

# **TOWARDS ZERO CARBON CITY**

## **A RECAP OF OTTV AND ROOF U-VALUES**

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# **TOWARDS ZERO CARBON CITY**

**UBBL CLAUSE 38A**

**OTTV**

**ROOF U-VALUES**

**NEW MS 1525 2019**

# Recap

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## UBBL Clause 38A



(1) New or renovated **non-residential** buildings with **air-conditioned** space **exceeding 4,000** square metres shall be –

- a) designed to meet the requirements of **MS 1525** with regards to the **Overall Thermal Transfer Value (OTTV)** and the **Roof Thermal Transfer Value (RTTV)**; and
- b) provided with an **Energy Management System**.

# Recap

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## UBBL Clause 38A



**“non-residential”**

**includes industrial, institutional, commercial, retail**

**“air-conditioned”**

**means buildings with centralised aircond system**

**“exceeding 4,000 sm”**

**refers to the requirement for EMS, where shophouses or small non-residential buildings even though centralised aircond is employed, are excluded from providing EMS.**

# Recap

## UBBL Clause 38A



(2) The roof for all buildings (**residential and non residential**) shall not have a thermal transmittance (**U-value**) greater than—

a)  $0.4 \text{ W/m}^2\text{K}$  for Light (under  $50 \text{ kg/m}^2$ ) weight roof;

b)  $0.6 \text{ W/m}^2\text{K}$  for Heavy (above  $50 \text{ kg/m}^2$ ) weight roof,

**unless provided** with other shading or cooling means.

# Recap

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## UBBL Clause 38A



- (2) For all residential and non-residential buildings; the **PSP** shall endorse and submit the **Roof U-value** calculations incorporating the following documents;
- a) Plans and elevations of the roof used for the calculation marked in blue
  - b) Description of roof materials specified
  - c) Calculation of Roof U-value for all roof types
  - d) Description and calculations of alternative means of compliance.

# Recap

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## UBBL Clause 38A



Implementation at Building Plan submission stage

(1) For non-residential building where the air-cond space exceeds 4,000 m<sup>2</sup>;

- the **PSP** shall endorse and submit **OTTV & RTTV** calculations conforming to the latest version of MS 1525 (the 2007 and 2014 revisions stated the OTTV and RTTV shall not exceed 50 W/m<sup>2</sup> and 25 W/m<sup>2</sup> respectively).

The submitted calculations shall incorporate the following documents :-

# Recap

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## UBBL Clause 38A



- a) Plans and elevations, marking out walls & apertures used for the calculation in blue colour; and walls & apertures not used for calculation in red. Recommended scale is 1:200;
- b) OTTV calculations for each facing wall/façade;
- c) Description of wall & aperture materials specified;
- d) Calculation of U-values for walls;
- e) Glazing specifications on Shading Coefficient and U-values;
- f) Confirm provision of Energy Management System.

# Recap

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## UBBL Clause 38A



- The submitted plans and calculations endorsed by the **PSP** shall be deposited with the Local Authority (LA) for record. **Self regulatory**
- This arrangement is similar to the submission of building structural engineering calculations by the Submitting Person which is kept by the LA for record.
- Such deposited plans and calculations will only be retrieved for checking in the event of complaints received. **Not part of approved endorsed BP drwgs**
- The LA may carry out **random check** of these documents and calculations.

# Recap

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## OTTV



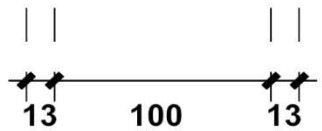
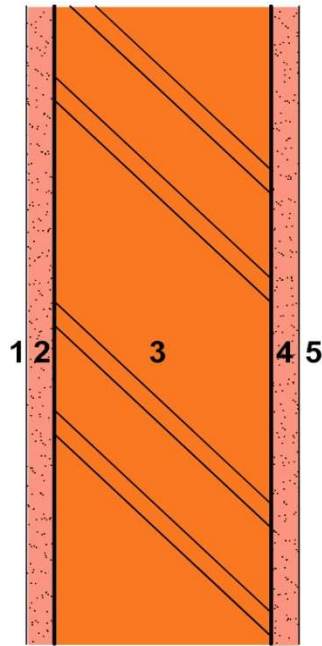
## VARIABLES OF OTTV

$$OTTV_i = 15\alpha(1 - WWR)U_w + 6(WWR)U_f + (194 \times CF \times WWR \times SC)$$

1.  $\alpha$
2. WWR
3.  $U_w$
3.  $U_f$
4. OF
5. SC

**These variables are some of the passive design parameters an architect is required to consider in the design of a building.**

# Plastered Brickwall



**k**

**R**

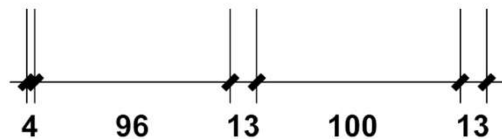
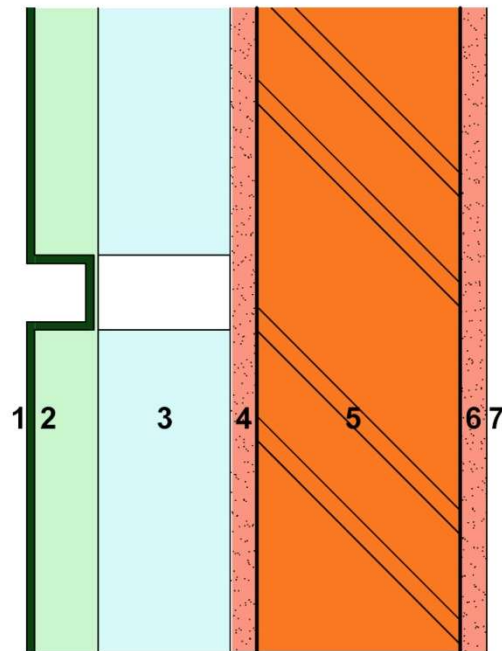
	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m <sup>2</sup> k/W)
1 External surface	nominal	0.044
2 External wall plaster, 13mm thk	0.57	0.023
3 Brickwall, 100mm thk	0.77	0.130
4 Internal wall plaster, 13mm thk	0.57	0.023
5 Internal surface	nominal	0.160
	Total R	0.380

