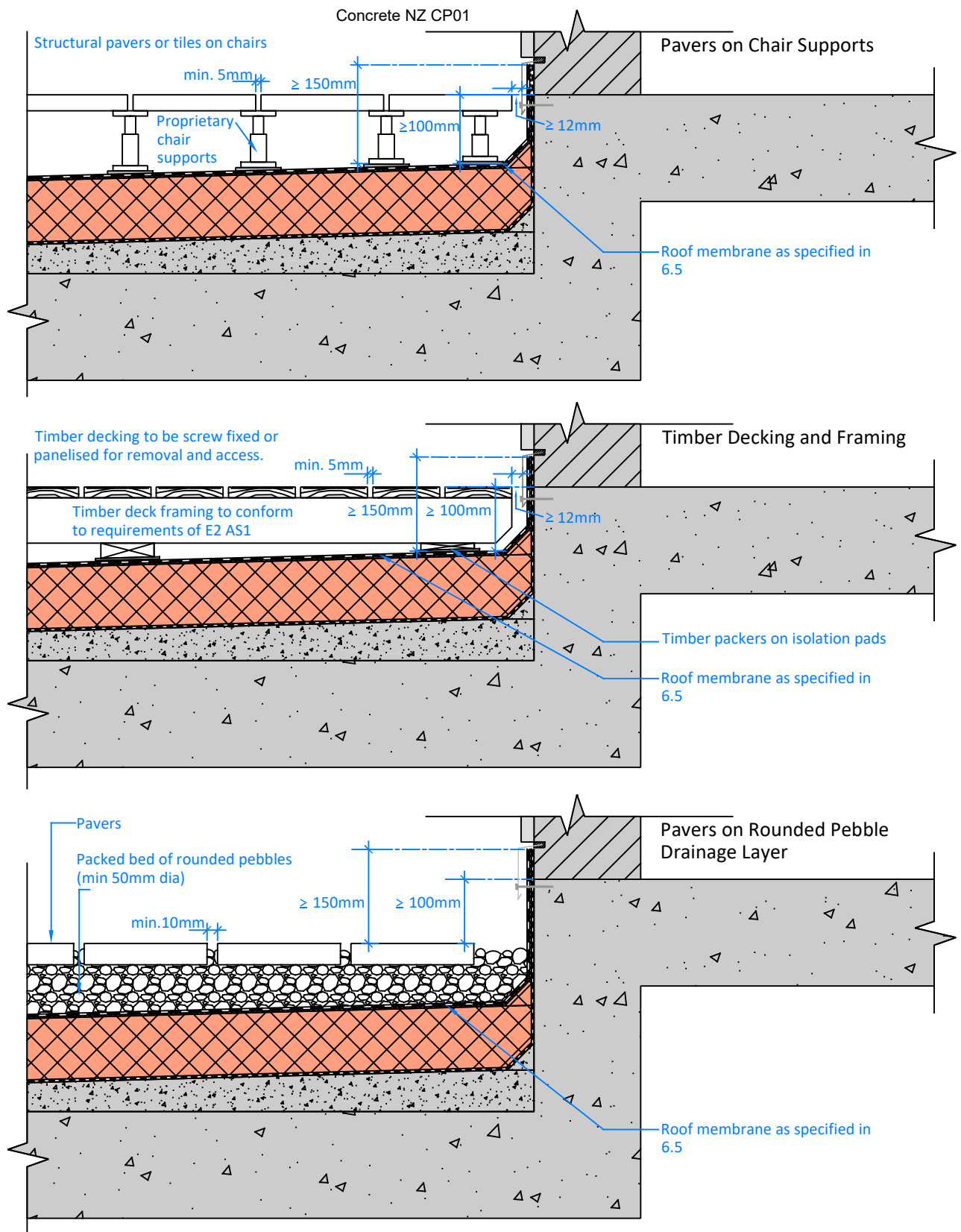
Comment 3: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 50

(not to scale)

Roof/ Deck at Wall: Internally Insulated Roof Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



Comment 1: Where a clear gap of at least 12mm between the raised decking and the wall is provided, the deck can be level with internal floor (provided the level of the waterproofing layer is min 100mm below floor level). Where water may collect on the deck surface, the deck should be min 100mm below internal floor level.

A min. 150mm upstand of the roof membrane with no penetrations at all roof to wall and parapet junctions (except at thresholds this can be reduced to 100mm) is also required.

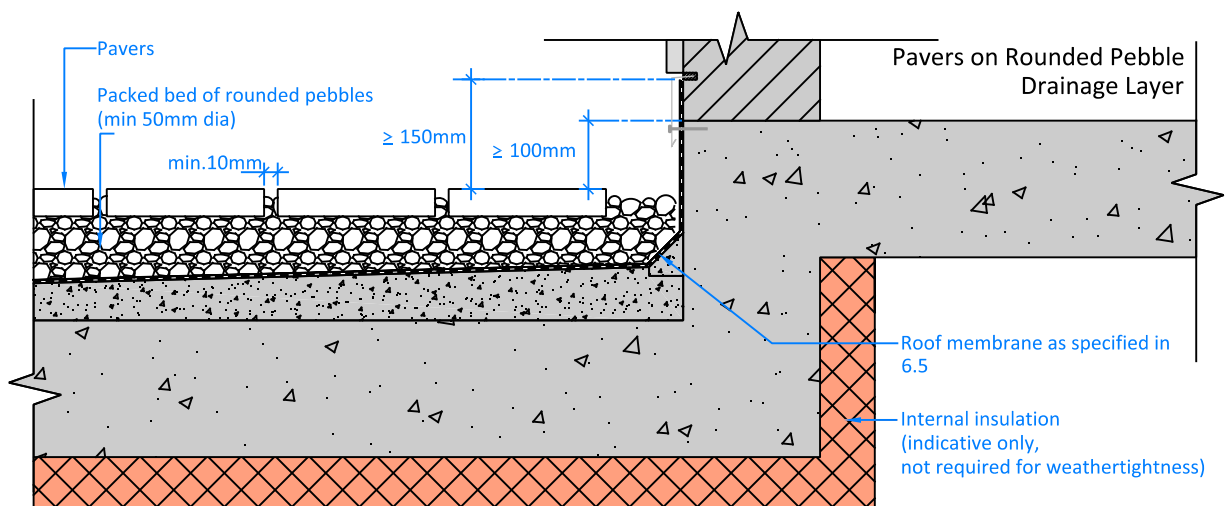
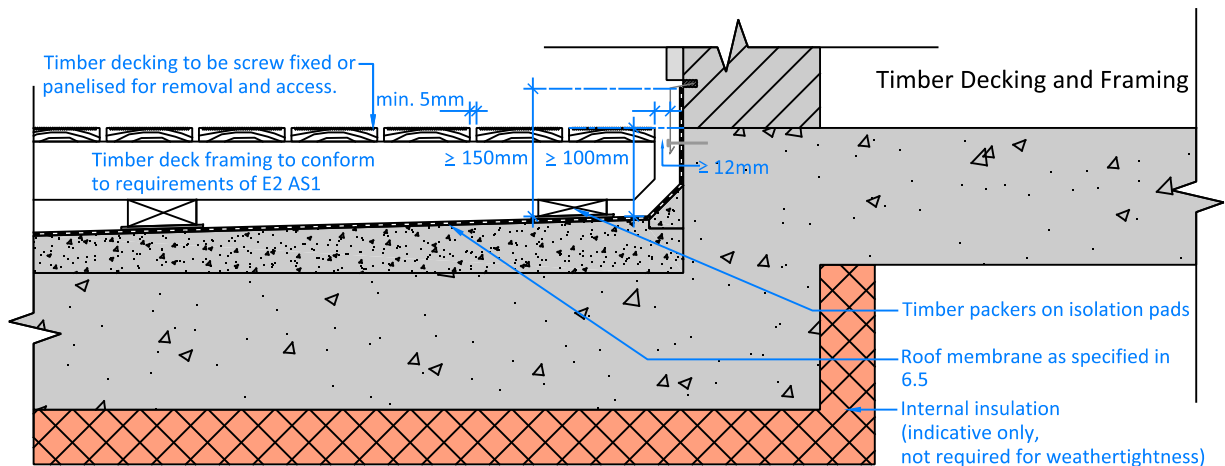
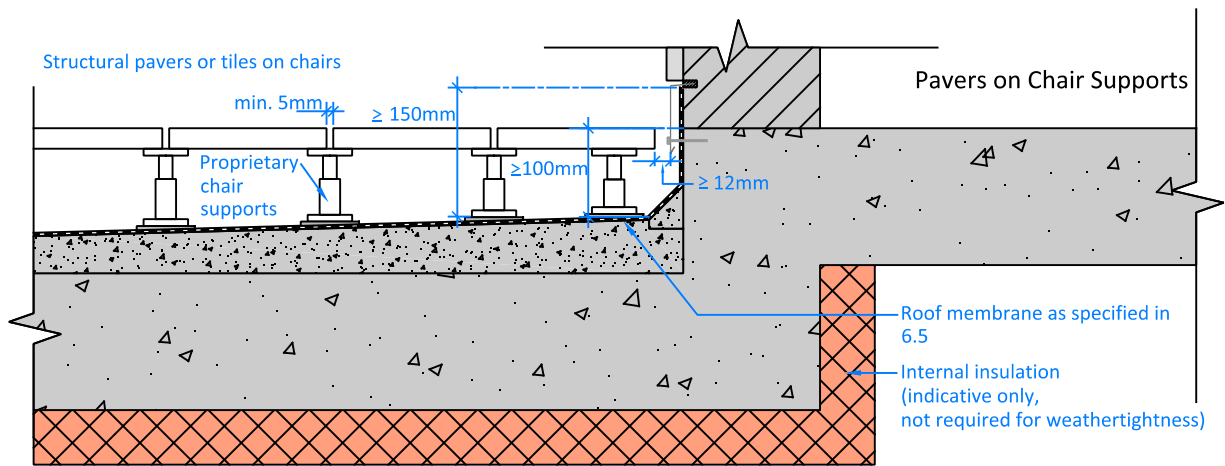
Comment 2: A 12mm perimeter gap is required between edge of deck and wall surface

Comment 3: Roof or Deck to wall junctions and membrane specifications are specified in Details 43 to 50

Detail 51

Decking Options

External Roof Insulation



Comment 1: Where a clear gap of at least 12mm between the raised decking and the wall is provided, the deck can be level with internal floor (provided the level of the waterproofing layer is min 100mm below floor level). Where water may collect on the deck surface, the deck should be min 100mm below internal floor level. A min. 150mm upstand of the roof membrane with no penetrations at all roof to wall and parapet junctions (except at thresholds this can be reduced to 100mm) is also required.

Comment 2: A 12mm perimeter gap is required between edge of deck and wall surface.

Comment 3: Roof or Deck to wall junctions and membrane specifications are specified in Details 43 to 50.

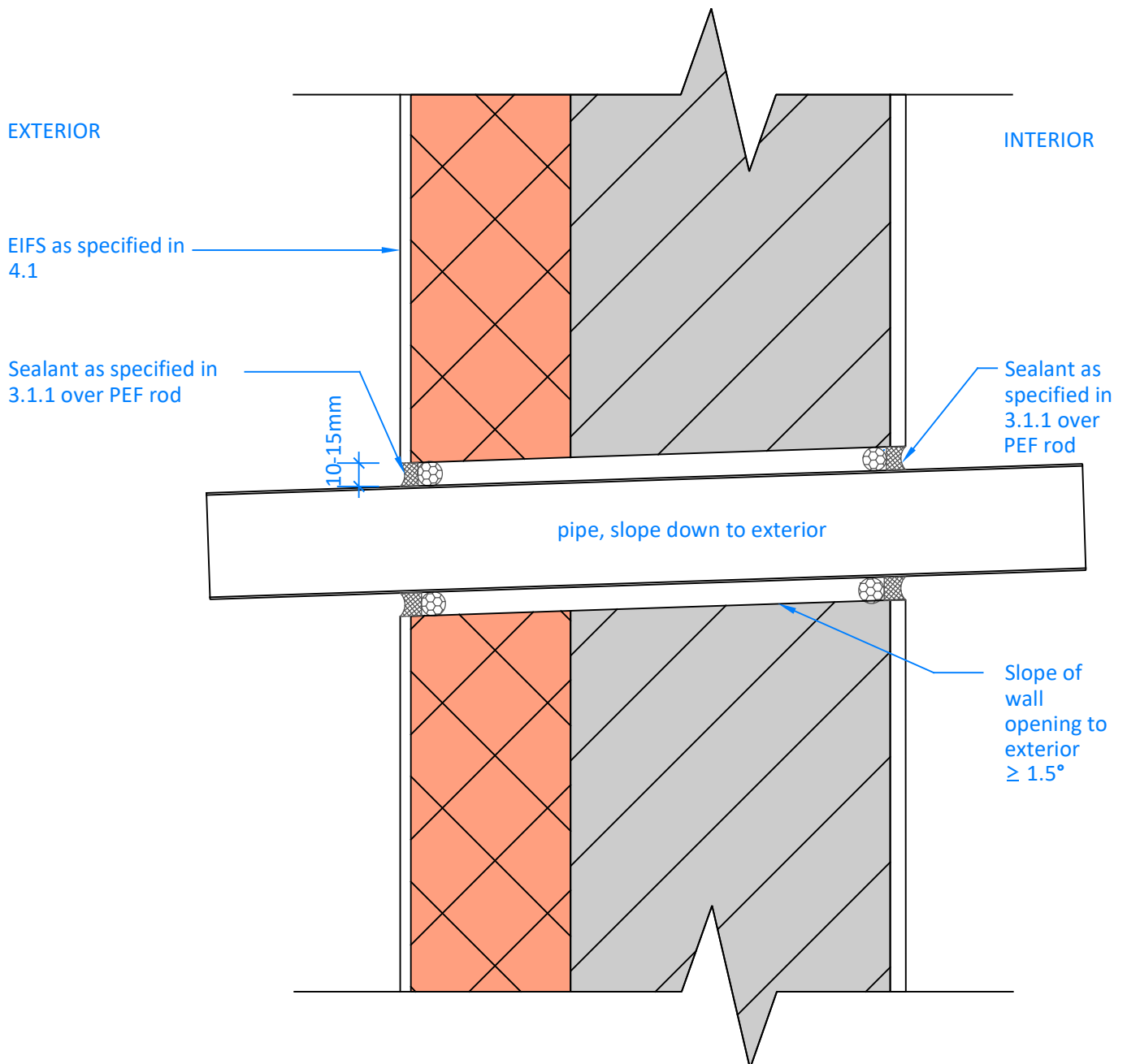
Comment 4: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 52

Decking Options

Internal Roof Insulation

(not to scale)



Comment: Structural layout is indicative only and subject to individual project design.

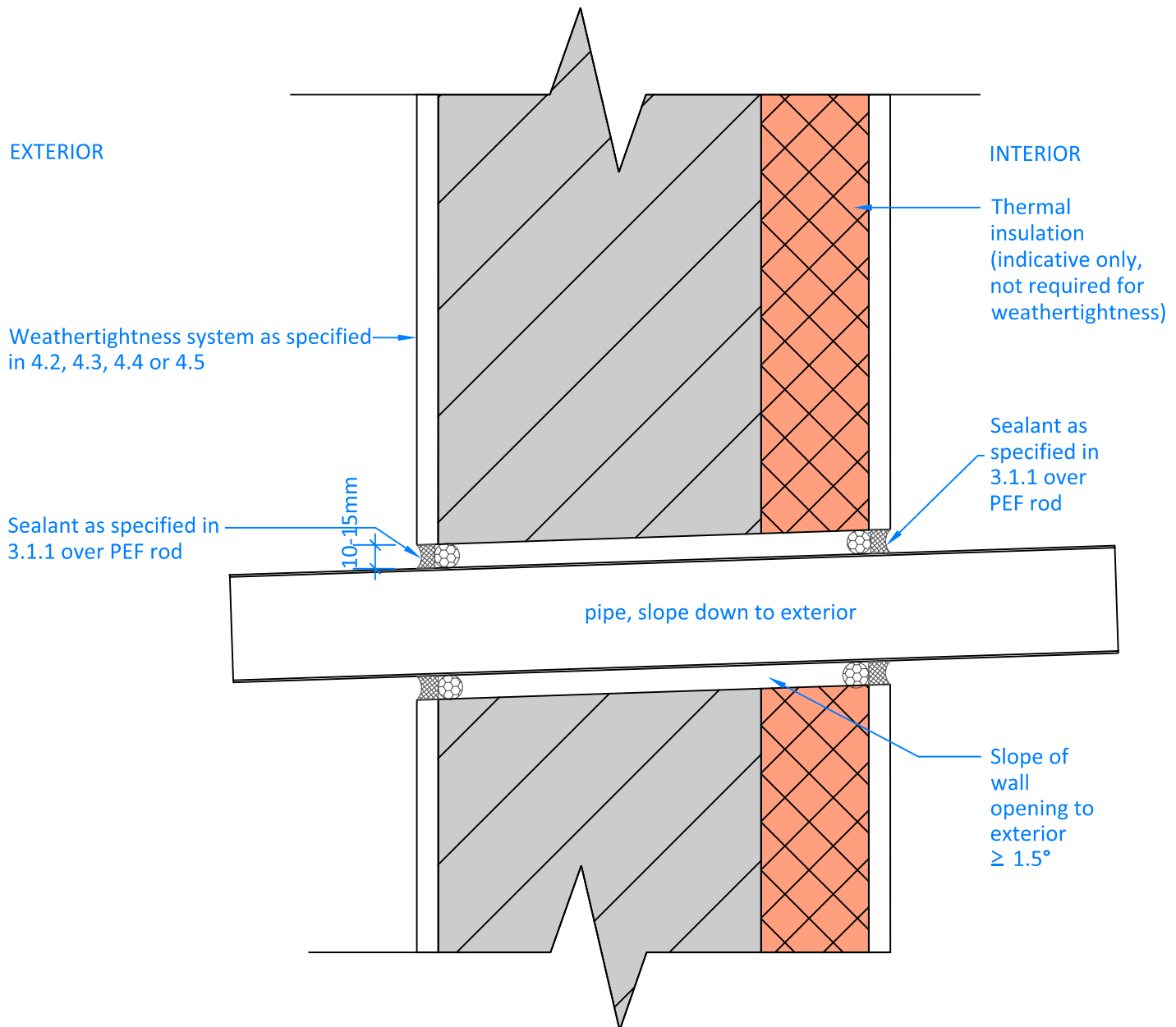
Detail 53

(not to scale)

Penetration Through Wall

Concrete Masonry, Insitu or Precast wall: EIFS

Wall type: A2, B2, C2



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

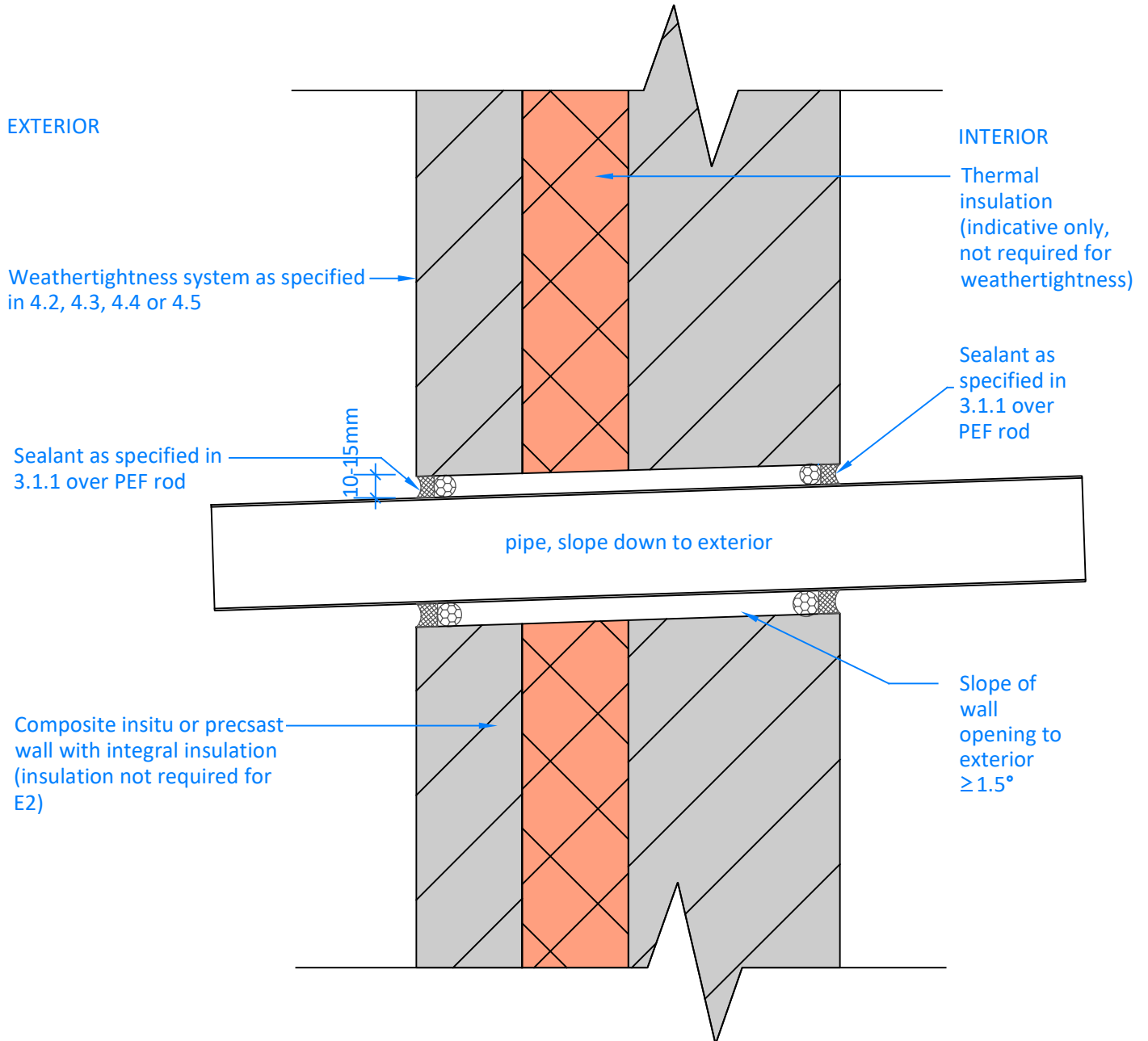
Detail 54

(not to scale)

Penetration Through Wall

Concrete Masonry, Insitu or Precast wall: internal insulation

Wall type: A1, A3, B1, C1



Comment: Structural layout is indicative only and subject to individual project design.

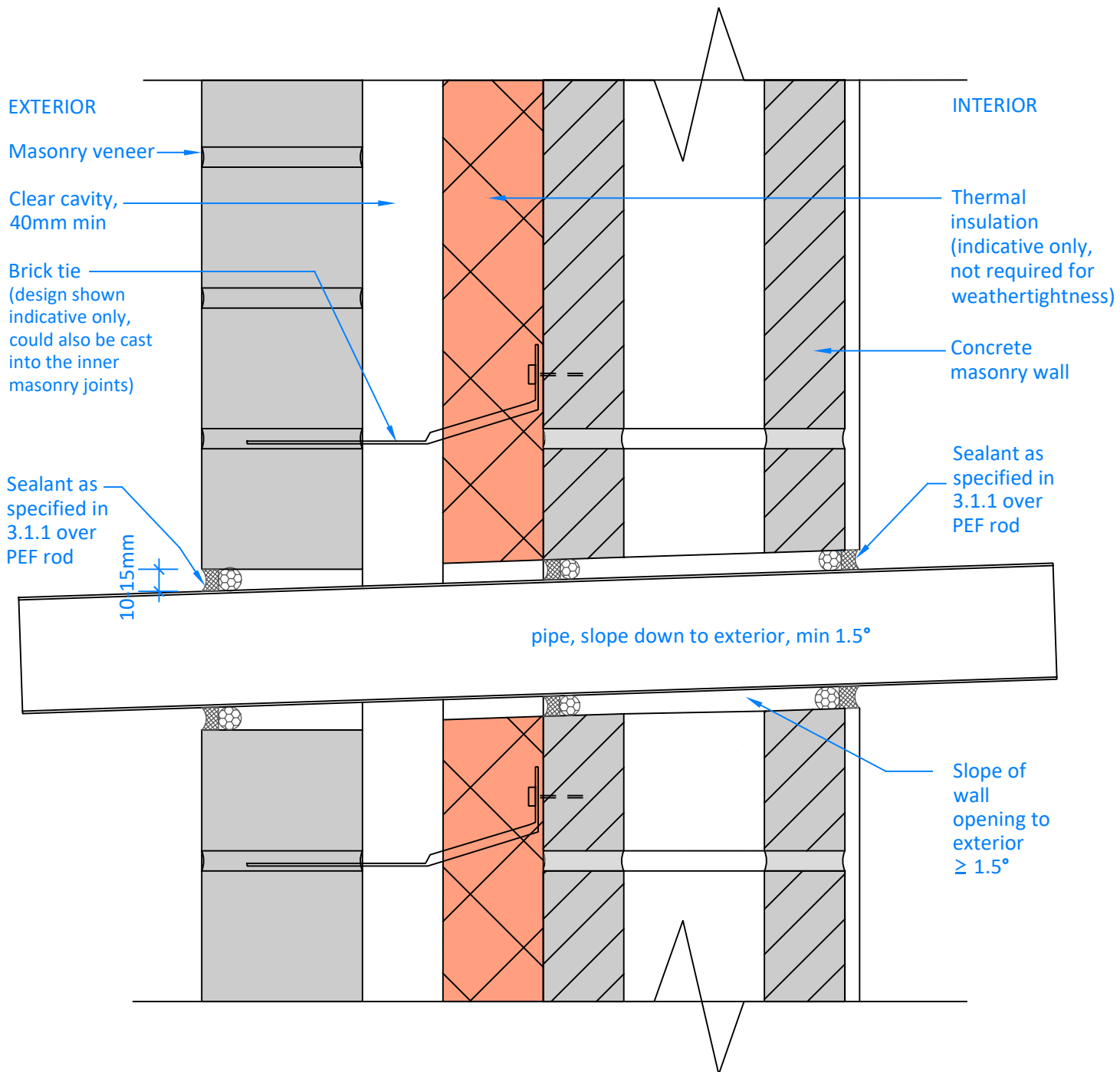
Detail 55

(not to scale)

Penetration Through Wall

Insitu or Precast wall: Integral Insulation

Wall type: B3, C3



Detail 56

(not to scale)

Penetration Through Wall

Concrete Masonry Cavity Wall: Cavity Insulation

Wall type: A4



EIFS as specified
in 4.1

Drip profile to match EIFS

Service box cover flashing

29

$\geq 20\text{mm}$

0-10mm

Continuous head and jamb seal over PEF backing rod. Sealant as specified in 3.1.1

Service box

mm

$\geq 20\text{mm}$

Service box drip section

EIFS finishing profile

Membrane as specified in 3.1.5.4 to run along the entire sill, down the face to overlap EIFS finishing profile for min. 30mm and min. 40mm up jambs

INTERIOR

Membrane
as specified
in 3.1.5.3
continuous
at head and
jambs



- Timber framing with insulation infill

Building paper

8-15m/n

m

mm

- Sealant as specified in 3.1.1 over PEF backing rod

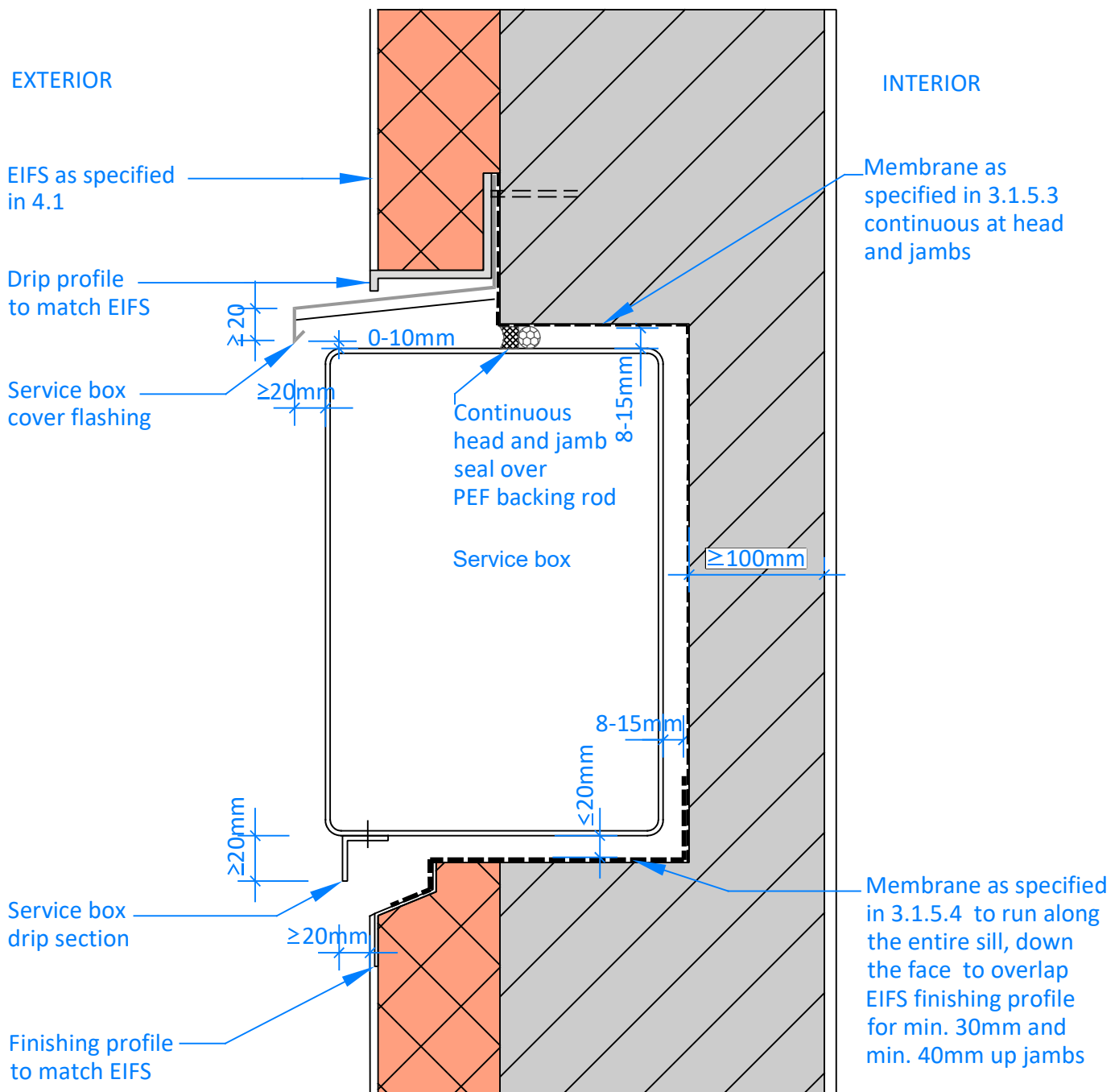
Comment: Structural layout is indicative only and subject to individual project design.

