Determination 2018/060

Regarding the refusal to grant building consent for retrofitting polyisocyanurate insulation in a house at 5 Grey Street, Marton

Summary

This determination considers the code-compliance of retrofitted rigid foam insulation board to insulate the walls of an existing house. The determination considers whether the proposed insulation board will satisfy certain clauses of the Building Code to the extent required by the Building Act.

1. The matter to be determined

1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004[1] ("the Act") made under due authorisation by me, Katie Gordon, Manager Determinations, Ministry of Business, Innovation and Employment ("the Ministry"), for and on behalf of the Chief Executive of the Ministry.

1.2 The parties to the determination are:

- the owners of the building, R and R Snijders, who are the applicants in this determination ("the applicants")
- Rangitikei District Council ("the authority"), carrying out its duties as a territorial authority or building consent authority.

1.3 The determination arises from a dispute between the parties as to whether proposed building work to retrofit polyisocyanurate insulation ("the PIR insulation") in the external walls of the applicants' house would comply with the Building Code (Schedule 1, Building Regulations 1992) to the extent required by section 112 of the Act. The authority has refused to grant building consent on the basis that it did not consider the application provided sufficient information to establish on reasonable grounds that the building work would comply.

1.4 The matter to be determined[2] is whether the proposed retrofitting of the PIR insulation to the existing building (as altered) will comply with the relevant clauses of the Building Code[3] to the extent required by the Act.

1.5 In making my decisions, I have considered the submissions of the parties and the other evidence in this matter. I have not considered the compliance of any of the building work other than the PIR insulation.

[1] The Building Act, Building Code, compliance documents, past determinations and guidance documents issued by the Ministry are all available at www.building.govt.nz or by contacting the Ministry on 0800 242 243.
[2] Under sections 177(1)(a), 177(1)(b) and 177(2)(a) of the Act.
[3] In this determination, unless otherwise stated, references are to sections of the current Act and references to clauses are references to the Building Code

2. The building work

2.1 The existing building

2.1.1 The applicants' building is a single-storey detached house located on a flat site in a residential area.

2.1.2 The applicants advise that the house was originally built around 1910, and is constructed of 'native timber', with a corrugated iron roof, and rusticated timber weatherboard cladding. The house is simple in shape and form with a hipped roof and a lean-to at the rear containing the kitchen, bathroom, and a third bedroom. The eaves on the main roof are about 325mm wide; those on the lean-to are somewhat narrower.

2.1.3 The applicants advise that sometime in the 1970s the house was renovated, with all of the original windows and doors removed and replaced with new joinery which appears to be timber. The applicants bought the house in 2014, and in 2016 had it re-piled and repositioned on the site.

2.1.4 Limited information has been provided about the existing house, including the condition of the various existing building elements affected by the building work and the depth of the existing framing timber. Given the age of the house, it is likely that the framing timber is rimu and the depth of the framing in the vicinity of 100mm. However, this is just an assumption. I understand that the existing weatherboard cladding, which I assume is also the original, is direct fixed to the framing timber.

2.2 The proposed building work

2.2.1 The proposed building work is part of broader work that the applicants are carrying out to modernise the house and reinstate some of its original features. This includes installing new sanitary fittings for a new bathroom, replacing the existing joinery throughout the house, re-cladding the outside of the house with new timber weatherboards to match existing, relocating an existing outbuilding, and installing insulation in three of the exterior walls of the house. Most of this work is not in dispute between the parties, and is not considered further in this determination.

2.2.2 It is the proposal to install new PIR insulation in three of the exterior walls of the house that is in dispute. The insulation will be installed in between the existing framing timber from the outside of the external walls. The walls will then be covered with a building wrap and new weatherboards direct fixed to the framing timber. This will be done on all but the rear (western) wall of the house, and the portions of the northern and southern walls that form the lean-to portion of the house.

2.2.3 The PIR insulation the applicants wish to use is a 100mm thick rigid polyisocyanurate foam board with a composite foil to both faces. The PIR insulation is manufactured in the UK[4], and is one of several PIR products that the manufacturer produces for use as 'thermal insulation in timber frame wall lining applications'.

2.3 The manufacturer's technical literature and certification

2.3.1 The manufacturer's technical literature about the use of PIR insulation in 'Timber Frame Wall Lining Applications' ("the manufacturer's technical literature") applies to several grades of PIR insulation, including the one proposed to be used by the applicants.

