Chapter 6 – External & Internal Shades

Building Energy Efficiency Technical Guideline for Passive Design (Draft 1)





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Foreword

This document is produced as part of Component 4, Building Sector Energy Efficiency Program (BSEEP) by CK Tang (ck@gbeet.com) and Nic Chin (nc.environmentology@gmail.com).

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6.1 Introduction

The use of external shades has been well promoted by many architectural books as essential solution to energy efficiency and thermal comfort in tropical climate. Meanwhile, improvement in glazing technologies (Chapter 5) has enable buildings to be built today without the use of external shading devices while complying with respective countries energy code. In addition, there exist internal shading devices in the market that claims to reduce solar heat gain in building by 80% or more. Is it beneficial to combined all these technologies together and how should this combination be made to optimize the efficiency for the building is addressed in this chapter.

Economic Justification

High performance double glazing technology that reduces solar heat gain significantly while maintaining high visible light transmission are significantly more expensive when compared to the typical single glazing that is commonly used today by the building industry in Malaysia. A high performance double glazing unit has 2 pieces of glazing, low-e coating, spacer, sealant and a larger window frame as compared to a typical single glazing unit. Meanwhile, depending on the choice of material, the cost of external sun shading devices may be higher (or lower) than the cost of investing in high performance double glazing units. Finally, internal blinds may be most economical solution initially, but, it may need to be replaced at regular intervals and it also has a host of issues that need to be addressed carefully.

Legitimate use of internal shades to reduce solar heat gain

The use of internal shades as a primary solar heat reduction solution is not known to be practiced in Malaysian building industry. This is largely due to the fact that internal shades are generally less effective in controlling solar heat gain than the use of external shades and glazing technologies. However, there exist real and practical solutions in the market where the use of internal shades can reduce solar heat gain in building significantly. In short, the consideration of internal shades to reduce solar heat gain in building is a real and legitimate solution; however, the risk associated with internal shades should be addressed carefully by building designers and is highlighted in this chapter.

Finally, the reduction of energy and peak cooling load from the use of external and internal shades is not well-known in the Malaysian building industry. Chapter 6 offers a methodology derived from Chapter 5 to provide an estimate of the energy and peak load reduction due to the use of external and internal shades on windows. In addition, this chapter provides guidance on the use of internal shades to reduce energy consumption in buildings.

6.2 Key Recommendations

The total SHGC of any fenestration system can be estimated using the following equations:

$$SHGC_{total} = SHGC_{ext}\ x\ SHGC_{glz}\ x\ SHGC_{int}$$

Where,

$SHGC_{total}$ is the Solar Heat Gain Coefficient of the entire fenestration unit.

$SHGC_{ext}$ is the Solar Heat Gain Coefficient of external shading devices (1, if no external shading device is used)
$SHGC_{glz}$ is the Solar Heat Gain Coefficient of the glazing.
$SHGC_{int}$ is the Solar Heat Gain Coefficient of internal shading devices (1, if no internal shading devices is used)

The equation above signifies that SHGC values of external shades, glazing and internal shades have equal weightages in its ability to reduce solar heat gain in buildings. In addition, since it is a multiplication of these 3 SHGC terms, as long as any one of the three SHGC term is reduced to a significantly low value, the resultant will be a low solar heat gain for that fenestration unit. Alternatively, it is also possible to reduce SHGC values marginally on all three (3) SHGC terms to reach the same performance. These possibilities of variation are highlighted in Table 6.2.1 below.

