BUILDING PERFORMANCE

GUIDANCE

Retrofitting insulation to external walls

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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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Ministry of Business, Innovation and Employment (MBIE)
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Contents

1. Purpose

This guidance provides information on the Building Code Regulations 1992 (the Building Code) and Building Act 2004 (the Building Act) requirements that relate to retrofitting insulation in external walls of buildings.

The guidance highlights the main considerations when assessing work for compliance. It lists the relevant Building Code performance criteria for common types of insulation retrofits.

What the law says:

- Schedule 1 of the Building Code
- Building Act 2004

Decisions on retrofitting insulation in external walls can be complex. Insulation is usually retrofitted into older houses that have stood the test of time but are now too cold and draughty for modern lifestyles. Older houses often have simpler designs and are built of naturally durable native timbers.

The increase in more complex designs and use of untreated pine during the 1990s increased the risk of moisture problems. Insulation retrofits deliver tangible benefits, but there can be unintended problems if the insulation or its installation is unsuitable.

This guidance does not provide solutions or recommend installation methods for particular types of insulation or building construction. Insulation specialists should be consulted if you have doubts about how best to retrofit insulation.

Features of this guidance document

Hyperlinks are provided to cross-reference within this document and to external websites. These hyperlinks appear with an underline.

Words in italics are defined terms and the definitions can be found in the Glossary of this document.

2. Who is this guidance for?

The guidance is intended for territorial authorities (TAs) and building consent authorities (BCAs) assessing building consent applications and applications for discretionary exemptions for retrofitting wall insulation.

TAs may use this guidance to assist them in decisions as to whether to exempt retrofitting of wall insulation from a building consent, which can be done under exemption 2 of Schedule 1 of the Building Act – Territorial and regional authority discretionary exemptions. Designers and installers may also find the document a useful guide to the relevant Building Code requirements for retrofitting wall insulation.

What the law says:

Clause 2 of Schedule 1 of the Building Act – Territorial and regional authority discretionary exemptions:

Any building work in respect of which the territorial authority or regional authority considers that a building consent is not necessary for the purposes of this Act because the authority considers that—

(a) the completed building work is likely to comply with the building code; or

(b) if the completed building work does not comply with the building code, it is unlikely to endanger people or any building, whether on the same land or on other property.

3. Check if a building consent is required

Retrofitting insulation into an external wall cavity is **not exempt** building work under Schedule 1 of the Building Act. It either requires a building consent or a specific exemption from a TA that a building consent is not required. Refer to exemption 2 of Schedule 1 of the Building Act.

Building consent applications for retrofitting wall insulation will need to cover all the associated building work, show that the building work will comply with the Building Code and that it will not adversely affect the performance of the existing building.

Note that exemption 13 of Schedule 1 of the Building Act exempts underfloor and roof insulation retrofits from requiring building consent. Home or building owners can still seek a building consent for this work should they choose to.

What the law says:

Schedule 1 Building work for which building consent not required

Why retrofitting external wall insulation is not in Schedule 1

Retrofitting insulation to walls involves more work than simply placing or injecting insulation in walls. All the associated work must be assessed to see if it complies with the Building Code, whether it is as small as drilling and repairing holes in interior linings or as significant as removing and reinstating exterior claddings. Even if the building work is relatively simple, the effects on the existing building may be complex and potentially problematic.

Retrofitted wall insulation may affect moisture transfer inside timber framed walls and change drying rates, which in turn may cause moisture to accumulate in the wall and affect the durability of timber framing and cladding. Poorly installed insulation may also affect the fire and electrical safety of buildings. Buildings must be assessed on a case-by-case basis to determine if they are suitable for retrofitting wall insulation and if the proposed methods and materials are appropriate.

4. Compliance with the law

Complying with the Building Act

Retrofitting insulation into the external walls of an existing building is 'building work' and is required by Section 17 of the Building Act to comply with the Building Code.

It is an alteration to an existing building and must also comply with either section 42A(2)(b) or section 112(1)(b) of the Building Act (depending on whether the work is carried out under a building consent or under a specific exemption from a TA (see previous section). Under these sections, alterations work must not reduce the extent to which the existing building meets the Building Code performance criteria.

Additionally, when carried out under a building consent, section 112(1)(a) of the Building Act requires the entire building's means of escape from fire to be upgraded to comply, as nearly as is reasonably practicable, with the Building Code. For certain buildings, accessibility needs to be similarly upgraded.

It is important to distinguish between the need -

- for new building work such as retrofitting insulation to comply with the Building Code (as required by section 17 of the Building Act), and
- for the existing building, after completion of the alteration, to not have had any aspect of its Building Code compliance reduced as a result of the building work (required by section 42A(2)(b) and section 112(1)(b) of the Building Act), and
- for the existing building, after completion of the alteration, to comply as nearly as is reasonably practicable with the means of escape requirements of the Building Code, and with the accessibility requirements where these are applicable, if the work is carried out under a building consent (as required by section 112(1)(a) of the Building Act).

These three requirements relate to different parts of the building (new part/s versus existing parts). The extent of Building Code compliance needed is different for each requirement, and the Building Code performance criteria relevant to each requirement can be different.

What the law says:

Section 17 of the Building Act specifies that all building work must comply with the building code to the extent required by this Act, whether or not a building consent is required in respect of that building work.

For building consent applications:

- Section 14F of the Building Act specifies the responsibilities of building consent authorities with regards to building consent applications.
- Section 49 of the Building Act details the conditions in which a building consent authority must grant a consent and the requirements before the building consent may be granted.
- Section 112 of the Building Act describes the conditions which building consent authorities must be satisfied relating to alterations to existing buildings.