$$U\text{-value} = \frac{1}{R}$$

$$= \frac{1}{0.380}$$

$$= 2.631 \text{ W/m}^2\text{k}$$

# Aluminium Composite Cladding without insulation



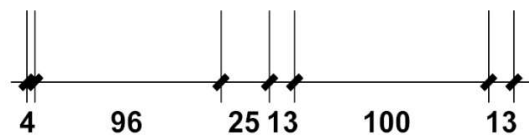
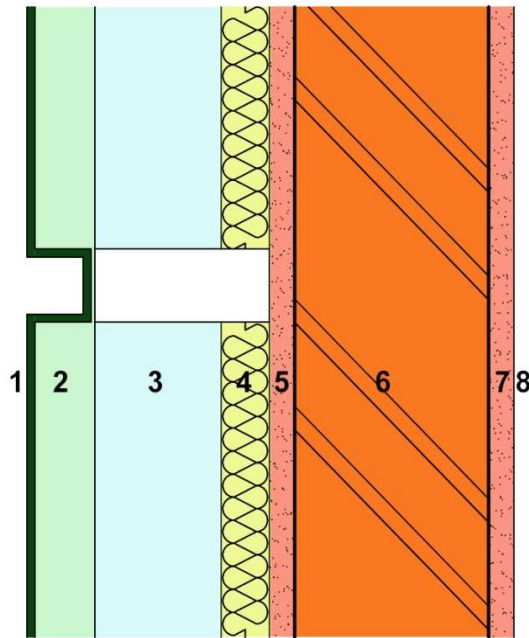
	<b>THERMAL CONDUCTIVITY (W/mk)</b>	<b>THERMAL RESISTANCE (m<sup>2</sup> k/W)</b>
1 External surface	nominal	0.044
2 ACP Cladding, 4mm	0.40	0.010
3 Cavity	nominal	0.090
4 External wall plaster, 13mm thk	0.57	0.023
5 Brickwall, 100mm thk	0.77	0.130
6 Internal wall plaster, 13mm thk	0.57	0.023
7 Internal surface	nominal	0.160
	<b>Total R</b>	<b>0.480</b>

$$U\text{-value} = \frac{1}{R}$$

$$= \frac{1}{0.480}$$

$$= 2.083 \text{ W/m}^2\text{k}$$

# Aluminium Composite Cladding with insulation



	<b>k</b> THERMAL CONDUCTIVITY (W/mk)	<b>R</b> THERMAL RESISTANCE (m <sup>2</sup> k/W)
1 External surface	nominal	0.044
2 ACP Cladding, 4mm	0.40	0.010
3 Cavity	nominal	0.090
4 Exp. Polystyrene board, 25mm thk	0.04	0.625
5 External wall plaster, 13mm thk	0.57	0.023
6 Brickwall, 100mm thk	0.77	0.130
7 Internal wall plaster, 13mm thk	0.57	0.023
8 Internal surface	nominal	0.160
	<b>Total R</b>	<b>1.105</b>

$$U\text{-value} = \frac{1}{R}$$

$$= \frac{1}{1.105}$$

$$= 0.905 \text{ W/m}^2\text{k}$$

# Recap OTTV

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## Revision to MS1525 2019

- 1) OTTV equations
- 2) Roof U-value equation
- 3) Solar Orientation Factors (OF)
- 4) RTTV equations
- 5) VLT > 30% recommended

# Recap

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# OTTV



## Additions

- 1) Added : OTTV shall apply to all external walls.
- 2) Added : each different wall type or different wall finishes or different shading devices shall be calculated individually for any given orientation.
- 3) Added : non-permanent shading devices (such as curtains or blinds, or films applied on the surface of glass, or green walls) shall not be considered.
- 4) Added : multiple roofs and definition of primary roof
- 5) Added : self-shading, or dynamic or complex shading devices
- 6) Added : descriptions of R1 and R2

