Determination 2013/078

The code-compliance of retrofitting foam wall insulation in a split-stone veneer house at 75 Thurleigh Grove, Karori, Wellington

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, John Gardiner, Manager Determinations and Assurance, Ministry of Business, Innovation and Employment ("the Ministry"), for and on behalf of the Chief Executive of the Ministry.

1.2 The parties to this determination are:

- the owners of the house, P and A Drysdale ("the applicants") acting through a building consultancy business as their agent ("the agent")
- Wellington City Council, carrying out its duties and functions as a territorial authority or a building consent authority ("the authority").

1.3 Airfoam Wall Insulation Limited and Airfoam Wall Insulators (Wellington) Limited are considered persons with an interest in this determination on the grounds of being the proprietary system provider and installer respectively. I have referred to both companies as "the insulation provider". I note that the insulation provider also represented the applicant for the purposes of the building consent application.

1.4 The determination arises from a dispute between the parties as to whether proposed building work to retrofit urea formaldehyde foam insulation ("the insulation") in the external walls of the applicants' house would comply with the Building Code (Schedule 1, Building Regulations 1992). The external cladding of the applicant's house is a mix of split stone veneer and fibre-cement sheet. However, I understand that the dispute is in relation to the split stone veneer cladding only, and accordingly I have limited my consideration to this.

1.5 Therefore, the matter to be determined[2] is whether the proposed retro-fitting of the insulation to the stone veneer cladding and the existing building (as altered) would comply with Clauses B1.3.1, E2.3.2, E2.3.5, E2.3.6 and E2.3.7 of the Building Code[3] to the extent required by the Act.

[1] The Building Act 2004, Building Code, compliance documents, past determinations and guidance documents issued by the Ministry are all available at ww.dbh.govt.nz or by contacting the Ministry on 0800 242 243.
[2] Under section 177(1)(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

1.6 In making my decision I have considered the submissions of the parties, and the other evidence in this matter.

1.7 I have not considered any other aspect of the code compliance of the building work. I emphasise that each determination is conducted on a case-by-case basis.

2. The proposed building work

2.1 The existing building

2.1.1 The building is a single storey detached dwelling, with a part-basement garage, built circa 1970s. The site is on a sloping section in a high to very high wind zone. The building has a medium to high weathertightness risk.

2.1.2 The upper level of the house not over the garage comprises a timber framed floor. The section not over the garage is founded on piles and a perimeter concrete foundation. Subfloor ventilation is provided through the perimeter concrete foundation – there appear to no perpends to the split-stone veneer. The basement garage is on a concrete slab.

2.1.3 The exterior walls are clad in a mix of split-stone concrete veneer panels over a 40mm cavity and flat fibre-cement boards direct-fixed over building wrap to the external framing.

2.1.4 There is a timber deck to the southwest elevation, and a concrete deck to the northeast elevation. The timber deck is open on two sides with the subfloor ventilation to the house unobscured. The concrete deck is original, but the concrete has been covered with a membrane and there is a translucent roof over. The concrete deck was originally open to the south, but the opening has been closed-in with fibre-cement and now only limited ventilation is provided. There is no other ventilation provided to the subfloor space under the concrete deck.

2.1.5 There are no eaves other than the translucent roof to the concrete deck. The exterior of the house appears to be well maintained, including the joints between the fibre-cement boards and the split-stone veneer, and around the joinery elements.

2.1.6 The external wall framing is pine, which is believed to be H1 boric treated given the age of the house. Joinery is aluminium throughout, complete with flashings.

2.2 The proposed work

2.2.1 The applicants are currently renovating the house inside and out. Some areas of the house have been renovated within the past 10 years and approximately 40% of the walls already have fibreglass insulation installed in them. These walls will not receive further insulation as part of the proposed building work.

2.2.2 The proposed building work is the injection of foam insulation into the remaining un-insulated walls. This consists of making a series of holes in the split stone veneer from the exterior and injecting the insulation in-between the internal lining and the building wrap, with the resulting insulation being 100mm thick. The insulation to

the fibre-cement sheet is to be injected from the inside through holes in the wall lining.

2.2.3 The holes to the external walls are then plugged and sealed, and a drying regime is followed while the insulation cures.

2.2.4 After installation, the split-stone veneer will be coated with a water-repellent coating (the same as that recommended by the consultant in paragraph 5.1.6). The manufacturer's information for the water-repellent coating describes it as a water based water-proofer that deeply penetrates porous cement surfaces; it does not create a 'plastic film' on the surface and has a 'high breathability'.

