

MALAYSIA GREEN BUILDING CONFEDERATION

High Performance Façade and Overall Thermal Transfer Value (OTTV)

by

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MALAYSIA GREEN BUILDING CONFEDERATION

GBI DA & CVA

> 90% compliant

Wide understanding of Passive Design
and Building Envelope

New

Amendments to UBBL

OTTV and Roof U-value compliant

GBI RNC v3 : Prerequisite with One Point

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MS1525:2007

1. MS1525:2007 is a Code of Practice (CP), and will be incorporated into **UBBL**, hence a CP becomes part of a By-law.
2. MS1525:2007 provides the **baseline minimum standard** for the GBI rating tools for energy efficient design.

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MS1525:2007

MS 1525 primarily deals with building energy.

The steps towards Energy Efficient buildings are:

PASSIVE MEASURES

Clause 4 :

Architectural and
Passive Design Strategy

Clause 5 :

Building Envelope



ACTIVE MEASURES

Clause 6 : Lighting

Clause 7

Power System and Distribution System

Clause 8

Air Cond and Mech Ventilation System

Clause 9

Energy Management Control System

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PASSIVE DESIGN STRATEGIES

Building Envelope

MS1525:2007 Clause 4.2

The basic approach towards good passive design is

**to orientate,
to shade,
to insulate,
to ventilate and
to daylight buildings.**

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PASSIVE DESIGN STRATEGIES

Building Envelope

MS1525:2007 Clause 4.2

The basic approach towards good passive design is

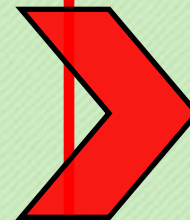
to orientate,

to shade,

to insulate,

to ventilate and

to daylight buildings.



**Building
Envelope**

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CONCEPT OF OTTV Walls and Roof

MS1525:2007 Clause 5.2

OTTV applies to building envelope

MS1525:2007 Clause 5.5

Roof U-value refers to the thermal transmittance of the roof construction

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CONCEPT OF OTTV BUILDING ENVELOPE

“the external portions of a building through which thermal energy is transferred” and

“this thermal transfer is the major factor affecting interior comfort level and energy usage”.

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CONCEPT OF OTTV

MS1525:2007 Clause 5.2

A design criterion for building envelope known as the **Overall Thermal Transfer Value (OTTV)** has been adopted. The OTTV aims at achieving the design of building envelope to reduce heat gain through the building envelope and hence reduce the cooling load of the air-conditioning system.

The OTTV...should not exceed **50 W / m²**

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CONCEPT OF OTTV

MS1525:2007 Clause 5.2.1

The OTTV of building envelope is given by the formula:

$$OTTV = \frac{A_{o1} \times OTTV_1 + A_{o2} \times OTTV_2 \dots + A_{on} \times OTTV_n}{A_{o1} + A_{o2} \dots + A_{on}}$$

where A_1 is the gross exterior wall area for orientation 1;

$OTTV_1$ is the OTTV value for orientation 1; and

OTTV for the whole building $\leq 50 \text{ W/m}^2$

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CONCEPT OF OTTV

MS1525:2007 Clause 5.2.2

The formula for the OTTV of any given wall orientation is as follows:

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

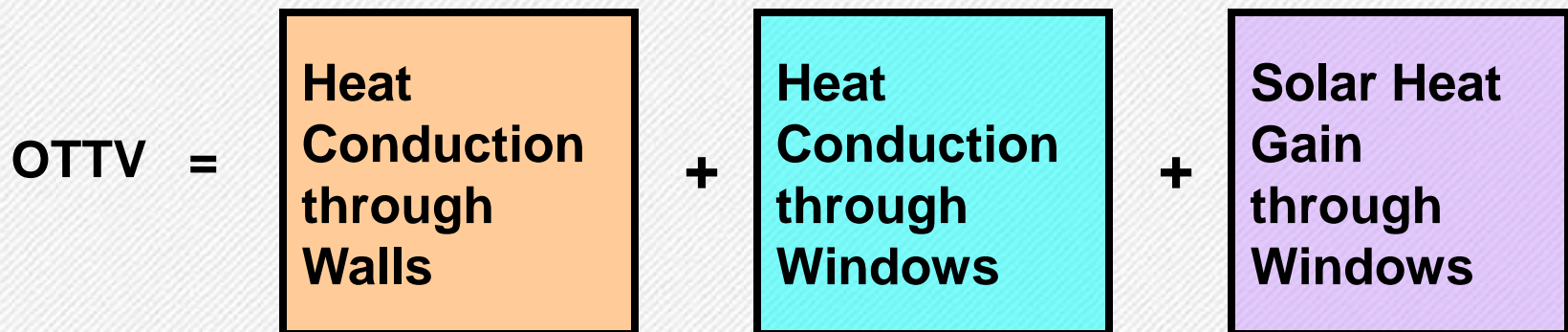
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CONCEPT OF OTTV

MS1525:2007 Clause 5.2.2

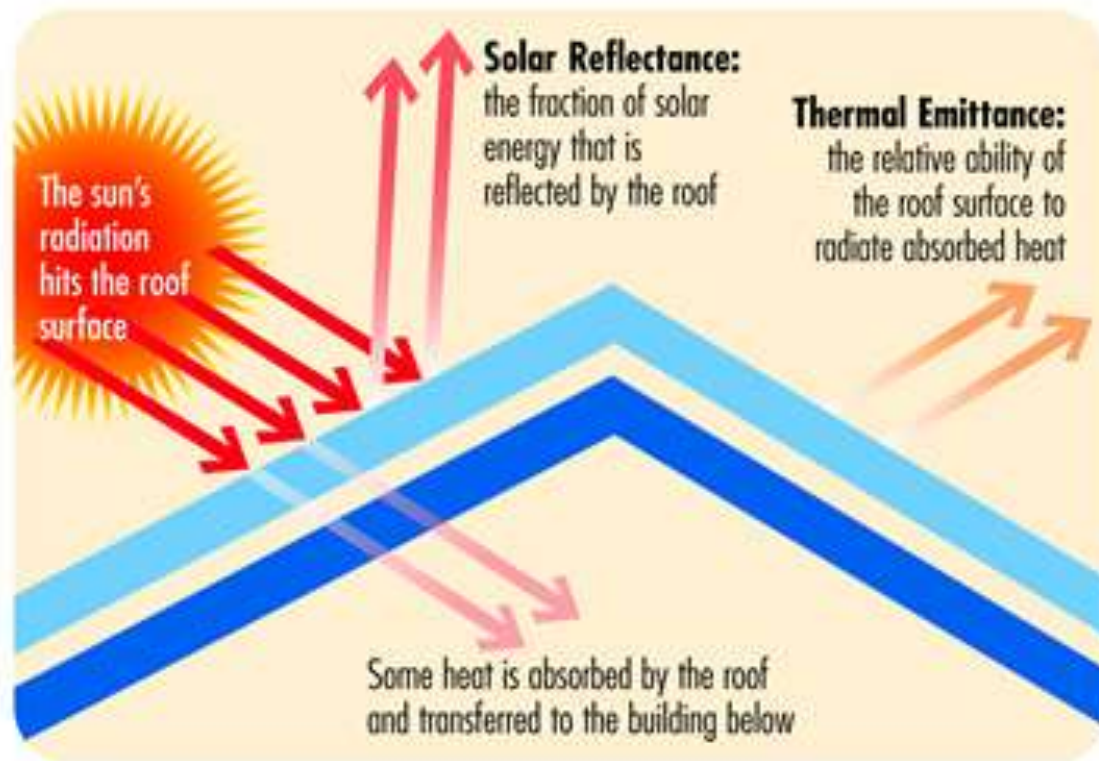
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THERMAL RESISTANCE

Solar Radiation and Roof Thermal Resistance



THERMAL RESISTANCE

Relationships between thermal resistance, thermal conductivity and U-value

1. In heat transfer, the Thermal Conductivity, k of a material is its ability to conduct heat.
2. Thermal conductivity approx tracks electrical conductivity, as moving electrons transfer not only electric current, but also heat energy.
3. Therefore, heat conductivity through layers of materials in a composite wall construction is analogous to adding up the resistance in an electric circuit connected in series.

