



Bulk thermal insulation—Installation



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The following are represented on Committee BD-058:

- Aluminium Foil Insulation Association
 - Australasian Fire and Emergency Service Authorities Council
 - Australian Building Codes Board
 - Australian Cellulose Insulation Manufacturers Association
 - Australian Professional Thermography Association
 - Community Energy Network
 - Consumers Federation of Australia
 - Council of Textile and Fashion Industries of Australia
 - CSIRO Material Science and Engineering
 - Curtin University of Technology
 - Electrical Regulatory Authorities Council
 - Housing Industry Association
 - Insulation Australasia
 - Insulation Council of Australia and New Zealand
 - Master Builders Australia
 - Plastics and Chemicals Industries Association
 - Pliable Membranes Association of Australia
 - Recessed Luminaire Enclosure Association of Australia
 - The Insulation Contractors Association of Australia, NSW
 - Thermal Insulation Contractors Association of Australia
-

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard®

Bulk thermal insulation—Installation

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PREFACE

This Standard was prepared by the Standards Australia Committee BD-058, Thermal Insulation, to supersede AS 3999—1992, *Thermal insulation of dwellings—Bulk insulation—Installation requirements*.

This Standard incorporates Amendment No. 1 (June 2020). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This Standard is an informative secondary reference in the Building Code of Australia by means of a guidance reference within AS/NZS 4859.1:2002, *Materials for the insulation of buildings*, Part 1: *General criteria and technical provisions*.

This Standard is primarily for domestic dwellings but many of the installation methods detailed could be applicable to other forms of construction. This Standard is intended to be used by the installers of bulk thermal insulation. In this edition, a new normative requirement has been introduced for the provision of an installer's statement that details the insulation type and materials used in the completed installation.

The terms 'normative' and 'informative' have been used in this standard to define application of the Appendix to which they apply. A 'normative Appendix is an integral part of a standard, whereas an 'informative' Appendix is only for information and guidance.

This Standard incorporates a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance.

CONTENTS

	<i>Page</i>
FOREWORD.....	5
 SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	6
1.2 APPLICATION	6
1.3 NORMATIVE REFERENCES	7
1.4 DEFINITIONS.....	8
1.5 ANCILLARY MATERIALS	11
 SECTION 2 PRE-INSTALLATION INSPECTION AND PROCEDURES	
2.1 SCOPE OF SECTION	12
2.2 GENERAL.....	12
2.3 SPECIAL FEATURES	12
2.4 TREATMENT REQUIRED FOR SPECIAL FEATURES.....	12
2.5 CONDENSATION ASSESSMENT.....	13
2.6 ELECTRICAL CABLES AND ELECTRICAL EQUIPMENT.....	13
2.7 BUILT-IN APPLIANCES	17
2.8 CONTROL MEMBRANES.....	17
 SECTION 3 GENERAL REQUIREMENTS FOR INSULATION INSTALLATION	
3.1 SCOPE OF SECTION	18
3.2 ENERGY EFFICIENCY.....	18
3.3 INSULATION INSTALLATION GUIDANCE AND RULES	21
3.4 GENERAL INSULATION METHOD.....	22
 SECTION 4 SAFETY REQUIREMENTS FOR INSULATION INSTALLATION	
4.1 SCOPE OF SECTION	26
4.2 GENERAL SAFETY REQUIREMENTS	26
4.3 ELECTRICAL SAFETY	26
4.4 SAFETY REQUIREMENTS WHEN WORKING WITH INSULATION PRODUCTS	28
4.5 SAFETY REQUIREMENTS FOR CONCEALED STRUCTURAL MEMBERS (CEILINGS)	28
4.6 POLYSTYRENE CONTACT WITH ELECTRICAL CABLES	28
 SECTION 5 THERMAL ENVELOPE DETAILED INSTALLATION METHODS	
5.1 SCOPE OF SECTION	29
5.2 INSTALLATION OF ROOF INSULATION.....	29
5.3 INSTALLATION OF CEILING INSULATION.....	39
5.4 INSTALLATION OF WALL INSULATION.....	53
5.5 INSTALLATION OF FLOOR INSULATION	65
 SECTION 6 INSTALLATION STATEMENT.....	 80

APPENDICES

A	RECESSED LUMINAIRES	81
B	‘Text deleted’	88
C	MECHANICAL STRENGTH TEST FOR ‘FIXED IN POSITION’	89
D	INSTALLER’S STATEMENT	94
E	CEILING PERIMETER INSULATION	95
F	EDGE INSULATION SOLUTIONS	96
G	CONDENSATION	98
H	INSULATING TRUSSED CEILINGS	101
I	INSULATING UNDER CONCRETE SLAB ROOFS AND FLOORS	105
J	INSULATION RETRO-FIT AND REMEDIATION	107
K	ELECTRICALLY CONDUCTIVE BULK INSULATION.....	112
BIBLIOGRAPHY		113

FOREWORD

This Standard specifies the procedures for installing bulk thermal insulation in dwellings. The requirements were compiled from a wide range of procedures used in Australia and considered as consistent with good building practice in the installation of bulk thermal insulation.

The Committee has recognized the risk of certain electrical cables and equipment overheating when operating for extended periods when partially or completely surrounded by thermal insulation. To minimize this possibility a pre-installation inspection has been called for in order to identify whether this potential problem may occur where the thermal insulation is to be placed. The procedure to be adopted as a result of the inspection is set out in this Standard.

The Standard does not attempt to specify requirements for every method of installation of insulation. Rather, it provides general requirements, together with a number of common methods.

The various sub-structures that may be insulated with bulk insulation are dealt with in Section 5 with cross-references where necessary.

It is recommended that users of this Standard read the document as a whole rather than only referring to information on the specific building sub-structure to be insulated.

Installation of bulk thermal insulation, using the requirements and methods given in this Standard, will lead to reduction of heat gain in summer and of heat loss in winter. Bulk insulation and membranes work together to control heat, air and moisture, therefore the properties of membranes should always be considered. This Standard may also be read in conjunction with AS/NZS 4200.2, *Pliable building membranes and underlays*, Part 2: *Installation requirements*.

STANDARDS AUSTRALIA

Australian Standard

Bulk thermal insulation—Installation

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

The Standard sets out requirements on installing insulation in both new dwellings during construction and the retrofitting of insulation in existing buildings.

This Standard is intended for residential-type construction; however, the methods may be appropriate to other forms of construction.

This Standard includes requirements for electrical safety and guidance on Work Health and Safety.

This Standard is not intended to apply to the insulation of building services and equipment or materials with structural and/or external cladding or internal lining purposes.

This Standard does not deal with insulation that is foamed *in situ* nor the installation of pliable building membranes except when forming part of a bulk insulation product.

Insulation installed for the sole purpose of reverberation control is excluded from this Standard.

For the purposes of this Standard, bulk insulation also includes products which create multiple airspaces with a total installed product thickness greater than 20 mm.

1.2 APPLICATION

1.2.1 General

Bulk thermal insulation installation shall comply with Sections 2, 3 and 4, and the following, as applicable:

- (a) Roofs—Clause 5.2.
- (b) Ceilings—Clause 5.3.
- (c) Walls—Clause 5.4.
- (d) Floors—Clause 5.5.

Additional requirements for electrically conductive bulk insulation are provided in Appendix K.

1.2.2 Relationship with regulations

This Standard is intended to provide technical requirements for implementation by reference in statutory (building) regulations.

This Standard may be read in conjunction with, but does not take precedence over, any statutory regulations that may apply in any area.

NOTE: An installation may come under the jurisdiction of several authorities with differing areas of responsibility, and an approval from one does not necessarily constitute an approval from others.

1.3 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard.

NOTE: Documents referenced for information purpose are listed in the bibliography.

The following documents are referred to in this Standard:

AS

A1 | **‘Text deleted’**

1530 Methods for fire tests on building materials, components and structures
1530.1 Part 1: Combustibility test for materials

1684 Residential timber-framed construction
1684.1 Part 1: Design criteria
1684.2 Part 2: Non-cyclonic areas
1684.3 Part 3: Cyclonic areas
1684.4 Part 4: Simplified—Non-cyclonic areas

2870 Residential slabs and footings

3660 Termite management
3660.1 Part 1: New building work

3700 Masonry structures

3959 Construction of buildings in bushfire-prone areas

4440 Installation of nailplated timber roof trusses

4654 Waterproofing membranes for external above-ground use
4654.2 Part 2: Design and construction

4773 Masonry in small buildings
4773.1 Part 1: Design
4773.2 Part 2: Construction

AS/NZS

1530 Methods for fire tests on building materials, components and structures
1530.3 Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release

2589 Gypsum linings—Application and finishing

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

4200 Pliable building membranes and underlays
4200.1 Part 1: Materials
4200.2 Part 2: Installation requirements

4859 Materials for the thermal insulation of buildings
4859.1 Part 1: General criteria and technical provisions

5110 Recessed luminaire barriers

A1 | 6059 Luminaires
60598.1 Part 1: General requirements and test
60598.2.2 Part 2.2: Particular requirements – Recessed luminaires

ASTM

C411 Standard test method for hot-surface performance of high-temperature thermal insulation

C447 Standard practice for estimating the maximum use temperature of thermal insulations

Australian Building Code Board (ABCB)
National Construction Code (NCC)

NASH Standard

Residential and Low-rise Steel Framing, Part 1: Design Criteria (NASH Standard Part 1)

1.4 DEFINITIONS

For the purpose of this Standard, the definitions given below apply.

1.4.1 Air barrier

A layer that prevents the movement of air under the normal pressure differences found across building elements.

1.4.2 Building membrane, pliable

A material that can be formed into a roll without breaking or cracking, enabling a continuous sheet of underlay material to be applied to act as a sarking, thermal insulation, vapour control membrane, air barrier, ember barrier or any combination of these.

1.4.3 Bulk insulation

Thermal insulation materials in the form of batts, blankets, rigid boards or loose fill and classified in accordance with AS/NZS 4859.1. For the purposes of this Standard, segmented foil products are also considered bulk insulation. Where the term 'insulation' is stated in this Standard, it is referring to bulk insulation only.

1.4.4 Ceiling, flat

Horizontal ceiling.

1.4.5 Ceiling, raked

Sloped ceiling.

1.4.6 Competent person

A person, who has acquired, through training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the required task correctly.

1.4.7 Completely surrounded electrical cables

Cables surrounded by, and in contact with, bulk thermal insulation on all sides.

1.4.8 Design specification

A specification in one or more of the following forms:

- (a) Architectural drawings and specifications.
- (b) Contract specifications.
- (c) Manufacturers' specifications.
- (d) Engineers' specifications.

1.4.9 Electrically conductive

A material with capacity to carry electrical current.

1.4.10 Electrically conductive ceiling insulation

A product used, or to be used, as ceiling insulation that is readily able to conduct electricity.

Does not include metal foil batts that are separate, and do not form a continuous membrane.

1.4.11 Guard

A fire retarding component, having a spread of flame index of 0, in accordance with AS/NZS 1530.3 used to provide adequate separation from combustible building elements, insulation, and/or debris to reduce the fire risk caused by recessed luminaires, chimneys and other heat generating equipment. A guard has a minimum long term surface operating temperature of 90°C.

1.4.12 Luminaire barrier

A product complying with AS/NZS 5110.

1.4.13 Partially surrounded electrical cables

Partially surrounded electrical cable is electrical cable that has at least one side not covered with thermal insulation.

1.4.14 Permeability, δ_p

The time rate of water vapour transmission through unit area of a flat material of unit thickness induced by unit vapour pressure difference between two specific surfaces, under specified temperature and humidity conditions. Permeability is a property of a material, but the permeability of a body that performs like a material may be used. Permeability is the arithmetic product of permeance and thickness.

Unit: Microgram per metre second pascal ($\mu\text{g}/\text{m.s.Pa}$)

Kilogram per metre second pascal ($\text{kg}/\text{m.s.Pa}$)

1.4.15 Protected circuit

A1 | An electrical circuit protected by an approved safety switch (RCD).