# Recap

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# OTTV



## Amendments and Omissions

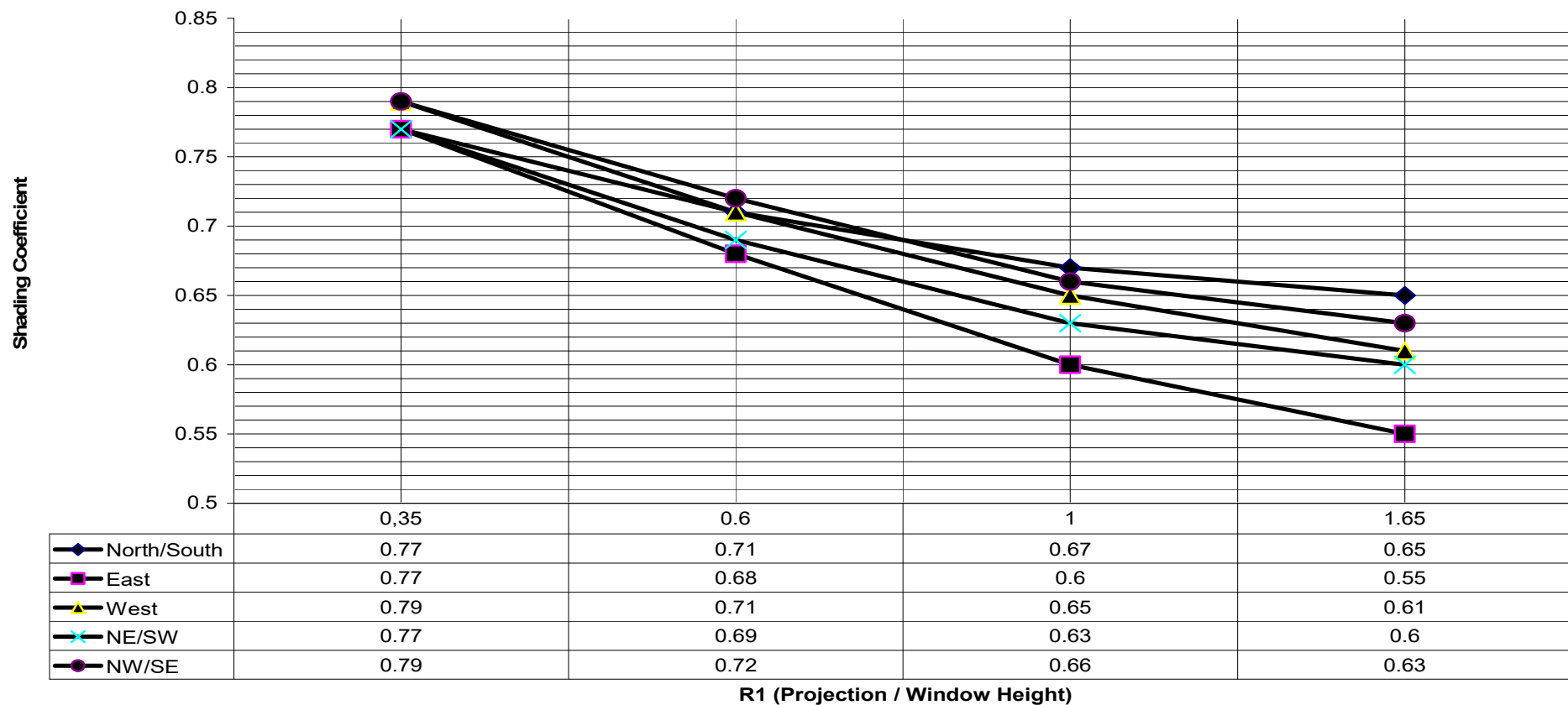
- 1) Omitted : total air-cond area > 1,000 sm, in line with UBBL Cl 38A
- 2) Amended : new graphs for SC2 for horizontal, vertical shading devices
- 3) Amended : roof weight definition amended, where  
Lightweight Roof = non-concrete construction, and  
Heavyweight Roof = concrete roof construction
- 4) Omitted : 50kg/m<sup>2</sup>
- 5) Omitted : equation for the calculation of the average weight of roof.
- 6) Amended : PSP is mentioned in line with UBBL Cl 38A, instead of  
“professional architect or professional engineer”.
- 7) Amended : Section on Vestibules simplified, “exceptions” omitted,  
and local terminology introduced.