THERMAL RESISTANCE

Relationships between thermal resistance, thermal conductivity and U-value

4. Thermal Resistance, R of each material is

$$R = (\text{material thickness}) \div (\text{thermal conductivity, } k)$$

5. Increasing the thickness of the material will increase its thermal resistance.

6. In a composite wall construction, the total R is

$$R_{\text{total}} = R_1 + R_2 + R_3 + \dots + R_n.$$

THERMAL RESISTANCE

Relationships between thermal resistance, thermal conductivity and U-value

7. Therefore, R_{total} is the sum of the thermal resistance of all the respective materials making up the composite wall.
8. U-value of the wall is the heat transmission value of the composite wall in $\text{W}/\text{m}^2\text{K}$, and is inversely proportional to the total R,
ie, $U = 1 / R_{\text{total}}$.
9. The higher the R, the lower the U, the better.

THERMAL RESISTANCE

Relationships between thermal conductivity, thermal resistance and U-value

k = Thermal conductivity

$$R = \frac{\text{Material thickness}}{k}$$

$$U = \frac{1}{R}$$

THERMAL RESISTANCE

Examples of thermal conductivity, k

Mineral wool insulation	0.039
Mineral fibreboard	0.053
Plasterboard	0.160
Common clay brick	0.950
Glass 3mm thick	1.050
Concrete	2.160
Granite	3.810
Aluminium sheet	160.0



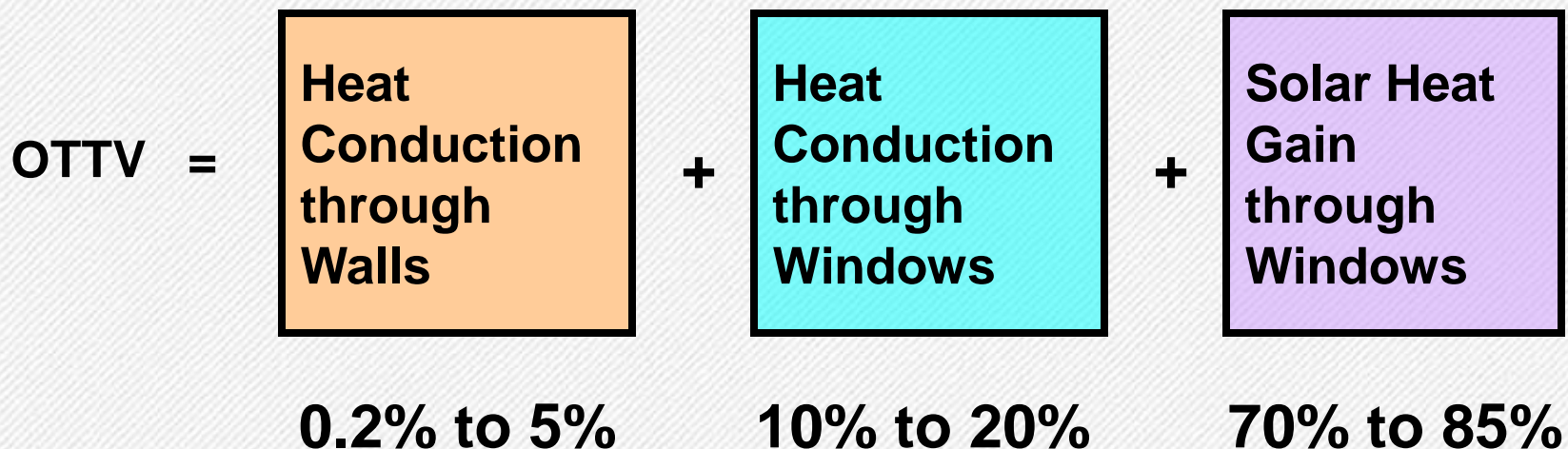
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CONCEPT OF OTTV

MS1525:2007 Clause 5.2.2

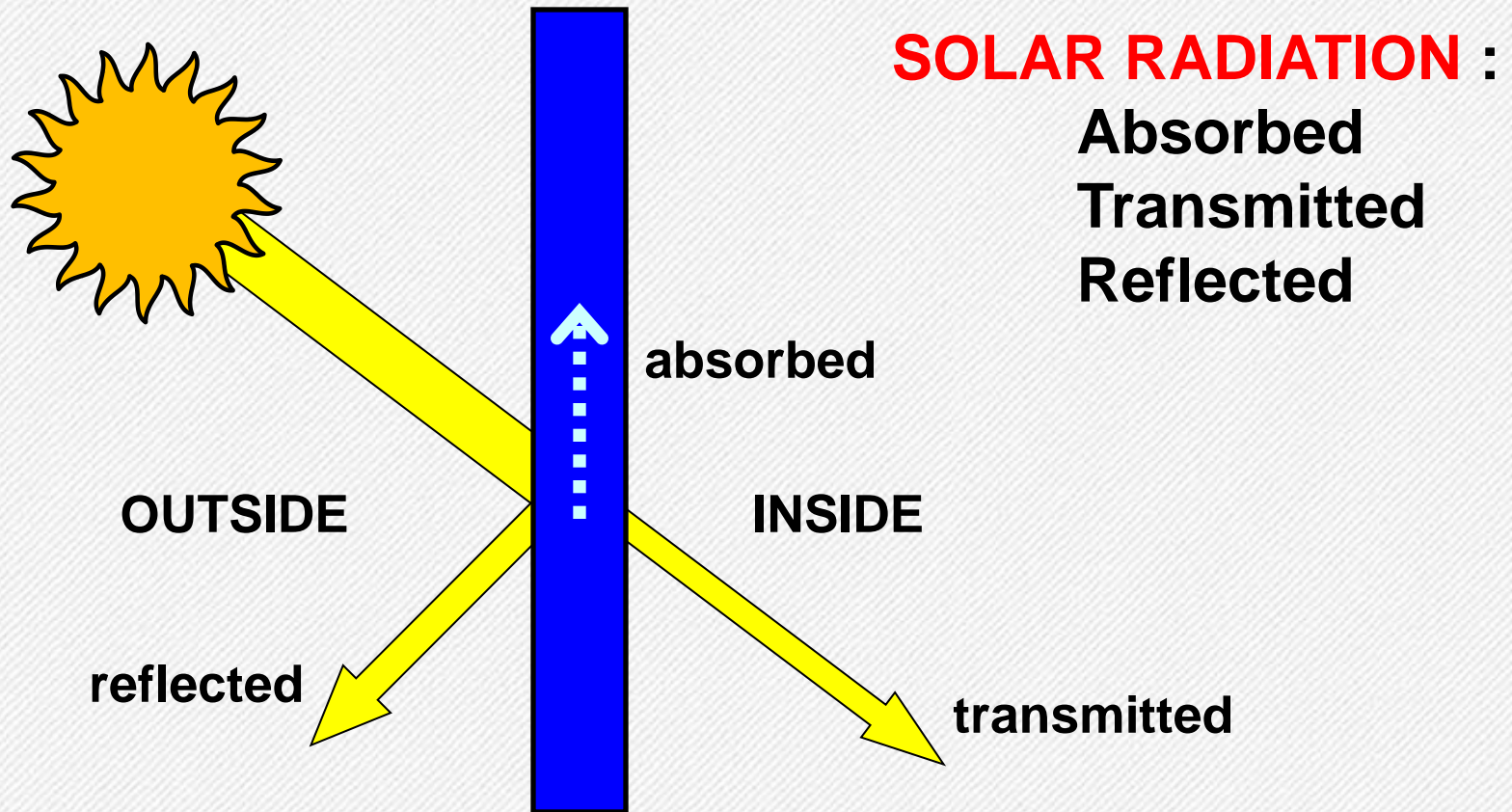
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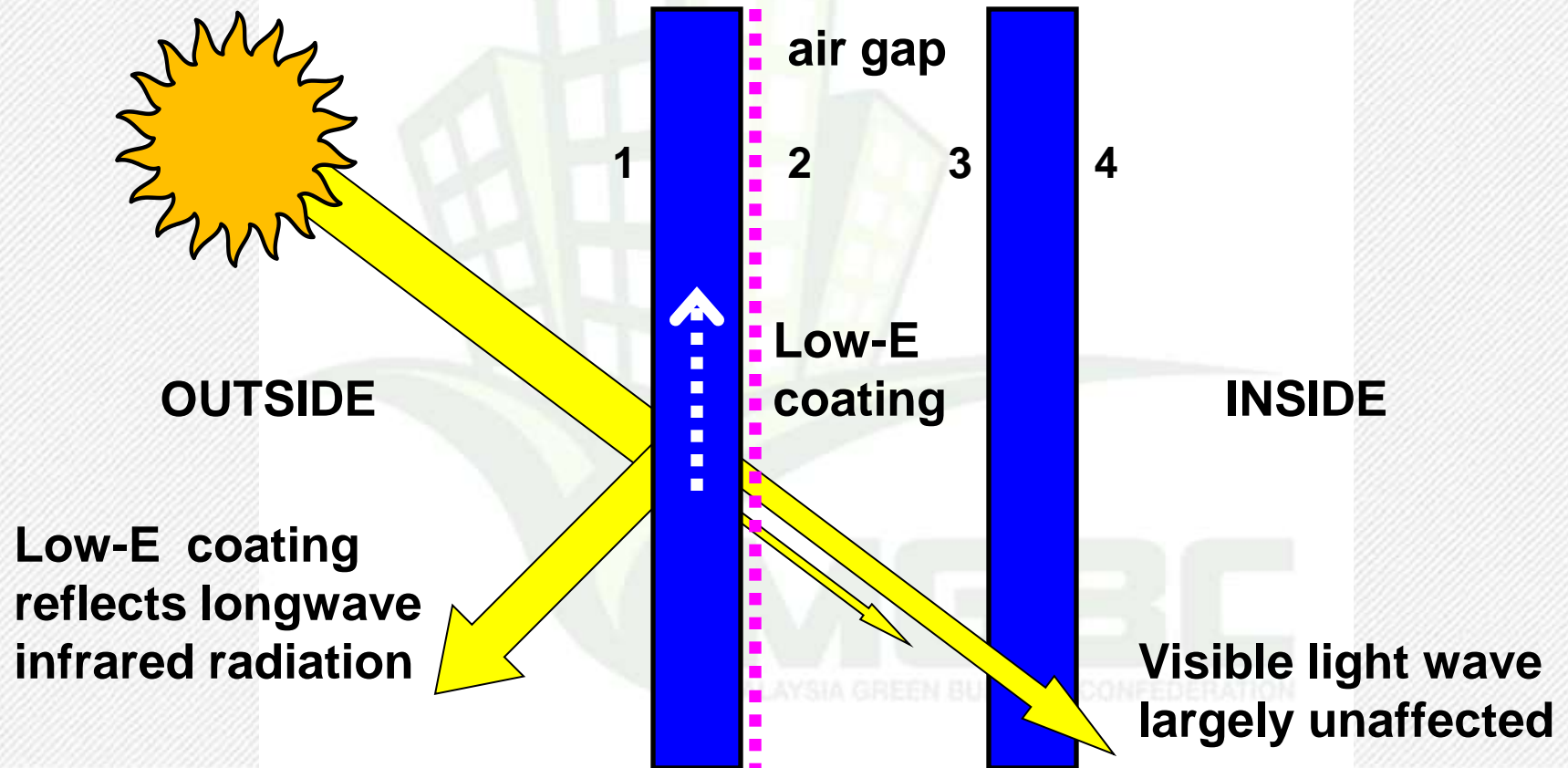
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SOLAR RADIATION AND GLAZING



