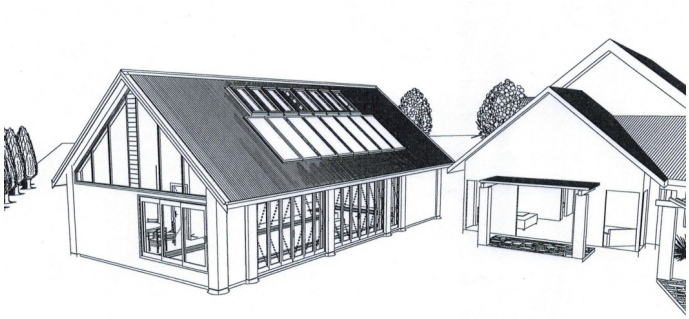
Determination 2016/026

Determination regarding the compliance of a vapour barrier to a proposed pool house at 867 Rapaura Road, Blenheim



Summary

This determination is concerned with the design of a proposed pool building that is an outbuilding to a dwelling. The determination considers what Building Code clauses apply to pool building, and whether the information provided with the application for building consent demonstrates that the proposed work will comply with the requirements of the Building Code.

1. The matter to be determined

1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004[1] ("the current 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 the determination are:

- the owners of the proposed building, P and G Marfell ("the applicants") acting through the designer of the pool house ("the designer")
- Marlborough District Council ("the authority"), carrying out its duties as a territorial authority or building consent authority.

1.3 The reason for the application

1.3.1 In response to the initial application for a building consent, the authority expressed concern about condensation within wall and roof framing resulting from the generation of water vapour from the heated pool.

1.3.2 The designer amended drawings to incorporate a vapour barrier within the structure ("the vapour barrier system"). However, the authority continued to refuse to issue to grant the building consent unless specialist advice was provided.

[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.

1.3.3 In the meantime, the authority has apparently agreed to approve the staging of construction to allow work to start on foundations, the pool, the concrete slab and the steel frame while the matter of the vapour barrier is being resolved.

1.3.4 The application for this determination arises from the decision of the authority to refuse to grant the building consent for the second stage of the building until it has received sufficient information to be satisfied that the pool house will comply with regard to internal moisture and specifically condensation forming in the wall framing.

1.4 Matter for determination

1.4.1 I note that the authority has referred to Clause E3 Internal Moisture[2] of the Building Code (Schedule 1, Building Regulations 1992). The pool house in this case is detached from the dwelling, and its classified use under Clause A1 is "Outbuilding". Outbuildings are defined in 7.0.1 of Clause A1 as:

> Applies to a *building* or use which may be included within each classified use but are not intended for human habitation, and are accessory to the principal use of associated *buildings*. Examples: a carport, farm *building*, garage, greenhouse, machinery room, private swimming pool, public toilet, or shed.

1.4.2 The objective and functional requirements of Clause E3 are in respect of the accumulation of internal moisture and avoiding the likelihood of fungal growth, contaminants, and damage to building elements. The limits on application for performance requirement E3.3.1 state that the clause 'does not apply to … outbuildings…' meaning that the requirement does not apply to the subject pool house.

1.4.3 Accordingly in this case it is the requirements under G4 Ventilation, B2 Durability and B1 Structure that apply, specifically:

> G4.3.3 Buildings shall have a means of collecting or otherwise removing the following products from the spaces in which they are generated: (b) moisture from laundering, utensil washing, bathing and showering,
>
> B1.3.3 Account shall be taken of all physical conditions likely to affect the stability of buildings, building elements and sitework, including: (e) water and other liquids,
>
> B2.3.1 Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or:
>
> (a) the life of the building, being not less than 50 years, if:
>
> (i) those building elements (including floors, walls, and fixings) provide structural stability to the building, or
>
> (ii) those building elements are difficult to access or replace, or
>
> (iii) failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building.

1.4.4 The matter to be determined[3] is therefore whether the building as proposed will comply with Clauses G4.3.3(b), B1.3.3(e) and B2.3.1(a) of the Building Code.

1.4.5 The relevant clauses of the Building Code discussed in this determination are included in Appendix A.

[2] In this determination, unless otherwise stated, references to sections and clauses are to sections of the Act and clauses of the Building Code.
[3] Under sections 177(1)(a), 177(1)(b) and 177(2)(a) of the Act

1.5 Matters outside this determination

1.5.1 The applicants have limited this application to the authority's concerns about internal humidity resulting from the swimming pool and this determination is therefore limited to the matters outlined above.