Detail 57a

(not to scale)

Service Box Set Into Wall Concrete Masonry: EIFS

Wall type: A2, B2, C2



Comment: Structural layout is indicative only and subject to individual project design.

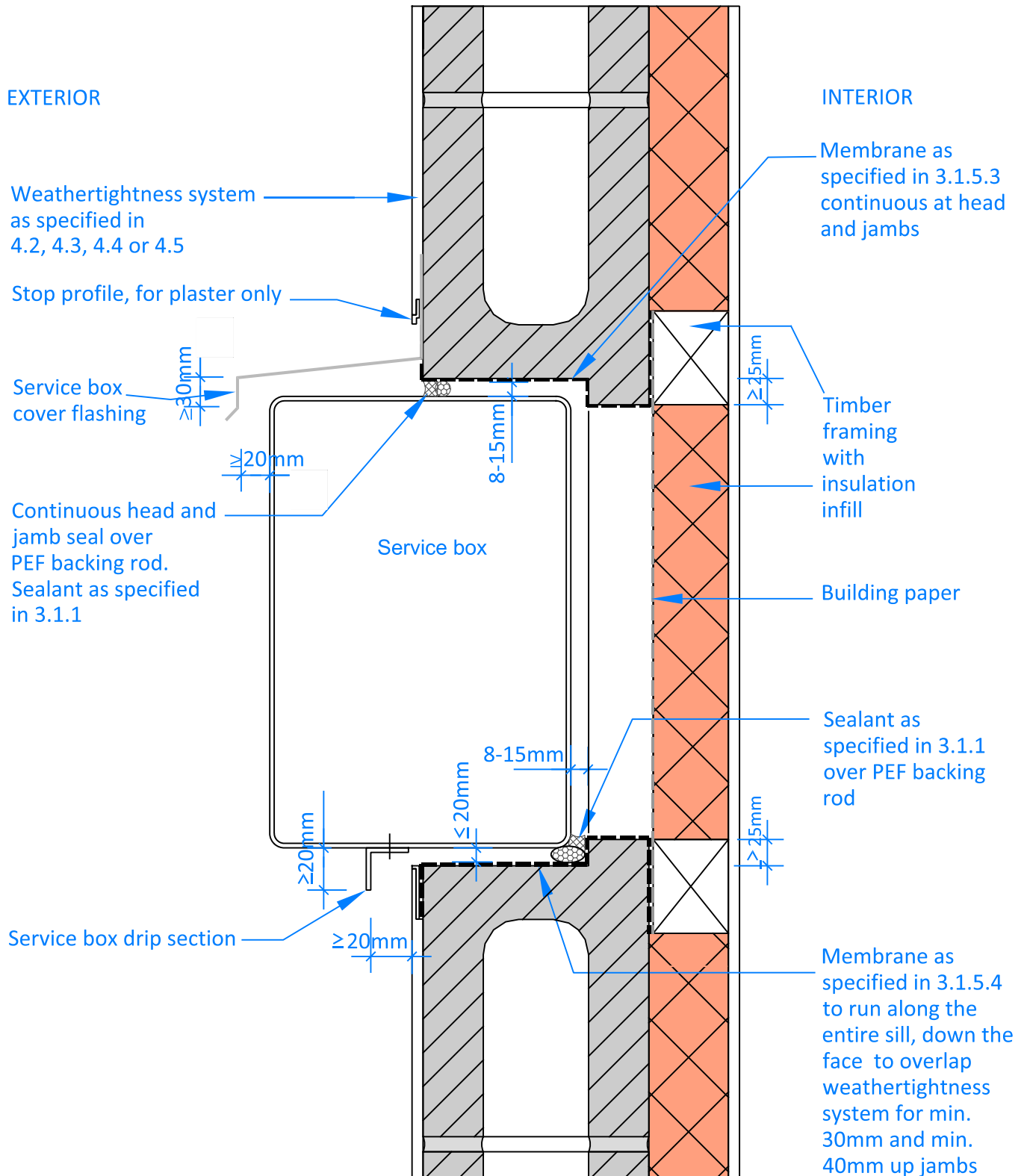
Detail 57b

Service Box Set Into Wall

Precast or Insitu: EIFS

Wall type: A2, B2, C2

(not to scale)



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

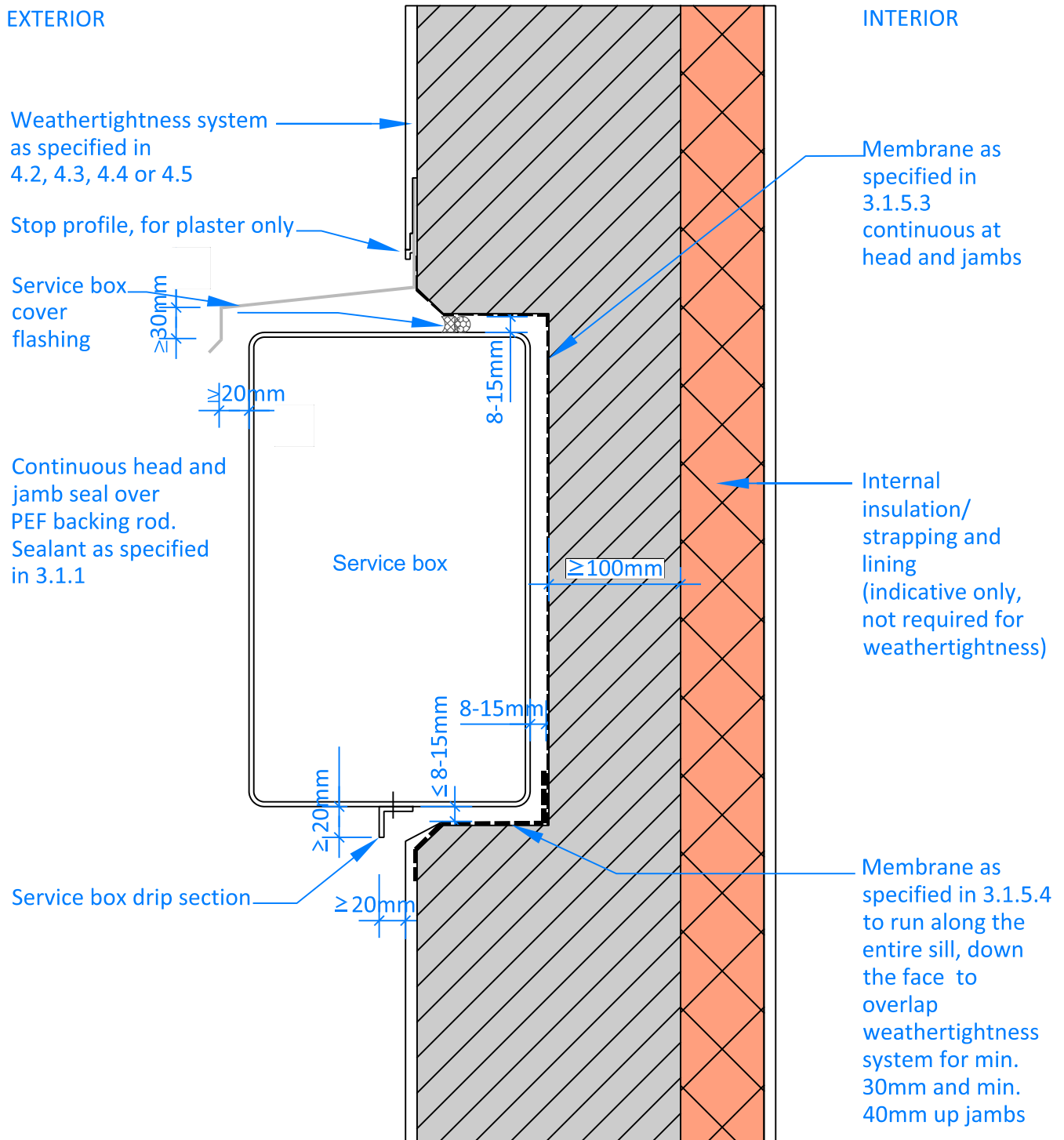
Detail 58a

Service Box Set Into Wall

Concrete Masonry: Internal Insulation

Wall type: A1, A3

(not to scale)



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

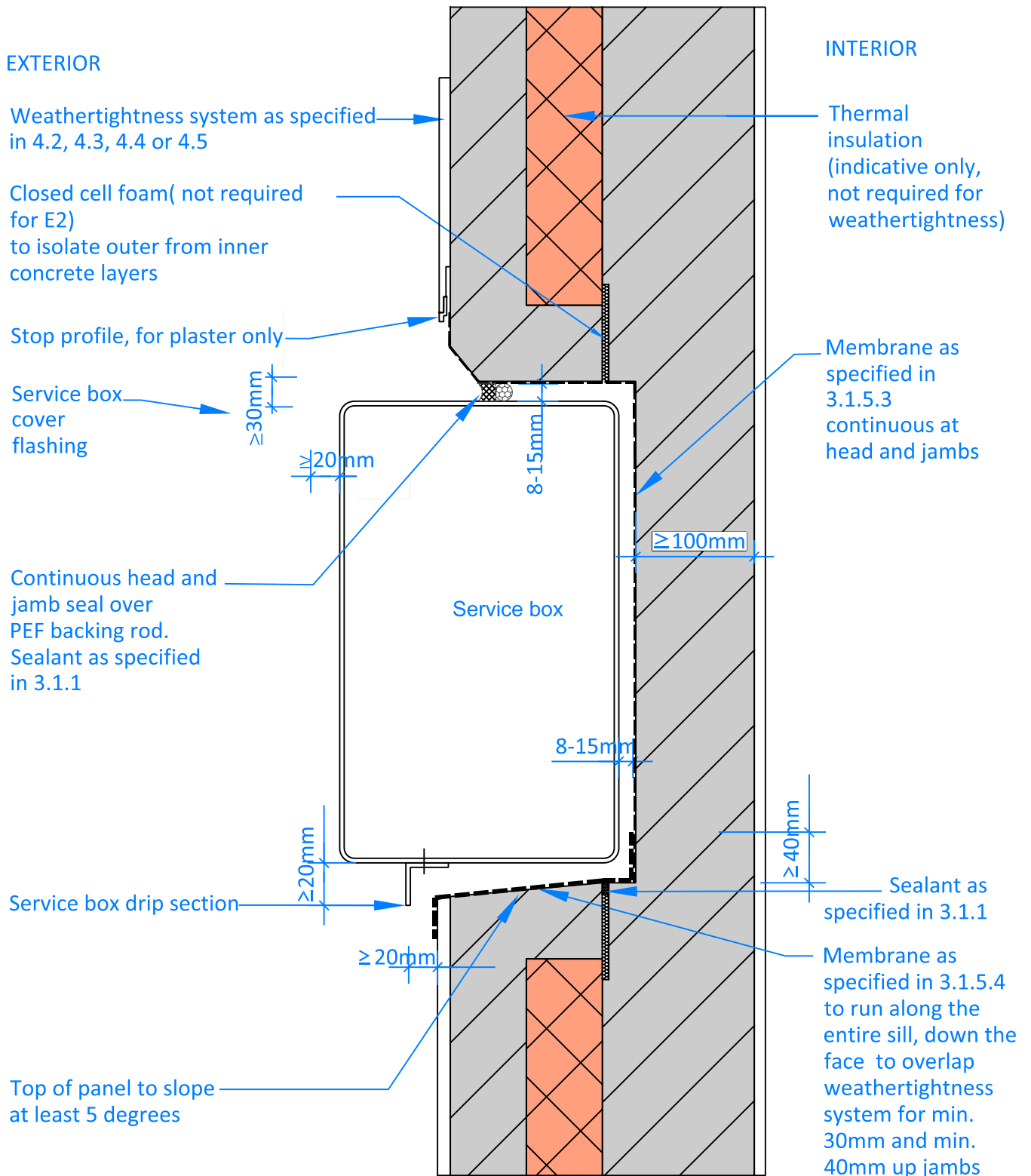
Detail 58b

Service Box Set Into Wall

Insitu and Precast: Internal Insulation

Wall type: B1, C1

(not to scale)



Comment 1: Structural layout is indicative only and subject to individual project design.

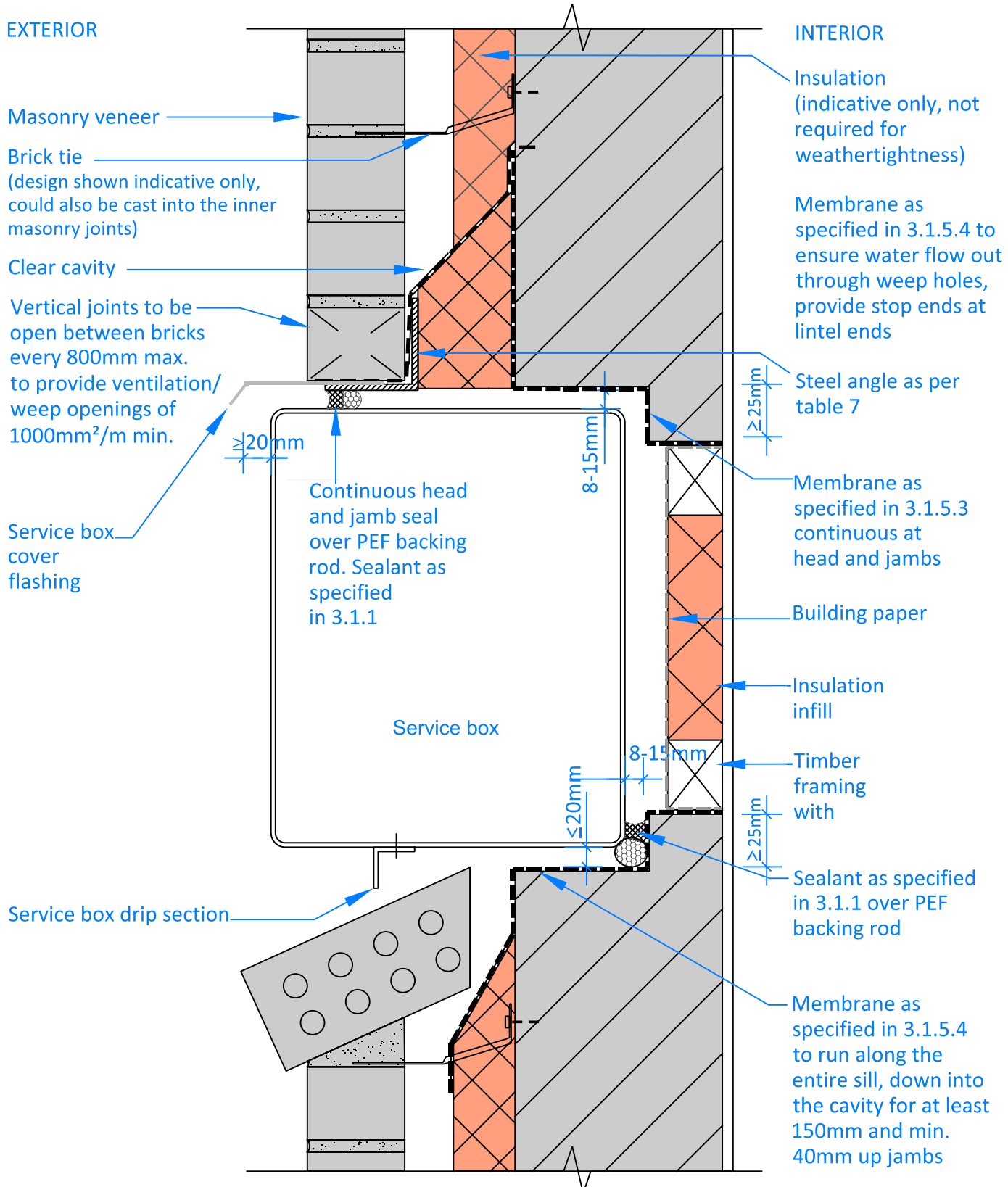
Detail 59

Service Box Set Into Wall

Precast or Insitu Wall: Integral Insulation

Wall type: B3, C3

(not to scale)



Comment 1: Structural layout is indicative only and subject to individual project design.

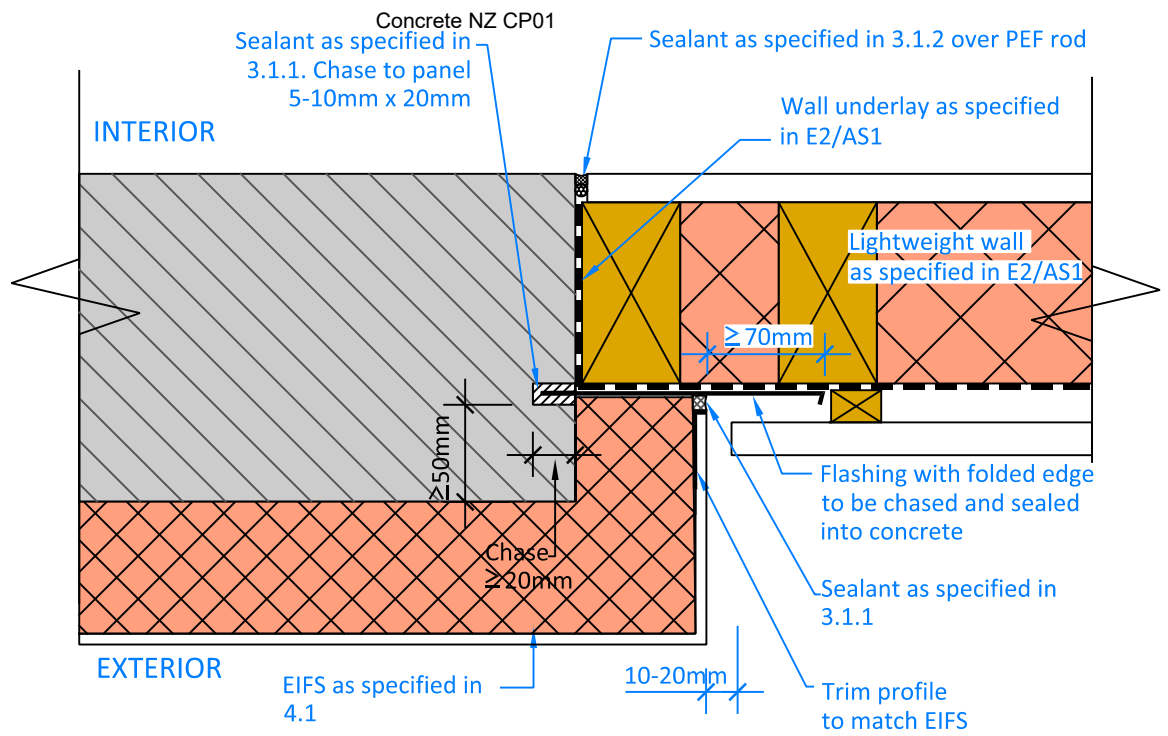
Detail 60

Service Box Set Into Wall

Concrete Masonry, cavity wall

Wall type: A4

(not to scale)



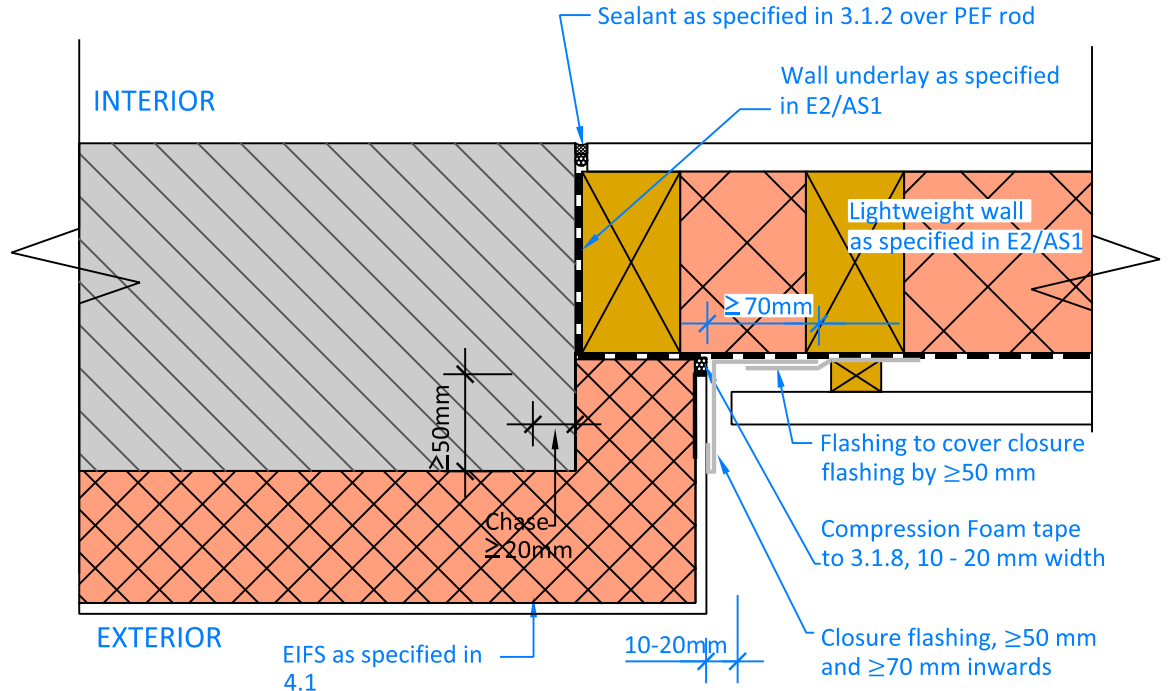
Comment: Structural layout is indicative only and subject to individual project design.

Detail 61a

(not to scale)

Concrete Wall Adjoining Other Wall Construction EIFS (Option 1)

Wall type: A2, B2, C2



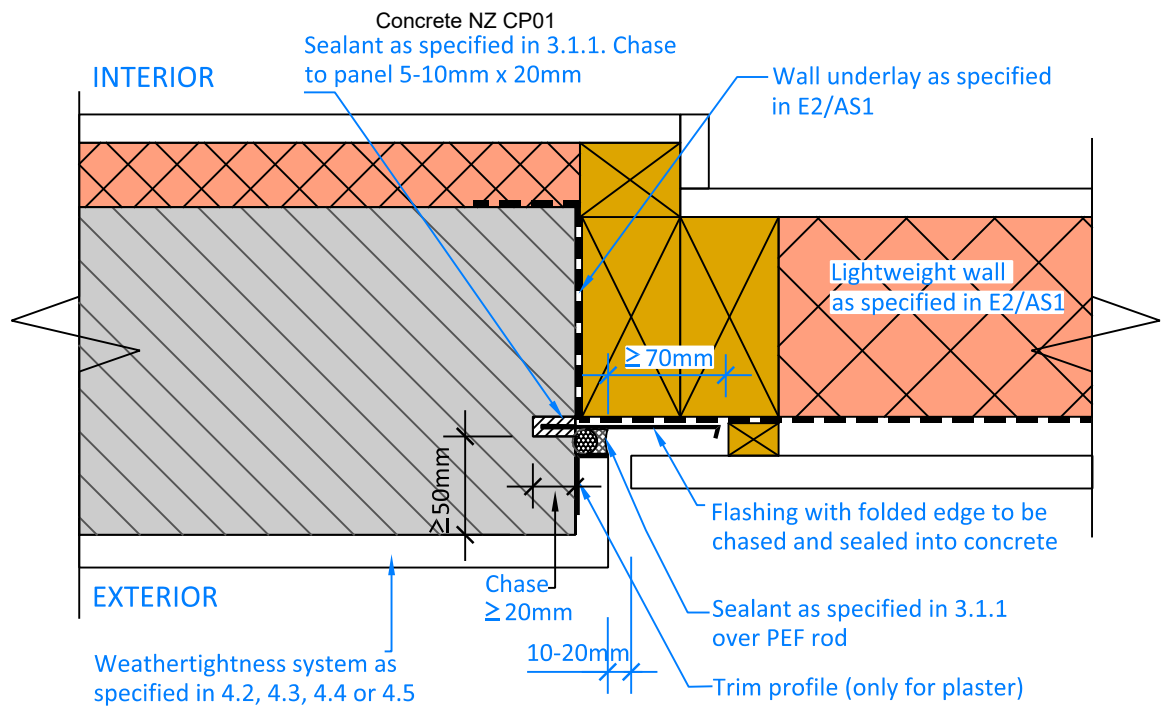
Comment: Structural layout is indicative only and subject to individual project design.

Detail 61b

(not to scale)

Concrete Wall Adjoining Other Wall Construction EIFS (Option 2)

Wall type: A2, B2, C2



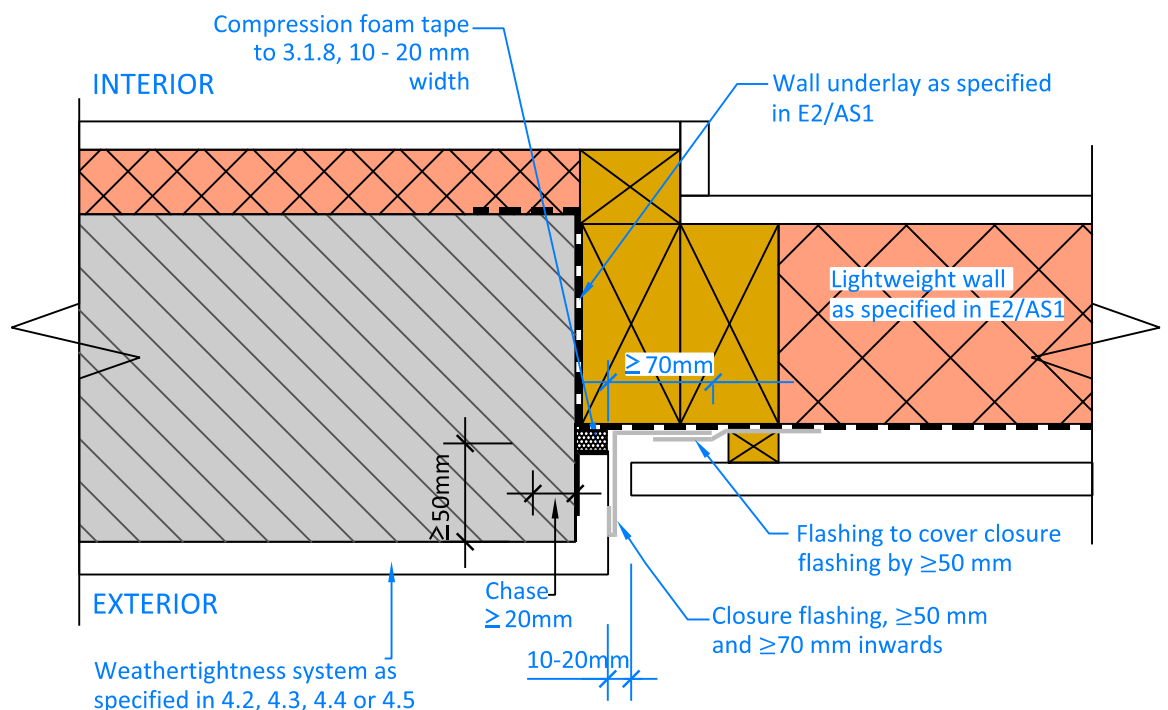
Comment: Structural layout is indicative only and subject to individual project design.

Detail 62a

(not to scale)

Concrete Wall Adjoining Other Wall Construction Internal Insulation (Option 1)

Wall type: A1, A3, B1, C1



Comment 1: Structural layout is indicative only and subject to individual project design.

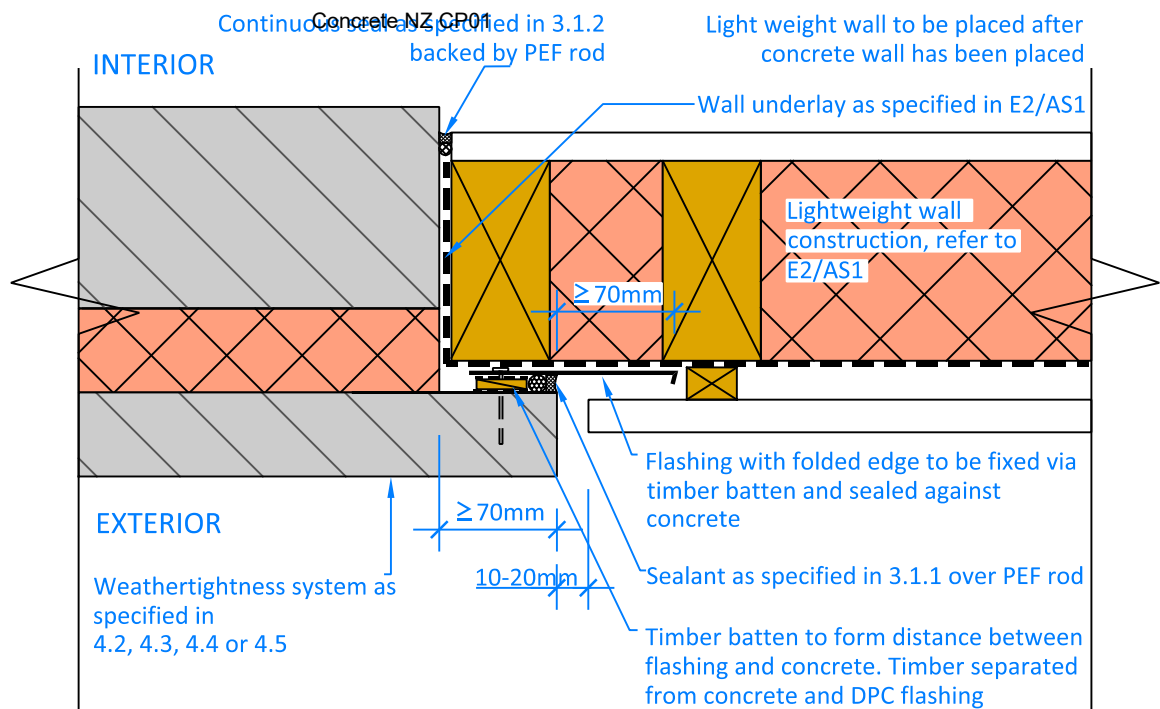
Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation. Batt insulation or moisture absorbing insulation should be avoided.