Cases	Descriptions	SHGC ext shades	SHGC glazing	SHGC int shades	**Computed SHGC total**	**% SHGC reduction**	**Potential VLT allowed into building.***
1	Poorly designed façade	1.00	0.87	1.00	**0.87**	**0%**	**70% - 90%**
2	Only 1 item done well	1.00	0.30	1.00	**0.30**	**66%**	**10% - 60%**
3	Only 1 item done well	1.00	0.87	0.30	**0.26**	**70%**	**70% - 90%** (open internal blind) **0% - 10%** (closed internal blind)
4	Two (2) items done moderately well	0.70	0.50	1.00	**0.35**	**60%**	**25% - 70%**
5	All 3 items done moderately well	0.70	0.50	0.70	**0.25**	**72%**	**25% - 70%** (open internal blind) **0% - 30%** (closed internal blind)
6	All 3 items done well	0.50	0.30	0.50	**0.08**	**91%**	**10% - 60%** (open internal blind) **0% - 10%** (closed internal blind)

Table 6.2.1: SHGC total computed from various potential design combinations.
* Varies depending on the properties of glazing, external and internal shading devices selected.

There are many potential combinations to reduce solar heat gain in building by 60% or more. Table 6.2.1 above, showed a sample of various potential design options of reducing solar heat gain from a façade by 60% or more as compared to a Case 1, where a single clear glazing is used without any external shades or internal shades. These potential solutions are summarized here:

- **Case 1***: Poorly designed façade.* Single clear glazing used with neither external nor internal shading provided. Base case.
- **Case 2:** *Only 1 item done well.* Use of a high performance double glazing (66% SHGC reduction compared to Case 1).
- **Case 3:** *Only 1 item done well.* Use of a highly reflective internal blind (70% SHGC reduction compared to Case 1).
- **Case 4:** *Two (2) items done moderately well.* Use of an external horizontal shade with R1 ratio of 0.35 or higher and a slightly tinted single low-e glazing (60% SHGC reduction compared to Case 1).

- **Case 5:** *All 3 items done moderately well.* Use of an external horizontal shade with R1 ratio of 0.35 or higher, a slightly tinted single low-e glazing and a light coloured reflective internal blind (72% SHGC reduction compared to Case 1).
- **Case 6:** *All 3 items done well.* Use of an external horizontal shade with R1 ratio of 1.0 or higher, a high performance double glazing and a highly reflective internal blind (91% SHGC reduction compared to Case 1).

An approximate estimate of the potential visible light transmitted into the building due to the use of these three (3) SHGC terms to reduce solar heat into building is also provided in Table 6.2.1 as an indication for architects to make quick decision. The visible light transmission value varies significantly depending on the properties (and design) of glazing, external and internal shading device used. However, it can be summarized that it is easily possible to allow as much as 70% visible light transmission in building while providing 60% to 90% solar heat gain reduction.

6.2.1 Estimating SHGC Values

The SHGC of glazing is normally provided by glazing suppliers and it ranges from a high of 0.87 (a single clear glazing) to a typical possible low of 0.20. It is also possible to estimate the potential SHGC in the absent of supplier's information, based on the visible light transmission of glazing desired for the building and the light to solar gain ratio (LSG) of different glazing technologies using the equation below.

$$SHGC = \frac{VLT}{LSG}$$

Where,

SHGC is the Solar Heat Gain Coefficient of the Glazing (%)
VLT is the Visible Light Transmission of the Glazing (%)
LSG is the Light to Solar Gain Ratio of the Glazing

Depending on the glazing colour and technology used, LSG can be approximated by these numbers:

- Single glazing **without** low-e properties has typical LSG values of 0.5 to 1.0.
- Single glazing **with** low-e properties has typical LSG values of 0.95 to 1.3.
- High performance double glazing **with** low-e properties has typical LSG values of 1.5 to 2.0.
- Colours such as Green, Clear or Blue usually have higher limits of LSG values; while
- Colours such as Bronze or Red usually have lower limits of LSG values.

The SHGC of external shading devices is provided in this chapter in Table 6.3.1.1 for horizontal shades, Table 6.3.3.1 for vertical shades and Table 6.3.4.1 for combined horizontal and vertical shades. SHGC of external shading devices ranges from 1.0 (no external shading devices used) to a potential low of 0.33 on the East façade using a combination of large horizontal and vertical shades.