1.5.2 This determination does not consider any matters relating to the staged consent application (refer paragraph 1.3.3), other building elements or other clauses of the Building Code.

2. The building work

2.1 General

2.1.1 The proposed building work is a single-storey detached outbuilding on a flat site in a medium wind zone for the purposes of NZS 3604[4]. The building accommodates a 12m x 3m heated pool, a shower room and a plant room within a 14m x 7m rectangle. The pool house is specifically engineered, with steel posts and beams and laminated veneer lumber ("LVL") rafters, timber infill framing, and a concrete slab, pool structure and foundations.

2.1.2 The pool house has EIFS[5] wall cladding to match the existing house, profiled metal roofing and thermally-broken double glazed aluminium joinery, with two sets of 3.5m long bi-fold doors to the north west elevation.

2.1.3 The 40^{o} pitch gabled skillion roof has 600mm eaves, with two rows of skylights below the roof ridge; installed between the three central LVL rafters forming a portal structure. All timber framing is H3.1 treated and steelwork is to be 'painted' after welding.

2.1.4 According to the designer, the applicants do not intend to heat the pool house and the pool will be covered when not in use in order to minimise heat loss and evaporation. The drawings show proprietary double-glazed skylights in the roof plan. The skylights are non-ventilating.

2.1.5 The pool is to use ozone treatment with 'low levels' of corrosive chemicals to treat the pool water.

2.2 The exterior walls and ceilings

2.2.1 An indicative sketch of the proposed vapour barrier system is provided in Figure 1:

2.2.2 As shown in Figure 1, the proposed vapour barrier is intended to be installed to the inside face of the insulated structure with the aim of preventing water vapour generated by the heated pool from reaching framing then condensing as interstitial moisture within the wall and roof structure when temperature conditions allow.

2.2.3 The vapour barrier is a woven polyethylene fabric coated on both sides with a polyethylene film to form a moisture barrier. The vapour barrier supplier has reviewed the drawings and confirmed that the design appears to meet the 'primary objective' of keeping 'humid air from entering the void in the wall' (see paragraph 3.4).

[4] New Zealand Standard NZS 3604:1999 Timber Framed Buildings
[5] Exterior Insulation and Finish System

2.2.4 The interior linings are a proprietary fibre-cement sheet suitable for internal wet areas, with long edges recessed to allow flush-jointing. The linings are not used as bracing elements. The designer has stated that the linings will be 'coated on all surfaces with an exterior grade paint, throughout' and also that:

> All joints in the linings are to be taped and stopped and all electrical fittings are to be surface mounted with all pipe and wire penetrations sealed with flexible sealants to provide an airtight barrier.

