OTTV FOR COMPLEX BUILDING
Ar Michael Ching
OTTV For Complex Building

- Use of Local Shading Coefficient, $R_v$ and $R_h$ to calculate complex external façade and internal courtyard
OTTV For Complex Building

Local Shading Coefficient
OTTV For Complex Building

$x = \text{opening width U-shaped building}$
$z = \text{distance from the unshaded surface due to vertical depth}$

$Rv = \frac{z}{x}$
OTTV For Complex Building

- Vertical Shading of U-shaped Building,
  - $R_v < 3$, No local shading; shading coefficient = 1. To include all the internal façades in the OTTV calculation.
  - $R_v \geq 3$, Local shading peaked; shading coefficient range from 0.35 to 0.5 depending on orientation and facing. To assume all the affected internal façades as wall in the OTTV calculation.
OTTV For Complex Building

Plan

\[ Rh = \frac{y}{x} \]

x = opening width of U-shaped building
y = distance from the unshaded surface due to horizontal depth
OTTV For Complex Building

- Horizontal Shading of U-shape Building,
  - \( \text{Rh} < 1 \), No local shading; shading coefficient = 1. To include all the internal façades in the OTTV calculation.
  - \( \text{Rh} \geq 1 \), Local shading peaked; shading coefficient range from 0.35 to 0.5 depending on orientation and facing. To assume all the affected internal façades as wall in the OTTV calculation.
OTTV For Complex Building

- Example of Calculation
<table>
<thead>
<tr>
<th>Location</th>
<th>Sunlight</th>
<th>Viscosity</th>
<th>Condition</th>
<th>OTTB</th>
<th>OTTB Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTHWEST</td>
<td>70.12</td>
<td>110.12</td>
<td>0.40</td>
<td>3.04</td>
<td>OTTB = 45.02 w/m²</td>
</tr>
<tr>
<td>SOUTHEAST</td>
<td>80.12</td>
<td>80.12</td>
<td>0.40</td>
<td>3.04</td>
<td>OTTB = 45.02 w/m²</td>
</tr>
</tbody>
</table>

**OTTB Formula**

1. Calculate the OTTB (Overall Transmittance of Building) for each location using the formula:
   
   \[ OTTB = \frac{\text{Viscosity} \times \text{Condition}}{10} \]

2. For the NORTHWEST location, the OTTB is calculated as:
   
   \[ OTTB = \frac{70.12 \times 0.40}{10} = 2.804 \text{ w/m²} \]

3. For the SOUTHEAST location, the OTTB is calculated as:
   
   \[ OTTB = \frac{80.12 \times 0.40}{10} = 3.2048 \text{ w/m²} \]
OTTV = 42.49 w/m² (-6%)
OTTV For Complex Building

- Open vs Close Loop OTTV Calculation?
OTTV For Complex Building

**MINIMUM REQUIREMENT AND AVERAGING**

- **NRNC and RNC EE1** - All buildings must meet MS1525 minimum requirement. Score base on highest OTTV value.
- **RNC EE2** - Averaging is permitted provided EE1 is score.
ROOF U-VALUE CALCULATION

Ar Michael Ching
Roof U-Value Calculation

- PRIMARY ROOF

- Mechanical plant, equipment (including PV) and water tank, which exposed to the sky, the Roof U-value are calculated on the Primary Roof construction
## Roof U-Value Calculation

### PRIMARY ROOF

<table>
<thead>
<tr>
<th>Primary Roof</th>
<th>Roof U-value applies here</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitable space, Res, Non-Res, AC, Non-AC</td>
<td></td>
</tr>
</tbody>
</table>

Section
Roof U-Value Calculation

- PRIMARY ROOF - EXEMPTION
  - Exempt from Roof U-value calculation if the following 2 conditions are met:
    - Secondary Roof (Heat Island Effect)
    - Meet requirement of Ventilation (ACH) and Height of the Secondary Roof
Roof U-Value Calculation

- SECONDARY ROOF (URBAN HEAT ISLAND)
  - UHI is about reflecting away Solar Radiation to achieve a cooler micro-climate
  - Secondary Roof like horizontal pergolas or screens can be used to be part of the calculation to reduce UHI
Roof U-Value Calculation

- PRIMARY & SECONDARY ROOF
Roof U-Value Calculation

- PRIMARY & SECONDARY ROOF

Diagram showing different roofing materials and spaces such as Tile, Cement, Timber, Landscape, Pool, and a Secondary Roof Over.
Roof U-Value Calculation

- VENTILATION & HEIGHT OF SECONDARY ROOF
Roof U-Value Calculation

- RTTV
- Applies if the roof is provided with skylight
Roof U-Value Calculation

- **EXISTING BUILDING**

- For renovation works, where the original roof is not replaced, insulation below rc slab in the ceiling space is considered
Roof U-Value Calculation

- **MINIMUM REQUIREMENT AND AVERAGING**
  - NRNC and RNC EE1 - All roofs must meet MS1525 minimum requirement. Score based on highest U-Value
  - RNC EE2 - Averaging is permitted provided EE1 scored
ROOF U-VALUE FOR RADIATION BARRIER