The SHGC of internal shading devices is provided in Table 6.4.2.1. The SHGC of internal shading devices range from 1.0 (no internal shades) to a potential low of 0.20 using a reflective internal blind. It is important to note that SHGC value of the same internal shading devices is different depending on the types of glazing it is combined with. For example, the SHGC of an internal reflective white opaque roller blind is 0.32 for a single clear glazing, 0.46 for single green glazing and 0.68 for a bronze low-e double glazing unit.

6.2.2 *Estimating Energy Saved*

It was found that the data from Table 5.6.2.1 from Chapter 5 offers a fairly good estimate of energy saved due to the reduction of SHGC. The Table 5.6.2.1 is reproduced below as Table 6.2.1.1 with percentage improvement shown from South orientation:

Preference	Orientation	Energy Reduction (per year) Per Glazing Area Per SHGC Reduction (kWh/m2.shgc of glazing area)	% Improvement Compared to South Orientation
1	East	150.14	49.1%
2	West	130.56	29.7%
3	North	115.54	14.7%
4	South	100.69	0.0%

Table 6.2.1.1: Energy Reduction per Glazing Area per SHGC Reduction (Extracted from Table 5.6.2.1 in Chapter 5)

6.3 External Shading Devices

Energy simulation study was conducted to derive the year average SHGC of external blinds. These simulations studies accounted for the reduction of solar gain due to direct and diffuse shading on a window. The energy simulation study was based on a full year, 8760 hours of weather data in Test Reference Year of Malaysia (Chapter 2).

6.3.1 *Horizontal Shading Devices*

The default MS1525 (2007), definition of horizontal shading device is used in this chapter and is shown in figure 6.3.1.1 below. In addition, it was also noted that it is often to find horizontal projections are not placed immediate above the window, but at a distance offset from the top of the window. The SHGC computation for "offset" horizontal projection is provided in section 6.3.2.

