GUIDANCE

External moisture – a guide to using the risk matrix

A companion guide to Acceptable Solution E2/AS1

July 2013

MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

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Contents

1. Introduction 1

Purpose 1
Scope and audience 1
Terminology 2
Acceptable Solutions: their regulatory context 2

2. Weathertightness: The E2/AS1 approach 4

Requirements for drained cavities 5
Philosophy of risk assessment 5

3. The risk assessment process 7

Establishing the risk score 7
- Step One: Obtain detailed drawings 8
- Step Two: Assess each external face against risk factors 8
- Step Three: Complete the Building Envelope Risk Matrix table 8
- Step Four: Determine suitable cladding and any cavity requirements 10

Choosing an elevation or wall face approach 12
Risk bands and borders 14
When you can use direct-fix wall claddings 15

4. Key risk factors for weathertightness 16

Wind zone 16
Number of storeys 17
Roof/wall junctions 18
- Low-risk junction designs 18
- Medium-risk junction designs 19
- High-risk junction designs 19
- Very high-risk junction designs 20

Eaves width 21
Envelope complexity 24
- Low-risk envelope complexity 25
- Medium-risk envelope complexity 26
- High-risk envelope complexity 27
- Very high-risk envelope complexity 28

Deck design 30
Timber slat decks 30
Enclosed decks 33

5. Applying the risk matrix: worked examples 36

Example 1: Simple house with three decks 37
Plan and elevations 37
Building envelope risk scores (elevation approach) 38
Summary: risk scores and wall cladding options 42
Example 2: Multi-storey house with clerestory window and enclosed deck 43
Plan and elevations 43
Building envelope risk scores (elevation approach) 44
Summary: risk scores and wall cladding options 48
Example 3: Two storey house with bay windows and decks 49
Plan and elevations 50
Building envelope risk scores (elevation approach) 51
Building envelope risk scores (wall face approach) 55
Summary: comparison of the elevation and wall face approaches 61

Appendix One: Resources 63

Appendix Two: Key definitions 64

Appendix Three: Templates 66

Definitions of risk levels (from Table 1 of E2/AS1, December 2011) 66
Risk matrix scoring template (from Table 2 of E2/AS1, December 2011) 67
Suitable wall claddings (from Table 3 of E2/AS1, December 2011) 68

Figures

Figure A: The building regulatory framework 3
Figure B: The 4Ds of water management.... 5
Figure C: How to assess risk (from Figure 1 of E2/AS1) 7
Figure D: Applying the risk matrix 10
Figure E: Applying the wall claddings table 11
Figure F: Differences between the elevation and wall face approaches 12
Figure G: Risk bands and the borders between them 14
Figure H: Number of storeys 17
Figure I: Low-risk roof/wall junction designs 18
Figure J: Medium-risk roof/wall junction designs....19
Figure K: High-risk roof/wall junction designs.... 20
Figure L: Very high-risk roof/wall junction designs 20
Figure M: Eaves width examples 22
Figure N: Examples of low-risk building envelopes 25
Figure O: Examples of medium-risk building envelopes.... 26
Figure P: Examples of high-risk building envelopes 27
Figure Q: Examples of very high-risk building envelopes 28
Figure R: Enclosed decks.... 35
Figure: Plan and elevations....37
Figure: Plan and elevations.... 43
Figure: Plan and elevations.... 50

Tables

Table A: Building envelope risk scores (from Table 2 of E2/AS1).... 9
Table B: Eaves width risk severity.... 22
Table C: Timber slat decks – risk levels 32
Table D: Enclosed decks – risk levels.... 34
Table E: Comparison of risk scores for Example 3 from the elevation and wall face approaches 62

1. Introduction

Purpose

This guidance document is aimed at designers, builders and building consent officials to help in assessing the weathertightness risk of low rise, timber-framed buildings using the risk matrix in Acceptable Solution E2/AS1 ("E2/AS1") for Clause E2 External Moisture of the New Zealand Building Code.

It provides explanation and examples to make it easier for you to:

- Assess the weathertightness risk factors applying to a particular building design (Table 1 of E2/AS1),
- Use the risk matrix (Table 2 of E2/AS1), and
- Identify accepted wall claddings and design requirements (Table 3 of E2/AS1).

By completing the weathertightness risk scoring in E2/AS1, you can quickly determine the need for a drained cavity with wall claddings. This will aid your decisions on cladding systems and support building consent applications. Calculating all the risk scores for a building design can also help you to:

- Confirm the building categorisation for licence classes
- Determine whether Douglas Fir timber can be used under the Acceptable Solution B2/AS1 for Building Code Clause B2 Durability, and
- Help identify simple, low-risk housing design; for example, where relevant to risk-based consenting.

Scope and audience

This guidance discusses the principles of weathertightness risk assessment, explains the six risk factors of the risk matrix in more detail, and provides three worked examples for different building designs.

> **For designers and builders:**
> This guidance can help you identify individual features that will require particular care and attention during design and construction. It may also help in your discussions with clients so you can highlight potential weathertightness risks of the proposed design and the options to either manage or otherwise reduce these risks.
>
> **For building consent officials:**
> This guidance can help you when considering the weathertightness risks for building designs in terms of E2/AS1. It may also help you when assessing alternative building envelope designs for compliance with Clause E2 External Moisture since, while many building materials are not included in E2/AS1, the principles of risk assessment can still be relevant.

This guidance document replaces the previous guidance of June 2005 on the E2/AS1 risk matrix and highlights the changes made to this matrix in E2/AS1 Amendment 5 (effective from August 2011) for particular wind zones and when a cavity is required. It does not itself form part of the Acceptable Solution.

The risk matrix only applies to wall claddings (roof cladding designs are not included). The scope of buildings covered by E2/AS1 is linked to NZS 3604:2011 Timber-framed buildings; i.e. low rise, timber framed buildings up to 10 m to the roof apex.

> **Note:**
> The risk matrix and associated tables in E2/AS1 do not provide weathertightness design details but generate a list of accepted wall cladding systems for given circumstances.
>
> The Ministry's publication External moisture – An introduction to weathertightness design principles discusses the principles behind constructing weathertight buildings and is a useful guide to help you design and evaluate specific performance-based alternative designs. (For details, see Appendix One.)

Terminology

E2/AS1 uses some specific terms and definitions in connection with the risk matrix; for example, to do with decks and eaves. There are further definitions in E2/AS1 in the New Zealand Building Code Handbook.

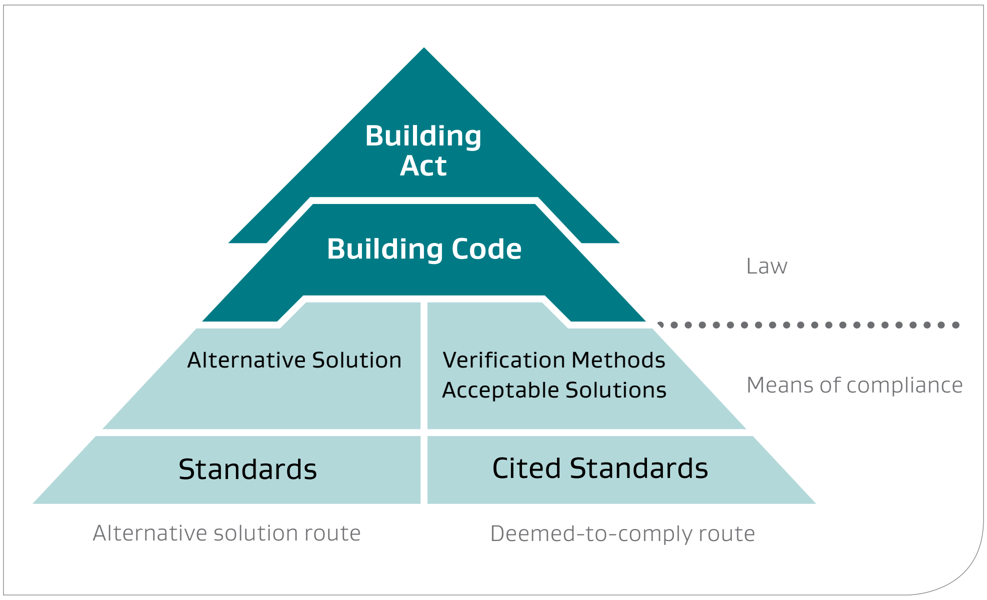
Acceptable Solutions: their regulatory context

New Zealand's building legislation exists to ensure buildings are safe and healthy to live and work in.

The framework for the building code system starts with the Building Act 2004, which sets out the law on building work. From this flows the New Zealand Building Code (contained within the Building Regulations 1992 as its 1st Schedule). The Building Code establishes the performance standards that all building work must meet. It consists of a number of preliminary and technical clauses and covers aspects such as moisture control and durability. Each technical clause has three levels:

1. **Objectives** – The social objectives that the building must achieve
2. **Performance** – The criteria the building must meet in order to comply
3. **Functional requirements** – What the building must do to satisfy the social objective.

Figure A: The building regulatory framework



Each Building Code clause may have one or more Verification Methods or Acceptable Solutions associated with it. The weathertightness risk matrix discussed in this guidance is part of the Acceptable Solution E2/AS1 for Clause E2 External Moisture.

Acceptable Solutions are deemed to comply, 'ready-made' design solutions for a particular code clause. However, they are not mandatory and following them is only one way of complying with the Building Code.

> **Note:**
> This guidance document is issued under section 175 of the Building Act and does itself not form part of the Acceptable Solution. Instead, it provides an explanation of the risk matrix development and use, with details on the criteria used to assess weathertightness risk and worked examples of how to use them.

2. Weathertightness: The E2/AS1 approach

Providing shelter from the weather is one of a building's primary functions. In recent times, the advent of more complex buildings, new materials and systems, and different construction practices mean it is even more important for buildings to be properly designed to ensure they remain weathertight throughout their lives.

From early 2000, there has been a growing body of evidence pointing to common weathertightness problems associated with certain design features. These include flat roofs, complex building shapes and junctions, parapets, narrow or no eaves, monolithic claddings, sealed decks, built-in balconies and inadequate flashings around windows and doors. Our experience over the last decade has shown that buildings with these types of design feature are more likely to leak and will therefore require extra protection through careful water management, design and detailing.

While there is more than one way to achieve a weathertight building, this guidance explains part of the methodology used in Acceptable Solution E2/AS1. This is to assess and score the weathertightness risk for a proposed building design using a risk matrix based on six key risk criteria or factors.

Using the risk matrix within E2/AS1 will give you the following information:

- A simple numerical score of the overall weathertightness risk of a building elevation or wall face
- Acceptable wall cladding options
- Whether wall cladding needs a nominal 20 mm cavity, and
- If specific design is required.

The risk matrix allows designers to choose wall claddings that can be fixed directly over framing in low-risk situations. However, as the assessed risk increases, the choices narrow and most types of wall cladding will require drained cavities to provide additional moisture protection for the wall framing.

Wind zone limits have been extended from 50 m/s to 55 m/s (the Extra High wind zone of NZS 3604:2011) in E2/AS1, allowing more buildings to be designed within its scope. However, buildings in this wind zone will require special weathering protection including drained cavities, rigid wall underlays, increased flashings and other details described in E2/AS1.

> **Note:**
> The range of wall claddings referred to in the risk matrix is limited to those covered by E2/AS1 (see Paragraph 3.3). Roof claddings are not covered by the risk matrix.

When the assessed risk exceeds a prescribed score, the proposed building (or part of the building) is outside the scope of the Acceptable Solution. It must therefore be specifically designed and detailed to handle the weathertightness risks of that particular situation.

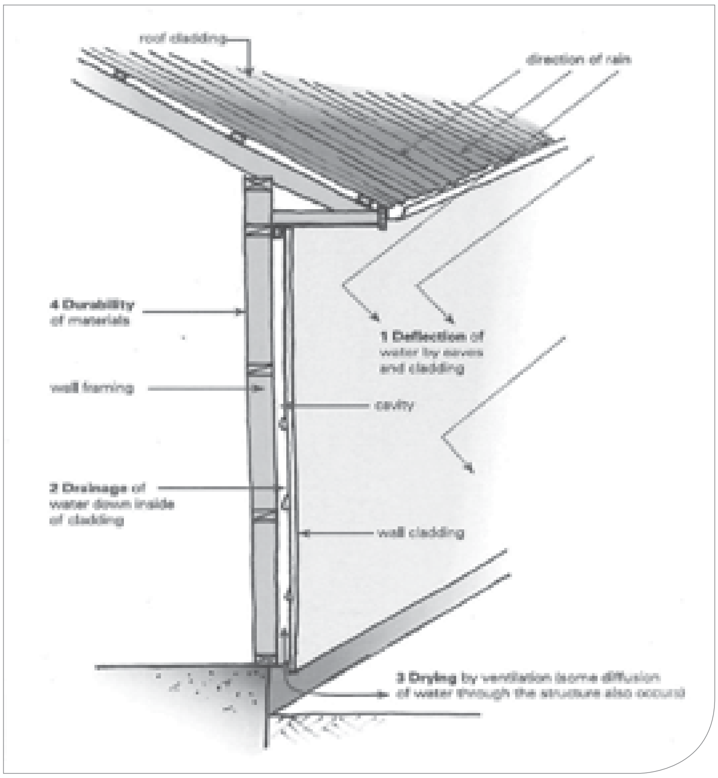
Requirements for drained cavities

Note:
While E2/AS1 Amendment 5 has left the risk matrix scoring unchanged, it has introduced three significant circumstances independent of the risk score that require the use of a drained cavity: on all buildings in the Extra High wind zone; on parapets and enclosed balustrades; and with all monolithic claddings.