3. The background

3.1 The insulation provider, on behalf of the applicants, applied for a building consent on 21 February 2013 to retrofit the insulation. The building work is described in the application as consisting of:

> Making a series of 25mm holes in the external walls and pumping the insulation into the walls to improve the thermal performance of the house. The holes to the external walls are subsequently plugged, sealed and painted. A drying regime is followed while the foam cures (which is monitored to ensure the moisture dissipates as required E2.3.6).

3.2 The documents that were part of the building consent application were as follows:

- A cover letter setting out the documentation provided in respect of the installation of the insulation, and commentary on a BRANZ study (refer paragraph 3.6).
- A 'Report of assessment of existing building' dated 17 January 2013 , completed following an assessment carried out by the insulation provider to determine if the applicants' house was suitable to have insulation installed ("the assessment", refer paragraph 3.5).
- A statement demonstrating how the building work and existing building would achieve compliance with relevant clauses of the Building Code.
- A 'summary assessment' of the house's suitability to have insulation installed, signed by the applicants to show they understood that a waterproof coating would need to be applied to the cladding after the insulation was complete.
- A blank example of the 'evidence of compliance' report that would be completed when a code compliance certificate for the building work was applied for (see paragraph 3.3).
- The insulation provider's 'NZ Building Code Compliance Documentation (for masonry veneer cladding): v4.0 February 2013'[4].

In its letter accompanying the application for a building consent, the insulation provider also noted that it had not supplied documentation for the fibre-cement cladding as this had already been supplied with other building consent applications.

[4] Version 4.0 was not provided in the application for determination; however version 5.0 was provided on request by the Ministry and is referenced hereafter.

3.3 The consent application noted that after the insulation was installed evidence of compliance would be provided by way of:

- photographic evidence of the process used to seal the installation holes
- a record and photos of moisture readings taken on the slowest drying elevation to demonstrate that construction moisture had dissipated, with the application for a code compliance certificate made when evidence shows moisture has dissipated; readings to be taken pre-installation, at installation and two dates post-installation
- the dates that there was no longer any odour after installation and that the ventilation stickers were removed
- photographic evidence of the completion of the work identified as necessary in the summary assessment (namely sealing the external cladding with a 'waterproof' coating)
- the application for a code compliance certificate will be made when the stone veneer has been coated
- signed confirmation from the applicants and insulation provider that all necessary work had been attended to and there were 'no outstanding issues'.

3.4 The insulation provider's 'compliance documentation' for masonry veneer cladding

3.4.1 The insulation provider supplied the Ministry with a copy of it's "NZ Building Code Compliance Documentation (for masonry veneer cladding): v5.0 March 2013" which sets out the relevant clauses of the Building Code and the processes for ensuring the building work will comply. The document includes a 3-page process and 2-page risk matrix tool for evaluating whether after the installation of the insulation the existing house will continue to comply with Clause E2.3.5 of the Building Code to the extent required by the Act.

3.4.2 I have copied some excerpts relevant to the matter to be determined below:

> E2.3.6.
>
> Note: Moisture levels >18% mc after 3 months:
>
> 'If the moisture levels are above 18% after 3 months there is a small risk that damage might have occurred to the timber framing. Therefore in these instances, the issue needs to be escalated to head office. Head office will engage the services of a building surveyor to identify the causes for the slow drying and establish if any structural damage has occurred.'
>
> E2.3.2 and E2.3.5
>
> 'Completion of the existing building condition report [is required] to establish that the current condition of the exterior cladding indicates that it is performing adequately…'
>
> 'After the installation of [the insulation], the installation penetrations through the masonry/veneer cladding must be filled with a durable material and be weathertight. Once the holes have been filled and sealed the building work must be durable for a period of no less than 15 years…'
>
> 'Based on … international evidence and the applicability of it in terms of Determination 2008/35, [the insulation] can be installed behind masonry veneer

providing the cavity is no less than 50mm and provided the exterior is made impervious via an accepted and durable method, such as painting or coating with [water repellent coating].'

'Application for a [code compliance certificate] cannot be made until the application of the impervious coating has been completed as compliance with clause E2.3.2 is reliant on completion of the paint work.'

3.5 The assessment report

3.5.1 The assessment report covered items relating to the performance of the existing building, including the electrical wiring, fire-rated walls, fixed appliances and smoke alarms, structural stability, internal moisture and weathertightness. The report also contained: a table showing the insulation provider's 'evaluation of compliance with E2.3.5': a floor plan showing where insulation would be installed, and the positions of smoke alarms, fireplaces and windows: and photos of the exterior cladding and moisture readings being taken under the joinery.