Detail 62b

(not to scale)

Concrete Wall Adjoining Other Wall Construction Internal Insulation (Option 2)

Wall type: A1, A3, B1, C1



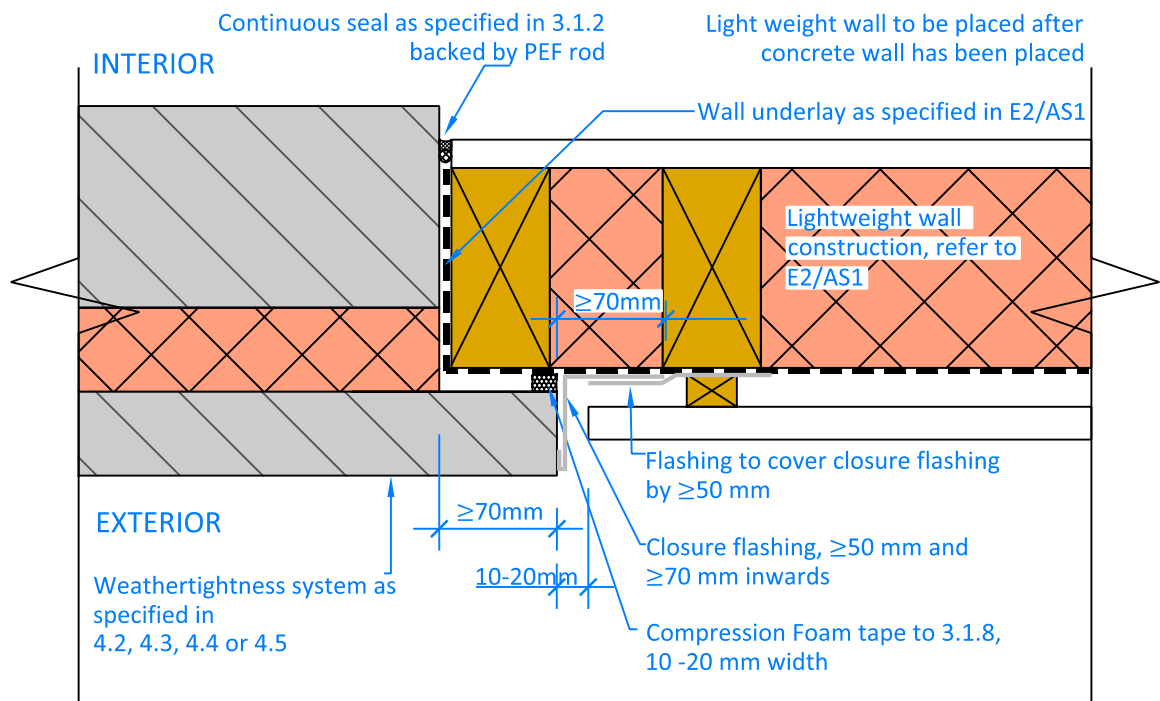
Comment: Structural layout is indicative only and subject to individual project design.

Detail 63a

(not to scale)

Concrete Wall Adjoining Other Wall Construction Integral Insulation (Option 1)

Wall type: B3, C3



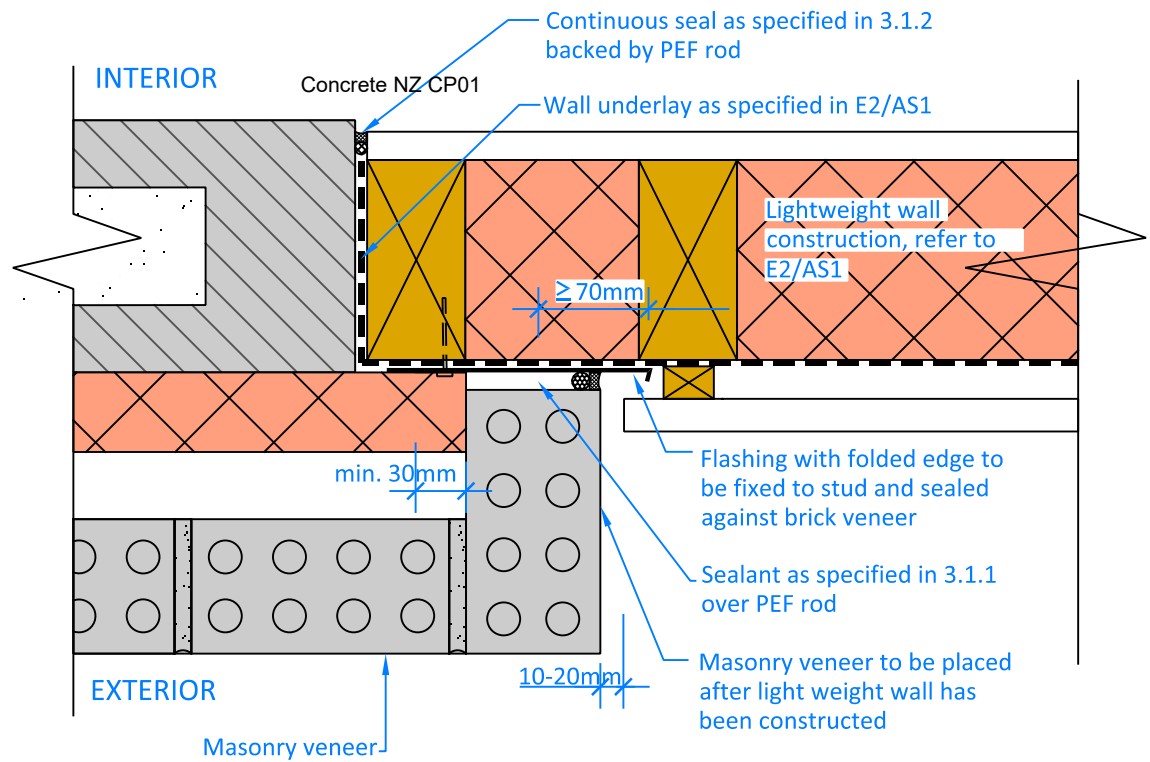
Comment: Structural layout is indicative only and subject to individual project design.

Detail 63b

(not to scale)

Concrete Wall Adjoining Other Wall Construction Integral Insulation (Option 2)

Wall type: B3, C3



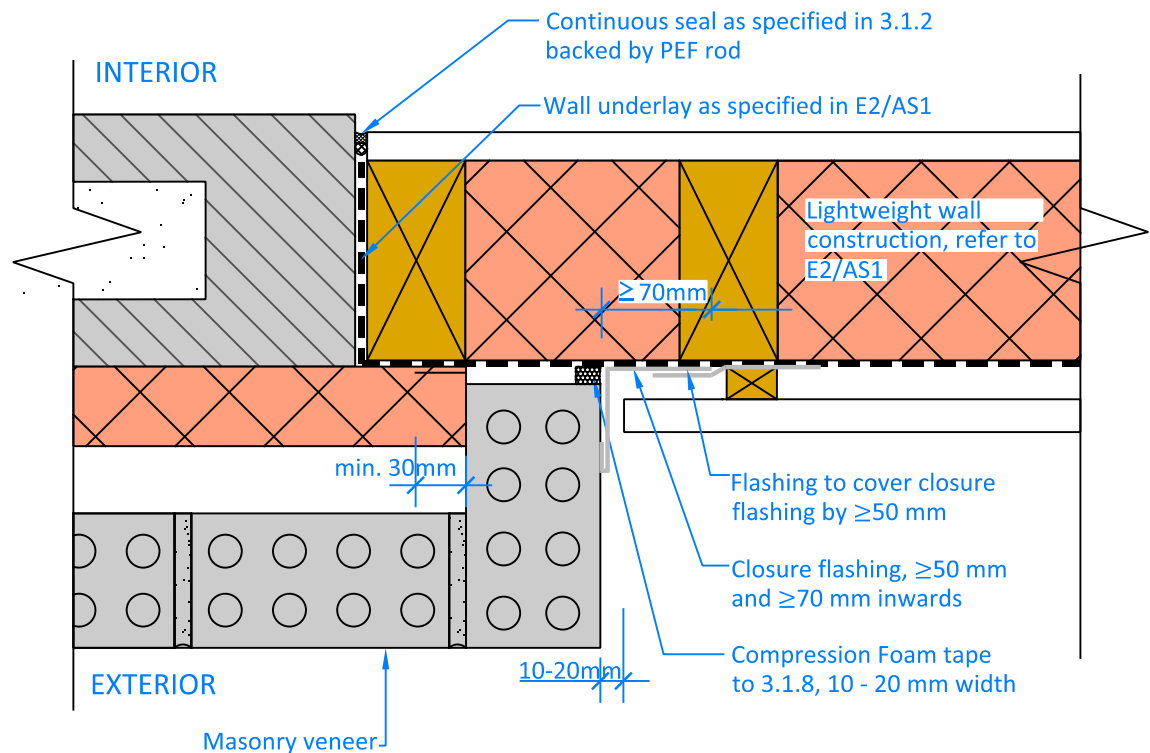
Comment: Structural layout is indicative only and subject to individual project design.

Detail 64a

(not to scale)

Concrete Wall Adjoining Other Wall Construction Cavity Insulation (Option 1)

Wall type: A4



Comment: Structural layout is indicative only and subject to individual project design.

Detail 64b

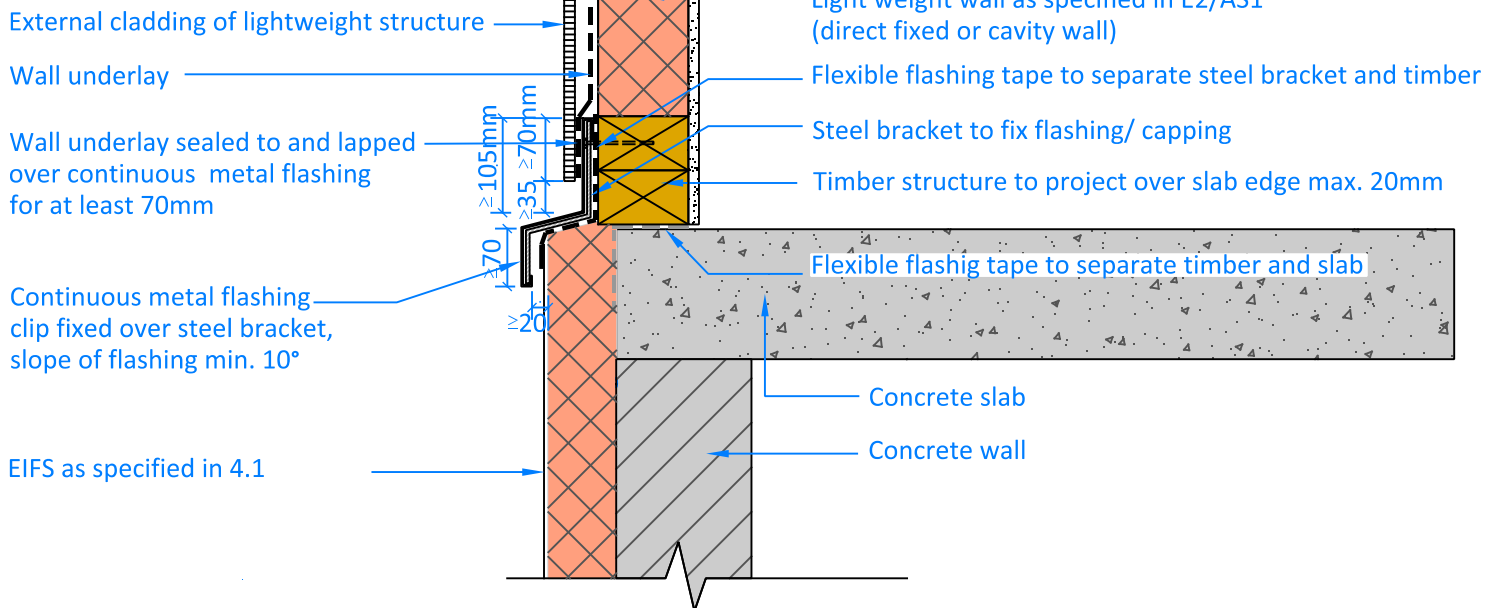
(not to scale)

Concrete Wall Adjoining Other Wall Construction Cavity Insulation (Option 2)

Wall type: A4

EXTERIOR

INTERIOR



Comment: Structural layout is indicative only and subject to individual project design.

Detail 65 (vertical section)

(not to scale)

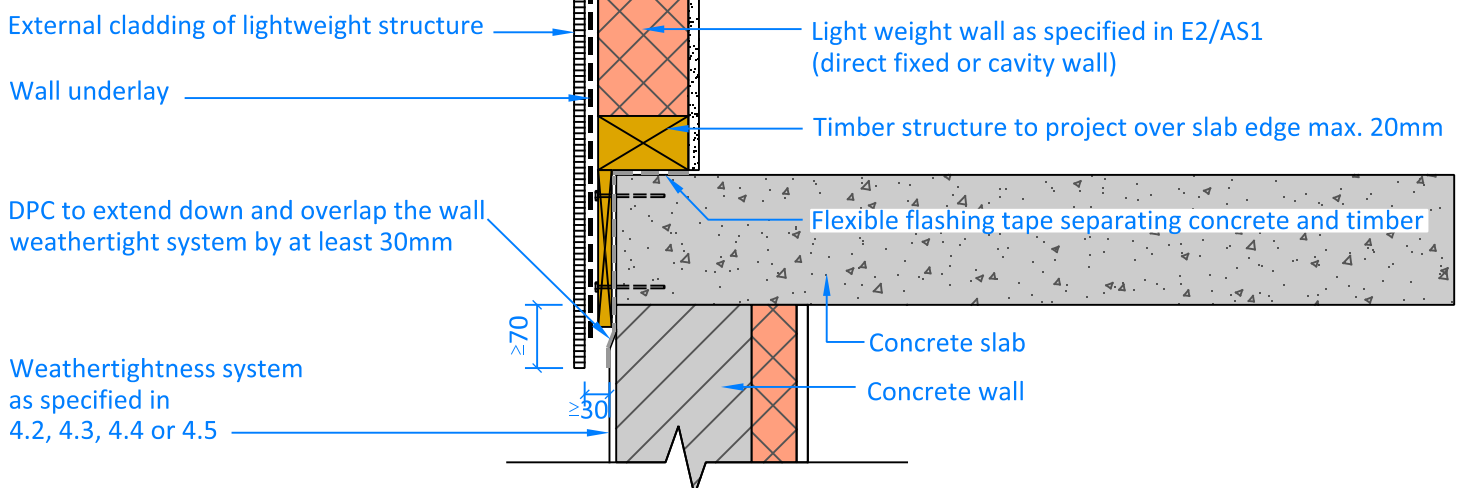
Concrete Wall adjoining other material above.

Concrete Masonry, Precast or Insitu: EIFS

Wall type: A2, B2, C2

EXTERIOR

INTERIOR



Comment 1: Structural layout is indicative only and subject to individual project design.

Comment 2: For internal insulation it is recommended using taped and sealed closed cell rigid insulation.

Batt insulation or moisture absorbing insulation should be avoided.

Detail 66 (vertical section)

(not to scale)

Concrete Wall adjoining other material above.

Concrete Masonry, Precast or Insitu: Internal Insulation

Wall type: A1, A3, B1, C1

EXTERIOR

Wall underlay

Wall underlay sealed to and lapped over continuous metal flashing for at least 70mm

Continuous metal flashing clip fixed over steel bracket, slope of flashing min. 10°

DPC to extend down and overlap the wall weathertight system by at least 30mm

Weathertightness system as specified in 4.2, 4.3, 4.4 or 4.5

INTERIOR

Light weight wall as specified in E2/AS1 (direct fixed or cavity wall)

Flexible flashing tape separating steel bracket and timber and sealed over top of weathertightness system

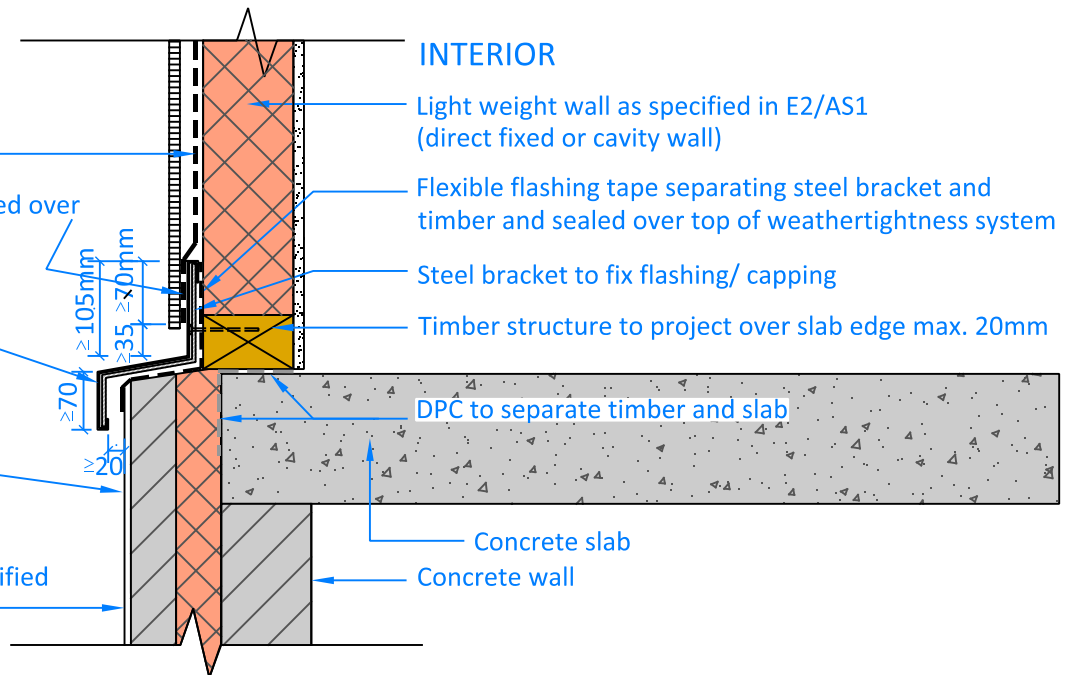
Steel bracket to fix flashing/ capping

Timber structure to project over slab edge max. 20mm

DPC to separate timber and slab

Concrete slab

Concrete wall



Comment 2: Structural layout is indicative only and subject to individual project design.

Detail 67 (vertical section)

(not to scale)

Concrete Wall adjoining other material above.**Insitu or Precast Wall: Integral Insulation**

Wall type: B3, C3

EXTERIOR

Wall underlay

Wall underlay sealed to and lapped over continuous metal flashing at least 70mm

Continuous metal flashing clip fixed over steel bracket, slope of flashing min. 10°

Cavity ventilation gap of at least 10mm at narrowest section

Brick tie (design shown indicative only, could also be cast into the inner masonry joints)

Masonry veneer

Clear Cavity, 40mm min

Thermal insulation

INTERIOR

Light weight wall as specified in E2/AS1 (direct fixed or cavity wall)

Flexible flashing tape separating steel bracket and timber

Steel bracket every 600mm, bolted to slab

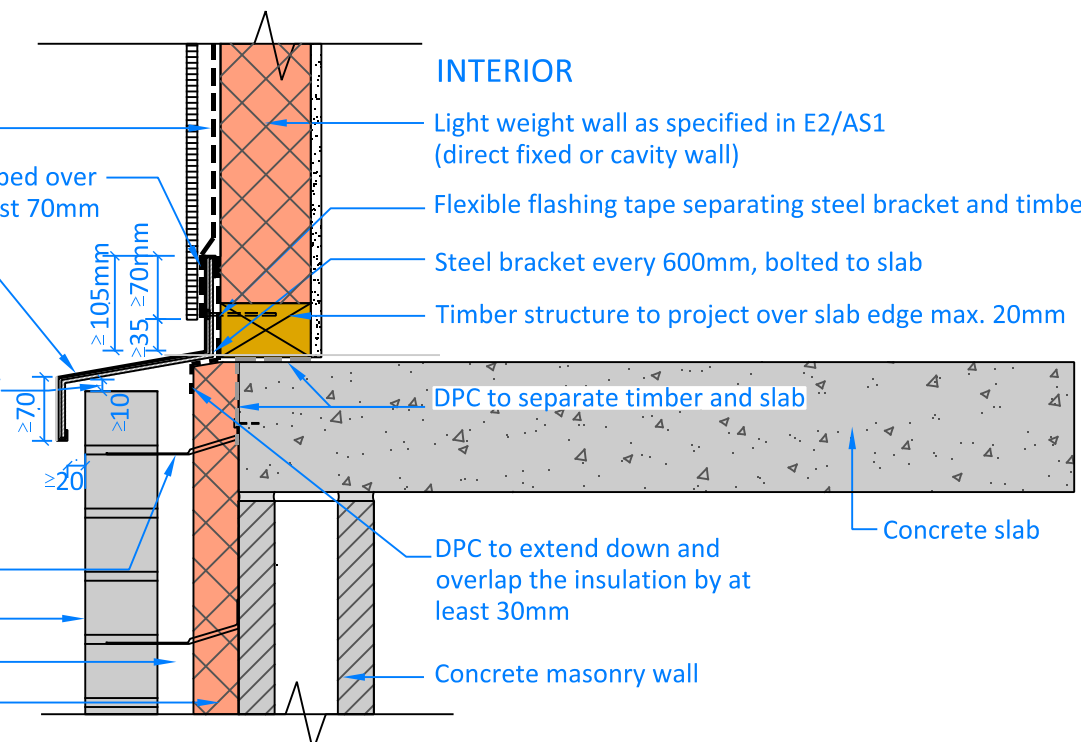
Timber structure to project over slab edge max. 20mm

DPC to separate timber and slab

DPC to extend down and overlap the insulation by at least 30mm

Concrete masonry wall

Concrete slab



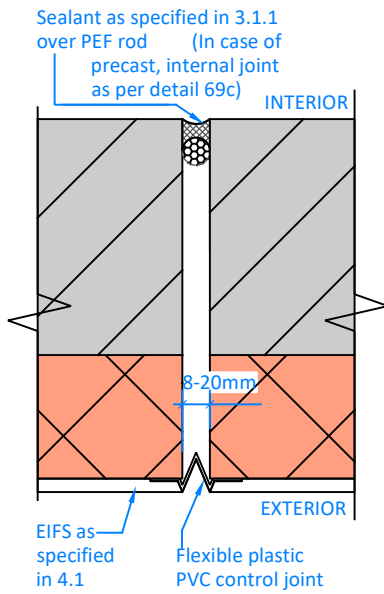
Comment 1: Structural layout is indicative only and subject to individual project design.

Detail 68 (vertical section)

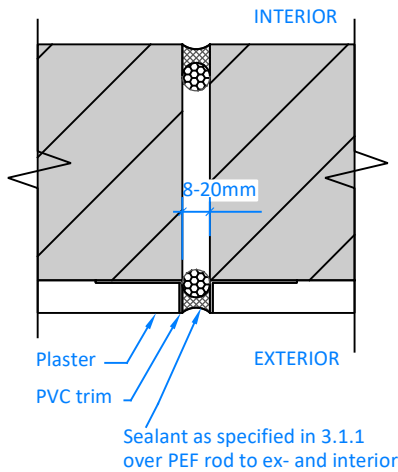
(not to scale)

Concrete Wall adjoining other material above.**Concrete Masonry Cavity Wall: Cavity Insulation**

Wall type: A4

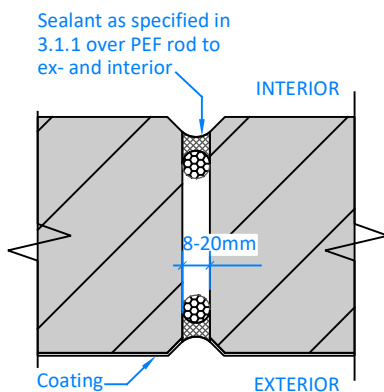


Detail 69a Vertical control Joint:
EIFS, horizontal section



Detail 69b Vertical control Joint:
Plastered masonry wall,
horizontal section

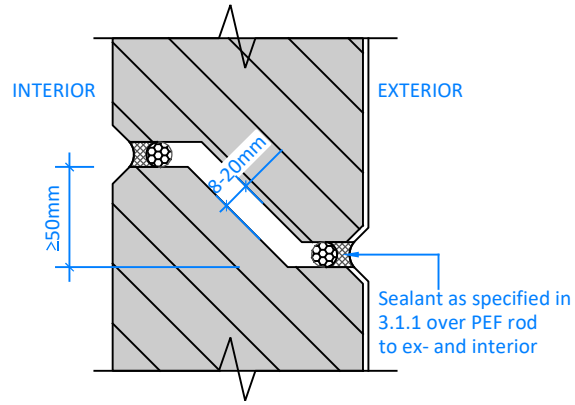
Applies also to internal and integral insulation.
Joint does not show in internal insulation.



Detail 69c Vertical control Joint:
precast wall, horizontal section

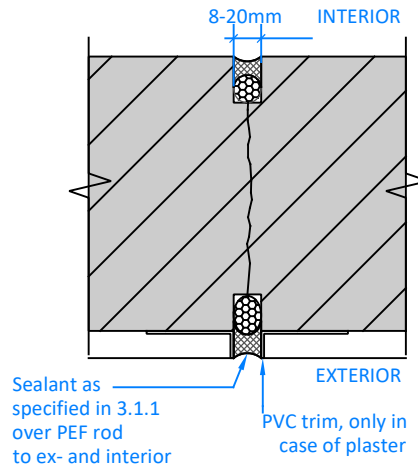
Applies also to internal and integral insulation.
Joint does not show in internal insulation.

Concrete NZ CP01



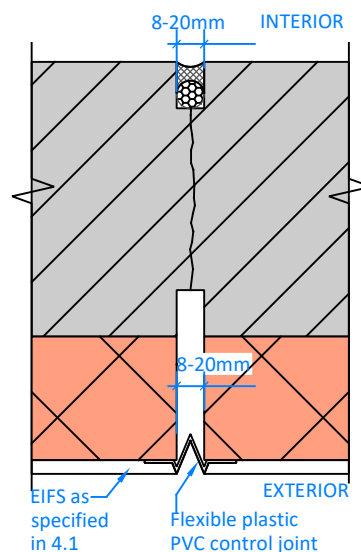
Detail 69d Horizontal Panel Joint:
Precast, vertical section

Applies also to internal and integral insulation.
Joint does not show in internal insulation.



Detail 69e Vertical control Joint:
Insitu with weathertightness system
4.2, 4.3, 4.4 and 4.5, horizontal section
Joints are planned for cracks

Applies also to internal and integral insulation.
Joint does not show in internal insulation.

