E2 AND E2/AS1

When it comes to weathertightness, Building Code Clause E2 *External moisture* and the compliance document E2/AS1 are the critical documents for any designer.

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It is mandatory for the design and construction of all new buildings to comply with the performance requirements of the New Zealand Building Code. The difference between the actual Building Code clause and the Acceptable Solution is often misunderstood or misquoted in the building industry. For weathertightness:

- E2 is the Building Code clause that sets out the performance criteria that must be achieved with respect to external moisture
- E2/AS1 is the compliance document that provides guidance with a range of examples of how to construct a building that will comply with E2. When a building is designed and built in line with E2/AS1, it is deemed to meet the performance requirements of the clause.

E2/AS1 usually easiest option

A number of designers follow E2/AS1 as a means of compliance with E2 because:

- it provides specific guidance
- in a lot of cases, it is the easiest option as it is accepted by Building Consent Authorities (BCAs)
- it is understood and regularly used by BCAs
- it is a Department of Building and Housing (and therefore government) document, so if a building built to E2/AS1 fails, then the Department has some responsibility.

Other options for compliance

Following E2/AS1 is not the only way of designing and constructing a weathertight building. There are a number of equally effective alternative methods of construction that designers can follow. Once these alternatives are proven to be Code-compliant, they are known as Alternative Solutions.

Most BCAs use E2/AS1 as their reference document for weathertight design and E2 compliance. They often use the solutions →

Table 1: Definitions of risk. (From E2/AS1, Table 1.)

A. Wind zone	Low risk	Low wind zone as described by NZS 3604.
	Medium risk	Medium wind zone as described by NZS 3604.
	High risk	High wind zone as described by NZS 3604.
	Very high risk	Very high wind zone as described by NZS 3604.
B. Number of storeys	Low risk	One storey.
	Medium risk	Two storeys in part.
	High risk	Two storeys.
	Very high risk	More than two storeys.
C. Roof/wall intersection design	Low risk	Roof-to-wall intersection fully protected (for example, hip and gable roof with eaves).
	Medium risk	Roof-to-wall intersection partly exposed (for example, hip and gable roof with no eaves).
	High risk	Roof-to-wall intersection fully exposed (for example, parapets, enclosed balustrades or eaves at greater than 90° to vertical with soffit lining).
	Very high risk	Roof elements finishing within the boundaries formed by the exterior walls (for example, lower ends of aprons, chimneys, dormers etc).
D. Eaves width (1) (2)	Low risk	Greater than 600 mm for single storey.
	Medium risk	451–600 mm for single storey, or over 600 mm for two storey.
	High risk	101–450 mm for single storey, or 451–600 mm for two storey, or greater than 600 mm above two storey.
	Very high risk	0–100 mm for single storey, or 0–450 mm for two storey, or less than 600 mm above two storey.
E. Envelope complexity	Low risk	Simple rectangular, L, T or boomerang shape, with single cladding type.
	Medium risk	Moderately complex, angular or curved shapes (for example, Y or arrow-head) with no more than two cladding types.
	High risk	Complex, angular or curved shapes (for example, Y or arrowhead) with multiple cladding types.
	Very high risk	As for high risk, but with junctions not covered in C or F of this table (for example, box windows, pergolas, multi-storey re-entrant shapes).
F. Deck design (3)	Low risk	None, timber slat deck or porch at ground floor level.
	Medium risk	Fully covered in plan by roof, or timber slat deck attached at first or second floor level.
	High risk	Enclosed deck exposed in plan or cantilevered at first floor level.
	Very high risk	Enclosed deck exposed in plan or cantilevered at second floor level or above.

Notes:
(1) Eaves width measured horizontally from external face of wall cladding to outer edge of overhang, including gutters and fascias.
(2) Balustrades and parapets count as 0 mm eaves.
(3) The term 'deck' includes balconies.

as a comparison when assessing alternative methods at building consent stage.

Table 2: Building envelope risk matrix. (From E2/AS1, Table 2.)

Risk factor	Risk severity								
	Low		Medium		High		Very high		Subtotals
Wind zone (per NZS 3604)	0		0		1		2		
Number of storeys	0		1		2		4		
Roof/wall intersection design	0		1		3		5		
Eaves width	0		1		2		5		
Envelope complexity	0		1		3		6		
Deck design	0		2		4		6		
(Enter the appropriate risk severity score for each risk factor in the score columns. Transfer these figures across to the right-hand column. Finally, add up the figures in the right-hand column to get the total risk score.)							Total risk score		

E2/AS1 risk matrix

One of the key tools for designers and builders in E2/AS1 is the risk matrix, which allows the designer to calculate the weathertightness risk of a building design. The risk matrix allows information about the proposed building design to be put into six different risk factor categories and the levels of risk in each category to be identified.