[4] United Kingdom of Great Britain and Northern Ireland

2.3.2 The literature sets out performance data on the insulation's thermal resistance and transmittance properties, and refers to its certification by the British Board of Agrément[5] ("BBA"). It also includes installation guidelines for the PIR insulation.

2.3.3 The manufacturer also produces a 'Handy Guide' for the use of its PIR products ("the manufacturer's guide"). A section of the manufacturer's guide relating to 'Single timber frame wall lining and dormer cheeks' includes external walls clad with weatherboard, tile, plaster render, etc. A table setting out the thermal transmittance values of such walls specifies that a 25mm[6] 'ventilated cavity batten air space' is required on weatherboard clad walls, between the cladding and the breather membrane.

2.3.4 The relevant BBA certificate for the PIR insulation in timber-framed walls (16/5352, dated 26 January 2018), refers to in the manufacturer's technical literature, assesses the PIR insulation's performance when used as 'insulation in walls of conventional timber-frame dwellings up to 18m in height'. The certificate is valid within the UK and states that the PIR insulation, if used in accordance with the provisions of the certificate, will meet or contribute to meeting the UK building regulations listed in the certificate in respect of requirements related to (in summary) thermal performance, condensation, behaviour in relation to fire, moisture resistance, emissions and durability.

2.3.5 The BBA certificate provides information about the thermal properties of the PIR insulation: the certificate says the PIR's thermal conductivity is $0.022 W.m^{-1}.^{o}K^{-1}$. For the proposed 100mm thick PIR insulation (excluding any effects of the foil insulation) this is equivalent to an R-value[7] of $4.5 m^{2}.^{o}C.W^{-1}$

2.3.6 The provisions in the BBA certificate relating to how the insulation is to be installed (if it is to comply with the relevant building regulations and British standards) include (among other things) the following directions:

- 'The [insulation] may be installed in between the timber studs (inter stud), as an internal lining, as an outer sheathing, and also as a combination of these'
- the number of services that penetrate the internal wall linings should be minimised, in order to limit vapour ingress and preserve the fire resistance of the wall
- a vapour control layer must be included 'behind the internal finish', such as 'polyethylene or plasterboard backed with a vapour control membrane or similar'
- where the insulation is to be used in the external walls of rooms expected to have high humidity, 'adequate permanent ventilation' should be provided, in order to avoid interstitial condensation
- a breather membrane should be incorporated between the insulation and the external cladding
- a minimum 50mm cavity needs to be maintained in all applications (to satisfy NHBC[8] standards).

[5] The British Board of Agrément (BBA) is a construction industry approvals body, originally set up in 1966 by the UK government and offering product and installer approval.
[6] Table 4 of the BBA certificate refers to a 50mm cavity being required, refer paragraph 2.3.6.
[7] R-value is a measure of resistance to heat flow through a given thickness of material
[8] National House Building Council is a UK warranty and insurance provider for new homes established in 1936.

2.3.7 Table 4 'System construction details' of the certificate describes the components and parameters that apply when the PIR insulation is used in various timber-framed wall systems. Where the PIR insulation is used inter stud, the table specifies that plasterboard, a vapour control layer, structural sheathing, a breather membrane, and a 50mm cavity is required.

2.3.8 Section 16 of the BBA certificate sets out the 'procedure' when the PIR insulation is used in different applications. With respect to inter stud applications it states as follows. (Note that the text refers to 'products' as more than one type of PIR insulation, including that proposed to be used by the applicants, is being referred to.)

> 16.1 The products should be cut to fit tightly between the timber studding and positioned against the inner face of the sheathing board. Any gaps should be filled with expanding insulation foam. …
>
> 16.3 A sealed polyethylene [vapour control layer] with a minimum thickness of 0.125 mm (500 gauge) with lapped and sealed joints is placed over the stud face before applying the internal finish.

2.3.9 Another BBA certificate, No 17/5405, for PIR floor insulation by the same manufacturer is referred to in paragraph 3.5 below.

3. Background

3.1 The applicants applied for a building consent with respect to their house in November 2017. Following discussions between the parties, the 'scope of work' to be covered by the application was redefined to exclude most of the exempt building work and the relocation of an existing outbuilding, which had originally been included.

3.2 The new scope of work dated 17 January 2018 was now stated to be 'Installation of Sanitary Fittings for a new bathroom and install insulation from the outside to all external walls except for rear (western) elevation'. New plans were submitted to the authority to reflect the altered scope of works, along with 'product literature' for the external wall insulation and building wrap.

