

3.2 Calculation Method

3.2.1

This method allows for a building to have more than one type of wall construction, glazing over 30% of total wall area, a mix of glazing types, etc., or to relax some R-value requirements providing this is compensated for a higher R-value elsewhere in the building thermal envelope.

3.2.2

Building thermal envelope components with R-values and conditions different from those given by table 1 or table 2 may be used providing the heat loss, as calculated by Equation 2 in 3.2.4, of the proposed building, is less than or equal to the heat loss of the reference building for the relevant climate zone, construction type and design. For compliance:

$$HL_{\text{Proposed}} \leq HL_{\text{Reference}} \dots\dots\dots(\text{Eq. 1})$$

Where

HL_{Proposed} is the heat loss of the proposed building

$HL_{\text{Reference}}$ is the heat loss of the reference building.

3.2.3

$HL_{\text{Reference}}$ shall be calculated from equation 2 in clause 3.2.4 using the thermal resistance and conditions for roof, wall and floor from tables 1 or 2 as appropriate. The glazing and door thermal resistances for the calculation of $HL_{\text{Reference}}$ shall be those given in table 4. Where the area of glazing is less than or equal to 30% of total wall area, the area of glazing of the reference building for use in equation 2 shall be set to 30%. The wall area of the reference building is therefore 70% of its total wall area.

3.2.4

The heat flow (HL) through the building fabric is calculated by the building heat loss in Equation 2.

$$HL = \frac{A_{\text{Roof}}}{R_{\text{Roof}}} + \frac{A_{\text{Wall}}}{R_{\text{Wall}}} + \frac{A_{\text{Floor}}}{R_{\text{Floor}}} + \frac{A_{\text{Glazing}}}{R_{\text{Glazing}}} \dots\dots\dots(\text{Eq.2})$$

Where

- A_{Roof} Is the roof area (m²)
- A_{Wall} Is the wall area (m²)
- A_{Floor} Is the floor area (m²)
- A_{Glazing} Is the area of glazing (m²)

And

R_{Roof} , R_{Wall} , R_{Floor} and R_{Glazing} are the proposed or reference R-values (m² °C/W) of the corresponding building envelope components.

3.2.5

Where a building thermal envelope component is proposed to have two or more methods of construction with different thermal resistances (Wall 1 and Wall 2 in the example), the corresponding term in the proposed building thermal characteristic shall be expanded to suit.

For example: $\frac{A_{\text{Wall}}}{R_{\text{Wall}}}$ becomes $\frac{A_{\text{Wall 1}}}{R_{\text{Wall 1}}} + \frac{A_{\text{Wall 2}}}{R_{\text{Wall 2}}}$

3.2.6

When the calculation method is used, the reduction in the R-values for a given component shall not be greater than 40% of the R-value required in table 1 or table 2 except in the case where the reduction in the R-value can be from clear double glazing to the R-value of single glazing.

For example: R3.0 → minimum possible is R1.8
 R1.5 → minimum possible is R0.9
 R1.0 → minimum possible is R0.6

NOTE – Designers should also be aware of the minimum R-values for housing, required in the Acceptable Solution of the NZBC Approved Document E3, Internal Moisture.

3.2.7

There are no R-value requirements for non-glazed doors with an opening area of 3 m² or less. Non-glazed areas of door openings greater than 3 m² are treated as wall.

3.2.8

For the purpose of calculation, the area of glazing includes glazing in walls, roof (skylights) and doors (see table 4).