Philosophy of risk assessment

The development of the risk assessment approach taken in E2/AS1 is based on work undertaken in 1999 by two Canadians, architect Don Hazeldon and building scientist Paul Morris. They developed a simple concept called the 4Ds to describe four basic principles of water management in buildings.

Figure B: The 4Ds of water management



The 4Ds, as used in E2/AS1, are:

1. Deflection: keeping water away from potential entry points
2. Drainage: providing means of removing water that does enter
3. Drying: allowing any remaining moisture to be removed by ventilation or diffusion, and
4. Durability: providing materials with appropriate durability.

Ideally, a building design incorporates and balances all 4Ds. Keeping these basic principles in mind will assist when assessing designs or preparing and evaluating alternative solutions. The publication External moisture – An introduction to weathertightness design principles discusses the 4Ds in further detail .

3. The risk assessment process

Establishing the risk score

The E2/AS1 approach to weathertightness risk uses a simple process that first assesses and then scores risks associated with various building features.

E2/AS1 uses the risk matrix to identify six key weathertightness risk factors that must be assessed for each building elevation or wall face for every design. The resulting overall risk score is then used to determine what types of wall claddings will be acceptable on each part of the building, whether a drained cavity is required for the preferred cladding, and whether specific design will be required.

To calculate the risk score for a building design, follow the four steps shown in E2/AS1 Figure 1: How to assess risk (reproduced here as Figure C).

Figure C: How to assess risk (referenced from Figure 1 of E2/AS1)

Figure 1:	How to assess risk Paragraph 3.1
Step one: Obtain detailed drawings	Suitably detailed drawings are required to assess *weathertightness* risk. This documentation may include a site plan, floor plans, elevations, details of junctions and penetrations, and the presence of features like *decks* and pergolas.
Step two: Assess each external face or elevation against risk factors	Assess the drawings for each external face to determine the *risk score* for each risk factor. Theses are: **wind zone**, **number of storeys**, **roof/wall intersection design**, **eaves width**, **envelope complexity** and **deck design**. Refer Table 1.
Step three: Complete the *Building envelope risk matrix* table	Complete the *Building envelope risk matrix* (Table 2) for each face of the *building*. It is possible for different elevations to have different *risk scores*.
Step four: Determine suitable cladding	Consult *Table 3: Suitable wall cladding* to determine what *claddings* types are recommended with the *risk score* for each face. The cladding selected must be appropriate for the score on that face, but can be beyond the minimum required (i.e. *cladding* suitable for a higher score can be used)

Step One: Obtain detailed drawings

To make an assessment of the building's weathertightness risk, you will need relatively detailed plans and elevations for the building design that show details such as elevations, the width of eaves, and the location of any decks or pergolas, etc.

Step Two: Assess each external face against risk factors

In assessing each external face, you can take this term to mean either an elevation or an individual wall face within that elevation: See Choosing an elevation or wall face approach.

Using the building plans and elevations, assess each external face of the building in turn against the six key weathertightness risk factors. These risk factors and the levels of risk associated with each are set out in E2/AS1 Table 1 and are discussed in more detail in the next section (see Key risk factors for weathertightness).

The six risk factors and their scores are:

- Wind zone (scoring range of 0-2)
- Number of storeys (scoring range of 0-4)
- Roof/wall junctions (scoring range of 0-5)
- Eaves width (scoring range of 0-5)
- Envelope complexity (scoring range of 0-6), and
- Deck design (scoring range of 0-6).

Step Three: Complete the Building Envelope Risk Matrix table

Use the descriptions and scores in E2/AS1 Table 1: Definitions of risk levels (see templates) to complete the risk matrix table E2/AS1 Table 2: Building envelope risk scores (reproduced here as Table A) for each elevation or external wall face, depending on your approach. This will give you a separate risk score for each elevation (or wall face). Different elevations may have different risk scores.

Note:
The risk score for any elevation or external wall face is the sum of the scores for each of the six risk factors. It is not the average of those assessments, the average of the four elevations, or the average of all the external face assessments.

The possible risk scores for a building range from a minimum of 0 for a very simple, single storey design through to a maximum of 28 for a very complicated, multi-level design with enclosed decks and very high weathertightness risk features throughout. Specific weathertightness design is required for any design with a risk score over 20.

There are some situations where a particular design feature in an elevation or wall is vulnerable to water penetration from different sources (such as Wall 4 in the worked Example 3). The risk matrix distinguishes such features through the 'very high risk' item for the envelope complexity risk factor (see Very high-risk junction designs).

> **Remember:**
> Knowing that you need a cavity as part of the wall cladding system is not the end of the process. Any risk score over 20 highlights the need for specific weathertightness design.

Table A: Building envelope risk scores (referenced from Table 2 of E2/AS1)

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

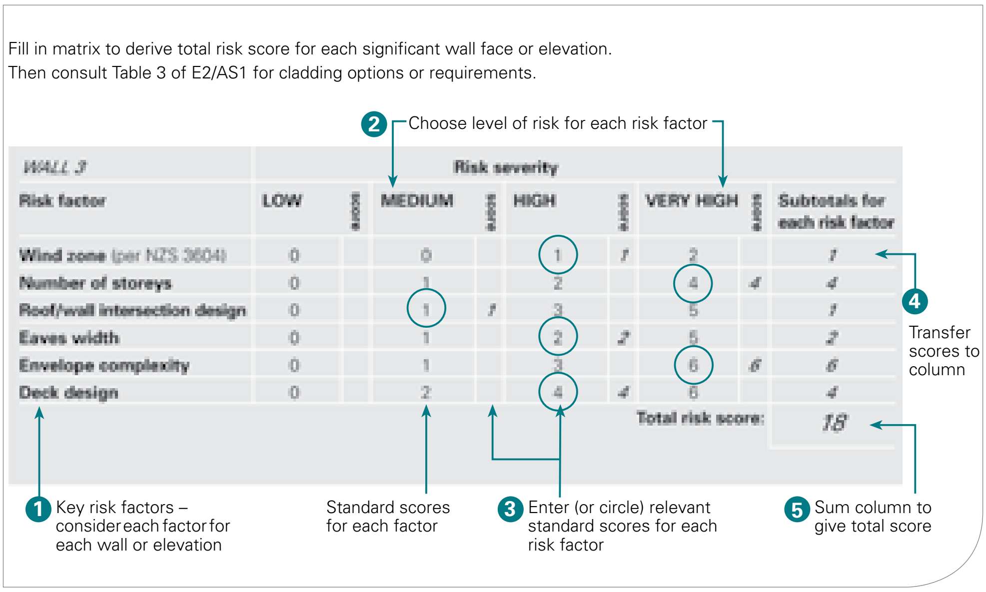
Risk factor	Risk severity								Subtotals for each risk factor
	LOW	score	MEDIUM	score	HIGH	score	VERY HIGH (1)	score	
Wind zone (per NZS 3604)(1)	0		0		1		2		
Number of storeys	0		1		2		4		
Roof/wall intersection design	0		1		3		5		
Eaves width	0		1		2		5		
Envelope complexity	0		1		3		6		
Deck design	0		2		4		6		
(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 for use in Table 3:**		

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

Table A includes the Extra High wind zone introduced in NZS 3604:2011. The maximum risk severity score of 2 covers buildings in both the Very High and Extra High wind zones. However, all buildings in Extra High wind zones will require drained cavities, rigid wall underlays, and other details as required by E2/AS1 Tables 1 and 3.

Figure D uses a notional "Wall 3" to show you how to calculate the risk score using E2/AS1 Table 2. Add together the assessed risk scores for each of the six risk factors to give an overall risk score for the particular elevation or wall face (a risk score of 18 in this example). You will also need to calculate the risk score for all other external faces around the building.

Figure D: Applying the risk matrix



Step Four: Determine suitable cladding and any cavity requirements

Once you have calculated a risk score for each relevant wall or elevation, refer to E2/AS1 Table 3: Suitable wall claddings. This table lists the only wall cladding types covered by the Acceptable Solution for each risk 'band'; i.e. for risk scores within the ranges 0-6, 7-12 and 13-20 (see Choosing an elevation or wall face approach).

Figure E shows how to determine acceptable wall claddings from E2/AS1 Table 3. It is based on the notional Wall 3 from Figure D which had a risk score of 18, meaning that the wall cladding options in the 13-20 risk band are acceptable.

Figure E: Applying the wall claddings table

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	Suitable wall claddings(1) – 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.

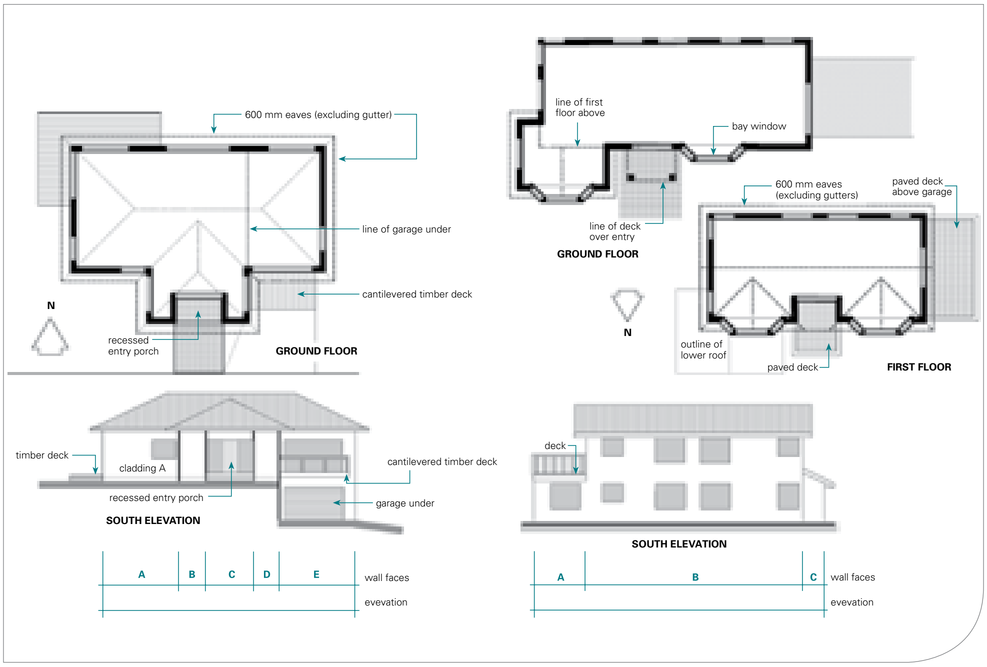
Choosing an elevation or wall face approach

In assessing the external faces of the building to come up with risk scores, you can choose to take either an elevation or a wall face approach.

The elevation means the view of a building seen from one side as a flat plane. A typical elevation may include all the parts of the building seen from a particular compass direction – north, east, south or west.

An external face or external wall face refers to either all or part of an elevation, depending on how the designer wishes to assess the building.

Figure F: Differences between the elevation and wall face approaches



The **elevation approach** works best for simple building designs that have similar design features contained within each elevation. It allows you to assess all the different external wall faces within an elevation as one group.

This is obviously the quickest and simplest assessment method as you only have to complete the risk matrix tables four times (one for each elevation). However, this global measurement reads the higher risk values in the elevation overall, even if it contains lower risk features. It therefore imposes the highest risk score for each of the six risk factors across the whole elevation.

The **wall face approach** is more suitable for complex designs. It involves completing a risk assessment for each external wall face in an elevation. This approach is useful where an elevation approach could generate scoring anomalies. For example, a particular elevation might contain wall faces with different weathertightness risks, such as walls at different planes or different heights. The elevation approach alone would transfer the higher scores across all the different wall faces in that elevation, whereas the wall face approach allows for a more precise assessment such as pinpointing where a cavity or specific design is required. However, the wall face approach can artificially lower a risk score as junctions and corners are not addressed.