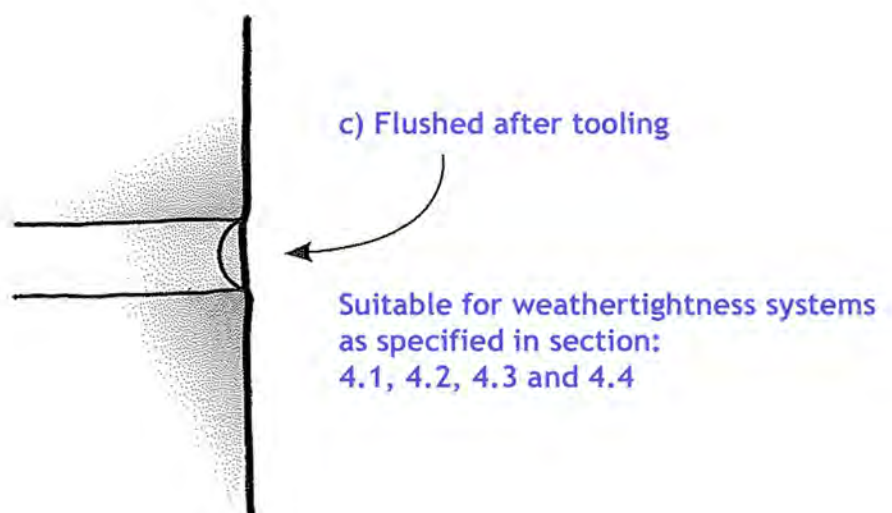
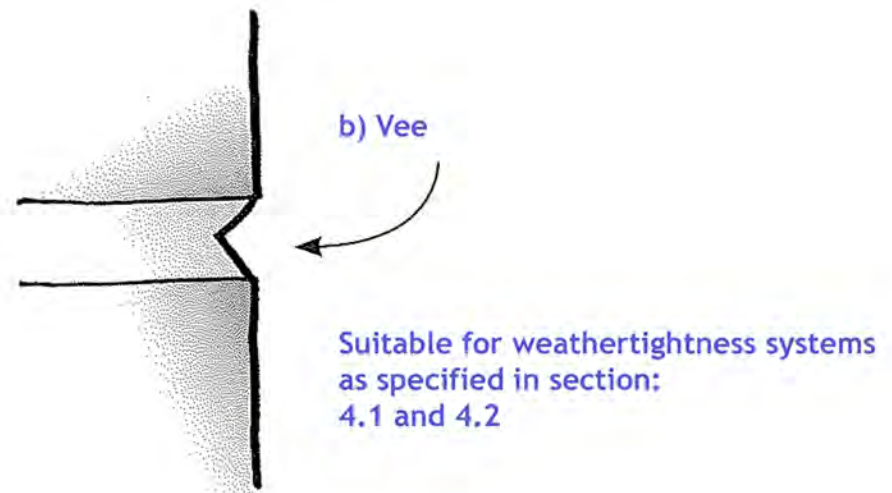
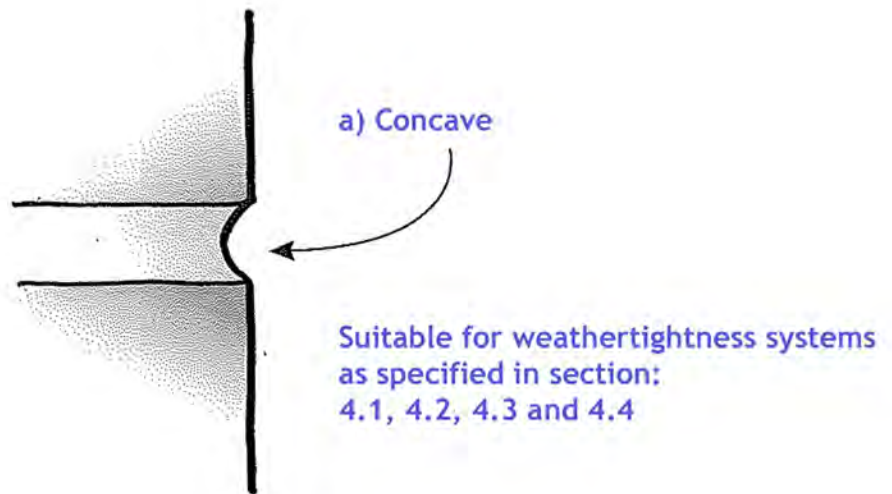


Detail 69f Vertical control Joint:
Insitu with EIFS, horizontal section
Joints are planned for cracks

Comment 3: drawings are not to scale

Comment 2: all sealant joints to be sized 2:1 (width equals two times depth)

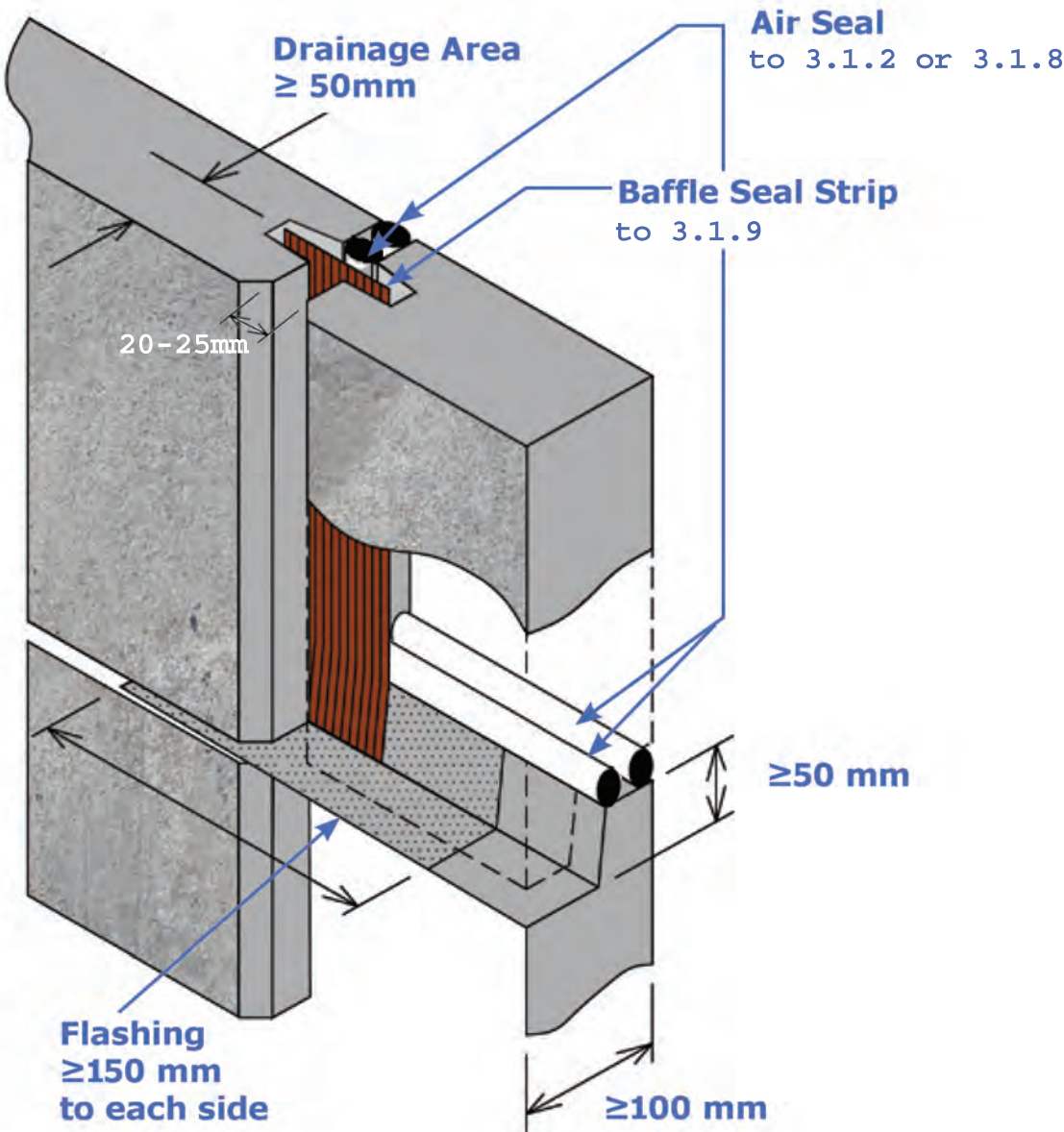
Comment 1: all joints to be primed prior to sealant installation



Detail 70 Mortar joints

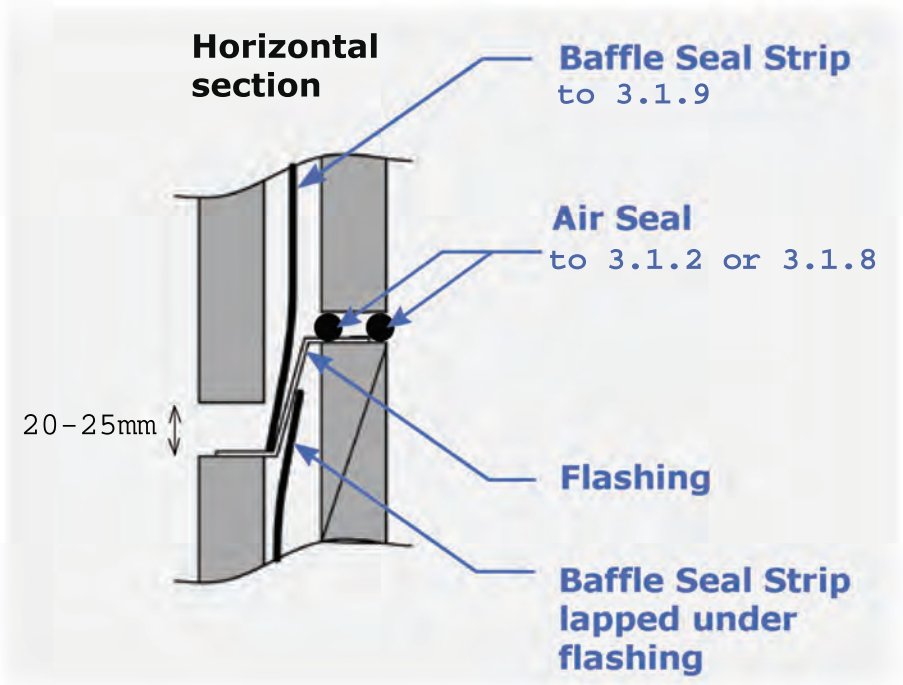
All joint profiles - to be tooled and retooled

Isometry



Structural layout
indicative only!

Detail 71
Open drained
precast panel joint



Appendix A (informative): Thermal performance

This appendix describes and contains:

- the methodology used for the thermal bridge calculations accompanying the detailed diagrams
- the temperature factor f_{Rsi} , how to calculate this for junctions, and relevant f_{Rsi} for different climate zones
- the potential for condensation with internal insulation and preventing mould growth
- the thermal bridging and surface temperature factors of CNZ CP01 construction details (Mould Index)

COMMENT:

This appendix is provided for information only, noting that compliance with Building Code Clause H1 Energy efficiency is outside the scope of this Code of Practice.

A.1 Methodology for thermal bridge calculations

Thermal bridge calculations for the graphs accompanying the detailed drawings have been made using ISO 10211:20107 and/or ISO 10077-2:2017 using ISO 6946:2017. Mixed materials are calculated using ISO 6946, as are ventilated cavities.

Contact resistances are neglected in the application of ISO 10211 / ISO 6946 as these are typically negligible except in steel-to-steel connections. Fixing bolts and discontinuous hardware, such as bottom plate hold-down bolts, window hinges and window latches, are not considered except where stated otherwise.

For simplicity, all wall insulation has been considered with 80 mm black EPS and all roof insulation with 140 mm black EPS. Wall thickness is considered with 150 mm and slabs with 100 mm. Window support bars have been considered of fiberglass and are recommended to use psince its thermal performance is substantially advanced when compared to aluminium support bars.

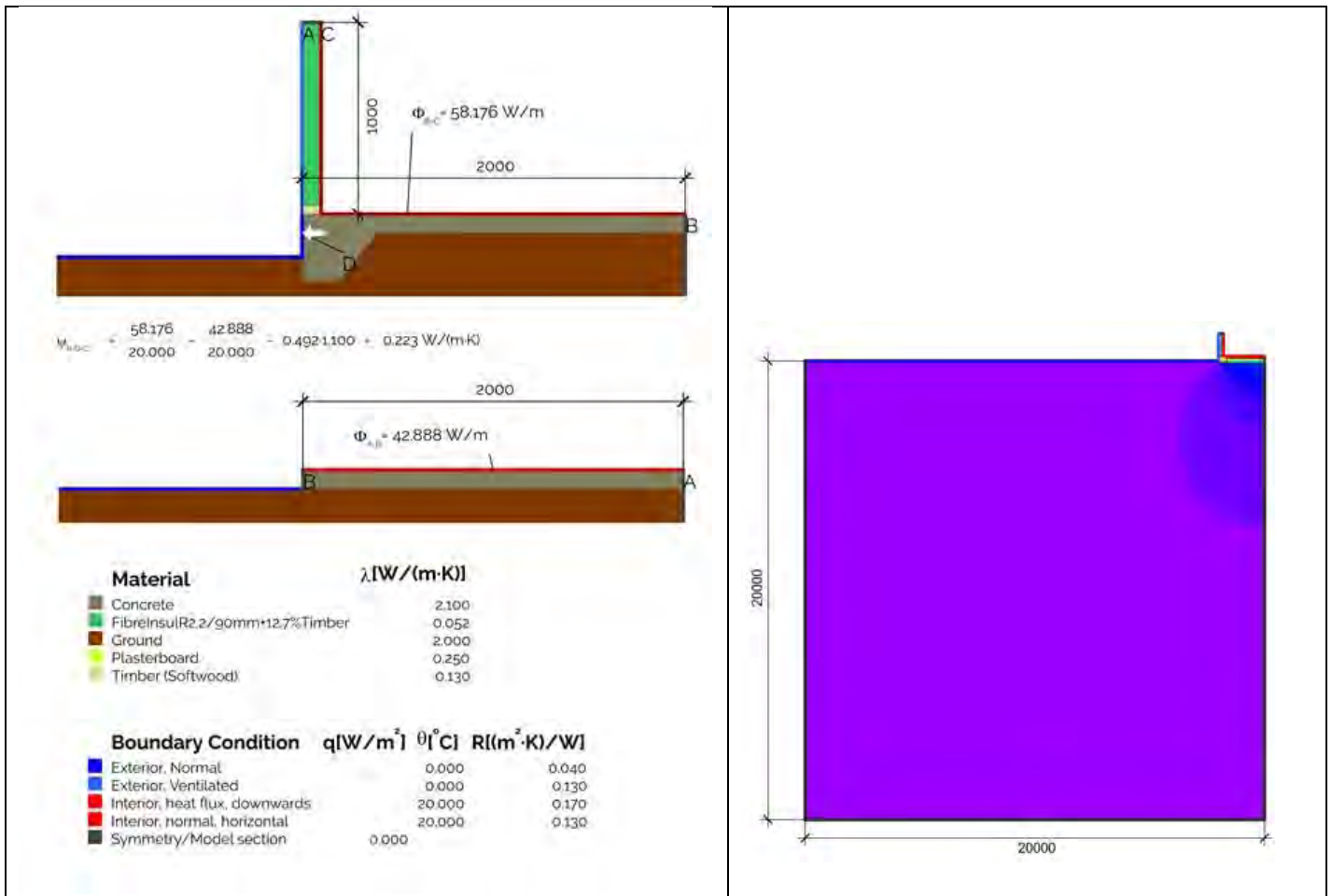


Figure A.1: Boundary conditions

Figure A.1 shows how the ground element was taken as 20 m by 20 m in all cases. In the interests of space the full model with ground elements is not shown. Also note that the slab $A/P=B'/2=2\text{m}$ in all Junctions modelled. Slab edges have been calculated using Passive House Institute practice as there are some differences in the interpretation of the way to model the base of the wall etc.

The software used for thermal modelling included PHPP, Flixo, UcanPSI and Mold3D.

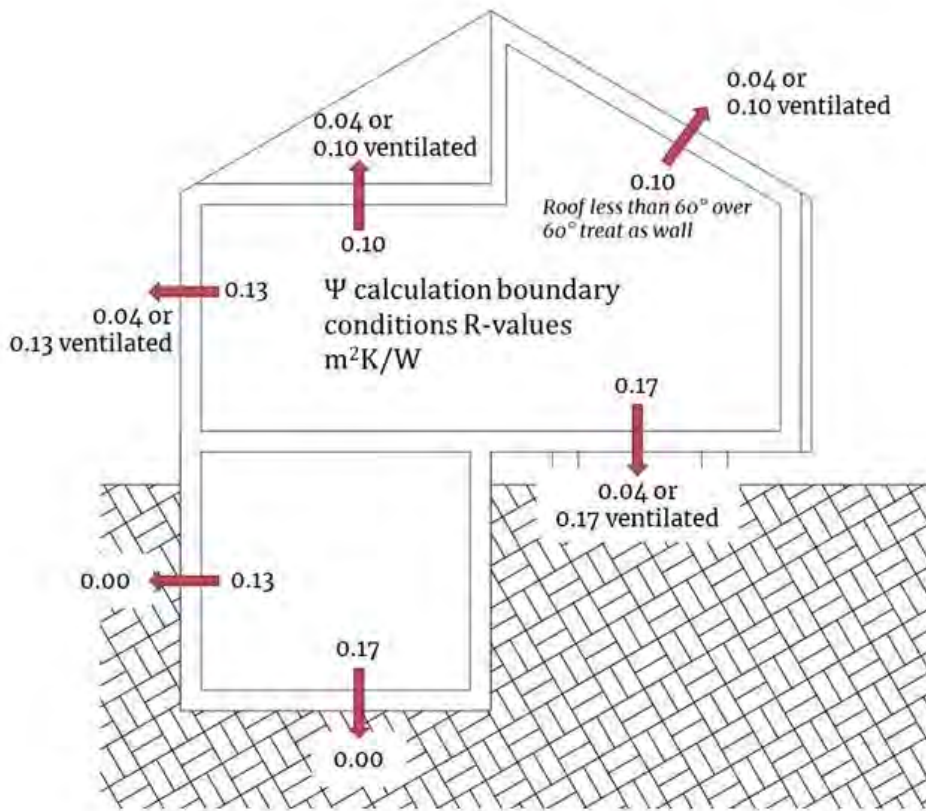


Figure A.2: Air film surface resistances using ISO 6946

The resistances shown in Figure A.2 were used for all elements and junctions. They differ only slightly from NZS 4214 standard values.

A.2 Temperature factor fR_{si}

fR_{si} (factor, resistance surface internal) is a simple ratio using the indoor air temperature, outdoor air temperature, and surface temperature (see Definitions in this Code of Practice).

$$\text{Minimum Temperature Factor} = \frac{\text{Minimum interior surface temperature} - \text{External temperature}}{\text{Interior air temperature} - \text{External temperature}}$$

The Passive House Institute (www.passivehouse.com) has established minimum fR_{si} values for the different climate zones. These values and the relevant New Zealand zones are shown in Figure A.4 below. Junctions should meet or exceed the PHI-critical fR_{si} values for the climate zone where a specific project is located.

To calculate fR_{si}, first model the Junction using ISO 10211 as would be done to calculate the thermal bridge coefficient. Next, change the internal surface air film resistance to 0.25 m²K/W. Find the minimum temperature and calculate the minimum temperature factor. Changes to the Junction's insulation level or geometry etc will in many cases require new calculations.

This process is discussed further at <https://sustainableengineering.co.nz/hygiene-criterion-applied-to-a-thermal-bridge>).

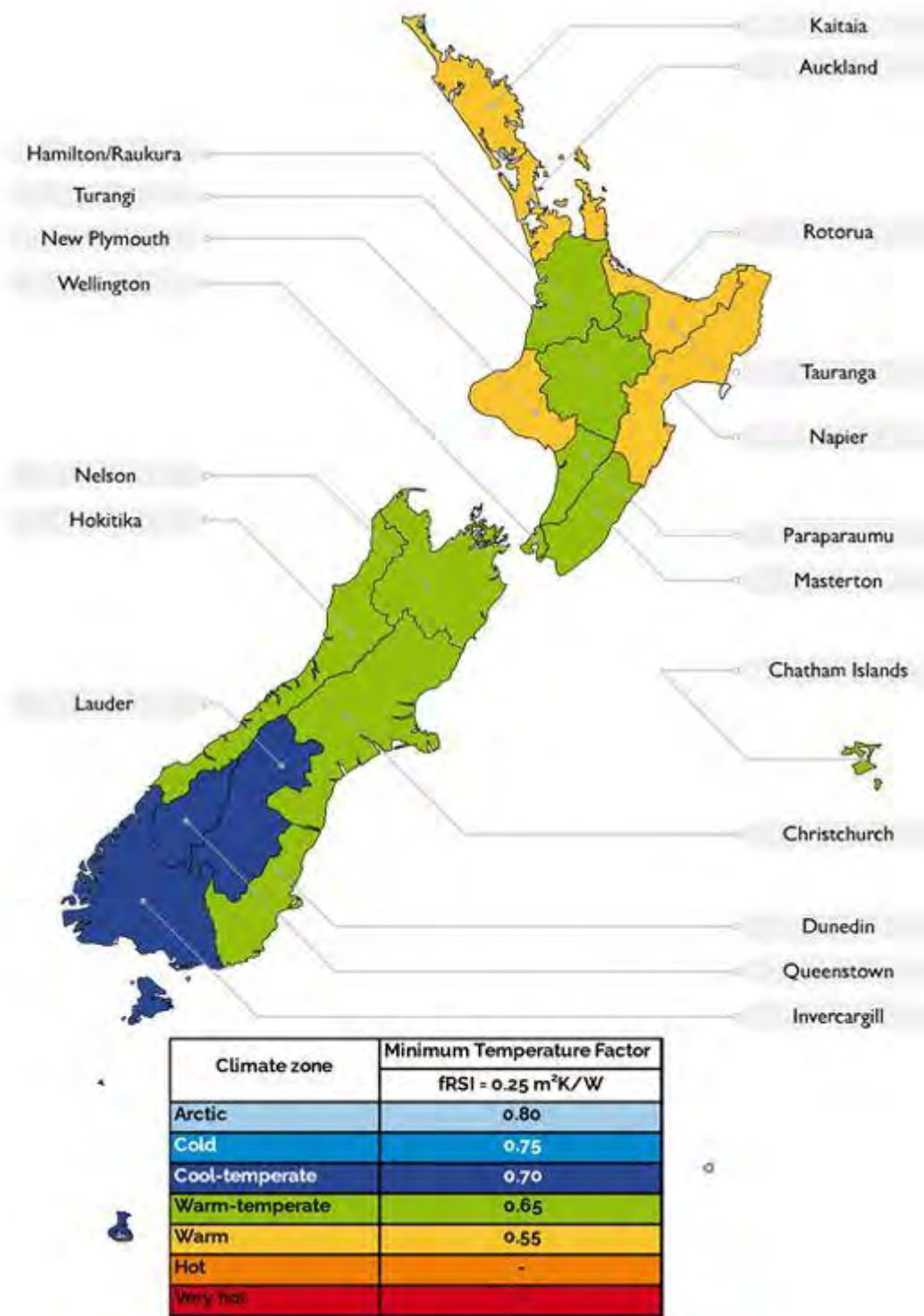


Figure A.3: Climate zones and relevant f_{RSI} requirements (image: Sustainable Engineering Ltd)

Note that Figure A.4 shows the three different f_{RSI} zones at the weather station altitudes. The climate zone and thus the f_{RSI} requirements also vary with altitude as the average temperatures typically drop by 0.6°C per 100m of elevation gain. In general these zones can be used without considering the elevation change.

A.3 Internal insulation and preventing mould growth

Internal insulation of concrete (and heavy mass) construction can be problematic as the internal insulation reduces heat flow into the concrete, which lowers its temperature. A rough rule of thumb when it comes to mould is: “cold spots equal mould spots”. If a surface is colder than the room it cools the air immediately adjacent to it, raising the local relative humidity as a consequence.

As an example, let's assume the warm and dry air inside a typical New Zealand home in the winter is 20°C and 60% relative humidity (RH). If the surface of the concrete inside the house is 15°C the relative humidity will be >80%, which is high enough for mould growth to be likely. This is true for surfaces inside building envelope build-ups as well as for interior surfaces. If moisture can move through the constructions either through convection (ie air leaks) or diffusion the relative humidity can be sufficiently high to permit mould growth. Therefore, appropriate ventilation is crucial. Aside from undertaking specific design analysis, there are three strategic approaches to reduce the risk of moisture issues:

1. provide continuous mechanical ventilation to reduce the moisture driving into the building constructions,
2. prevent warm (moist) interior air from contacting cold areas of constructions, and
3. use constructions that are more permeable as you move from the inside of the construction to the outside (allowing drying to the exterior).

These strategies are suitable for heating-dominated climates and are general guides. While the first of these strategies is relatively easy to understand the other two need a bit more explanation.

We've all seen condensation on a cold glass in the summer. Designing building constructions to prevent warm air leaking into and through constructions is critical to preventing similar condensation (or even high relative humidity) in our building assemblies. This is done by preventing warm interior air from entering the construction with an air control layer to the warm side of the construction. One common approach is to use airtight insulation boards, such as EPS/XPS, on the warm side of concrete constructions. These boards will need to be sufficiently thick so the interior surface is warm enough to prevent any moisture issues. Thermal bridges around the insulation boards and any penetrations will also need to be addressed to prevent air leaks.

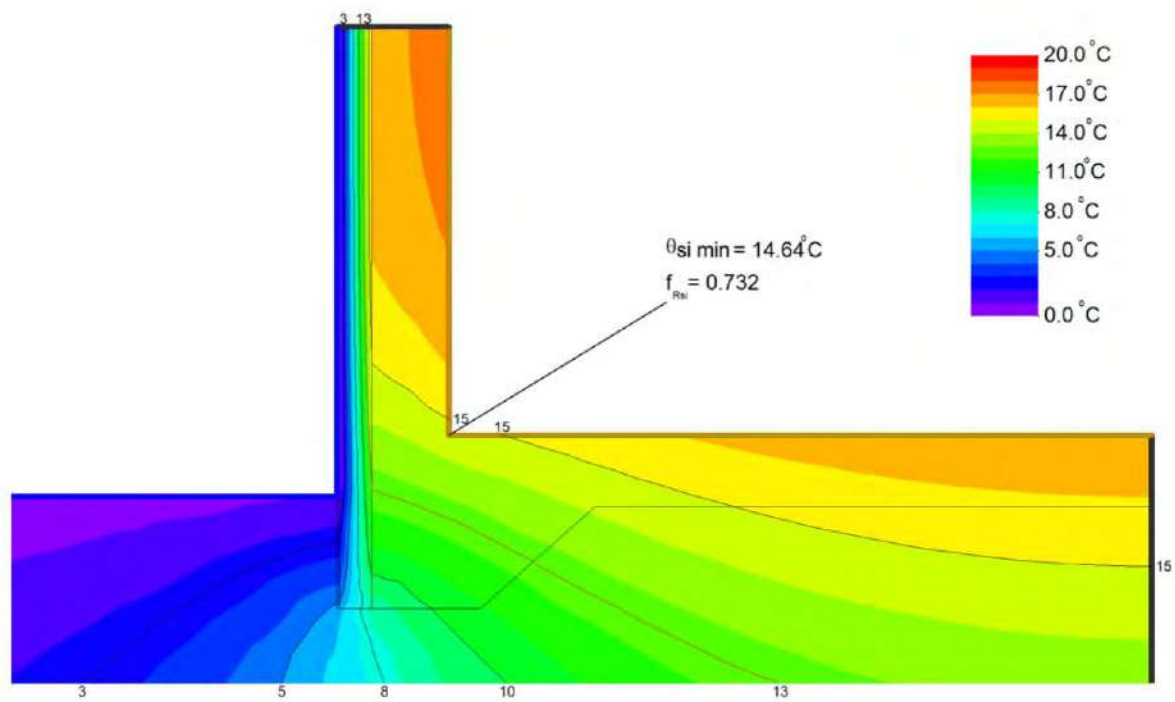
Why allowing building constructions to dry to the exterior is essential if you think of a material's moisture permeability as the steepness of a ski slope. If the less permeable layer is on the inside of the construction and the more permeable layer is on the outside, any water molecules inside can ski faster and faster down the slope and then through and out of the wall. However, if the more permeable layer is on the inside then moisture can easily penetrate this and accumulate. A common example of this is strapping and internal lining of concrete walls with fibre insulation. As the gypsum wall board and fibre insulation is much more vapour permeable than a concrete wall, moisture easily diffuses through these and can reach moisture levels that result in mould against the concrete.

To thoroughly assess mould risk is a little more complicated because it involves the materials, amount of time at high relative humidity and the moisture storage capacity of each of the materials. Best practice in assessing building assembly moisture durability and resistance to mould growth is to simulate the heat and moisture transfer over time (hygrothermal modelling), which is performed using software like WUFI[®]. The results are then evaluated using ANSI/ASHRAE 160-2016 (Criteria for Moisture-Control Design Analysis in Buildings), which specifies criteria for predicting, mitigating and reducing moisture damage to the building envelope depending on climate, construction type and HVAC system operation.

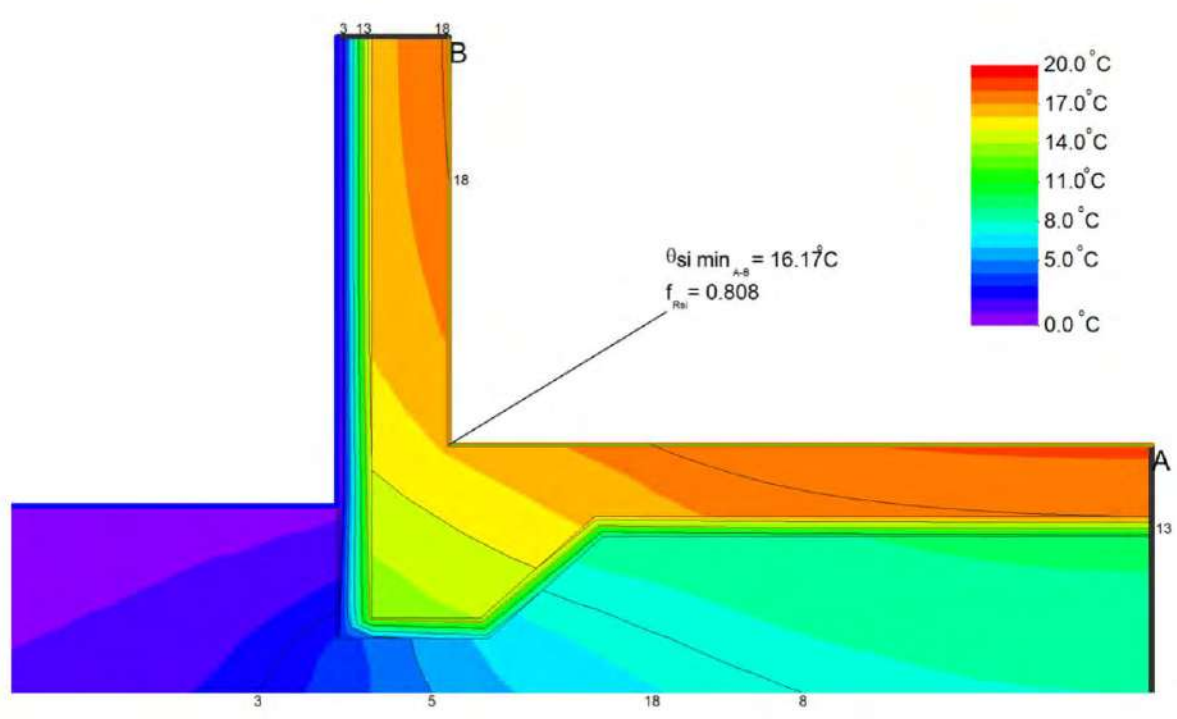
A.4 Thermal bridging and surface temperature factors of CNZ CP01 construction details (Mould Index)

The following thermal images of junctions support the detailed drawings in section 9 by enabling better understanding of heat and moisture transfer within the building's envelope.