For discretionary exemptions (territorial authority):

Section 42A of the Building Act specifies conditions for building work for which building consent is not required under Schedule 1.

Definitions of 'Building work' can be found in the Building Act:

- Section 7
- Section 8 and
- Section 9

Section 67 of the Building Act provides information about territorial authorities being able to grant an application for a building consent subject to a waiver or modification of the building code.

Complying with the Building Code

When buildings, or parts of buildings, are constructed or altered, the new building work must meet the Building Code performance criteria. This includes when:

- retrofitted insulation material is installed in wall cavities, and
- there is associated building work, such as repairing cracks in claddings, fixing holes that have been drilled and reinstating linings or claddings.

When an existing building is altered, the overall building (including the wall assembly being retrofitted) must continue to comply with relevant Building Code performance criteria to (at least) the same extent as before. These performance criteria may or may not be the same as those relating to the new building work of the alteration (insulation retrofitting) work. Additionally, the overall building must also be upgraded to comply as nearly as reasonably as practicable, with the Building Code performance criteria for means of escape from fire, and, where relevant to the building use, for accessibility.

The Building Code performance criteria relevant to the new retrofitting work, and the performance criteria relevant to the existing building, are analysed in sections 6 and 7.

What the law says:

Section 112(1)(b) of the Building Act sets out the considerations for BCAs that are assessing building consent applications for alterations to existing buildings:

The building will,—

(i) If it complied with the other provisions of the building code immediately before the building work began, continue to comply with those provisions; or

(ii) If it did not comply with the other provisions of the building code immediately before the building work began, continue to comply at least to the same extend as it did then comply.

How to show the work complies with the Building Code

There are no Acceptable Solutions or Verification Methods specifically for retrofitting insulation into wall cavities. However, Acceptable Solutions for new builds may provide useful benchmarks when deciding if relevant performance criteria are met. See Acceptable Solutions and Verification Methods.

Further reading

- The Building Research Association of New Zealand (BRANZ) have published a house insulation guide: House Insulation Guide – BRANZ
- **New Zealand Standard NZS 4246** ***Energy efficiency – Installing bulk thermal insulation in residential buildings*** provides useful information regarding good practice for the installation of insulation. NZS 4246:2016 – Standards New Zealand
- **Australian/New Zealand Standard AS/NZS 3000** ***Electrical installations*** (known as the Australian/New Zealand Wiring Rules) includes specific information on insulation requirements around recessed luminaires. AS/NZS 3000:2018 (incorporating Amendments No 1, 2, 3) – Standards New Zealand

Decisions on the Building Code compliance of retrofitting wall insulation and the effects of the retrofit on the existing building can be complex.

Section 6 New building work – Building Code performance requirements for retrofitting insulation of this document highlights relevant factors to consider when deciding whether insulation retrofit work complies with the Building Code. Section 7 Existing building compliance level after retrofitting insulation highlights relevant factors to consider when assessing the extent of compliance of an existing building after an alteration.

Several different approaches may be used to support claims that building work, or an altered building, complies with the Building Code (whether in full, to the same extent as before, or as nearly as is reasonably practicable). These include relevant Determinations, compliance with Standards, test results, expert opinion, appraisals or in-service history.

5. Risks with retrofitting wall insulation

A number of risks can arise when retrofitting wall insulation. The most significant of these are discussed below.

Section 7 Existing building compliance level after retrofitting insulation also discusses how to ensure risks relevant to building code compliance are not increased after retrofitting insulation, and some others that may be applicable.

Fire and electrical safety with retrofitted insulation

Fire safety can be affected if insulation is installed over or around appliances that dissipate heat.

For example, fires have occurred in buildings where ceiling insulation has been installed over downlights. In these situations, heat built up within the insulation, downlight, and adjacent parts of a ceiling until it reaches combustion temperatures. Similar problems could occur in an insulated wall that has a flue penetration.

NZS 4246 provides recommended safety clearances between thermal insulation and such heat sources for common residential construction. Further requirements for luminaires can be found in AS/NZS 3000.

Retrofitting insulation to fire separation walls (such as external walls of houses that are close to boundaries) should be considered on a case-by-case basis. Many such walls will already contain insulation as part of the fire rated system. The use of highly flammable insulation could also affect the performance of the fire separation.

Electrical safety can be compromised if existing electrical wires are covered by thermal insulation. Electrical cables and fittings could be damaged or short-circuited if disturbed when retrofitting insulation. Old electrical circuits are most at risk, as the electrical insulation covering the wires can be fragile and prone to fail. Additionally, foamed polystyrene insulation can damage the PVC insulation on most modern wiring, creating a new electrical safety risk.

VIR (vulcanised India rubber) and TRS (tough rubber sheathed) cables were used in Aotearoa New Zealand up until the late 1950s when they were replaced by more durable TPS (toughened plastic sheathed) cables. If these products are found when retrofitting insulation, you may wish to consult with an electrician to see if they should be replaced.

Another safety consideration is that both the current carrying capacity of electrical wiring, and the heat dissipation from the wires, will be reduced when these are covered by thermal insulation.

Miniature circuit breakers (MCBs) can help to mitigate the harmful effects of covering electrical wires with thermal insulation, by cutting power off when a circuit is overloaded and the wiring could overheat. Electrical outlets could also be rewired with thicker wiring or with additional subcircuits to reduce the subcircuit load. Older electrical installations tend to have hard wired fuses, which provide less overload protection than MCBs.

