

## 1. Purpose

The purpose of this practice note is to address the incidence of deck and roof membrane failures that cause damage to buildings. Under the Building Act 2004 Auckland Council has the role of undertaking a design assessment of building consent applications and critical checking of construction details prior to issuing a code compliance certificate.

## 2. Background

Experience to date has provided the Council with a clear indication that there are weathertightness issues with membranes on roofs, decks, gutters and other external or exposed surfaces. There is a high occurrence of membrane failure where these surfaces are constructed with minimal falls and where tiles have been directly fixed to membranes. Membranes have also failed due to age and movement in substrates.

## 3. Legislative requirements

All building work constructed in New Zealand is regulated by the Building Act 2004 and Regulations made under the Act (including the Building Code). Some of the key requirements in the Act that relate to this Practice Note include:

Section 14G states the responsibilities of a product manufacturer or supplier

Section 17 states that all building work must comply with the Building Code

Section 18 states that building work does not have to achieve performance criteria additional to, or more restrictive than the Building Code

Section 19 specifies a number of ways that compliance with the Building Code can be established, examples include:

- complying with a document published by the Ministry of Business, Innovation and Employment
  - e.g. acceptable solution; verification method; current product certificate; national multi-use approval
- complying with a Determination issued by the Ministry of Business, Innovation and Employment

## 4. Means of compliance

The above documents, if followed, will result in compliance with the Building Code. A building consent application that complies with one of the above documents must be accepted by Council as complying with the Building Code.

There are 38 technical clauses in the Building Code; each clause contains at least one or both of the following:

- A verification method (VM) tests or calculations that prescribe a method of complying with the Building Code); and / or

- An Acceptable Solution (AS) which prescribe step-by-step instructions that demonstrate compliance with the Building Code

Clause E2 External Moisture has one Verification Method and three Acceptable Solutions. The Acceptable Solutions for clause E2 are E2/AS1, E2/AS2, E2/AS3.

An alternative solution is a building design, of all or part of a building that demonstrates compliance with the Building Code. It can include a material, component or construction method that differs completely or partially from those described in the technical clauses. It can be a minor change, or a radically different design and construction approach.

## 5. E2/AS1 External moisture

E2/AS1 is the Acceptable Solution that deals with external membranes for certain buildings.

- E2/AS1 has a clearly define scope.
- Table 1 summarises the broad scope of E2/AS1.
- Table 2 provides a more focussed summary of the key parts of E2/AS1, which specifically relates to membrane roof and decks.

**Table 1: Scope of E2/AS1**

Construction included	Construction excluded
<p>E2/AS1 includes:</p> <ul style="list-style-type: none"> <li>• Materials, products, and processes contained in E2/AS1 for buildings within the scope of clause 1.1.2 of NZS3604:2011 Timber Framed buildings and: <ul style="list-style-type: none"> <li>➢ Buildings with a total height from lowest ground level highest point of roof up to 10 metres; and</li> <li>➢ Buildings with a floor plan area limited to 300 square metres for two storey buildings and 250 square metres for three storey buildings (depends on construction method)</li> </ul> </li> </ul> <p>Additionally, some of the specific inclusions covered in clause 1.1.2 of NZ3604 are as follows:</p> <ul style="list-style-type: none"> <li>• Buildings shall be founded on good ground</li> <li>• Buildings that fall within the building wind zones as described in NZS3604 and are either low, medium, high, very high or extra high</li> <li>• The floor and roof live loadings applicable to domestic, residential, institutional and educational buildings fall within the scope of NZ3604 (provided that the floor loading shall not exceed 1.5 kPa for the uppermost floor of 3 storey buildings)</li> </ul> <p><b>Note:</b> The floor plan area can be unlimited for 1 or 2 storey buildings where all storeys are of timber frame.</p>	<p>E2/AS1 excludes:</p> <ul style="list-style-type: none"> <li>• Outbuildings (such as pergolas and carports which do not have any external walls)</li> <li>• Buildings with drained cavities and spread of flame requirements as specified in NZBC C3.3</li> <li>• Buildings with drained cavities and acoustic requirements as specified within NZBC G6.</li> </ul> <p>NZS3604 specifically excludes:</p> <ul style="list-style-type: none"> <li>• Buildings above extra high wind zones as described in NZS3604 (specific engineering design is required)</li> </ul>

**Table 2: Limitations of E2/AS1 in relation to membranes roofs and decks (section 8.5)**

Construction included	Construction excluded
<p>Membranes composed of butyl or EPDM installed over plywood substrates for:</p> <ul style="list-style-type: none"><li>• Roofs with a minimum fall of 2.0 degrees (1:30)</li><li>• Decks with a minimum fall of 1.5 degrees (1:40)</li><li>• Decks with a maximum area of 40 square metres</li><li>• Internal gutters with a minimum fall of 1:100 (see also the exclusion opposite) with no cross seams in the gutters.</li><li>• Decks with removable raised surfaces to give level access (refer to Figure 17A in E2/AS1)</li></ul>	<ul style="list-style-type: none"><li>• Decks with steps within the same level of the deck area (except into gutters)</li><li>• Decks with integral roof gardens</li><li>• Decks with a downpipe directly discharging onto the deck</li><li>• Internal gutters with a minimum fall of 1:100, with cross seams in the gutters</li><li>• The application of directly-applied wearing or decorative surfaces to membranes (e.g., tiled surfaces)</li></ul>

Tables 1 and 2 are intended to summarise a number of caveats only. People should always refer to the scope of E2/AS1 and NZS3604 to ensure design parameters are met.