3.5.2 The assessment report included three non-invasive moisture readings (ranging from 14% to 16%), and included the following comments (in summary):

- There is existing black building wrap; the framing is pine and likely to be H1 Boric treated.
- The external cladding has 'no visible gaps, cracks or loose mortar joints' or other defects, the windows appear well flashed and there is no 'evidence of failure or moisture entry' around the joinery.
- There are currently 'minimal penetrations through the external walls.'
- The internal wall linings are plasterboard, compatible, and are complete and 'in good order'.
- There are no visible leaks or mould; however the applicants noted that there had been mould on the bedroom and bathroom walls after they had been away.
- The house has PVC wiring.
- The ground clearance ranges from 250mm – 2.5m, and all weep and vent holes are unobstructed.

3.5.3 The report also contains the results of an 'Evaluation of compliance with E2.3.5' using the risk matrix tool included in the insulation provider's compliance manual.

3.6 The BRANZ study

3.6.1 The covering letter to the consent application referred to and commented on the Building Research Association of New Zealand (BRANZ) study report SR 234:2010 ("the BRANZ study"), which investigated the potential for the insulation to create a moisture bridge between the external cladding and the external wall framing, when installed behind brick veneer cladding. The BRANZ test demonstrated that moisture can travel through the insulation and would therefore result in non-compliance with Clause E2.3.5.

3.6.2 The insulation provider noted the differences between the BRANZ testing methodology and the proposed installation in the applicant's house, noting that:

- the split-stone veneer is to be coated and will no longer be porous
- the insulation is to be installed between the internal lining and building wrap, with the wrap providing a barrier between the insulation and the stone veneer

3.6.3 The insulation provider also noted that coating the veneer fundamentally changes the requirement for a drainage cavity, and considered that relevant United Kingdom ("UK") building requirements could be used to establish likely future compliance.

3.7 In an email dated 22 March 2013, the authority requested further information to demonstrate the proposed building work's compliance with clauses

- B1.3.1: in respect of the effect of the insulation on the existing structure throughout its life
- E2.3.2, E2.3.5, E2.3.6 and E2.3.7: information provided has not satisfied the authority that the requirements will be met. The authority has concerns over the dissipation of moisture without permanent damage to the building elements.

3.8 The authority also stated its concern that 'the building paper which is the second line of defence being compromised on numerous occasions', and that

> … our specific concern with [the insulation] within a masonry veneer property is the change to the physics in relation to the 'drained and vented cavity', as opposed to a 'drained cavity' in a traditional weatherboard or sheet clad property.
>
> The [Ministry] give guidance on the 4'd's. The installation of insulation within the cavity will adversely affect drainage and drying by ventilation and vapour diffusion.
>
> In addition to this the masonry absorbs water. This could be from the inside or the outside. The installation of [the water repellent coating] will prevent water from capillary transfer and solar assisted diffusion form the outside, but it will also prevent trapped moisture drying from within the wall to the outer surface of the masonry wall. If a protective layer like [the water repellent coating] is not used, our concern is [the insulation] will absorb the moisture by capillary transfer and solar assisted diffusion.

3.9 On 20 May 2013, the applicants' agent applied for a determination on their behalf.

4. The submissions

4.1 The agent made a submission in a letter accompanying the application for a determination. The submission commented on the building work's compliance with the code clauses identified in the authority's email of 22 March 2013. It also considered the findings of the BRANZ report and concluded that:

- there were issues with the testing methods BRANZ used
- 'In over 30 years of [the insulation] being installed in brick veneer homes there has been no evidence of systemic failure. This would seem to suggest that the concerns and conclusions raised in [the study] have not been replicated in real life'
- while it is recognised that brick veneer clad houses are at 'greater risk of possible failure' changes can be made to the building system 'to reduce the risk of non-compliance with E2.3.2 and E2.3.5', including:

- ‘increasing the impermeability of the brick veneer’ (through painting or coating the exterior cladding to make it ‘waterproof’)
- ‘ensuring current performance of joinery/brick junctions’ by taking moisture readings as part of the existing building assessment

- ‘it is difficult to use the [BRANZ] case study as robust evidence to support’ non-compliance.