HEAT LOSS EQUATION EXAMPLE

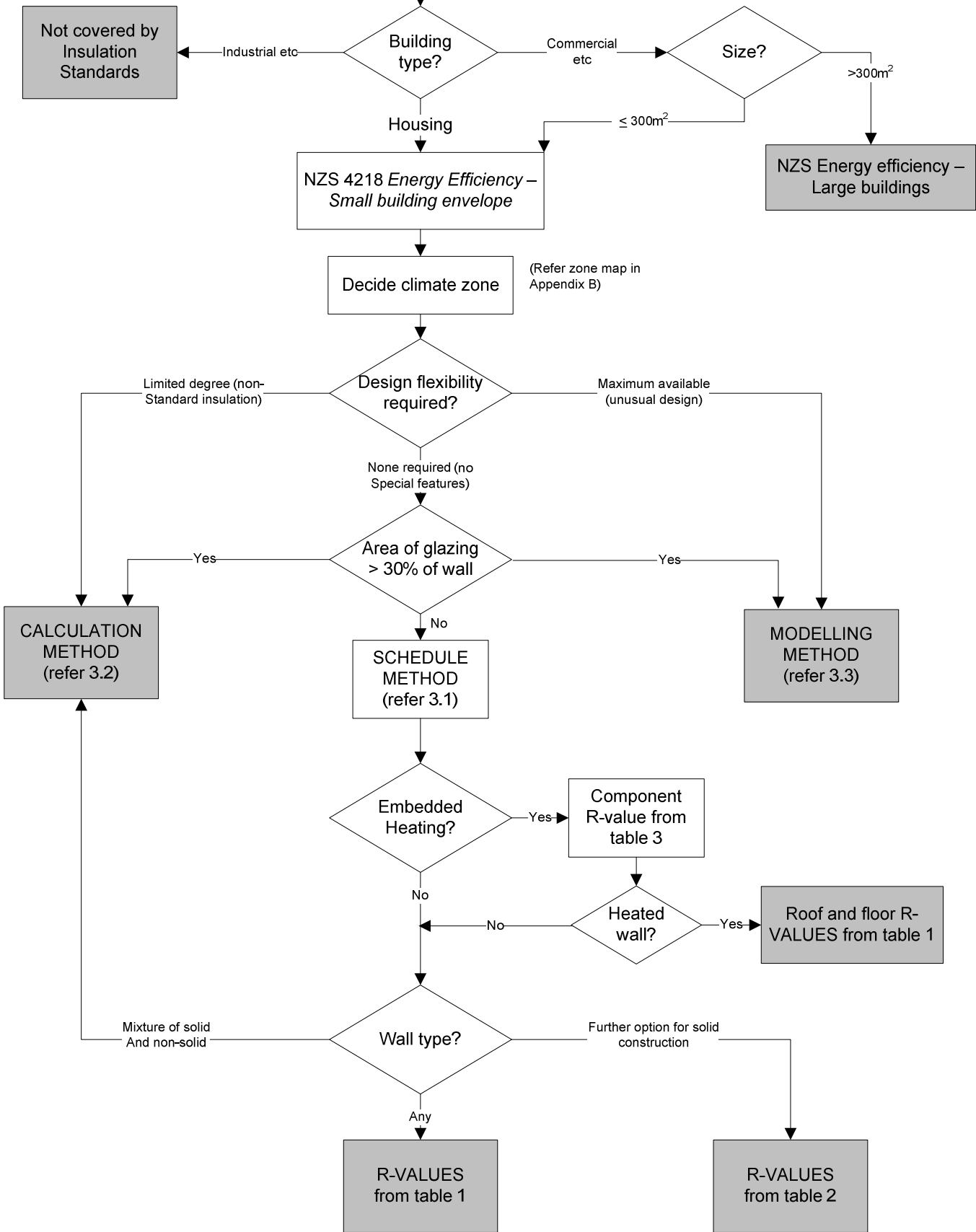
(Normative)

Reference heat loss equations – non-solid construction

Area of glazing	Climate zone	Reference building heat loss equation
≤ 30% of total wall area	2	$HL_{\text{Reference}} = \frac{A_{\text{Roof}}}{2.9} + \frac{A_{\text{70\% of total wall area}}}{1.9} + \frac{A_{\text{Floor}}}{1.3} + \frac{A_{\text{30\% of total wall area}}}{0.26}$ <p>R-values from tables 1 & 4</p>
> 30% of total wall area	2	$HL_{\text{Reference}} = \frac{A_{\text{Roof}}}{2.9} + \frac{A_{\text{Wall}}}{1.9} + \frac{A_{\text{Floor}}}{1.3} + \frac{A_{\text{Glazing}}}{0.26}$ $+ \frac{A_{\text{Glazing}}}{0.31} \geq \frac{A_{\text{30\% of total wall area}}}{0.31}$ <p>R-values from tables 1 & 4</p>