Residual current device (RCD) protection can also be added to subcircuits at the distribution board, to mitigate against any short-circuits.

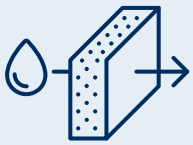
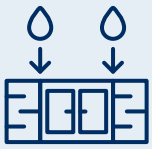
An electrician can advise on suitable measures to improve electrical safety during insulation retrofits.

Moisture transfer and retrofitted insulation

The biggest potential problem for retrofitted insulation is that the insulation material will create a pathway for external moisture to migrate to where it could damage moisture-sensitive materials in the wall.

This occurs when the insulation material creates a pathway for moisture present on the back (inside) face of the cladding to penetrate further into the wall cavity. That moisture could then come into contact with the wall framing and interior lining and could also be held within or adjacent to the insulation for a prolonged period. Any increase in moisture can cause or increase fungal growth in a wall. Moisture could also cause or exacerbate any electrical hazards where there are electrical fittings in the wall.

Sources of moisture within a wall cavity may include:

			
External water passing through a porous or absorbent cladding (for example rain on brick veneer)	External moisture entering at joints in the cladding or around openings (such as at laps in weatherboards or at a defective or ineffective window flashing)	Moisture generated within the building (for example clothes drying or cooking)	Moisture rising from a damp and inadequately ventilated subfloor space

Moisture transfer into and out of walls occurs in a variety of ways through the movement of liquid water, through the movement of air which carries water droplets and water vapour, and through the diffusion of vapour through building materials.

The amount of water that transfers through a wall via these different mechanisms will vary with different types of construction, different climatic conditions, and different ways that a building is used.

Moisture transfer through walls can be beneficial as well as problematic. Problems arise when drying and ventilation is inadequate to remove moisture and it accumulates inside walls, providing suitable conditions for fungal growth. The presence of insulation tends to inhibit ventilation and drying in comparison with an uninsulated wall.

Further reading

BRANZ have published several useful articles on water-management of different methods of retrofitting wall insulation, see:

- Warmer drier healthier #1: Retrofitting insulation in weatherboard walls with linings on: Effective water management (2020)
- Warmer drier healthier #7: Assessing retrofitted external wall insulation techniques (2023)

Potential problems with fungal growth inside walls include:

- production of mycotoxins, which are harmful to human health, and
- timber decay, which reduces the strength of framing and other wall components.

Older houses often do not have the cladding drainage cavities and timber treatments that are common in new houses, making them more vulnerable to moisture entry, fungal growth, and the problems that arise from this. On the other hand, older houses may have mitigating factors such as:

- native heartwood timber that is more resistant to fungal growth/decay than radiata pine
- designs that are less prone to moisture ingress (eg simple forms, wide eaves, single cladding type), or
- high ventilation rates from relatively high air-leakage, both within wall cavities and within the interior of the house.

Specific consideration should be given on a case-by-case basis to:

- the amount and source(s) of moisture that may be transferred into a wall (eg the existing weathertightness, air and water permeability of interior linings in wet areas, and subfloor conditions), and whether any defects will be rectified
- how the proposed method of retrofitting wall insulation manages the risks of moisture transfer and accumulation (see BRANZ articles linked in the box above)
- the extent to which ventilation of the framing cavities in a wall, and drainage cavity if included, would be affected by the installation of insulation, and
- the resistance of wall materials to fungal growth (eg timber treatments).

Asbestos

Older buildings may have asbestos-containing materials present. These will need to be identified and managed as part of the retrofit planning.

Further reading

WorkSafe has published guidance on the management and removal of asbestos:

- Management and removal of asbestos

6. New building work – Building Code performance requirements for retrofitting insulation

The Building Act 2004 requires all new building work to comply with the Building Code. The Building Code performance criteria listed below are the most relevant provisions of the Code to consider when assessing retrofitted wall insulation and whether it complies with the Code.

Protection from fire

What the Building Code says:

C2.2 The maximum surface temperature of *combustible building materials* close to fixed appliances using controlled combustion and other fixed equipment when operating at their design level must not exceed 90°C.

Most types of insulation must be protected from being heated to over 90°C by nearby appliances. This can be achieved by having sufficient distance between the appliance and the insulation, or by protecting the insulation with fire retardant material such as fire rated plasterboard.

Although there is no Acceptable Solution covering fire hazards associated with insulation, Part 7 of either C/AS1 or C/AS2 may help in determining compliance for the placement of fixed appliances near combustible building materials.

Energy efficiency and Internal moisture

What the Building Code says:

E3.3.1 An *adequate* combination of *thermal resistance*, ventilation, and space temperature must be provided to all *habitable spaces*, bathrooms, laundries, and other spaces where moisture may be generated or may accumulate.

H1.3.1 The *building* envelope enclosing spaces where the temperature or humidity (or both) are modified must be constructed to—

(a) provide *adequate thermal resistance*; and

(b) limit uncontrollable airflow.

Clause H1.3.1(a) of the Building Code has a requirement for the building envelope of many buildings to provide adequate thermal resistance. However, that clause applies to the overall performance of the building envelope: for a timber framed wall, thermal resistance is determined by how the interior linings, framing, installation, underlay, cladding cavity (if any) and cladding all interact. The compliance of wall insulation alone, whatever its thermal resistance (R-value), cannot be evaluated against the requirements of clause H1.3.1.

Similarly, although clause E3.3.1 has a requirement for the provision of an adequate combination of thermal resistance, ventilation and space temperature, the compliance of wall insulation alone cannot be evaluated against clause E3.3.1.