3.3 On 23 January 2018, the authority made a request for further information in relation to the building consent application. With respect to the insulation, the request asked for installation instructions for the PIR insulation and information showing how the insulation 'can be installed into a timber frame building with no cavity'.

3.4 The applicants sought information from the manufacturer of PIR insulation and subsequently replied (undated) stating:

> Attached are installation instructions for the [PIR insulation]. The detail supplied does include a plywood layer which is a requirement under UK regulations for bracing.
>
> [The applicants] will be installing the insulation in to the wall with a 20mm nominal cavity to E2/AS1[9]. [The PIR insulation] can be used under a slab and in flat roofing. Although the product is robust in various situations, the manufacturer's recommending a cavity to protect the cladding.

3.5 With their reply, the applicants enclosed an excerpt from the manufacturer's guide relating to using PIR insulation in single timber-framed walls (see paragraph 2.3.3), as well as a BBA certificate (No. 17/5405) relating to the use of PIR insulation as floor insulation, including 'under-slab' insulation. The applicants advise that they

[9] An Acceptable Solution for Clause E2 External moisture.

provided the latter document 'as proof that the insulation could be installed without a cavity'.

3.6 Further discussions ensued between the parties as to whether the PIR insulation could be installed as insulation without a cavity. During these conversations, the applicants state that the authority informed them that they could substitute proprietary fibreglass insulation for the PIR insulation and there would be 'no problem'. The parties also discussed the possibility of adding a cavity, although the applicants state that they have subsequently reconsidered this idea, due to the knock-on effect on the recladding.

3.7 As part of these discussions, the applicants provided further information, including a copy of Determination 2017/071[10], which considered the use of another brand of PIR insulation in a steel-framed house. They stated, in a letter dated 11 April 2018, that they were seeking:

> Approval to install the PIR Insulation … between the studs, followed by a proprietary vapour barrier (already specified) and then weatherboards which is an acceptable solution as set out in E2/AS1.

3.8 On 13 April 2018, the authority issued a further request for information in respect of the following matters:

> I can find no evidence in the information provided that [the PIR insulation] can be installed without a cavity, as the determination and the [BBA] certificate clearly show installation of insulation with a cavity.
>
> Please provide documentation from the manufacturer showing how 100mm [PIR insulation] can be installed into timber framed building with no cavity.
>
> With the technical information provided (BBA certificate) it raise questions about how the existing electrical cables and services will be protected. Please show how this will be achieved.

3.9 The applicants responded to the request for information on 18 April 2018. Their response referred to the PIR insulation's compliance with various clauses of the Building Code; Determination 2017/071; the use of the PIR as insulation under a concrete slab or floor; and the proposed method of installation and its compliance with NZS 4246[11] and the Acceptable Solution for Clause E3 Internal moisture, E3/AS1. The reply also raised again the possibility of installing the insulation with a cavity.

3.10 On 19 April 2018, the authority issued a third request for information. The request stated that the authority did not agree that the PIR insulation complied with the Building Code, and that it considered that Determination 2017/071 was not relevant as it related to a different product. It also:

- discounted the information about using the insulation as floor insulation as not relevant
- repeated its request for evidence as to how the PIR insulation complied with the Building Code
- suggested that the applicants apply for a waiver of the "relevant code clauses"

[10] Determination 2017/071 The code-compliance of a proposed house with steel framing and polyisocyanurate insulation board (31 August 2017)
[11] NZS 4246: 2016 Energy efficiency - Installing bulk thermal insulation in residential buildings

- noted that if the applicants were changing to a cavity system the replacement of the timber weatherboard cladding would no longer be exempt building work, and requested details of the cavity system and flashing details.

3.11 The applicants responded in an email dated 23 April 2018, in which they compared the PIR insulation that they were proposing to use with the one discussed in Determination 2017/017, and asserted that the earlier determination could be used as guidance by the authority. With the letter the applicants included a table comparing the two PIR insulation products, using the information from their respective BBA certificates, and concluded that the two products were 'identical except for the quoted vapour resistance for the foil facings. This is clear evidence that the products are generically the same'.

3.12 On 24 April 2018, the authority sent the applicants a letter refusing to grant the building consent. The letter said that the reason for the refusal was:

> Refusal to provide clarification on Request for Further Information questions, so that the [authority] could not determine compliance with the relevant building codes.

The letter did not describe what code clauses were in dispute in relation to the proposed work.