A completed risk matrix should be included in the building consent documentation. This will clearly identify the level of weathertightness risk to the BCA and allow them to accurately assess the building's ability to meet that level of risk.

Risk factors

The six risk factor categories included in the E2/AS1 risk matrix relate to aspects of design proven to affect the weathertightness of a building:

- Wind zone – wind drives rain against a building and increases the potential for leaks.
- Number of storeys – the taller the building, the more wall area it has and the greater the effect of wind and rain on the exterior.
- Roof and wall intersection design – the junctions between roofs and walls are often difficult to detail and build.
- Eaves width – eaves provide shelter to the walls of a building and reduce the wetted area during rain.
- Envelope complexity – complex buildings are more difficult to design and build accurately.
- Deck design – waterproof decks and solid balconies are also difficult to detail and build.

Risk severity

Within the six risk factor categories, relevant building features are defined as low, medium, high and very high risk severity (see Table 1).

Risk scores

Designers complete a risk matrix for each face of the building by entering a risk severity score for each risk category and adding them up to reach a total risk score (see Table 2).

The total risk score applicable to the design of each face puts it into a particular overall risk category. The total risk scores for each overall risk category are:

- 0–6 = low risk
- 7–12 = medium risk
- 13–20 = high risk
- over 20 = very high risk.

Aspects of the design may make one face a higher risk than the others, each face of the building could even end up with a different total risk score.

Cladding options

Once the risk score has been calculated, the designer uses the suitable wall claddings table in E2/AS1 to select a suitable cladding type and construction details for that level of risk (see Table 3). Cladding options cover both direct-fixed claddings (where the cladding is fixed directly to the frame over a wall underlay) and drained and vented cavity claddings (where the cladding is fixed to battens forming a nominal 20 mm cavity between the back of the cladding and the face of the wall underlay or is a masonry veneer).

As the weathertightness risk score of the building increases, E2/AS1 calls for cavity-based cladding systems to be used. Cavity systems offer another level of protection with more potential to drain or dry water that has penetrated the exterior cladding.

For example, for a risk score up to and including 12, bevel-backed timber weatherboards can be direct-fixed to the framing. For a risk score of 13–20, bevel-backed timber weatherboards must be fixed over a drained and vented cavity – the cavity provides extra protection by managing and removing any water that may penetrate the cladding in the higher-risk situation.

High scores – redesign or specific design

If the designer believes the risk is too high, they may redesign that face of the building and remove some of the high-risk features to end up with a lower risk score.

E2/AS1 can't be used as the means of compliance for a building that scores 21 or more – this is outside the scope of the Acceptable Solution. A different means of demonstrating compliance must be used, and it must be specifically designed to meet the higher level of risk.

Table 3: Suitable wall claddings. (From E2/AS1, Table 3.)		
Risk score	**Suitable wall claddings (limited to those covered in E2/AS1)**	
	Direct-fixed to framing	**Over nominal 20 mm drained cavity**
0–6	• Timber weatherboards – all types • Fibre-cement weatherboards • Vertical profiled metal – corrugated and symmetrical • Fibre-cement sheet (except stucco over a fibre-cement backing) • Plywood sheet • EIFS	• Masonry veneer (1) • Stucco • Horizontal profiled metal – corrugated and trapezoidal only
7–12	• Bevel-backed timber weatherboards • Vertical timber board and batten • Vertical profiled metal – corrugated only	• Masonry veneer (1) • Stucco • Horizontal profiled metal – corrugated and trapezoidal only • Rusticated weatherboards • Fibre-cement sheet • Plywood sheet • EIFS
13–20	• Vertical profiled metal – corrugated only	• Masonry veneer (1) • Stucco • Horizontal profiled metal – corrugated and trapezoidal only • Rusticated weatherboards • Fibre-cement weatherboards • Fibre-cement sheet • Plywood sheet • EIFS • Bevel-backed weatherboards
Over 20	a) Redesign the building to achieve a lower score, or b) Specific design: • The design may need changing to reduce the risk. • The Building Consent Authority may require more comprehensive details and documentation providing evidence of weathertightness. • The Building Consent Authority, designer or owner may require more inspections. • A third party audit of the design may be required.	
Note: (1) Traditional masonry veneer as per SNZ HB 4236, with minimum 40 mm cavity.		