This means that there is no minimum R-value required by the Building Code for the retrofitted insulation.

However, the retrofitting of insulation must not reduce the extent that the building envelope complies with clauses H1.3.1(a) and E3.3.1. This is discussed in Section 7. It is easily met, as retrofitting insulation generally improves the R-value of a previously uninsulated wall.

While the thermal performance is not relevant to issuing a building consent, it is likely to be fundamental to any contract between a homeowner and the supplier/installer. The thermal performance of retrofitted insulation can vary considerably, depending on the type of insulation, the quality of installation and the in-service conditions.

What the law says:

The relevant legal mechanisms that ensure retrofitted insulation delivers good thermal performance are:

- the contract
- the implied warranties that are specified in section 362H of the Building Act, and the Fair Trading Act 1986.

Structure

What the Building Code says:

B1.3.1 *Buildings, building elements* and *sitework* shall have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during construction or alteration and throughout their lives.

Removing and reinstating structural wall linings when retrofitting wall insulation, or drilling holes through studs, would require compliance with Building Code clause B1.3.1. However, the insulation work itself is not part of the structural system of a building, and therefore does not need to (and in fact cannot) be evaluated for compliance with B1.3.1.

What the Building Code says:

B2.3.1 *Building elements* must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the *specified intended life* of the *building*, if stated, or:

(a) the life of the building, being not less than 50 years, if:

. . .

(iii) failure of those *building elements* to comply with the *building code* would go undetected during both normal use and maintenance of the *building*.

Durability

The durability requirement in the Building Code applies only to the extent that other Building Code performance requirements apply.

The Building Code requires 50-year durability for building elements that are difficult to access or replace, or where failure of the building element to comply would go undetected.

In most situations, insulation retrofitted into a wall cavity can be expected to remain substantially protected from common causes of degradation such as dampness, vermin, and ultraviolet light, when appropriately designed and installed. In such conditions, common types of insulation are likely to meet the 50-year durability performance criteria B2.3.1(a). Unusual types of insulation or very harsh environments may cause insulation to degrade over time, reducing its effectiveness (thermal resistance) and perhaps producing hazardous materials or creating new risks. Such possibilities can only be assessed on a case-by-case basis.

External moisture

Insulation retrofitted into a wall cavity will not form part of a wall's weathertightness protection, and so cannot be evaluated for compliance with most parts of Building Code clause E2 External moisture.

However, clause E2.3.6 deals with construction moisture, and is relevant to some types of insulation retrofitting work.

What the Building Code says:

E2.3.6 Excess moisture present at the completion of *construction* must be capable of being dissipated without permanent damage to *building elements*.

Most types of insulation are designed to be installed dry and therefore have acceptable moisture levels when installed.

However, some less common types of insulation may be designed to be installed wet. Compliance of insulation that is installed wet with Building Code E2.3.6 will be difficult to assess given the variability in drying rates that occur, and the variability in susceptibility to moisture of nearby materials. Compliance would need to be assessed on a case-by-case basis that could involve an extended series of moisture measurements. There is no Acceptable Solution for the dissipation of construction moisture from retrofitted insulation.

Factors that will affect the drying potential of insulation in a cavity wall include:

- the vapour permeability of the wall linings and claddings (including any building wraps, paints and surface coatings)
- the rain and wind environment (ie the wetting potential)
- the ground conditions and foundation connections to a wall
- the condition of the existing cladding (eg cracks and gaps)
- the ventilation rate within the wall cavity
- temperature of the external and internal wall surfaces.

Hazardous materials

Provided insulation is sourced from a reputable manufacturer, then handled and installed in accordance with manufacturers' instructions, it is likely that it will comply with Building Code clause F2.3.1.

What the Building Code says:

F2.3.1 The quantities of gas, liquid, radiation or solid particles emitted by materials used in the *construction* of *buildings*, shall not give rise to harmful concentrations at the surface of the material where the material is exposed, or in the atmosphere of any space.

There is no Acceptable Solution covering material hazards for wall insulation. However, off-gassing and small airborne particles are the primary material hazards to consider.

A number of different chemicals can be used to manufacture various types of insulation materials or used in the binders that hold them together.

While some such chemicals can be hazardous in high concentrations, generally the concentrations that are associated with thermal insulation are not high enough to be considered problematic to building users. Formaldehyde is such an example, and while relatively common in many different building products it is generally not found in sufficiently high concentrations in insulation to be considered hazardous.

7. Existing building compliance level after retrofitting insulation

Retrofitted insulation may affect the way existing parts of a building perform, particularly parts of a building that are adjacent to the insulation such as wall frames, claddings and linings. The performance of an existing building should not be reduced in relation to the following provisions of the Building Code.

Means of escape from fire and accessibility

When a building is being retrofitted with insulation in exterior walls, section 112 (1)(a) of the Building Act requires that the entire building's means of escape from fire be upgraded to comply as nearly as reasonably practicable with the Building Code. For certain buildings, accessibility needs to be similarly upgraded. These upgrade requirements do not apply if a TA has issued a specific exemption from obtaining a building consent.

A BCA must not grant a building consent for the alteration of an existing building (including retrofitting insulation to external walls), unless the BCA is satisfied that after the alteration the building will comply, as nearly as it is reasonably practicable, with the provisions of the Building Code that relate to means of escape from fire and, where applicable, accessibility.

What the law says:

Refer to Section 112 (1) of the Building Act – Alterations to existing buildings

Upgrading the means of escape in standalone housing is likely to require, at a minimum, ensuring it has a suitably located and working smoke alarm system. In larger buildings, upgrading could involve assessing and potentially modifying features such as alarm systems, internal fire separations, fire doors and escape routes. In buildings used by the public, upgrading of accessibility could involve assessing and potentially installing or modifying features such as accessible parking, entrance and access routes, and sanitary facilities.