3.13 The applicants applied for a determination and this was received by the Ministry on 20 June 2018.

3.14 On 27 June 2018, the Ministry sought clarification from the authority about which clauses of the Building Code it considered the proposed building work did not comply with. The authority replied on 5 June 2018 (see paragraph 4.1.5).

4. The submissions, the draft determination and the responses received

4.1 The initial submissions

4.1.1 The applicants made a submission, dated 19 June 2018, with their application for a determination. The submission described the proposed building work and set out the background to the dispute.

4.1.2 In their submission, the applicants acknowledged that all of the manufacturer's technical literature relating to the PIR insulation specifies that a cavity must be used between the insulation and the external cladding, when it is used in external walls. The applicants submitted that, 'A cavity is mandatory in the UK in order to comply with their building regulations' but that 'The climate in the UK is more severe than in NZ.'

4.1.3 The applicants raised concerns about the lack of clarity in the authority's refusal to grant a building consent, as to which aspects of the building work did not comply with the Building Code.

4.1.4 With their submission the applicants enclosed copies of:

- the building consent documentation
- excerpts from the manufacturer's technical information and manufacturer's guide
- the BBA certificates relating to the PIR insulation when used as wall and floor insulation

- the correspondence between the parties,
- the authority's refusal to grant the building consent.

4.1.5 The authority responded to the Ministry's request for clarification in an email dated 5 July 2018. The authority stated that the clauses of the Building Code that it did not consider the proposed building work complied with were Clauses B2 Durability, C2 Prevention of fire occurring, E3 Internal moisture, F2 Hazardous building materials, and H1 Energy efficiency. The authority did not agree with the applicants that compliance with these clauses had been proven, especially as the only evidence the applicants had provided was Determination 2017/071, which related to a different product. The authority said it had insufficient information to "determine compliance with [section] 112 of the Act" with respect to Clause E3.

4.1.6 The authority also made a submission, in response to the application for a determination, dated 24 July 2018. In its submission the authority asserted that:

- its reason for refusing to grant the building consent was 'in relation to the [PIR insulation] and the evidence that it could be installed without a cavity'
- the applicants have provided no evidence that the PIR insulation can be installed without a cavity, but their own submissions provided 'evidence that the product requires a cavity', including the information relayed to the applicants by the manufacturer, the BBA certificate, and Determination 2017/071, 'which also clearly indicates a wall and roof cavity although this is for a [different] product'
- the applicants have also provided no evidence that the PIR insulation 'meets the requirements of E3', noting:

  > [the applicants had provided no] drawings to clarify the method of the proposed installation to support [their] understanding that NZS 4246:2016 allows for this provided E3/AS1 is followed. The standard does not include foil faced PIR installation and where it does talk about rigid sheet insulation it has to be installed following manufactures [sic] installation specifications. (Clause 5.3.3.2 [of the NZS 4246])

- the applicants were unsure what they intended to do, in particular in relation to whether the PIR insulation would be fitted with or without a cavity.

4.2 The draft determination

4.2.1 The draft determination was issued to the parties for comment on 21 September 2018. The authority accepted the draft determination without comment on 24 September 2018.

4.2.2 The applicant responded to the draft determination on 8 October 2018. The applicant did not accept the draft and submitted, in summary, that:

- The authority had not made it clear on what basis the consent had been refused, saying it was "'presumed' the applicant would be aware that the refusal was in relation to the insulation". The authority should confirm what proposed work is "approved".
- The following was clarified in relation to the existing building, including:
  - the lean-to will be remodelled in the near future and is why insulation is not being installed in this portion of the building as this time

- the framing was of native timber, sarking was installed to the inside face, there were no dwangs
- plaster board was installed in the 1970s, in places over the existing scrim and wallpaper.

- In relation to the proposed work:
  - all linings to external walls were to be removed and replaced with 10mm plasterboard – this would address concerns in relation to Clause C4
  - The existing softboard ceiling lining was to be replaced with 13mm plasterboard
  - the house was to be rewired.
- Technical information and the BBA certificate for the PIR insulation was referred to where:
  - the insulated walls would "limit the risk of surface condensation"
  - the PIR insulation can be used as "for loft insulation" which would not be recommended if there was a problem with condensation accumulating on the foil.
- Other typographical errors were noted.

5. Discussion: the matters in dispute and the applicable legislation

5.1 The matters in dispute

5.1.1 The applicants have requested a determination about the authority's decision to refuse to grant a building consent for the proposed building work. The authority has stated that the reason it refused the building consent was because it did not have sufficient evidence to be satisfied on reasonable grounds that the proposed building work would comply with the Building Code.