For solid construction use the R-values from Tables 2(a), 2(b) & 4

PROPOSED NEW BUILDING



Decision flowchart

WORKED EXAMPLE 1

(Informative)

The following provides information by way of a worked example, to show how increasing the R-value in one building component allows a decrease in another component. Consider a house in Zone 2 with non-solid construction for walls and roof with a window area of 35 m². There is a door opening of 5 m² which includes 3 m² of glazing. Thus the total glazing is 38 m² including the door glazing. The calculation shows the wall R-value is also achieved by the non-glazed portion of the door:

House dimensions: Length 22m, Width 9m, Height 2.4m
 Total wall area: (22m x 2.4m x 2) + (9m x 2.4 x 2) = 148.8
 Floor area and roof area: 22m x 9m = 198 m²
 Area of glazing: 35 m² + 3 m² (door) = 38 m²
 % Glazing/wall area: 38 m² / 148.8 m² = 25.5%
 Wall area: 148.8 m² - 38 m² = 110.8

Glazing over 30% = NIL

REFERENCE BUILDING

$$HL_{\text{Reference}} = \frac{A_{\text{Roof}}}{2.9} + \frac{A_{\text{70\% of total wall area}}}{1.9} + \frac{A_{\text{Floor}}}{1.3} + \frac{A_{\text{30\% of total wall area}}}{0.26}$$

$$HL_{\text{Reference}} = \frac{198}{2.9} + \frac{104.2}{1.9} + \frac{198}{1.3} + \frac{44.6}{0.26}$$

$$HL_{\text{Reference}} = 68.3 + 54.8 + 152.3 + 171.5 = 446.9$$

PROPOSED BUILDING

Assume that the designer is prepared to increase the R-value of the roof, but wishes to use the minimum window R-value allowed by 3.2.6 re single glazing of 0.15

$$HL_{\text{Proposed}} = \frac{A_{\text{Roof}}}{R_{\text{Roof}}} + \frac{A_{\text{Wall}}}{R_{\text{Wall}}} + \frac{A_{\text{Floor}}}{R_{\text{Floor}}} + \frac{A_{\text{Glazing}}}{R_{\text{Glazing}}}$$

$$HL_{\text{Proposed}} \leq HL_{\text{Reference}}$$

$$\frac{198}{R_{\text{Roof}}} + \frac{110.8}{1.9} + \frac{198}{1.3} + \frac{38}{0.15} \leq 446.9$$

$$\frac{198}{R_{\text{Roof}}} + 58.3 + 152.3 + 253.3 \leq 446.9$$

$$R_{\text{Roof}} = \frac{A_{\text{Roof}}}{HL_{\text{Reference}} - HL_{\text{Proposed}}} = \frac{198}{446.9 - 463.9}$$

Proposal not possible using calculation method as HL_{Proposed} exceeds $HL_{\text{Reference}}$

Reconsider glazing R-value

WORKED EXAMPLE 2

(Informative)

The following provides information by way of a worked example, to show how increasing the R-value in one building component allows a decrease in another component. Consider a house in Zone 2 with non-solid construction for walls and roof with a window area of 35 m². There is a door opening of 5 m² which includes 3 m² of glazing. Thus the total glazing is 38 m² including the door glazing. The calculation shows the wall R-value is also achieved by the non-glazed portion of the door:

House dimensions: Length 22m, Width 9m, Height 2.4m
 Total wall area: (22m x 2.4m x 2) + (9m x 2.4 x 2) = 148.8
 Floor area and roof area: 22m x 9m = 198 m²
 Area of glazing: 35 m² + 3 m² (door) = 38 m²
 % Glazing/wall area: 38 m² / 148.8 m² = 25.5%