Protection from fire – Fire affecting areas beyond the fire source

What the Building Code says:

C3.4 (a) Materials used as internal surface linings in the following areas of *buildings* must meet the performance criteria specified in the table below. This clause does not apply to *detached dwellings*, within *household units* in multi-unit dwellings, *outbuildings* and *ancillary buildings*.

Area of *building*	**Performance determined under conditions described in ISO 9705: 1993**	
	***Buildings* not protected with an automatic *fire* sprinkler system**	***Buildings* protected with an automatic *fire* sprinkler system**
Wall/ceiling materials in sleeping areas where care or detention is provided	Material Group Number 1-S	Material Group Number 1 or 2
Wall/ceiling materials in exitways	Material Group Number 1-S	Material Group Number 1 or 2
Wall/ceiling materials in all *occupied spaces* in importance level 4 *buildings*	Material Group Number 1-S	Material Group Number 1 or 2
Internal surfaces of ducts for *HVAC systems*	Material Group Number 1-S	Material Group Number 1 or 2
Ceiling materials in crowd and sleeping uses except *household units* and where care or detention is provided	Material Group Number 1-S or 2-S	Material Group Number 1 or 2
Wall materials in crowd and sleeping uses except ho*usehold units* and where care or detention is provided	Material Group Number 1-S or 2-S	Material Group Number 1, 2, or 3
Wall/ceiling materials in occupied spaces in all other locations in *buildings*, including *household units*	Material Group Number 1, 2, or 3	Material Group Number 1, 2, or 3
External surfaces of ducts for *HVAC systems*	Material Group Number 1, 2, or 3	Material Group Number 1, 2, or 3
Acoustic treatment and pipe insulation within airhandling plenums in sleeping uses	Material Group Number 1, 2, or 3	Material Group Number 1, 2, or 3

A Group Number is a classification for a finishing material by its behaviour in fire. Within household units, outbuildings and ancillary buildings, there are no requirements for the behaviour in fire of retrofitted insulation exposed to the building's interior. For interior spaces of other buildings, and in any common spaces of attached housing (eg shared corridors of apartment buildings), insulation materials would commonly be covered with lining that meets C3.4(a) requirements. If left exposed, the insulation material itself should have the appropriate Material Group Number.

What the Building Code says:

C3.5 *Buildings* must be designed and constructed so that *fire* does not spread more than 3.5m vertically from the *fire source* over the external cladding of multi-level *buildings*.

Retrofitted insulation material may be part of the external wall cladding materials and could contribute to vertical fire spread. Refer to C/AS1 Part 5.3 or C/AS2 Part 5.8.

What the Building Code says:

C3.7 External walls of *buildings* that are located closer than 1m to the *relevant boundary* of the property on which the *building* stands must either:

(a) be constructed from materials which are not *combustible building materials*, or

(b) for *buildings* in importance levels 3 and 4, be constructed from materials that, when subjected to a radiant flux of 30 kW/m^2, do not ignite for 30 minutes, or

(c) for *buildings* in Importance Levels 1 and 2, be constructed from materials that, when subjected to a radiant flux of 30 kW/m^2, do not ignite for 15 minutes.

Retrofitted insulation material in external walls may contribute to the fire risk from the wall if the distance to the property boundary is closer than 1m. Refer to C/AS1 or C/AS2 Part 5.

Other Building Code performance criteria

Other Building Code performance criteria also need to be considered, to ensure they are not compromised by the building work associated with retrofitting insulation.

If you are altering an existing building by installing new insulation into external walls, sections 42A (2)(b) and 112 (1)(b) of the Building Act require you to ensure the building will comply with the other requirements[1] of the Building Code at least to the same extent as it did immediately before the building work began.

What the law says:

Section 112 (1) of the Building Act – Alterations to existing buildings

Retrofitted insulation may affect the way existing parts of a building perform, particularly those parts that are adjacent to the insulation such as wall frames, cladding and linings. The Building Code provisions described in the remainder of this section can be used to help assess whether an existing building's performance is affected by retrofitting insulation.

1. 'Other' meaning Building Code requirements other than those relating to means of escape from fire and access and facilities for persons with disabilities.

Structure

Retrofitted insulation could affect the structural performance (ie B1.3.1) of an existing building if moisture were to accumulate in a wall cavity and cause timber framing to decay and lose support. This could occur if the weathertight performance of an existing building is compromised, as discussed below in relation to the effect retrofitted insulation has on compliance with the Building Code performances E2.3.2 and E2.3.5 for External Moisture.

The performance of structural claddings or linings may be affected if they are altered as part of retrofitting insulation. Any holes, patching or reinstatement of structural claddings or linings will need to be done in a way that both complies with the Building Code (see Section 6) and that doesn't reduce the overall structural performance of the building.

What the Building Code says:

B1.3.1 *Buildings, building elements* and *sitework* shall have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during *construction* or *alteration* and throughout their lives.

Durability

The durability requirements in the Building Code only apply to the extent that other Building Code performance requirements apply. Effects that retrofitted insulation could have on the building's durability are considered in the discussion of the other Building Code performance requirements in this section.

What the Building Code says:

B2.3.1 *Building elements* must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the *specified intended life* of the *building*, if stated, or:

(a) the life of the building, being not less than 50 years, if:
   (i) those *building elements* (including floors, walls, and fixings) provide structural stability to the *building*, or
   (ii) those *building elements* are difficult to access or replace, or
   (iii) failure of those *building elements* to comply with the *building code* would go undetected during both normal use and maintenance of the *building*.