Note:
Whether you take an elevation or a wall face approach to assessing weathertightness risk for a particular building is a question of judgement based on the complexity of your building design. For uncomplicated buildings, the elevation approach should produce similar risk scores to the wall face approach. However, on more complex building designs, it will result in simply defaulting to the higher risk values for the four elevations. This will make your documentation easier, but it can also increase costs unnecessarily through over-design for the particular circumstances.

You should also treat the wall face approach with caution when assessing a complex elevation design. Measuring a series of small wall faces in isolation may underestimate the overall weathertightness risk of the building, as it does not fully allow for adjoining intersections or for the complexities of the overall building shape.

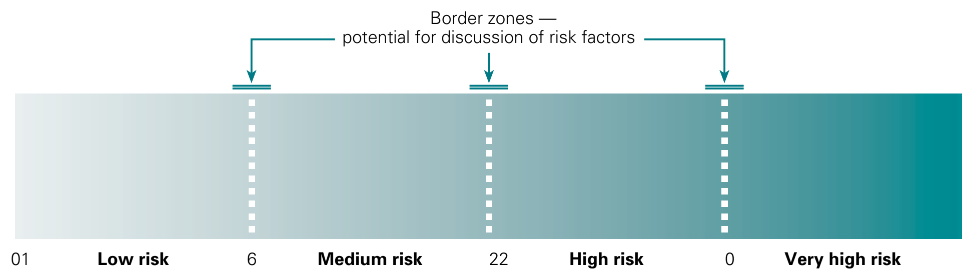
We illustrate both the elevation and wall face approaches in the worked examples. In Example 3, we also compare both approaches on a complex building design.

Risk bands and borders

E2/AS1 Table 3 indicates bands of weathertightness risk along with associated wall cladding options. These risk bands group the risk scores as follows:

- 0 to 6
- 7 to 12
- 13 to 20
- Over 20: specific design is required.

Figure G: Risk bands and the borders between them



Note: The colours used in this figure have no particular significance and are for illustration purposes only.

Determining the risk scores for a building design can require your judgement, and the assessment of risk may vary between people.

If a change of risk score could move an elevation or particular wall into a new risk band, this may not be of particular concern if the requirement for a cavity (or not) with the preferred wall cladding is unchanged. However, you may find that risk scores fall close to a critical border between risk bands where (say) the requirement changes from direct fixed to a drained cavity, or to requiring specific design. Therefore, assessing risk scores in these cases will require greater care.

When you can use direct-fix wall claddings

You may want to follow the Acceptable Solution, but the risk score for your preferred design and/or wall cladding system requires the use of cavities under E2/AS1 Table 3.

In this case, your options include:

- Changing the wall cladding type to one acceptable as direct-fixed for the assessed risk score, or
- Changing the design features or details (e.g. by adding wider eaves) to lower the risk score so it falls within a risk band with direct-fixed cladding options.

Claddings covered by E2/AS1 that do not need a drained cavity in the following situations are:

A risk score of 0–6 and using:

- Timber weatherboards
- Flat fibre cement weatherboards
- Vertically installed corrugated or symmetrical trapezoidal profiled metal
- Fibre cement sheets (with vertical jointers or battens), or
- Plywood sheets (with vertical battens).

A risk score of 7–12 and using:

- Timber bevel-back weatherboards
- Vertical timber board and batten, or
- Vertically installed corrugated profiled metal.

A risk score of 13–20 and using:

- Vertically installed corrugated profiled metal.

Remember:
If the building is in the Extra High wind zone, E2/AS1 specifies that all wall cladding will automatically require a cavity regardless of the risk score. E2/AS1 does consider direct fix, vertically installed corrugated profile metal to be the same as cavity construction.

E2/AS1 also specifies the use of drained cavities with all monolithic cladding and on parapets and enclosed balustrades. However, these requirements may be avoided by the choice of different claddings or by changing the building design.

4. Key risk factors for weathertightness

This section explains each of the six weathertightness risk factors in turn and gives some of the reasons for their score weighting.

Wind zone

The wind zones for E2/AS1 are taken from section 5 of NZS 3604: 2011 Timber-framed buildings and include the new Extra High wind zone, which has a maximum speed of 55 m per second.

Wind zone					
Risk severity and score	**Low = 0**	**Medium = 0**	**High = 1**	**Very high = 2**	
Description	Low wind zone (maximum wind speed of 32 m/s)	Medium wind zone (maximum wind speed of 37 m/s)	High wind zone (maximum wind speed of 44 m/s)	Very High wind zone (maximum speed of 50 m/s)	Extra High wind zone (maximum wind speed of 55 m/s)

Note: All wind zones are as specified in NZS 3604:2011.

While wind has commonly been considered a large contributor to water penetration, it has not featured significantly in leaky house cases. Therefore, scores assigned to wind in the risk matrix are relatively low compared to the other risk factors.

The maximum wind speeds given for each wind zone in the risk matrix follow Section 5 of NZS 3604: 2011 Timber-framed buildings. This standard now includes the Extra High wind zone of up to 55 m/s, which allows for the increasing number of buildings being built on exposed sites. Buildings in extra high wind zones attract the same risk score of 2 as those in Very High wind zones.

If the wind zone is beyond the upper limit of 55m/s defined in NZS 3604:2011, the building will require specific design.

Remember:
Any building designed for an Extra High wind zone based on E2/AS1 will automatically require a cavity with the wall cladding system and other features such as rigid wall underlays. Refer to E2/AS1 Tables 1, 3 and 7 and Paragraphs 4.5.1 and 9.1.4.

Number of storeys

There is a correlation between the number of storeys and the incidence of leaks.

Number of storeys				
Risk severity and score	**Low = 0**	**Medium = 1**	**High = 2**	**Very high = 4**
Description	One storey	Two storeys in part	Two storeys	More than two storeys

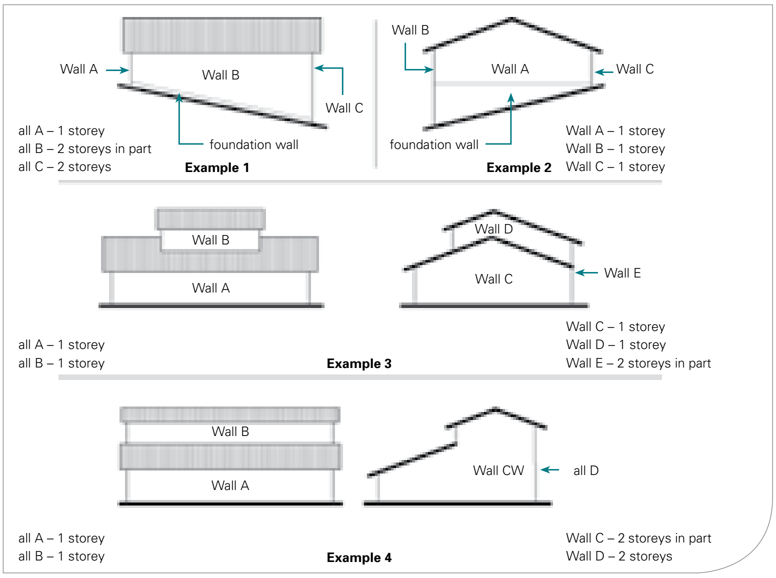
Increasing a building height above a single storey also increases the catchment area of the higher walls when exposed to wind-driven rain. This increase in catchment area increases the risk of gravity-fed leaking because more water will run over any vulnerable areas associated with window and door openings, or over penetrations and other junctions on lower levels.

Some buildings may have a partial upper storey, such as a pop-up clerestory or a point where an upper level overhangs the lower storey. For the purposes of this weathertightness risk factor in E2/AS1, a particular wall may be classified as 'one storey', 'two storeys in part', 'two storeys' or 'more than two storeys'.

Note that, for this risk factor, the number of storeys means the height of the actual wall you are assessing, excluding any unlined foundation or basement walls. It does not refer to the relative position of the wall in the building.

A building can have a mix of different storey heights, as Figure H illustrates. This figure also gives examples of the classifications for different walls. In Figure H example 2, note that the walls above foundation walls do not include the unlined foundation wall within the storey height. In Figure H examples 3 and 4, clerestory walls are classified separately.

Figure H: Number of storeys



Roof/wall junctions

Junctions of roofs with walls create the potential for water penetration and are therefore assigned varying risk scores.

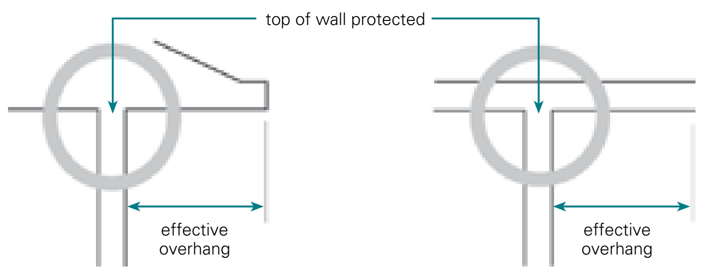
Roof/wall junctions				
Risk severity and score	**Low = 0**	**Medium = 1**	**High = 3**	**Very high = 5**
Description	Fully protected (e.g. hip and gable roof with eaves)	Partly exposed (e.g. hip and gable roof with no eaves)	Fully exposed (e.g. parapets, enclosed balustrades or eaves at greater than 90° to vertical with soffit lining)	Very high risk junctions (e.g. lower ends of aprons, chimneys, dormers etc)

Junctions or intersections between roofs and exterior walls are potential leak points, and are therefore assessed in the risk matrix. The roof design itself is not a key risk factor for weathertightness in the risk matrix and is therefore not assessed.

Low-risk junction designs

Eaves direct roof water away and protect the vulnerable joint at the top of the wall from rain. The least risky roof/wall junction design is the fully protected junction provided by traditional eaves, as shown in Figure I.

Figure I: Low-risk roof/wall junction designs

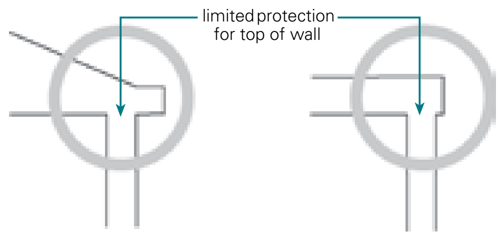


- Roof/wall intersection fully protected by eaves.
- Overhang is measured from the outside of wall cladding to the outer limit of any gutter or fascia.

Medium-risk junction designs

Partly exposed junctions have either minimal eaves (such as only external guttering) or no eaves (such as only a fascia or barge overlapping the top of the wall cladding). These provide limited protection to the top of the wall either from wind-driven rain or from direct rain, as shown in Figure J.

Figure J: Medium-risk roof/wall junction designs



Roof/wall intersection only partly protected.

High-risk junction designs

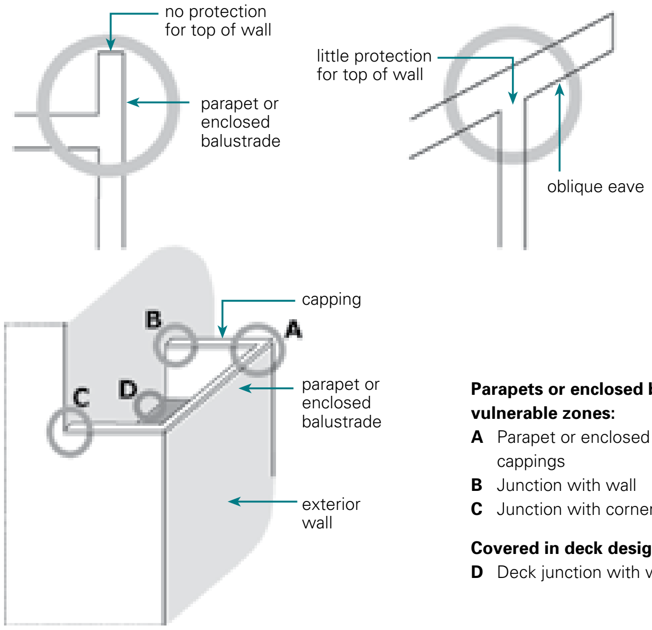
High-risk roof/wall junctions occur where exposure of the junction allows water to run over areas vulnerable to penetration, as shown in Figure K.

Design features such as enclosed balustrades (a term that E2/AS1 uses to describe framed and clad 'solid' balustrades) and parapets include potentially vulnerable junctions located directly above the wall. As water can run over these junctions, a failure in these locations poses a high potential hazard.

> **Note:**
> Parapets and enclosed balustrades are considered as narrow roofs within the risk matrix and are assessed for their roof/wall intersections. They both require a cavity automatically under E2/AS1.
>
> To complete the risk matrix, you still need to complete the assessment of the risk scores around the building.