4.2 With the application, the agent provided copies of the following documents.

- The original building consent application and its supporting documentation.
- The authority’s email of 22 March 2013 requesting further information.
- A case study dated April 2013, conducted by the agent on behalf of the insulation provider (“the agent’s case study”). The study looks at the circumstances surrounding a brick veneer clad house where elevated moisture levels and decay in the timber wall framing were detected in the exterior walls 18 months after the insulation had been installed. It details the construction faults and features contributing to this decay and the changes in standard practices introduced by the insulation provider as a result.
- A report dated March 2013, completed by the agent on behalf of the insulation provider (“the performance monitoring report”) detailing the procedure and results of nine site visits to brick and brick veneer clad houses that already had insulation installed. The purpose of the report being to establish performance after the installation with respect to moisture management.
- A report by BRANZ dated 25 February 1985 completed following a site visit to a brick veneer house where the insulation had been installed.
- The manufacturer’s technical information for the water repellent coating that is proposed to be applied to the cladding of the applicants’ house after the insulation has been installed, states:

  > Coating does not create a film on the surface it is applied to, but penetrates ‘the pores of its substrates…assuring that water or other corroding factors are effectively repelled…’
  >
  > Coating ‘creates a water barrier on the material’, but retains ‘the “breathability” of the modified surface. In case moisture is trapped or a water leakage takes place behind [the coated] surface, water can evaporate through the open pores to the environment relieving negative capillary pressure.’

4.3 In response to a request from me, the insulation provider also provided a copy of its ‘NZ Building Code Compliance Documentation (for masonry veneer cladding): v5.0 March 2013’.

4.4 The authority acknowledged the application for determination but made no submission in response.

4.5 A draft determination was issued to the parties for comment on 3 October 2013. I have summarised the submissions received in response to the draft below and have included in paragraphs 4.9 and 6 my comments on the points raised.

4.6 In a response dated 7 October 2013 the agent accepted the determination subject to the following comments:

- Given that it is almost impossible to establish the state of existing building wrap in older houses the insulation provider's process discounts the performance of any existing building wrap.
- The absence of building wrap in other non-brick veneer dwellings has been the subject of other determinations, with the result that the insulation was retrofitted to those dwellings.
- It would be helpful for guidance for future applications if any conclusions the consultant drew as to the ability to retrofit insulation in dwellings where no building wrap had been installed were to be included in this determination.

4.7 In a response dated 16 October 2013, the authority did not accept the draft and submitted (in summary):

- the description of the building work is 'to improve the thermal performance of the house' and the 'relevant performance of H1 [was] applicable due to the description of [the] works'. The Ministry should define what adequate performance is in this instance.
- it is highly probably that the moisture content within the construction of the building will be elevated above that originally found; accordingly the building work does not comply with section 112(1)(b)
- the officer of the authority 'has considerable experience in the UK' and noted that: coating a brick veneer with an 'impermeable coating' is considered 'neither necessary nor good building practice': the use of the insulation in the UK is not relevant to its use in New Zealand given the limitations on use in the UK: a proposal to retrofit the insulation into a space behind a brick veneer to a timber-framed house in the UK would not receive consent
- compliance relies on whether it is possible to deliver the insulation to the 'intended concealed spaces'; the method of delivery, and the 'high probability' of delivering insulation within the cavity between the brick veneer and wall framing must be seriously considered
- the building wrap is of 'paramount importance'.

4.8 The agent provided a further submission, received on 29 October 2013, in response to the authority's submission on the draft. The agent submitted that:

- compliance with Clause H1 and the method of delivery is beyond the scope of the matter to be determined and therefore not relevant
- in respect of section 112(1)(b), previous determinations have concluded that the insulation provider's method for tracking the level of construction moisture will demonstrate compliance with Clause E2.3.6
- given that it is impossible to assess the building wrap in an existing building, particularly one constructed prior to 1991, it is considered prudent to consider the future performance of the building as if no building wrap is present.

4.9 In regard to the authority's submission I note the following:

- The coating is permeable to water vapour and does not create any coating on the surface of the veneer (refer paragraph 2.2.4).
- Regarding the use of retrofitting urea formaldehyde insulation in the UK: as part of my considerations in Determination 2008/35 the Ministry undertook an internal study that took into account the use of this type of insulation in other countries including in the UK. I have taken that study into account in considering the matters to be determined in this case.
- The compliance of the work in respect of Clause H1 is discussed in paragraph 6.3.

5. The peer review and site visit

5.1 The peer review

5.1.1 I engaged the services of an independent building consultant ("the consultant") with specialist expertise in brick construction to undertake a peer review of the draft determination. I have amended the draft to take account of the consultant's comment.

5.1.2 The consultant stated that to his knowledge there were 'a good number of houses in New Zealand where the described process has been done', with no 'issues' that the consultant was aware of. He also noted that many brick veneer dwellings were built prior to the requirement to install building wrap and do not have any wall insulation.