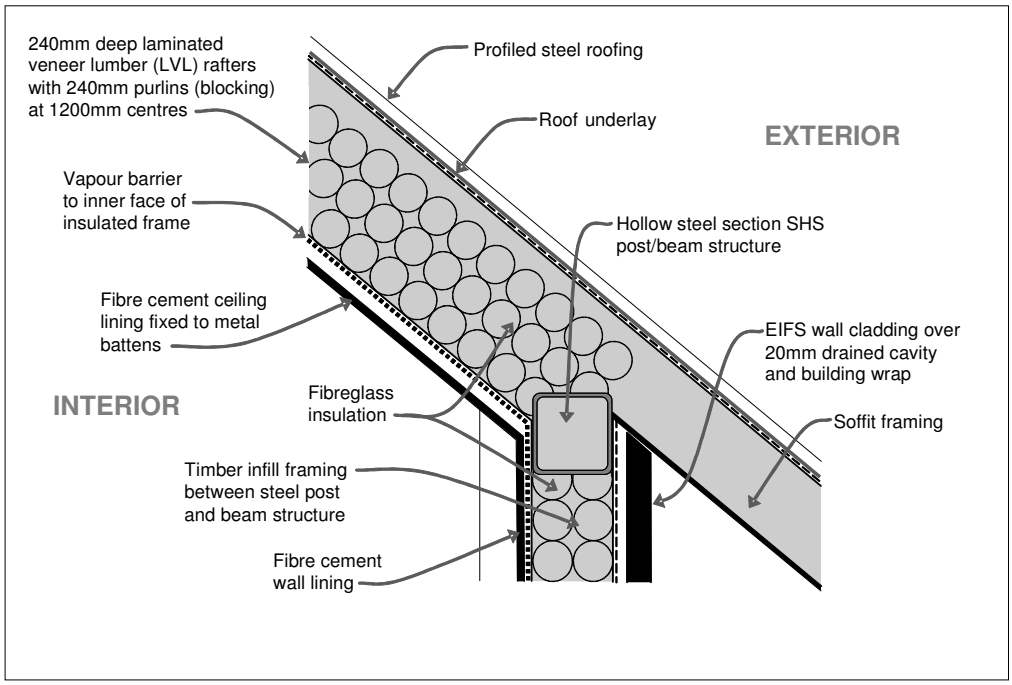


Figure 1: General roof / wall construction (not to scale)

2.3 Water vapour transmission

2.3.1 The relevant local standard for membranes and underlays AS/NZS 4200[6] classifies the water vapour resistance of materials as:

- High: 450 MN.s/g or above
- Medium: between 7 and 450 MN.s/g
- Low: 7 MN.s/g or below.

2.3.2 This determination uses the following terms that are commonly used in international literature to describe the resistance of various materials:

- Vapour blocker: 5,000 MN.s/g or above (e.g. glass, steel roofing)
- Vapour barrier: between 250 and 5,000 MN.s/g
- Vapour retarder: between 50 and 250 MN.s/g. (e.g. roof underlay, some types of internal linings etc.).

[6] AS/NZS 4200.1:1994 Pliable building membranes and underlays - Materials

2.3.3 The data sheet for the proposed vapour barrier provides various properties for the product, including its water vapour resistance tested in accordance with AS/NZS 4200. That data sheet shows a resistance of 308 MN.s/g[7], which would accordingly classify it as a vapour barrier with a medium water vapour resistance.

3. Background

3.1 The applicants lodged an application for a building consent for the building work. I have not seen a copy of that application. It appears that the drawings did not incorporate a specific vapour barrier and the authority requested further information, stating:

> Surface condensation can be a problem where vapour barriers are needed for buildings enclosing very warm or wet areas such as spa pools, saunas and swimming pools. These situations are not covered by the acceptable solution.

3.2 According to the designer, he was referred to a BRANZ article[8] for guidance on the way the building needed to be constructed. The designer investigated the type of building the article was based on and found that the situations were not comparable. Following further general research into vapour barriers, the designer amended the drawings to include a vapour barrier on the inside face of the structural elements and insulation, and re-submitted these to the authority.

3.3 In a letter to the designer dated 7 March 2016, the authority listed items needing to be resolved. Item 5 of the list stated:

> The internal environment in the pool house is a complex problem that needs to be addressed. The referral to the BRANZ article was to highlight the moisture issues and to assist you with the design. [The authority] believes what you are proposing with a vapour barrier under the internal linings will not prevent condensation forming in the wall framing. You need to come up with a suitable solution with back up evidence from a person suitably qualified in the area of E3 Internal Moisture.

3.4 The designer consulted the manufacturer regarding the choice and location of the vapour barrier. In a letter to the designer dated 10 March 2016, the manufacturer referred to its review of the drawings; noting that the 'proposed design is in keeping with standard design layout where the primary objective is to keep humid air from entering the void in the wall.' The manufacturer also noted that the painted linings would form the 'primary barrier layer', with the 'vapour control layer' provided by the vapour barrier as 'a back up to the primary protection.'

3.5 In a letter to the designer dated 11 March 2016, the authority stated that the manufacturer's statement 'falls well short of the evidence [the authority] expects for this high risk construction' and requested further information be provided by 24 March or 'this consent will be declined.' The authority also noted that a determination could be sought on the matter and stated:

> You are proposing a system for the construction of a building over a swimming pool. You need to provide evidence to [the authority] from a suitably qualified person that the system you are proposing will work and the building will have a minimum life expectancy of 50 years.

3.6 The Ministry received an application for a determination on 5 April 2016.

[7] With a vapour permeance of 0.0032 µg/Ns
[8] *Indoor Pool Challenge*, S. Alexander: Build 133 – December 2012/January 2013

4. The submissions

4.1 The initial submissions

4.1.1 The designer made a submission on behalf of the applicants, which set out the background to the authority's refusal to issue a building consent without a specialist report on the proposed vapour barrier system. The designer described the building and its intended use, explaining in detail his logic and theory behind the measures he proposes to protect against any risk of condensation damage.