Glazing over 30% = NIL

REFERENCE BUILDING

$$HL_{\text{Reference}} = \frac{A_{\text{Roof}}}{2.9} + \frac{A_{\text{70\% of total wall area}}}{1.9} + \frac{A_{\text{Floor}}}{1.3} + \frac{A_{\text{30\% of total wall area}}}{0.26}$$

$$HL_{\text{Reference}} = \frac{198}{2.9} + \frac{104.2}{1.9} + \frac{198}{1.3} + \frac{44.6}{0.26}$$

$$HL_{\text{Reference}} = 68.3 + 54.8 + 152.3 + 171.5 = 446.9$$

PROPOSED BUILDING

Assume that the designer is prepared to increase the R-value of the roof, but wishes to use the window R-value of 0.22 for single Low E glazing

$$HL_{\text{Proposed}} = \frac{A_{\text{Roof}}}{R_{\text{Roof}}} + \frac{A_{\text{Wall}}}{R_{\text{Wall}}} + \frac{A_{\text{Floor}}}{R_{\text{Floor}}} + \frac{A_{\text{Glazing}}}{R_{\text{Glazing}}}$$

$$HL_{\text{Proposed}} \leq HL_{\text{Reference}}$$

$$\frac{198}{R_{\text{Roof}}} + \frac{110.8}{1.9} + \frac{198}{1.3} + \frac{38}{0.22} \leq 446.9$$

$$\frac{198}{R_{\text{Roof}}} + 58.3 + 152.3 + 172.7 \leq 446.9$$

$$R_{\text{Roof}} = \frac{A_{\text{Roof}}}{\frac{HL_{\text{Reference}} - HL_{\text{Proposed}}}{198}} = \frac{198}{446.9 - 383.3}$$

$$R_{\text{Roof}} \geq \frac{198}{63.6}$$

$$R_{\text{Roof}} \geq 3.1 \text{ (changes from 2.9) increase roof to 3.1}$$

WORKED EXAMPLE 3

(Informative)

The following provides information by way of a worked example, to show how increasing the R-value in one building component compensates for an increase in the area of glazing. Consider a house in Zone 2 with non-solid construction for walls and roof with a window area of 43 m². There is a door opening of 4m² which includes 2m² of glazing. Thus the total glazing is 45² including the door glazing. The calculation shows the wall R-value is also achieved by the non-glazed portion of the door:

House dimensions: Length 15m, Width 12m, Height 2.4m
 Total wall area: (15m x 2.4m x 2) + (12m x 2.4 x 2) = 129.6 m²
 Floor area and roof area: 15m x 12m = 180 m²
 Area of glazing: 43 m² + 2 m² (door) = 45 m²
 % Glazing/wall area: 45 m² / 129.6 m² = 34.7%
 Wall area: 129.6 m² - 45 m² = 84.6 m²

$$\text{Glazing over 30\%} = 45 \text{ m}^2 - (129.6 \text{ m}^2 \times 30\%) = 6.1 \text{ m}^2$$

REFERENCE BUILDING

$$HL_{\text{Reference}} = \frac{A_{\text{Roof}}}{2.9} + \frac{A_{\text{Wall}}}{1.9} + \frac{A_{\text{Floor}}}{1.3} + \frac{A_{\text{30\% of total wall area}}}{0.26} + \frac{A_{\text{Glazing} > 30\% \text{ of total wall area}}}{0.31}$$

$$HL_{\text{Reference}} = \frac{180}{2.9} + \frac{84.6}{1.9} + \frac{180}{1.3} + \frac{38.9}{0.26} + \frac{6.1}{0.31}$$

$$HL_{\text{Reference}} = 62 + 44.5 + 138.5 + 149.6 + 19.7 = 414.3$$

PROPOSED BUILDING

Assume that the designer is prepared to increase the R-value of the roof to compensate for > 30% glazed area

$$HL_{\text{Proposed}} = \frac{A_{\text{Roof}}}{R_{\text{Roof}}} + \frac{A_{\text{Wall}}}{R_{\text{Wall}}} + \frac{A_{\text{Floor}}}{R_{\text{Floor}}} + \frac{A_{\text{Glazing}}}{R_{\text{Glazing}}}$$

$$HL_{\text{Proposed}} \leq HL_{\text{Reference}}$$

$$\frac{180}{R_{\text{Roof}}} + \frac{84.6}{1.9} + \frac{180}{1.3} + \frac{45}{0.26} \leq 414.3$$