1.4.16 Roofs, flat

Roofs having gradients less than 1:5.7 (less than approximately 10°).

1.4.17 Roofs, pitched

Roofs having gradients equal to or greater than 1:5.7 (slope approximately 10° or greater).

1.4.18 Thermal conductance, U

The quotient of the conductivity of a material and its thickness.

Reciprocal of thermal resistance ($1/R$).

Unit: Watts per square metre kelvin ($\text{W}/\text{m}^2.\text{K}$), also called U-value.

1.4.19 Thermal conductivity, k

A measure of the quantity of heat flow under steady state conditions, which passes through a unit area of a homogeneous material with flat and parallel faces and unit thickness (in metres), when a unit temperature difference (in kelvin or degrees Celsius) is maintained between these faces in unit time (J/s or W).

Unit: Watt per metre kelvin ($\text{W}/\text{m.K}$)

1.4.20 Thermal resistance, R

The quotient of the thickness of the material and its conductivity.

Unit: Square metre kelvin per watt ($\text{m}^2.\text{K}/\text{W}$)

The reciprocal of thermal conductance, also called R-value.

1.4.21 Thermal resistivity

Reciprocal of thermal conductivity ($1/k$).

Unit: Metre kelvin per watt ($\text{m.K}/\text{W}$)

1.4.22 Unprotected circuit

An electrical circuit that has not been fitted with an approved safety switch.

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‘Text deleted’

1.4.23 Vapour barrier

Layer of material or component intended to almost completely restrict the transmission of water vapour.

1.4.24 Vapour control membrane

A layer of material or component intended to regulate water vapour transfer between each side of the layer.

1.4.25 Vapour permeance, β_p

A measure of the rate of transfer of water vapour through a product of uniform thickness, normal to specified parallel surfaces under unit vapour pressure difference.

Unit: Kilogram per square metre second pascal, $\text{kg/m}^2\cdot\text{s}\cdot\text{Pa}$

Microgram per square metre second pascal, $\mu\text{g/m}^2\cdot\text{s}\cdot\text{Pa}$

Gram per mega-newton second, $\text{g/MN}\cdot\text{s}$

Microgram per newton second, $\mu\text{g/N}\cdot\text{s}$

1.4.26 Vapour resistance

The ability of a material to resist the passage of water vapour. Reciprocal of vapour permeance.

Unit: Square metre second pascal per kilogram, $\text{m}^2\cdot\text{s}\cdot\text{Pa/kg}$

Square metre second pascal per microgram, $\text{m}^2\cdot\text{s}\cdot\text{Pa}/\mu\text{g}$

Mega-newton second per gram, $\text{MN}\cdot\text{s/g}$

Newton second per microgram, $\text{N}\cdot\text{s}/\mu\text{g}$

1.4.27 Vapour resistivity

Reciprocal of vapour permeability.

Unit: Metre second pascal per kilogram, $\text{m}\cdot\text{s}\cdot\text{Pa/kg}$

Metre second pascal per microgram, $\text{m}\cdot\text{s}\cdot\text{Pa}/\mu\text{g}$

A1

1.4.28 Residual current device (RCD)

A device intended to isolate supply to protected circuits, socket-outlets or electrical equipment in the event of a current flow to earth that exceeds a predetermined value.

[SOURCE: AS/NZS 3000]

1.4.29 Non-IC luminaire

A recessed luminaire that cannot be abutted against or covered by normally flammable materials or used in installations where building insulation or debris is, or may be, present in normal use.

NOTE: This classification is not suitable for residential installations.

[SOURCE: AS/NZS 60598.2.2:2016]

A1

1.4.30 CA90 luminaire

A recessed luminaire that can be abutted against normally flammable materials, including building insulation, but cannot be covered in normal use. Building elements, building insulation or debris have limited access to the heated parts of the luminaire.

[SOURCE: AS/NZS 60598.2.2:2016]

1.4.31 IC luminaire

A recessed luminaire that can be abutted against normally flammable materials, including building insulation, and can be covered in normal use. Building elements, building insulation or debris have limited access to the heated parts of the luminaire.

[SOURCE: AS/NZS 60598.2.2:2016]

1.4.32 IC-4 luminaire

A recessed luminaire that can be abutted against normally flammable materials, including building insulation, and can be covered in normal use. Building elements, building insulation or debris have restricted access to the heated parts of the luminaire. This classification of recessed luminaire is effectively a sealed unit that has a restricted flow of air between the habitable room the luminaire emits light into and the void/space where the main body of the luminaire is located.

[SOURCE: AS/NZS 60598.2.2:2016]

1.5 ANCILLARY MATERIALS**1.5.1 General**

All materials referred to in this Clause shall comply with any relevant building regulations.

1.5.2 Support materials

Support materials used to retain in position a pliable building membrane or bulk insulation shall comply with the following (as appropriate):

- (a) *Steel wire or mesh*—shall be rust inhibited by a protective coating such as zinc, plastic material or paint.
- (b) *Cord or non-metallic mesh*—shall be durable and retain its position without sag.
- (c) *Pliable building membrane*—shall comply with AS/NZS 4200.1.
- (d) *Edge-restraint materials*—used to prevent bulk insulation sliding or falling out of place. They may include pliable building membrane or other durable material.
- (e) *Other support materials*—where used, they shall provide support no less effective than that afforded by the materials specified in Items (a), (b), (c) and (d).

SECTION 2 PRE-INSTALLATION INSPECTION AND PROCEDURES

2.1 SCOPE OF SECTION

This Section prescribes requirements for an inspection and procedures to be carried out prior to the installation of bulk insulation. The procedures take account of a number of features and equipment found in dwellings, including electrical cables.

2.2 GENERAL

Prior to installing bulk thermal insulation in a dwelling, there shall be a pre-installation assessment to determine the following:

- (a) Electrical safety requirements, as listed in Section 4.
- (b) Sufficient space shall be available for the insulation to achieve its designed thermal performance.
- (c) The design specification shall clearly state the insulation type and properties that are required in the construction system to enable the system to appropriately control heat and moisture.
- (d) The location of the bulk insulation shall be clearly specified in relation to any sarking or pliable building membranes.

2.3 SPECIAL FEATURES

Treatments (as set out in Clause 2.4) shall be carried out on the following special features:

- (a) Electrical cables that will be completely or partially surrounded by thermal insulation for lengths of cable greater than 400 mm.
- (b) Electrical equipment that will be enclosed by thermal insulation.
- (c) Built-in appliances.
- (d) Hot-gas flues.
- (e) Drop-ceilings.
- (f) Control membranes.
- (g) Recessed luminaires.

2.4 TREATMENT REQUIRED FOR SPECIAL FEATURES

Where the special features described in Clause 2.3, Items (a), (b), (c) and (g) are present, the installation shall comply with Clause 2.6 or Clause 2.7, as appropriate, before installation.

Where the special features described in Clause 2.3, Items (d) and (e) are present, the installation shall comply with Clause 3.4, Items (f) and (g), and Clause 5.3.4.1(d), as appropriate, before installation.

Where the special features described in Clause 2.3, Item (f) are present, the installation shall comply with Clause 2.8, before installation.

Bulk insulation suitable for surrounding an object that produces heat, e.g. recessed luminaires, chimneys and other heat generating equipment, shall have a minimum long term surface operating temperature of 90°C. Where the manufacturer of the heat generating equipment requires insulation to operate at a temperature higher than 90°C, the insulation shall be non-combustible to AS 1530.1 and tested to the required higher surface temperature as per ASTM C411 and ASTM C447 to determine its suitability.

2.5 CONDENSATION ASSESSMENT

The insulation shall be selected and installed in accordance with the design specification, which may include vapour control membranes, air barriers or additional ventilation to reduce the potential for condensation [see Clause 3.4(i) and Note 3 to Clause 5.2.3.2(c)].

Where vapour barriers, vapour permeable membranes or air barrier membranes are already installed or are intended to be installed, the following factors shall be assessed:

- (a) The design specification shall clearly state where the bulk insulation is to be installed in relation to any vapour barriers located within the construction system.
- (b) The type of bulk insulation shall be clearly stated in the design specification with adequate information to enable the installer to select the insulation in accordance with Clause 3.2.3.
- (c) Whether the building designer has considered condensation risk.

NOTES:

- 1 Guidance on condensation is given in Appendix G.
- 2 Types of insulation refers to fibrous batts, extruded polystyrene (XPS), expanded polystyrene (EPS), polyisocyanurate (PIR), loose fill, etc.

2.6 ELECTRICAL CABLES AND ELECTRICAL EQUIPMENT

2.6.1 Electrical cables

2.6.1.1 General

The flow of electric current in cables generates heat that is dissipated to the surroundings. The introduction of bulk insulation around cables will reduce the heat dissipation and in some instances may result in electrical cables overheating and the electrical insulation exceeding its rated temperature, and degrading. It is also possible that electrical equipment may overheat if enclosed by thermal insulation.

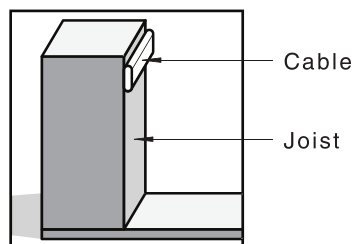
For the purpose of this Standard electrical cables are classified according to their degree of proximity to insulation as follows:

- (a) Unsurrounded (see Clause 2.6.1.2).
- (b) Partially surrounded (see Clause 2.6.1.3).
- (c) Completely surrounded (see Clause 2.6.1.4).

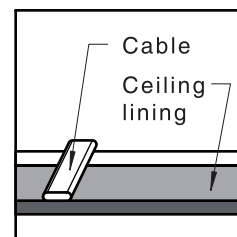
2.6.1.2 Unsurrounded electrical cable

Unsurrounded electrical cable is any electrical cable that is completely free of thermal insulation. An electrical cable attached to a building member is also classified as an unsurrounded electrical cable. This means that a building member (e.g. a ceiling joist) is not classified as a thermal insulator. See Figure 2.6.1.2.

A1



Cable running along the inside of a joist



Cable running across ceiling lining

FIGURE 2.6.1.2 UNSURROUNDED ELECTRICAL CABLES

2.6.1.3 *Partially surrounded electrical cable*

The side of the electrical cable not covered with thermal insulation may be open to free air or in contact with a building member that is not classified as thermal insulation such as a timber ceiling joist. See examples in Figure 2.6.1.3.

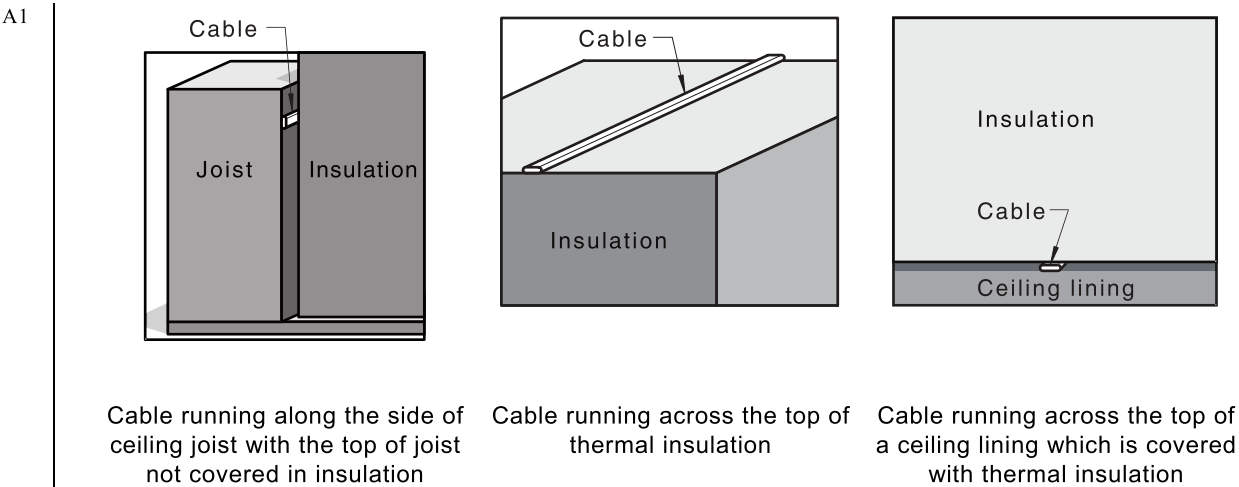


FIGURE 2.6.1.3 PARTIALLY SURROUNDED ELECTRICAL CABLES

2.6.1.4 *Completely surrounded electrical cable*

Completely surrounded electrical cable is electrical cable that has thermal insulation on all sides of the cable for a continuous length greater than 400 mm. See examples in Figure 2.6.1.4.