4.1.2 The designer attached copies of:

- the drawings dated 10 March 2016
- the manufacturer's letter dated 10 March 2016
- some correspondence from the authority
- various published articles and other information.

4.1.3 The authority acknowledged the application for determination and in a covering email on 5 April 2016 noted that it had not formally refused to issue the building consent but rather had been seeking clarification on the proposal in order to establish compliance.

4.2 The first and second draft determinations and submissions in response

4.2.1 On 11 May 2016 a draft determination was issued to the parties for comment. The draft determination found that the pool with the proposed vapour barrier would be compliant subject to the revision of items listed in the determination. Both parties accepted the draft without comment.

4.2.2 An internal review of the draft determination highlighted issues beyond those listed in the first determination, and the matter was reconsidered. The draft was amended and was reissued to the parties as a second draft for comment on 17 June 2016.

4.2.3 The authority accepted the second draft on 20 June 2016, saying the findings were 'in line with Councils concerns'.

4.2.4 The designer responded on 22 June 2016. The designer did not accept the second draft and provided a detailed submission in response and provided a set of amended drawings (Revision Date 26/05/2016) in response to the second draft determination. The revised drawings included the addition of the vapour barrier to some details only, noted the skylights as non-ventilating, and added a finishes schedule for the wall and ceiling linings.

4.2.5 The designer made the following points (in summary):

- The review referred to in paragraph 4.2.2 should have taken place before the first draft determination was issued for comment.
- 'The decision was made to not heat the interior air, cover the pool with an insulating cover when not in use and provide sufficient ventilation to control humidity levels within the building.' The primary intention was to prevent moisture from entering building cavities causing interstitial condensation.
- For moisture-related problems to occur, four conditions must be met (a moisture source, a mechanism to drive moisture movement, a route for the moisture take through the structure, and materials used that are not susceptible

to damage from moisture). There is a moisture source, but as the other three conditions are satisfied, moisture related problems 'are unlikely to occur'.

- The vapour barrier, plus the lining painted both sides (the latter is a 'vapour retarder') provide an adequate barrier to vapour if properly installed. 'What then becomes important is the … sealing of all penetrations, laps and edges.' The fixings to wall and ceiling linings 'pose no additional risk to vapour transmission.' The metal ceiling battens were faced-fixed to the roof framing and not fixed using the normal proprietary clips.
- Passive ventilation only was proposed. The owners had been made aware of the need for ventilation to reduce humidity. A notice to this effect could be placed on the title or fixed to the building to inform future owners.
- It was likely the air temperature in the pool would be 'very close' to the outdoor temperature and humidity' meaning the situation is similar to 'an outdoor pool with rain and wind screening'. The provision of tempered air would increase the rate of evaporation and hence condensation.
- Specialist advice had been sought from the author of the BRANZ article referred to by the authority (refer paragraph 3.2), and the vapour barrier supplier.
- Why was modelling analysis (refer paragraph 5.5) not completed as part of the determination process or requested of the applicants?
- The designer questioned how it was that there was no reliable history for the use of vapour barriers, yet the draft determination said one was required?

4.2.6 I have taken account of the designer's submission and amended the determination as appropriate.

4.2.7 In response to the designer's question why modelling analysis, such as WUFI, was not completed by MBIE or requested of the applicants (I note the authority recommended the designer seek specialist advice). The application arises from the authority not being satisfied that the proposed work as detailed in the application for consent will satisfy the Building Code in respect of internal moisture. The determination makes a decision in respect of the authority's position: it is not up to the determination to say how compliance is to be achieved. The Building Code is performance-based and an owner can elect to use a range of methods to achieve compliance.

5. The available evidence

5.1 In order to form a view as to code compliance of the proposed building I need to consider the evidence that is available, which includes:

- the available test and technical information on the system
- the available technical information on the wall system proposed for this particular building, including the detailed drawings.

5.2 The vapour barrier manufacturer provides technical information on various properties of the barrier, which provides values and test methods used to determine those values. The data sheet includes values determined by testing for water vapour transmission rate, permeance and resistance.

5.3 The results are based on test methods that accord with AS/NZS 4200 and testing was carried out by a recognised New Zealand Crown Research Institute[9], which provided a test report in 2011[10].