5.1.2 In response to the Ministry's request for clarification, the authority listed the specific clauses that it is not satisfied that the building work complies with, namely Clauses B2 Durability, C2 Prevention of fire occurring, E3 Internal moisture, F2 Hazardous building materials, and H1 Energy efficiency.

5.1.3 In its submission, the authority has elaborated that its main concern is in relation to the applicants' plans to install the PIR insulation without a cavity, and the lack of evidence to demonstrate how this would achieve compliance.

5.2 The applicable legislation

The grant of the building consent

5.2.1 Section 49 of the Act stipulates the circumstances in which an authority must grant a building consent.

> **49 Grant of building consent**
>
> (1) A building consent authority must grant a building consent if it is satisfied on reasonable grounds that the provisions of the building code would be met if the building work were properly completed in accordance with the plans and specifications that accompanied the application.

5.2.2 Section 50 of the Act dictates the form that an authority's refusal to grant a building consent must take.

50 Refusal of application for building consent

If a building consent authority refuses to grant an application for a building consent, the building consent authority must give the applicant written notice of—

(a) the refusal; and

(b) the reasons for the refusal.

The level of compliance required by the Act

5.2.3 I have issued several determinations about the requirements of the Act as they relate to alterations to existing buildings, including the retrofitting of insulation. The Ministry has also issued guidance[12] under section 175 of the Act on Building Code compliance for retrofitting insulation in external walls that is relevant to this determination.

5.2.4 The requirements under the Act for compliance of the building work are that:

- the new building elements and the "building work" (i.e. the retrofitting) must comply with the Building Code as required by section 17 of the Act
- the retrofitting of the insulation must not reduce the extent to which the existing building complies with the Building Code as required by section 112(1)(b) of the Act.

5.2.5 These requirements relate to different parts of the building. The extent of code compliance required in relation to each part is different, and different Building Code performance criteria can relate to each.

5.2.6 In this determination, I will consider both the compliance of the new building elements and building work, and the level of compliance of the existing building after the proposed alteration.

Section 17 as it applies to the building work

5.2.7 Section 17 stipulates that all building work must comply with the Building Code to the extent required by the Act. Examples of particular Building Code clauses that the installation of the insulation must comply with in this case include B2.3.1, in regards the durability of the PIR insulation, and F2.3.1 in regards to any hazard arising from the PIR insulation itself, both during and after its installation.

Section 112 as it applies to the altered house

5.2.8 The retrofitting of insulation is an alteration to an existing building and section 112 of the Act contains specific requirements for the level of compliance expected from buildings that are altered. The provisions of section 112 include:

(1) A building consent authority must not grant a building consent for the alteration of an existing building, or part of an existing building, unless the building consent authority is satisfied that, after the alteration,—

(a)…

(b) 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

[12] *Guidance on Building Code compliance for retrofitting insulation in external walls* (August 2011)

(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 extent as it did then comply.

5.2.9 It is important to note that section 112 relates to the compliance of the existing building (which is the whole building as altered, not merely the alteration); it does not detract from the section 17 requirement that all building work must comply with the Building Code (subject to any waivers or modifications).

5.2.10 The relevant Building Code obligations that relate to the compliance of the existing building after the insulation has been installed in this case include Clauses B2, E2, E3, C2, G9, and H1: for example; is the existing building's compliance with, say Clause E3, adversely by the installation of the PIR insulation?

6. Discussion: the compliance of the proposed PIR insulation in this case

6.1 The available technical information

6.1.1 In considering this matter I have also taken account of the information available to me. The PIR insulation that the applicants are proposing to install is a UK manufactured product that is widely available in New Zealand. The insulation has BBA certification for use as an insulation product in timber-framed dwellings and in floors.

6.1.2 The British Board of Agrément holds a combination of UKAS[13] accreditations within the construction industry. BBA certificates show a product's compliance with building regulations and other requirements, including installation quality, and cover 200 different product sectors, with the largest being insulation and roofing.

6.1.3 The consent application documentation included two BBA certificates for the PIR insulation, one relating to its use in timber-framed walls and the other in floors. These certificates are valid only with the UK. I have considered this restriction in a previous determination[14], and I maintain the view that the conditions on scope set in the BBA certificate do not prevent conclusions being drawn from it about the product's compliance with the New Zealand Building Code.