5.1.3 In respect of the subject house the consultant made the following general comments:

- It is not absolutely clear as to what part of the structure is to be filled with the insulation, with three possibilities including
  - between the brick and the wrap (50mm), which the consultant considered to be unlikely and of little benefit
  - between the wrap and the internal wall lining (100mm), considered the most likely option in this case
  - between the brick and the internal wall lining (150mm).
- With the insulation fitted between the wrap and the internal wall lining, the significance of the issues to be considered are greatly reduced and the foam would probably dry a lot quicker due to air movement in the 40mm cavity.
- The only question then would be how you can tell if the individual cavities are full, how damaged the wrap may be, and whether consideration had been given to filling the cavities from the inside of the building or even from inside the roof space (if that was possible).

5.1.4 The consultant considered there were three issues that required consideration in respect of compliance, which I have summarised as follows:

Performance of brick ties in a seismic event

The function of the cavity includes separating a rigid structure from a flexible structure and to enable a method by which the brick ties secure the veneer to the

structural frame. The consultant was of the opinion that brick ties would likely cut through the foam in a seismic event and generally perform as it should.

Moisture from the liquid foam

It is when timber is exposed to a continuous cycle of wetting and drying, or continuous wetting, over a considerable period of time that issues will arise. Water will evaporate from the foam and the timber in what the consultant considers a reasonably short period of time.

Moisture ingress

There is an established history of performance of this insulation in brick veneer houses without building wraps throughout the country where the insulation spans between the back of the brick and the inside lining and where the porous surfaces have not been sealed. The consultant is of the view that the system has performed 'very well over a long period of time, and subjected to all weather conditions'.

5.1.5 The consultant also commented on the properties of brick veneer, noting that it sheds water exceedingly well, it has a very limited ability to absorb moisture, and as a heat sink any moisture present also evaporates rapidly.

5.1.6 The consultant noted that he would consider the application of a water repellent coating on masonry veneer as an essential precaution to the weathertightness of the building, as well as the specification of a flexible sealant between the window and door joinery and the brick. The consultant named one such repellent coating (the same as that proposed by the insulation installer, refer paragraph 4.2) that he advised was a breather-type product that allowed moisture to escape from inside the cavity.

5.1.7 The consultant concluded that he considered the building work and existing building as altered would comply with the relevant clauses of the Building Code.

5.2 The site visit

5.2.1 The house was visited by an officer of the Ministry on 25 September 2013. The visit was to confirm the description of the house provided by the insulation provider in its assessment report dated 17 January 2013 (refer paragraph 3.2).

5.2.2 The visit's findings are reflected in paragraph 2. It is noted that some areas of the perimeter foundation appear to have limited subfloor ventilation, particularly adjacent the concrete deck.

6. Discussion

6.1 General

6.1.1 The matter for determination is whether the proposed building work complies with the relevant clauses of the Building Code, identified by the authority as of concern (refer paragraph 3.7).

6.1.2 I have issued a number of determinations[5] about the requirements of the Act, as they relate to alterations to existing buildings, including those that involve retrofitting urea foam insulation. These determinations set out the Building Code obligations that apply to building work of this nature, both with respect to the building work itself and with respect to the existing building. The Ministry has also issued guidance[6] under section 175 of the Act on Building Code compliance for retrofitting insulation in external walls that is relevant to this determination.

6.1.3 The approach established in these determinations applies in the current case. However, those determinations considered all aspects of compliance. In the current case I have confined my discussion to the proposed building work's compliance with the clauses where the authority considered compliance had not been established (refer paragraph 3.7).

6.1.4 The insulation provider has provided a methodology for the proposed work. While this appears generally adequate, it is unclear now much the ventilation capacity of the wall cavity will be reduced after the insulation has been installed.

6.1.5 The cavity to the split-stone veneer is to be filled from the outside to a thickness of 100mm. It is unclear how this is to be achieved in practice. The foam will need to be injected past the 40mm cavity, through the building paper, and into each section of wall that is bounded by studs and dwangs – it is not clear how the installer can then be satisfied that each section of wall has been filled. In my view this should be clarified in the installer's methodology as a matter of best practise: it does not impact on the compliance of the work to the extent required by the Act.

