Calculation Method Example

NZBC H1: Acceptable Solution

Acceptable Solution
Calculation Method: Some algebra…

$$H_{REF} = \frac{A_{ROOF}}{R_{ROOF}} + \frac{A_{WALL}}{R_{WALL}} + \frac{A_{FLOOR}}{R_{FLOOR}} + \frac{A_{GLAZING}}{R_{GLAZING}}$$

$$H_{New} \leq H_{REF}$$

$$H_{New} = \frac{A_{ROOF}}{R_{ROOF}} + \frac{A_{WALL1}}{R_{WALL1}} + \frac{A_{WALL2}}{R_{WALL2}} + \frac{A_{FLOOR}}{R_{FLOOR}} + \frac{A_{GLAZING}}{R_{GLAZING}}$$
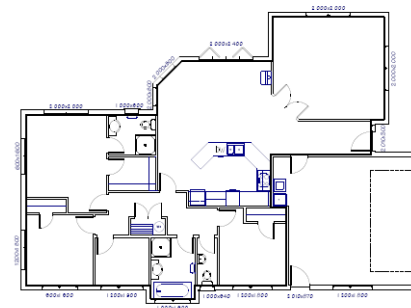
Don't worry ….the next few pages explain how to work all this out step by step

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Calculations
H_{REF}

Reference Building Heat Loss

Component	Area	R-value	Heat Loss	
Roof	130.4	2.9	45.0	
Wall	98.83	1.9	52.0	
Floor	130.4	1.3	100.3	
Glazing (30%)	42.35	0.26	162.9	
Glazing (>30%)	0	0.26	0.0	Total Loss
Skylights	0	0.31	0.0	**360.1**

Areas= Actual Areas of building

R-value= Construction R-values as stipulated in NZBC H1 for the zone (This example located in Climate Zone 1)

Heat Loss = Area/ R-value

Total Loss= Sum of all the Heat Losses

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Calculation Method
Information required

Building Description		
Roof	**Roof Cladding**	Concrete Tile
	Roof Framing	Pitched, 140mm joists @ 900
Wall	**Wall Cladding**	50% Brick
		50% Weather Board
	Wall Framing	90mm Frame, 600 studs, 800 dwangs
Floor	**Floor**	Concrete Slab with 1.2m EPS (50mm)
Windows	**Glazing**	Double Glazing

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Calculations
H_{NEW}

Proposed Building Heat Loss

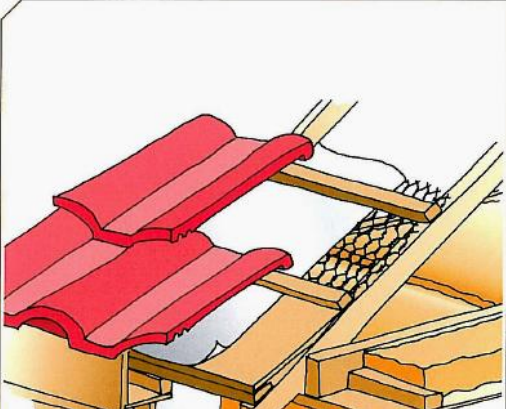| Component	Description	Insulation Used	Area	R-value	Heat Loss	Heat Loss =
Roof 1	Concrete Tiles 140mm joist @ 900 centres	Pink Batts R3.2 Ceiling 170mm	130.4			Area / R-value
Wall 1	Brick 90mm 600 studs, 800 dwangs	Pink Batts R2.2 Wall	49.42			
Wall 2	Weather Board 90mm 600 studs, 800 dwangs	Pink Batts R2.2 Wall	49.42			
Floor 1	Concrete Slab 1.2m x 50mmm EPS	EPS 1.2m x 50mm	130.4			
Glazing 1	Double Glazing	N/A	42.35			
Skylight 1						Total Loss
Skylight 2						

We now have the required details and must use the schedule method to work out the construction R-value for each section

Construction R-values
ROOF

ELEMENT	CLADDING	CONSTRUCTION
Roof	**Concrete or clay tile**	**Pitched timber-framed roof** 140 mm ceiling joists and dwangs