Other examples of high-risk junctions are those using eaves with soffits at an angle of more than 90o to the exterior walls, such as in mono-pitched roof designs. These are also as shown in Figure K. This type of eave exposes the soffit/wall cladding junction to water running over the vulnerable junction located at the top of the wall framing.

Figure K: High-risk roof/wall junction designs



Parapets or enclosed balustrades vulnerable zones:

A Parapet or enclosed balustrade cappings

B Junction with wall

C Junction with corner wall

Covered in deck design:

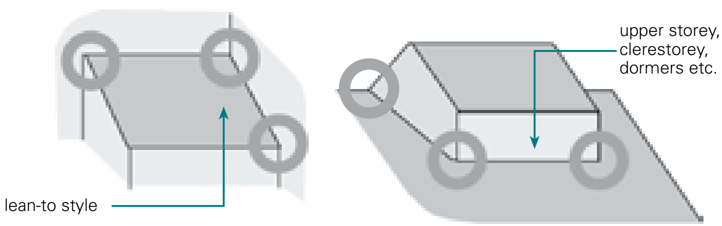
D Deck junction with wall

Very high-risk junction designs

Very high risk roof/wall junctions occur where upper roofs or walls terminate within lower exterior walls or roofs, as shown in Figure L. When these junctions are exposed to water run-off, they create opportunities for leaks to penetrate the building. They are considered very high risk because the potential consequence of any failure can be serious.

Examples of very high risk roof/wall junctions include multiple-level roofs, clerestories, dormers and chimneys. Similarly, typical lean-to buildings introduce risky roof-to-wall intersections, such as aprons, that require correctly designed and installed flashings. These will need care, especially at each end of the flashings.

Figure L: Very high-risk roof/wall junction designs



Upper walls finishing within boundaries of lower exterior walls.

Note:
In some cases, a particular design feature can be vulnerable to different sources of water penetration. The risk matrix avoids scoring this more than once by the provision under the envelope complexity risk factor for very high risk severity.

Eaves width

Weather protection provided by eaves is a function of eaves width as well as the wall height.

Eaves width					
Risk severity and score		**Low = 0**	**Medium = 1**	**High = 2**	**Very high = 5**
Description	Single storey	Greater than 600 mm	451-600 mm	101-450 mm	0-100 mm
	Two storey		Over 600 mm	451-600 mm	0 – 450 mm
	Above two storey			Greater than 600 mm	Less than 600 mm

Eaves shelter walls from rainfall. However, as rain is often wind-driven, the effective shelter that the eaves provide will decrease as their width decreases. Similarly, the effective eave shelter will also decrease as the continuous wall height increases.

Note:
When assessing the risk score of an eave, measure horizontally from the external face of the wall cladding to the outer limit of the overhang, including any gutters or fascias.

Solid balustrades and parapets count as 0 mm eaves width.

To determine this risk score, consider the eaves width in conjunction with the actual height of the wall protected by the eave, rather than the relative height of the wall in the building. For this risk factor, unlike the number of storeys risk factor, partial height walls simply default to the higher storey (e.g. a one and a half storey wall is considered to be 'two storey').

To help you assess eaves risk, Table B re-expresses the definitions from E2/AS1 Table 1 by eaves dimension.

Figure M shows the different risk scores associated with two notional building designs in relation to the range of eaves width defined in E2/AS1.

Table B: Eaves width risk severity

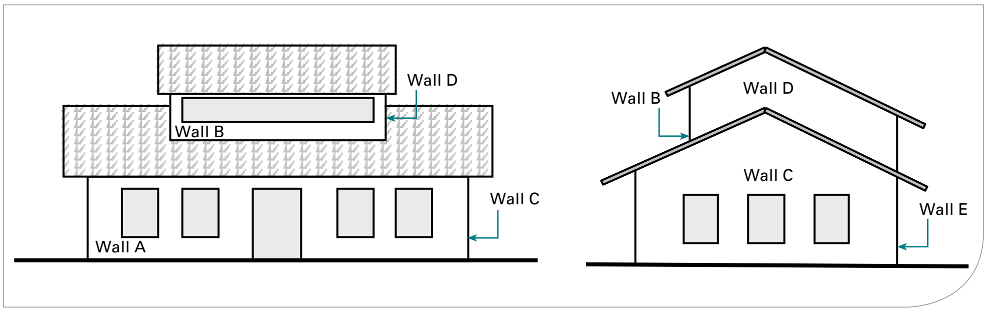
Eaves width	Greater than 600 mm	451 – 600 mm	101 – 450 mm	0 -100mm
Single storey	L	M	H	VH
Two storey	M	H	VH	VH
Above two storey	H	VH	VH	VH

Key:

L = low risk, M = medium risk, H = high risk, VH = very high risk.

Figure M: Eaves width examples

Example 1: Two storey building with a clerestory window



Eaves width	Greater than 600 mm	451 – 600 mm	101 – 450 mm	0 -100mm
Wall A	L	M	H	VH
Wall B	L	M	H	VH
Wall C	L	M	H	VH
Wall D	L	M	H	VH
Wall E[1]	M	H	VH	VH

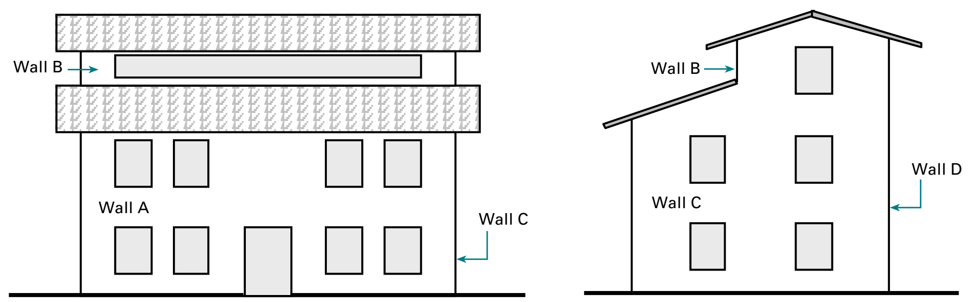
Key:

L = low risk, M = medium risk, H = high risk, VH = very high risk.

Note:

(1) Wall E is the one and a half height wall. As the eaves width risk factor does not measure part height walls, it defaults to the higher wall overall; i.e. two storeys.

Example 2: Two-three storey building with a clerestory window



Eaves width	Greater than 600 mm	451 – 600 mm	101 – 450 mm	0 -100mm
Wall A	M	H	VH	VH
Wall B	L	M	H	VH
Wall C (1)	H	VH (2)	VH	VH
Wall D	H	VH	VH	VH

Key:

L = low risk, M = medium risk, H = high risk, VH = very high risk.

Note:

(1): Wall C is the partly two and partly three storey high wall. As the eaves width risk factor does not measure part height walls, this defaults to the higher wall overall, i.e. above two storeys.

(2): Any eaves dimension within the range of 451 - 600 mm will effectively be 'less than 600 mm above two storeys', so the risk score is very high.

Envelope complexity

A more complex building envelope means more wall junctions and greater risk of leaks.

Envelope complexity				
Risk severity and score	**Low = 0**	**Medium = 1**	**High = 3**	**Very high = 6**
Description	Simple rectangular, L, T or boomerang shape, with single cladding type	Moderately complex, angular or curved shapes (e.g. Y or arrowhead) with no more than two cladding types	Complex, angular or curved shapes (e.g. Y or arrowhead) with multiple cladding types	As for high risk, but with junctions not covered in the roof/wall junctions or deck design risk factors (e.g. box windows, pergolas, multiple storey re-entrant shapes etc)

The more complicated the building shape, the higher its weathertightness risk. This is because the number of wall junctions increases as the building envelope's complexity increases. The greater the number of junctions and the more complex they are, the more measures you will need to take to keep the building envelope weathertight.

Assessing the complexity of the building envelope can be subjective: what may seem simple to one person may seem more risky to another. It is important to recognise that there is no checklist to produce one consistent answer. Base your judgement on an understanding of the principles underlying increased vulnerability for complex building envelopes and on being able to identify potential water entry points.

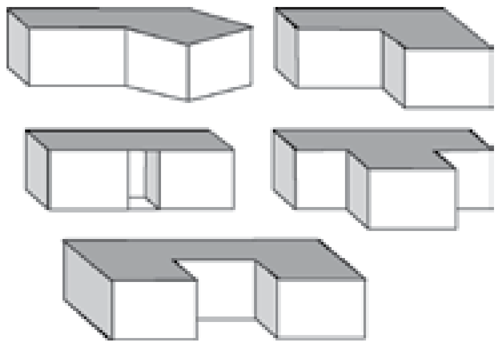
To gain a full, three-dimensional picture of envelope complexity and assess this weathertightness risk factor correctly, you will need to consider both the plan view (the building shape) as well as the elevation view, including wall claddings, joinery type and attachments. If you only assess a complicated elevation design by looking at a series of small, isolated wall faces, you may not allow sufficiently for the complexities in the overall building shape or adjoining intersections. In this regard, the wall face approach alone may provide incorrect risk scores that underestimate the building's overall weathertightness risk.

First, consider the building shape from the plan view for such features as the number and types of corners, and multi-storey intersections. Next, view the elevation: this will indicate multi-storey intersections, wall cladding types and any increased complexity from cladding joints or penetrations and where these increase the weathertightness risk. Junctions or penetrations associated with windows, doors, pipe or cable entry points, and attachments such as pergolas are areas particularly vulnerable to water penetration.

To help you assess envelope complexity, we have included some generic descriptions and illustrations, along with brief checklists for both plan views and the elevation views. To make these illustrations easier to follow roof shapes are not shown.

Low-risk envelope complexity

Figure N: Examples of low-risk building envelopes



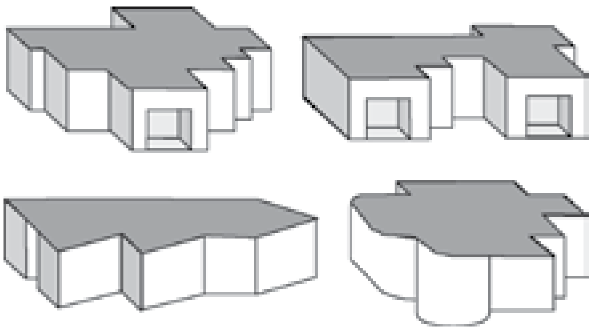
- May be more than one storey high.
- Simple floor plan, limited corners, one wall cladding, simple doors and windows.

Low-risk building envelopes tend to have the following features:

- **Building shape**
  The floor plan is simple, which limits the number and complexity of corner junctions and hence the number of potentially vulnerable points.
- **Wall cladding**
  There is a single wall cladding, so there are no inter-cladding junctions vulnerable to water entry.
- **Windows**
  Window and door joinery is simple in design.
- **Attachments and penetrations**
  There are no exposed attachments such as pergolas, and penetrations are limited to the meter box.

Medium-risk envelope complexity

Figure O: Examples of medium-risk building envelopes



- May be more than one storey high.
- Complex floor plan, many/difficult corners, one wall cladding, simple joinery.
- Otherwise simple floor plans with two wall claddings.

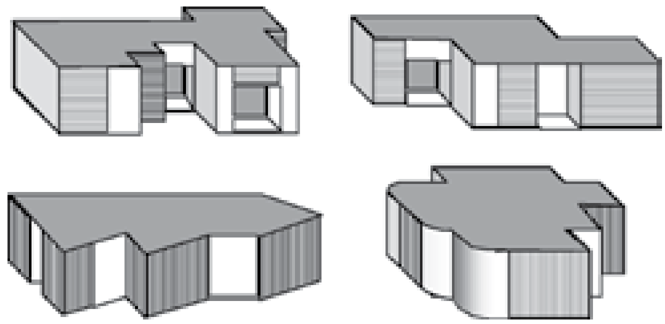
Medium-risk building envelopes tend to have the following features:

- **Building shape**
  The floor plan is moderately complex, with more corner junctions and possibly curved walls or corners at acute angles. The number and complexity of corner junctions is increased.
- **Wall cladding**
  There are no more than two different wall claddings, so there are limited inter-cladding junctions vulnerable to water entry.
- **Windows**
  Window and door joinery is reasonably simple in design, with no complex windows.
- **Attachments and penetrations**
  There are no exposed attachments, such as pergolas, with fixings that penetrate wall claddings.

> **Note:**
> If a simple building envelope has two types of cladding, even if it has otherwise low risk characteristics, it must be classified as medium risk for envelope complexity.