6.1.6 The agent has submitted that the existence of building wrap is discounted in terms of the insulation provider's process (refer paragraph 4.6). I note that the documentation provided for building consent purposes should be clear on this point, particularly as the assessment report identifies the existence of building wrap (refer paragraph 3.5.2) and the presence of wrap is included in the evaluation matrix used by the insulation provider. In my consideration of compliance with Clause E2 I have taken into account the possibility of the building wrap being degraded and or absent and insulation filling the cavity.

6.1.7 The insulation provider has advised that the walls with the fibre-cement sheet cladding will be filled from the inside given potential difficulties of patching the fibre-cement sheets. I note that it would also be possible for the insulation to the split stone veneer to be installed from the inside.

6.2 Compliance with Clause E2.3.6

6.2.1 The installation of the insulation must comply with Clause E2.3.6 of the Building Code with respect to the dissipation of the excess moisture present at the completion of construction.

6.2.2 The insulation provider offered information to demonstrate how compliance with the Building Code would be achieved; some of which is general to the product

[5] Including determinations 2012/026, 2012/027 and 2013/005.
[6] Guidance on Building Code compliance for retrofitting insulation to external walls, August 2011, Department of Building and Housing

installation methodology and some is specific to the proposed building work. The authority remains concerned about the effect that the construction moisture will have on the external wall faming and other elements, and the ability of the construction moisture to dissipate.

6.2.3 While it is true that the building work will involve the introduction of moisture, there is also evidence that this usually dissipates quite rapidly. Factors that will affect how quickly the insulation dries will include the vapour permeability of the wall linings and claddings, the rain and wind environment, the ground conditions and foundation connections to a wall, the condition of the existing cladding, the ventilation rate within the cavity (including whether or not the cavity is partially or completely filled with the insulation), and the relative temperature of the external and internal wall surfaces.

6.2.4 The authority has also submitted that the elevation of moisture content of existing building elements above that prior to the building work would mean that the building work does not comply with requirement set out in section 112(1)(b) that 'after the alteration the building will continue to comply with the other provisions of the building code to at least the same extent as before the alteration.' I consider that in respect of retro-fitting urea formaldehyde foam insulation, the period of exposure that would elevate the moisture content in existing building elements is relatively low and as it is a temporary effect only the building work does ultimately comply with section 112(1)(b).

6.2.5 In the current case, the insulation provider has supplied evidence (in its pre-installation building assessment) that the cladding and internal wall linings are in good condition and vapour permeable, and that there is good subfloor ventilation. I consider the adequacy of the subfloor ventilation with respect to the concrete deck, and the ventilation to the southwest wall to the lounge (being double-height split-stone veneer) needs to be verified. I note the insulation contains a fungicide to offset the impact of the construction moisture for the time that it remains present.

6.2.6 I am satisfied that the insulation provider's process for monitoring post-construction moisture levels is acceptable, and that there is a suitable procedure in place for dealing with any situation where moisture levels do not reduce for any reason. The consultant is also of the view that the introduced moisture will evaporate in a reasonable short period of time.

6.2.7 I note here that the rate of drying will be affected by a reduction in the cavity space or the lack of a cavity if it is to be filled with insulation. I concur with the consultant's view that building wrap will reduce the significance of issues related to the dissipation of construction moisture; however, I also consider that although it would take longer for moisture to evaporate it does not necessarily follow that the building work would not comply.

6.2.8 In determination 2008/35 an opinion was obtained from a major brick manufacturer which stated that the warranty would be invalidated if the cavity were to be infilled. The manufacturer noted that any latent salts and moisture produced during the laying, and in that case also the plastering process, would be entrapped in the bricks which could result in the structure and compressive strengths of the bricks being

compromised. The brick manufacturer also stated that a foam-filled cavity could be considered if the following actions were taken:

1. The bricks [and in that case plaster as well] would need to be completely dry before foam could be added (how would this be measured?).
2. The coating system would need to be completely impervious to any form of moisture leakage or failure for the 50 year life of the brick. Zero leakage tolerance.
3. The top of the veneer would need to be completely closed off and sealed.
4. The brick would need to be a solid unit (no voids) simply because there is a real possibility of condensates forming on the inside walls of the brick voids causing moisture to be trapped in the veneer.

6.2.9 In the present case, I note that the split stone veneer has been in place for many years, the coating to the stone is also proposed to be a breathable product rather than plaster, and that the likelihood of the wrap being present means the foam insulation is unlikely to completely fill the cavity. In addition I am of the view that post-installation shrinkage will mean there is still capacity for any water that does penetrate the external cladding or internal linings to dissipate.

