DESIGN RIGHT

Using the E2/AS1 risk matrix

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The risk matrix in E2/AS1 is a key tool for weathertightness assessment and showing compliance with the Building Code. Let's walk through the steps on how to use it.

NEW ZEALAND Building Code clause E2 *External moisture* deals with the weathertightness of the building envelope for buildings within the scope of NZS 3604:2011 *Timber-framed buildings*. These are described as up to 3 storeys or no greater than 10 m in height, with a floor plan limited by seismic and structural control joints and with vertical walls and roofs with a pitch of 60º or less.

Acceptable Solution E2/AS1 provides one means of compliance with clause E2 so buildings that are designed in accordance with E2/AS1 must be accepted by the building consent authority (BCA).

E2/AS1 risk matrix

A key tool for weathertightness assessment in E2/AS1 is a risk matrix, which allows designers to calculate the weathertightness risk of the building envelope. The risk matrix identifies six different risk factor categories, each of which is assessed with a low, medium, high, very high or extra high-risk severity (see Table 1 from E2/AS1).

A risk matrix is prepared for each external face of the building with each risk factor allocated a value according to the particular risk. The values are then added together to give a total risk score (see Table 2 from E2/AS1) on which selection of the wall cladding and type of fixing may be made.

Risk factor categories

These are the risk factor categories:

- Wind zone – as per NZS 3604:2011 section 5.
- Number of storeys – may be 1, 2 or 3 storeys. Note that the Acceptable Solution describes 'more than 2 storeys', while the scope of E2/AS1

Table 1: Definitions of risk levels
Paragraph 3.1.1, Figure 1

Risk Factor	Score(5)	Risk severity	Comments	
A: Wind zone	0	Low risk	Low *wind zone* as described by NZS 3604	
	0	Medium risk	Medium *wind zone* as described by NZS 3604	
	1	High risk	High *wind zone* as described by NZS 3604	
	2	Very high risk	Very High *wind zone* as described by NZS 3604	Errata 2 Dec 2011
	2	Extra high risk	Extra High *wind zone* as described in NZS 3604 (4)	
B: Number of storeys	0	Low risk	One *storey*	
	1	Medium risk	Two *storeys* in part	
	2	High risk	Two *storeys*	
	4	Very high risk	More than two *storeys*	
C: Roof/wall junctions	0	Low risk	Roof-to-wall intersection fully protected (e.g. hip and gable roof with *eaves*)	
	1	Medium risk	Roof-to-wall intersection partly exposed (e.g. hip and gable roof with no *eaves*)	
	3	High risk	Roof-to-wall intersection fully exposed (e.g. *parapets*, *enclosed balustrades* or *eaves* at greater than 90° to vertical with soffit *lining*)	Amend 2 Jul 2005
	5	Very high risk	Roof elements finishing within the boundaries formed by the exterior walls (e.g. lower ends of aprons, *chimneys*, *dormers* etc)	
D: Eaves width (1)(2)	0	Low risk	Greater than 600 mm for single storey	
	1	Medium risk	451–600 mm for single storey, or over 600 mm for two storey	
	2	High risk	101–450 mm for single storey, or 451–600 mm for two storey, or greater than 600 mm above two storey	
	5	Very high risk	0–100 mm for single storey, or 0–450 mm for two storey, or less than 600 mm above two storey	Amend 2 Jul 2005
E: Envelope complexity	0	Low risk	Simple rectangular, L, T or boomerang shape, with single *cladding* type	
	1	Medium risk	Moderately complex, angular or curved shapes (e.g. Y or arrowhead) with no more than two *cladding* types	Amend 2 Jul 2005
	3	High risk	Complex, angular or curved shapes (e.g. Y or arrowhead) with multiple *cladding* types	
	6	Very high risk	As for High risk, but with junctions not covered in C or F of this table (e.g. box windows, pergolas, multi-storey re-entrant shapes etc)	
F: Decks(3)	0	Low risk	None, timber slat *deck* or porch at ground floor level	Amend 2 Jul 2005
	2	Medium risk	Fully covered in plan by *roof*, or timber slat *deck* attached at first or second floor level	
	4	High risk	*Enclosed deck* exposed in plan or cantilevered at first floor level	
	6	Very high risk	*Enclosed deck* exposed in plan or cantilevered at second floor level or above	