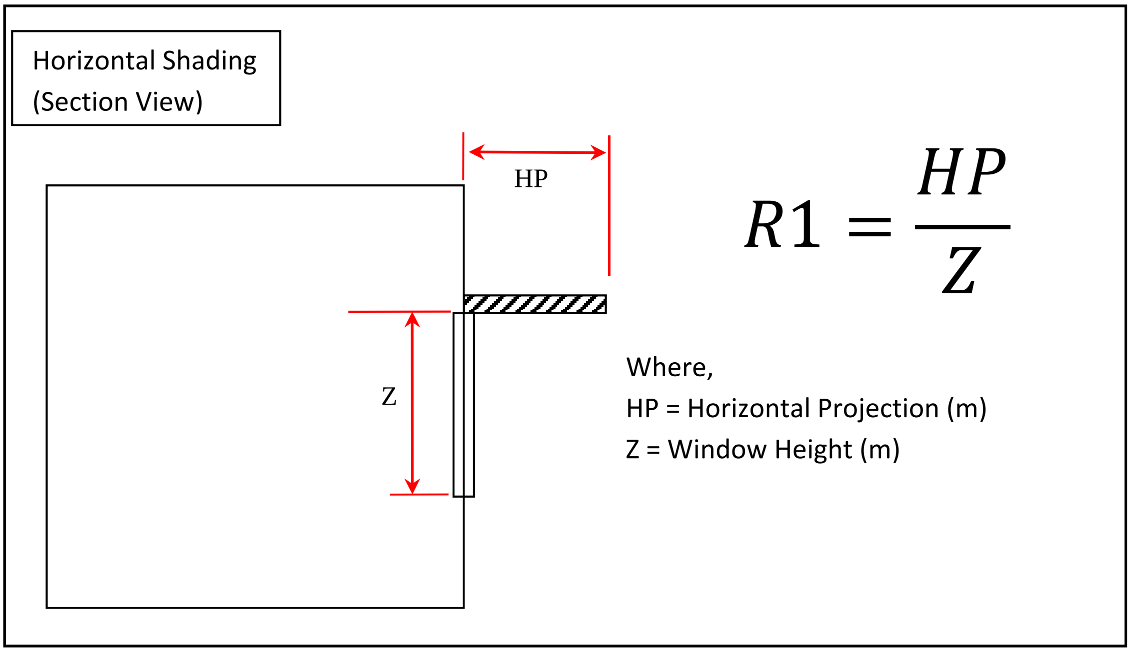

Figure 6.3.1.1: Definition of R1 ratio for Horizontal Shades

The SHGC of using horizontal shades in this climate is provided in Table 6.3.1.1. These numbers are derived from energy simulation studies. It can be observed from the table that the difference of

SHGC from the use of horizontal external shade for different facade orientations is relatively small. This could be due to the significantly higher diffuse solar radiation (as compared to the direct solar radiation) of the Test Reference Year Malaysian weather data (Chapter 2).

R1	1.65	1.00	0.60	0.35	0.10	0.00
SHGC North	0.46	0.53	0.62	0.71	0.90	1.00
SHGC South	0.45	0.52	0.60	0.71	0.90	1.00
SHGC East	0.39	0.49	0.61	0.74	0.91	1.00
SHGC West	0.45	0.53	0.64	0.75	0.92	1.00

Table 6.3.1.1: SHGC of Horizontal Shades based on R1 Ratio

Chart 6.3.1.1 and Table 6.3.1.2 is provided with the curve fit equation for various R1 ratios for different orientation. This information is provided to give exact estimates of SHGC value from any R1 values.