# Recap OTTV



## 2014

### HORIZONTAL PROJECTION SHADING COEFFICIENTS



# Recap OTTV

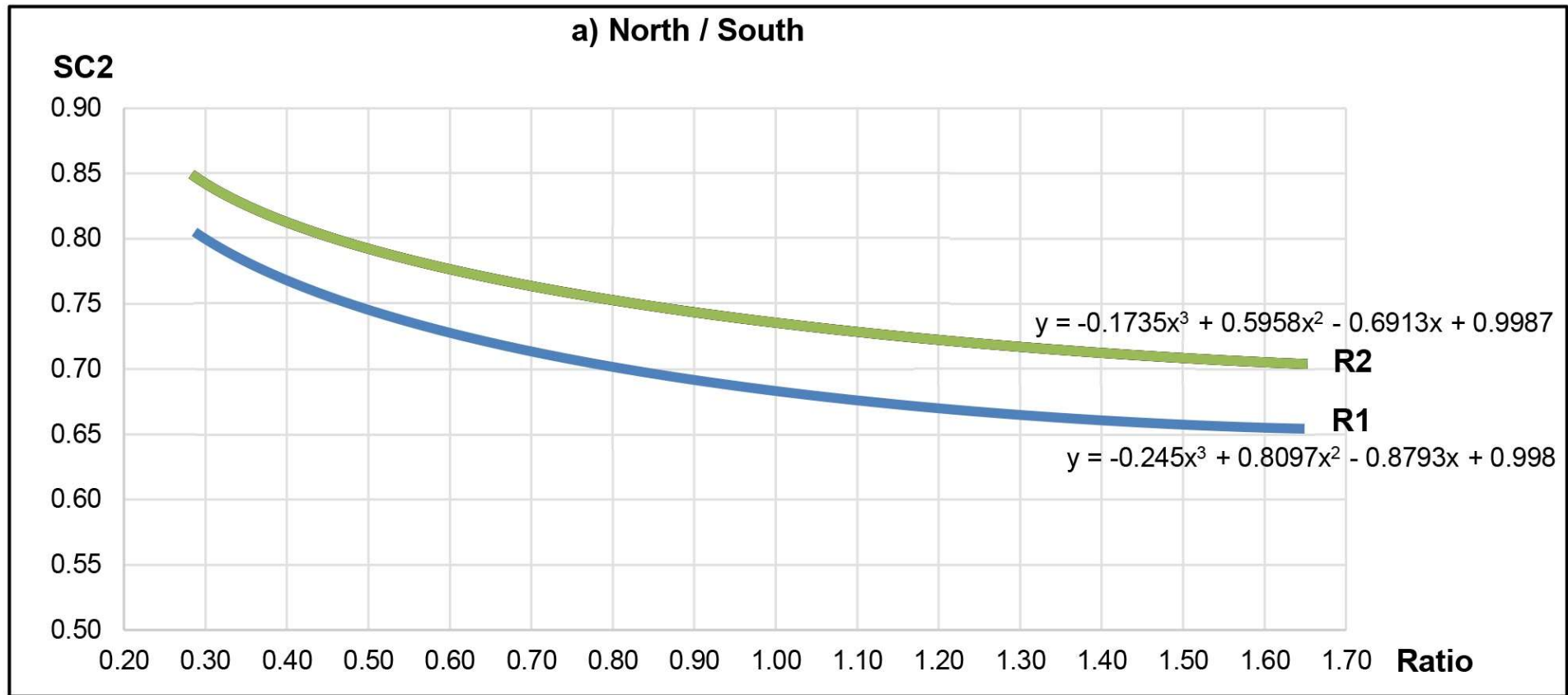


2014

VERTICAL PROJECTIONS SHADING COEFFICIENTS  
R2 (Projection / Window Width)

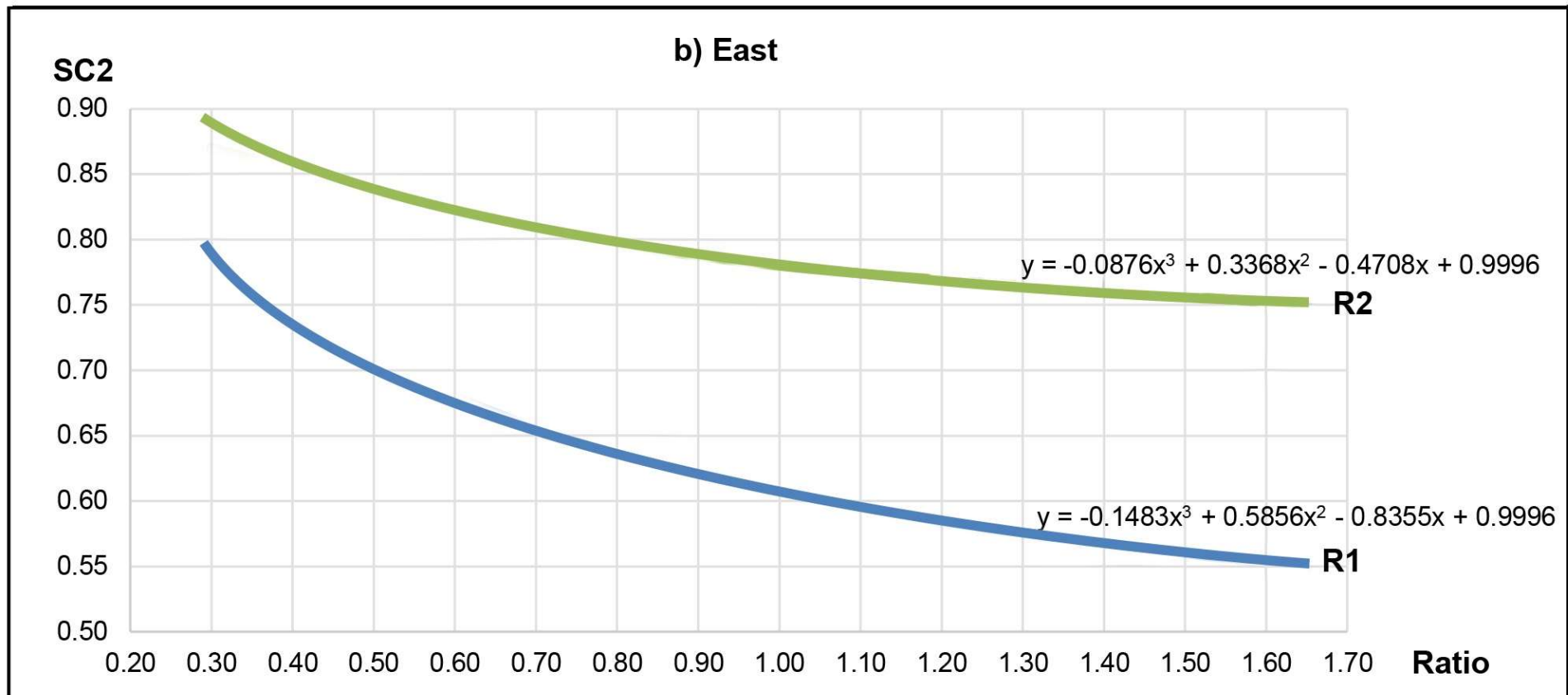


# Recap OTTV



**SC 2**

# Recap OTTV



SC 2

# Recap

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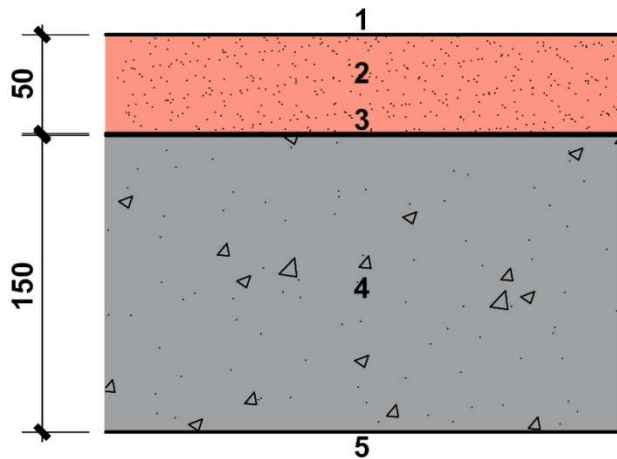
## Roof U-value