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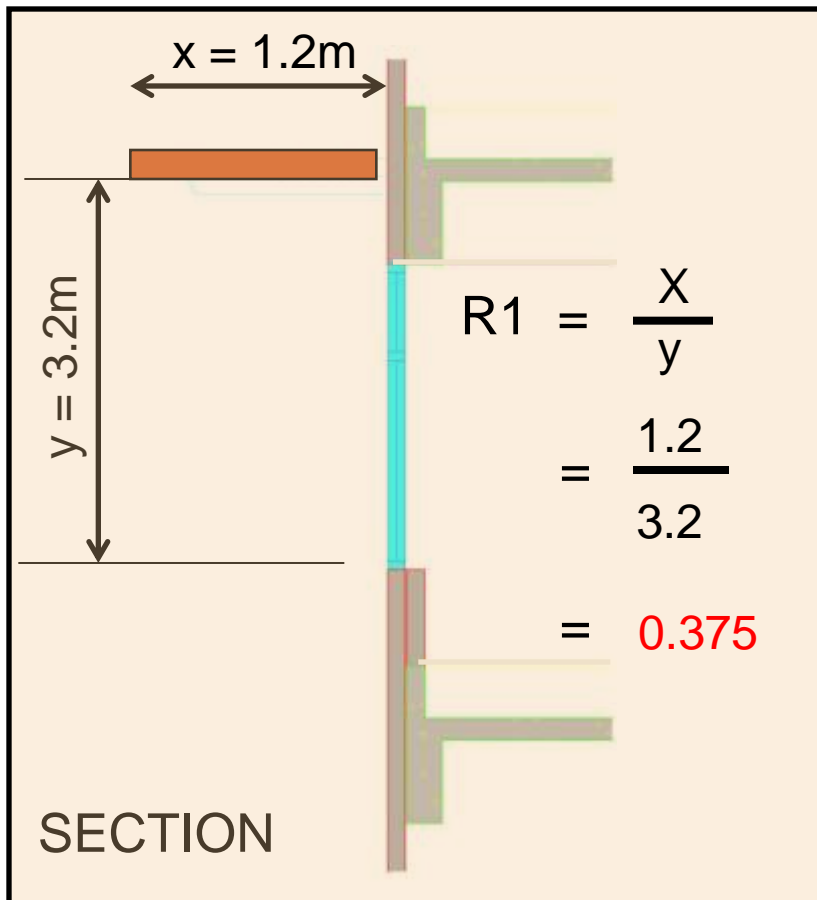
SOLAR RADIATION AND GLAZING



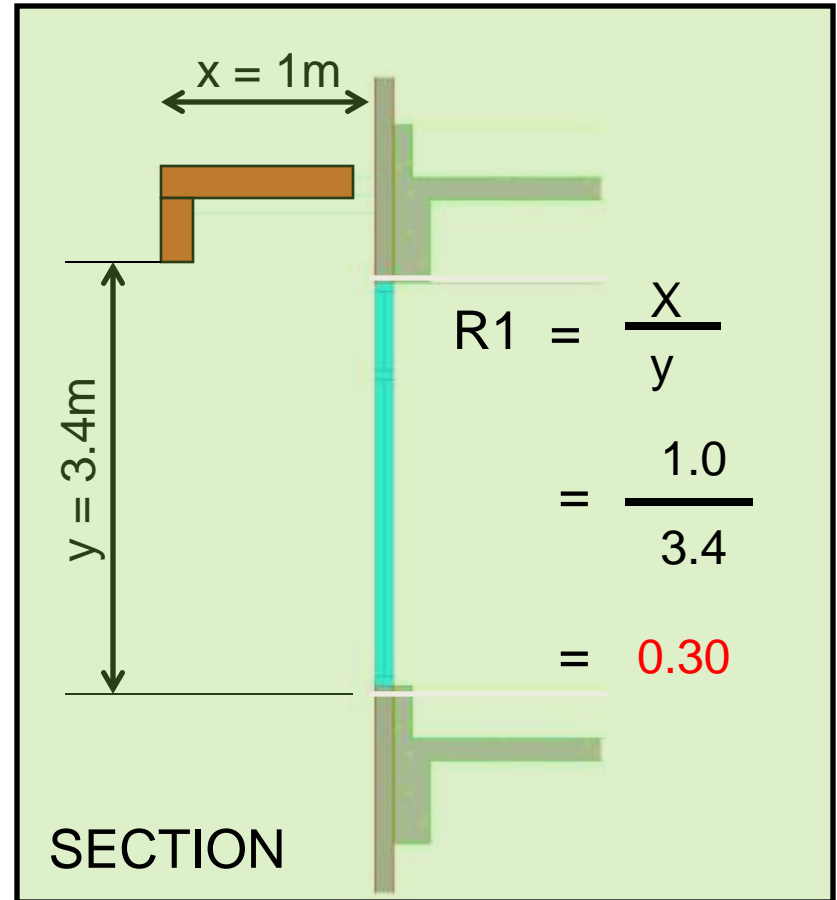
SHADING COEFFICIENT – R1

Horizontal Shading Devices

Eg 1



Eg 2



MALAYSIA GREEN BUILDING CONFEDERATION

MS1525:2007 Table 5

SHADING COEFFICIENT OF HORIZONTAL PROJECTIONS

RATIO	ORIENTATION				
	North / South	East	West	North-East / South-East	North-West / South-West
0.30 - 0.40	0.77	0.77	0.79	0.77	0.79
0.50 - 0.70	0.71	0.68	0.71	0.69	0.72
0.80 - 1.20	0.67	0.60	0.65	0.63	0.66
1.30 - 2.00	0.65	0.55	0.61	0.60	0.63