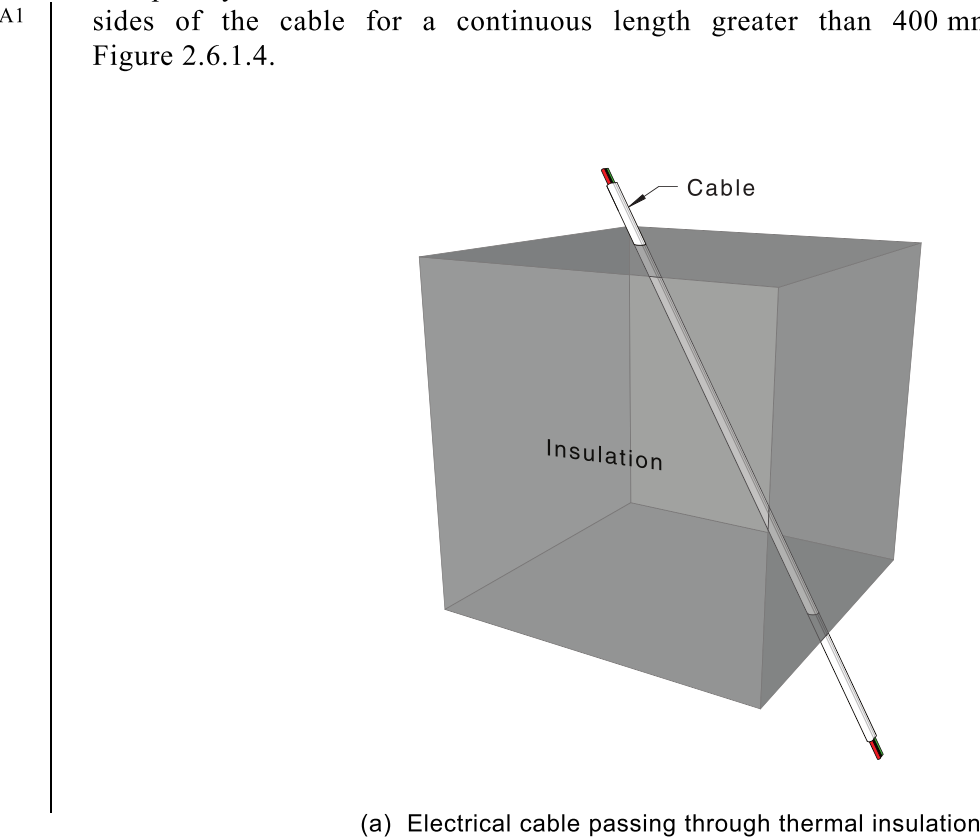
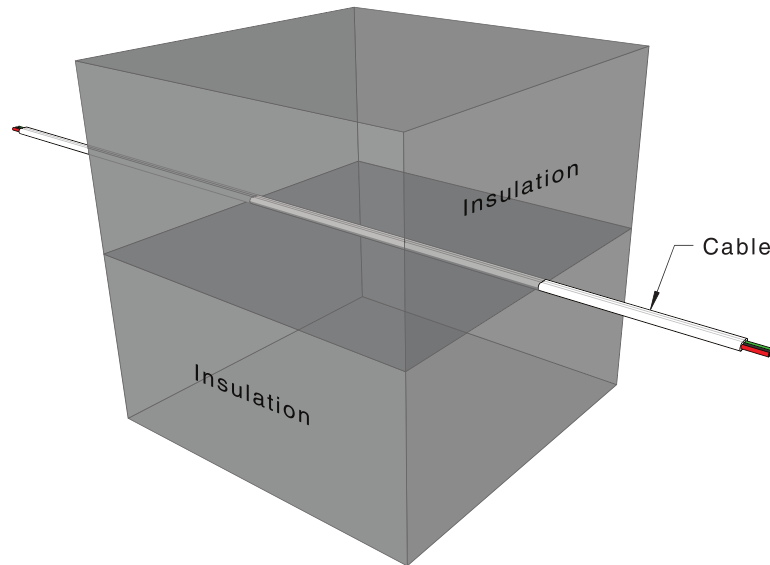


FIGURE 2.6.1.4 (in part) COMPLETELY SURROUNDED ELECTRICAL CABLES

A1



(b) Electrical cable running in between layers of thermal insulation

FIGURE 2.6.1.4 (in part) COMPLETELY SURROUNDED ELECTRICAL CABLES

A1

2.6.2 Insulation installation and electrical cables

2.6.2.1 General

This Clause (2.6.2) details the requirements for the installation of insulation in ceilings, walls (internal and external) and underfloor of new and existing premises.

NOTE: In the early nineties, the classification of the cables in thermal insulation was introduced into the Wiring Rules. The cables were rated as to how much of the cable was enclosed in thermal insulation; this included the distance that the cable was enclosed in thermal insulation and the number of sides in direct contact with the thermal insulation. Previous editions specified cable to be surrounded by no greater than 300 mm length.

A step change within domestic installation has occurred in line with the publication of the 2018 Wiring Rules.

Electrical cables have been installed within ceilings, walls (internal and external) and underfloor for many years. Originally the cables were installed and sized without the consideration of thermal insulation unless insulation was installed prior to the electrical cables being installed.

2.6.2.2 Dwellings not wired in accordance with AS 3000—1986 or subsequent editions

The installation of bulk insulation in spaces where electrical cables that do not comply with AS 3000—1986, or a subsequent edition, are present and where the bulk insulation would surround the cables for lengths of cable greater than 300 mm, either of the following alternatives shall apply, as appropriate:

- (a) The bulk thermal insulation shall be installed so that it does not surround electrical cables, either completely or partially.
- (b) A written statement from a licensed electrical contractor or electrical engineer qualified in electrical cabling shall be required, confirming the suitability of surrounding the electrical cables with bulk thermal insulation either completely or partially.

If the cables are found unsuitable for surrounding with thermal insulation, the installation of bulk insulation shall comply with the requirement of Item (a) or the relevant areas shall be left uninsulated, or the cables shall be re-routed by a licensed electrical contractor away from the space to be insulated.

A1 **2.6.2.3** *Insulation installations and wiring systems in domestic installations in accordance with AS/NZS 3000:2018*

Wiring systems in domestic installations have been installed on the assumption that thermal insulation in ceilings, walls and under floors, if not currently installed, will be installed in the future. When installing insulation, the following shall apply to cables:

- (a) Only bulk thermal insulation shall be used.

NOTE: Building material that may be used for bulk thermal insulation include—

- (a) glasswool or rockwool batts or loose-fill;
- (b) cellulose fibre, paper, cork, seagrass or similar organic materials that are normally installed in a loose-fill form;
- (c) expanded synthetic foams such as polystyrene, urea formaldehyde or polyurethane, which may be installed by pumping or injection as a wet foam; or
- (d) Electrically conductive bulk insulation (see Appendix K).

- (b) The following shall apply to cables:

- (i) Cables shall be deemed to be unenclosed, where they are installed without further enclosure—

- (A) lying on a horizontal surface;
- (B) lying across ceiling joists;
- (C) supported on perforated or unperforated cable trays, ladders, hangers or racks;
- (D) fixed in place at intervals to a vertical or horizontal surface such as a wall or ceiling joist; or
- (E) surrounded by bulk thermal insulation for a length of less than or equal to 150 mm.

- (ii) Cables shall be deemed to be partially surrounded, where they are installed in such a way that—

- (A) bulk thermal insulation is prevented from completely surrounding unenclosed or enclosed cables over a length of more than 150 mm, such as where an unenclosed or enclosed cable is clipped to a structural member or is lying on a ceiling; or
- (B) cables are completely surrounded by bulk thermal insulation for over a length of more than 150 mm but not more than 400 mm.

- (iii) Cables shall be deemed to be completely surrounded where they are installed in such a way that bulk thermal insulation totally surrounds cables over a length of more than 400 mm.

NOTES:

- 1 This applies to insulation installation in ceilings, walls and floors.
- 2 See Figures 2.6.1.4 for examples of electrical cable passing through up to 400 mm of ceiling insulations to reach a light fitting on the ceiling.

- (c) If an electrical cable is completely surrounded by bulk insulation for a length of 400 mm or greater, a licensed electrician shall be consulted except where Clause 2.6.3 applies.

2.6.3 Electrical accessories and equipment

If electrical equipment is present in the area to be insulated, thermal insulation shall not be placed closer than 50 mm around the equipment unless assurance has been first obtained from the equipment manufacturer that the safe operation of the equipment will not be jeopardized by the proposed placement of thermal insulation. Installation of bulk thermal insulation in conjunction with recessed luminaires shall be in accordance with Appendices A and C.

2.7 BUILT-IN APPLIANCES

If built-in appliances are present in the space to be insulated, thermal insulation shall not be placed closer than 50 mm around the appliance unless assurance has been obtained from the appliance manufacturer that the safe operation of the appliance will not be jeopardized by the proposed placement of thermal insulation. Built-in appliances include heaters, ovens and stoves.

2.8 CONTROL MEMBRANES

Bulk insulation installed on ceilings, under roof cladding, in walls or floors shall comply with the following, as appropriate. This includes where sarking (water barrier membranes), vapour control membranes, radiant barrier membranes (reflective), ember barrier membranes or air barrier membranes are required in the construction:

- (a) The bulk insulation shall be positioned in relation to any currently installed sarking, vapour control membranes, reflective membranes, water barriers, air barriers or ember barriers in accordance with the design specification, manufacturer's specifications or AS/NZS 4200 series.
- (b) The bulk insulation type being installed shall match the design or manufacturer's specifications in conjunction with the type and purpose of membrane (see Clause 3.2.3).
- (c) The insulation shall not inhibit the ability to install any membrane layers specified to be laid after the insulation.
- (d) Any composite blanket products that include a vapour control membrane shall be installed with the membrane in the correct arrangement according to the design specification, manufacturer's specifications, AS/NZS 4200 series and Clause 2.5.
- (e) Any board insulation products shall be in accordance with Clause 2.5, Clause 3.2.2 and Clause 3.2.3 as well as the design specification or manufacturer's specifications.
- (f) Where applicable, bulk insulation shall be installed in accordance with AS 3959.

SECTION 3 GENERAL REQUIREMENTS FOR INSULATION INSTALLATION

3.1 SCOPE OF SECTION

This Section specifies the general requirements for the installation of all types of bulk insulation in order to achieve the designed thermal purpose, for all roofs, ceilings, walls and floors.

3.2 ENERGY EFFICIENCY

3.2.1 General

Insulation shall be installed in accordance with the general requirements in this Section. This will result in the energy efficiency of dwellings being improved.

The following Clause 3.2.2 outlines the fundamental principles of how thermal insulation works and the principles which govern the effectiveness of the insulation once installed. Failure to meet the general requirements and key installation principles may result in thermal non-compliance with the building regulations.

3.2.2 Product description, application and purpose

Bulk insulation installations shall comply with the following:

- (a) The key properties inherent in the thermal insulation materials to be installed shall be identified and shall be suitable for the application.

NOTE: Bulk insulation products may be specially designed for thermal insulation for use in—

- (a) roofs;
- (b) ceilings;
- (c) walls; or
- (d) floors.