6.1.4 Notwithstanding the above, I must also consider the scope and the other conditions described within the BBA certificate for the PIR insulation, and how these relate to the particular circumstances of this particular house and its construction.

6.1.5 As noted above the authority has specified the particular clauses that it considers the proposed building work has not demonstrated compliance with, namely B2 Durability, C2 Prevention of fire occurring, E3 Internal moisture, F2 Hazardous building materials, and H1 Energy efficiency. I consider each of these clauses in turn below.

6.2 Clause B2 Durability

6.2.1 BBA certificate No. 16/5352 for the use of the PIR insulation in timber-framed dwellings states in relation to durability that the product is 'unaffected by the normal conditions in a wall and [is] durable, rot proof, water resistant and sufficiently stable to remain effective as insulation for the life of the building'.

[13] The United Kingdom Accreditation Service
[14] Determination 2016/046 (26 September 2016)

6.2.2 I consider there is no significant difference between the service conditions for insulation in New Zealand when compared with the UK – if anything the conditions experienced in New Zealand will be more benign.

6.2.3 Provided the PIR insulation as installed continues to be protected from adverse effects including physical and chemical damage, and the effects of sunlight, it is reasonable to expect the PIR insulation will remain durable for the life of the building under New Zealand conditions.

6.3 Clause C2 Prevention of fire occurring

6.3.1 The authority has indicated that it does not consider compliance has been demonstrated in respect of Clause C2 Prevention of fire occurring.

6.3.2 The plans show an external instantaneous gas water heater and a "feature gas fire" that are both located on external walls that are to receive the PIR insulation - it is not known if these appliances are new or existing. The instantaneous water heater will vent exhaust gases directly to the outside and is of no concern in respect of the insulation and Clause C2.

6.3.3 It is assumed a flue from the gas fire will pass through the PIR insulation. The flue is very likely to have been designed to pass through combustible material, i.e., the flue will prevent adjacent combustible surfaces reaching a temperature in excess of 90^{o} as provided for in Clause C2.2. I have been presented with no evidence to show the PIR insulation will present any particular problem in this respect, any more so than other combustible building elements, such as building wrap and the timber.

6.4 Clause E3 Internal moisture

6.4.1 Clause E3.3.1 requires a combination of thermal resistance, ventilation, and temperature to prevent the accumulation of internal moisture as follows:

> 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.

6.4.2 The performance of any internal space with respect to Clause E3.3.1 requires management of ventilation and temperature, taking into account the thermal resistance of the building envelope. Any space, regardless of its thermal performance, may have a problem with internal moisture if the ventilation and temperature is not managed appropriately. Poor management of a space is more likely to lead to problems with condensation rather than solely the performance of the thermal envelope. Clause E3.3.1 itself says a combination of insulation, ventilation and space heating is required to prevent the accumulation of internal moisture.

6.4.3 The installation of insulation into a wall will improve the thermal efficiency of the building envelope which will assist with the building's compliance with Clause E3.3.1. As a general rule installing insulation will reduce the risk of condensation and mildew on internal surfaces.

6.4.4 With respect to the potential for interstitial moisture[15] to accumulate, I note that the BBA certificate specifies in several places that a vapour control layer should be installed between the internal wall finish and PIR insulation. However, I also note that the climatic conditions under which the PIR insulation is likely to be used in the

[15] Interstitial moisture is occurs when warm, moist air penetrates inside a wall, roof or floor structure, and reaches the dew point and condenses into liquid water.

UK are more severe than will be experienced in New Zealand. The PIR insulation is a closed-cell foam and the insulation as supplied is faced both sides with aluminium foil – both will resist the uptake of moisture.

6.4.5 The possible need for vapour control membranes to prevent interstitial condensation within walls and roofs has been the subject of various reports and investigations by BRANZ in New Zealand. In its 2016 report, *Vapour Control in New Zealand Walls*,[16] BRANZ reported on a three-year study into vapour control and confirmed its long-standing advice that vapour control layers are not required in most circumstances in New Zealand. The exceptions are within environments with exceptional humidity, such as within swimming pool complexes and alpine lodges etc. As this is not the case here, and no equivalent risks apply, there is no reason to consider a vapour control layer is necessary.

6.4.6 I note that the applicants have signalled their intention to install the PIR insulation in accordance with E3/AS1. Given this, I consider it unlikely that the installation of the PIR insulation without a vapour control barrier will lead to non-compliance with Clause E3.3.1.