Note :

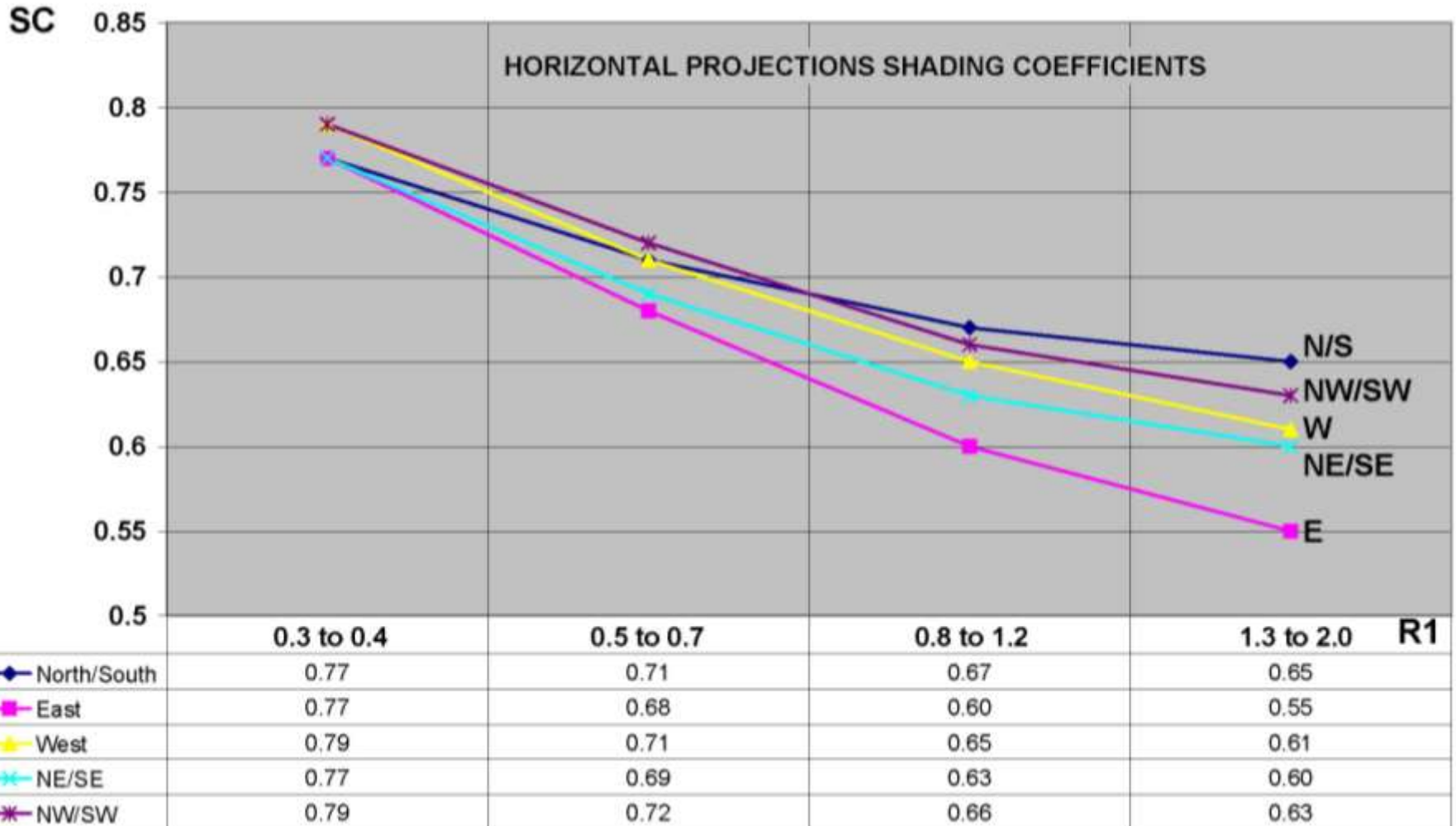
R1 is the ratio: Width of horizontal projection / Height of fenestration

If R1 falls between increments, adopt the next larger ratio.

If R1 is below 0.30, SC2 = 1.