(b) 15 years if:
   (i) those *building elements* (including the *building* envelope, exposed plumbing in the subfloor space, and inbuilt chimneys and flues) are moderately difficult to access or replace, or
   (ii) failure of those *building elements* to comply with the *building code* would go undetected during normal use of the *building*, but would be easily detected during normal maintenance.

(c) 5 years if:
   (i) the *building elements* (including services, linings, renewable protective coatings, and *fixtures*) are easy to access and replace, and
   (ii) failure of those *building elements* to comply with the *building code* would be easily detected during normal use of the *building*.

Protection from fire – Prevention of fire occurring

What the Building Code says:

C2.3 The Fixed appliances using controlled combustion and other fixed equipment must be designed, constructed and installed so that there is a low probability of explosive or hazardous conditions occurring within any spaces in or around the *building* that contains the appliances.

Retrofitted insulation can affect compliance of an existing building in relation to outbreak of fire if the insulation covers or is too close to appliances that generate heat, such as recessed luminaires or a flue penetrating through the wall. Sufficient clearance must be provided between thermal insulation and a heat source to prevent an undue build-up of heat.

NZS 4246 provides recommended safety clearances between thermal insulation and such heat sources for common residential construction. Further requirements for luminaires can be found in AS/NZS 3000.

Moisture penetration

What the Building Code says:

E2.3.2 The Roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to *building elements*, or both.

The penetration of water through wall claddings is unlikely to be affected by insulation unless the cladding is damaged and compromised by poor installation.

The effect that retrofitted insulation has on compliance of an existing wall with E2.3.2 will depend largely on the construction and condition of the existing wall and the physical properties of the insulation.

Walls with porous claddings, with multiple regular laps or joints in the cladding, with poorly maintained claddings, with pre-existing leaks or moisture problems, and with high exposure to wind and rain, are more likely to have water penetrate through the cladding.

Insulation has potential to reduce the penetration of wind driven water through claddings by increasing the air tightness of the wall and reducing the pressure differences that are generated across the cladding. However, any increase in air tightness may adversely affect the drying rate within the wall cavity, as discussed below in relation to E2.3.5.

Insulation materials that are porous or hydrophilic will tend to hold and transfer moisture through the insulation. In these situations, retrofitted insulation may cause or exacerbate the transfer of moisture from the back of the cladding to other building elements, thereby reducing compliance with E2.3.2.

The biggest potential problem for retrofitted insulation in relation to E2.3.2 is that the insulation material will create a pathway for external moisture on the inside of the cladding to migrate further into the wall cavity, to the framing and the lining. This bridging effect may be mitigated where the insulation is separated from the cladding or from the framing and lining.

- Small, well-defined, gaps between the insulation and the framing, cladding and/or lining will act as a physical barrier to moisture transfer, like the drainage cavity that is designed into new timber framed walls. However, such gaps can be difficult to reliably construct, and generally lower the thermal effectiveness of the insulation. They should be avoided when insulation is retrofitted unless they are specifically designed. As a result, any mitigation from small gaps in the insulation should not be relied upon when assessing the building's performance for a building consent, unless specifically designed.
- A wall underlay (eg building paper) which forms a continuous layer between the cladding and framing will help to mitigate the effects of any moisture bridging by retrofitted insulation, as it physically separates the cladding from the insulation and will reduce the amount of moisture reaching the insulation.

Walls with well-maintained non-porous claddings with minimal laps and joints, with no leaks or moisture problems, which have low exposure to wind and rain, and which include an intact wall underlay behind the cladding, are unlikely to have water penetrate to the framing cavity. In this situation retrofitting the insulation will not reduce compliance with E2.3.2.

Moisture accumulation

There are many factors that contribute to condensation, fungal growth, and the degradation of building elements. This complexity means it is difficult to provide simple rules for assessing compliance with E2.3.5 and E3.3.1. Installers, designers and BCAs need to consider the merits of each installation when assessing the effects of retrofitted insulation on the compliance of existing walls with E2.3.5 and E3.3.1.

What the Building Code says:

E2.3.5 *Concealed spaces* and cavities in *buildings* must be constructed in a way that prevents external moisture being accumulated or transferred and causing condensation, fungal growth, or the degradation of *building elements*.

E3.3.1 An *adequate* combination of *thermal resistance*, ventilation, and space temperature must be provided to all *habitable spaces*, bathrooms, laundries, and other spaces where moisture may be generated or may accumulate.

Retrofitted insulation has potential to cause or exacerbate the accumulation of water in wall cavities, causing condensation, fungal growth or degradation of building elements.

Insulation will reduce the air movement in the wall cavities where it is installed, and in doing so will reduce the rate at which they dry out. However, the drying rate depends on several factors, including climate, wall design and the vapour permeability of the claddings, linings and insulation, as well as the air permeability. The net effect on drying rate will depend to a large degree on the design and condition of the existing wall/building, the climate and the physical properties of the insulation.

The resistance of the materials used to construct the wall to fungal growth and degradation, can also impact on compliance with E2.3.5 and E3.3.1.

On the other hand, retrofitted insulation is likely to lessen the risk of surface condensation within habitable spaces, bathrooms, laundries and spaces where moisture is generated. Insulation will reduce heat loss through the wall, and in cold weather will help its interior surface temperature remain higher than that of an uninsulated wall.