High-risk envelope complexity

Figure P: Examples of high-risk building envelopes



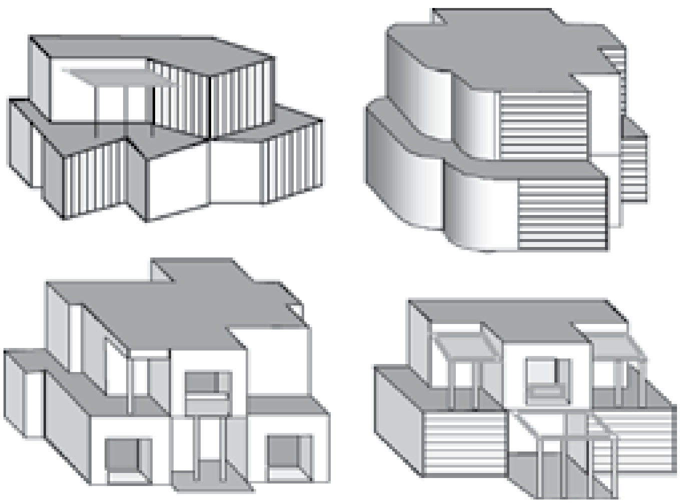
- May be more than one storey high.
- Shapes similar to those for medium risk, except with multiple claddings.

High-risk building envelopes tend to have the following features:

- **Building shape**
  The floor plan is complex, with many corner junctions and possibly curved walls. The number and complexity of vulnerable corner junctions is increased.
- **Wall cladding**
  There are multiple wall claddings and therefore a range of inter-cladding junctions vulnerable to water entry.
- **Windows**
  Window and door units are mostly conventional in design, without specialised windows (no box, bay or conservatory-type glazing) that may be difficult to weatherproof.
- **Attachments and penetrations**
  There are no exposed attachments, such as pergolas or open balustrades, with fixings that penetrate wall claddings.

Very high-risk envelope complexity

Figure Q: Examples of very high-risk building envelopes



- May be more than two storeys.
- Very complex multi-level floor plans, many or difficult corners, multiple wall claddings, non-standard windows, and attachments such as pergolas.

A very high risk envelope has many junctions not already assessed under the risk factors for roof/wall junctions or deck design.

Such additional, very high risk junctions occur with:

- Box windows or conservatory joinery
- Attachments such as pergolas or open balustrades with fixings that penetrate wall claddings, and
- Multi-storey, re-entrant shapes where an upper level wall finishes within a lower level roof or deck.

See examples of these very high risk situations.

Very high risk building envelopes tend to have the following features:

- **Building shape**
  The floor plan is very complex, with multiple levels, many corner junctions and possibly curved walls. Corners may be at acute angles. The number and complexity of corner junctions is very high.
- **Wall cladding**
  There are multiple wall claddings and many inter-cladding junctions vulnerable to water entry.

- **Windows and doors**
  Window and door joinery may be non-standard in design. They may also have complex features such as box, bay or dormer windows, or special conservatory-type glazing that lead to complex window-to-wall junctions.
- **Attachments and penetrations**
  There are exposed attachments, such as pergolas or open balustrades, with fixings that penetrate wall claddings.

An open balustrade has a limited number of areas that can trap moisture and these are readily visible. However, it will have multiple fixings that penetrate the wall claddings and is considered a very high risk feature – refer to Figure R Enclosed decks. An exception to this is if the open balustrade is around a simple, cantilevered timber deck structure with free-draining slats (as in Example 1: Simple house with three decks).

> **Note:**
> In some cases, a particular design feature in an elevation or wall is vulnerable to water penetration from more than one source. While it could be considered under more than one of the weathertightness risk factors, this could result in over-counting.
>
> The risk matrix allows for such circumstances in this very high risk category for the envelope complexity risk factor. This score should only be used if the design being assessed has similar high risk envelope features and also has junctions which you have not already covered in your roof/wall or deck design risk factor assessments.

Deck design

Decks have a strong correlation with leaks and can create significant weathertightness risks for a building.

Deck design				
Risk severity and score	Low = 0	Medium = 2	High = 4	Very high = 6
Description	None, timber slat deck, or porch at ground floor level	Fully covered in plan by roof, or timber slat deck attached at first or second floor level	Enclosed deck exposed in plan or cantilevered at first floor level	Enclosed deck exposed in plan or cantilevered at second floor level or above

A high proportion of buildings experiencing leaks have decks and/or waterproofed balconies. The level of weathertightness risk will vary according to the deck type, design and location. For example, decks fully protected by a roof overhang have a much lower risk than cantilevered decks and/or decks located on higher storeys, where the weather exposure and consequences of failure are greater.

Note:
E2/AS1 uses the term 'decks' to include both decks and balconies. It divides decks into two categories based on their water management characteristics:

- Spaced timber slat decks or other decks with a free-draining surface, and
- Enclosed decks with an impervious or waterproofed upper surface and either closed in or lined underneath.

Timber slat decks

You can determine the risk levels for timber slat decks through a combination of the following factors:

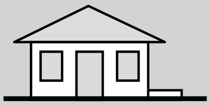
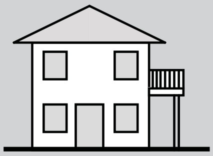
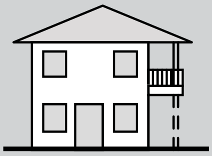
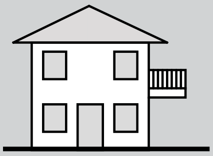
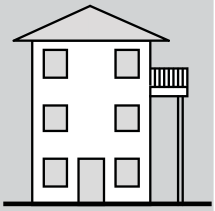
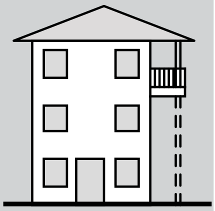
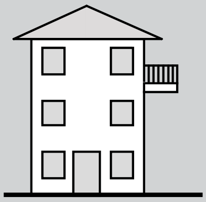
- Their height above ground
- Whether or not they are fully covered (i.e. fully protected) by the building roof or verandah, and
- Whether or not the deck joists are cantilevered.

For example, a traditional timber slat deck at ground level is free draining and is therefore unlikely to increase the danger of water penetration into the wall framing. However, a deck from an upper storey can have vulnerable penetrations through the wall cladding such as bolted connections or stringers not properly spaced off the cladding. The risk increases as the height of the deck is raised to upper storeys.

Risk is reduced where a roof provides full cover over the deck. Note that the risk matrix has no halfway point between 'fully covered' and 'exposed'; meaning that a wide eave (say 600 mm) over a deck would still have the deck assessed as an 'exposed' deck.

The most vulnerable areas for timber slat decks are the connections of the deck structure to the exterior wall. Timber slat decks with cantilevered joists have increased risk of water entry, as the joists penetrating the wall cladding are difficult to weatherproof. The risk of consequent damage to the storeys below increases with the height of the deck. Therefore, cantilevered decks are given higher risk classifications based on the risk level definitions for desk design in E2/AS1 Table 1, as shown in Table C: Timber slat decks – risk levels. This table is based on the risk level definitions for desk design in E2/AS1 Table 1.

Table C: Timber slat decks – risk levels

	Low risk	Medium risk	High risk	Very high risk
Ground floor level	 Timber slat deck			
First floor level		 Exposed and non-cantilevered  Fully protected by roof	 Exposed or cantilevered	
Second floor level		 Exposed and non-cantilevered  Fully protected by roof at second floor level or above		 Exposed or cantilevered at second floor level or above

Enclosed decks

E2/AS1 defines an enclosed deck as one with an impermeable upper surface and closed-in on the underside (i.e. with a soffit or a ceiling). These decks can create rain catchment areas and are therefore considered higher risk than timber slat decks or other free-draining decks.

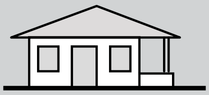
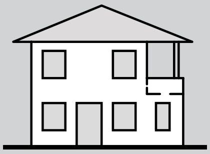
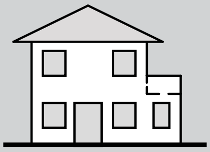
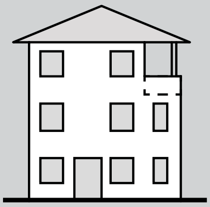
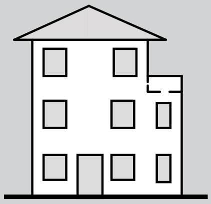
Any moisture penetration in an enclosed deck endangers the framing of the deck and adjoining walls and is often difficult to detect. Since the deck-to-wall junction and the door threshold opening are vulnerable to water penetration, the level of risk relates directly to the exposure of these areas. The full roof cover helps to protect the junctions of the deck to the exterior walls. Note that the risk matrix has no halfway point between 'fully covered' and 'exposed'.

You can determine the risk levels for an enclosed deck by considering the following factors:

- Its height above ground, and
- Whether or not it is fully covered by the building roof overhead.

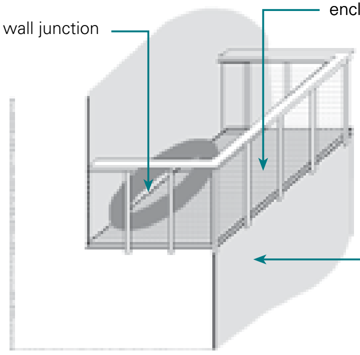
This is summarised in Table D: Enclosed decks – risk levels. This table is also based on the risk level definitions for desk design in E2/AS1 Table 1.

Table D: Enclosed decks – risk levels

	Low risk	Medium risk	High risk	Very high risk
Ground floor level	 Simple porch			
First floor level		 Fully covered by roof	 Exposed (attached or cantilevered)	
Second floor level		 Fully covered by roof at second floor level or above		 Exposed at second floor level or above (attached or cantilevered)

The risk assessment for decks is concerned with the junctions of the deck with the exterior wall (as shown in Figure R: Enclosed decks), including door thresholds. However, junctions between the exterior wall and an enclosed or otherwise solid balustrade around the deck are assessed in the roof/wall junctions risk factor (as shown in Figure K: High-risk roof/wall junction designs).

Figure R: Enclosed decks



- Enclosed deck-to-wall junction – vulnerable to moisture penetration.
- Enclosed balustrade – refer section 5 Risk factor C – Roof/wall intersection design, High-risk intersection designs

Note: Around this enclosed deck is an example of an open balustrade showing the numerous wall cladding penetrations for the balusters and handrail.

Note:
Junctions between the exterior wall and the balustrade (whether an open balustrade or an enclosed or otherwise solid balustrade) are assessed in the roof/wall junctions risk factor.

5. Applying the risk matrix: worked examples

These three worked examples offer a variety of design features and complexities to assess for risk. They are:

- Example 1: Simple house with three decks
- Example 2: Multi-storey house with a clerestory window and enclosed deck, and
- Example 3: Two storey house with bay windows and decks.

Note:
These examples are worked examples only and that every house design has different design features and complexities that need to be taken into account, even if the house design is is identical to those shown here.

These examples are based on real buildings, although they are not drawn to scale. To make them easier to follow, we have only shown the relevant exterior walls and features. Elevations showing roof overhangs may not necessarily show the gutters/fascias. Therefore, where an eaves dimension is specified, we have assumed that any gutters and fascias are included and that eaves at gable ends are the same dimension as eaves with spouting.

E2/AS1 Amendment 5 introduced circumstances independent of the risk matrix that automatically require a drained cavity with the wall cladding system. However, we have not used a default conclusion in these examples so we can illustrate the whole process of assessing and scoring each of the six risk factors in turn. In practice, you will still need to complete these assessments to confirm if specific design is required (i.e. when any particular elevation or wall faces achieves a risk score over 20).