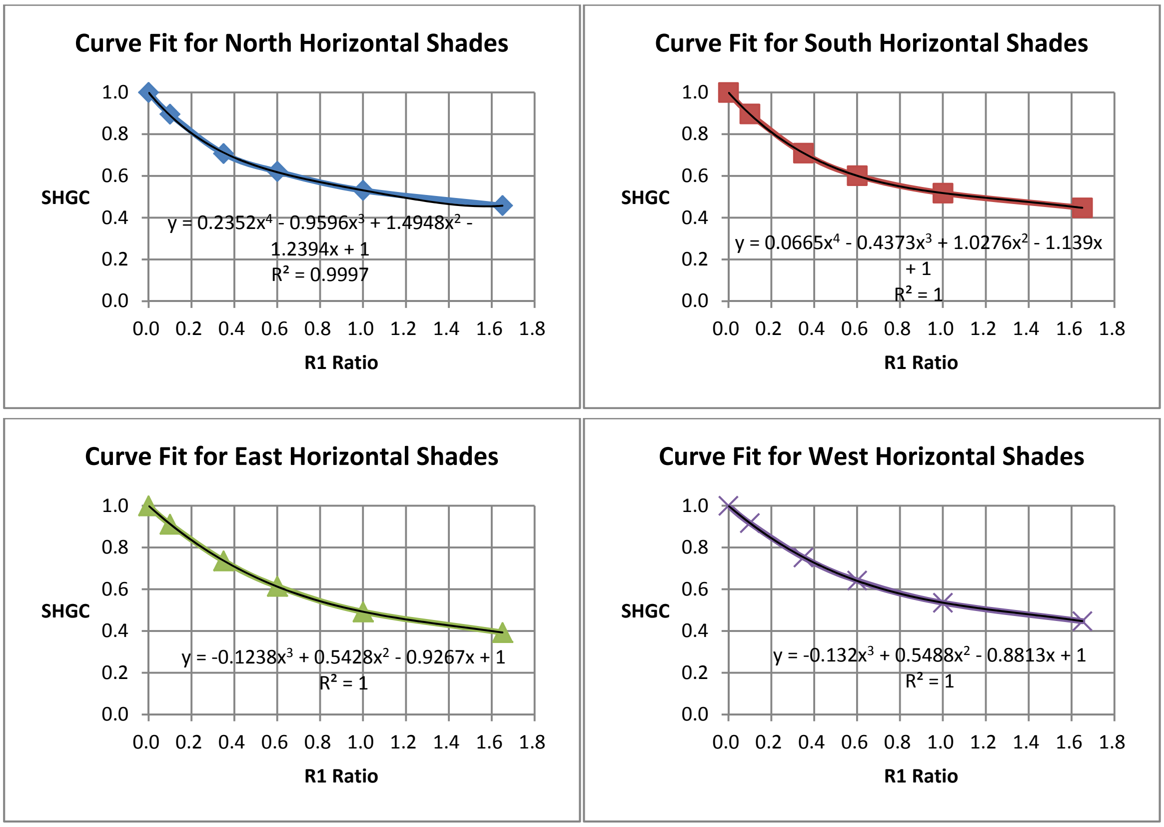

Chart 6.3.1.1: SHGC Curve Fits for Horizontal Shades for North, South, East and West Orientations

Orientation	SHGC Curve Fit Equation	R^2
North	$SHGC = 0.2352x^4 - 0.9596x^3 + 1.4948x^2 - 1.2394x + 1$	0.9997
South	$SHGC = 0.0665x^4 - 0.4373x^3 + 1.0276x^2 - 1.139x + 1$	1.0000
East	$SHGC = -0.1238x^3 + 0.5428x^2 - 0.9267x + 1$	1.0000
West	$SHGC = -0.132x^3 + 0.5488x^2 - 0.8813x + 1$	1.0000

Table: 6.3.1.2: SHGC Curve Fit Equation, where: x is R1 ratio

Chart 6.3.1.2 below, provides the energy reduction for each orientation of the building, assuming a single clear glazing is used. The energy reduction can be estimated from this chart with information of the glazing area, orientation of the window and R1 ratio. This chart is created from the combination of Table 6.2.1.1 and Table 6.3.1.1. Although the SHGC value for all orientation of the building is similar for the same R1 ratio, the energy reduction is significantly higher on the East façade, followed by West, then North and lastly South façade. Refer to Chapter 5 for more details on the influence of SHGC reduction for different façade orientation.

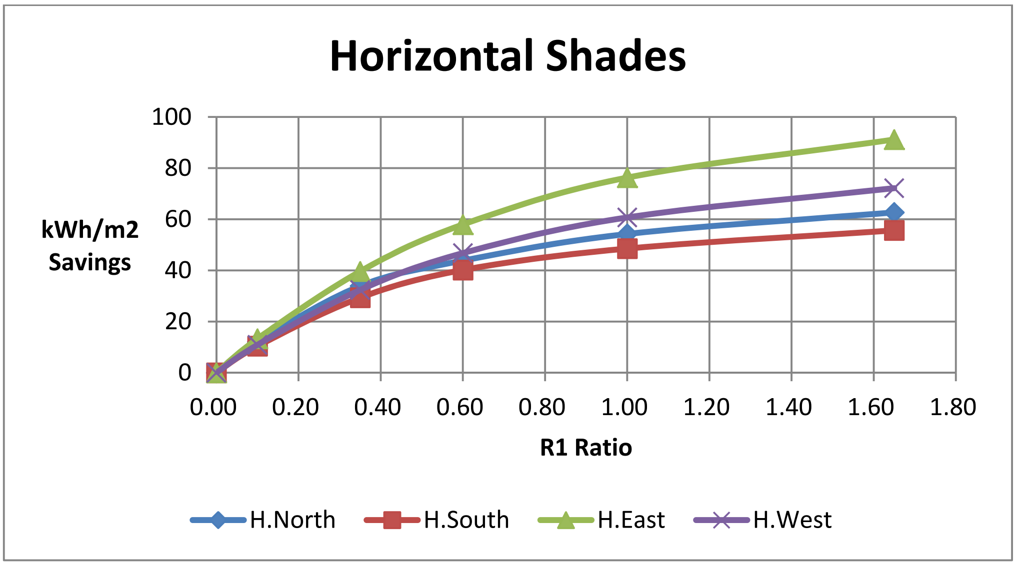

Chart 6.3.1.2: kWh of energy savings per glazing area due to the provision of Horizontal Shading Devise

6.3.2 *Estimating SHGC of Horizontal Shading Devices with Offset Distance*

Figure 6.3.2.1 below describes a very common scenario found in building design. It has been observed that many architects and engineers are using many different methods to estimate the SHGC of horizontal shading device for the window. The appropriate method to estimate the SHGC for the window is provided in this section.

