Shaking up façade testing

For low-rise buildings, E2/VM1 can be used to demonstrate that a cavity-based wall system can meet the requirements of E2. But what is E2/VM1, and why might it not be suitable for medium-rise buildings?

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IN *BUILD* 154 (pages 50–51), some of the difficulties demonstrating compliance for medium-rise buildings were discussed. Building Code clause E2 *External moisture* was used to illustrate that there is sometimes no clear compliance pathway.

What is E2/VM1?

E2/VM1 is the test method for proving the weathertightness of wall claddings on low-rise buildings within the scope of NZS 3604:2011 *Timber-framed buildings*. It was derived from AS/NZS 4284:2008 *Testing of building facades*, which, in turn, was derived from work by CSIRO in Australia in the 1970s.

The Australian work utilised an old aero engine and spray nozzles to simulate wind-driven rain. Such engines are still used occasionally, but generally, water penetration tests have moved to a more repeatable method utilising a pressurised box, with the test specimen forming one side of the box. This approach is used in both AS/NZS 4284:2008 and E2/VM1.

AS/NZS 4284 for curtain wall systems

AS/NZS 4284 was primarily intended for investigating curtain wall systems on buildings above 25 m in height. The test specimen can be subjected to a number of different tests, but the mandatory tests are:

- preliminary tests
- structural test at serviceability limit state

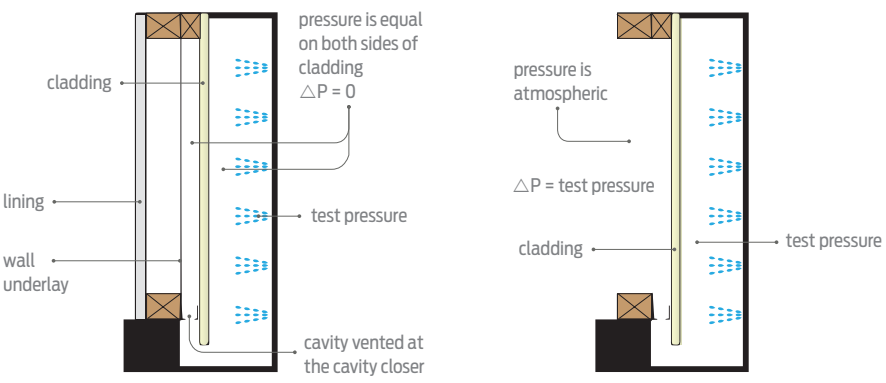

Figure 1: Difference between standard water penetration test (left) and wet wall test (right), with the linings and underlay removed.

Figure 2: A typical E2/VM1 test specimen.

water penetration test by static pressure followed by cyclic pressure test
- strength test at ultimate limit state.

AS/NZS 4284:2008 is used to test multiple aspects of a façade's performance, including its structural strength. E2/VM1 is intended only to look at the water penetration and water management of a façade system.

In AS/NZS 4284:2008, the water penetration tests consist of spraying the specimen with a known amount of water and subjecting it to a steady pressure and then cyclic pressure tests. Failure generally occurs when uncontrolled water is visible on the inside surface of the façade.

Water penetration tests differ

The water penetration criterion used in AS/NZS 4284:2008 is similar to other tests around the world and assumes the use of structural materials that do not absorb water. However, this is not necessarily suitable for typical low-rise residential construction, which will often include materials that do absorb water.

Residential systems may have a damaging leak, but this may not manifest as water visible on the inside surfaces. For this reason, E2/VM1 has a slightly different set of water penetration tests and a slightly different failure criterion.

As well as water penetration tests equivalent to those in AS/NZS 4284:2008, E2/VM1 requires that holes be drilled in the cladding and the tests repeated. After that, the wet wall test is performed, where the pressure is applied across the cladding itself rather than the whole wall. Failure is when the cavity is breached or, in the case of the wet wall test, when water penetrates the cladding.

E2/VM1 mainly checks cavity drainage

E2/VM1 is basically checking that the cavity works. In terms of the 4Ds of weathertightness (deflection, drainage, drying and durability), it mainly looks at drainage. Water that penetrates the cladding must not reach the underlay.

Drilling holes in the outer layer of the cladding attempts to test the effect of workmanship errors. Will the cavity (nominally 20 mm wide in E2/VM1) still drain water away even if some defect allows water in?

Wet wall test checks deflection of water

The wet wall test is unique among international water penetration standards and is arguably the toughest part of the test because it stresses the cladding itself.

In most test situations, a cladding on a cavity will only have a very small pressure difference across it, regardless of the actual test pressure. This replicates the real situation where façades are typically designed to separate the roles of water shedding (cladding) and holding air pressure (air barrier or lining) (see Figure 1).

The cavity is usually vented to the inside of the test chamber so the pressure inside the cavity is the same as that in the main chamber. This will structurally load the underlay and linings but means there is no pressure difference driving water through the cladding. Therefore, attempts to make the test harder simply by increasing the test pressure will not have a big effect, because the pressure across the cladding will still be close to zero.

The wet wall test ensures the cladding itself offers a degree of protection. In terms of the 4Ds, the wet wall test is checking deflection of water.

E2/VM1 very stringent

Compared to other water penetration tests around the world, E2/VM1 is among the more stringent:
- It has more severe failure criteria.
- It attempts to mimic less-than-perfect build quality.
- It has the wet wall test.

Why wouldn't such a test be suitable for medium-rise construction? To answer this, we need to go back to E2/VM1's parent standard, AS/NZS 4284:2008.

Unsuitable to test for medium-rise

Although not a mandatory part of the AS/NZ 4284:2008 testing schedule, the standard describes how to perform a seismic test of the façade. This entails racking the specimen and then redoing the water penetration test. Façade consultants recognise that this test is often a good way to discover weak points in the design of the façade, which can then be addressed. It is a means to improve the chance of the façade working in real life rather than simply passing a one-off water penetration test in a laboratory.

Another reason to deviate from E2/VM1 is that the standard test details may not be representative of medium-rise construction (see Figure 2). A more representative specimen for medium-rise construction may not need a meter box, but it would probably have features such as inter-storey drainage, ventilation openings and possibly complex balcony details.

BRANZ looking for better method

A new Building Research Levy-funded project at BRANZ will look at how claddings that are likely to be used on medium-rise buildings behave under seismic and weathertightness loading.

The results will help to inform any new Verification Method for medium-rise buildings. This will need to account for the residential-style construction normally investigated using E2/VM1 that meets the performance levels of higher-rise façades tested using AS/NZS 4284:2008.

Interim solution

Until this research is completed, BRANZ has developed an interim solution for assessing the weathertightness of medium-rise cladding systems. This method borrows from both AS/NZS 4284:2008 and E2/VM1 and will be offered as part of a BRANZ Appraisal on medium-rise cladding systems.