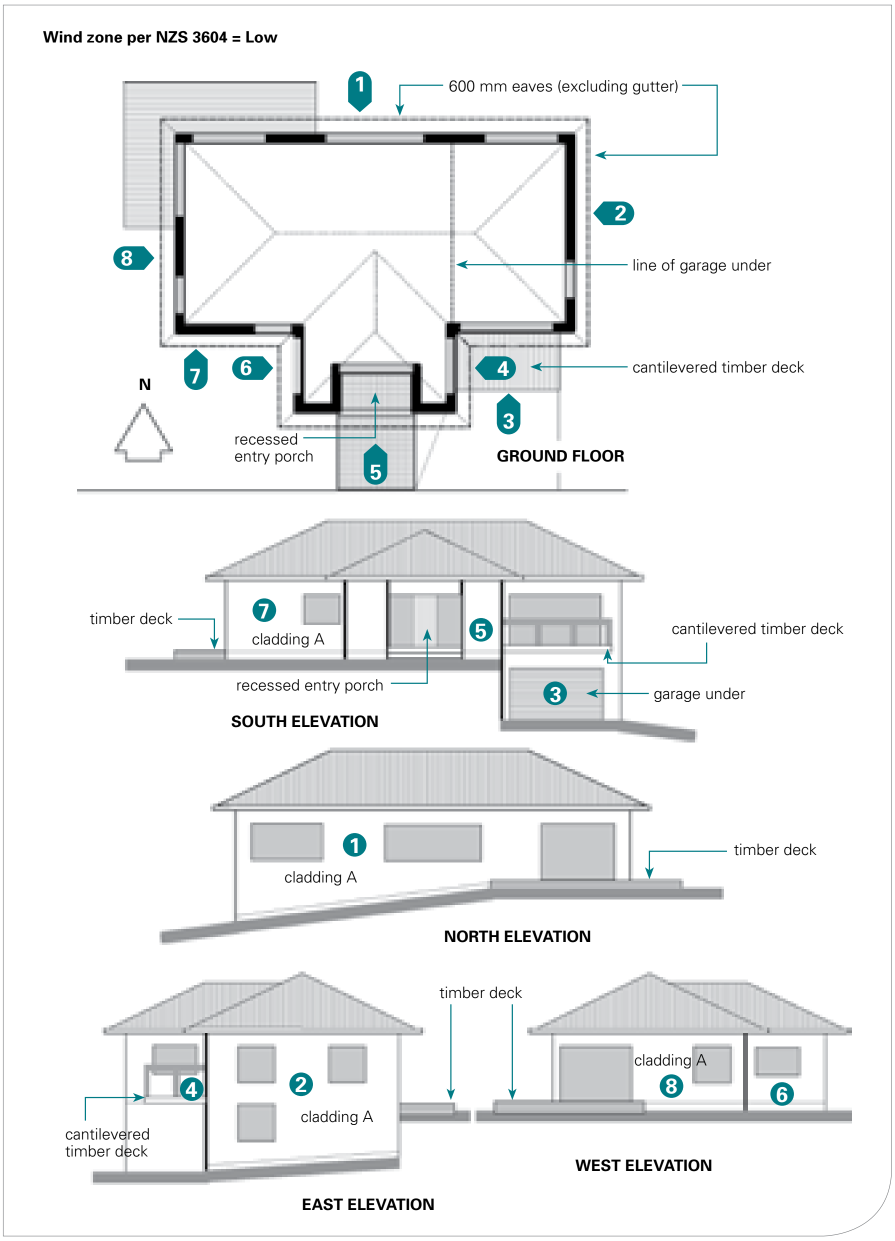
As explained earlier, you can choose an elevation or wall face approach to assess the weathertightness risk scores depending on the building's complexity. We have used both approaches in these examples and compared the two in the worked Example 3.

Example 1: Simple house with three decks

This is a relatively simple, single storey house located in a low wind zone and with a lined garage under the southeast corner. The design has a hip roof with 600 mm eaves all around, a single type of wall cladding, and three decks (two at ground level and another cantilevered above the garage with an open balustrade fixed directly to the deck structure). The specified eaves width dimension on the plans is taken to include gutters and fascias.

Plan and elevations

Figure: Plan and elevations



Building envelope risk scores (elevation approach)

This worked example illustrates the use of the elevation approach for what is a relatively simple building but which still includes some walls on different planes in the same elevation and others with different heights and risks.

The north and west elevations illustrate simple building elevations that pose very little weathertightness risk for the cladding system. The south elevation covers three walls with different weathertightness risk features, while the east elevation contains one straightforward, two storey wall and a double height wall supporting a cantilevered deck.

The elevation approach is the quickest and simplest method, as you only have to complete one assessment for each whole elevation. However, it is a global measurement that reads the higher risk values in the elevation even if it contains lower risk features.

We have chosen to start the assessment with the north elevation and work clockwise around the building.

Elevation: North (Wall 1)	**Risk Severity**								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0	0	0		1		2		0
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0		1	1	2		5		1
Envelope complexity	0	0	1		3		6		0
Deck design	0	0	2		4		6		0
Total risk score:									1

Reasoning: The north elevation is Wall 1 and is one storey in height for most of its length.

The wind zone is low and the wall is single storey, with both assessed as low risk. The hip roof has eaves protecting the roof/wall junctions giving a low risk score. The 600 mm eaves cover the predominantly single height wall to give a medium risk score. Envelope complexity is low. Deck design is low risk with the timber deck on the northwest corner at ground-floor level.

The total risk score of 1 for this elevation falls near the bottom of the 0 to 6 risk band.

Elevation: East (Walls 2 and 4)	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0	0	0		1		2		0
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0		1		2	2	5		2
Envelope complexity	0	0	1		3		6		0
Deck design	0		2		4	4	6		4
Total risk score:									8

Reasoning: The east elevation contains Walls 2 and 4 and the two storey high section of the building. The cantilevered timber slat deck connects to Wall 2.

The wind zone is low risk while the two storey walls are high risk. The hip roof with eaves gives the roof/wall junction a low risk score. The 600 mm eaves give a high risk score as they are in the range of 451 – 600 mm for the two storey walls. Envelope complexity is low risk, but the deck design is high risk due to the timber slat deck cantilevered at the first floor.

The total risk score of 8 for this wall falls within the lower end of the 7 to 12 risk band.

Elevation: South (Walls 3, 5 and 7)	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0	0	0		1		2		0
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0		1		2	2	5		2
Envelope complexity	0	0	1		3		6		0
Deck design	0		2		4	4	6		4
Total risk score:									8

Reasoning: The south elevation includes the single storey Wall 5 (with the inset entry porch walls) and Wall 7, plus Wall 3 with the timber slat deck cantilevered at the first floor.

The wind zone is low risk. The two storey Wall 3 puts the storey height risk at high. The hip roof with eaves gives the roof/wall junction a low risk score. The 600 mm eaves covering the two storey wall give a high risk score overall. Envelope complexity is low, while the deck is high risk due to the timber slat deck cantilevered at the first floor.

The total risk score of 8 for this wall falls at the lower end of the 7 to 12 risk band.

Elevation: West (Walls 6 and 8)	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0	0	0		1		2		0
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0		1	1	2		5		1
Envelope complexity	0	0	1		3		6		0
Deck design	0	0	2		4		6		0
Total risk score:									1

Reasoning: The west elevation is the single storey Walls 6 and 8.

The wind zone is low and the walls are single storey, with both factors assessed a low risk score. The hip roof has eaves protecting the roof/wall junction giving it a low risk score. The 600 mm eaves cover the single height walls giving a medium risk score, as they are in the range of 451 – 600 mm for a single storey wall. Envelope complexity is low risk with a simple shape and only one wall cladding type. Deck design is low risk, as the timber deck on the northwest corner is at ground-floor level.

The total risk score of 1 for this elevation falls near the bottom of the 0 to 6 risk band.

The combined total score of the risk factors could increase up to 5 without changing the overall classification of risk severity.

Summary: risk scores and wall cladding options

For this building design, the risk scores and subsequent wall cladding options under E2/AS1 Table 3 are as follows.

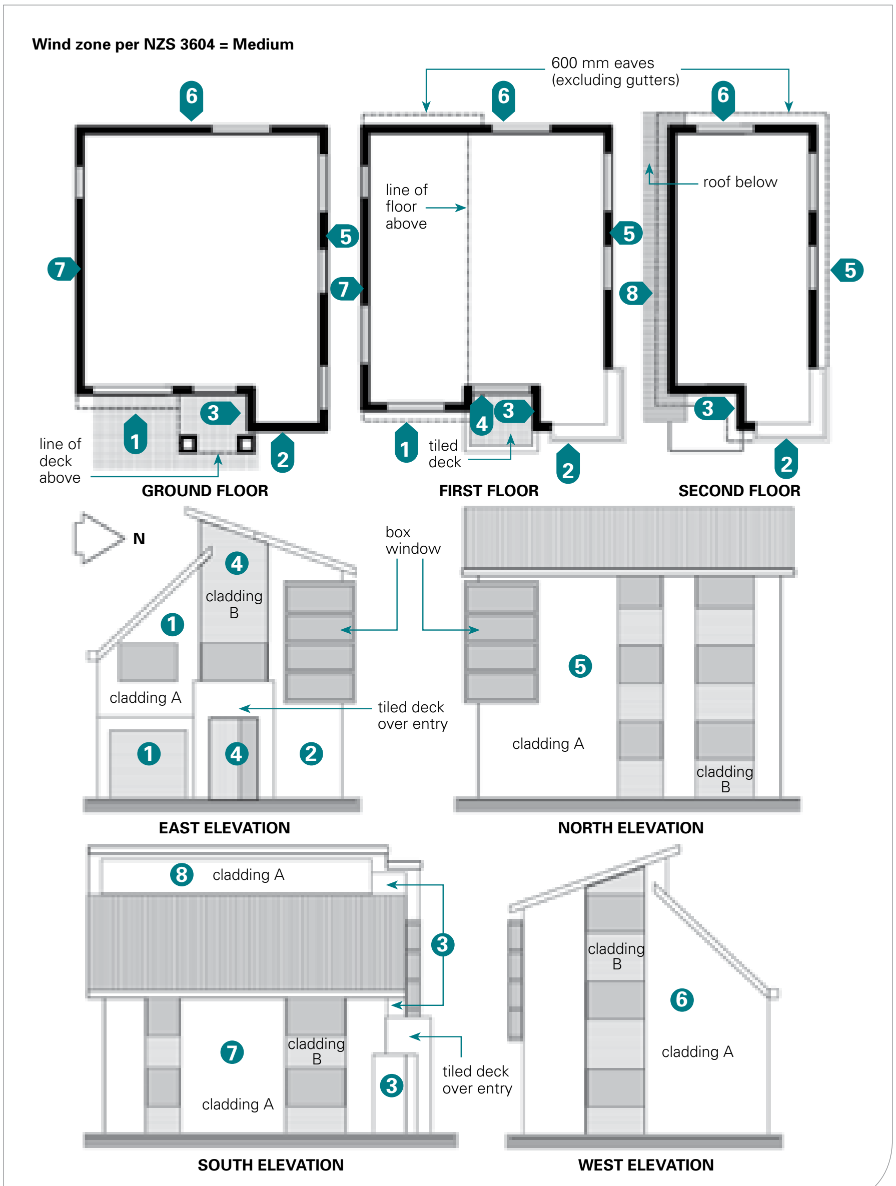
Elevation	Wall(s)	Score	Risk band	Wall cladding options (from E2/AS1 Table 3)	
				Direct fixed	Over a cavity
North West	1 6, 8	1 1	0 -6 0- 6	Timber weatherboards (all types) Fibre cement weatherboards Vertical profiled metal (corrugated and symmetrical trapezoidal) Fibre cement sheet (batten or jointed finish) Plywood sheet	Masonry veneer Stucco Horizontal profiled metal (corrugated and trapezoidal only) Fibre cement sheet (flush-finished) EIFS
East South	2, 4 3, 5, 7	8 8	7 - 12 7 - 12	Bevel-back timber weatherboards Vertical timber board and batten Vertical profiled metal (corrugated only)	As above, plus Fibre cement sheet (batten, flush or jointed finish) Plywood sheet (batten finish) Fibre cement weatherboards Rusticated weatherboards

Example 2: Multi-storey house with clerestory window and enclosed deck

This is a moderately complex house in a medium wind zone, with mono-pitch roofs separated by a clerestory section of wall. Eaves are specified at 600 mm (with gutters and fascias taken as being included). It is over two storeys high and has two different types of wall cladding. The design includes a corner box window at the first floor level and an enclosed deck, which is partially set back into the building envelope.

Plan and elevations

Figure: Plan and elevations



Building envelope risk scores (elevation approach)

This moderately complex design shows how the overall elevation approach can bring together into four simple assessments all the many different features and weathertightness risks. This follows on from Example 1, which used the elevation approach for a relatively simple building.

The east and south elevations for this building have multiple risk features such as walls on different planes, a clerestory, an inset deck and a box window. The north and south appear more straightforward until you consider such features as the eave details at high level and the box window.

Choosing to assess each wall separately for this design (i.e. to use the wall face approach) would produce eight assessments and might lower some scores. However, the practicalities of having a cavity start and stop around the two cladding systems would produce its own complications for detailing and construction. Demonstrating the wall face approach is left for the last worked example, Example 3, where it is explored in detail.

Elevation: North	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		1	0	1		2		0
Number of storeys	0		1		2		4	4	4
Roof/wall intersection design	0		1	1	3		5		1
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1	1	3		6		1
Deck design	0	0	2		4		6		0
Total risk score:									11

Reasoning: The north elevation is over two storeys with two claddings, a box window and an external gutter but no eaves shown.

The medium wind zone is medium risk while the more than two storey wall height is very high risk. The roof/wall intersection is partly exposed due to the lack of eaves, leading to a medium risk score. The risk score for eaves width is very high, being less than 600 mm above two storeys (Wall 5). Envelope complexity is medium due to the two claddings. There is no deck on this wall.

The total risk score of 11 lies near the top of the 7 to 12 risk band.