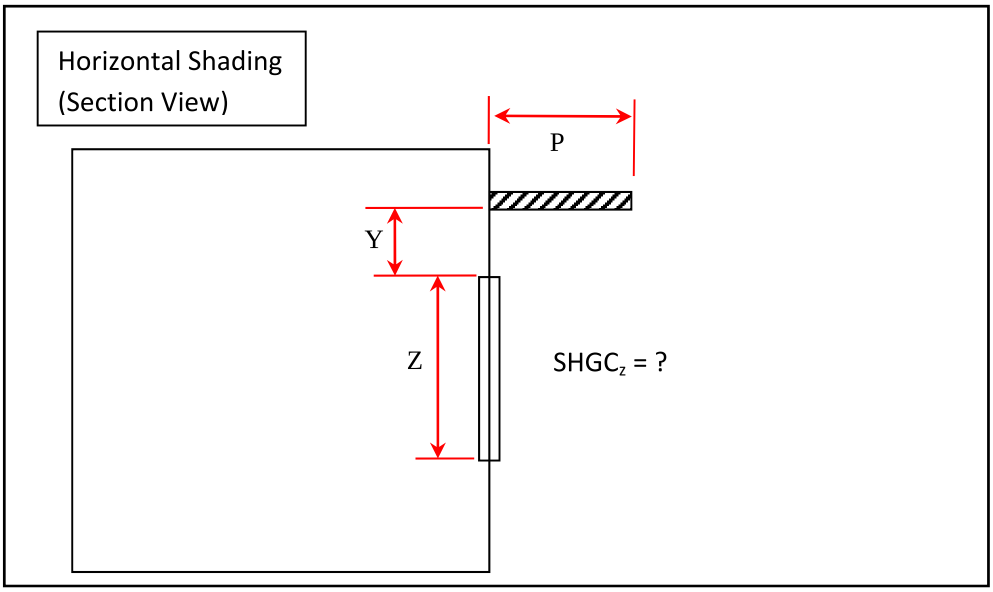

Figure 6.3.2.1: Horizontal External Shading Devices with Offset

The following assumptions can made as shown from Figure 6.3.2.2 and Figure 6.3.2.3:

QsolarT = QsolarY + QsolarZ

Where,
QsolarT = Total solar radiation received by Window (T)
QsolarY = Total solar radiation received by Window (Y)
QsolarZ = Total solar radiation received by Window (Z)