5.4 Other information available for the vapour barrier includes:

- the manufacturer's instructions for installation
- the manufacturer's letter dated 10 March 2016 about the intended use
- the detailed drawings of the proposed construction.

5.5 I note that there has been no computer modelling of performance carried out for the building. Modelling software tools such as WUFI[11] can analyse heat and moisture changes over time in building envelopes. The results predict when condensation will occur and how much moisture will be in a wall or roof assembly over time; identifying potential moisture problems caused by poor design, or inappropriate material use.

5.6 The results of modelling software analysis would allow a link to the information to the applicable performance requirements of the New Zealand Building Code. However, no thermal modelling has been carried out and limited specialist advice has been obtained.

5.7 I am aware of local and international problems arising from the inappropriate use of vapour barriers where they have been installed incorrectly. The successful installation of a vapour barrier to this building will rest on specialist advice, and I am not aware of any established method that can be applied in this case. While local research on interstitial condensation is underway[12], results useful for assessing the particular circumstances of the subject building are not yet available.

6. Discussion: The compliance of the proposed building

6.1 General

6.1.1 The authority's concerns about the use of this vapour barrier system are associated with the potential accumulation of internal moisture within the building envelope.

6.1.2 In the case of this building, the matter in dispute is whether moisture vapour from the heated pool, under anticipated use patterns, is likely to generate condensation and cause fungal growth and damage to building elements within concealed spaces if the building envelope is constructed as proposed.

6.1.3 An indoor pool environment is typically moist, and, depending on the water treatment chemicals used, corrosive.

6.1.4 Condensation takes two forms:

- surface condensation that will form on cold surfaces
- interstitial condensation that will form within the building envelope.

Condensation is managed through a combination of the use of vapour barriers to prevent moisture entering the building envelope, the provision of insulation to the

[9] NZ Forest Research Institute Ltd
[10] Scion Test Report 48053 (July 2011)
[11] Developed by Fraunhofer Institute for Building Physics (FIBP), with BRANZ as local partner for NZ use
[12] BRANZ Vapour control in New Zealand walls project

building envelope to raise the temperature of internal surfaces, and ventilation to remove moisture-laden air.

6.2 The vapour barrier and insulation

6.2.1 The purpose-made vapour barrier provides the primary means of preventing water vapour entering the building envelope. The wall and ceiling linings (which are to be flush-jointed and painted with all penetrations sealed) are considered, by the designer, a 'backup' to the vapour barrier. Insulation takes the form of fibreglass batts installed between timber wall and ceiling framing.

6.2.2 The installation of the vapour barrier is critical to prevent the passage of water vapour from passing into the building envelope, and requires careful attention to the installation of linings, services, the detailing of junctions and joinery openings. Any fixings to the wall and ceiling linings will puncture the vapour barrier, at which point the vapour barrier's performance is compromised.

6.2.3 The designer has said that fixings will form a negligible proportion of the area of the barrier, and fixings will be into the timber framing preventing vapour transmission. I note in the case of the galvanised mild steel ceiling battens, no such seal can be formed between the 'hollow' underside of the batten and the ceiling framing.

6.2.4 The successful use of the vapour barrier places heavy reliance on the prevention of cold bridging to prevent condensation; cold surfaces allow the formation of condensation. The proposed design presently contains thermal bridges, being: the inside faces of steelwork, which would require insulation in addition to a vapour barrier; and the skylights. The building elements must therefore be sufficiently durable to allow for the condensation that is likely to form. I note the ceiling lining is located on proprietary galvanised mild steel ceiling battens faced fixed to the ceiling framing. It is not clear how durable the steel battens will be when used in this situation.

6.2.5 The proposed solution is fully reliant on the skill and diligence of the installer. In my view the construction details shown in the drawings do not adequately describe how the building envelope is to be protected from the ingress of internally-generated water vapour.

6.2.6 An option open to the designer is to apply suitably-treated timber battens over the vapour barrier installed to the wall and ceiling framing, with the battens sealed at each point of fixing to the framing. With the integrity of the vapour barrier protected, the linings can be installed with less attention to sealing, and the like. I note also that gaps at the top and bottom of the linings may assist in mitigating 'sweating' behind linings should cold bridges be present. I note that linings using insulated panels with an ability to withstand high humidity may also offer a more robust solution. These design options are not be taken as a decision by the determination that they will provide a compliant solution: any proposal must be based on a fully detailed solution provided to the authority for its consideration.