Elevation: East	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0	0	1		2		0
Number of storeys	0		1		2		4	4	4
Roof/wall intersection design	0		1		3		5		3
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1		3	3	6		3
Deck design	0		2		4	4	6		4
Total risk score:									19

Reasoning: The east elevation is more than two storeys in height, has two claddings, a box window and the enclosed deck with a solid balustrade.

The medium wind zone is medium risk while the more than two storey wall height (Wall 2) is very high risk. While the eaves protect the upper roof/wall intersections, the enclosed balustrade takes this to a high risk score for the roof/wall junction. Eaves width (Wall 2) is very high, being less than 600 mm above two storeys. The envelope complexity is high due to the multiple cladding junctions across four wall planes plus the box window feature. The enclosed deck at the first floor is high risk.

The total risk score of 19 sit at the upper end of the 13 to 20 risk band.

Elevation: South	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		1	0	1		2		0
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0		1		3		5	5	5
Eaves width	0		1		2	2	5		2
Envelope complexity	0		1		3	3	6		3
Deck design	0		2		4	4	6		4
Total risk score:									16

Reasoning: The south elevation is more than two storeys overall with two different claddings and a high clerestory. It has walls on different planes, including Wall 3 and one side of the enclosed balustrade.

The medium wind zone is medium risk while the two storey high walls (Walls 3 and 7) are high risk. The soffit is greater than 900, but the apron flashing to the clerestory window takes this to very high risk for roof/wall junctions. Eaves width is high, being 451 - 600 mm for two storeys (Wall 7). The envelope complexity is high due to the multiple cladding junctions. The enclosed deck at the first floor is high risk.

The total risk score of 16 sits within the 13 to 20 risk band.

Elevation: West	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0	0	1		2		0
Number of storeys	0		1		2		4		4
Roof/wall intersection design	0		1	1	3		5		1
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1	1	3		6		1
Deck design	0	0	2		4		6		0
Total risk score:									11

Reasoning: The west elevation, which comprises Wall 6, is more than two storeys high with eaves. It has two different claddings and a small portion of intersecting roof.

The wind zone is medium risk, while this wall at over two storeys is very high risk. The roof/wall junction has eaves protection but is partially exposed at the intersection of the roof planes, so is considered medium risk. The risk score for eaves width is very high, being no more than 600mm above two storeys. Envelope complexity is medium because of the two claddings. There is no deck.

The total risk score of 11 is near the top of the 7 to 12 risk band.

Summary: risk scores and wall cladding options

For this building design, the risk scores and subsequent wall cladding options under E2/AS1 Table 3 are as follows.

Elevation	Score	Risk band	Wall cladding options (from E2/AS1 Table 3)	
			Direct fixed	Over a cavity
North West	11 11	7 – 12 7 – 12	Bevel-back timber weatherboards Vertical timber board and batten Vertical profiled metal (corrugated only)	Masonry veneer Stucco Horizontal profiled metal (corrugated and trapezoidal only) Rusticated weatherboards Fibre cement weatherboards Fibre cement sheet (batten, jointed or flush finish) Plywood sheet (batten finish) EIFS
East South	19 16	13 – 20 13 - 20	Vertical profiled metal (corrugated only) (1)	As above, plus bevel-back timber weatherboards

Note:

(1) Direct fix vertical corrugated steel is included in E2/AS1 Table 3 as being suitable for cavity construction. It may be used in lieu of those claddings designated as requiring a nominal 20 mm drained cavity.

Example 3: Two storey house with bay windows and decks

This two-storey house, located in a high wind zone, has 600 mm wide eaves specified (these are taken to include gutters and fascias). There are two single storey areas extending from the ground floor. One of these is a garage that has a paved (i.e. 'enclosed') deck above with an open balustrade, while the other is an extension for a lounge. The design also includes a number of bay windows and a second enclosed deck which is partially set back into the building envelope above the front door entry.

For the purposes of this guidance document, we work through both the elevation and the wall face approaches, and then use the resulting risk scores for a comparison of the two assessment approaches.

We first demonstrate the elevation approach, as it is the simplest way to assess the weathertightness risks of a building like this which has so many different design features. However, the west and north elevations are examples of where an overall elevation approach will result in the high risk scores from any one wall face overriding other walls where the risk does not apply directly. These higher risk scores will result in requiring cavities for the entire building rather than pinpointing particular items for special attention (as shown in our workings for the wall face approach). Therefore, choosing the elevation approach is a separate decision for the designer, who may want to simplify the detailing and construction without further effort.

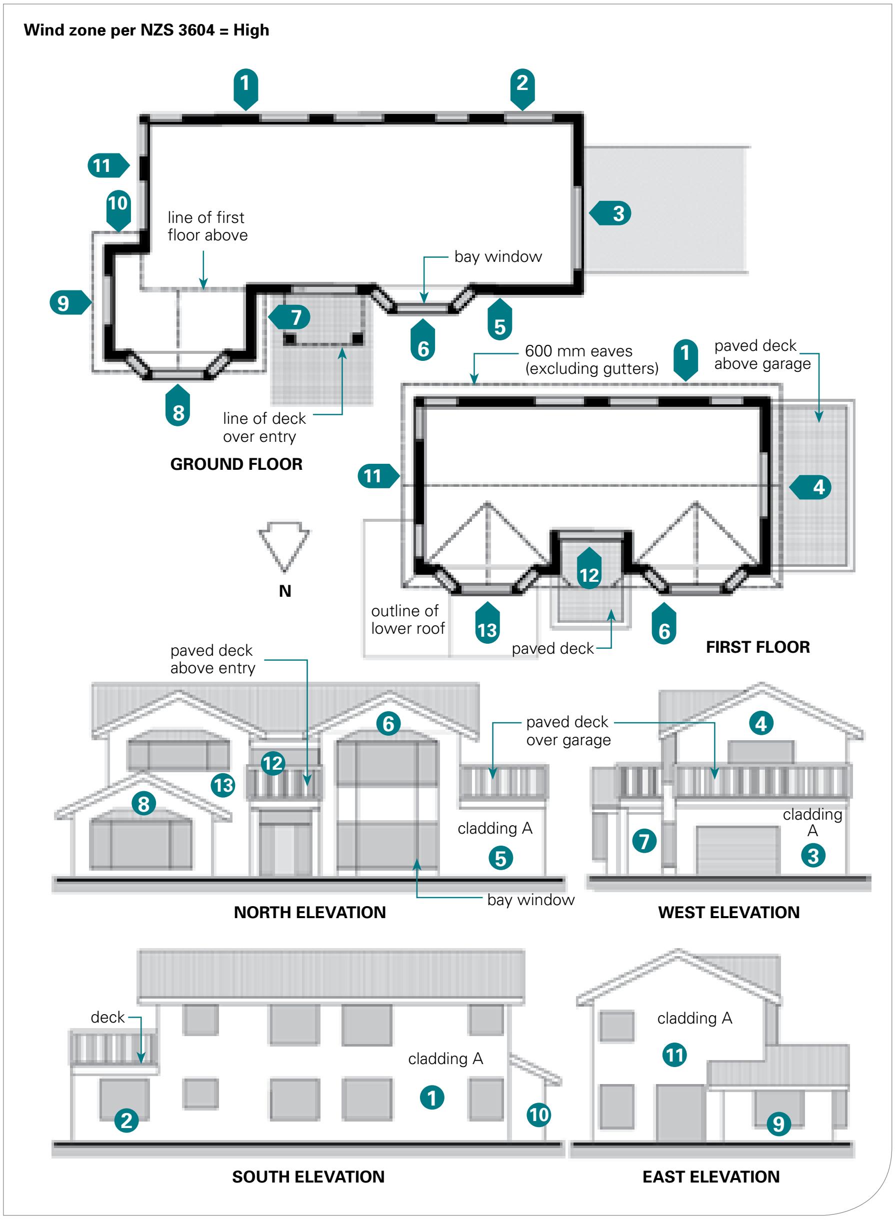
> **Note:**
> Take care when using the simple elevation approach to weathertightness risk assessment, especially with more complex buildings. Applying higher risk scores overall may be the easiest and more cautious approach and may simplify documentation, but it can also increase costs through over-design for the particular circumstances.

On the other hand, while the wall face approach allows closer consideration of each design feature, it can underestimate the overall weathertightness risk – particularly for such a complex building design – by focusing on smaller parts of the design and missing the complexities of the overall building shape and adjoining intersections.

Some assessments made under the wall face approach will also split wall planes into separate faces (in this example, Walls 1 and 2, or Walls 5 and 6). While this may be of use for designs with multiple claddings, it could be impractical to mix cladding systems with different cavity requirements on the same plane. Some design issues might need careful consideration: for example, whether or not you need to provide special junction details or adjust framing widths.

Plan and elevations

Figure: Plan and elevations



Building envelope risk scores (elevation approach)

The elevation approach involves assessing each building elevation in turn. Here, we again start with the north elevation and work clockwise around the building.

Elevation: North	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0		1		3		5	5	5
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1		3	3	6		3
Deck design	0		2		4	4	6		4
Total risk score:									20

Reasoning: The north elevation is the most complex. It has different height walls, including Wall 5 to the garage with the roof deck and no eaves. Eaves are otherwise 600 mm or wider. There are three bay windows and Wall 13 has a high risk roof finishing within it.

The high wind zone is high risk and the two storey walls are high risk. The risky junctions at the lower roof extension with Wall 13 lead to a very high risk score for roof/wall junctions. There are no eaves at the Wall 5 roof deck, leading to a very high risk score for eaves width (0 – 100 mm for single storey). The envelope complexity is considered high due to the three bay windows and the open balcony connections. The deck at first floor level is partially covered, so is still high risk.

The total combined risk score of 20 is at the upper limit of the risk band 13 – 20. Any further risk would result in this elevation requiring specific design.

Elevation: East	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0		1		3		5	5	5
Eaves width	0		1		2	2	5	5	2
Envelope complexity	0		1	1	3		6		1
Deck design	0	0	2		4		6		0
Total risk score:									11

Reasoning: The east elevation is the two storey Wall 11, again with a high risk roof finishing within it, and the single storey Wall 9.

The high wind zone is high risk and the predominantly two storey wall (Wall 11) gives a high risk. The roof/wall junction at the intersection with the lean-to is very high risk. The eaves are high risk, being no more than 600 mm covering the two storey wall height. The envelope complexity is considered medium risk. There is no deck.

The total risk score of 11 for this elevation falls into the risk band of 7 to 12.

Elevation: South	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0		1	1	3		5		1
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1	1	3		6		1
Deck design	0	0	2		4		6		0
Total risk score:									10

Reasoning: The south elevation is the mainly two storey face of Wall 1 with protecting eaves and the single storey Wall 2 to the garage with the roof deck and no eaves. Wall 10 is set further back on a different plane.

The high wind zone is high risk and the predominantly two storey wall puts the number of storeys at high risk. The roof eaves protect much of the elevation, but the roof/wall junction is partly exposed along the deck giving it a medium risk score. There are eaves to two walls but none to Wall 2 giving a very high risk score (0 – 100 mm for single storey) for eaves width. The envelope has a single cladding type, but the open balustrade intersection increases envelope complexity to medium. There is no additional deck risk to add.

The total risk score of 10 sits within the risk band of 7 to 12.

Elevation: West	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0		1	1	3		5		1
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1	1	3		6		1
Deck design	0		2		4	4	6		4
Total risk score:									12

Reasoning: The west elevation contains three walls (Walls 3, 4 and 7) each on entirely different planes. Two of these walls also have open balustrade fixings for the enclosed deck over the garage.

The high wind zone is high risk and the single storey walls are low risk. The roof eaves protect one wall of the elevation, but the roof/wall junction is partly exposed along the two decks giving a medium risk score. There are eaves to the separate Wall 4 but none to Walls 3 and 7, giving a very high risk score (0 – 100 mm for single storey) for eaves width. There is one cladding but the open balustrade intersection connections to both decks increases envelope complexity to medium. The enclosed deck is exposed on the first floor and is high risk.

The total risk score of 12 for this wall puts it at the top of the 7 to 12 risk band.

Building envelope risk scores (wall face approach)

The wall face approach involves assessing each of the building's 13 walls. Starting with Wall 1, we consider each wall face in turn around the building. However, where walls have similar risk features (e.g. Walls, 2, 3 and 5), we have grouped the results to avoid repeating information.

Wall number: 1	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0		1		2	2	5		2
Envelope complexity	0	0	1		3		6		0
Deck design	0	0	2		4		6		0
Total risk score:									5

Reasoning: This initial wall face assessment considers the two-storey Wall 1. (The plan and elevation sketches of the open balustrade around the enclosed deck indicate connections to only the adjoining Walls 2 and 4).

The high wind zone is high risk and the two storey wall is high risk. The gable roof has eaves protecting the roof/wall junction, giving it a low risk score. The 600 mm eaves cover the two storey wall to give a high risk score. The envelope is simple with one cladding and is therefore low risk. There is no deck.