- (b) The installation of bulk insulation shall ensure the bulk insulation does not infringe on the designed purpose of the membrane, any damage incurred during the installation to the membrane shall be repaired.

NOTE: Pliable building membranes generally come in rolls and are commonly utilized to sark the dwelling to prevent water ingress. However, they may have additional purposes in the overall design of the building including, preventing unwanted air leakage into cavities, allowing trapped vapour in construction assemblies to dry, reflect radiant heat, and as ember barriers in bushfire prone areas.

- (c) Prior to the installation of bulk insulation, consideration shall be given to the location of any pliable building membranes with a reflective face. These provide a level of thermal resistance when installed with an air space adjacent to the reflective surface. An unventilated air gap shall be left to allow any air spaces adjacent to reflective or semi-reflective surfaces to maintain a minimum of 20 mm to provide a level of heat flow resistance, or as otherwise specified.

NOTES:

- 1 The total system R-values are determined in AS/NZS 4859.1 and are based on still air space. Where the cavity is ventilated, it will affect the total system R-values.
- 2 Some foil surfaces have an ink coating designed to stop discomfort glare which can occur from the reflection of direct sun during installation. These 'anti-glare' coatings are used in both roof and wall applications when an otherwise bright reflective surface would face the exterior of the building causing a possible safety concern. Anti-glare foil/pliable membranes are considered a semi reflective surface and its level of performance is not equal to a reflective shiny surface but still require an air gap of 20 mm to contribute to the overall thermal performance.

3.2.3 Insulation selection

Where a specific insulation manufacturer or product has not been explicitly specified by the designer, an insulation type shall be selected with material properties that meet the design specification or regulatory authority guidelines for all performance parameters. These parameters may include—

- (a) size and dimensions, thickness, width and height of insulation segments or rolls appropriate to the structure and application in which it is being applied;
- (b) thermal resistance tested in accordance with AS/NZS 4859.1;
- (c) density;
- (d) fire hazard properties determined in accordance with AS 1530.1 and/or AS/NZS 1530.3;
- (e) moisture absorptance;
- (f) water vapour permeance in accordance with ASTM E96, Procedure B; and
- (g) product purpose for the specific application and/or purpose in which it was manufactured.

NOTES:

- 1 The comprehensive range of available types and sizes of insulation ensure there is an efficient and effective insulation material suitable for most applications.
- 2 Insulation should be installed based on its stated nominal stabilized thickness.
- 3 Bulk insulation thermal performance is a function of its nominal stabilized thickness.
- 4 The National Construction Code sets out performance targets expressed as total R-values for summer and winter based on climate zone conditions.

3.2.4 Continuity of insulation

The following requirements shall be met as appropriate:

- (a) Bulk insulation shall be installed so that it—
 - (i) abuts or overlaps adjoining insulation other than at structural members such as columns, studs, noggins, joists, furring channels, and the like, where the insulation shall butt against the member;
 - (ii) forms a continuous barrier with ceilings, walls, bulkheads, floors, or the like, that inherently contribute to the thermal envelope (see examples in Figures 3.2.4.1 and 3.2.4.2); and

NOTE: The thermal envelope of a building is the part of a buildings fabric that separates heated or cooled spaces from the exterior of the building or other spaces that are not heated or cooled. A continuous thermal barrier around the envelope is necessary to achieve good performance.
 - (iii) does not affect the safe or effective operation of a service or fitting.
- (b) The settling factors for any loose fill materials being installed shall be confirmed by manufacturer's technical information and extra thickness provided to allow for settling as required to meet the R-value and building regulations.

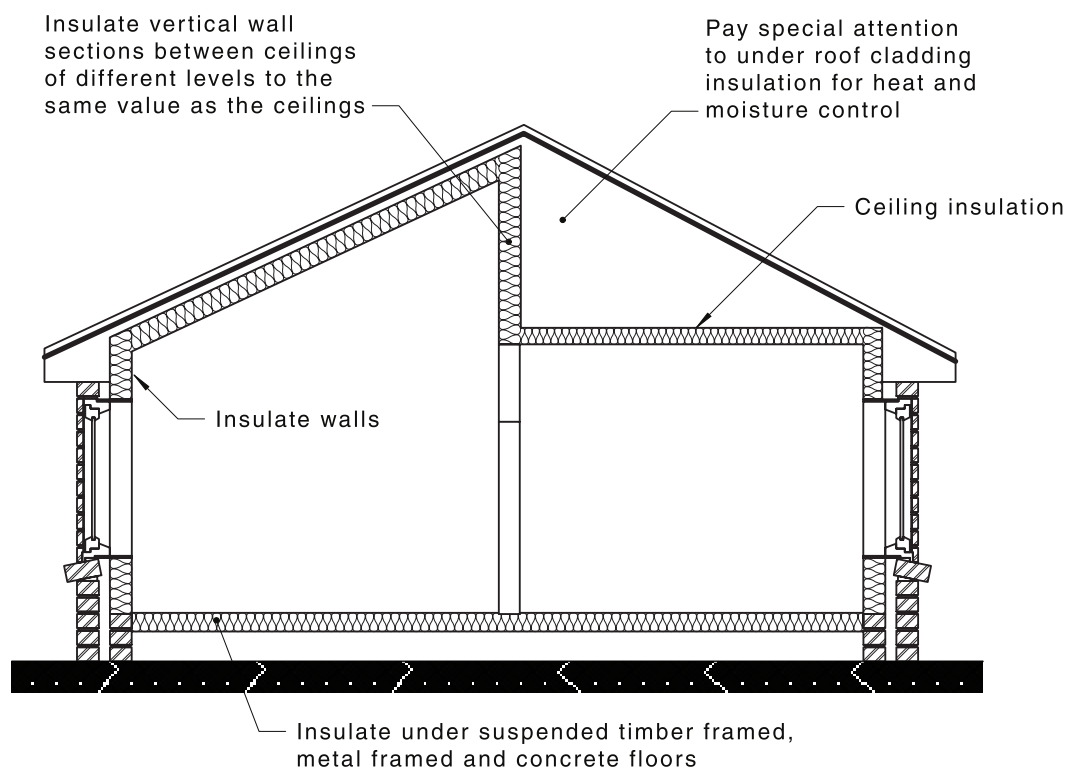


FIGURE 3.2.4.1 EXAMPLE OF THERMAL ENVELOPE WITH SUSPENDED FLOOR

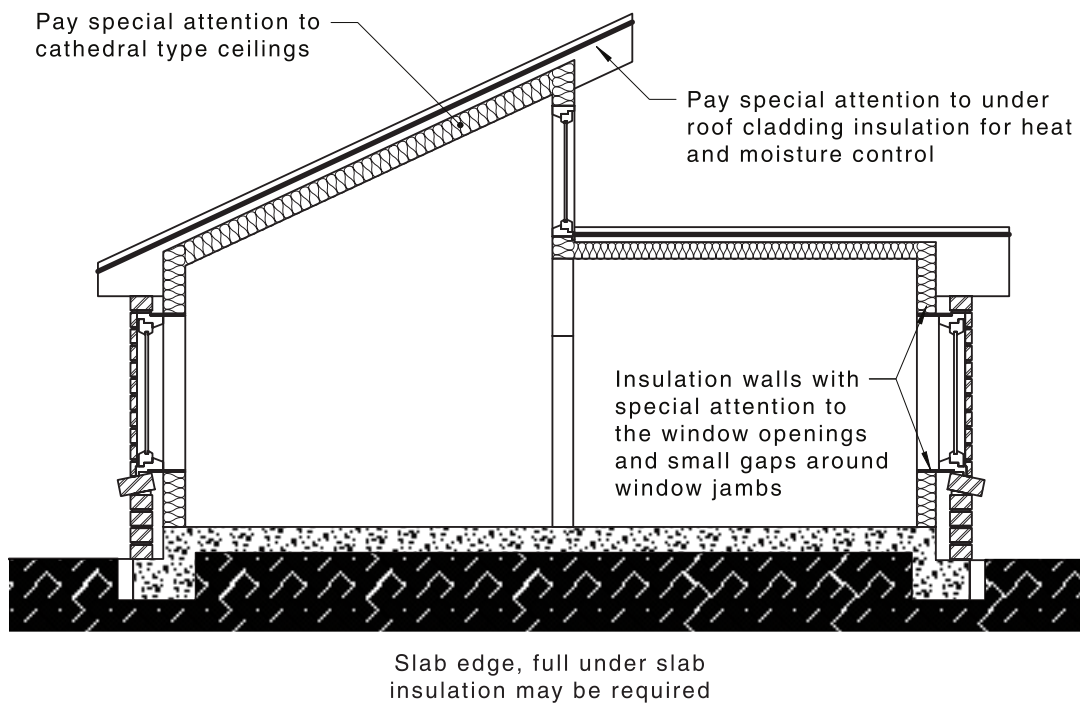


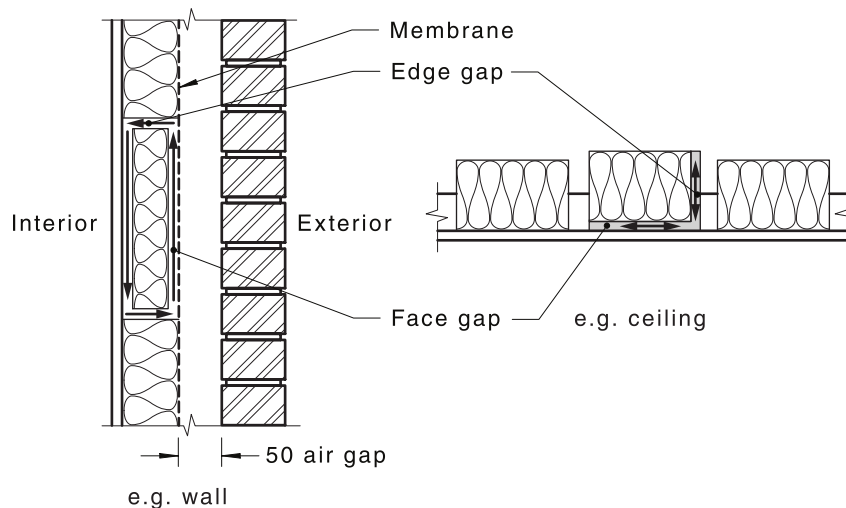
FIGURE 3.2.4.2 EXAMPLE OF THERMAL ENVELOPE WITH SLAB ON GROUND

3.3 INSULATION INSTALLATION GUIDANCE AND RULES

3.3.1 Insulation gaps, joints and thermal bypass

The following requirements apply:

- (a) Gaps around the edges of insulation segments, on all four edges, both sides or gaps at the top and bottom shall be avoided (see Figure 3.3.1).
- (b) Interconnecting cavities shall be avoided (see Note to Figure 3.3.1).



NOTE: The occurrence of face gaps in conjunction with edge gaps allows air on either side of the insulation to exchange and they can render an insulating layer nearly ineffective. This is known as interconnecting cavities.

FIGURE 3.3.1 EDGE GAPS AND SIDE GAPS

- (c) Where practical folding, tucking in and compression shall be avoided as this will reduce the effectiveness of insulation.

C3.2.1 *In practice, the R-value of a building element will depend to a large extent on the material R-value of the insulation product installed and the quality of the installation itself. R-values for building elements are specified in AS/NZS 4859.1 and the National Construction Code (NCC), so insulation must be installed such that conformance is achieved.*

3.3.2 Thermal bridging

Thermal bridging occurs where more thermally conductive structural elements, fixings, etc. bridge the insulation layer (see Figure 3.3.2) providing a path for heat to flow through the insulation layer. The following requirements apply:

- (a) Structural materials that are very conductive to heat shall be either—
 - (i) fully covered with insulation; or
 - (ii) insulation shall be tightly abutted to structural member.

NOTE: Steel, zinc, copper, lead or aluminium, can transmit significant amounts of heat through the insulation layer, significantly reducing the overall total R-value of the building envelope.