Buildings, components, or junction details outside the scope of E2/AS1 require specific design. Details of specific design shall be provided to Council for assessment and approval as part of the building consent process.

## 6. Summary of potential compliance pathways for external membranes

Council staff and applicants/designers need to consider the specific building work and design that is actually being proposed.

In general terms, any given building consent application could seek to demonstrate compliance with clause E2 by either:

- Fully adhering to the requirements of Acceptable Solution E2/AS1
- Partially or substantially complying with Acceptable Solution E2/AS1, but proposing a specific design or alternative solution for one or more components of the design
- Not referring to E2/AS1 at all, but using a specific design by way of an alternative solution to demonstrate compliance

The flow chart (page 6) outlines some key decisions that must be considered for code compliance. Note: refer to the Ministry's guidance document on alternative solutions for further guidance.

## 7. Guidance regarding minimum falls

For building consent applications that propose using an alternative solution to establish compliance with Clause E2, the Council will assess each case on its own merits. If the Council does not consider that the degree of fall used in the proposed alternative solution provides it with reasonable grounds to be satisfied that compliance with the Building Code would be achieved, then the Council will communicate its decision and the reasons for its decision to the applicant/designer.

Council notes that membrane specifications do not always recognise that buildings move, shrink, creep, settle, compress, etc. Differential shrinkage also occurs and beams are designed to include deflection with loads.

When minimal falls (as low as 1 degree or 1:60) are used and movement occurs, the nominated falls are often no longer met.

One degree equates to 16.6mm of fall per metre. In these instances, water may pond on the membrane. This can invalidate the manufacturer's specifications and any warranties that may be provided for the product. In these circumstances, the building no longer complies with clause E2, which amongst other things requires roofs to shed moisture.

The Building Research Association of New Zealand (BRANZ) publication Selecting Roofing Claddings first published in 1998, states that "BRANZ recommends that the minimum flat roof be 1.5 degrees (1:40) but 3 degrees is preferable to ensure efficient water drainage from the roof".

## 8. Direct fixing of tiles and other products onto membranes

In the past, it has been common practice to fix tiles directly onto membranes. Direct fixing does not allow for inspection or maintenance of the membrane, makes leak detection difficult, and repairs costly. Direct fixing of tiles on membranes is an alternative solution.

Council's position is that we **will not approve** applications for alternative solutions for direct fixing of tiles over a timber framed substrate (direct fixing onto a concrete floor is acceptable subject to an assessment of the membrane via the alternative solution process). If tiles are to be laid, they must be on a floating deck or be installed over an approved de-coupling layer.

### Comment:

We have recently seen the failure of a building, which had a code compliance certificate issued in 2009 where the membrane has failed, causing serious damage to the property. In this particular instance, ceramic tiles had been direct fixed to the membrane preventing early maintenance and detection of the problem.

## 9. Councils technical considerations when assessing alternative solutions and external membranes

Council staff may consider the following matters when checking building consent applications:

- a. Consideration should be placed on checking there is good design around roof and deck membranes. In some circumstances it may be appropriate to suggest that a minimum fall greater than 1.5 degrees would be appropriate and provide better surface draining. The substrate design should incorporate the minimum fall as part of the building consent documentation. It is good practice for concrete screeds to be positively pre-cambered to account for carrying live loads and dead loads, i.e., air conditioning units or other equipment.
- b. Some gutters will have membrane laps across the fall. Consideration should be placed on checking their location and fall. This will require the substrate design to incorporate the minimum fall as part of the building consent documentation.
- c. Gutters with no membrane laps will also need to be checked as above and require incorporation of the minimum fall into the substrate design as part of the building consent documentation.
- d. Gutter and scupper outlets through parapet walls are common areas of design weakness. Gutter and scupper outlets must be formed with four sided waterproof seamless castings and flanges. Materials should be compatible with the membrane adhesives. The practice of dressing a membrane onto a substrate through a formed aperture is not acceptable.
- e. Gutter and scupper outlets must be formed so that they are flush with the substrate.

- f. Gutter outlet downpipes attached to a surface other than the exterior walls of the building must be pressure tested and fixed to allow vertical differential movement, preventing outlets from thrusting up through the gutter (slip joints).
- g. The deck or balcony membrane system must be maintainable. One way of achieving this is by designing a removable proprietary floating tile or timber system on pads or feet.
- h. It is considered good practice that all membrane upstands have a sheet substrate over timber framing. The upstand substrate should be of the same material as the deck substrate. If not, construction joints should be designed to allow for the associated differential movement.
- i. The finished membrane installation must be flood and flow tested, demonstrating to the Council inspector that the roof, deck or balcony sheds water.

## 10. Direct fixing of tiles and other products onto membranes

Direct fixing of tiles on membranes may only be used in wet areas inside a building. It is important to ensure that the type of adhesive is compatible with the membrane used. As an example, acrylic membranes and cement-based adhesives have the potential to cause the tiled surface to fail.

## 11. Underfloor heating of wet areas

Poor construction and installation methods of heating tubes (water) and cables (electric) minimally embedded in concrete or levelling compounds show shrinkage and movement cracks on the surface where cover is insufficient.

The heating element must be effectively encapsulated within the screeding material, providing adequate margins and consistent separation of the waterproof membrane. Underfloor heating elements must not have direct contact with the membrane either above or below, as it may cause the membrane to separate from the underlying substrate and subsequently fail.

## 12. References

NZS3604:2011

The New Zealand Building Code

- E2 External Moisture
- E3 Internal Moisture
- B2 Durability

Ministry of Business, Innovation and Employment guidance:

- Means of Establishing Compliance: Alternative Solutions
- External Moisture: An Introduction to Weathertightness Design Principles