6.3 Ventilation

6.3.1 The pool area relies solely on passive ventilation in the form of opening windows and doors, and the timber louvres. No form of forced or automatic ventilation is proposed.

6.3.2 The proposed ventilation solution relies on intervention by the applicants, being the current owners, who have been made aware of the need to reduce humidity by

ventilating the space, however, any future owners may not be as aware. While the pool may be covered to minimise heat loss and evaporation when not in use, condensation will still occur, particularly in the colder months. Colder outside temperatures will mean it is unlikely that pool users will open doors and windows to reduce humidity levels.

6.3.3 Adequate ventilation to assist in properly managing the internal humidity is required to ensure the ongoing compliance of the pool building, in particular the requirement for structural elements to be durable for a minimum of 50 years. I note the owners can nominate a specified intended life for the building for a period less than 50 years under section 113 of the Act, however, it is a moot point what period the building as proposed would satisfy.

6.3.4 The use of mechanical ventilation is strongly suggested. Passive ventilation, via open windows and the like, is dependent on intervention by the user and is unlikely to achieve the required ventilation required to manage the removal of internal moisture.

6.4 Conclusion

6.4.1 I consider there is insufficient evidence to be satisfied that the proposed design will adequately manage the generation of internal moisture from the heated pool to satisfy Clauses G4.3.3(b), B1.3.3(e) and B2.3.1(a) of the Building Code.

7. The building consent application documentation

7.1 The drawings and specification for the building consent application must provide instruction and certainty on those areas of the buildings that are specifically designed or alternative solutions, which applies to the proposed work.

7.2 The Act allows the authority to set reasonable requirements for documentation that accompanies applications for building consents, and Section 45(c) requires documentation to 'contain or be accompanied by any other information that the building consent authority reasonably requires'.

7.3 Without adequate documentation, the authority cannot be satisfied on reasonable grounds that the provisions of the Building Code will be met if the proposed building work is completed in accordance with the plans and specifications that accompanied the application to amend the consent.

7.4 Taking account of risks of interstitial condensation in buildings housing heated pools and the lack of specific guidance on the topic, I acknowledge the authority's concerns about the proposed work. The authority assessed the information it received with the building consent application and appropriately sought further information.

7.5 I have identified some areas associated with the performance of the proposed building which are not clearly and specifically documented. While the designer has made some changes to the drawings, as noted in paragraph 4.2.4, I consider the changes made are not sufficient to describe a compliant solution.

8. The decision

8.1 In accordance with section 188 of the current Act, I hereby determine that there is insufficient evidence for me to be satisfied that the proposed building will comply with Clauses G4.3.3(b), B1.3.3(e), B2.3.1(a) of the Building Code.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 12 July 2016.

John Gardiner
Manager Determinations and Assurance

Appendix A

A.1 The relevant requirements of the Building Code include:

Clause A1 Classified Uses

7.0 Outbuildings

7.0.1 Applies to a building or use which may be included within each classified use but are not intended for human habitation, and are accessory to the principal use of associated buildings. Examples: a carport, farm building, garage, greenhouse, machinery room, private swimming pool, public toilet, or shed.

Clause B1 Structure

B1.3.3 Account shall be taken of all physical conditions likely to affect the stability of buildings, building elements and sitework, including:

(e) water and other liquids,

Clause B2 Durability

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

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

(i) those building elements (including floors, walls, and fixings) provide structural stability to the building, or

(ii) those building elements are difficult to access or replace, or

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

Clause E2 External Moisture

PERFORMANCE

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

Clause E3 Internal Moisture

OBJECTIVE

E3.1 The objective of this provision is to–

(a) Safeguard people against illness, injury, or loss of amenity that could result from the accumulation of internal moisture

FUNCTIONAL REQUIREMENT

E3.2 Buildings must be constructed to avoid the likelihood of–

(a) Fungal growth or the accumulation of contaminants on linings and other building elements...

(c) Damage to building elements being caused by the presence of moisture.

PERFORMANCE REQUIREMENT

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

Limitations on application

Performance E3.3.1 does not apply to communal non-residential, commercial, industrial, outbuildings, or ancillary buildings

Clause G4 Ventilation

G4.3.3 Buildings shall have a means of collecting or otherwise removing the following products from the spaces in which they are generated:

(b) moisture from laundering, utensil washing, bathing and showering,