- (b) Thermal bridging shall be kept to a minimum, where possible, and shall be achieved through complying with Item (a) and the use of low conductivity fixings where possible, i.e. nylon anchors or telescopic plastic insulation fasteners.

C3.3.2 *It is very difficult to achieve total coverage of insulation without some amount of thermal bridging through the insulation layer without compromising the structural integrity of the building; therefore, some thermal bridging will always be expected.*

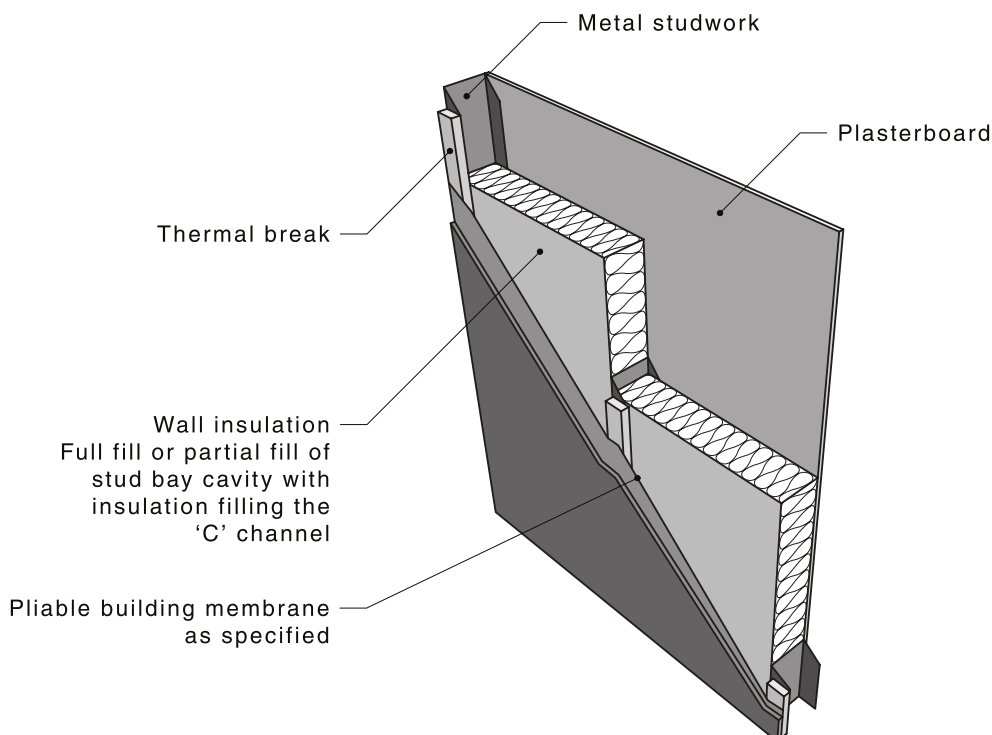


FIGURE 3.3.2 EXAMPLE OF THERMAL BREAKS WITH CLADDING
DIRECT FIXED TO METAL STUDWORK

3.4 GENERAL INSULATION METHOD

Bulk insulation installed in all roofs, ceilings, walls and floors shall comply with the following in order to achieve the thermal performance as designed:

- (a) The bulk insulation shall be installed without reduction in thickness to provide the specified R-value over the whole area to be insulated except where special considerations require otherwise. Examples are:
 - (i) Where bulk insulation is placed between ceiling/floor joists, and does not exceed the height of the joists, it is not required to cover the top/bottom of the joists.
 - (ii) The presence of fittings and electrical wiring may necessitate a reduction or complete absence of bulk insulation in some places (see Section 2 and Appendices A and C).
- (b) Bulk insulation shall not be compressed against linings or the roof cover [see Clause 5.3.4.1(h) and Figure 5.3.4.1.7]. Where the structure will not accommodate the thickness required to give the specified R-value, a lesser value shall be used.

NOTES:

- 1 It is desirable to cut insulation and then place around services providing that such compression is limited so that it does not compromise adjacent linings or roof cover.
- 2 The R-value of insulating materials is quoted for a specific nominal stabilized thickness. Reduction of this thickness results in a lowering of the R-value, e.g. where blanket insulation is compressed between roof members and roof sheeting (see Figure 3.4.1.1).

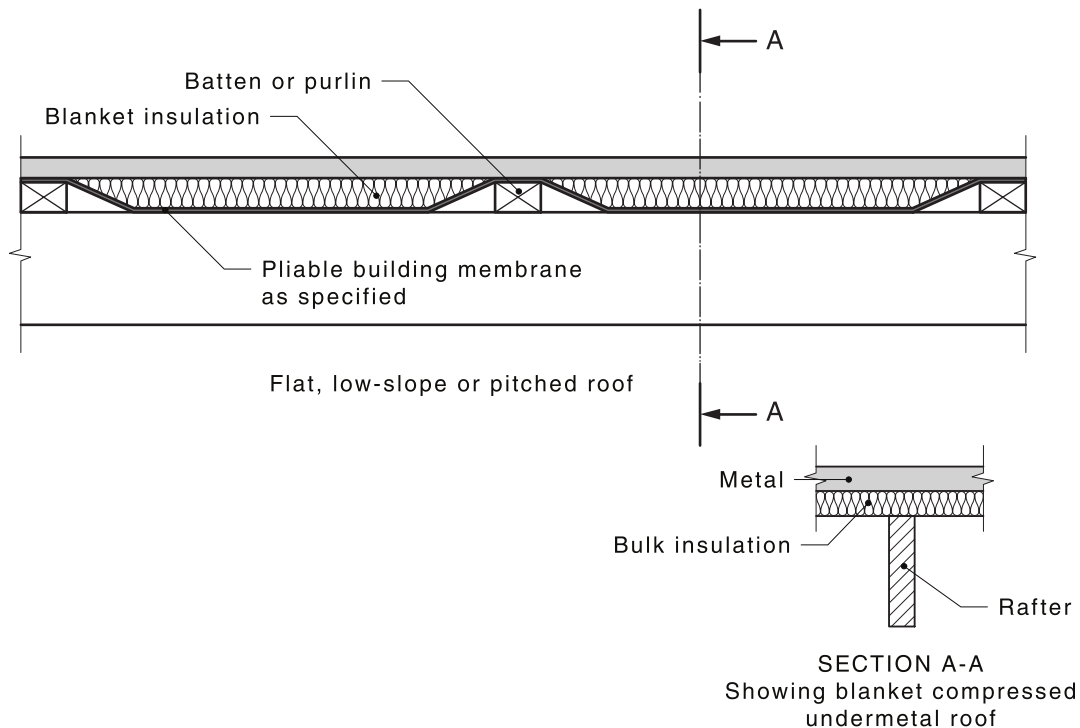


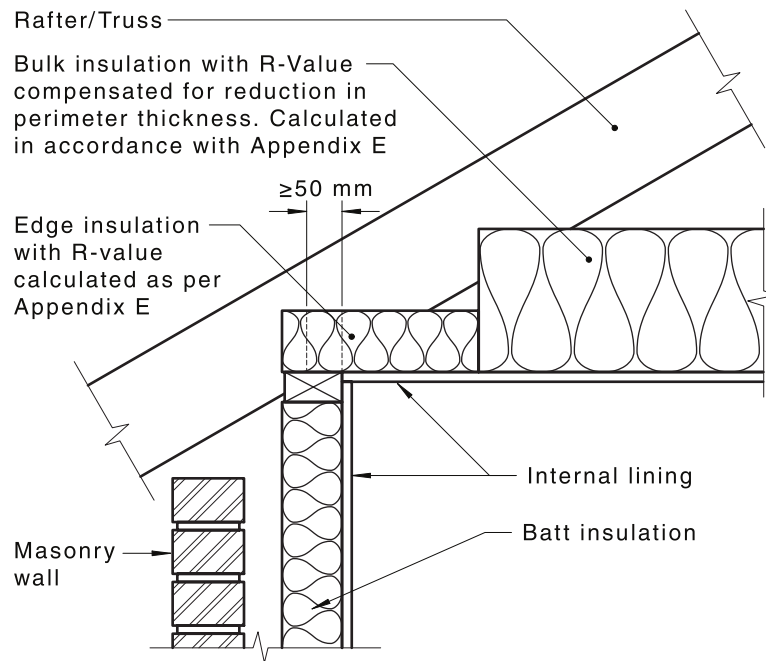
FIGURE 3.4.1 REDUCTION IN THICKNESS OF BLANKET INSULATION WHERE COMPRESSED BETWEEN ROOF SHEETING AND BATTENS

- (c) Bulk insulation shall be dry when installed unless otherwise specified by the manufacturer.
- (d) Batt, blanket and board insulation shall be butted at all joints to avoid gaps or voids as per Clause 3.3.1.
- (e) Bulk insulation shall be restrained where it may fall or slide out of position.

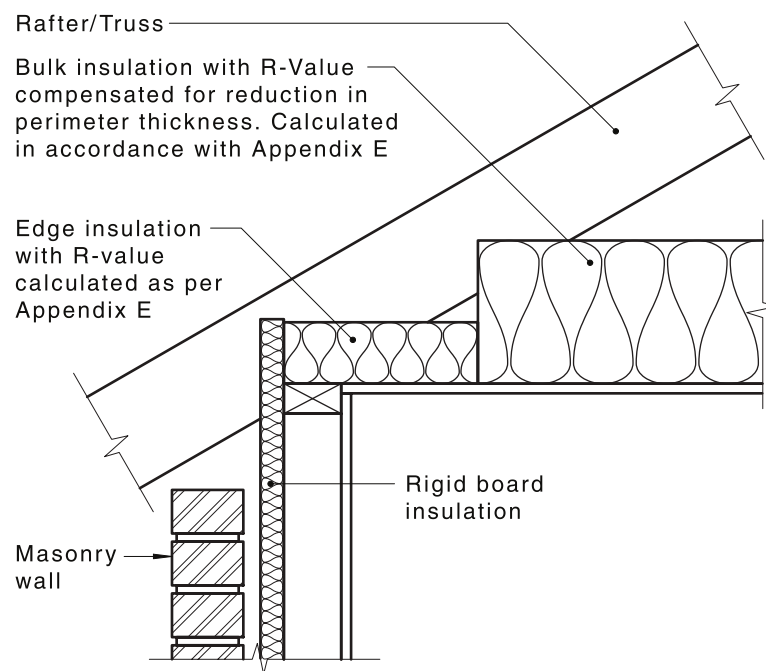
NOTES:

- 1 This situation can apply, for example, to bulk insulation installed between the studs of brick veneer walls or on sloping ceilings.
 - 2 Batt, blanket or rigid board insulation may be secured with cord or mesh. Loose-fill insulation may be restrained by appropriate support materials described in Clause 1.5.2.
- (f) Where bulk insulation is installed in adjacent building elements, e.g. ceilings, walls and bulkheads, provision shall be made, where practicable, to overlap or butt the insulation installation at all the junctions between elements as shown in Figure 3.4.2.
NOTE: Such overlapping or butting of bulk thermal insulation is intended to reduce the potential for thermal bridges.
 - (g) Bulk insulation shall be cut or placed to fit snugly around any penetrations through the insulation, e.g. pipework; except where there is danger of overheating, e.g. flues, electrical cables and equipment, wall furnaces [see Clauses 2.4 and 5.3.4.1(c), and Figure 5.3.4.1.3].
 - (h) A clearance of not less than 50 mm or manufacturer's specifications and which complies with building regulations shall be provided around the outer skin of any flue likely to carry hot gases [see Figure 5.3.4.3].
 - (i) When sarking membranes, vapour control membranes, air barriers, reflective barriers or ember barriers have been specified in conjunction with bulk insulation, refer Clauses 2.5, 3.2.2 and 3.2.3.

NOTE: For classification of pliable building membranes, membrane properties and membrane performance, refer to AS/NZS 4200.1.