NOTES:

Amend 2 Jul 2005 (1) *Eaves* width measured horizontally from external face of *wall cladding* to outer edge of overhang, including fascias and external gutters/spoutings.

(2) Balustrades and *parapets* count as 0 mm *eaves*.

Amend 2 Jul 2005 (3) The term *deck* includes balconies, as described in the Definitions.

(4) *Buildings* in Extra High *wind zones* require rigid *underlays* and *drained cavities*, refer to Table 3.

(5) Refer also to Table 2.

Errata 2 Dec 2011

Amend 5 Aug 2011

Table 1 from E2/AS1.

states 'up to 3 storeys with height measured from the lowest ground level adjacent to the building to the highest point of the roof – except for chimneys and aerials – of 10 m or less'.

- Roof/wall intersection design – junctions and intersections have a higher risk of leaks.
- Eaves width – the presence of eaves provides walls with shelter from rainfall. The amount of shelter provided is a function of both the width of the eave and the height of the wall.
- Envelope complexity – a more complex building envelope means more junctions and intersections and a correspondingly higher risk of leaks.
- Deck design – decks often penetrate the external cladding and therefore pose a significant weathertightness risk to a building. The level of risk also varies according to the deck type – slatted or enclosed, design and location.

Risk scores

Once the values of each risk factor have been added together, the total risk score gives a risk category for each face of the building of:

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

From the risk score, an appropriate cladding and fixing system can be selected (see Table 3 from E2/AS1). If the total risk score for a façade is greater than 20, the building or the façade will need to be redesigned or alternatively require specific design.

Specific design requirements may include:

- changing the design to reduce the risk
- providing the BCA with more comprehensive evidence of weathertightness of the building
- carrying out more inspections during construction
- a third-party audit of the design.

Complete a risk matrix for each façade

A risk matrix should be completed for each façade of the building and may apply to either:

- each elevation of the building,
- each external wall face of the building (see Figure 1). ➤

Table 2: Building envelope risk scores
Paragraph 3.1.2, Figure 1

Risk factor	Risk severity										Subtotals for each risk factor
	LOW	score	MEDIUM	score	HIGH	score	VERY HIGH (1)	score			
Wind zone (per NZS 3604)(1)	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				
									Total risk score for use in Table 3:		

(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.)

NOTE: (1) For *buildings* in Extra High *wind zones*, refer to Tables 1 and 3 for rigid *underlay* and *drained cavity* requirements.

Table 2 from E2/AS1.

Table 3: Suitable wall claddings
Paragraphs 3.1.2, 7.4, 9.1.1,9.1.7.2, 9.4.1.2, 9.4.1.3, 9.6, 9.6.1, Figure 1

Risk Score from Table 2	Suitable wall claddings(1)	
	Direct fixed to framing	Over nominal 20 mm drained cavity
		Claddings on *parapets*, *enclosed balustrades*, and in Extra High *wind zones* shall be installed over *drained cavities*.(5)(6)
0 – 6	a) Timber weatherboards – all types b) Fibre cement weatherboards c) Vertical profiled metal – corrugated and symmetrical *trapezoidal* (3) d) Fibre cement sheet(4) (Jointed finish) e) Plywood sheet	a) *Masonry veneer* (2) b) *Stucco* c) Horizontal profiled metal(3) – corrugated and *trapezoidal* only d) Fibre cement – *flush-finished* e) *EIFS*
7 – 12	a) Bevel-back timber weatherboards b) Vertical timber board and batten c) Vertical profiled metal – corrugated only(3)(6)	a) *Masonry veneer* (2) b) *Stucco* c) *Horizontal* profiled metal – corrugated and *trapezoidal* only d) Rusticated weatherboards e) Fibre cement weatherboard f) Fibre cement sheet – flush and jointed finish g) Plywood sheet h) *EIFS*
13 – 20	a) Vertical profiled metal – corrugated only(3)(6)	a) *Masonry veneer* (2) b) *Stucco* c) Horizontal profiled metal – corrugated and *trapezoidal* only d) Rusticated weatherboards e) Fibre cement weatherboards f) Fibre cement sheet – flush and jointed finish g) Plywood sheet h) *EIFS* i) Bevel-back 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.	