Factors that will tend to avoid or lessen any reduction in compliance of an existing wall with E2.3.5 or E3.3.1 when insulation is retrofitted include:

- non-porous claddings with minimal laps and joints, that are well maintained
- no leaks or moisture problems,
- low exposure to wind and rain (eg wide eaves and low wind)
- continuous wall underlay behind the cladding
- treated timber framing, or galvanised or aluminium-zinc coated steel
- vapour permeable wall linings, insulation, underlay, and cladding
- dry climate
- good exposure of the wall to sun and some wind to improve drying
- the installation of drainage plane mesh as part of the wall insulation retrofit in walls without building paper.

Further reading

See Warmer drier healthier #7: Assessing retrofitted external wall insulation techniques (2023) by BRANZ.

Factors that will tend to cause or exacerbate a reduction in compliance of an existing wall with E2.3.5 and E3.3.1 when insulation is retrofitted include:

- porous claddings
- claddings with multiple regular laps and joints
- claddings with leaks or moisture problems
- poor maintenance of claddings
- lack of wall underlay, or wall underlay that is no longer intact
- high rain exposure
- high wind exposure
- untreated timber framing and cladding, including native sapwood
- low vapour permeability of wall linings, insulation or cladding, or the presence of a vapour barrier in the wall
- high humidity climate
- poor exposure to sun and some wind.

Noise performance

Insulation will have no effect on the compliance of an existing building in relation to noise (ie G6.3.1), because the Building Code only controls sound transmission through walls when they are common between occupancies (i.e. G6.2), and therefore not through external walls.

What the Building Code says:

G6.2 *Building elements* which are common between occupancies, shall be constructed to prevent undue noise transmission from other occupancies or common spaces, to the *habitable spaces* of *household units*.

G6.3.1 The *Sound Transmission Class* of walls, floors and ceilings, shall be no less than 55.

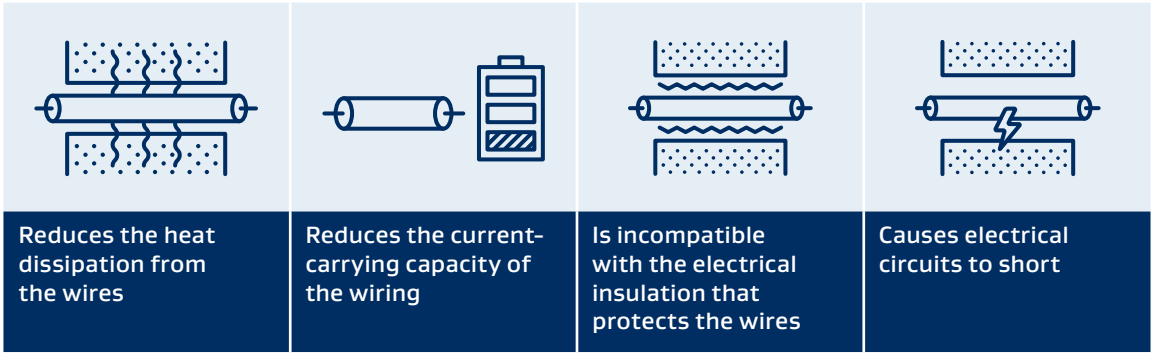
Only when insulation is retrofitted to intertenancy walls is there potential for it to affect compliance with G6.3.1. In these unlikely situations, the insulation materials and the installation will have a large bearing on the noise transmittance performance of the wall, and so must be considered on a case-by-case basis.

Electrical safety

What the law says:

In addition to the Building Code clause G9, the Electricity (Safety) Regulations 2010 must be complied with when thermal insulation is installed near electrical wiring and appliances.

Retrofitted insulation in external walls can affect the continued electrical safety of an existing building if the thermal insulation:



The safety of electrical systems may be compromised by retrofitted insulation if electrical wires that lie within a wall cavity are encased or enclosed by the insulation.

Both the current carrying capacity of the wiring and the heat dissipation from the wires will be reduced by the thermal insulation. The effects of these reductions in performance will depend on:

- the original rating of the electrical circuit,
- the electrical load on the circuit, and
- the proximity of the wire to combustible building elements.

What the Building Code says:

G9.3.1 The *electrical installation* shall incorporate systems to:

(. . .)

(d) safeguard people from injury which may result from electromechanical stress in electrical components caused by currents in excess of the installation rating

(e) protect *building elements* from risk of ignition, impairment of their physical or mechanical properties, or function, due to temperature increases resulting from heat transfer or electric arc

(. . .)

The current-carrying capacity of electrical wires surrounded by thermal insulation is half that of wires surrounded by air.

What the law says:

Refer to the **Electricity Act 1992** and Electrical (Safety) Regulations 2010

Regulation 17(4) of the Electricity Regulations specifies that 'A person commits an offence and is liable on conviction to a level 2 penalty if the person places thermal insulating material on or around fittings in an installation in such a way that the safety of the installation is compromised.'

The compatibility of thermal insulation with the electrical insulation protecting the wiring must also be checked. The common material incompatibility is polystyrene thermal insulation and PVC insulation on electrical wires. Care must be taken to avoid contact between these materials, as polystyrene has the potential to embrittle PVC.

Liquid-applied and loose-fill insulation may cause short-circuits if it migrates into unsealed electrical flush boxes or contacts surface mounted electrical switches and fittings. If the retrofitting of insulation inadvertently causes or exacerbates moisture accumulation in the wall (see the earlier subsection on moisture accumulation) near the back of electrical switches, outlets or junctions within a wall, this could also create an electrical safety risk.