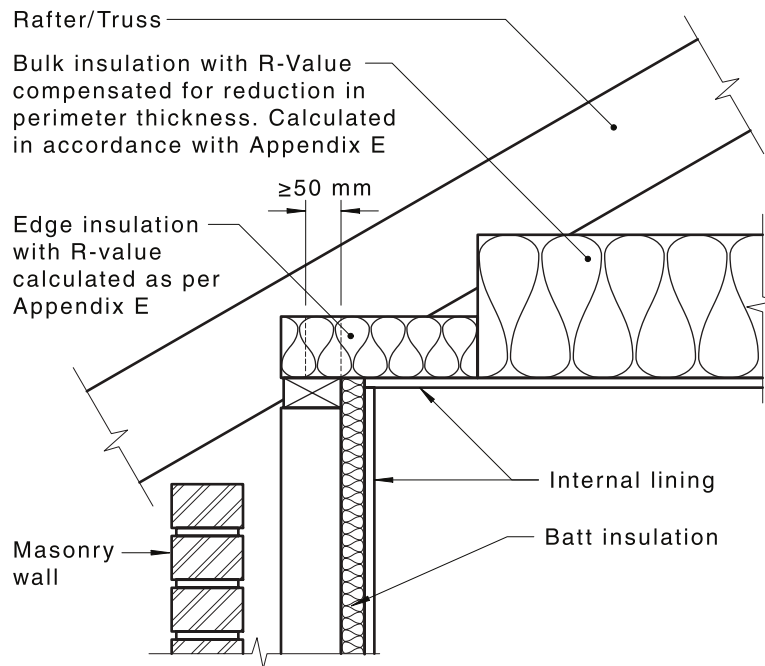


(a) Batt insulation on ceilings and within wall cavity



(b) Batt insulation on ceilings and rigid board insulation externally in framed walls

FIGURE 3.4.2 (in part) PLACEMENT OF THERMAL INSULATION TO ELIMINATE THERMAL BRIDGING



(c) Batt insulation on ceilings and rigid board insulation internally in framed walls

FIGURE 3.4.2 (in part) PLACEMENT OF THERMAL INSULATION TO ELIMINATE THERMAL BRIDGING

- (j) Gaps in the bulk insulation shall be avoided at penetrations and overlaps in vapour control membranes to prevent the passage of air and water vapour. See Clause 2.5.
Overlaps and sealing of membranes shall be in accordance with AS/NZS 4200.2.
NOTE: Sealing may require the use of contact adhesive or pressure sensitive tape.
- (k) All packaging materials, other than those used for support purposes, shall be removed from the building upon completion of the installation. The exception being when a product label is required to be left on site for future product identification. The label shall be affixed to the building using an approved method.
- (l) When bulk insulation is faced with a pliable building membrane, the composite product shall be installed as to achieve the membrane purpose (see Clauses 3.2.2 and 3.2.3) within the construction system according to manufacturer's specifications, designer's specifications and AS/NZS 4200.2.
- (m) Reflective bulk insulation products shall be installed—
 - (i) over the whole area to be insulated and lap or abut other insulation;
 - (ii) when installed, contact with the reflecting surfaces and other materials shall be avoided maintaining a minimum of 20 mm gap; and
 - (iii) such that air movement in and around the reflective insulation products shall be controlled through sealing, overlapping or tightly fitting where it abuts with other insulation or structural members.

SECTION 4 SAFETY REQUIREMENTS FOR INSULATION INSTALLATION

4.1 SCOPE OF SECTION

This Section sets out requirements for the safe work procedures for the installation of bulk insulation, with particular attention to installations in roofs, ceilings and floors where electrical wiring, equipment or electrically conductive ceiling insulation is present.

4.2 GENERAL SAFETY REQUIREMENTS

Safe practices contained in federal and state WHS legislation shall be followed.

C.4.2 Installation of insulation in existing structures may present a more aggressive environment principally due to elevated temperature, dusty environment and higher risk of electrocution.

There are specific requirements in some state legislation regarding the installation of all types of insulation including electrically conductive insulation, such as the foil faced bulk thermal insulation. Refer to relevant state electrical safety legislation.

An appropriate safe work method statement (SWMS) shall be completed before commencing any work. If the risks are found to be high, then no work should commence until these risks have been managed to a low level.

The appropriate personal protection equipment (PPE) shall be selected to meet any requirements identified in a SWMS (e.g. use of leather gloves, dust masks, rubber soled shoes and safety harnesses).

4.3 ELECTRICAL SAFETY

When insulation is to be installed in an existing building or in a new building after electrical wiring or equipment has already been installed across ceiling joists, the following procedures apply:

- (a) Prior to installation an assessment shall be conducted for input in to the SWMS by a competent person in carrying out an assessment of the electrical risk from the installation of insulation.

NOTES:

- 1 The risk assessment need not be done by a licensed electrician unless required by state regulations.
- 2 It is recommended that a record of the on-site assessment is kept for at least 5 years after the assessment is conducted.

- (b) Prior to entering a ceiling space, how to de-energize circuits located in the roof space shall be identified.

If warning signs on recessed luminaries in accordance with Appendix A are not present, then they shall be installed on each access point to the ceiling.

Before commencing installation:

- (i) Before entering into the ceiling, map the position of downlights and other appliances on a sketch plan of the building as they may be difficult to see once in the ceiling.
- (ii) Check and note the location of electrical cables, electrical equipment and accessories in the area to be insulated.

- (iii) Check and note the location of any cabling that cannot be de-energized at switchboard, e.g. mains supply and some solar PV wiring.

NOTE: Unprotected electrical cables should not be positioned in locations where they are vulnerable to damage, such as over the tops of joists.

- (c) The power to the work area that can be de-energized shall be switched off and, if required, an alternative safe power supply shall be provided for lighting and other work equipment.

NOTES:

- 1 Based on risk assessment further actions may be required to de-energize circuits located in the work area that cannot be de-energized from the switch board.
- 2 Residual Current Devices (RCDs) provide added protection but should not be relied upon during installation.
- 3 Alternative lighting may include natural lighting or use of batteries.
- 4 The use of lock out arrangements and signage should be provided to avoid inadvertent re-energization of the circuit.

- (d) Where it is suspected or ascertained that electrically conductive insulation has been installed across the ceiling joists, the ceiling space shall not be entered. Before any work in the ceiling space commences, an electrical contractor shall make an electrical safety assessment, and issue a written statement stating the contractor has inspected the installation and tested the electrically conductive insulation to establish it is not energized.

- (e) Risk assessment outcomes:

- (i) If the cabling or electrical equipment is suspected to be faulty, then the owner shall be advised.
- (ii) If the electrical insulation or equipment appears to be inadequate, the installation shall not proceed until the installation is assessed and if required made safe or rectified by an electrician.
- (iii) If installation is to proceed, all circuits that cannot be de-energized at switchboard, e.g. mains supply and some PV solar wiring, shall be identified.

NOTE: Based on the risk assessment, further actions may be required to de-energize circuits located in the work area that cannot be de-energized from the switchboard.

- (f) Equipment and fixings:

- (i) All equipment used for installing insulation shall be designed to minimize the risk of electric shock. Only tools (knives, screwdrivers, etc.) that are non-conductive or have electrically insulated handles shall be used. Clothing or protective equipment that are non-conductive shall be worn.
- (ii) If fasteners are required to be used, non-metallic, non-conductive fasteners shall be used.

- (g) During installation:

- (i) When stapling or cutting insulation, ensure that there are no cables or other electrical equipment in the vicinity.

NOTE: Cutting may be done on a kneeling board, not with the insulation in place.

- (ii) When installation is complete, the correct operation of the electrical device shall be checked again. If a fault is detected, that was not present at the start of the work, then an electrician is needed to rectify the situation.

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- (h) Where bulk insulation materials are faced with aluminium foil, which can conduct electricity, the installation process shall ensure that the foil facing does not become energized through contact with electrical wiring and equipment.

NOTE: These requirements, which apply generally to all installations where electrical equipment or cabling is present, are particularly important when installing foil-faced bulk insulation.

- (i) Where pre-existing electrical cables are installed, electrically conductive insulation shall only be installed on top of ceiling surfaces or ceiling joists and under subfloors where—
- (i) permitted by the relevant state regulation; and
 - (ii) installed in accordance with Appendix K.

4.4 SAFETY REQUIREMENTS WHEN WORKING WITH INSULATION PRODUCTS

Instructions contained in the product manufacturer's specifications relevant to the handling, installation and disposal of waste insulation product shall be followed.

4.5 SAFETY REQUIREMENTS FOR CONCEALED STRUCTURAL MEMBERS (CEILINGS)

Where the structural members are concealed, a safe egress pathway shall be created in the roof space as required for maintenance.

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4.6 POLYSTYRENE CONTACT WITH ELECTRICAL CABLES

Electrical cabling shall not be in contact with polystyrene unless the cables and polystyrene are compatible.

NOTE: Plasticizer can migrate out of the electrical insulation of the wiring, making it less flexible, and into the polystyrene insulation, therefore potentially compromising the insulation and wiring.

SECTION 5 THERMAL ENVELOPE DETAILED INSTALLATION METHODS

5.1 SCOPE OF SECTION

This Section sets out the requirements for installation of bulk insulation products in roofs, ceilings, walls and floors.

5.2 INSTALLATION OF ROOF INSULATION

5.2.1 Scope

This Clause (5.2) outlines the installation of insulation located directly on top of roof truss top chords, on top of roof rafters, over roof battens or in close proximity to the roof cladding commonly used in dwellings. This includes bulk insulation below tiled roofs, sheet roofs, metal roofs and concrete roofs.

5.2.2 General

5.2.2.1 Roof framing

Insulation shall be installed to accommodate the following structural elements:

- (a) Timber-framed constructions, as described in AS 1684 series.
- (b) Nail plated trusses and associated bracing members, bracing strapping and spacing members, as described in AS 4440.

NOTE: An example of insulation to accommodate trusses is provided in Appendix H.

- (c) Metal framed trusses, as described in NASH Standard Part 1.

NOTE: Metal framed trusses are designed to minimum load combinations as specified in NASH Standard Part 1, which consider the truss self-weight plus weight of the remaining roof system; roofing, battens, ceiling, ceiling battens, insulation and services.

Commentary: The design would be expected to account for the type and installed thickness of ceiling insulation and that the weight does not exceed the specified load allowance allocated for insulation in the truss or framing design. Loads other than the standard loads on the trusses require approval. The standard loads, i.e. dead load, live load, wind load, and earthquake load, imposed on trusses are specified in AS/NZS 1170.0, AS/NZS 1170.1, AS/NZS 1170.2, AS/NZS 1170.3 and AS 1170.4, as appropriate.

5.2.2.2 Specific installation issues

When installing insulation under roofs it shall be ensured that—

- (a) the ceiling insulation can be installed around the perimeter of the roof where the roof meets the load bearing walls in accordance with the criteria outlined in Clause 5.2.4;
- (b) the insulation shall be installed to meet safety criteria outlined in Section 2 and 4 and Appendices A and C;
- (c) care shall be taken when installing insulation to ensure that it does not interfere with the safety or performance of domestic services and fittings in accordance with Clause 2.4;
- (d) the design specification, where available, shall be checked to ensure the bulk insulation is installed in the correct position in relation to any existing membranes already installed or any future insulation intended to be installed in accordance with Clause 5.3 and the requirements of Clause 2.5 are met;

- (e) any bulk insulation materials (excluding R0.2 thermal breaks), which are compressed between cladding materials and structural members, or to which cladding materials are directly fixed, shall not compromise the structural integrity of the roof construction as required by the National Construction Code (NCC); and
- (f) insulation installed between counter battens or rafters shall maintain a minimum of 10 mm clearance under the battens for drainage between the sarking and the fixing battens unless otherwise specified (see Figure 5.2.2.2).