Ar Michael Ching
Roof U-Value for Radiant Barrier

- ENGAGEMENT WITH STAKE HOLDER
- Confusion on the Air Gap R-Value in the Industry
- On-going discussion with Reflective Insulation Manufacturers of Malaysia (RIMM)

FMM RIMM

- Input from Market Leading Manufactural
Roof U-Value for Radiant Barrier

► ENGAGEMENT WITH STAKE HOLDER

► Presentation from
  ► San Migual Yamamura
  ► Monier
  ► Terreal
Roof U-Value for Radiant Barrier

**GBI REQUIREMENT**

- The Testing Method for the Radiant Barrier Air Gap to follow MS 2095:2014 or an equivalent standard
- Apply a Reduction Coefficient to Air Gap R-value, until an in-depth experiment is conducted to conclude the findings
Roof U-Value for Radiant Barrier

▶ GBI REQUIREMENT

▶ The Testing Method for the Radiant Barrier Air Gap to follow MS 2095:2014 or an equivalent standard
5.6.2 Test method

The test method shall be as follows:

a) cut the appropriate size of 500 mm × 500 mm, and approximately 10 cm from the edge of the material roll of the specimen;

b) place the specimen on the wooden frame, then place the second frame on top of the test specimen, then, the test specimen shall be securely sandwiched between the two wooden frames;

c) the test specimen shall be installed with an air gap of 40 mm on the "hot" side and similarly, an air gap of 60 mm on the "cold" side, by mounting the sample on the wooden frame where the reflective surface is facing the hot side;

d) the temperature of hot and cool plate shall be 35 °C and 20 °C, with the temperature difference of 15 °C;

e) the sample thickness used in calculating the equivalent thermal resistance of the sample is not the actual thickness of the foil sample, but (100 ± 10) mm, being the actual thickness of the test system. Calculate the system thermal resistance for this combination of test specimen and air gaps, using the equations given in the relevant test methods; and

f) the reported values for thermal resistance shall be the equivalent thermal resistance values (in m²K/W) for a system, consisting of a sample of reflective foil mounted between the two plates of the apparatus with specified air gaps, not for the foil sample in isolation.

6 Recommended usage

6.1 General

A radiant barrier and reflective insulation building materials shall be allowed for use according to its classifications. In each application, the intended functions (as defined in 5.1 to 5.6) shall be determined to enable selection of the allowable classifications.

6.2 Duty

When a radiant barrier and reflective insulation building materials are installed, its duty classification shall be as specified in Table 3.
Roof U-Value for Radiant Barrier

**GBI REQUIREMENT**

- Apply a **20%** Reduction Coefficient to Air Gap R-value, due to:
  - Angle of Roof Slope
  - Varies Dimension of Air Gap above and below the Radiant Barrier
  - The condition of the Site, viz cleanliness
Roof U-Value for Radiant Barrier

- Example of Calculation
### REPORT NO: 2015CB1052

**PAGE: 1 OF 2**

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**Reference:** MS 2095: 2014
Radiant Barrier And Reflective Insulation Building Materials—Specification (First Revision)

**Sample:** Reflective Insulation Building

**Test Result:**

<table>
<thead>
<tr>
<th>Clause</th>
<th>Specification / Requirements</th>
<th>Results</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>Emittance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Reflective: at least one of its faces has an emittance of not greater than 0.06</td>
<td>0.02</td>
<td>Type: Reflective</td>
</tr>
<tr>
<td></td>
<td>b) Value: can be classify as value if the emittance within 0.06 to 0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Non Reflective: For the material that was not classified as reflective or as a value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>Thermal Resistance</td>
<td>1.97 m²K/W</td>
<td>No Requirement</td>
</tr>
</tbody>
</table>

(The remainder of this page is intentionally left blank)
# Roof U-Value for Radiant Barrier

<table>
<thead>
<tr>
<th>Item</th>
<th>Original R-Value</th>
<th>Revised R-Value (Reduction Air Gap of 20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Surface Resistance</td>
<td>0.040</td>
<td>0.040</td>
</tr>
<tr>
<td>Clay Tile Roof</td>
<td>0.020</td>
<td>0.020</td>
</tr>
<tr>
<td>Insulation &amp; Air Gap</td>
<td>1.970</td>
<td>1.576</td>
</tr>
<tr>
<td>Attic</td>
<td>0.650</td>
<td>0.650</td>
</tr>
<tr>
<td>Plaster Ceiling</td>
<td>0.056</td>
<td>0.056</td>
</tr>
<tr>
<td>Internal Surface Resistance</td>
<td>0.160</td>
<td>0.160</td>
</tr>
<tr>
<td>Total R Value</td>
<td>2.896</td>
<td>2.502</td>
</tr>
</tbody>
</table>

### U Value (1/R)

<table>
<thead>
<tr>
<th></th>
<th>Original R-Value</th>
<th>Revised R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>U Value</td>
<td>0.345</td>
<td>0.400</td>
</tr>
</tbody>
</table>

Note: Attic Emittance R-Value proposed by RIMM
THANK YOU