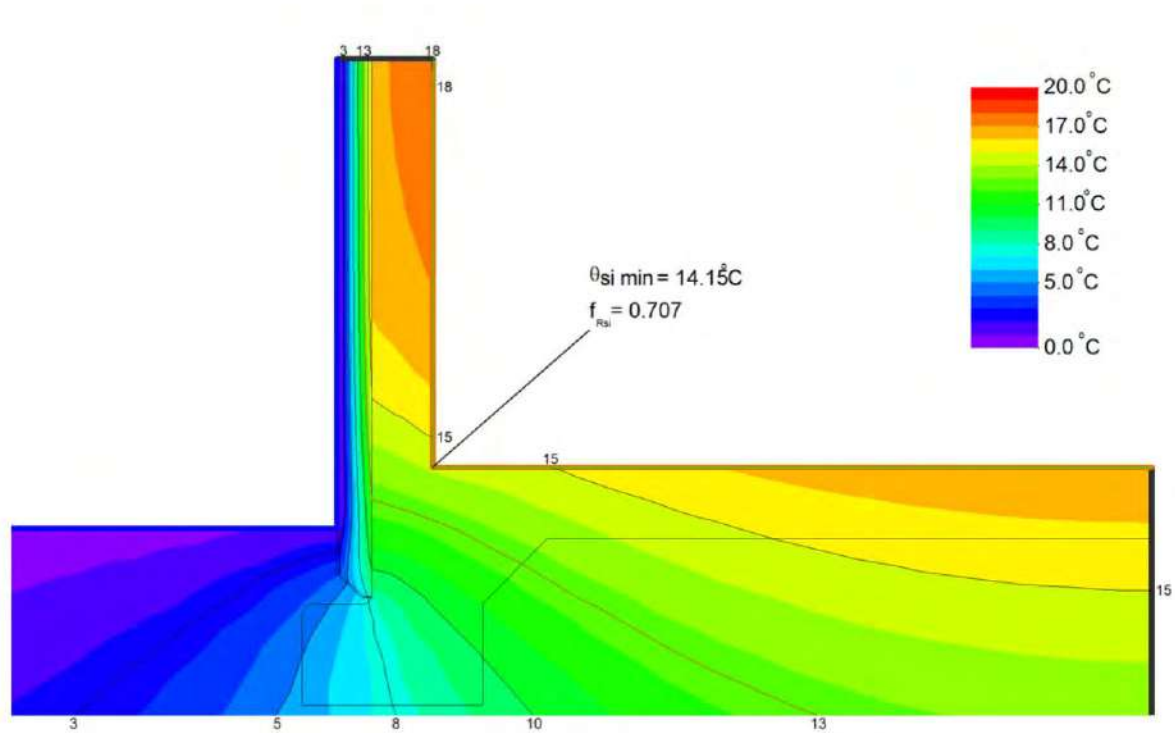
Detail 1a



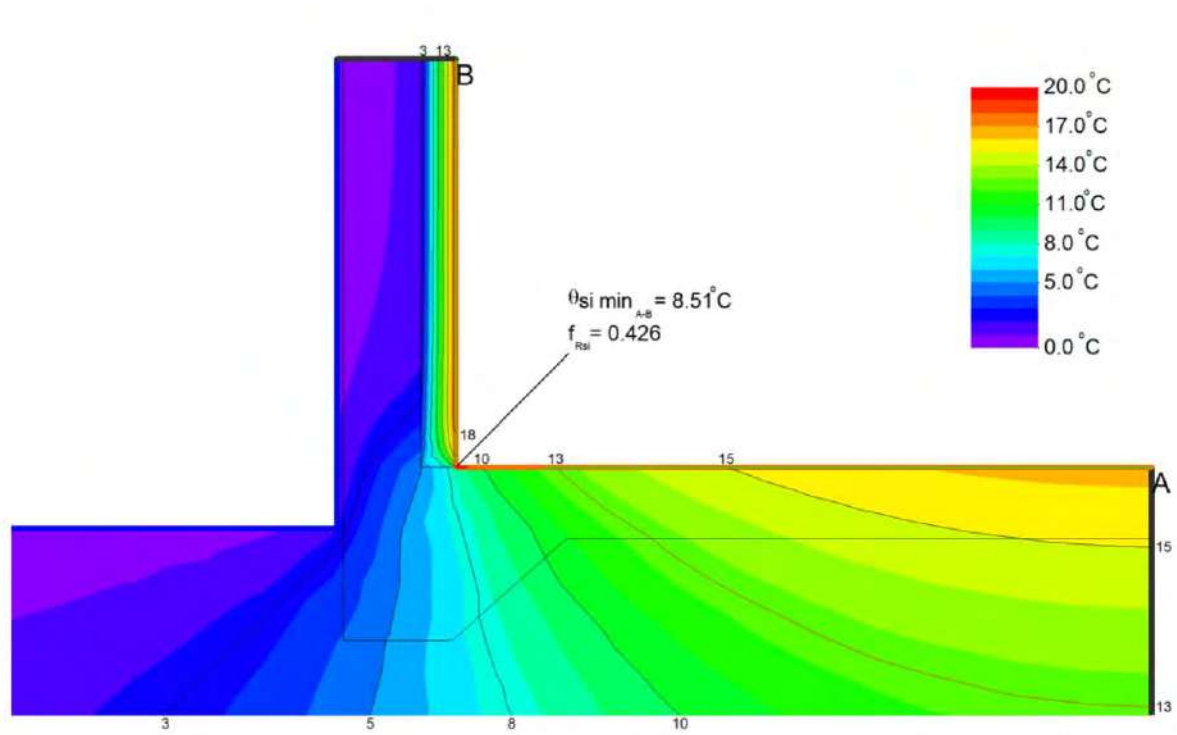
Detail 1b



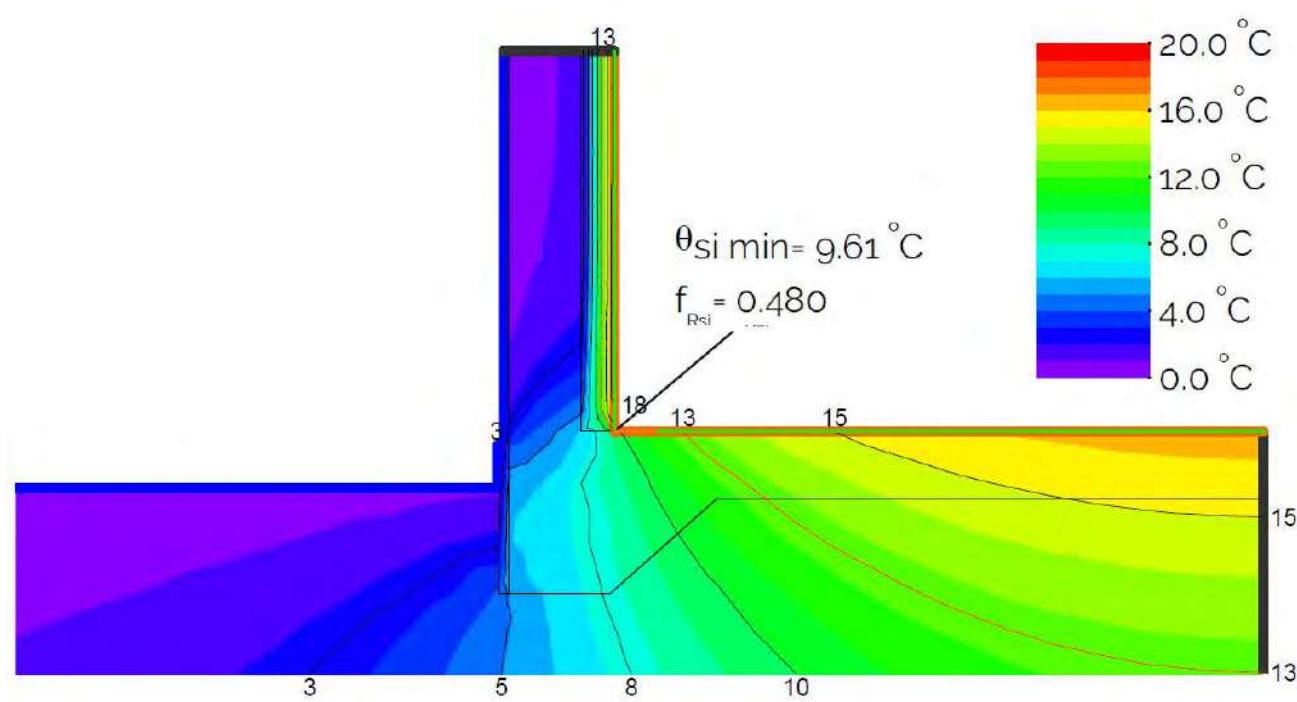
Detail 2



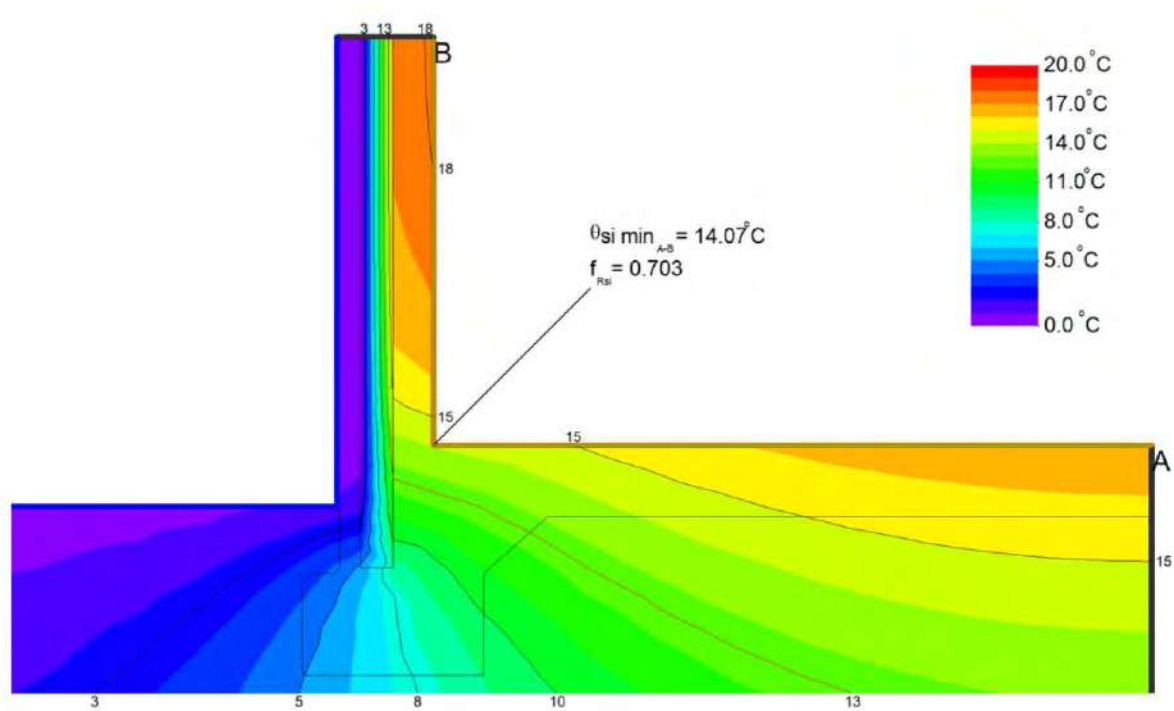
Detail 3a (3b is similar)



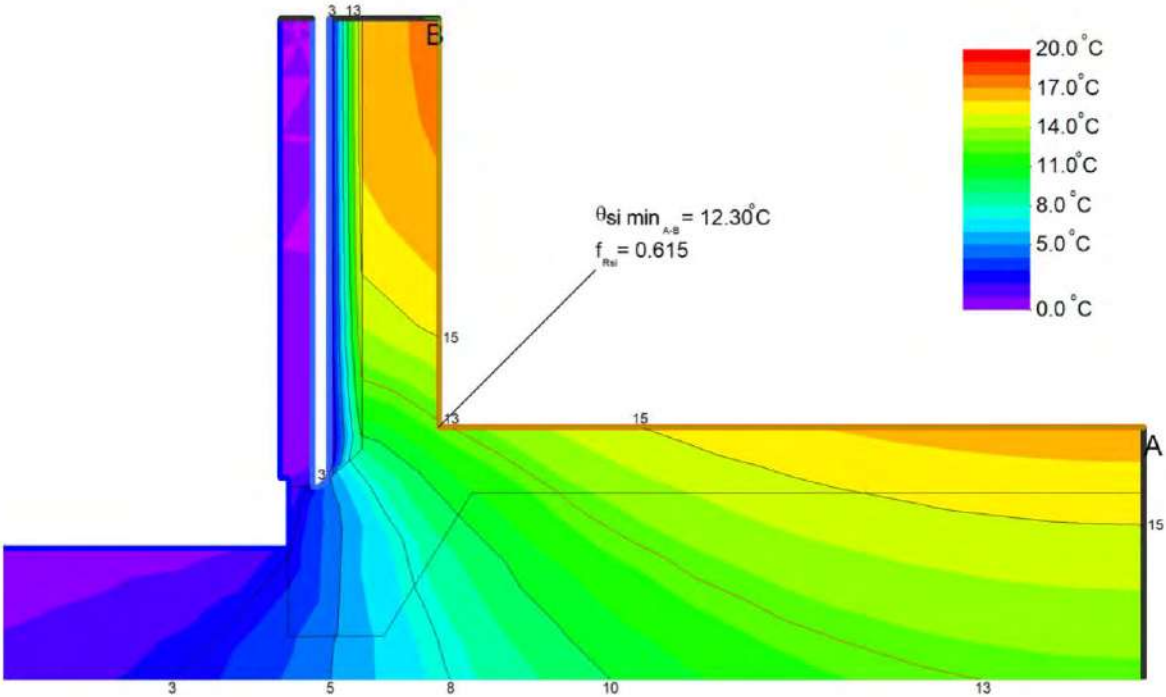
Detail 3c



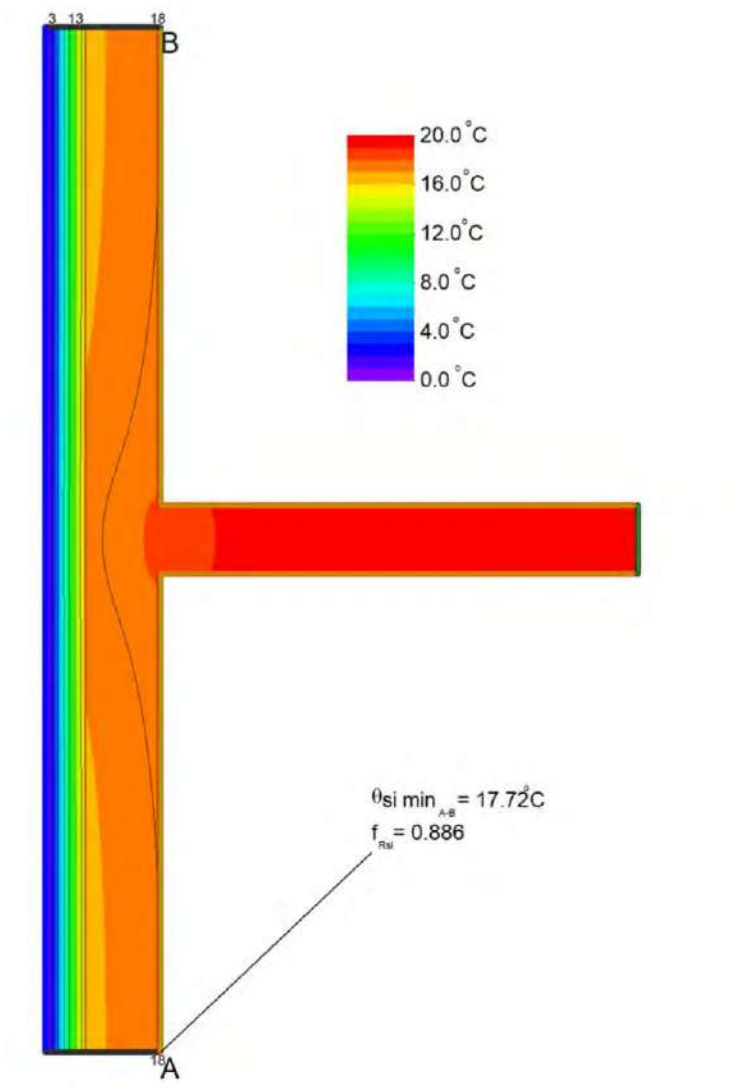
Detail 5



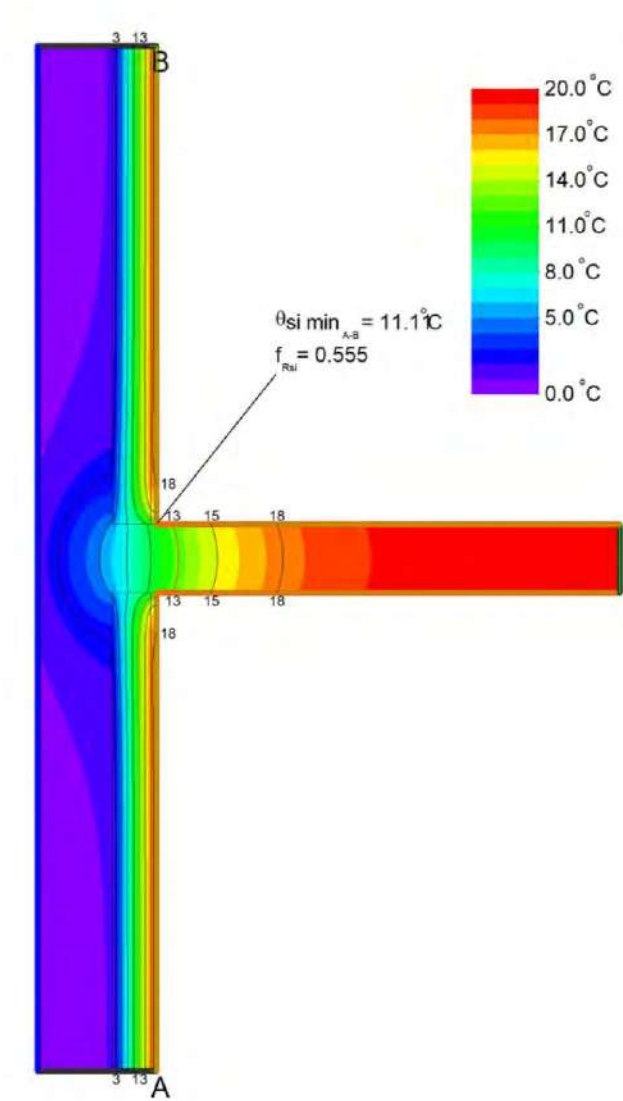
Detail 6



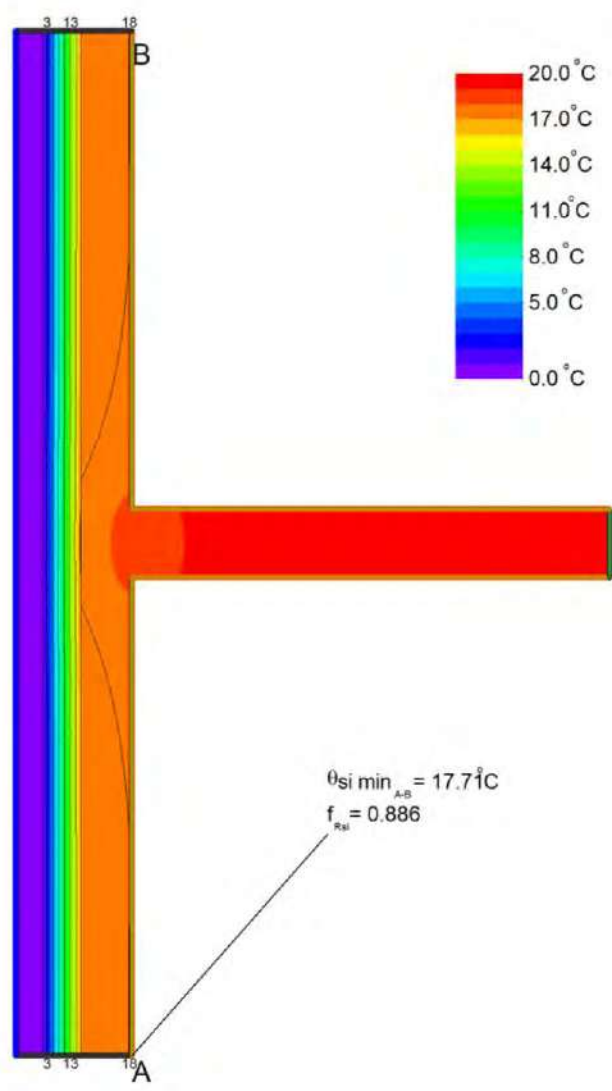
Detail 7



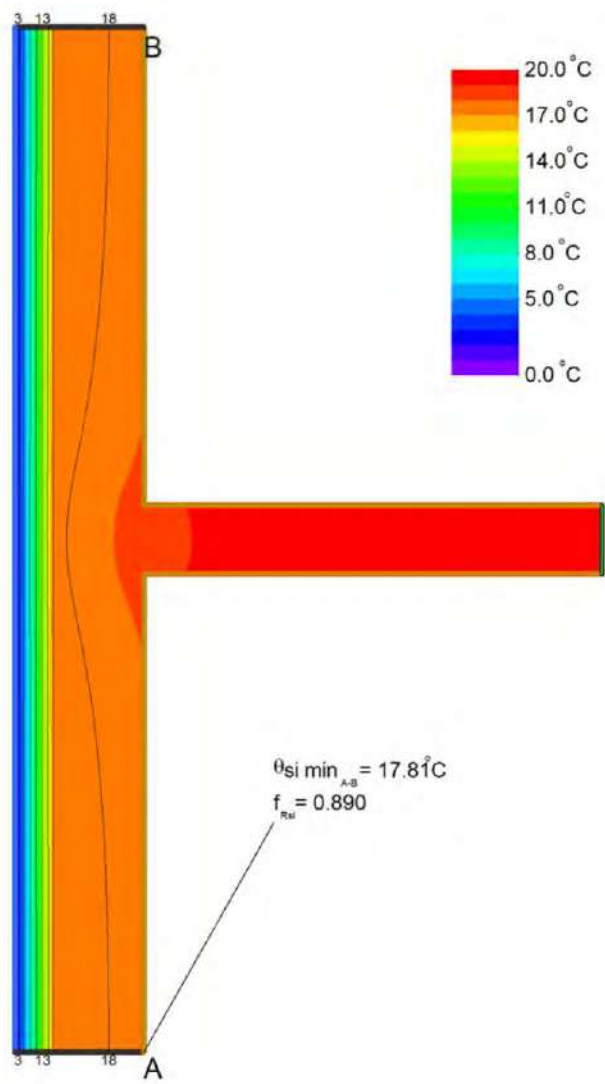
Detail 8



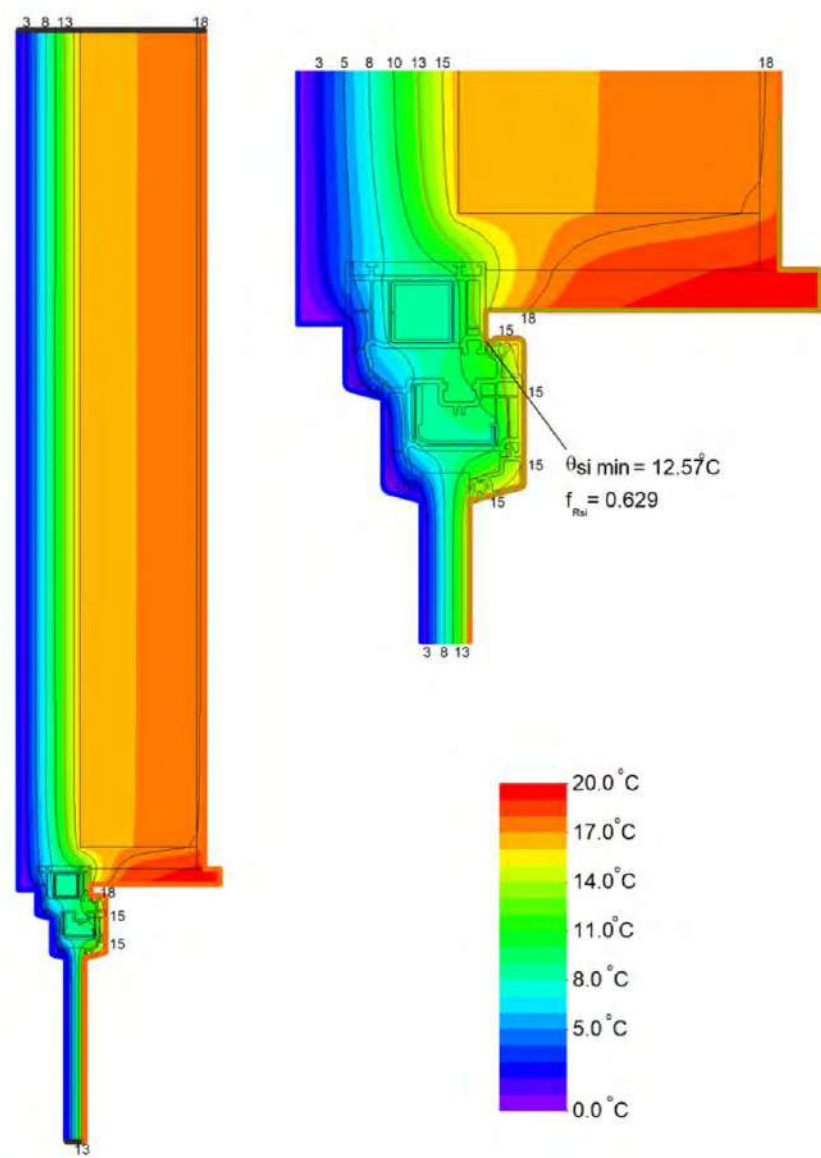
Detail 9



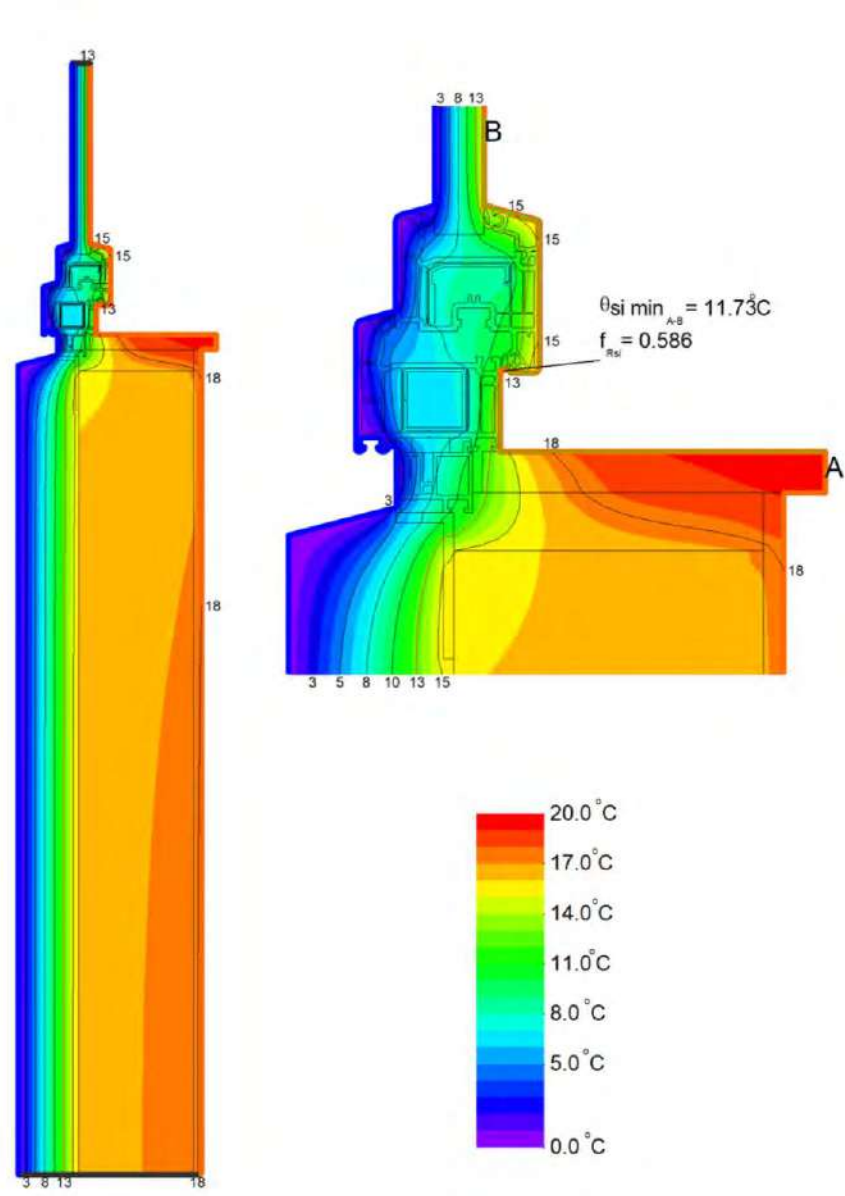
Detail 10



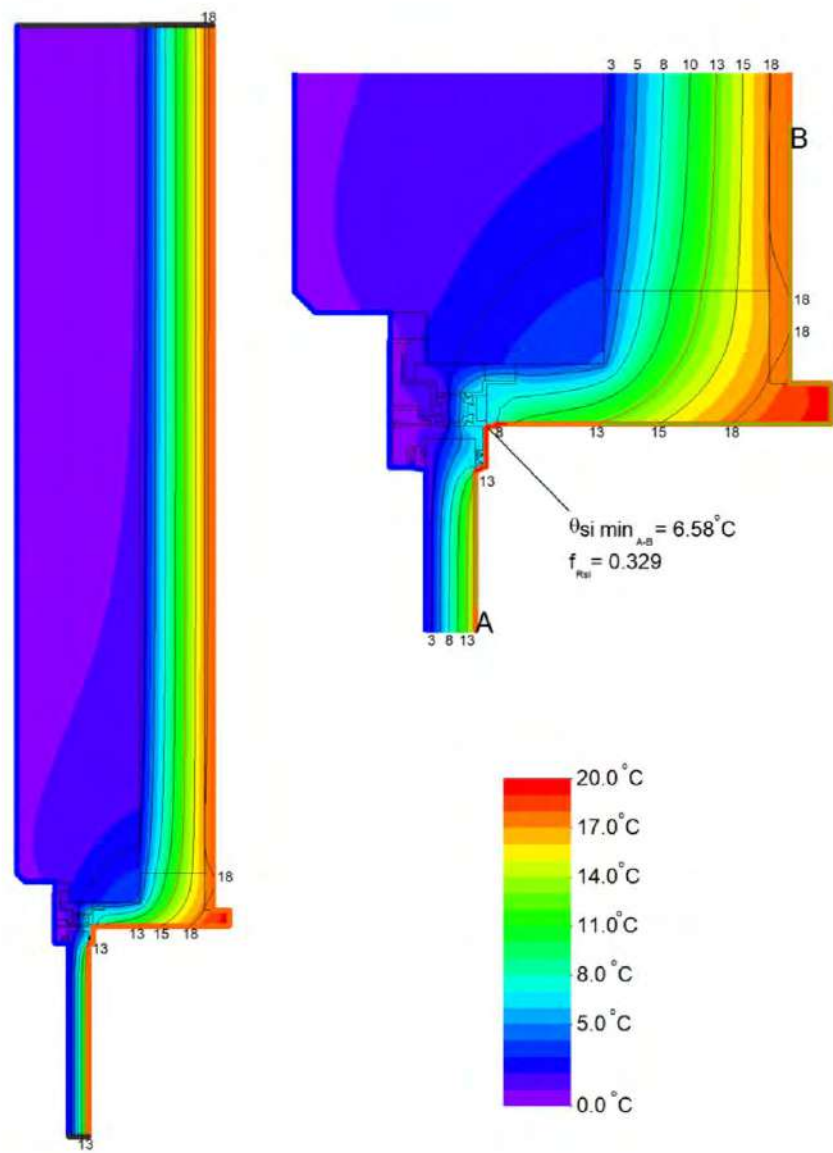
Detail 11a (head)