6.2.10 From earlier determinations on the insulation provider's product, I am aware that it has taken steps to strengthen its processes and consent documentation. I am satisfied that this documentation, subject to verification of the ventilation (refer paragraph 6.2.5), is sufficient to demonstrate compliance with Clause E2.3.6. In particular, I am satisfied that the monitoring information that the insulation provider has undertaken to supply with the application for a code compliance certificate is sufficient to establish compliance on reasonable grounds, and that the performance monitoring report on brick houses where insulation has been installed in the past demonstrates that this risk is low.

6.3 Compliance with Clause H1

6.3.1 In response to the draft determination the authority requested the determination consider compliance Clause H1 and provide guidance on what would be considered 'adequate' in this instance. I note the authority had not previously raised concerns in relation to H1 and therefore it was not included in the matter for determination, however, I provide the following comment to assist the authority.

6.3.2 The purpose of retrofitting insulation is to provide improved thermal resistance. It is almost certain that retrofitted insulation will improve both the thermal resistance and the airtightness of the existing walls, so the work will not adversely affect the compliance of an existing house in relation to H1.3.1.

6.3.3 Clause H1.3.2E requires that 'Buildings must be constructed to ensure that their building performance index does not exceed 1.55'; this clause is relevant to the performance of buildings. Therefore Clause H1.3.2E is not applicable to the retrofitting of insulation as this building work is an alteration to the existing thermal envelope, but not a replacement of the thermal envelope. Accordingly the performance of the retro-fitted insulation need only comply to the extent required by section 112(1)(b), in that the thermal envelope must be no worse than before the alteration.

6.4 Compliance of the existing building with respect to the requirements of Section 112 (Clauses E2.3.2, E2.3.5, E2.3.7 & B1.3.1)

6.4.1 With respect to the impact of retrofitting insulation and under section 112 of the Act, the altered building needs to comply to at least the same extent as before the building work is done. It is therefore necessary to consider the impact of installing the insulation on the existing building elements and components of the building, and the way in which the components work (e.g. the effect on moisture transfer inside the walls, and the change in drying rates). This is both in terms of the installation and drying process, and once the insulation is dry.

6.4.2 I have discussed below the relevant Building Code obligations, with respect to the compliance of the existing building to the same extent as before the proposed alterations are undertaken:

Clause E2.3.2

the ability of the external wall to prevent the penetration of water that could cause undue dampness or damage must not be reduced

6.4.3 I accept the insulation provider's submission that the process described in the building consent and installation manual to make good the penetrations in the external cladding is sound and follows accepted practice. I am of the view that the ability of the external walls to prevent the penetration of water will not be reduced as a result of forming and repairing the installation holes, and will be enhanced by the application of the water repellent coating.

6.4.4 The authority is also concerned about the effect that the installation holes will have on the building paper, given that it sits behind the cladding and, in the authority's words, is the 'second line of defence'. However, the cladding at issue in this determination is the split-stone veneer, where the building paper is located on the outside face of the timber framing and not directly behind the cladding.

Clause E2.3.5

the ability of the cavity to prevent external moisture being accumulated or transferred must not be reduced.

6.4.5 I accept the insulation provider's assessment, as set out in its pre-installation building inspection report, that the cladding and external walls of the applicants' house are currently in good condition and comply with the Building Code. The question then becomes whether they will continue to comply to the same extent after insulation has been installed.

6.4.6 The authority is concerned that the installation of the insulation will 'change the physics' of the wall cavity, in particular through 'closing off drainage paths, effect on air movement, drying rates, moisture retention and moisture transfer towards internal linings'.

6.4.7 There is some evidence that the installation of foam insulation within brick and brick veneer clad walls may, in certain circumstance, reduce the wall's ability to dissipate moisture or create moisture bridging between the external cladding and the internal linings. This is seen in the BRANZ study, in the case study provided by the

insulation provider, and in limits set around the installation of foam insulation in houses in the UK where it is widely used.

6.4.8 However, I accept the insulation provider's submission that there are limitations with the BRANZ study and that its findings are not necessarily borne out in practice. The performance monitoring report on the performance of brick houses where the insulation has been installed in the past supports this, and demonstrates that the risk is low.

6.4.9 I also accept that these risks can be managed through appropriate assessment of the suitability of houses, and that the insulation provider now has robust assessment procedures in place. Its 'NZ Building Code Compliance Documentation (for masonry veneer claddings): v5.0' contains detailed information about the specific risks associated with installing the insulation in brick veneer houses, the checks that installers must take to avoid these, and the situations where installation would be unsuitable. The manual includes a risk matrix tool that enables all of the relevant factors to be taken into account when assessing suitability. The manual directs that an existing building condition report must be completed in all cases, and that the cladding should be coated with 'an appropriate impervious coating'.