$$\frac{180}{R_{\text{Roof}}} + 44.5 + 138.5 + 173 \leq 414.3$$

$$R_{\text{Roof}} = \frac{A_{\text{Roof}}}{HL_{\text{Reference}} - HL_{\text{Proposed}}} = \frac{180}{414.3 - 356}$$

$$R_{\text{Roof}} \geq \frac{180}{58.3} =$$

$$R_{\text{Roof}} \geq 3.1 \text{ (changes from 2.9) increase roof to 3.1}$$



H1 ENERGY EFFICIENCY COMPLIANCE WITH CALCULATION METHOD NON-SOLID CONSTRUCTION, ZONE 2 < 30% GLAZING

OWNER:

SITE ADDRESS:

DESCRIPTION OF WORK:

House dimensions:	
Total wall area:	
Floor area and roof area:	
Area of glazing:	
% Glazing/wall area:	
Wall area:	

REFERENCE BUILDING

$$HL_{Reference} = \frac{A_{Roof}}{2.9} + \frac{A_{70\% \text{ of total wall area}}}{1.9} + \frac{A_{Floor}}{1.3} + \frac{A_{30\% \text{ of total wall area}}}{0.26}$$

$$HL_{Reference} = \frac{\quad}{2.9} + \frac{\quad}{1.9} + \frac{\quad}{1.3} + \frac{\quad}{0.26}$$

$$HL_{Reference} = \quad + \quad + \quad + \quad = \quad$$

PROPOSED BUILDING

$$HL_{Proposed} = \frac{A_{Roof}}{R_{Roof}} + \frac{A_{Wall}}{R_{Wall}} + \frac{A_{Floor}}{R_{Floor}} + \frac{A_{Glazing}}{R_{Glazing}}$$

$$HL_{Proposed} \leq HL_{Reference}$$

$$HL_{Proposed} = \quad + \quad + \quad + \quad$$

$$HL_{Proposed} = \quad + \quad + \quad + \quad = \quad$$

(Must be ≤ Total of Reference Building)

Location	System or Product	'R' Value
Roof		
Wall		
Floor		
Glazing (Vertical)		
Glazing (Skylight)		



H1 ENERGY EFFICIENCY COMPLIANCE WITH CALCULATION METHOD NON-SOLID CONSTRUCTION, ZONE 2 > 30% GLAZING

OWNER:

SITE ADDRESS:

DESCRIPTION OF WORK:

House dimensions:	
Total wall area:	
Floor area and roof area:	
Area of glazing:	
% Glazing/wall area:	
Wall area:	

REFERENCE BUILDING

$$HL_{\text{Reference}} = \frac{A_{\text{Roof}}}{2.9} + \frac{A_{\text{Wall}}}{1.9} + \frac{A_{\text{Floor}}}{1.3} + \frac{A_{\text{30\% of total wall area}}}{0.26} + \frac{A_{\text{Glazing}}}{0.31}$$

$$HL_{\text{Reference}} = \frac{\quad}{2.9} + \frac{\quad}{1.9} + \frac{\quad}{1.3} + \frac{\quad}{0.26} + \frac{\quad}{0.31}$$

$$HL_{\text{Reference}} = \quad + \quad + \quad + \quad + \quad = \quad$$

PROPOSED BUILDING

$$HL_{\text{Proposed}} = \frac{A_{\text{Roof}}}{R_{\text{Roof}}} + \frac{A_{\text{Wall}}}{R_{\text{Wall}}} + \frac{A_{\text{Floor}}}{R_{\text{Floor}}} + \frac{A_{\text{Glazing}}}{R_{\text{Glazing}}}$$

$$HL_{\text{Proposed}} \leq HL_{\text{Reference}}$$

$$HL_{\text{Proposed}} = \quad + \quad + \quad + \quad$$

$$HL_{\text{Proposed}} = \quad + \quad + \quad + \quad = \quad$$

(Must be ≤ Total of Reference Building)

Location	System or Product	'R' Value
Roof		
Wall		
Floor		
Glazing (Vertical)		

Glazing (Skylight)		
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