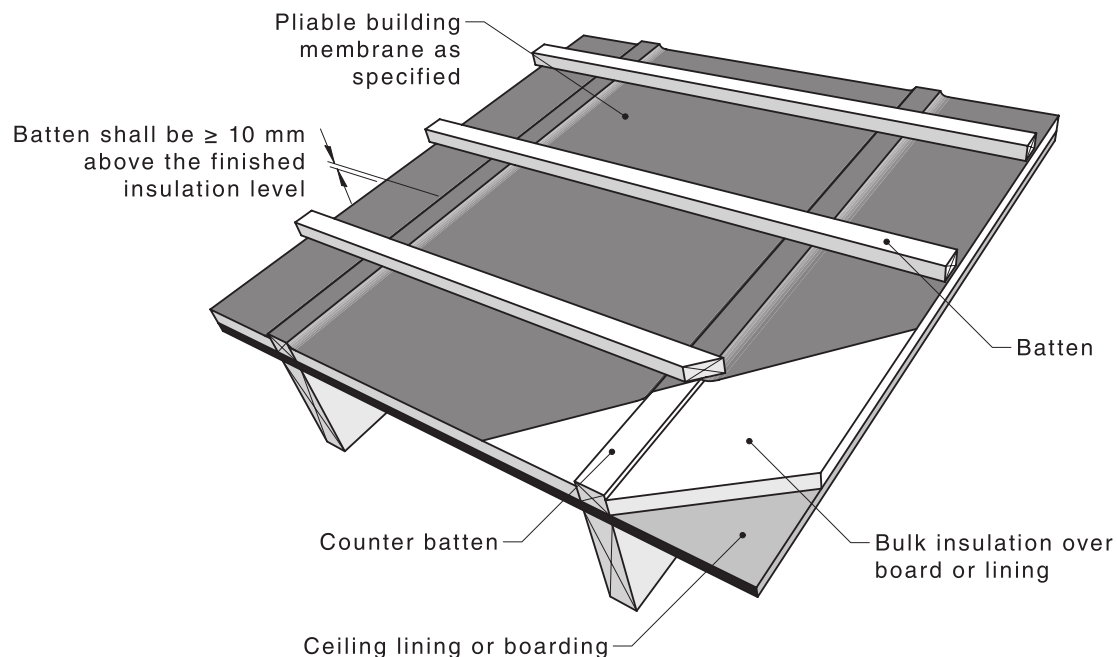


FIGURE 5.2.2.2 FORMING DRAINAGE CHANNELS

5.2.3 Flat roofs

5.2.3.1 Metal clad roofs

Bulk insulation installed in flat metal roofs shall comply with the following, as appropriate:

- (a) Bulk insulation installed between the roof supporting members is shown in Figure 5.2.3.1.2 and above the roof battens is shown in Figure 5.2.3.1.1.

Blanket insulation shall be installed over the roof battens or purlins (see Figure 5.2.3.1.1) and tensioned before fixing to ensure contact between the insulation and the metal roof sheet. Where used as a vapour control membrane, shall comply with AS/NZS 4200.

- (b) Where the roof construction having the roof supporting members above the ceiling lining. The required R-value may be achieved by installing part of the bulk insulation in the form of blanket insulation to comply with Item (a) and with the addition of sufficient bulk insulation applied on the upper surface of the ceiling to achieve the required R-value (see Figures 5.2.3.1.1 and 5.2.3.1.2).

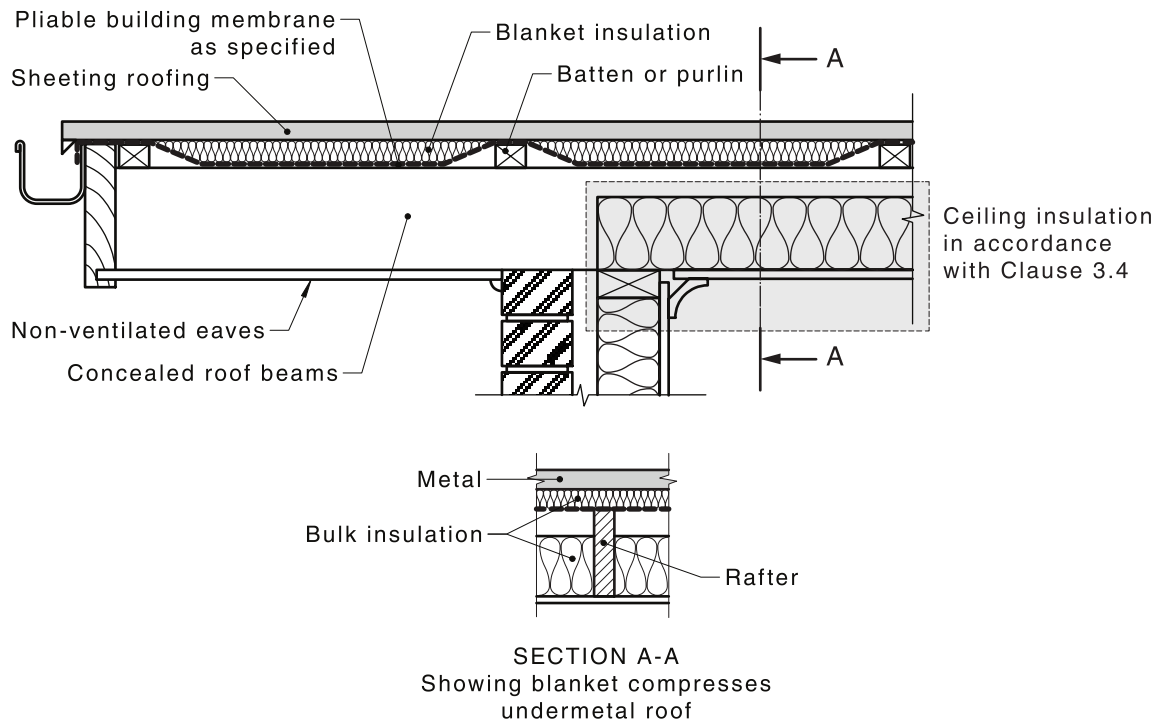


FIGURE 5.2.3.1.1 FLAT METAL ROOF WITH COMPRESSIBLE BLANKET BULK INSULATION

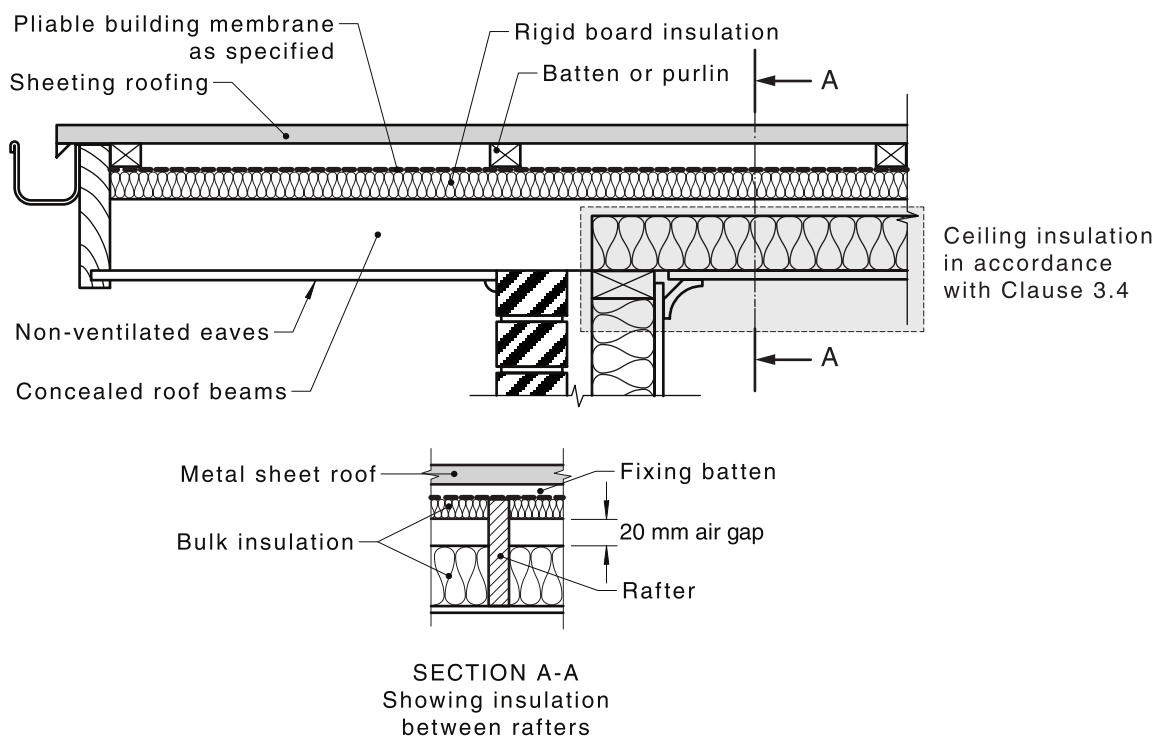


FIGURE 5.2.3.1.2 FLAT METAL ROOF WITH RIGID BOARD BULK INSULATION BETWEEN RAFTERS

- (c) Rigid board insulation shall be laid between the rafters, joists or the purlins. A vapour control sarking above the board and/or a vapour control membrane below the insulation shall be provided with permeability as specified in the design (see Clause 2.5). The installer shall check the design specification to ensure the bulk insulation is in the correct position in relation to the membrane.

5.2.3.2 Concrete roofs

Bulk insulation installed on or below concrete roofs shall comply with the following, as appropriate:

- (a) *Insulation on underside of roof (see Figure 5.2.3.2.1)* Bulk insulation shall be installed as follows:
- (i) The bulk insulation shall be either of the following:
 - (A) Held in contact with the underside of the roof slab by suitable fixing devices, e.g. adhesives or mechanical fasteners. The type and spacing of the fixing device shall follow the manufacturer's specifications and will depend on the insulation type and its dimensions.
 - (B) Installed in a continuous layer beneath the roof slab and be sealed around the perimeter and joints to prevent air flow between any air cavities formed above or below the insulation.
 - (ii) Blanket insulation shall be installed under the concrete roof with a vapour control membrane below complying with AS/NZS 4200. The insulation blanket shall be tensioned before fixing to ensure contact between the insulation and the concrete roof.

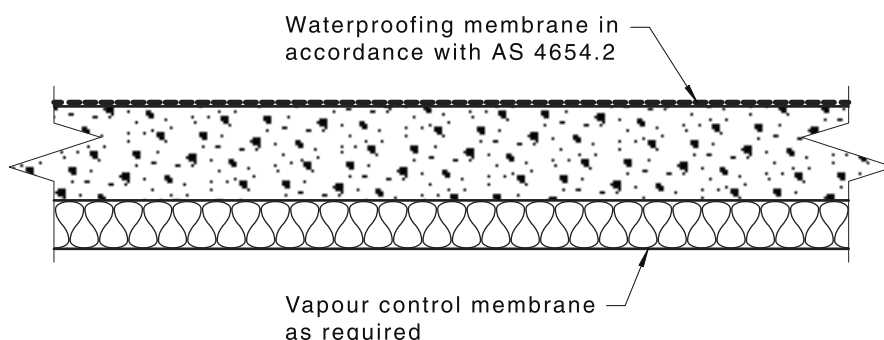


FIGURE 5.2.3.2.1 BULK INSULATION BELOW A CONCRETE ROOF

- (b) *Insulation above the roof and beneath a waterproofing membrane (see Figure 5.2.3.2.2)* Bulk insulation shall be installed as follows:

Rigid board insulation shall be installed on the roof without gaps and secured in accordance with the rigid board insulation manufacturer's specifications. The rigid board insulation shall then be covered with a waterproofing membrane installed in accordance with the membrane manufacturer's instructions.

NOTE: Precise details of fixing the rigid board insulation will depend on the type of membrane used and the exposure conditions expected.