6.4.7 The BBA certificate also refers to the need for permanent ventilation in rooms expected to have high humidity. In the current case, the only such room affected by the installation of the PIR insulation is the bathroom and the proposed building work includes a new ducted bathroom extract fan, so this requirement is met.

6.5 Clause F2 Hazardous building materials

6.5.1 Clause F2 requires that the materials used in the construction of buildings should not give off harmful concentrations of hazardous substances. The BBA certificate for the PIR insulation states that the product is light to handle and can be cut using a fine-toothed saw. No particular precautions are required.

6.5.2 In addition, a literature search revealed no known hazards associated with the material. PIR insulation is a widely used product in Europe and the UK, and if there were any specific hazards associated with its use, then I would expect these to have been documented. Dust during fabrication can be a mechanical irritant to skin, eyes, and the upper respiratory system, but is little different to other building materials cut on site. Similarly, the recommendations for cutting and installation are no different than the precautions that would normally be taken with other commonly-used insulation materials.

6.5.3 Given this, and provided the manufacturer's handling recommendations are followed, I consider that the statements in the BBA certificate can be accepted as reasonable grounds for believing that the PIR insulation will meet Clause F2.

6.6 Clause H1 Energy efficiency

6.6.1 In my view the BBA certificate provides adequate evidence that the PIR insulation will be able to be used in a thermal envelope to achieve compliance with Clause H1.

6.6.2 The 100mm thick PIR insulation has an R-value of $4.5 m^2.{}^oC.W^{-1}$. The R-value of the insulation alone will exceed the highest minimum values listed in the tables in NZS 4218[17], (being R1.9 for Zone 2) which is the standard cited in the Acceptable Solution H1/AS1.

[16] *BRANZ Study Report SR244 [2016]: Vapour control in New Zealand walls*. BRANZ: Wellington.
[17] NZS 4218: 2009 Thermal Insulation - Housing and Small Buildings

6.6.3 The PIR insulation is being installed in external walls that are not presently insulated. It is almost certain that the insulation will improve both the thermal resistance and airtightness of the existing walls which will not adversely affect the compliance of the existing house in relation to the requirements of section 112.

6.7 Additional matters

6.7.1 In addition, I will also consider the extent to which the existing building as a whole will continue to comply with the Building Code, after the alteration, as required by section 112. In this respect, I will look at Clauses E2 External moisture, and C4 Movement to place of safety.

6.8 Clause E2 External moisture

6.8.1 The authority did not identify Clause E2 as an area where compliance would not be achieved, however, it has referred repeatedly to the lack of a cavity between the PIR insulation and the external cladding.

6.8.2 Clause E2.3.5 reads:

> 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.

6.8.3 The installation details shown in the technical literature (including the BBA certificate) for the PIR insulation show a minimum 25mm cavity between the insulation and the external cladding, when the insulation is installed between the framing in timber-framed walls. In the current case, it is assumed the studs are approximately 100mm (4 inches) deep, but this is not confirmed, and the 100mm PIR insulation will likely be a tight fit between the cladding and the lining.

6.8.4 It is also noted that the subject building is simple in shape and form and has a low weathertightness risk as described in E2/AS1. The horizontal weatherboard cladding would not be required to be installed on a drained and ventilated cavity in order to meet E2/AS1. On the face of it, there would appear to be no reason why a cavity (either a simple closed cavity or one described in E2/AS1) is necessary to satisfy Clause E2.

6.8.5 However, given that the insulation is foil-faced on the outer face, this creates a risk of condensation forming on the outside face of the insulation in certain circumstances, for example, on winter mornings. The foil will prevent the transfer of this moisture across the external wall, however, it may cause moisture to become trapped between the foil and the building wrap/weatherboards. Moisture could potentially run down the foil face of the PIR insulation onto any horizontal framing below. It is accepted the moisture arising from such an occurrence is unlikely to be significant, but the effect could be cumulative without a means of dissipating the moisture by means of a cavity, a drainage plane, or similar.

6.8.6 More information is required about the construction of the existing walls, along with confirmation from the manufacturer about the possible effect of condensation.

6.8.7 I note here that under section 112, the test that must be met is that the building's capacity to prevent the accumulation of moisture in its cavities and concealed spaces must not be reduced by the building work. In other words, the building must continue to comply to the same extent that it did before the insulation was installed. If the insulation does fill the entire wall cavity, and no space is left between it and the

building wrap and weatherboards, then it seems likely that section 112 will not be met.