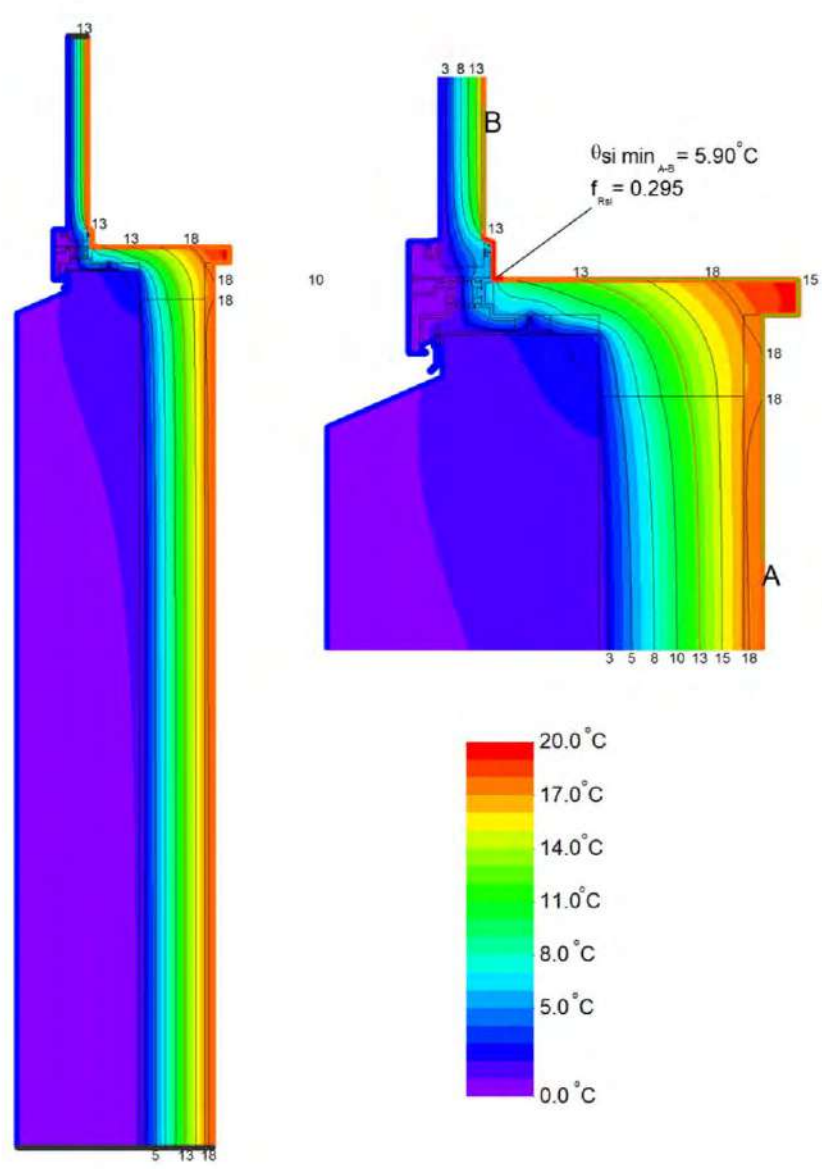
Detail 11a (sill)



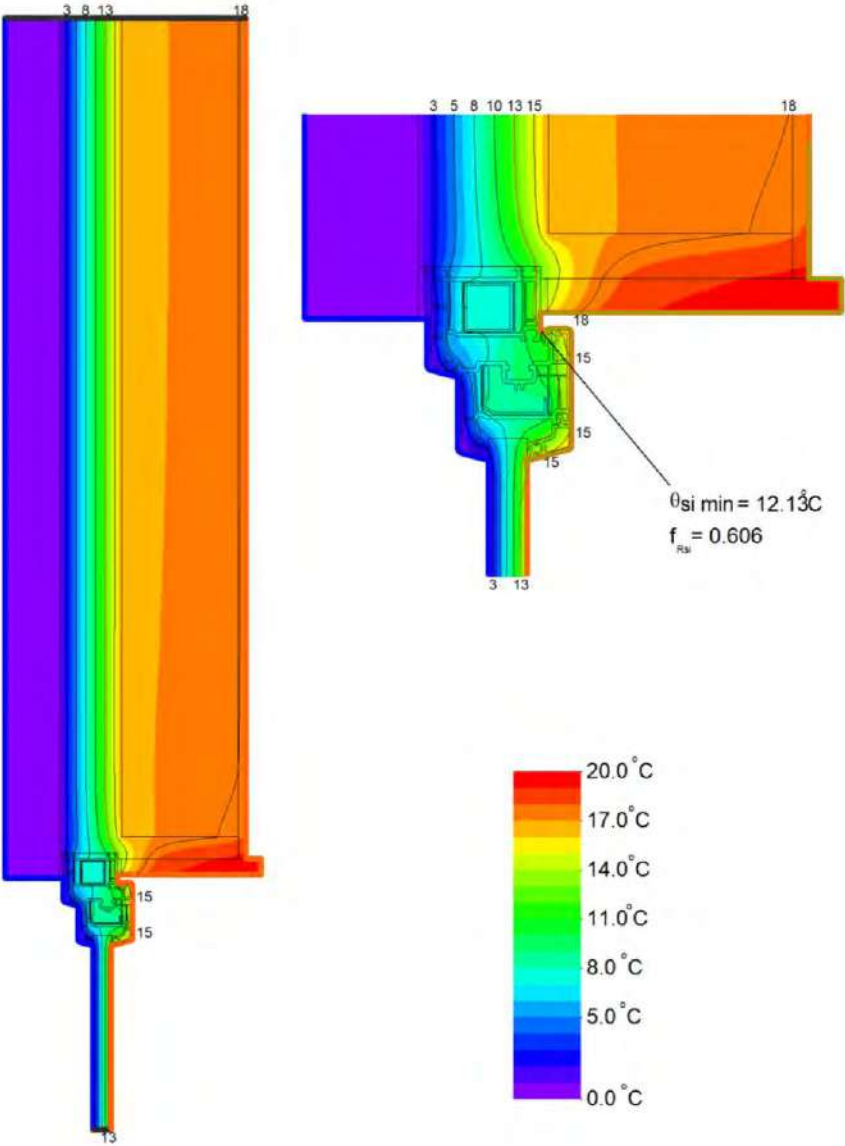
Detail 13 (head)



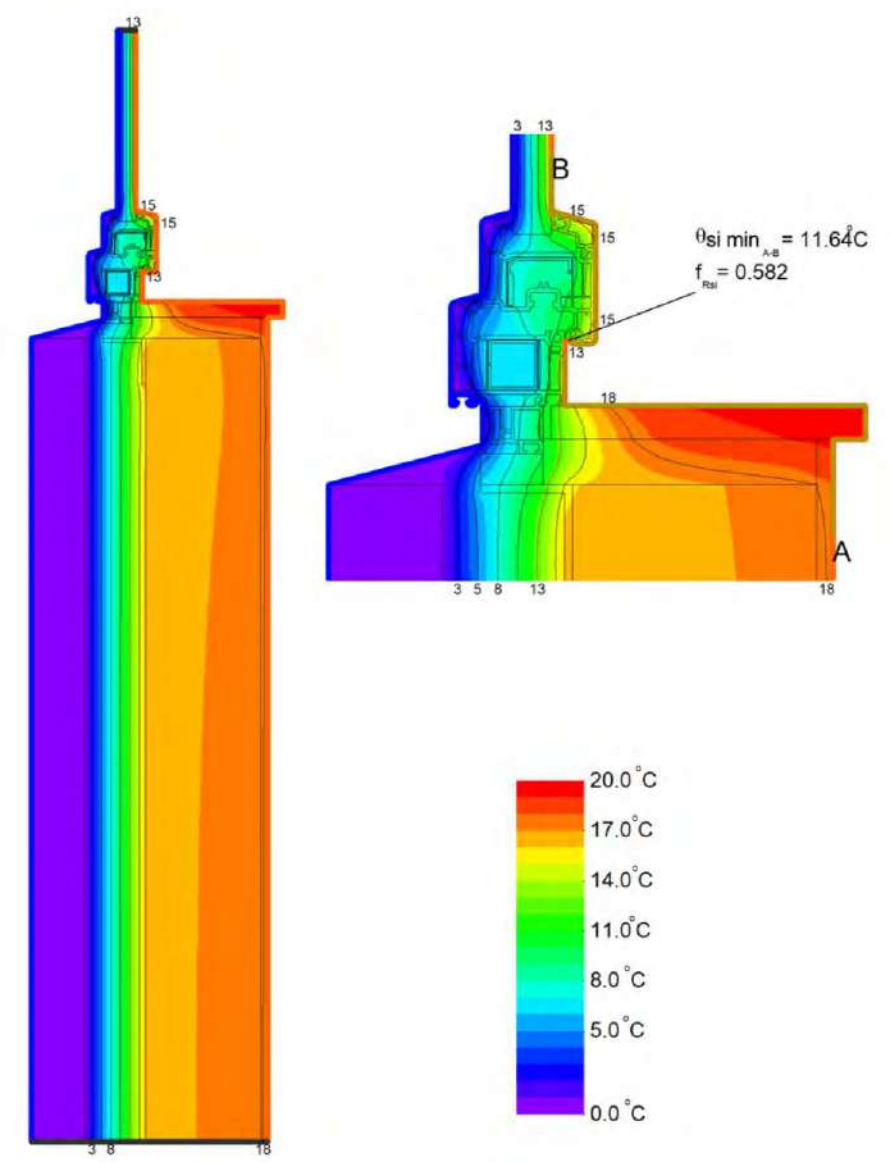
Detail 13 (sill)



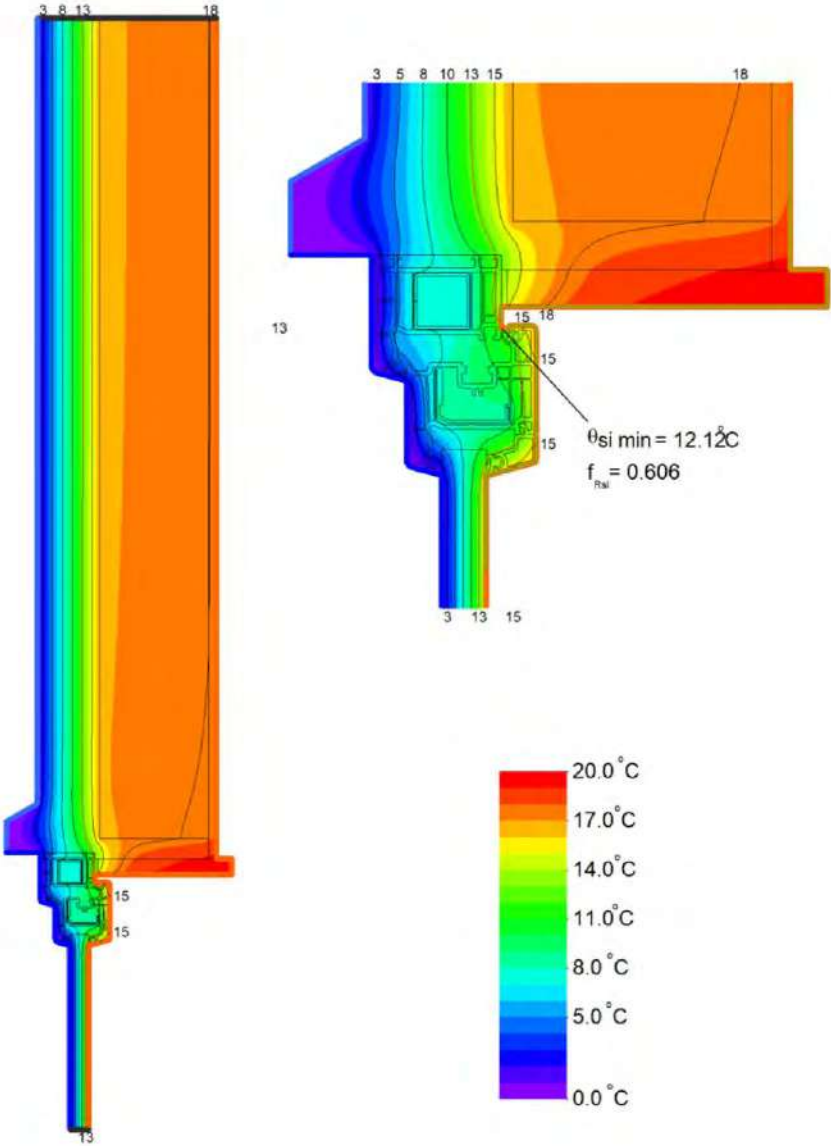
Detail 14 (head)



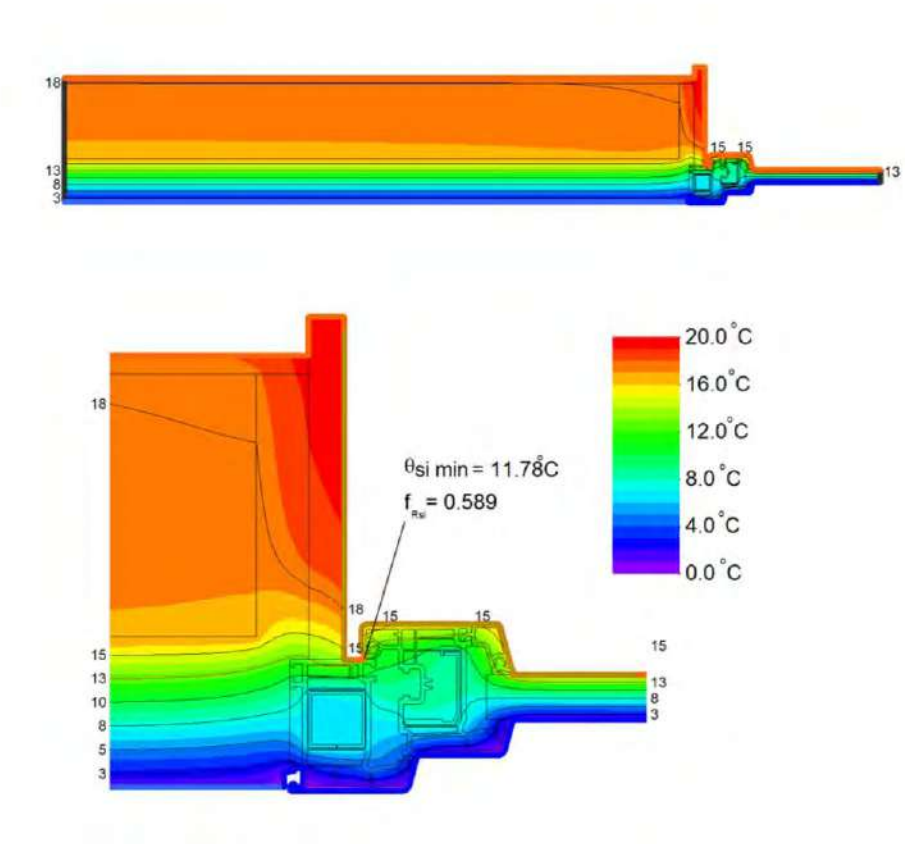
Detail 14 (sill)



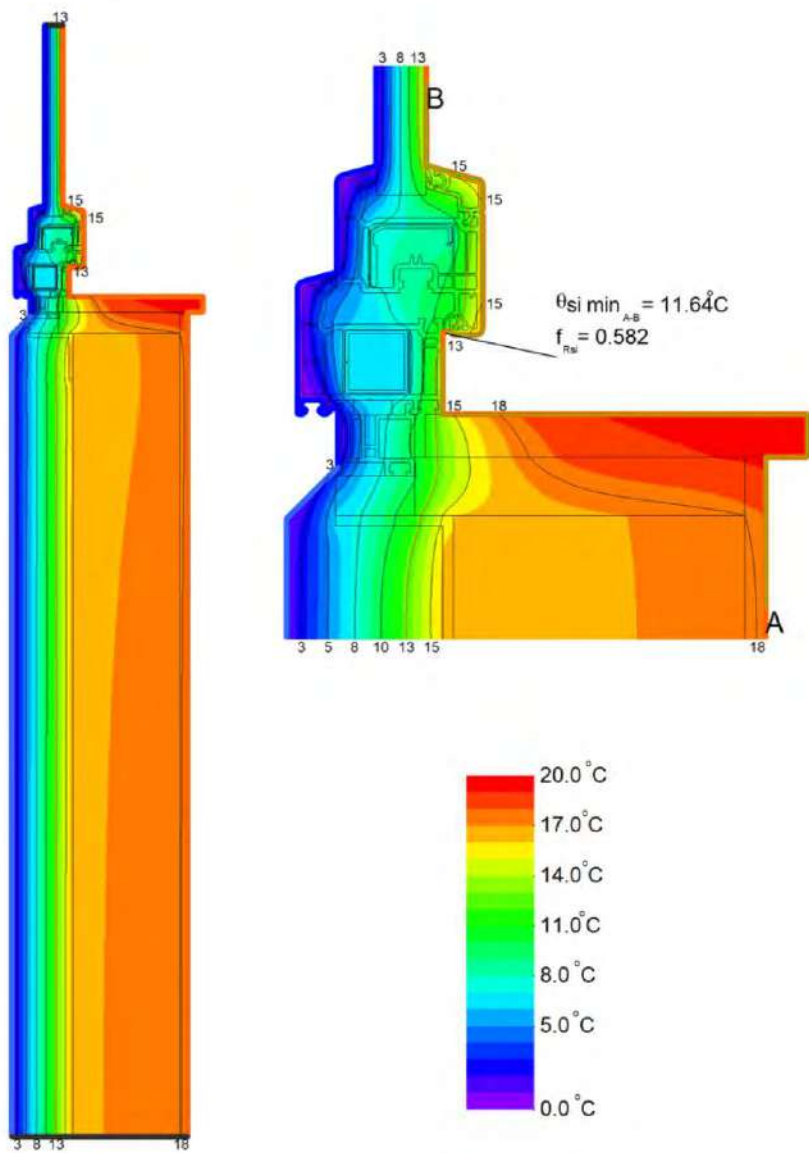
Detail 15 (head)



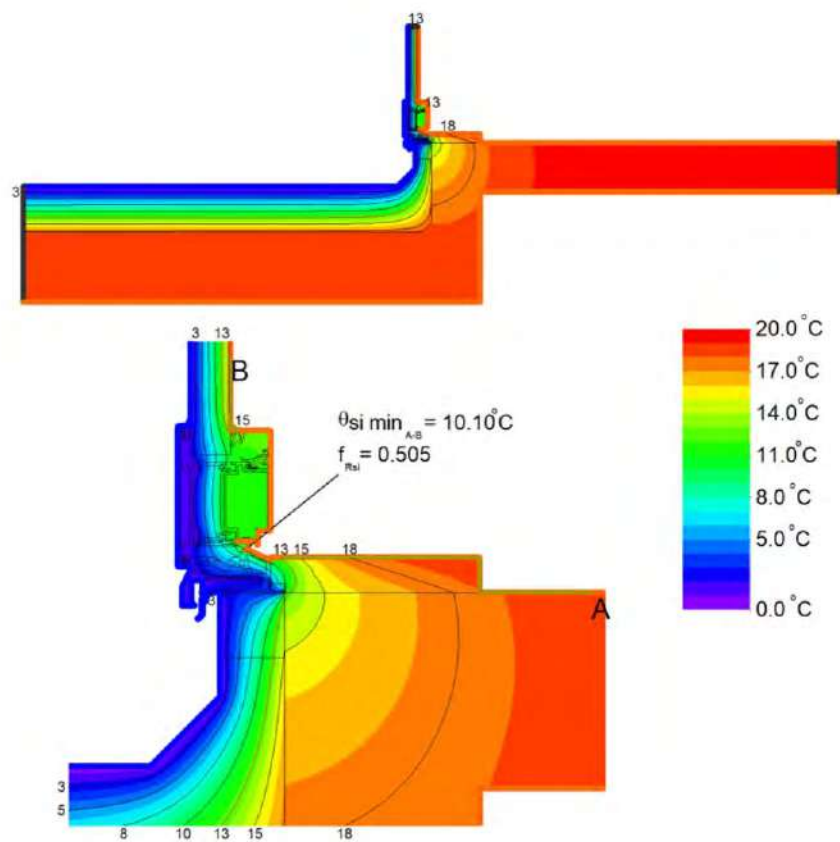
Detail 15 (jamb)



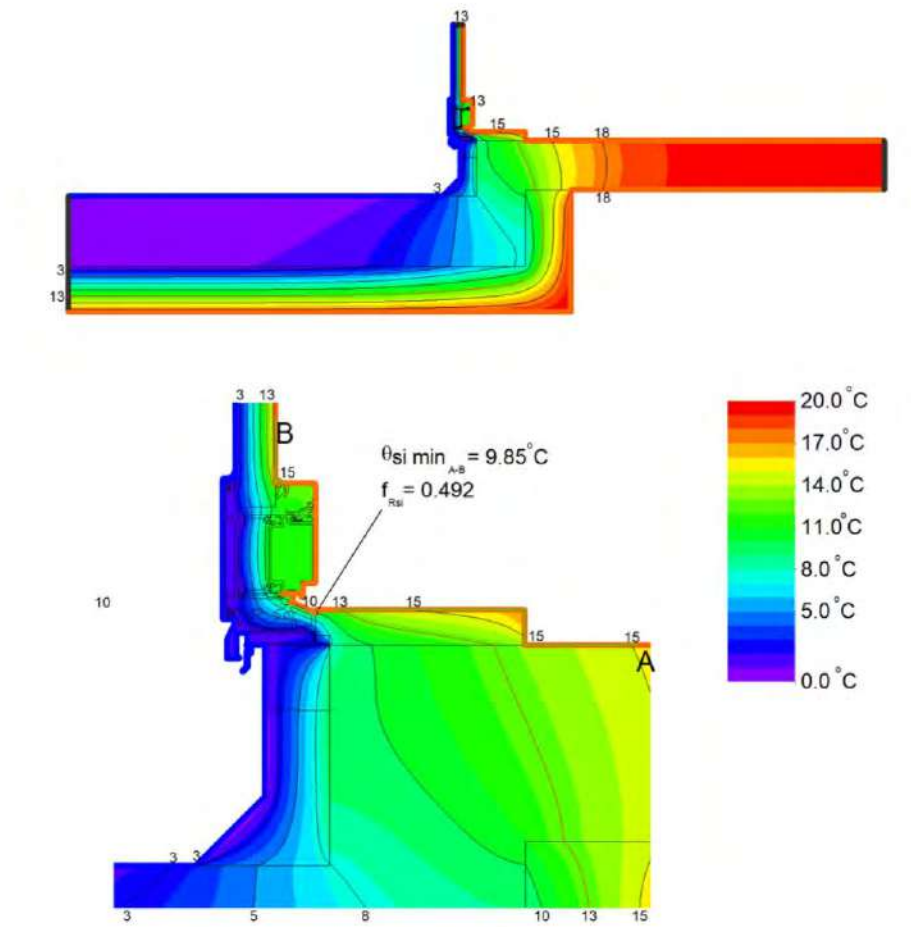
Detail 15 (sill)