Framing timber spacing	Insulation material R-value						
	2.4	2.8	3.2	3.6	4.0	4.4	4.8
	Total construction R-value						
joists 1200, dwangs 900 (8.6%)	2.5	2.8	3.1	3.4	3.9	3.9	4.1
joists 900, dwangs 900 (10%)	2.5	2.7	3.0	3.3	3.5	3.8	4.0
joists 600, dwangs 900 (12%)	2.4	2.7	3.0	3.2	3.4	3.6	3.8

Using an **R3.2** product the construction R-value is **R3.0**

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Construction R-values
WALL

ELEMENT	CLADDING	CONSTRUCTION
Wall	**Masonry Veneer**	**Timber framed** 90 mm frame
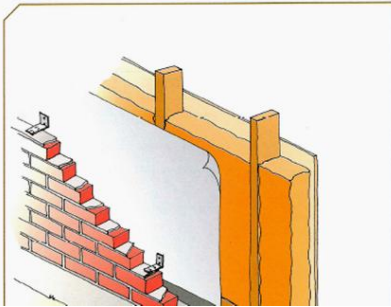
Framing timber spacing	Insulation material R-value					
	1.8	2.0	2.2	2.4	2.6	2.8
	Total construction					
studs 600, dwangs 800 (14%)	1.7	1.8	1.9	2		
studs 600, dwangs 600 (16%)	1.7	1.8	1.9	2		
studs 400, dwangs 800 (18%)	1.6	1.7	1.8	1		
studs 400, dwangs 600 (20%)	1.6	1.7	1.8	1		
(22%) framing ratio	1.6	1.7	1.7	1		
(24%) framing ratio	1.5	1.6	1.7	1		

ELEMENT	CLADDING	CONSTRUCTION
Wall	**Bevel-back Weatherboard**	**Timber framed – cavity** 90 mm frame
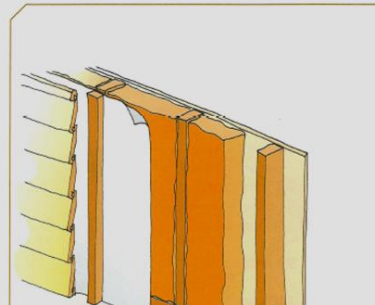
| Framing timber spacing	Insulation material R-value					
	1.8	2.0	2.2	2.4	2.6	2.8
	Total construction R-value					
studs 600, dwangs 800 (14%)	1.8	1.9	2.1	2.2	2.3	2.3
studs 600, dwangs 600 (16%)	1.8	1.9	2.0	2.1	2.2	2.3
studs 400, dwangs 800 (18%)	1.8	1.9	2.0	2.0	2.1	2.2
studs 400, dwangs 600 (20%)	1.7	1.8	1.9	2.0	2.1	2.1
(22%) framing ratio	1.7	1.8	1.9	1.9	2.0	2.1
(24%) framing ratio	1.7	1.8	1.9	1.9	2.0	2.0

Using an **R2.2** product the :

Brick Area construction R-value is **R1.9**

Weather Board area construction R-value is **R2.1**

Construction R-values
FLOOR
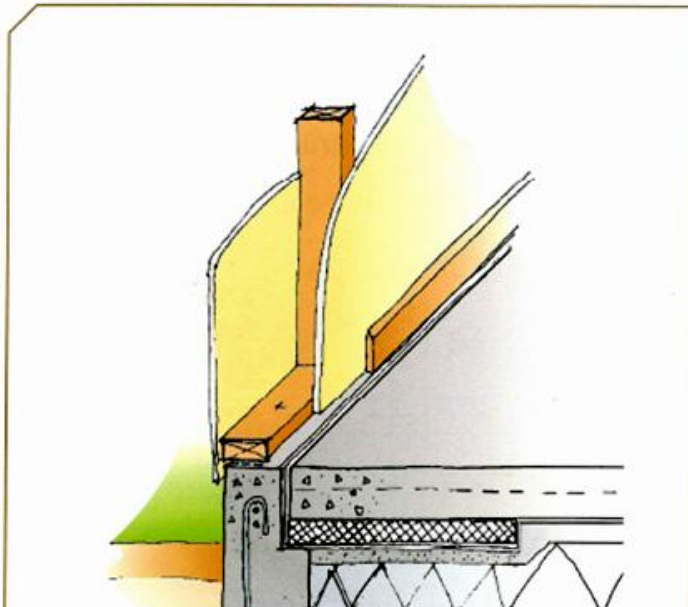
Construction	Area/perimeter ratio						
	1.3	1.9	2.2	2.5	2.8	3.1	4.0
	Total construction R-value						
140 mm stud, 1.2 m x 50 mm perimeter EPS	1.1	1.4	1.5	1.7	1.8	1.9	2.3
90 mm stud, 1.2 m x 50 mm perimeter EPS	1.0	1.3	1.4	1.5	1.6	1.7	2.1
Plain slab with 250 mm masonry wall	1.0	1.3	1.4	1.6	1.7	1.9	2.3
Plain slab with 200 mm masonry wall	0.9	1.2	1.4	1.5	1.6	1.8	2.2
Plain slab with 150 mm masonry wall	0.8	1.1	1.3	1.4	1.5	1.7	2.1
Plain slab with 90 mm stud wall	0.7	1.0	1.2	1.3	1.4	1.5	1.9