NOTES: (1) The wall claddings in this table are limited to those covered in this Acceptable Solution.
(2) Traditional *masonry veneer* as per SNZ HB 4236, with minimum 40 mm cavity.
(3) Refer Figure 38 for profiles.
(4) Except *stucco* over a fibre cement backing.
(5) *Claddings* in Extra High *wind zones* require rigid *underlays* – refer to Paragraph 9.1.7.2
(6) Direct fix vertical corrugated steel is included as cavity construction.

Amend 5 Aug 2011 | Amend 2 Jul 2005 | Amend 5 Aug 2011 | Amend 2 Jul 2005 | Amend 5 Aug 2011 | Amend 2 Jul 2005 | Amend 5 Aug 2011 | Amend 2 Jul 2005 | Amend 5 Aug 2011 | Amend 2 Jul 2005 | Amend 2 Jul 2005 | Amend 5 Aug 2011

Table 3 from E2/AS1.

Source of tables: www.building.govt.nz/building-code-compliance.

An elevation is a plane view of one side of the building, and includes all the parts of the building seen from a particular compass direction. An external wall face refers to either part or all of an elevation depending on how the building is to be assessed.

The elevation approach works best for simple building designs whereas the external wall face approach is more suitable for complex building designs.

A building envelope risk matrix must be included in building consent application documentation.

Refer to the guide

A guide to using the E2/AS1 risk matrix is provided by the Ministry of Business, Innovation and Employment in the publication *External moisture – a guide to using the risk matrix*. This is available online at www.building.govt.nz.

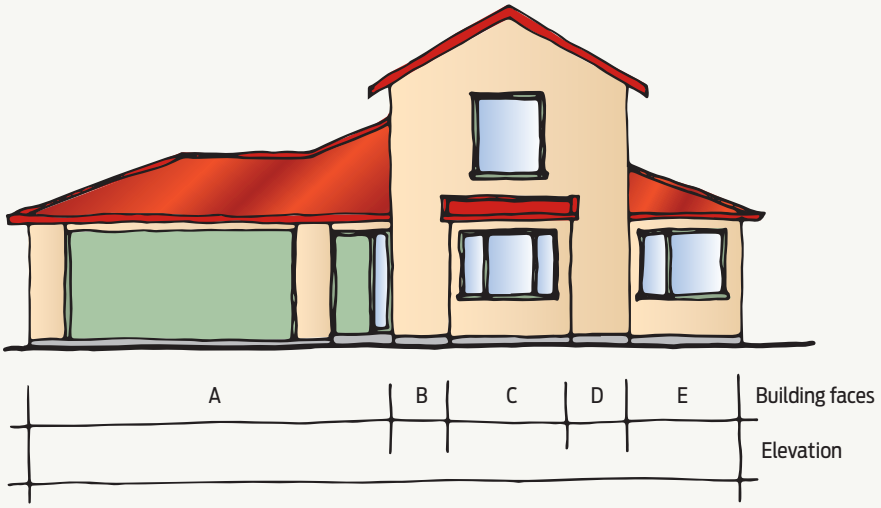

Figure 1 **A building elevation – external façade of a building.**