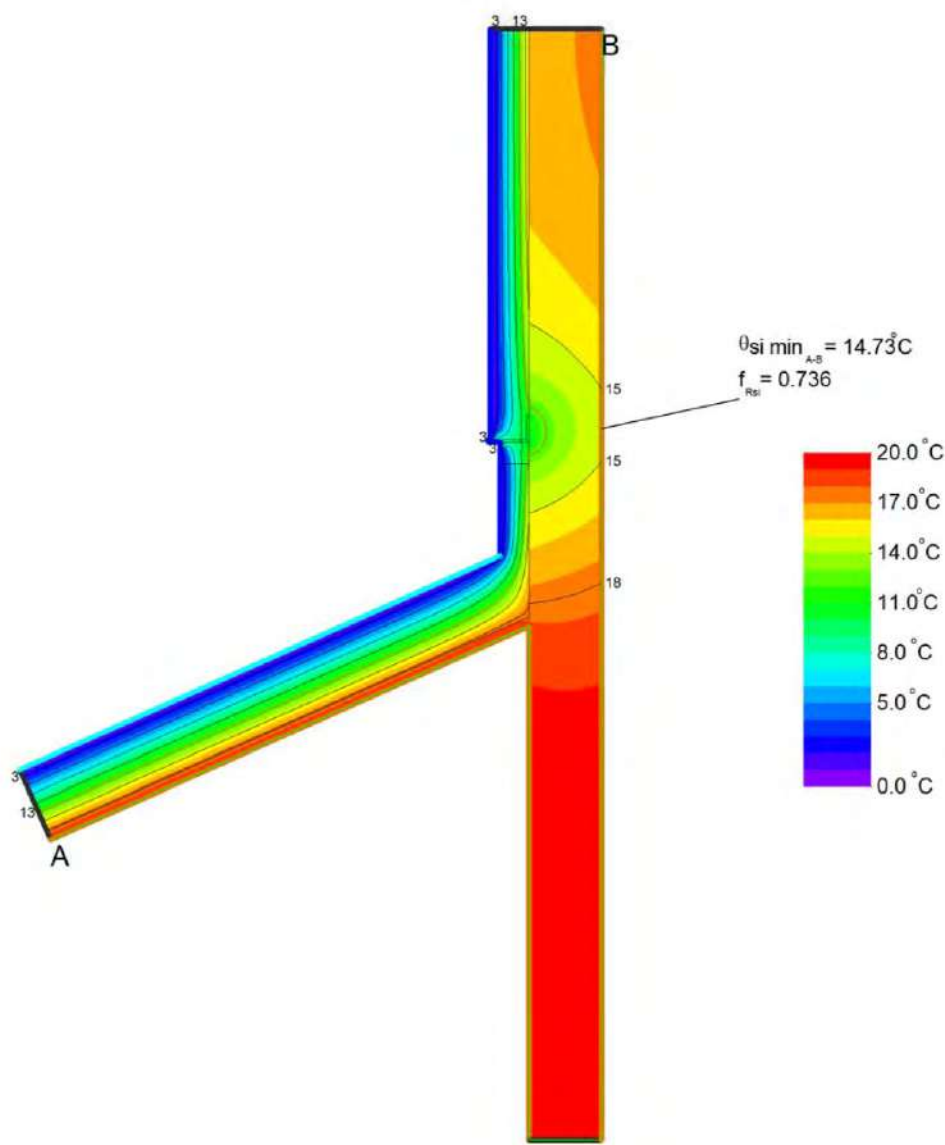
Detail 16



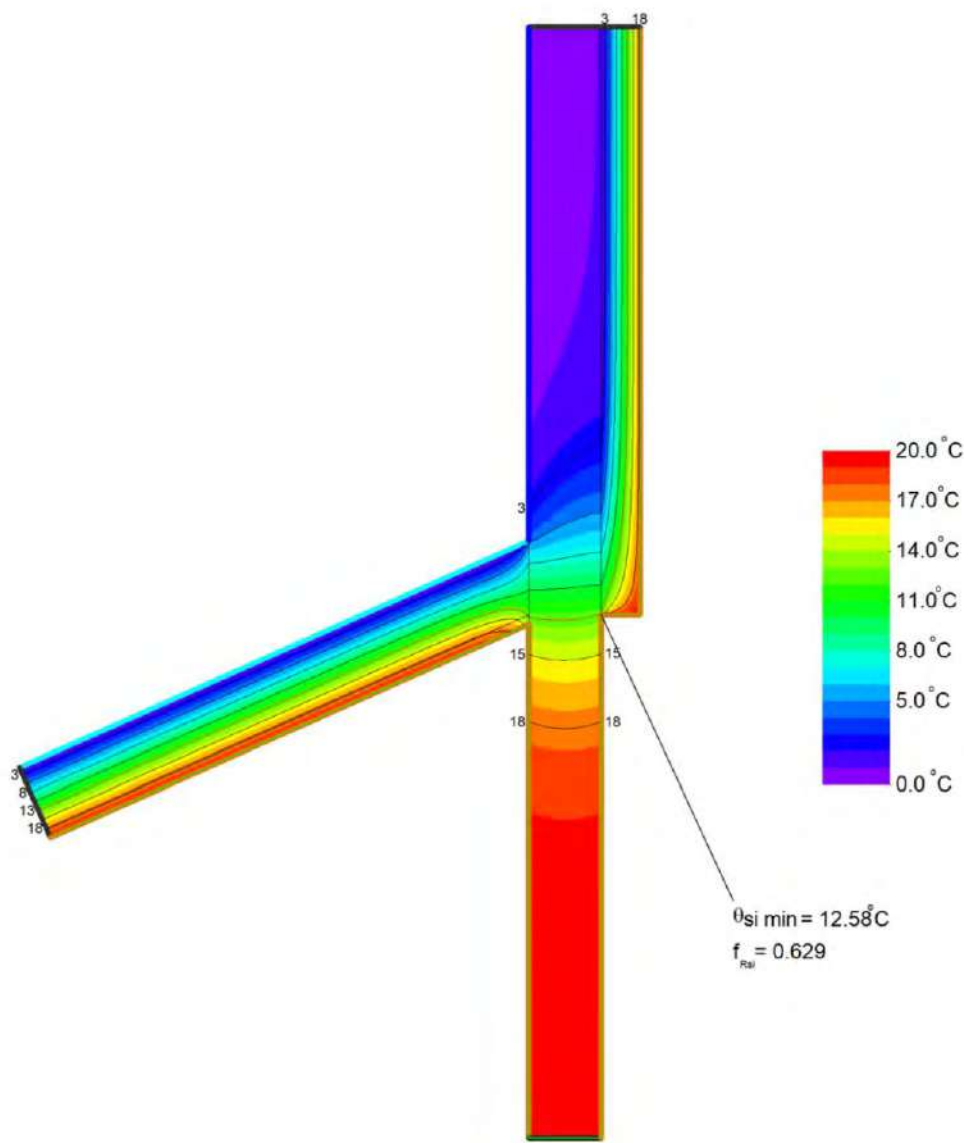
Detail 17



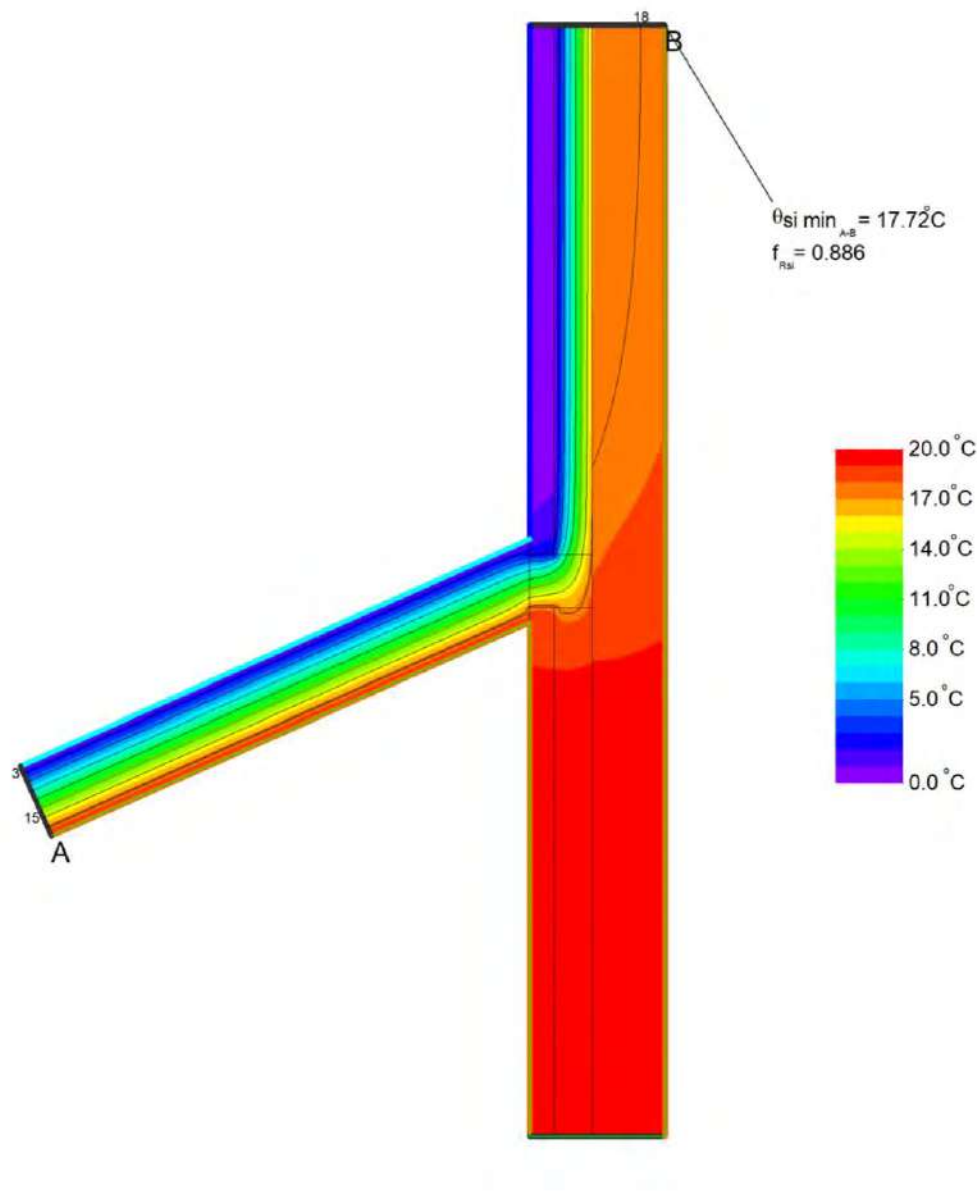
Detail 18



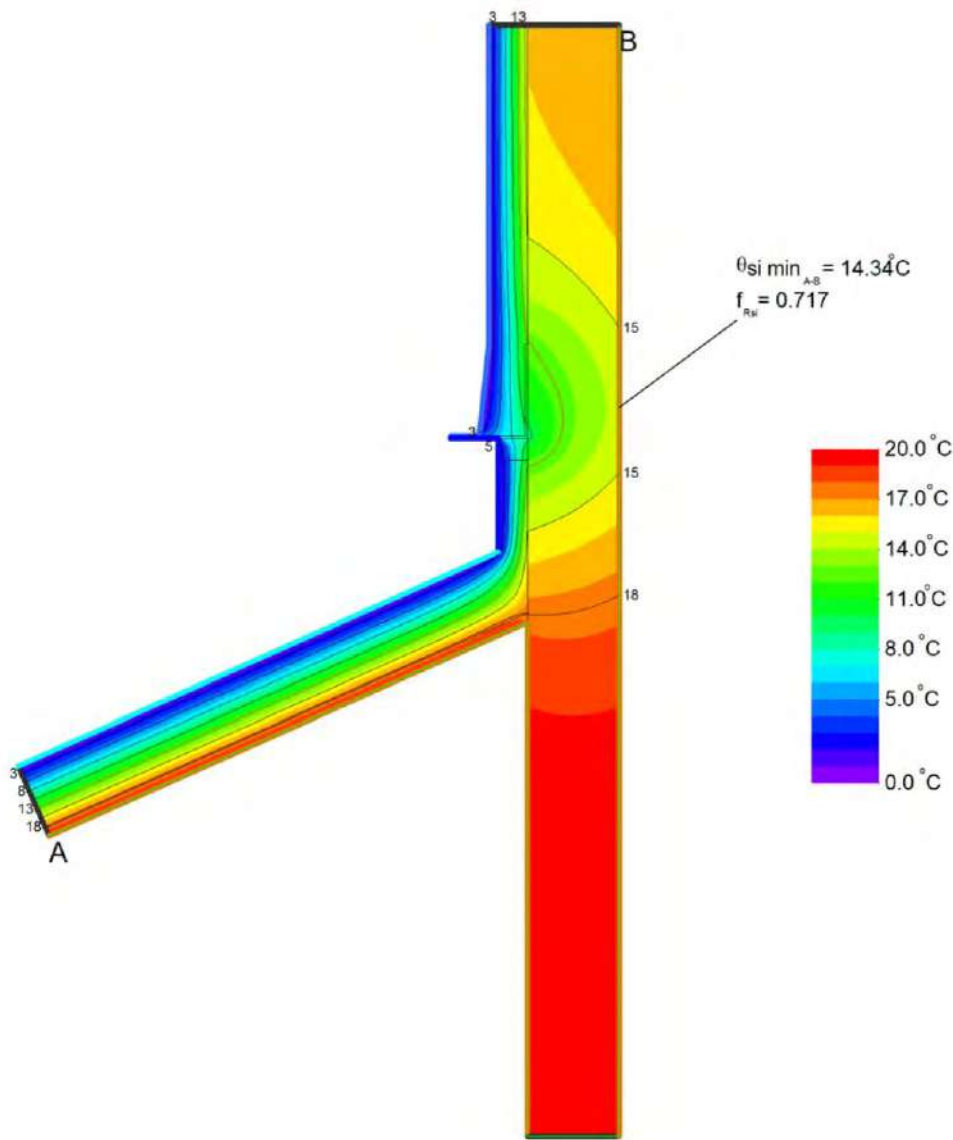
Detail 19



Detail 20



Detail 21



Detail 22

Detail 22 has not been modelled.

However, Detail 26 shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 22.

Detail 23

Detail 23 has not been modelled.

However, Detail 27 shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 23.

Detail 24

Detail 24 has not been modelled.

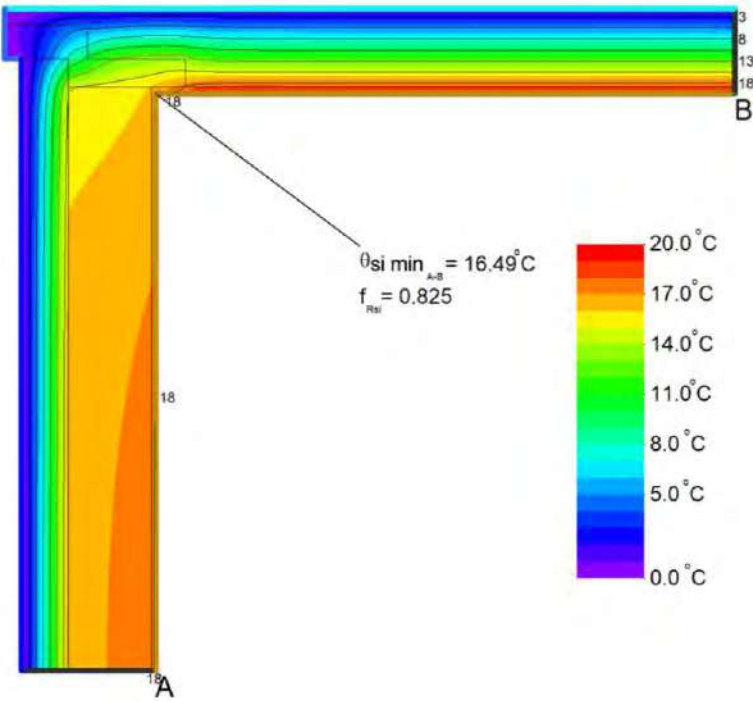
However, Detail 28 shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 24.

Detail 25

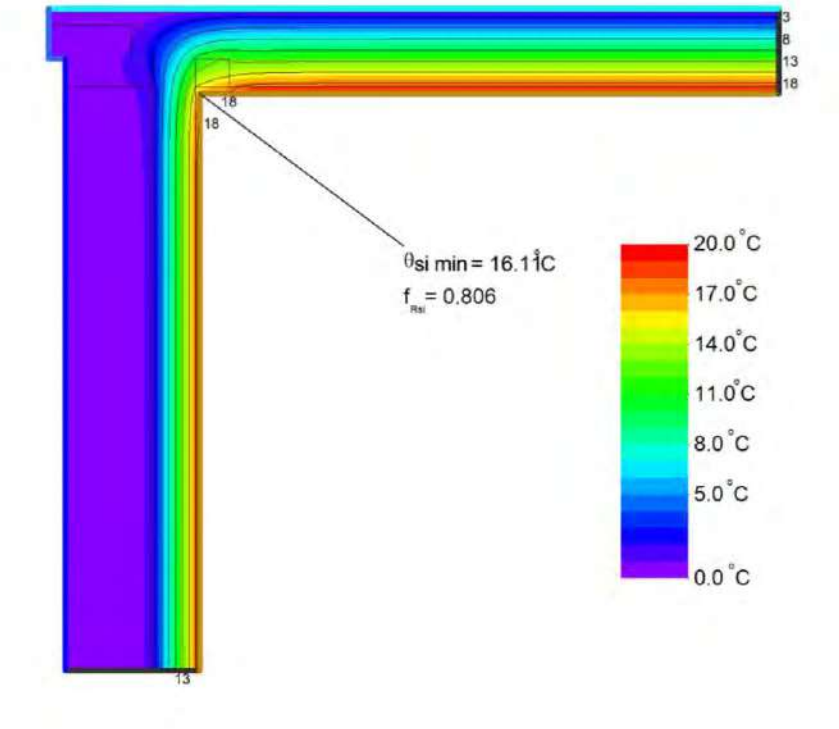
Detail 25 has not been modelled.

However, Detail 29 shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 25.

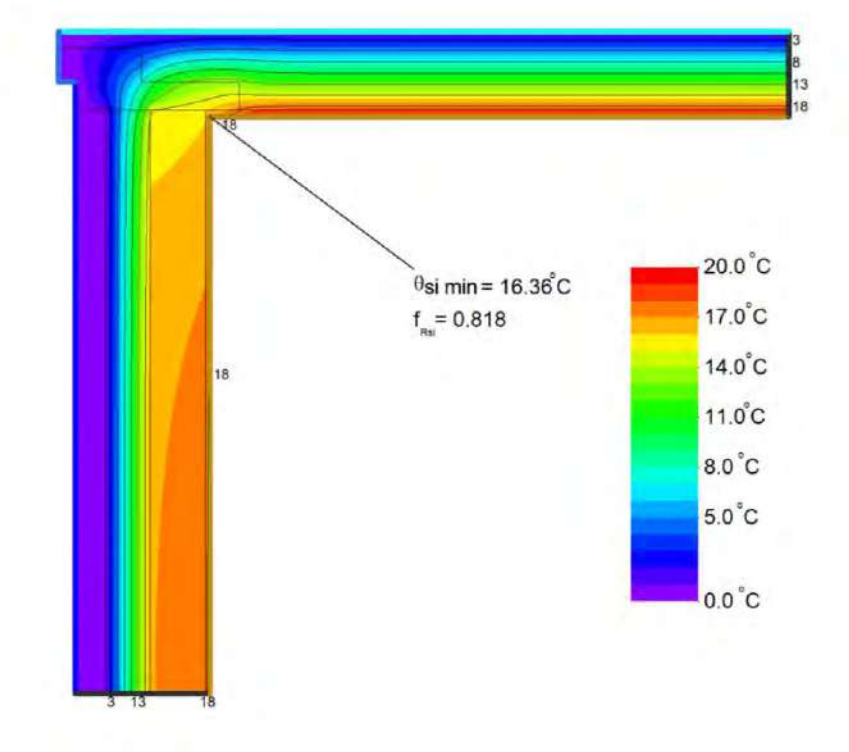
Detail 26



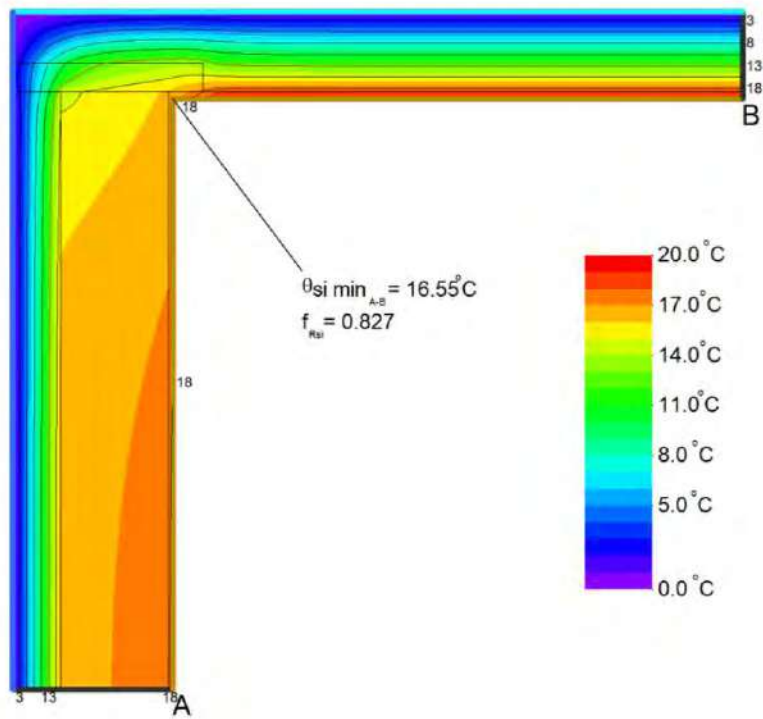
Detail 27



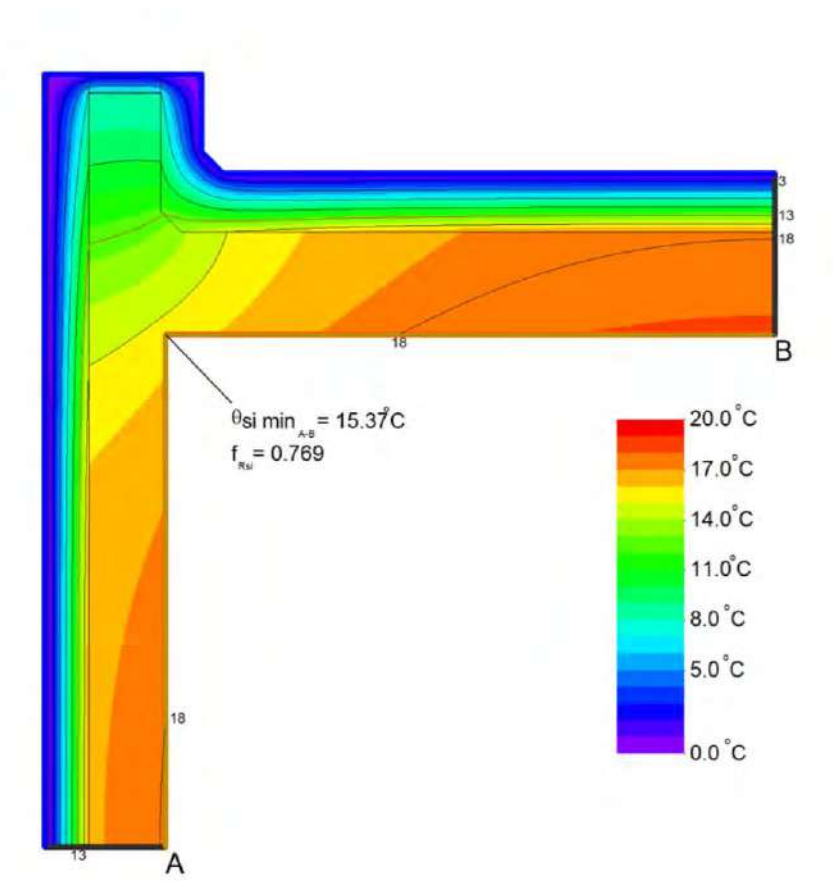
Detail 28



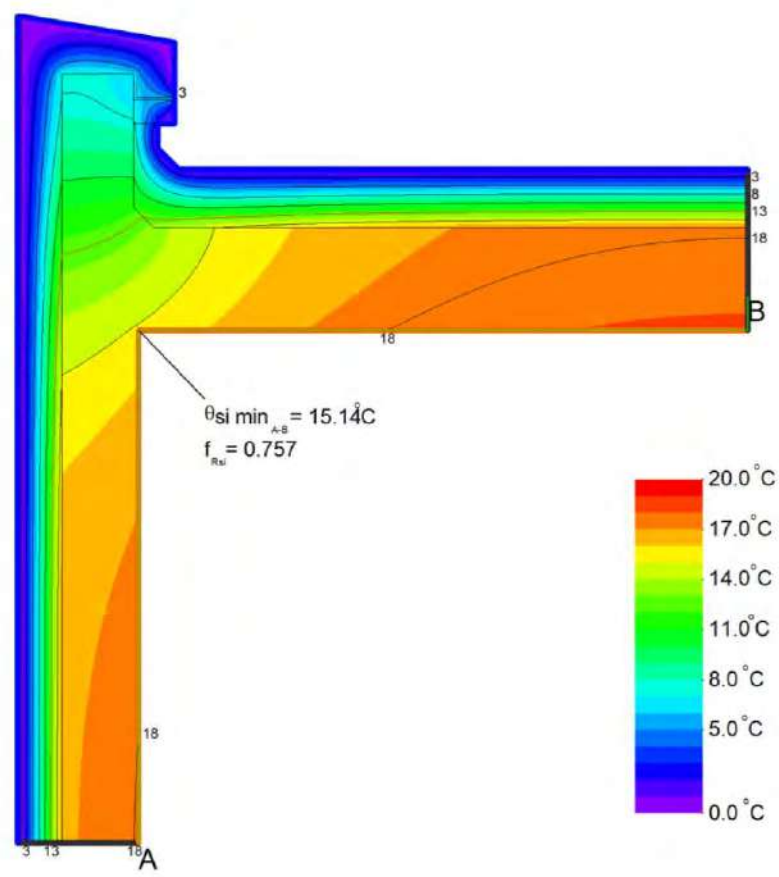
Detail 29



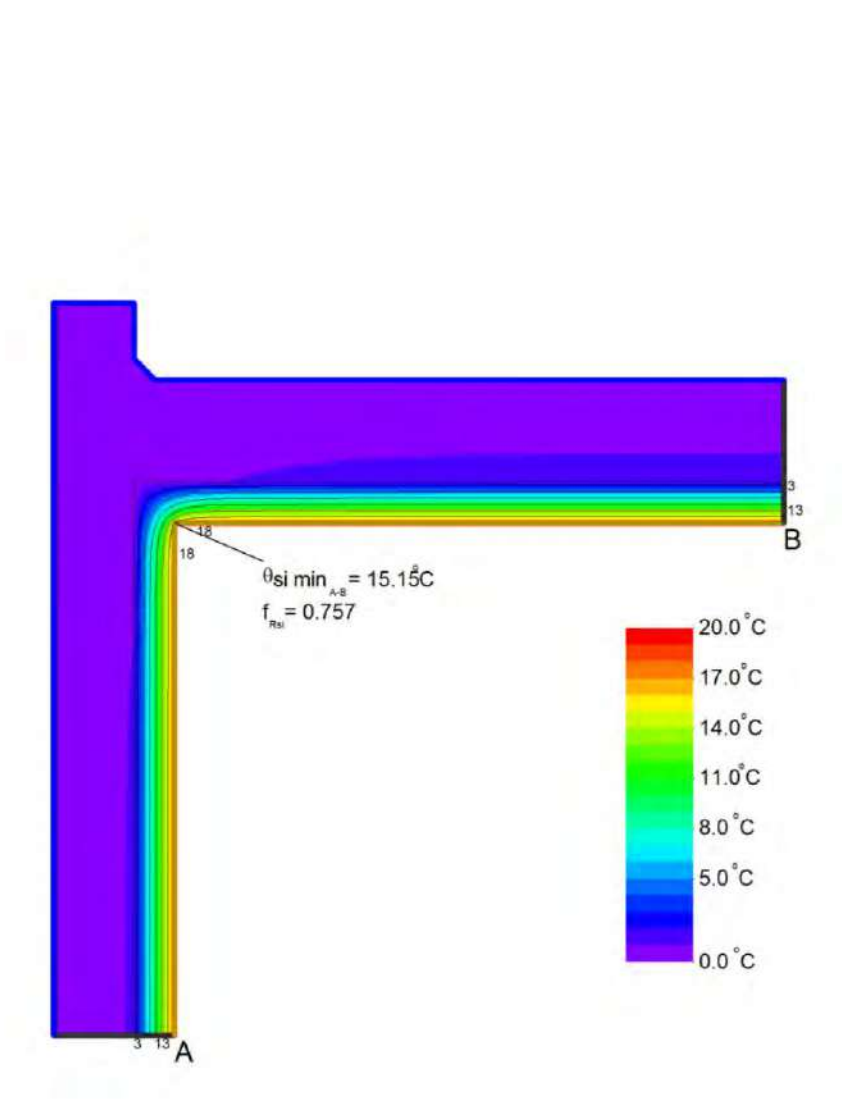
Detail 31



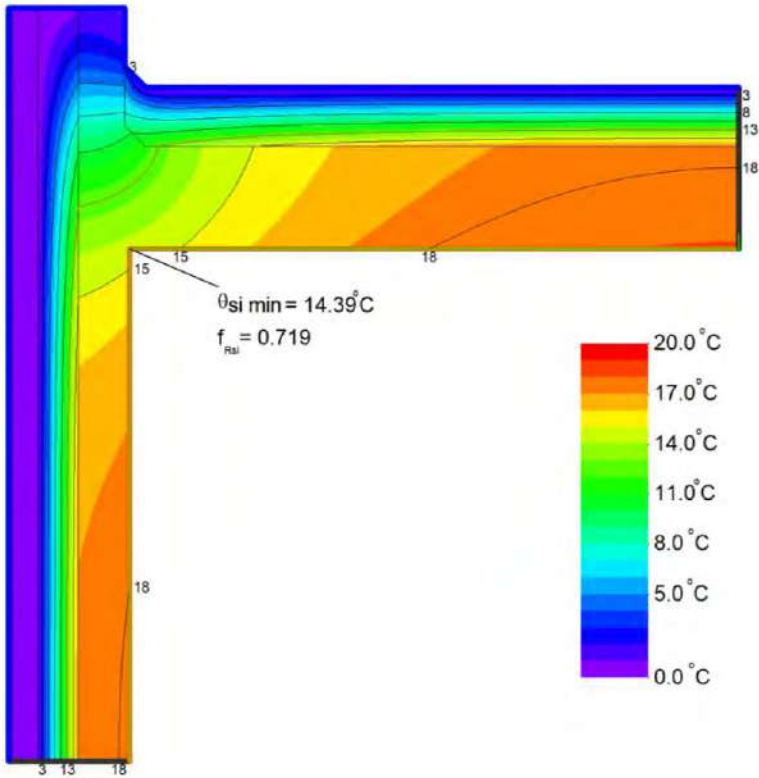
Detail 33



Detail 34a



Detail 36a



Detail 36b

Detail 36b has not been modelled.

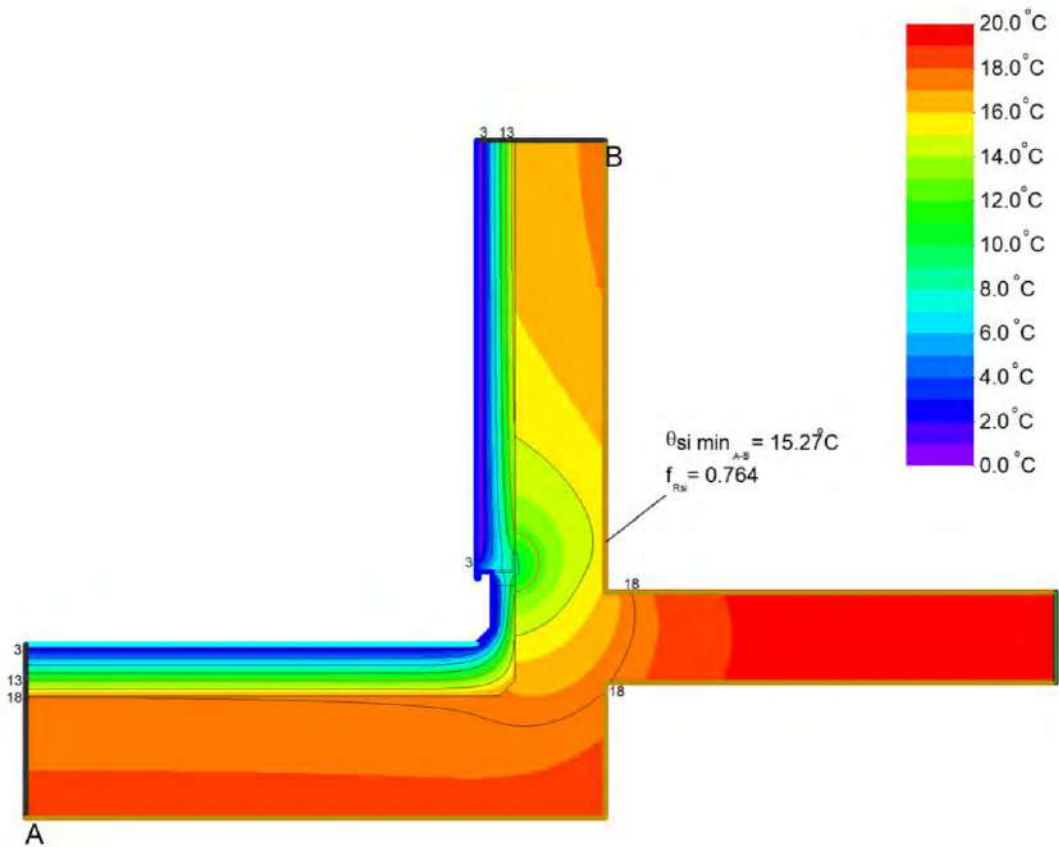
However, Detail 36a shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 36b.

Detail 38

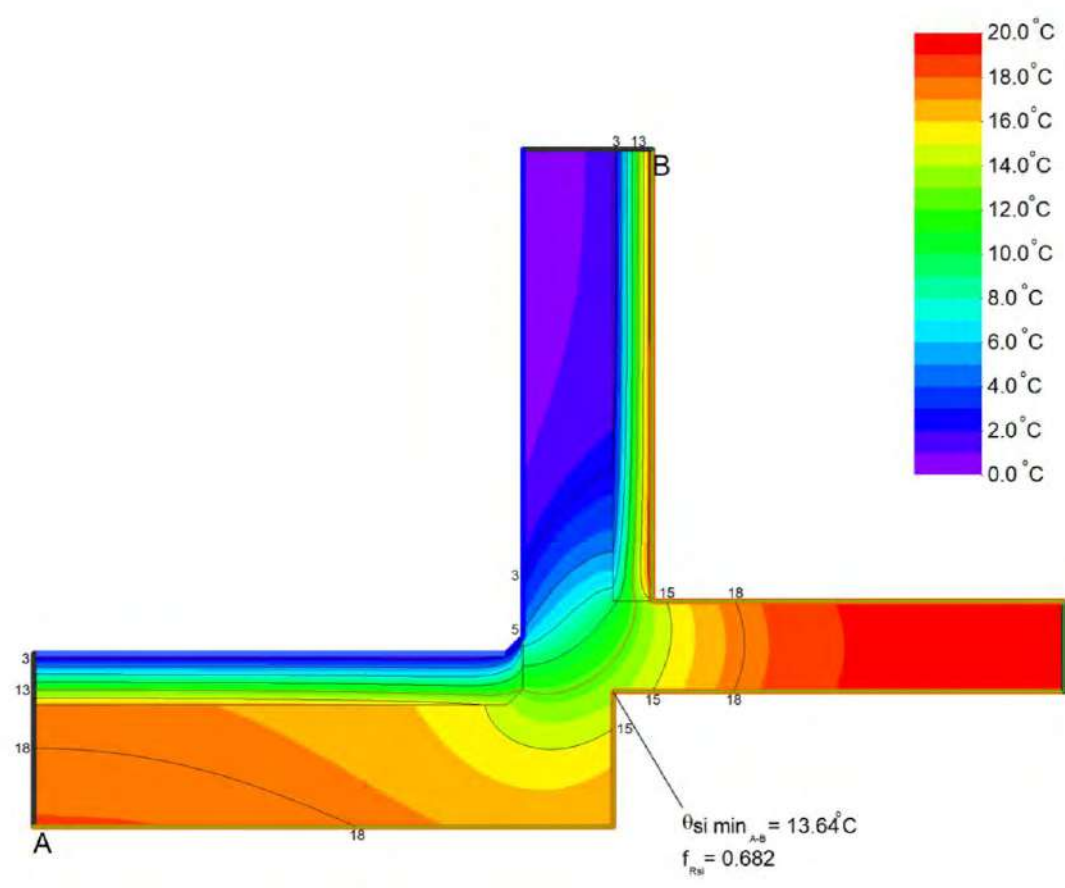
Detail 38 has not been modelled.

However, Detail 36a shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 38.