The Slab area= 179.61m^2 Perimeter= 62.77m

Area/perimeter ratio = 2.8

Construction R-value =**R1.8**

Calculations
H~NEW~

Proposed Building Heat Loss

Component	Description	Insulation Used	Area	R-value	Heat Loss	
Roof 1	Concrete Tiles 140mm joist @ 900 centres	Pink Batts R3.2 Ceiling 170mm	130.4	3	43.5	Heat Loss =
Wall 1	Brick 90mm 600 studs, 800 dwangs	Pink Batts R2.2 Wall	49.42	1.9	26.0	Area / R-value
Wall 2	Weather Board 90mm 600 studs, 800 dwangs	Pink Batts R2.2 Wall	49.42	2.1	23.5	
Floor 1	Concrete Slab 1.2m x 50mmm EPS	EPS 1.2m x 50mm	130.4	1.8	72.4	
Glazing 1	Double Glazing	N/A	42.35	0.26	162.9	
Skylight 1						Total Loss
Skylight 2						328.3

HL of 328.3 is Less than the HL 360 of the Reference Building

There design is compliant

Calculations
Change glazing H~NEW~

Designer has a large north facing window which will be very expensive to double glaze (Area=15m^2)

To reduce cost it is decided the Large north facing window will be Single Glazed

Component	Description	Insulation Used	Area	R-value	Heat Loss	
						Heat Loss =
Roof 1	Concrete Tiles 140mm joist @ 900 centres	Pink Batts R3.2 Ceiling 170mm	130.4	3	43.5	Area / R-value
Wall 1	Brick 90mm 600 studs, 800 dwangs	Pink Batts R2.2 Wall	49.42	1.9	26.0	
Wall 2	Weather Board 90mm 600 studs, 800 dwangs	Pink Batts R2.2 Wall	49.42	2.1	23.5	
Floor 1	Concrete Slab 1.2m x 50mmm EPS	EPS 1.2m x 50mm	130.4	1.8	72.4	
Glazing 1	Double Glazing	N/A	27.35	0.26	105.2	
Glazing 2	Large Single Glazed window		15	0.16	93.8	**Total Loss**
Skylight 2						364.4

HL of 364.4 is greater than the HL 360 of the Reference Building

There design is *NOT* compliant

Calculations
Change glazing and insulation H~NEW~

To reduce cost it is decided the Large north facing window will be Single Glazed but the insulation levels are increased.

Component	Description	Insulation Used	Area	R-value	Heat Loss	
Roof 1	Concrete Tiles 140mm joist @ 900 centres	Pink Batts R3.6 Ceiling 180mm	130.4	3.3	39.5	Heat Loss = Area / R-value
Wall 1	Brick 90mm 600 studs, 800 dwangs	Pink Batts R2.6 Wall	49.42	2.1	23.5	
Wall 2	Weather Board 90mm 600 studs, 800 dwangs	Pink Batts R2.6 Wall	49.42	2.3	21.5	
Floor 1	Concrete Slab 1.2m x 50mm EPS	EPS 1.2m x 50mm	130.4	1.8	72.4	
Glazing 1	Double Glazing	N/A	27.35	0.26	105.2	
Glazing 2	Large Single Glazed window	N/A	15	0.16	93.8	**Total Loss**
Skylight 2						**355.9**

HL of 355.9 is Less than the HL 360 of the Reference Building

There design is compliant