Roof Weight Group	Maximum U-Value (W/m <sup>2</sup> K)
Non-Concrete Roof	0.4
Concrete Roof	0.6

# Recap

## Roof U-value



	<b>k</b>	<b>R</b>
	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m <sup>2</sup> k/W)
1 External surface	nominal	0.044
2 Cement screed, 50mm thk	0.41	0.122
3 Waterproof membrane	0.23	0.004
4 R.C Slab, 150mmthk	2.30	0.065
5 Internal surface	nominal	0.160
	Total R	0.395

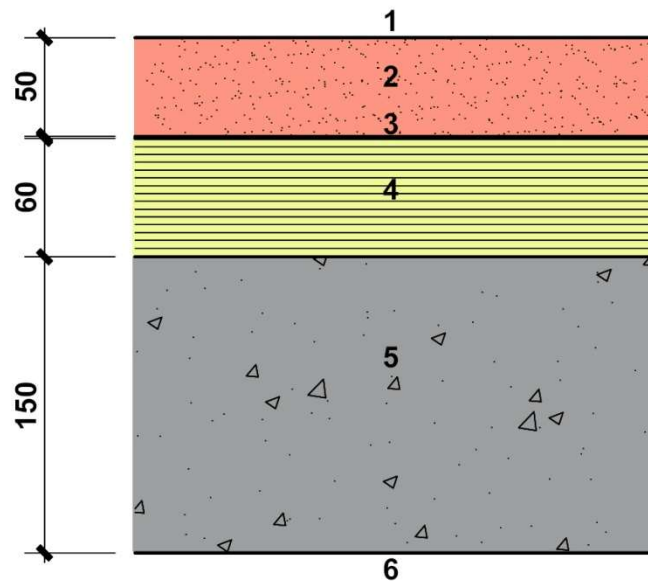
$$U\text{-value} = \frac{1}{R}$$

$$= \frac{1}{0.395}$$

$$= 2.532\text{W/m}^2\text{k}$$

# Recap

## Roof U-value



	<b>k</b> THERMAL CONDUCTIVITY (W/mk)	<b>R</b> THERMAL RESISTANCE (m <sup>2</sup> k/W)
1 External surface	nominal	0.044
2 Cement screed, 50mm thk	50	0.122
3 Waterproof membrane	0.23	0.004
4 Expanded polystyrene, 60mm thk	0.04	1.500
5 R.C Slab, 150mmthk	2.30	0.065
6 Internal surface	nominal	0.160
	Total R	1.895

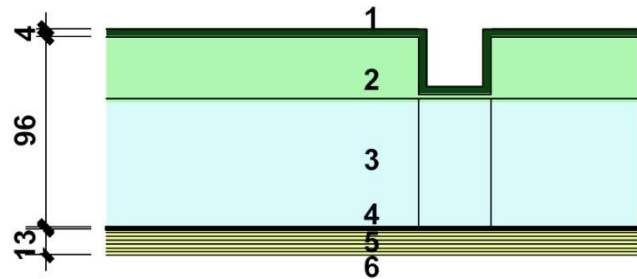
$$U\text{-value} = \frac{1}{R}$$

$$= \frac{1}{1.895}$$

$$= 0.528 \text{ W/m}^2\text{k}$$

# Recap

## Roof U-value



	<b>k</b>	<b>R</b>
	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m <sup>2</sup> k/W)
1 External surface	nominal	0.044
2 Steel decking & structure	50	0.00008
3 Cavity	nominal	0.090
4 Sisalation		-
5 Plasterboard liner, 13mm thk	0.25	0.052
6 Internal surface	nominal	0.160
	Total R	0.346

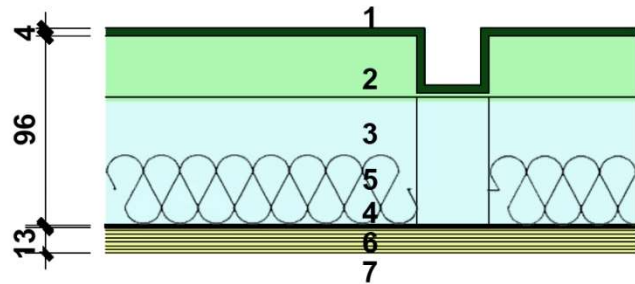
$$U\text{-value} = \frac{1}{R}$$

$$= \frac{1}{0.346}$$

$$= 2.890 \text{ W/m}^2\text{k}$$

# Recap

## Roof U-value



	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m <sup>2</sup> k/W)
1 External surface	nominal	0.044
2 Steel decking & structure	50	0.00008
3 Cavity	nominal	0.090
4 Sisalation		-
5 Mineral wool batt, 150mm thk	0.038	3.947
6 Plasterboard liner, 13mm thk	0.25	0.052
7 Internal surface	nominal	0.160
	Total R	4.293