If R1 is > 2.00, SC2 values shall be the same as R1 between 1.30 and 2.00

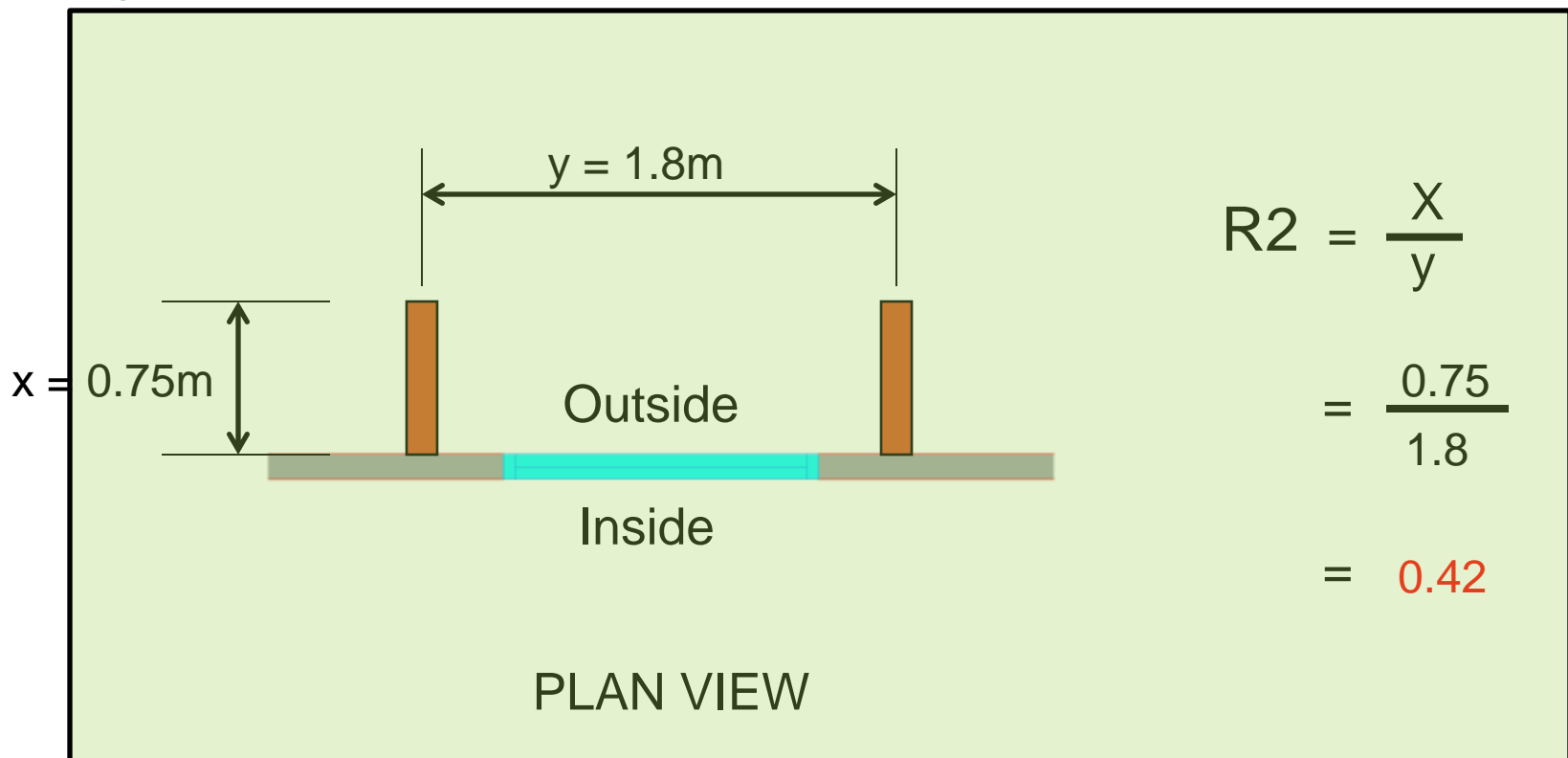
SHADING COEFFICIENT - R1



SHADING COEFFICIENT - R2

Vertical Shading Devices

Eg 1



MALAYSIA GREEN BUILDING CONFEDERATION

MS1525:2007 Table 6

SHADING COEFFICIENT OF VERTICAL PROJECTIONS

RATIO	ORIENTATION				
	North / South	East	West	North-East / South-East	North-West / South-West
0.30 - 0.40	0.82	0.87	0.86	0.83	0.84
0.50 - 0.70	0.77	0.82	0.81	0.77	0.79
0.80 - 1.20	0.73	0.78	0.77	0.72	0.74
1.30 - 2.00	0.70	0.75	0.74	0.69	0.71

Note :

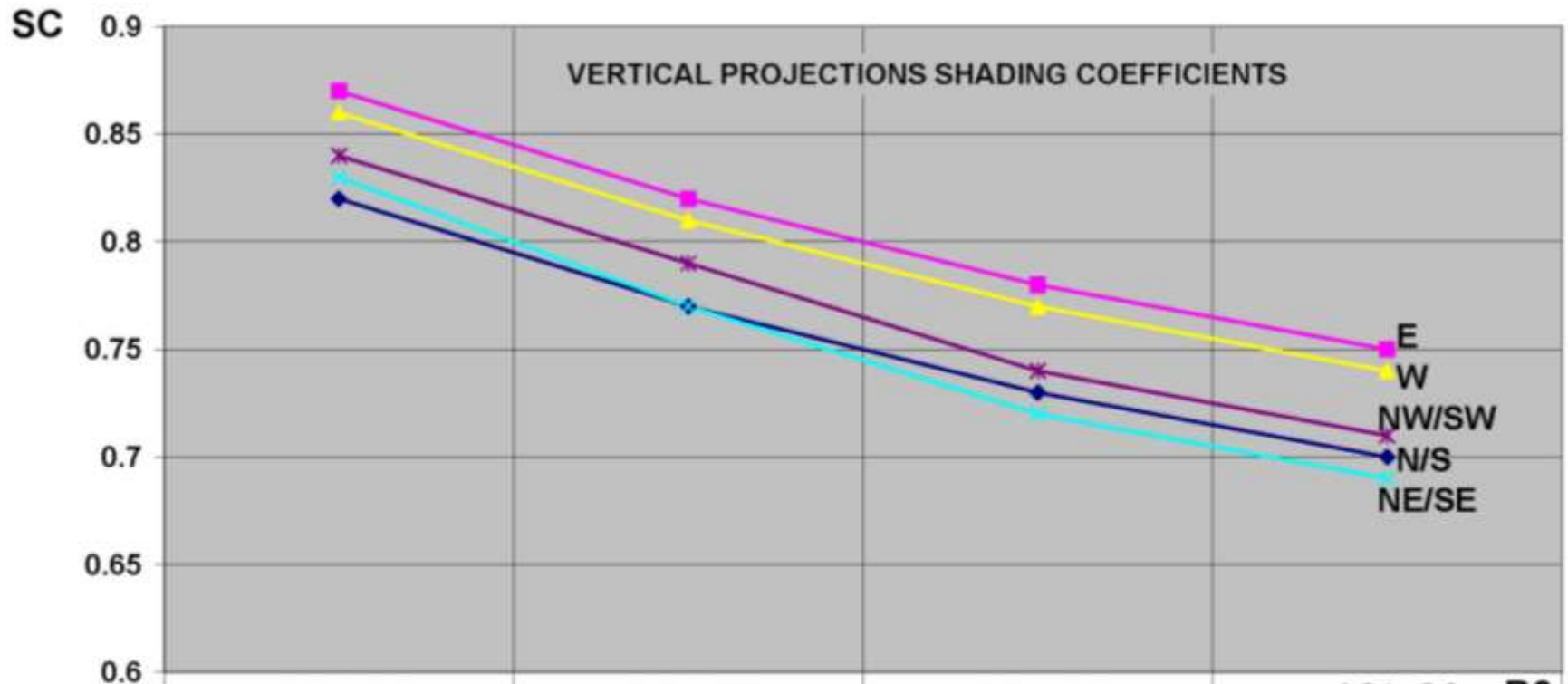
R2 is the ratio: Width of vertical projection / Length of fenestration

If R2 falls between increments, adopt the next larger ratio.

If R2 is below 0.30, SC2 = 1.

If R2 > 2.00, SC2 values shall be the same as R2 is between 1.30 and 2.00.

SHADING COEFFICIENT - R2



	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0	R2
◆ North/South	0.82	0.77	0.73	0.70	
■ East	0.87	0.82	0.78	0.75	
▲ West	0.86	0.81	0.77	0.74	
✕ NE/SE	0.83	0.77	0.72	0.69	
* NW/SW	0.84	0.79	0.74	0.71	

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VARIABLES OF OTTV

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

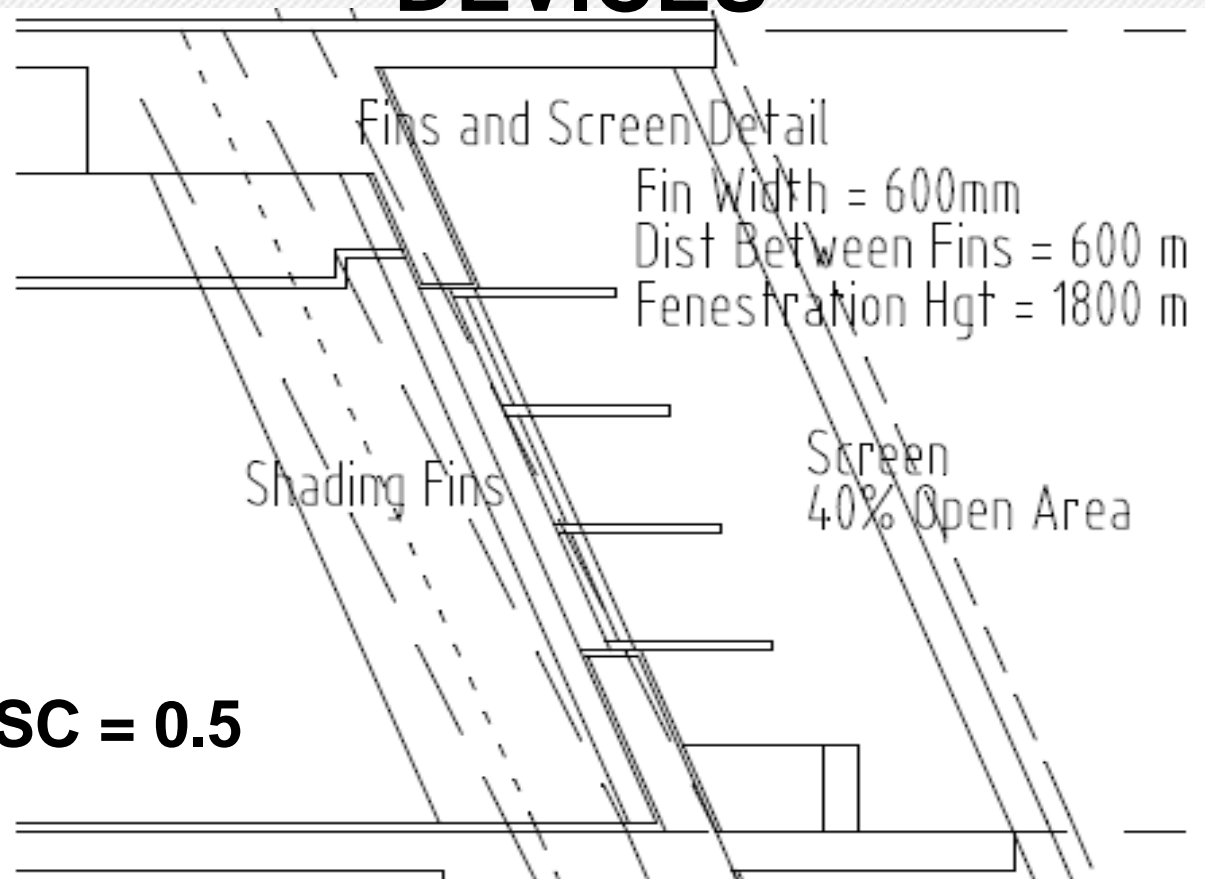
VARIABLES:

1. α
2. WWR
3. U_w
3. U_f
4. CF
5. SC

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

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CASE 1: MULTIPLE TYPES OF SHADING DEVICES

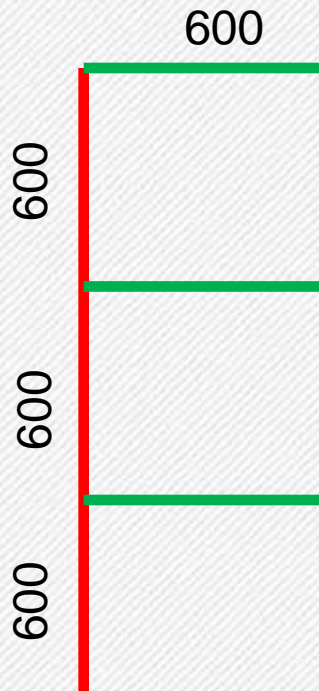


Glass SC = 0.5

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CASE 1: MULTIPLE TYPES OF SHADING DEVICES

SC2: Intermediate Fins



$R = \text{Projection} / \text{Window Height}$

$R = 600/600 \text{ or } 1800/1800 = 1$

$SC2 (N) = 0.67$

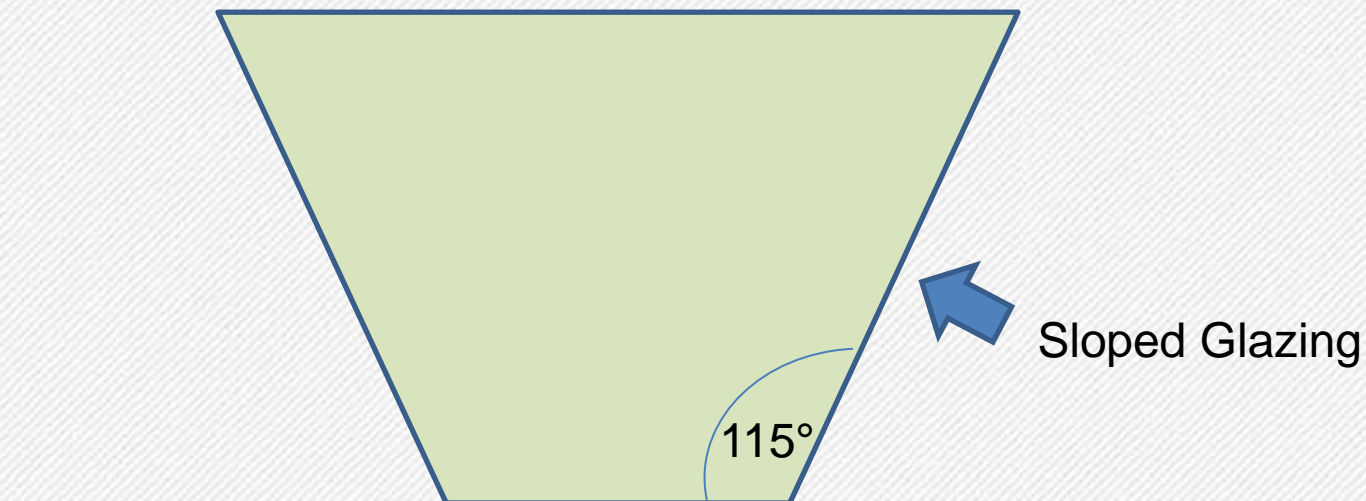
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CASE 2: ST BUILDING Self Shading Due to Pitch Angle



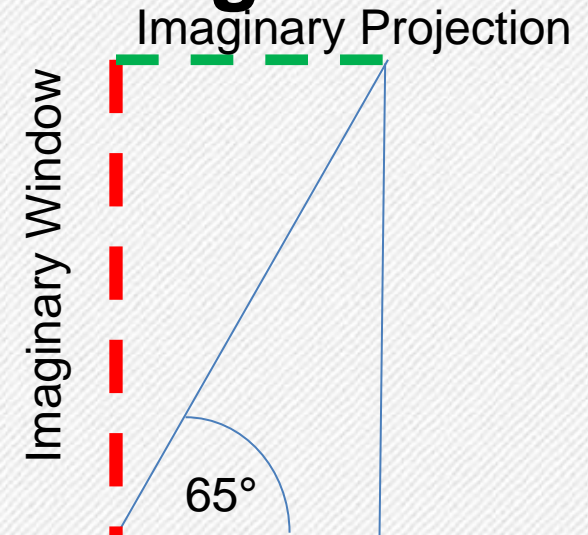
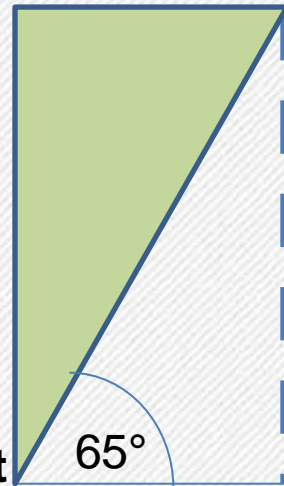
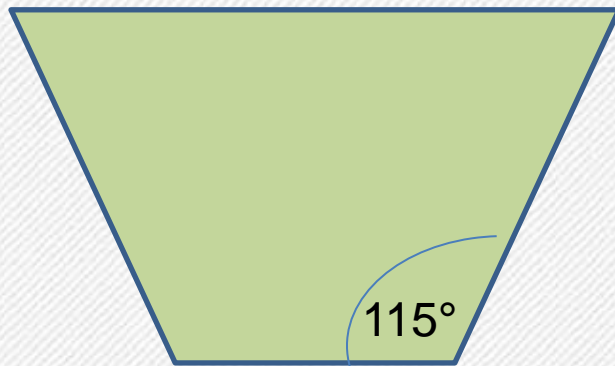
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MALAYSIA GREEN BUILDING CONFEDERATION