6.4.10 The authority is also concerned about the effect of the water repellent coating on the performance of the external walls. In particular, it is concerned that coating the cladding will prevent any moisture that does enter the wall, either from the inside or the outside, from being diffused through the split-stone veneer in the normal way and hence becoming trapped.

6.4.11 The water repellent coating does not create any film on the surface of the spilt-stone veneer and the manufacturer has described it as having a high breathability. It is a material recommended by the consultant.

6.4.12 I do not believe the water repellent coating will greatly change the way in which the external wall manages moisture. The coating will help to repel any liquid water from entering the veneer, but it will not stop water vapour leaving the veneer. The addition of the coating should not materially affect the functioning of the veneer, other than to reduce the amount of water that can enter the wall from the outside. I do not consider the water repellent coating will render the wall impermeable as might be the case with a high-build acrylic paint system.

6.4.13 The authority has noted that moisture may enter the wall from inside the house. The presence of the insulation will not increase the likelihood of this happening, as internal water vapour would reach the external wall framings anyhow, without possible bridging of the cavity between the framing and the split stone veneer. What is potentially reduced is the ventilation paths open to disperse this vapour if the ventilation cavity is also filled or reduced. This would be case with any installation and is not a risk peculiar to brick veneer clad houses. I do not consider this a high risk, and, as discussed above, the wall will still retain some ability to diffuse water to the outside. The cladding's ability to diffuse water internally will not be detrimentally affected.

6.4.14 In respect of the possibility of the building paper in this house being ineffective or absent, in many cases the presence of building paper is an important factor in

ensuring compliance with Clause E2.3.5, however, it is not the only factor, and there will be situations where a lack of building paper may not be critical to Building Code compliance, even though it may be best practice.

6.4.15 I am of the opinion that the insulation provider has robust procedures in place for ensuring that brick veneer clad houses will continue to comply with Clause E2.3.5 of the Building Code after the installation of the insulation, and that these procedures have been appropriately applied in the current case. Accordingly, I conclude that the applicants' house will continue to comply with Clause E2.3.5 to the extent required by the Act after the proposed building work has been carried out.

6.4.16 Whether the house continues to comply over time will depend on the maintenance of the cladding and the water repellent coating. This, in itself, is not unusual, as there are many cladding systems that rely on regular maintenance to maintain their performance. The insulation provider's procedures include alerting home owners of the need for coating and gaining their agreement to this.

6.4.17 I conclude that the exterior walls will continue to comply with Clause E2.3.2 to the extent required by the Act after the proposed building work has been carried out.

Clause E2.3.7

building elements must be constructed in a way that makes due allowance for:

(a) the consequences of failure:

(b) the effects of uncertainties resulting from construction or from the sequence in which different aspects of construction occur:

(c) variation in the properties of materials and in the characteristics of the site.

6.4.18 The authority has stated that it considers Clause E2.3.7 applies, with respect to 'the building paper which is the second layer of defence being compromised on numerous occasions'.

6.4.19 The cladding at issue in this determination is the split-stone veneer, where the building paper is located on the outside face of the timber framing and not directly behind the cladding. The existing cladding provides a robust system preventing moisture ingress that will allow for variations in materials and construction. I do not believe the proposed work will detrimentally affect the performance of the cladding to the extent anticipated by the authority.

Clause B1.3.1

the structural performance of the framing is not reduced, with respect to the accumulated moisture causing damage to the framing [relates to Clause E2]

the structural performance of claddings and internal linings (for withstanding normal loads in use and providing bracing units where relevant) is not reduced

6.4.20 Maintaining compliance with Clause B1.3.1 is achieved by maintaining at least the same compliance with Clauses E2.3.2 and E2.3.5. I have found above that the split-stone veneer's compliance with Clause E2 will not worsen as a result of the installation of the insulation; it follows that the insulation will not worsen the buildings performance with Clause B1.3.1 through the effects of any additional moisture.

6.5 I note here that all determinations are decided on a case-by-case basis and that in different circumstances the absence of building paper, water repellent coating or the other factors mentioned in this determination may be a material factor.

7. Decision

7.1 In accordance with section 188 of the Act, I hereby determine that the proposed building work and the existing building (as altered) would comply with Clauses B1.3.1, E2.3.2, E2.3.5, E2.3.6 and E2.3.7 of the Building Code to the extent required by the Act.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 12 December 2013.

John Gardiner
Manager Determinations and Assurance