$$\text{U-value} = \frac{1}{R}$$

$$= \frac{1}{4.293}$$

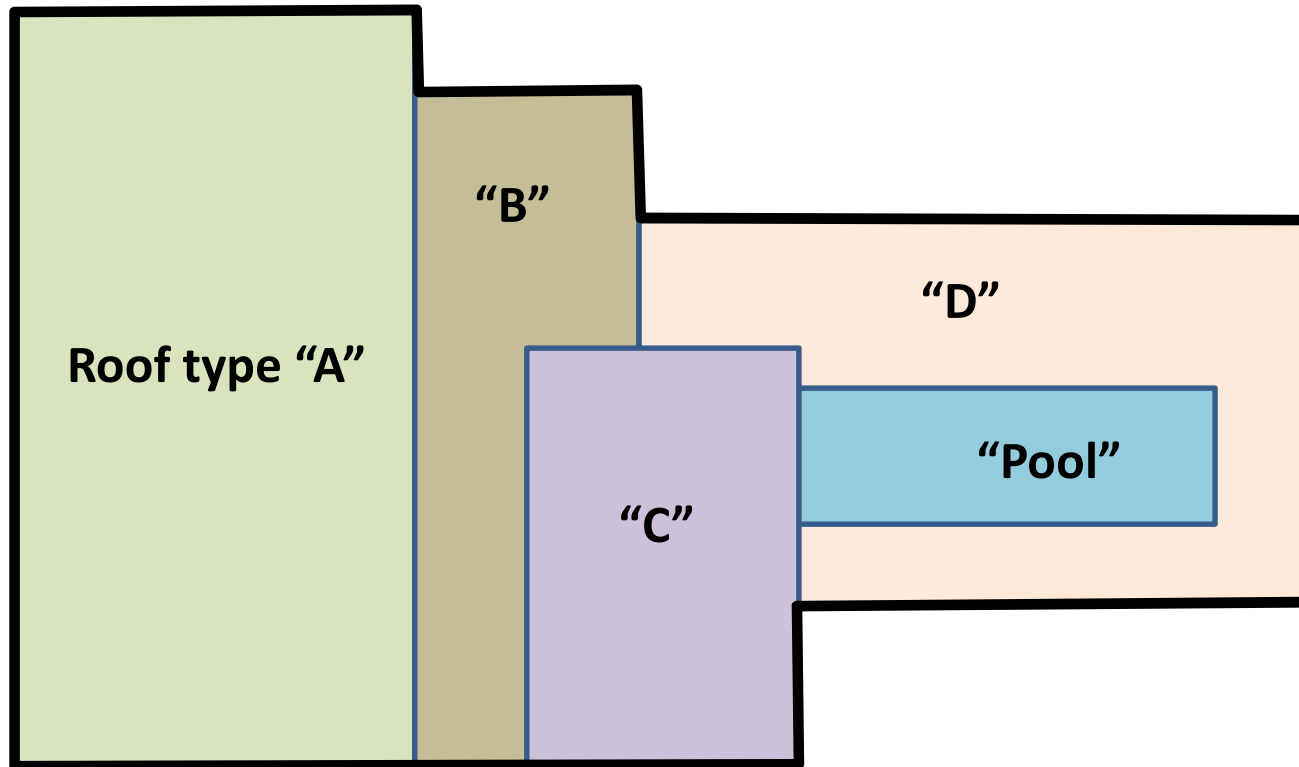
$$= 0.233 \text{ W/m}^2\text{k}$$

# Recap



## Roof U-value

Multiple Roof Types : Worst case applies



Plan View

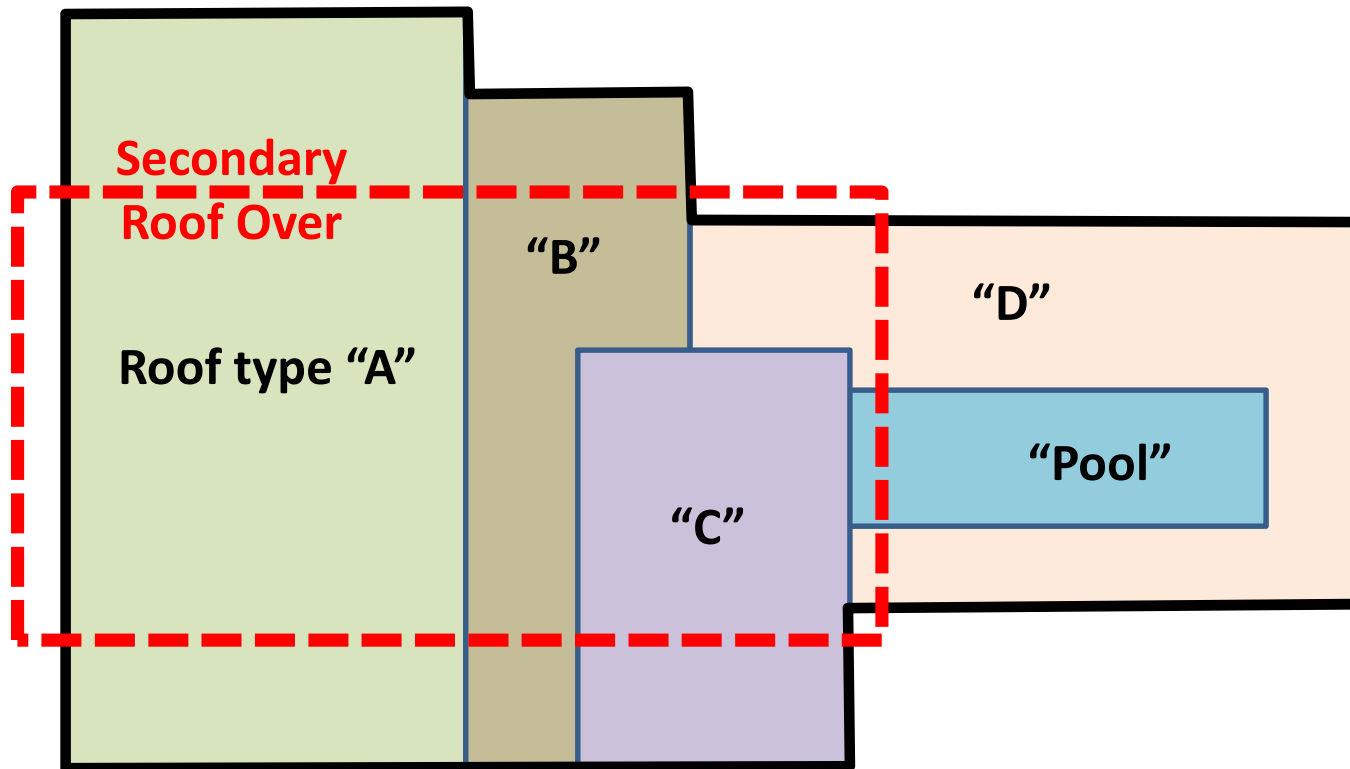


# Recap

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## Roof U-value

## Secondary Roof



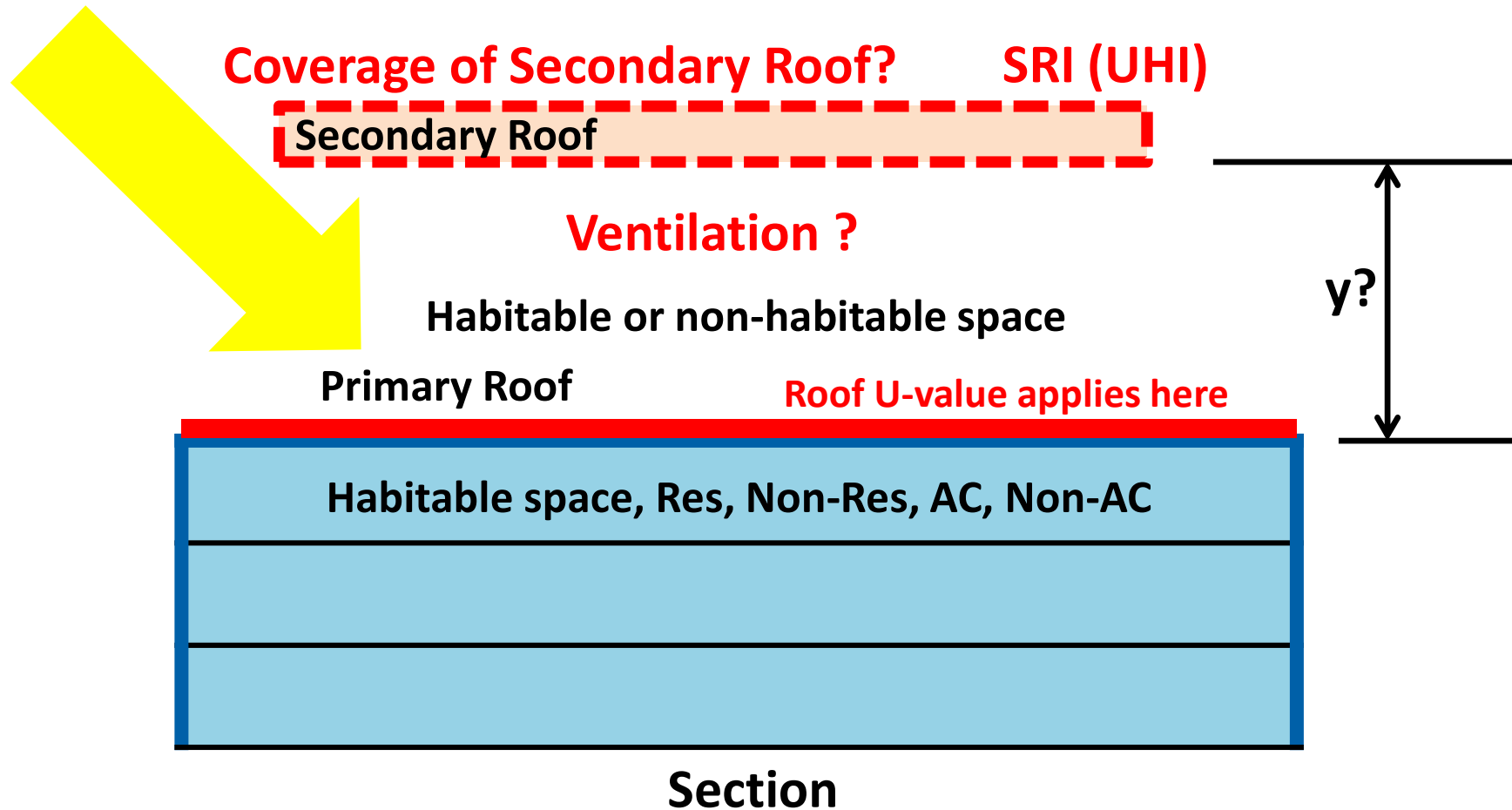
## Plan View



# Recap

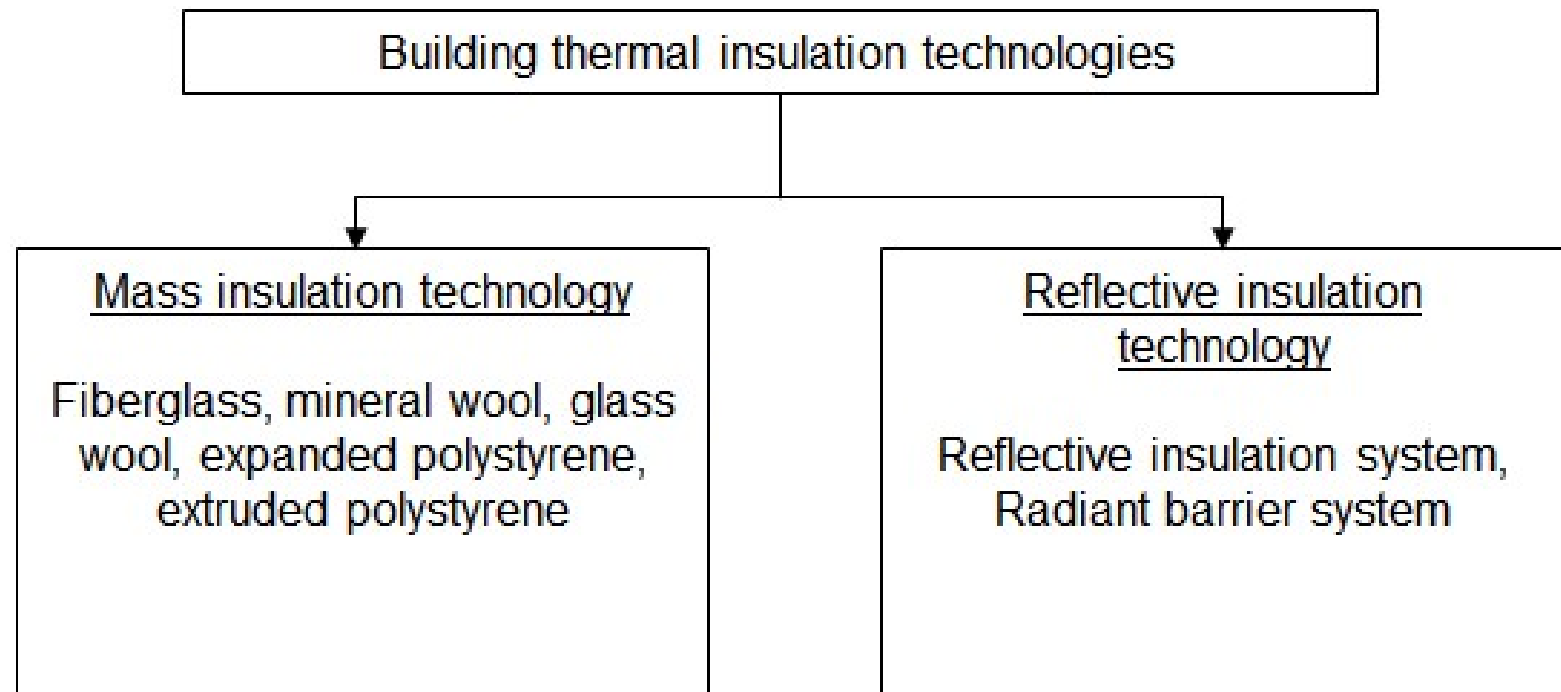
## Roof U-value

### Secondary Roofs



# Recap

## Roof U-value



**Figure 14**

**A combination of both technologies is recommended**

# Recap

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## Roof U-value

### Thermal Insulation



- 1) use of both technologies is encouraged;
- 2) simple equation for thermal conductivity (k), thermal transmittance (U-value) and thermal resistance (R-value);
- 3) description of the differences between Mass Insulation technology and Reflective Insulation technology;