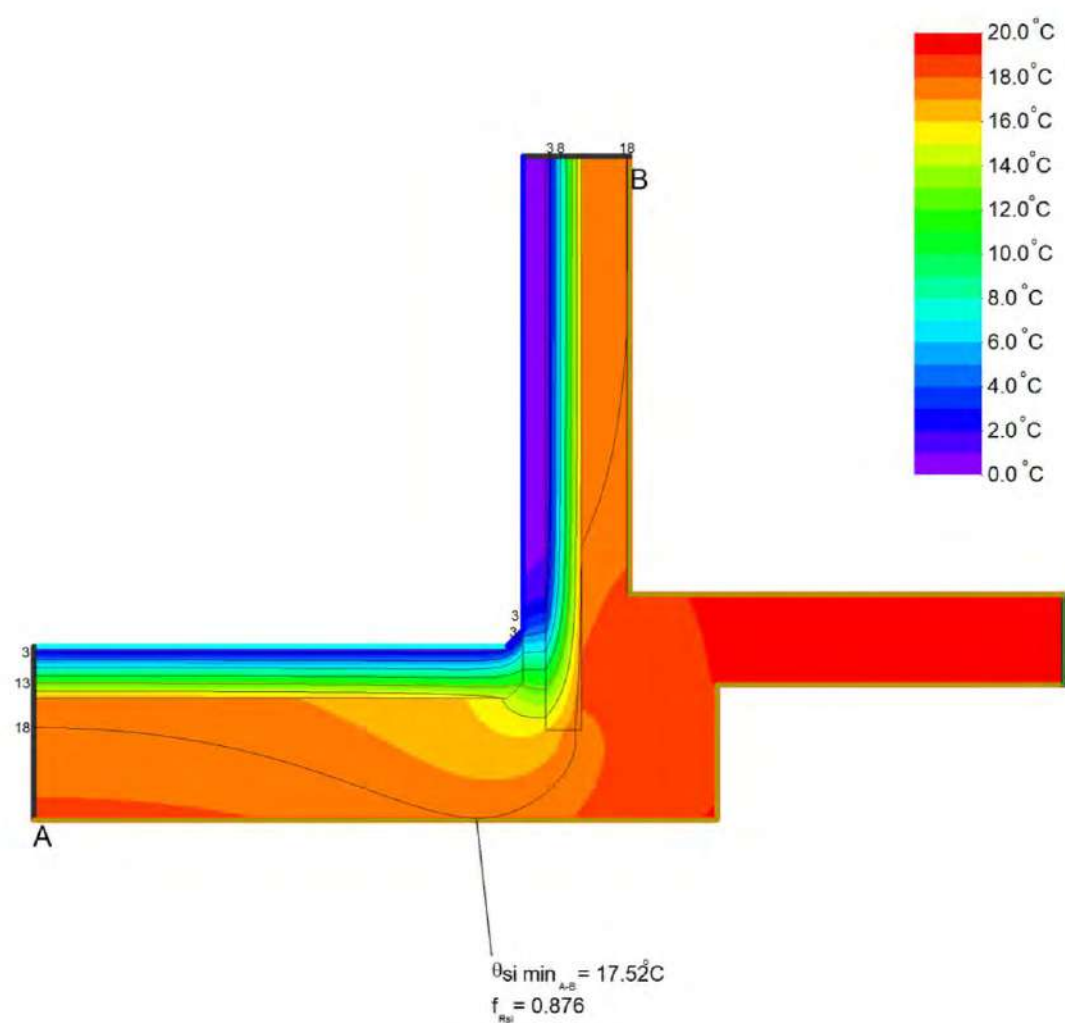
Detail 43



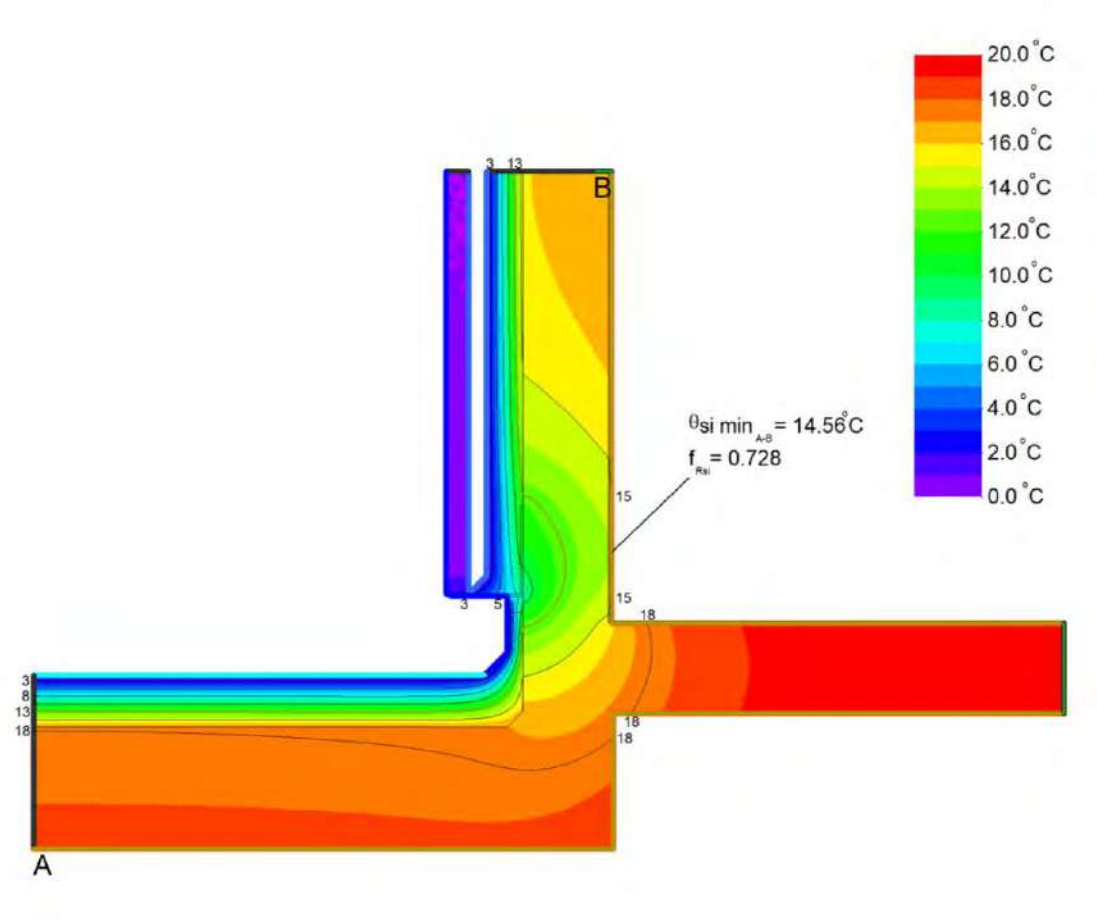
Detail 44



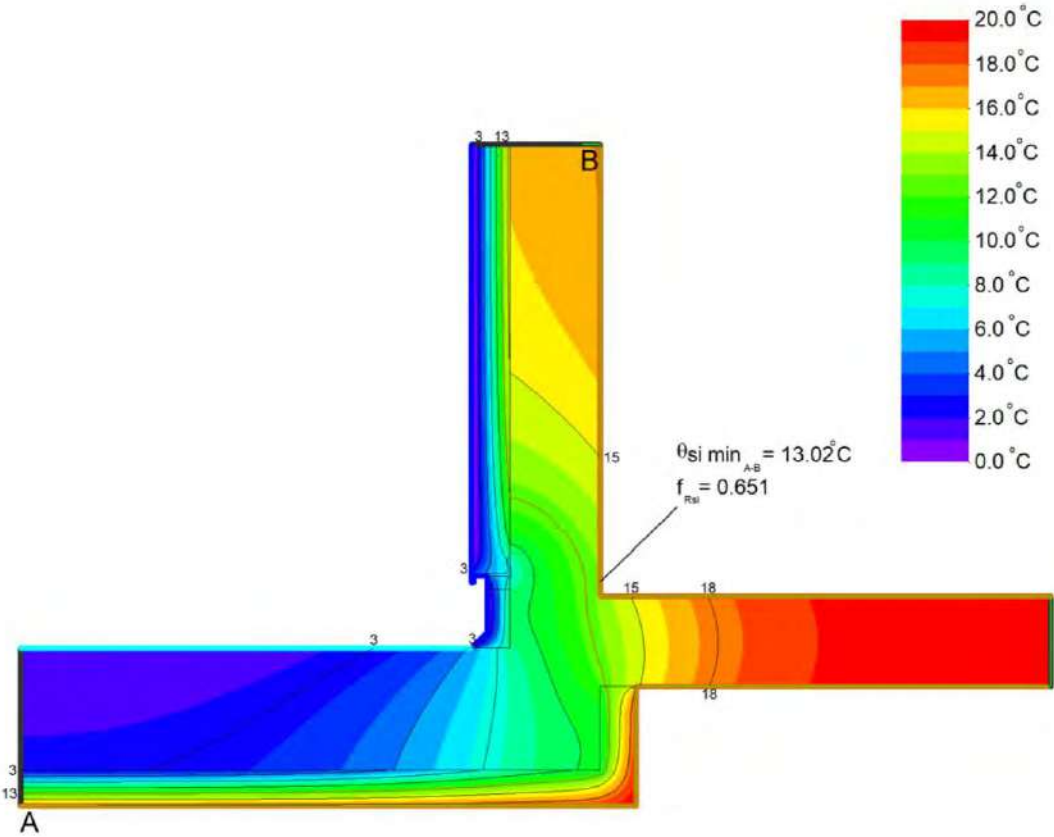
Detail 45



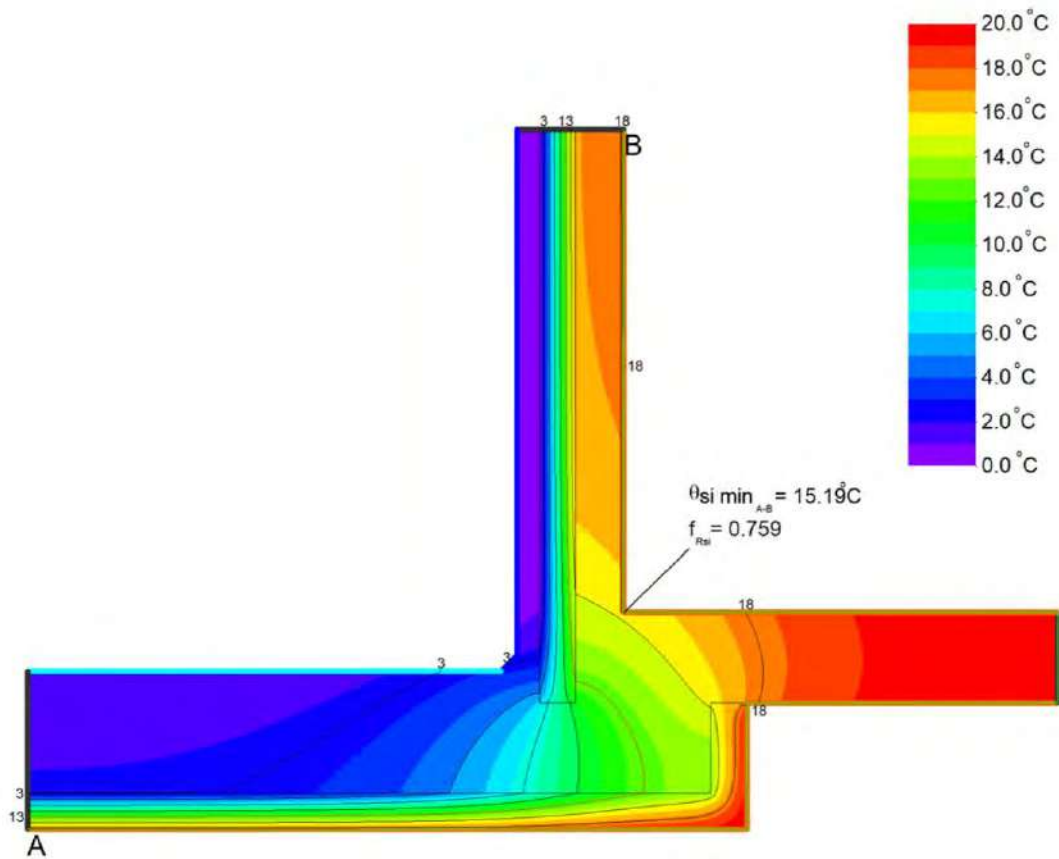
Detail 46



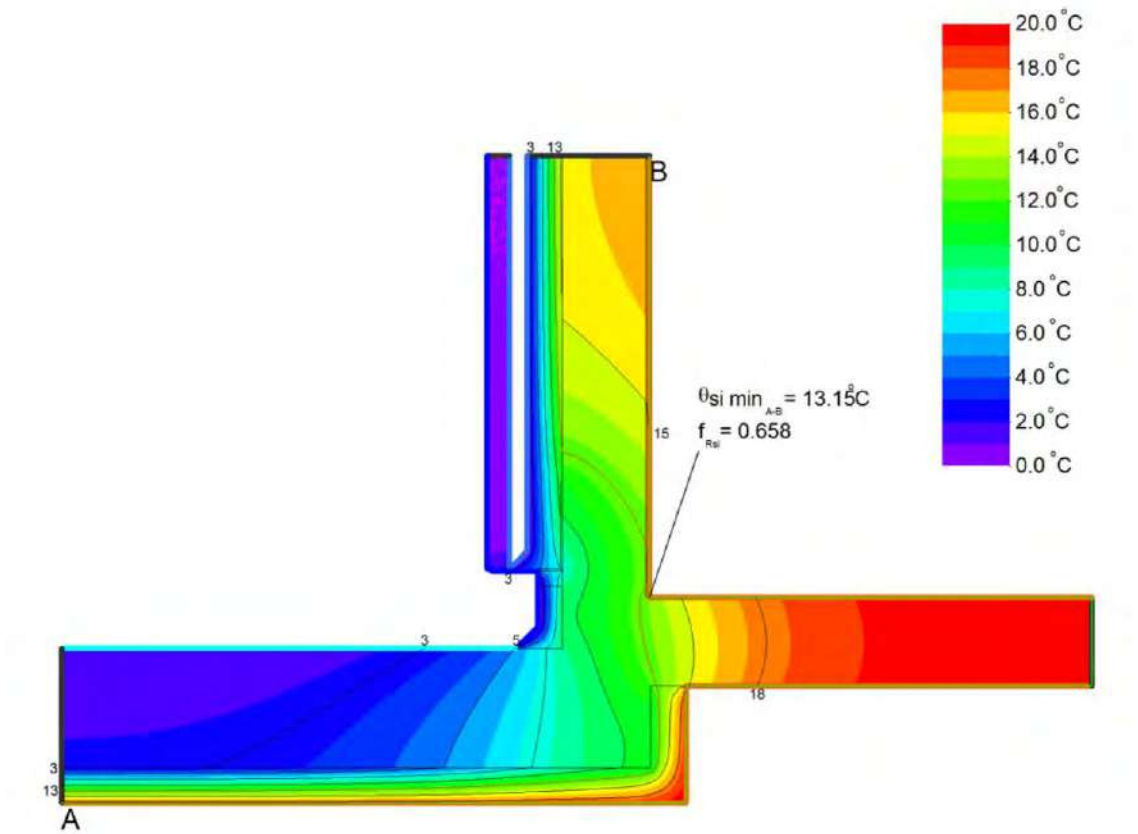
Detail 47



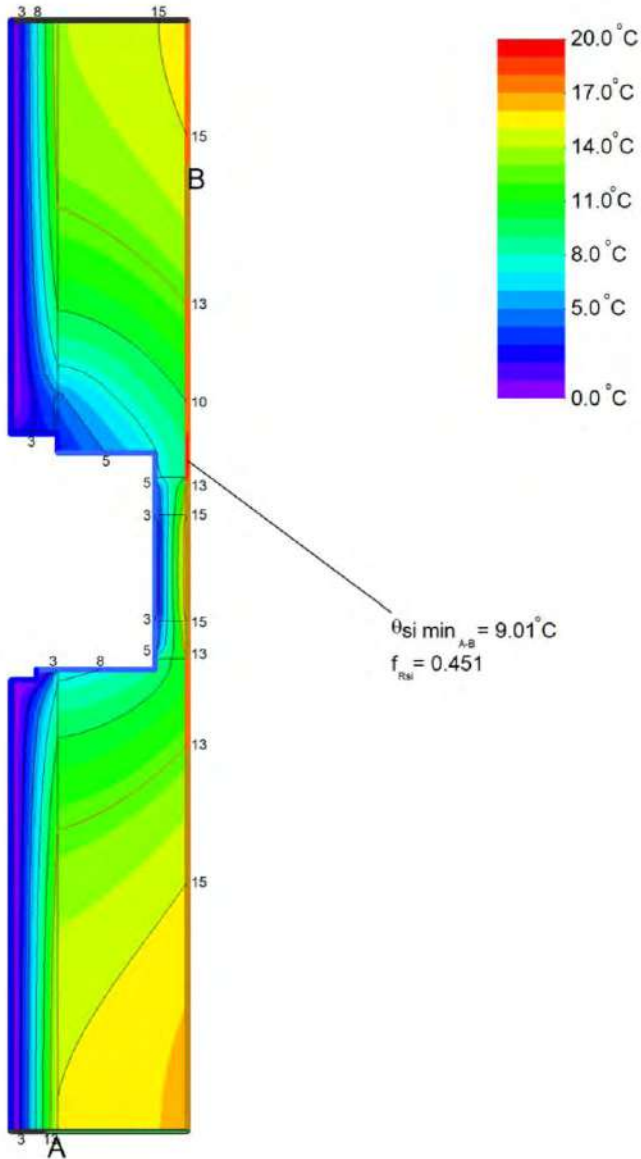
Detail 49



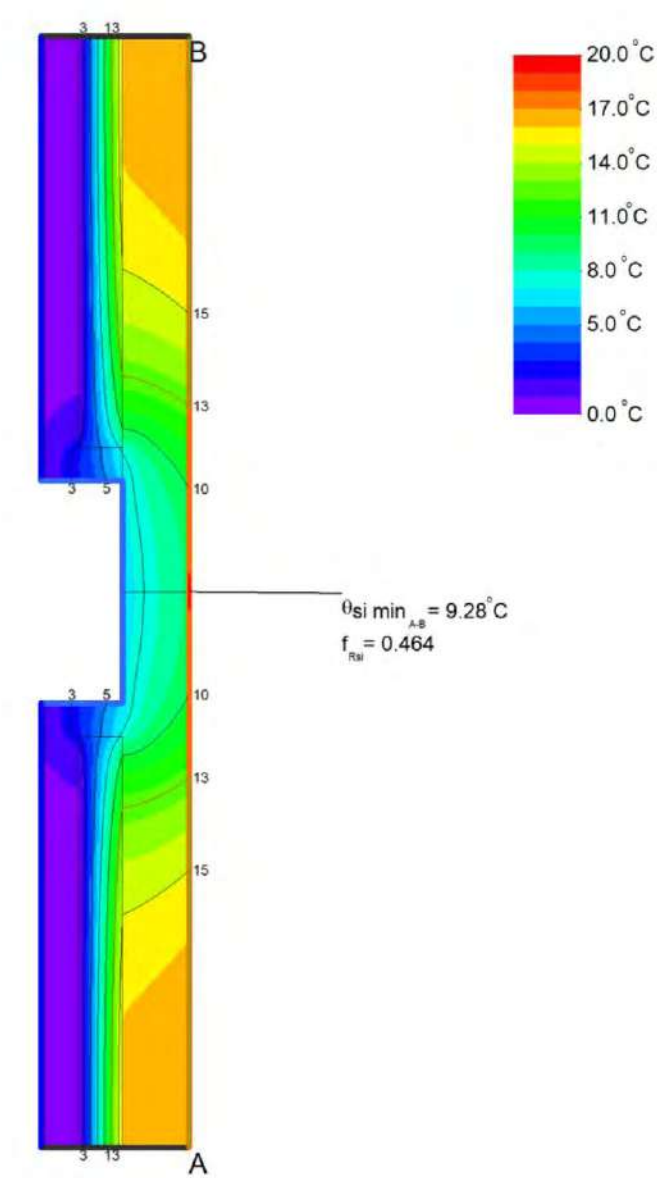
Detail 50



Detail 57a



Detail 59

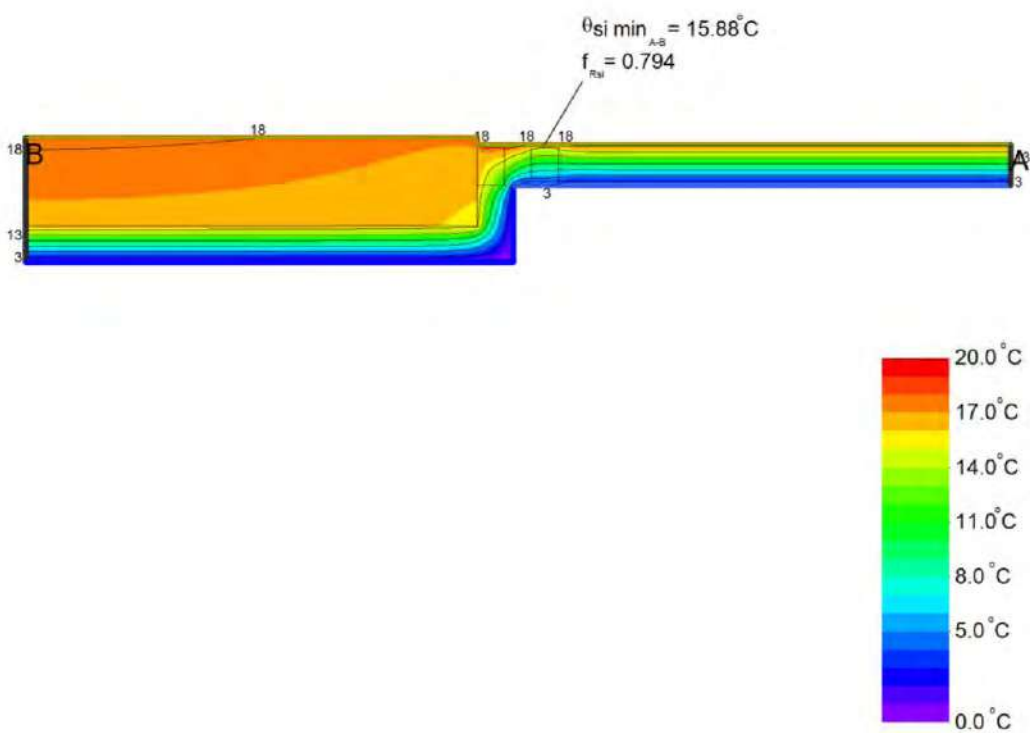


Detail 60

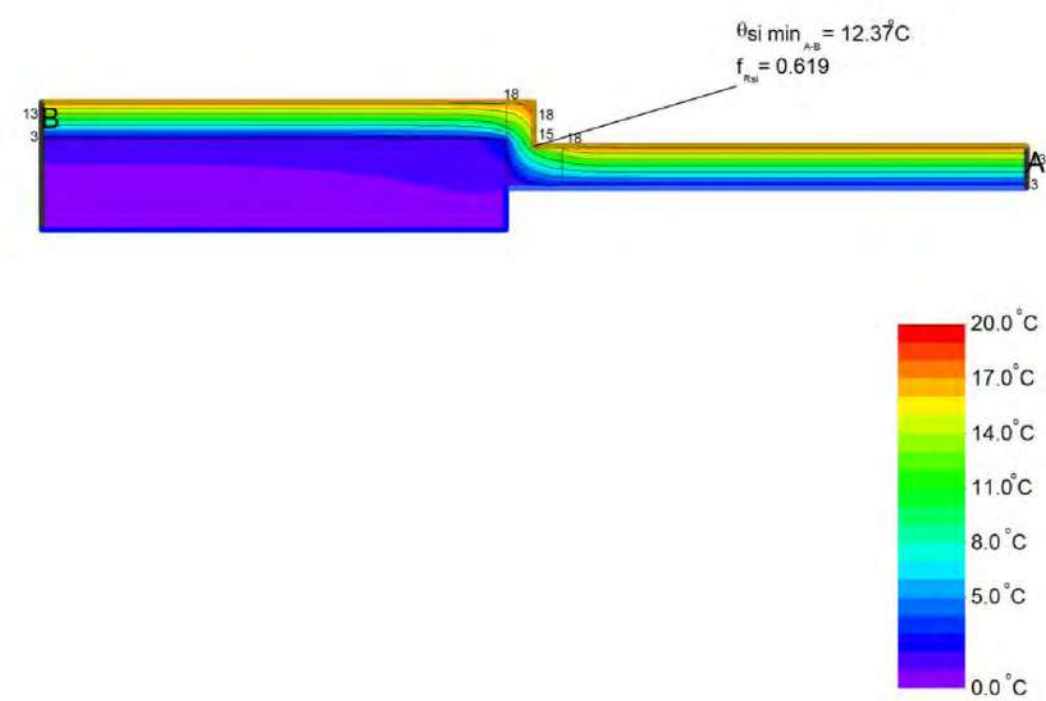
Detail 60 has not been modelled.

However, Detail 57a shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 60.

Detail 61a & b



Detail 62a & b

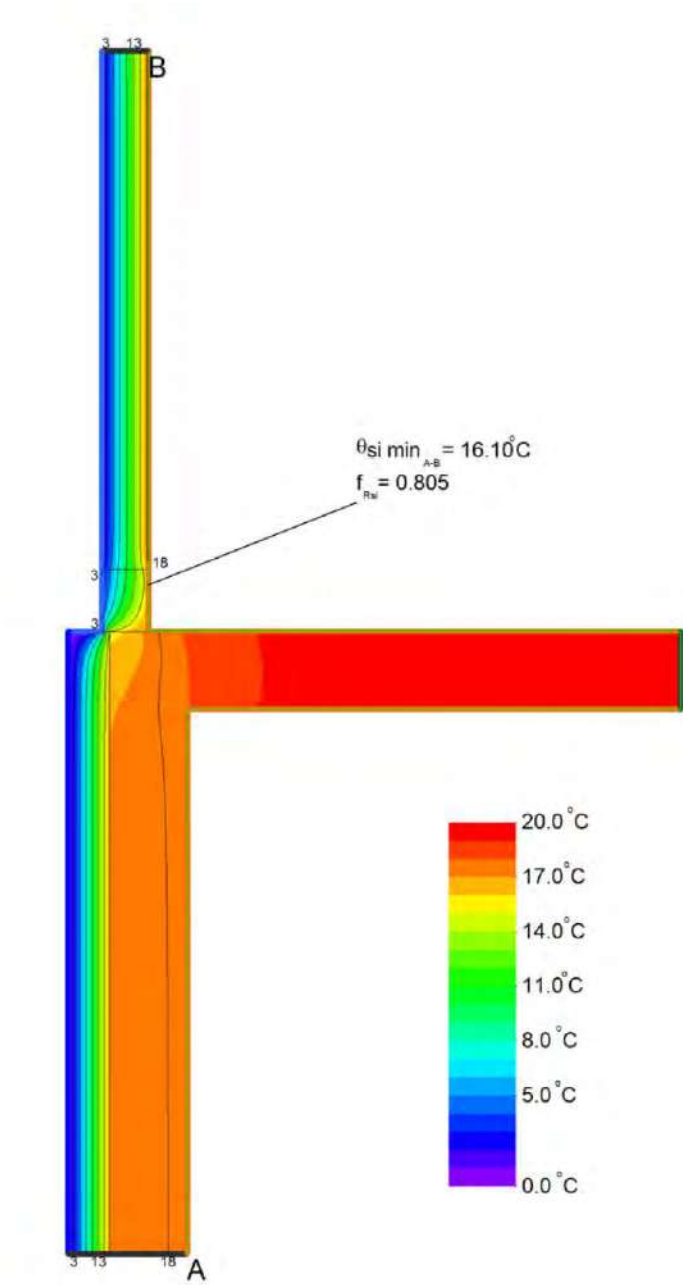


Detail 63a,b & 64a,b

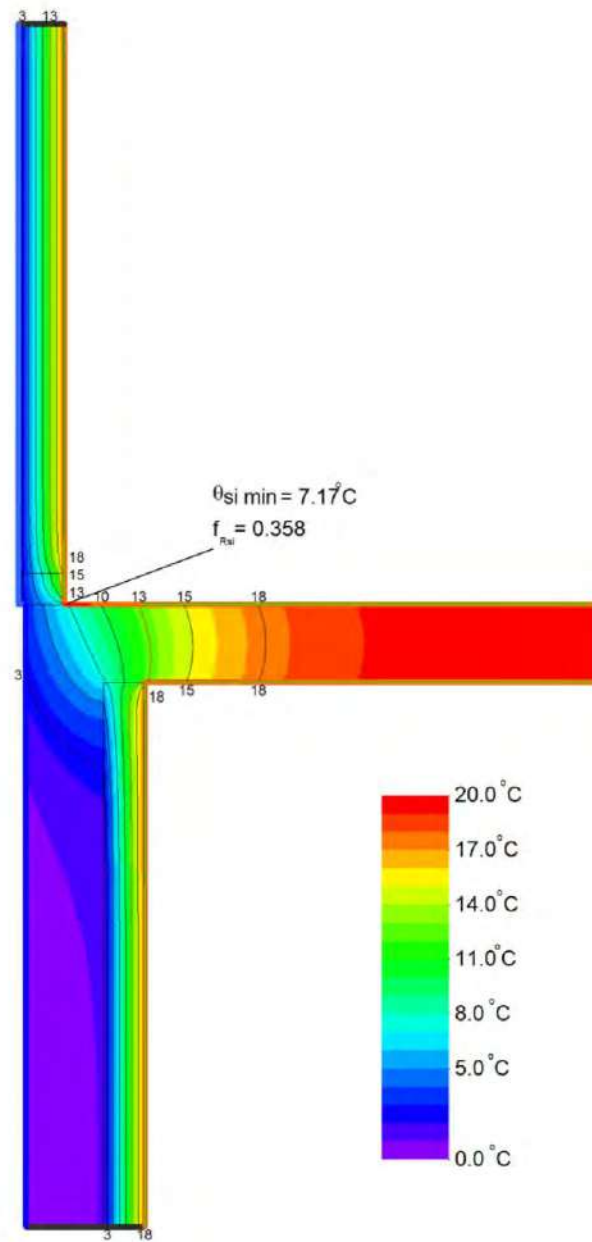
Details 63a,b & 64a,b have not been modelled.

However, Detail 61 shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 63a,b & 64a,b.

Detail 65



Detail 66



Details 67 & 68

Details 67 & 68 have not been modelled.

However, Detail 65 shows a similar thermal insulation build up and provides an indication of the fRsi value of Detail 67 & 68.