CASE 2: ST BUILDING Self Shading Due to Pitch Angle

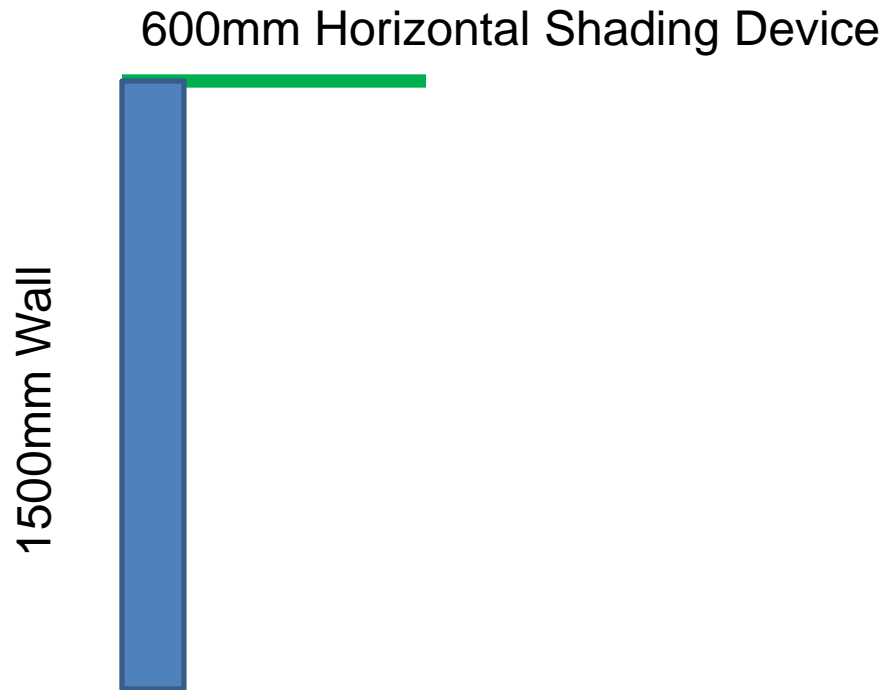


$R = \text{Projection} / \text{Window Height}$

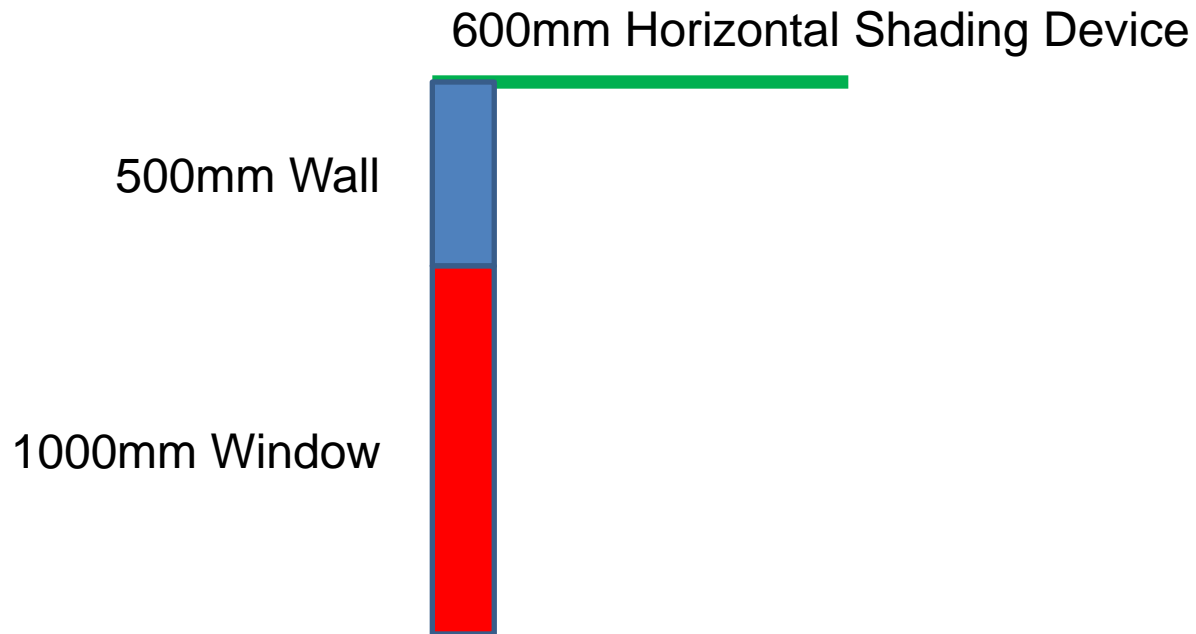
$$R = 1 / \tan (65^\circ) = 0.466$$

$$\text{SC2 (N/S)} = 0.71$$

BONUS Question: Calculate the SC

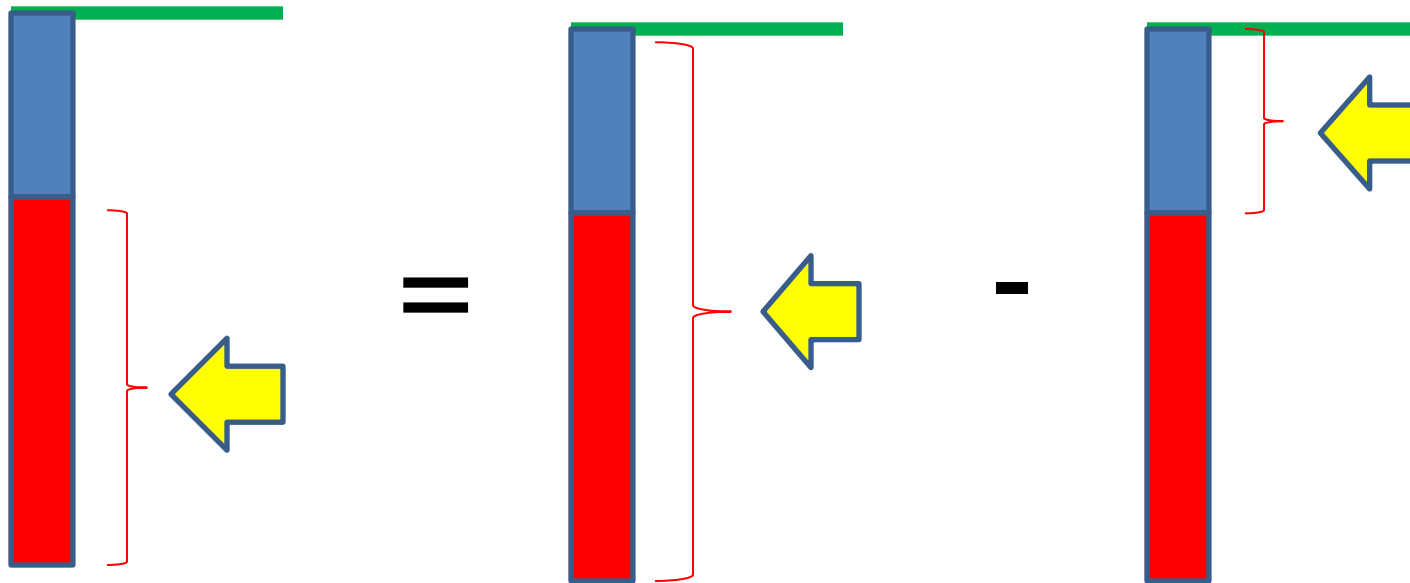


Case 3: Windows Offset from Horizontal Shading Device



Case 3: Windows Offset from Horizontal Shading Device

Heat gain on window = Heat Gain on All - Heat Gain on Wall

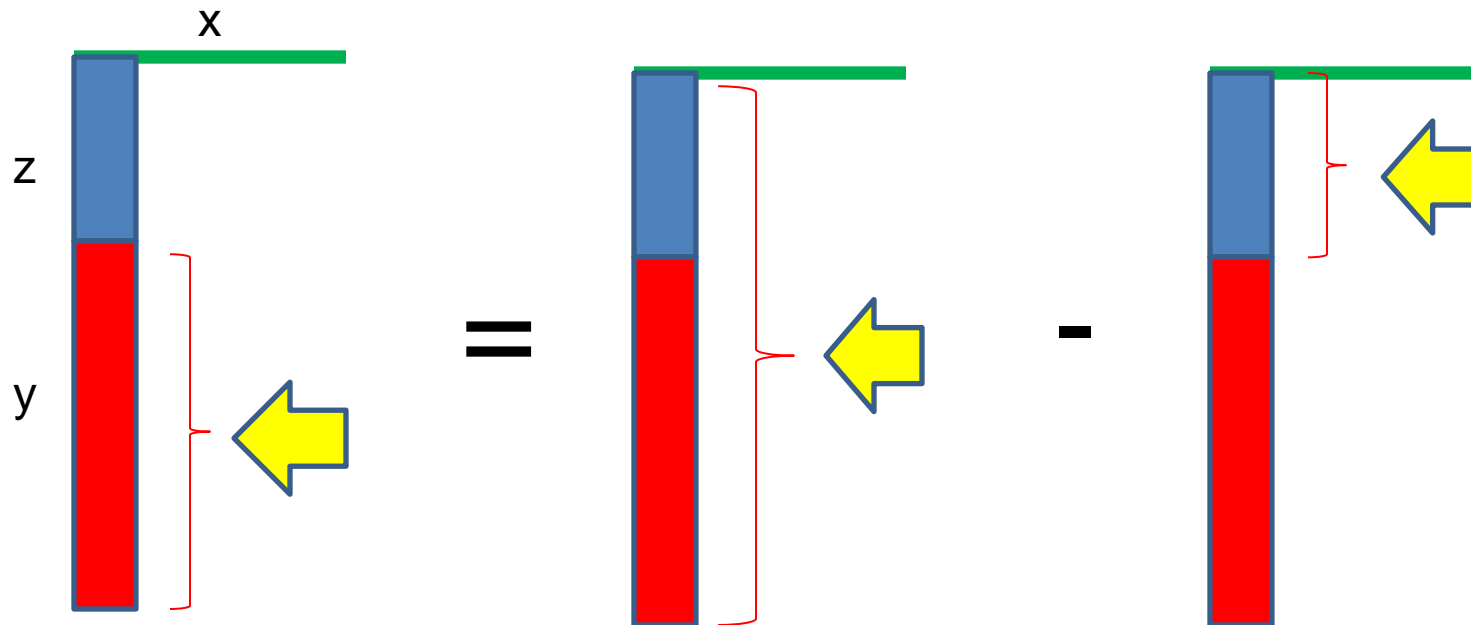


Solar Heat Gain Through Windows

$$194 \times CF \times WWR \times SC$$

Case 3: Windows Offset from Horizontal Shading Device

Heat gain on window = Heat Gain on All - Heat Gain on Wall



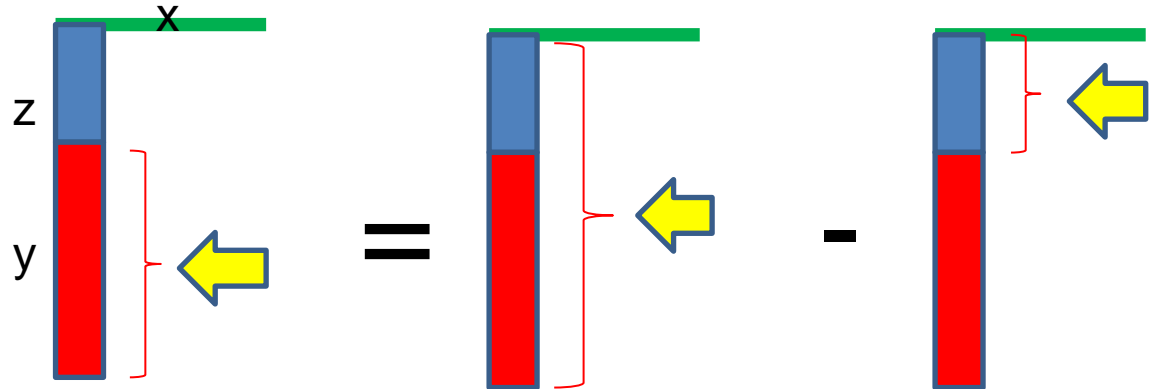
$$194 \times CF \times WWR \times SC$$

$$SC_{\text{window}} * (y) = SC_{\text{all}} * (z+y) - SC_{\text{wall}} * (z)$$

Case 3: Windows Offset from Horizontal Shading Device

Heat gain on window = Heat Gain on All - Heat Gain on Wall

X = 600mm
Z = 500mm
Y = 1000mm



SCall = Refer Table 5 for Rall of 0.4 (0.6/1.5) = 0.77

SCwall = Refer Table 5 for Rwall of 1.2 (0.6/0.5) = 0.67

SCwindow * (1) = SCall * (1+0.5) - SCwall * (0.5)

SCwindow * (1) = 0.77 * (1+0.5) - 0.67 * (0.5)

SCwindow * (1) = 1.155 - 0.335

SCwindow = 0.82

Is there an easier way?



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BEIT 1.1 Software Download



Written by ACEM Secretariat
Tuesday, 09 August 2011

BEIT (Building Energy Intensity Tool) is a software tool meant to assess energy use in buildings and has been developed by the Association of Consulting Engineers Malaysia (ACEM).

This software tool allows easy OTTV and RTTV calculations, and to make quick and reliable predictions of energy savings that can be achieved for various new design and retrofit measures. BEIT is developed specifically for use under the equatorial climatic conditions found in Malaysia.

BEIT makes comparison between two (2) building scenarios, the baseline building and the proposed building. The baseline building represents the building as it is (or as currently designed), while the proposed building is the same building to be retrofitted (or to be enhanced in design).

The BEIT is a copyright of ACEM in which ACEM reserves all rights.