6.8.8 The applicants contend that that firstly; PIR-insulated walls would limit the risk of surface condensation and secondly; that the PIR insulation can be used as "for loft insulation" which would not be recommended if there was a problem with condensation accumulating on the foil. The first point is in respect of condensation to internal linings which the determination considers is acceptable (refer paragraph 6.4). In respect of the second point, the loft insulation is described as being retrofitted over the ceiling joists in existing roof spaces. This assumes the free movement of air in the space immediately above the PIR insulation which would not be the case in respect of the insulated walls to the house.

6.9 Clause C4 Movement to place of safety (the use of the PIR board as a foamed plastic under C/AS1[18])

6.9.1 Building Code Clause 4.3 states that during a fire, occupants must not be exposed to a 'fractional effective dose' of carbon monoxide and other thermal effects. Some of the products of combustion of PIR insulation are known to be toxic, and the BBA certificate notes the insulation is not classified as non-combustible and is restricted to buildings less than 18m in height.

6.9.2 While the PIR insulation is technically combustible, it can be used in assemblies for applications where fire resistance is required. The Acceptable Solution, C/AS1, Part 4, Paragraph 4.3, says:

> Where foamed plastics or combustible insulating materials form part of a wall or ceiling system, the completed system (see comment) shall achieve a Group Number of not more than 3.

The Comment to Part 4 says:

> The completed system may or may not include a surface lining product enclosing any insulation material from any adjacent occupied space. If a surface lining is not included, then the foamed plastics or combustible insulating materials when tested alone shall achieve a Group Number of 3, otherwise a surface lining is also required such that the completed system achieves a Group Number of 3 (see Appendix A of C/VM2).

Section A1.7 of C/VM2 says:

> Foamed plastics or combustible insulating materials that form part of an element requiring a group number can be assumed not to influence the group number classification and need not be included in the test specimen in the following examples.
>
> a) The surface lining material is a rigid sheet product of gypsum plasterboard, plywood, solid wood, wood composite, fibre reinforced cement, concrete or masonry and is not less than 9 mm thick, and
>
> b) It is securely fastened with steel fasteners to a conventional lightweight timber or steel frame or a concrete/masonry wall, according to manufacturers' literature, and
>
> c) All sheet joins are supported and sealed and/or stopped with a non-flaming material.

6.9.3 Therefore, if there is no wall or ceiling lining the foamed plastic is required to achieve a Group Number[19] of 3; if the walls and ceilings are lined, then the wall and

[18] Acceptable Solution C/AS1 Acceptable Solution for Buildings with Sleeping (residential) and Outbuildings (Risk Group SH)

ceiling systems are to achieve a Group Number of 3. If the assessment under A1.7 of C/VM2 is satisfied, then C/AS1 allows the use of the PIR insulation irrespective of its Group Number.

6.9.4 This raises the question of whether installing the insulation will reduce the building as a whole's compliance with Clause C4; in other words, whether after the PIR insulation is installed there is a greater risk of toxic fumes being released in a fire than there were before. The applicants have advised the proposed internal linings with respect to walls and ceilings (respectively 10 and 13mm plasterboard) and this information should be confirmed in the consent documentation.

6.10 Conclusion

6.10.1 Taking into account the matters discussed in this determination, I consider the proposed work to install the PIR insulation will satisfy Clauses B2 Durability, C2 Prevention of fire occurring, Clause C4 Movement to place of safety, E3 Internal moisture, F2 Hazardous building materials, and H1 Energy efficiency.

6.10.2 I have insufficient information to be satisfied that the proposed work will satisfy and Clause E2 External moisture.

7. The decision

7.1 In accordance with section 188 of the Act, I hereby determine that the proposed work to install the PIR insulation will satisfy Clauses B2 Durability, C2 Prevention of fire occurring, C4 Movement to place of safety, E3 Internal moisture, F2 Hazardous building materials, and H1 Energy efficiency.

7.2 I have insufficient information to be satisfied that the proposed work will satisfy Clause E2 External moisture, and accordingly I confirm the authority's decision to refuse to issue the building consent in respect of these matters.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 4 December 2018.

Katie Gordon
Manager Determinations

[19] Group Numbers provide a way of categorising building materials by their relative performance when subject to a fire. Group Numbers are assigned based on the time taken to release 1MW of heat (flashover) within the test room. Group Number 1 are the least flammable and Group Number 4 are the most flammable.