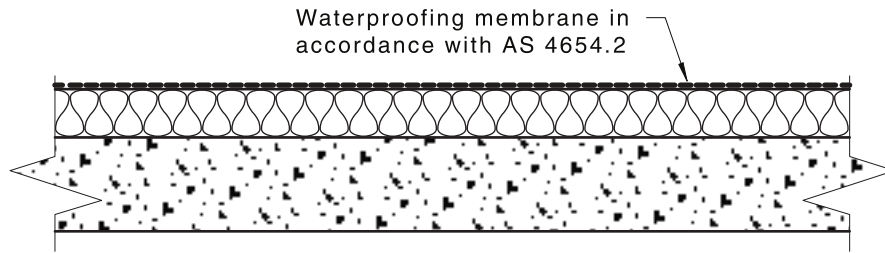


FIGURE 5.2.3.2.2 INSULATION ABOVE A CONCRETE ROOF AND BENEATH A WATERPROOFING MEMBRANE

- (c) *Insulation above the roof and above a waterproofing membrane (see Figure 5.2.3.2.3)* Bulk insulation shall be installed as follows:

The waterproofing membrane shall be laid on the upper surface of the roof slab in accordance with the membrane manufacturer's specifications. Rigid board insulation shall be installed on the membrane with edges butted tightly together but not adhered to the membrane (this is known as loose laying) and covered with a suitable ballast system to prevent wind blow-off in accordance with the rigid board manufacturer's specifications.

NOTES:

- 1 Suitable ballast systems for the method in Clause 5.2.3.2(c) include gravel, paving slabs or a concrete screed laid over the rigid board insulation.
- 2 The method of application described in Clause 5.2.3.2(c) is suitable only with insulation having a high resistance to water absorption and a high compressive strength, e.g. rigid boards. The advantage of this method is that the membrane is protected from mechanical damage, ultraviolet radiation attack and excessive thermal cycling which may cause structural damage.
- 3 Insulation fixed to the underside of a concrete roof will cause an increased condensation risk. Under some circumstances, a vapour barrier may be required beneath the insulation (see Clause 2.5).

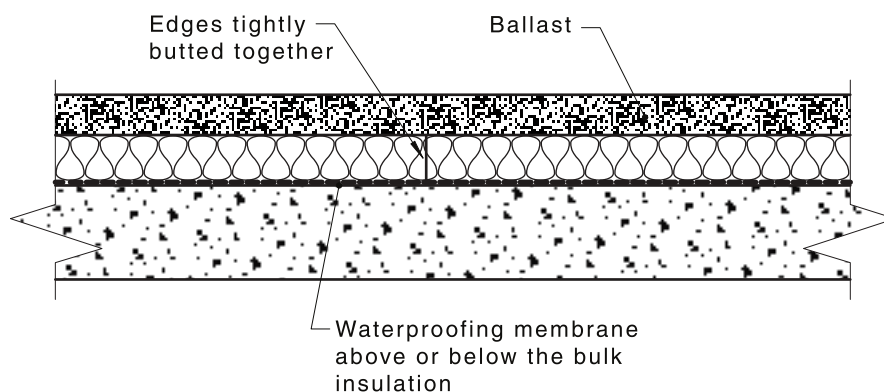


FIGURE 5.2.3.2.3 INSULATION ABOVE A CONCRETE ROOF AND ABOVE A WATERPROOFING MEMBRANE

5.2.4 Pitched roofs

5.2.4.1 Metal clad roofs with horizontal ceilings

Bulk insulation installed in pitched metal roofs shall comply with the following, as appropriate:

- Roof construction having either blanket insulation laid over the roof cladding supporting members (as in Figure 5.2.4.1.1), supported between the roof rafters hard up against the roof battens (as in Figure 5.2.4.1.2) or supported by a rigid board and between counter battens (as in Figure 5.2.4.1.3). In all cases the use of a membrane either above, below, or both above and below the insulation layer may be required.
- The required R-value may be achieved by installing part of the bulk insulation in the form of blanket insulation or otherwise to comply with Item (a) and with the addition of sufficient bulk insulation applied on the upper surface of the ceiling to achieve the required R-value in accordance with Clause 5.3.1.
- Blanket insulation shall be installed over the roof battens or purlins on a vapour control membrane complying with AS/NZS 4200. The vapour control membranes shall be overlapped at all joins as specified in AS/NZS 4200 and tensioned before fixing to ensure contact between the insulation and the metal roof sheet (see Figure 5.2.4.1.1).

NOTE: A sarking material may be required above the upper surface of the insulation.

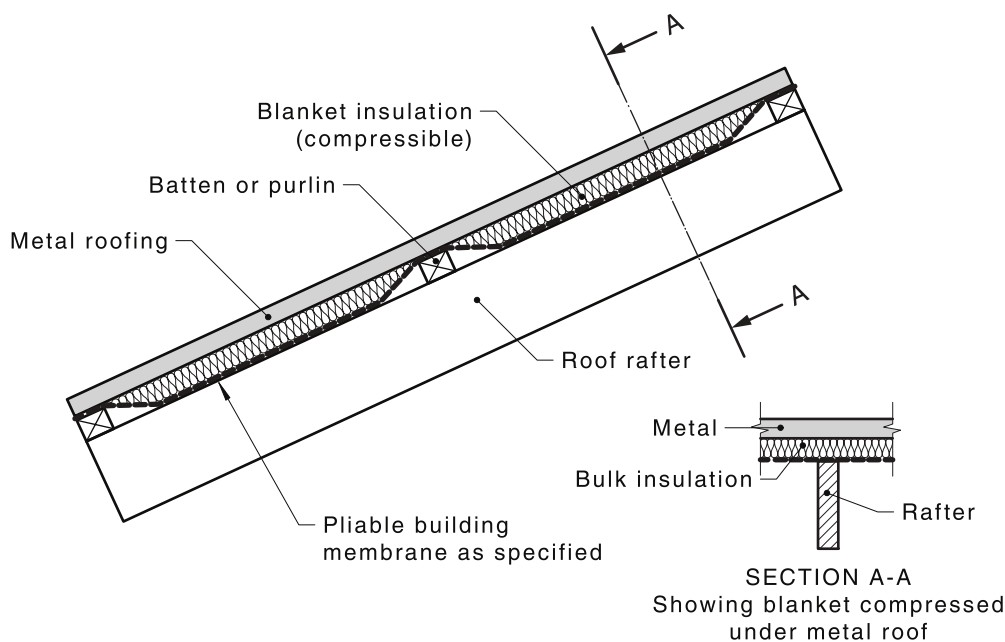


FIGURE 5.2.4.1.1 METAL SHEET ROOF WITH COMPRESSIBLE BLANKET BULK INSULATION

- Board bulk insulation shall be installed between the rafters.

NOTE: A sarking material may be required above the upper surface of the insulation (Figure 5.2.4.1.2).

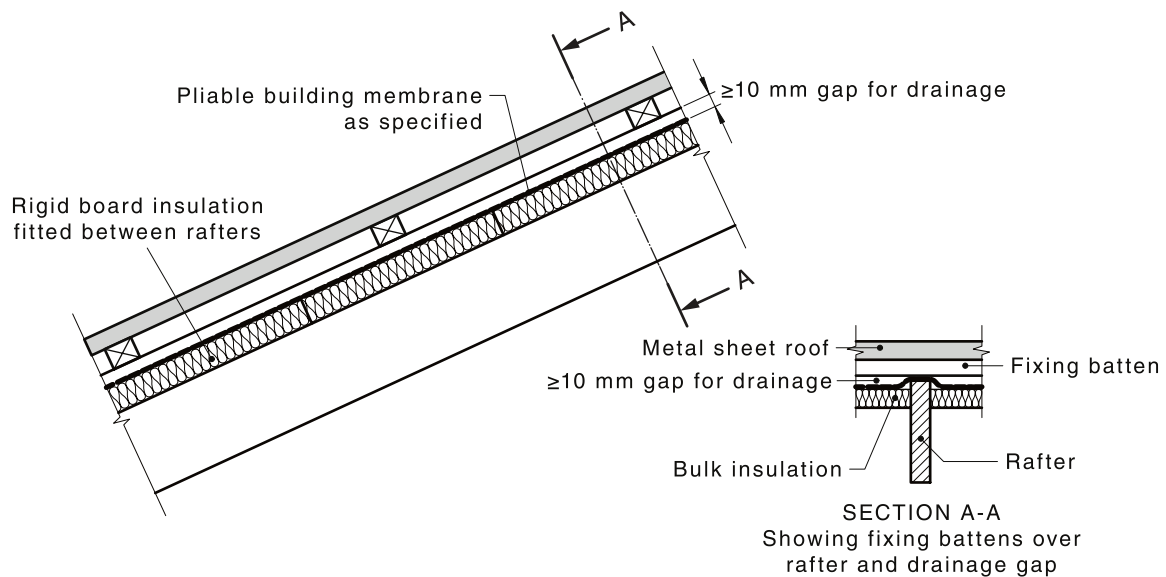


FIGURE 5.2.4.1.2 EXAMPLE OF METAL SHEET ROOF WITH RIGID BOARD INSULATION SHOWING POSSIBLE MEMBRANE LOCATIONS

- (e) When roof supporting members (rafters or joists) are below a bracing board, bulk insulation shall be installed between counter battens, maintaining a clearance of not less than 20 mm between the insulation and the metal or sheet roofing unless otherwise specified. Where this clearance is not maintained, a sarking material shall be installed above the upper surface of the insulation. A vapour control membrane above or beneath the bracing board shall be provided unless the board itself has a vapour control function and joints between boards and where the boards abut the rafters include a suitable seal to prevent air and vapour transmission between joints (see Figure 5.2.4.1.3).

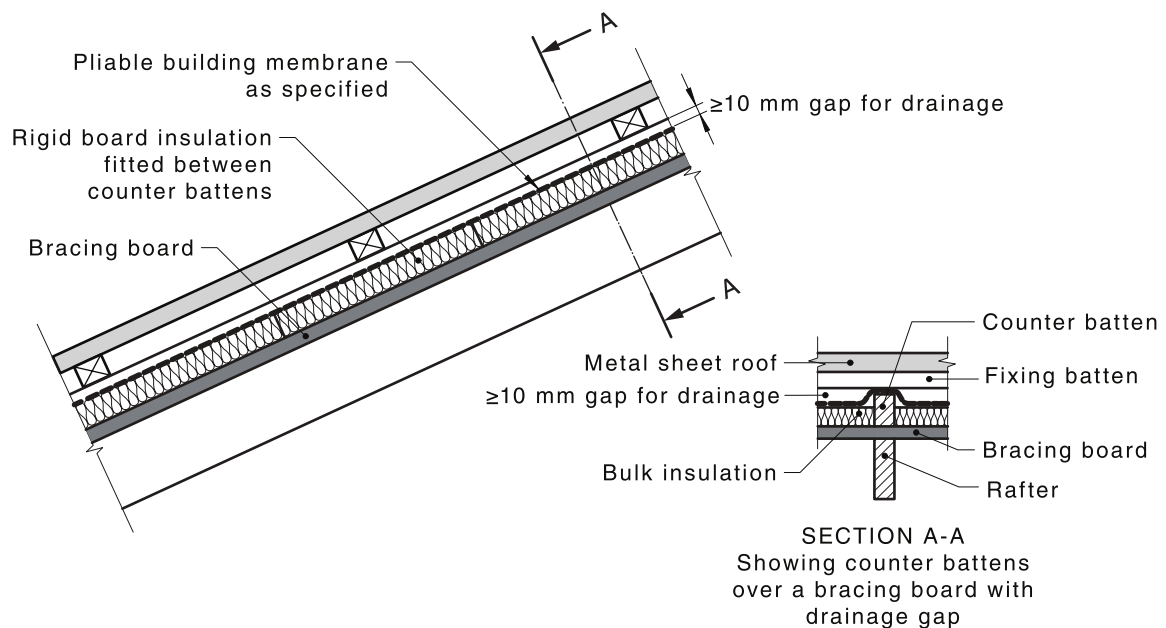


FIGURE 5.2.4.1.3 METAL SHEET ROOF WITH RIGID BOARD INSULATION ABOVE A BRACING BOARD