- 4) air space required for Reflective Insulation as part of its overall system or assembly R-value which relies on the low thermal conductivity of air;
- 5) description of the Reflective Insulation technology's principles of reflecting and re-emitting radiant heat due to the properties of high reflectivity and low emissivity.

# Recap

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## Roof U-value

### Radiant Barrier



- ▶ Engagement with stake holders
- ▶ Confusion on the Air Gap R-Value in the Industry
- ▶ On-going discussion with Reflective Insulation Manufacturers of Malaysia (RIMM)
- ▶ Input from Market Leading Manufacturers
  - ▶ San Miguel Yamamura
  - ▶ Monier
  - ▶ Terreal

# Recap

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## Roof U-value

### Radiant Barrier



- ▶ **GBI REQUIREMENT**
- ▶ **The Testing Method for the Radiant Barrier Air Gap to follow**  
**MS 2095:2014 or an equivalent standard**
- ▶ **A Reduction Coefficient to Air Gap R-value will be applied by GBI until an in-depth experiment is conducted to conclude the findings**

# Recap

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## Roof U-value

Radiant barrier



- ▶ The 20% Reduction Coefficient to Air Gap R-value is due to:-
  - ▶ Angle of Roof Slope
  - ▶ Variable dimensions of Air Gap above and below the Radiant Barrier
  - ▶ The condition of the Site, viz cleanliness and dust in the roof space

# Recap

## Roof U-value



Clay Tile Roof		
Item	Original R-Value	Revised R-Value (Reduction Air Gap of 20%)
External Surface Resistance	0.040	0.040
Clay Tile Roof	0.020	0.020
Insulation & Air Gap	1.970	1.576
Attic	0.650	0.650
Plaster Ceiling	0.056	0.056
Internal Surface Resistance	0.160	0.160
Total R Value	2.896	2.502
<b>U Value (1/R)</b>	<b>0.345</b>	<b>0.400</b>
Note: Attic Emittance R-Value proposed by RIMM		

**TOWARDS ZERO CARBON CITY**

**THANK YOU**