Old electrical circuits which use VIR (vulcanised India rubber) or TRS (toughened rubber sheathed) cables may also short-circuit if insulation is pushed onto and around these old cables. This is because the electrical insulation on VIR and TRS cables tends to degrade and become fragile and brittle over time.

If water accumulation occurs near the back of electrical switches, outlets or junctions within a wall, it could also create an electrical safety risk (see moisture accumulation earlier in this section).

When the safety of electrical circuits is likely to be compromised by retrofitting insulation, or when electrical wiring is modified, a registered electrician should check and certify the electrical safety.

Where older hard-wired fuses are present, miniature circuit breakers can be used to improve protection from overload currents on circuits when the electrical wiring is surrounded by thermal insulation. Alternatively, the thickness of electrical wiring may be increased to safely carry the current and limit temperature build up, or the electrical load may be divided by rewiring some outlets to additional subcircuits. VIR and TRS cables may need to be replaced, depending on their condition.

Residual current device (RCD) protection can also be added to subcircuits at the distribution board, to mitigate against any short-circuits.

Energy efficiency

The retrofitting of insulation must not reduce the extent that the building envelope complies with clause H1.3.1. Retrofitted insulation will improve both the thermal resistance and the airtightness of an existing wall, so will not adversely affect the compliance of an existing house in relation to H1.3.1.

For example, the thermal envelope of an old timber framed house would comprise the weatherboard cladding, the air in the framing cavity and the interior wall linings.

Installing insulation into the framing cavity will not alter the thermal performance of the weatherboards or linings and will improve the performance of the air within the framing cavity, which will by and large be replaced by insulation.

What the Building Code says:

E3.3.1 An *adequate* combination of *thermal resistance*, ventilation, and space temperature must be provided to all *habitable spaces*, bathrooms, laundries, and other spaces where moisture may be generated or may accumulate.

H1.3.1 The *building* envelope enclosing spaces where the temperature or humidity (or both) are modified must be constructed to—

(a) provide *adequate thermal resistance*; and

(b) limit uncontrollable airflow.

No consideration needs to be given to the compliance of the insulation with H1.3.1 when retrofitting insulation into an existing external wall forming part of the building envelope.

8. Glossary

Words in the document that are ***italicised*** are defined terms. Please see the table below for the definitions:

Term	Definition
adequate	means adequate to achieve the objectives of the Building Code.
allotment	has the meaning ascribed to it by section 10 of the Building Act 2004.
alteration	alter, in relation to a building, includes to rebuild, re-erect, repair, enlarge and extend; and alteration has a corresponding meaning.
ancillary	applies to a *building* or use not for human habitation and which may be exempted from some amenity provisions, but which are required to comply with structural and safety-related aspects of the *Building Code*.
building code	means the Building Code set out in Schedule 1 of the Building Regulations 1992.
building elements	any structural or 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.
building importance levels	refer to the Building Regulations 1992 Clause A3 – Building importance levels for definitions.
building	has the meaning ascribed to it by sections 8 and 9 of the Building Act.
combustible building materials	means building materials that are deemed combustible according to AS 1530.1.
concealed spaces	any part of the space within a building that cannot be seen from an occupied space.
construction	construct in relation to a building, includes to design, build, erect, prefabricate, and relocate the building.
detached dwelling	applies to a *building* or use where a group of people live as a single household or family.
electrical installation	any electrical fixed appliances, and components used in the reticulation of electricity, which are intended to remain permanently attached to and form part of the building.
group number	the classification number for a material used as a finish, surface, lining, or attachment to a wall or ceiling within an *occupied space* and determined according to the *standard test* methods for measuring the properties of lining materials. The method for determining a Group Number is described in C/VM2 Appendix A.
habitable space	a space used for activities normally associated with domestic living, but excludes any bathroom, laundry, water-closet, pantry, walk-in wardrobe, corridor, hallway, lobby, clothes-drying room, or other space of a specialised nature occupied neither frequently nor for extended periods.
household unit	means any *building* or group of *buildings*, or part of any *building* or group of *buildings*, used or intended to be used solely or principally for residential purposes and occupied or intended to be occupied exclusively as the home or residence of not more than one household; but does not include a hostel or boarding house or other specialised accommodation.
multi-unit dwelling	applies to a *building* or use which contains more than one separate household or family.
occupied space	any space within a building in which a person will be present from time to time during the intended use of the building.

Term	Definition
other property	means any land or *buildings* or part thereof which are— (a) not held under the same *allotment*; or (b) not held under the same ownership— and includes any road.
outbuilding	applies to a *building* or use which may be included within each classified use but are not intended for human habitation and are accessory to the principal use of associated *buildings*.
relevant boundary	means the *boundary* of an *allotment* that is *other property* in relation to the *building* in question and from which is measured the separation between the *building* and that *other property*.
sitework	means work on a building site, including earthworks, preparatory to or associated with the construction, alteration, demolition, or removal of a building.
sound transmission class	(STC) a single number rating derived from measured values of transmission loss in accordance with classification ASTM E413, Determination of Sound Transmission Class. It provides an estimate of the performance of a partition in certain common sound insulation situations.
specified intended life	has the meaning ascribed to it by subsection (2) of section 39 of the Act as follows: "Specified intended life", in relation to a building, means the period of time, as stated in an application for a building consent or in the consent itself, for which the building is proposed to be used for its intended use.
thermal resistance	the resistance to heat flow of a given component of a *building element*. It is equal to the air temperature difference (°C) needed to produce unit heat flux (W/m^2) through unit area (m^2) under steady conditions. The units are $°Cm^2/W$.

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