Please make sure you have the latest Java runtime installed.
You may get it here: [Java Download](#)



BEIT 1.1

Download the BEIT software for your platform:

Windows [Download](#)
Mac OS X [Download](#)
Linux and Others [Download](#)



NEWSFLASH

P. Ganendra Scholarship

The Association of Consulting Engineers Malaysia (ACEM) invites qualified applicants for education sponsorship to pursue an undergraduate course in engineering at a local university recognized by the Board of Engineers, Malaysia.
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Malaysia's Green Building Index

Malaysia's Green Building Index was introduced on 3 January 2009, at the Green Design Forum organized by the Pertubuhan Akitèk Malaysia (PAM). A preview of the Green Building Index for Non-residential and Residential buildings were presented by Ir. Chen Thiam Leong and Ar. Chan Seong Aun respectively. These presentations are available for download at www.greenbuildingindex.org.
[Read more...](#)

ACEM Gold Award 2010

The ACEM Gold Award is a special award to recognise, honour and celebrate a member of ACEM, whether past or present, who has made significant contributions to the advancement and development of the engineering consultancy industry in the country. It is

BEIT Software free to download from ACEM website

2 OTTV (Heat Gain from Building Walls and Glazing)

Use Simplified Data (same data for all 4 façades)?

Data below is used for façades in all 4 orientations

	Baseline Building	Proposed Building	Estimated Cost (RM)
Windows to Wall Ratio	0.40	0.40	\$ -
Alpha (Colour of opaque Wall)	0.30	0.30	\$ -
U-value of Walls (W/m2K)	2.60	2.60	\$ -
U-value of Glazing (W/m2K)	5.70	1.80	\$ -
SC of glazing	0.37	0.37	\$ -

Horizontal Shading

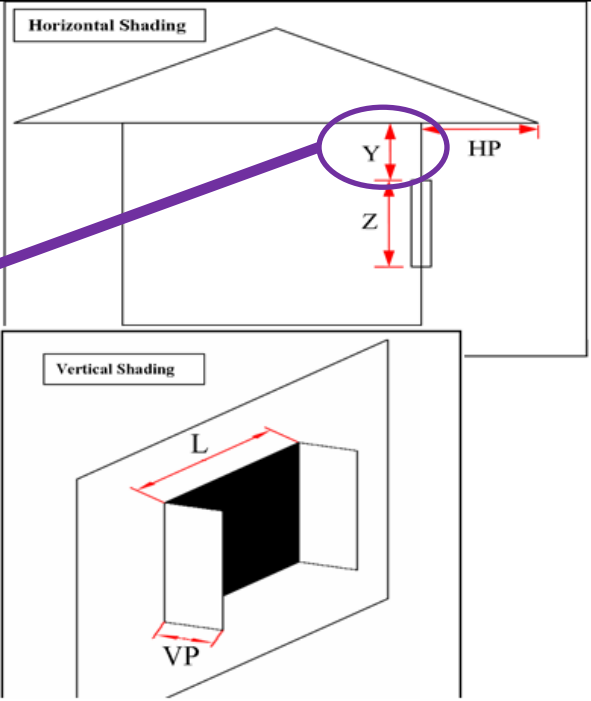
Width of Horizontal Projection (HP) (m)	0.00	0.00	\$ -
Height of fenestration (Z) (m)	2.00	1.70	\$ -
Height of top of fenestration to bottom of projection (Y) (m)	0.00	0.00	\$ -

Vertical Shading

Width of Vertical Projection (VP) (m)	0.00	0.00	\$ -
Length of fenestration (L) (m)	2.60	2.60	\$ -

OTTV Calculated (W/m2) must \leq 50	49.46	36.22	\$ -
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OTTV calcs is based on same data input for all 4 façades.





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THANK YOU