The total risk score of 5 for this wall sits in the risk band of 0 to 6.

Wall number: 2, 3 & 5	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0		1	1	3		5		1
Eaves width	0		1		2		5	5	5
Envelope complexity	0		1	1	3		6		1
Deck design	0		2		4		6		0
Total risk score:									8

Reasoning: Wall 2 is the single storey wall to the lined garage with the deck above. It has a direct counterpart in Wall 5 and the same risk features as Wall 3, so all three are assessed together. (Note that you might choose to introduce another cladding system to these walls, but you would have to manage the jointing/cavity details carefully where wall planes are broken – as in Walls 1 and 2, and Walls 5 and 6.)

The wind zone is high risk and the single storey walls are low risk. The partially exposed roof/wall junction is medium risk. The 0 -100 mm eaves cover for the single storey is very high risk. The envelope is medium risk due to the open balustrade junctions. There is no additional risk score for the deck (as it is considered with the eaves width and envelope complexity risk factors).

The total risk score of 8 for each of these three walls falls into the risk band of 7 to 12.

Wall number: 4	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0		1		3		5	5	5
Eaves width	0		1	1	2		5		1
Envelope complexity	0		1	1	3		6		1
Deck design	0		2		4	4	6		4
Total risk score:									12

Reasoning: Wall 4 is the upper floor on the west elevation, located above the deck on the garage.

The high wind zone is high risk and the single storey wall is low risk. While the gable eaves protect the top of the roof to wall junction, the bottom of the wall intersects with the deck so the greater risk score is very high for roof/wall junctions. The 600 mm eaves cover the single storey wall to give a medium risk score. The envelope is simple with one cladding, but both ends of the wall adjoin the open balustrade at the corners so envelope complexity increases to medium. The enclosed deck is exposed at the first floor level so is high risk.

The total risk score of 12 sits at the top of the risk band of 7 to 12.

Wall number: 6	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0	0	1		3		5	5	0
Eaves width	0		1	1	2		5		1
Envelope complexity	0	0	1		3		6		0
Deck design	0	0	2		4		6		0
Total risk score:									2

Reasoning: Wall 7 is a single storey wall on the northeast extension. It has a direct counterpart in Wall 9 and the same risk features.

The high wind zone is high risk and the single storey walls are low risk. The roof eaves protect the roof/wall junction, giving a low risk score. The 600 mm eaves cover the single storey walls for a medium risk score. The envelopes are simple and low risk. There are no decks.

The total risk score of 2 falls well down into the risk band of 0 to 6.

Wall number: 8	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0		1		3	3	5	5	3
Eaves width	0		1	1	2		5		1
Envelope complexity	0		1	1	3		6		1
Deck design	0	0	2		4		6		0
Total risk score:									6

Reasoning: Wall 8 is the single storey gable end of the northeast extension containing the bay window.

The high wind zone is high risk and the one storey wall is low risk. While the roof eaves protect the top roof/wall junction, the bay window 'roof' is a risky junction giving it a high risk score. The 600 mm eaves to the single storey wall give a medium risk score. The envelope with the bay window joints gives envelope complexity a medium score. There is no deck.

The total risk score of 6 for this wall sits within the risk band of 0 to 6.

Wall number: 10	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0		1	1	2		5		1
Envelope complexity	0	0	1		3		6		0
Deck design	0	0	2		4		6		0
Total risk score:									2

Reasoning: Wall 10 is a single storey wall on the southeast corner of the lounge extension.

The high wind zone is high risk and the single storey walls are low risk. The roof eaves protect the roof/wall junction giving a low risk score. The 600 mm eaves cover the single storey walls for a medium risk score. The envelopes are simple and low risk. There are no decks.

The total risk score of 2 falls well down into the risk band of 0 to 6.

Wall number: 11	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0		1		3		5	5	5
Eaves width	0		1		2	2	5		2
Envelope complexity	0		1	1	3		6		1
Deck design	0	0	2		4		6		0
Total risk score:									11

Reasoning: Wall 11 is the two storey wall on the east elevation. Eaves protect the top of the wall framing. However, there is a risky junction with the lean-to roof from the lounge extension.

The high wind zone is high risk and the two storey wall is high risk. While the gable end protects the top roof/wall junction, the lean-to roof and apron makes this very high risk. The 600 mm eaves cover the two storey wall to give a high risk score. The envelope complexity is medium. There is no deck.

The total risk score of 11 for this wall falls in the upper end of the risk band of 7 to 12.

Wall number: 12	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0	0	1		2		4		0
Roof/wall intersection design	0	0	1		3		5		0
Eaves width	0	0	1		2		5		0
Envelope complexity	0		1	1	3		6		1
Deck design	0		2		4	4	6		4
Total risk score:									6

Reasoning: Wall 12 is the recessed wall on the north elevation along with the adjacent side walls to both the ground floor entry and the second storey deck. Strictly speaking, this could be assessed as six separate walls. However, as the risks are similar, they are considered together as one element.

The high wind zone is high risk and the one storey walls are low risk. Both the roof overhang and the deck protect the roof/wall junctions, giving them a low risk score. The roof overhang is greater than 600 mm giving a low risk score for eaves width. Envelope complexity is considered to be medium risk with the open balustrade connections at the corners. The deck at first floor level is partly exposed and is high risk.

The total risk score of 6 for this wall is at the top of the 0 to 6 risk band.

Wall number: 13	Risk Severity								
Risk factor	Low		Medium		High		Very high		Subtotals for each risk factor
Wind zone (up to Extra High)	0		0		1	1	2		1
Number of storeys	0		1		2	2	4		2
Roof/wall intersection design	0		1		3		5	5	5
Eaves width	0		1		2	2	5		2
Envelope complexity	0		1		3	3	6		3
Deck design	0	0	2		4		6		0
Total risk score:									10

Reasoning: Wall 13 is the two storey gable-end wall on the north elevation. It has junctions at the bay window, an intersection with the lower roof, and balcony side fixings.

The high wind zone is high risk and the two storey wall is high risk. The roof/wall junction is very high risk due to the lower roof finishing within this wall. Eaves are no more than 600 mm for the second storey wall and classified as high risk. Envelope complexity is high due to the bay window junctions and to the abutting roof and open balcony. There is no additional risk score for the deck.

The total risk score of 13 for this wall is at the bottom of the 13 to 20 risk band.

Summary: comparison of the elevation and wall face approaches

The two different approaches to assessing this complex building design have generated quite different results for some walls, as shown in Table E: Comparison of risk scores for Example 3 from the elevation and wall face approaches.

The elevation approach has generated overall risk scores ranging from 10 to 20. While these risk scores do not require specific weathertightness design, the majority of cladding choices from E2/AS1 will require a cavity. Meanwhile, the wall face approach has generated a wider range of risk scores: from 2 to 15.

The elevation approach provides more straight forward documentation and construction, but is a more conservative design approach. As this example illustrates, it can impose a higher score on some wall faces than they would achieve if assessed separately.

On the other hand, using the wall face approach alone may provide risk scores that actually underestimate the weathertightness risk. This can occur when assessing a complicated elevation through a series of only small, isolated wall faces as the results may not fully allow for the complexities in the overall building shape or for adjoining intersections.

Note:
Take care in concluding that the wall face approach avoids specific design or cavity installation and will therefore be cheaper than the elevation approach because the risk may be understated when the building is considered as an entity. The approach you choose to assess a building for weathertightness risk should relate to the particular circumstances.

Table E: Comparison of risk scores for Example 3 from the elevation and wall face approaches

	Elevation Approach		Wall Face Approach	
Elevation	Risk score (risk band)	Wall number	Risk score (risk band)	Risk band shift
North	20 (13 – 20)	5	8 (7 – 12)	1 level
		6	11 (7 - 12)	1 level
		8	6 (0 - 6)	2 levels
		12	6 (0 - 6)	2 levels
		13	13 (13 – 20)	unchanged
East	11 (7 – 12)	9	2 (0 – 6)	1 level
		11	11 (7 – 12)	unchanged
South	10 (7 – 12)	1	5 (0 - 6)	1 level
		2	8 (7 – 12)	unchanged
		10	2 (0 - 6)	1 level
West	12 (7 – 12)	3	8 (7 – 12)	unchanged
		4	12 (7 – 12)	unchanged
		7	2 (0 - 6)	1 level

Appendix One: Resources

The following Ministry of Business, Innovation and Employment publications are available from the Ministry via our freephone 0800 242 243, or as a free download from www.dbh.govt.nz:

- Acceptable Solution E2/AS1
  www.dbh.govt.nz/compliance-documents#E2
- External moisture – An introduction to weathertightness design principles
  www.dbh.govt.nz/weathertightness-guides
- New Zealand Building Code Handbook
  www.dbh.govt.nz/compliance-documents#handbooks

Appendix Two: Key definitions

We have listed some of the most important definitions below, including terms used with a particular meaning in E2/AS1. You can find further definitions within E2/AS1 itself and in the New Zealand Building Code Handbook.

Acceptable Solution	A solution that must be accepted as complying with the Building Code. It provides step-by-step instructions that prescribe one way of complying with the provisions of the Building Code.
Deck	An open platform projecting from an exterior wall of a building and supported by framing. A deck may be over enclosed internal spaces, or may be open underneath. Also known as a balcony. Refer also to Enclosed deck.
	Note: In E2/AS1, a deck is divided into two construction types: a free-draining deck, such as a timber slat deck, and an enclosed deck, which has a waterproof upper surface and is either lined or closed in underneath.
Drained cavity	A cavity space, immediately behind a wall cladding, that has vents at the base of the wall. Also known as a drained and vented cavity and referred to in E2/AS1 as a cavity or a drained cavity.
Eaves	That part of the roof construction, including cladding, fascia and eaves gutter (spouting) that extends beyond the exterior face of the wall.
	Note: In the E2/AS1 risk matrix, eaves design is one of the key risk factors for assessing weathertightness. The eaves measurement is taken horizontally from the external face of the wall cladding and includes any external gutter/spouting or fascia.
EIFS	External insulation and finish systems. A polystyrene sheet-based cladding system that uses mesh reinforced polymermodified cement-based or polymer-based plaster base coats and a protective top coating.
Enclosed balustrade	A timber-framed barrier, under E2/AS1, with cladding across all exposed faces. Refer also to Parapet.
Enclosed deck	A deck, whether over an interior or exterior space, that has an impermeable upper surface and is closed on the underside. May also be known as a balcony. With the risk matrix, the term "enclosed" considers the water management ability of the deck and does not refer to the space surrounding it or to where it is located within the building.
Envelope complexity	The categorisation of the complexity of the total building envelope into one of four classes, depending on the particular features of the building as specified in E2/AS1.
Flush-finished	The description of a cladding and joints system which relies on a protective coating applied to the face of the cladding to prevent the penetration of water.
	Note: In the E2/AS1 cladding options, this refers to flush-finished fibre cement sheet.

Monolithic cladding	An exterior wall cladding system of stucco or sheet material with an applied coating giving the appearance of a continuous cladding. The system relies on protective coatings for weathertightness. **Note:** Within the E2/AS1 cladding options, monolithic cladding refers to stucco, flush-finished fibre cement sheet (where joints are sealed) and to external insulation and finish systems (EIFS).
Parapet	A timber-framed wall that extends above the level of the roof cladding. Refer also to Enclosed balustrade.
Specific design	Design and detailing for compliance with the Building Code of a proposed part or parts of a building which are not shown in an Acceptable Solution.
Weathertightness and weathertight	Terms used to describe the resistance of a building to the weather.
Wind zone	Categorisation of wind force experienced on a particular site as per NZS 3604:2011 Timber-framed buildings, Section 5.

Appendix Three: Templates

Definitions of risk levels
(referenced from Table 1 of E2/AS1, December 2011)

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
	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*)
	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
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
	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
	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:

(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*.

(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.

Risk matrix scoring template
(referenced from Table 2 of E2/AS1, December 2011)

Elevation or Wall:	Risk Severity								
Risk factor	Low		Medium		High		Very high [1]		Subtotals for each risk factor
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		
Total risk score (for application to Table 3 of E2/AS1). **To use:** Enter the appropriate risk severity score for each risk factor. 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 of E2/AS1 for rigid underlay and drained cavity requirements.

Elevation or Wall:	Risk Severity								
Risk factor	Low		Medium		High		Very high [1]		Subtotals for each risk factor
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		
Total risk score (for application to Table 3 of E2/AS1). **To use:** Enter the appropriate risk severity score for each risk factor. 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 of E2/AS1 for rigid underlay and drained cavity requirements.

Suitable wall claddings
(referenced from Table 3 of E2/AS1, December 2011)

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.**