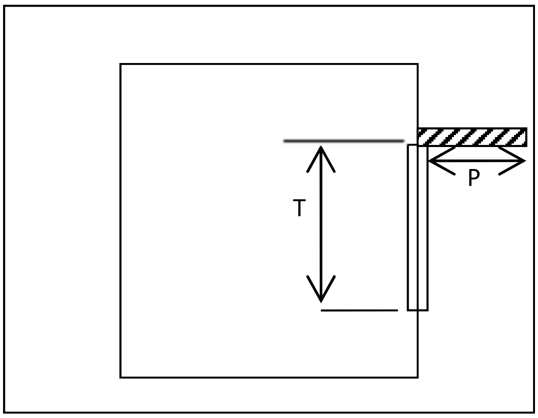

Figure 6.3.2.2: Simplification 1

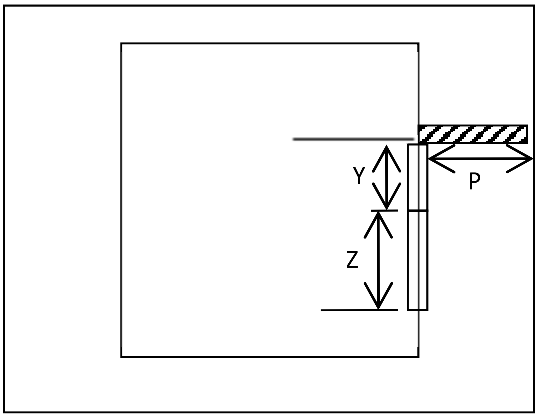

Figure 6.3.2.3: Simplification 2

Based on the OTTV equation, the solar portion of the window can be written as:
QsolarT = A_t x 194 x CF x $SHGC_t$
QsolarY = A_y x 194 x CF x $SHGC_y$
QsolarZ = A_z x 194 x CF x $SHGC_y$

Where,
A_t = Size of Window T = T x Depth
A_y = Size of Window Y = Y x Depth
A_z = Size of Window Z = Z x Depth
$SHGC_t$ = SHGC of Window T (available from Table 6.3.1.1 with R1 ratio of P/T)
$SHGC_y$ = SHGC of Window Y (available from Table 6.3.1.1 with R1 ratio of P/Y)
$SHGC_z$= SHGC of Window Z
CF = Correction Factor = same for all 3 windows because it all faces the same direction.

The solar equation can be rewritten:

T x Depth x 194 x CF x $SHGC_t$ = (Y x Depth x 194 x CF x $SHGC_y$) + (Z x Depth x 194 x CF x $SHGC_z$)

Rewriting it,

$$\boldsymbol{SHGC_z = \frac{(T\ x\ \mathrm{SHGC}\ _t) - (Y\ x\ SHGC_y)}{Z}}$$

Where,
$SHGC_t$ = SHGC of Window T (available from Table 6.3.1.1 with R1 ratio of P/T)
$SHGC_y$ = SHGC of Window Y (available from Table 6.3.1.1 with R1 ratio of P/Y)
T, Y and Z = respective window height.

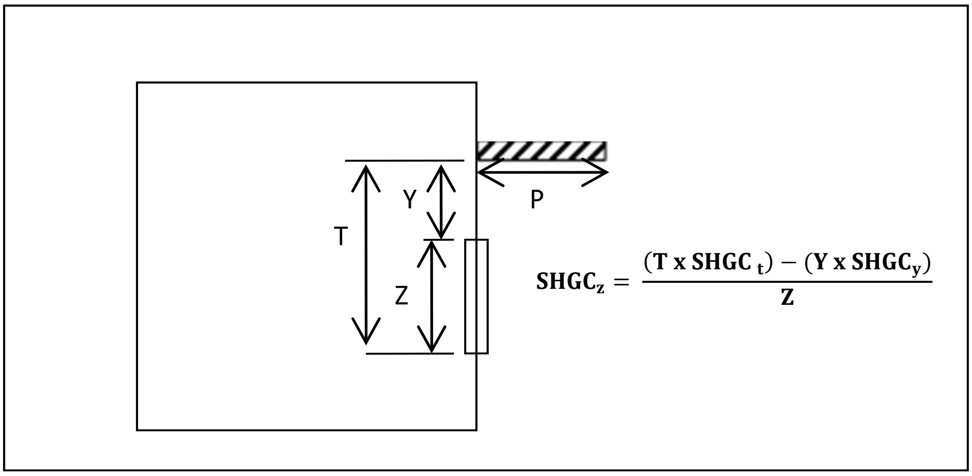

Figure 6.3.2.4: Solution to calculate SHGC of Fenestration with Offset Horizontal Projections

6.3.3 *Vertical Shading Devices*

The default MS1525 (2007), definition of vertical shading device is used in this chapter and is shown in figure 6.3.3.1 below. The vertical shading device is assumed to be placed on both right and left side of the window.

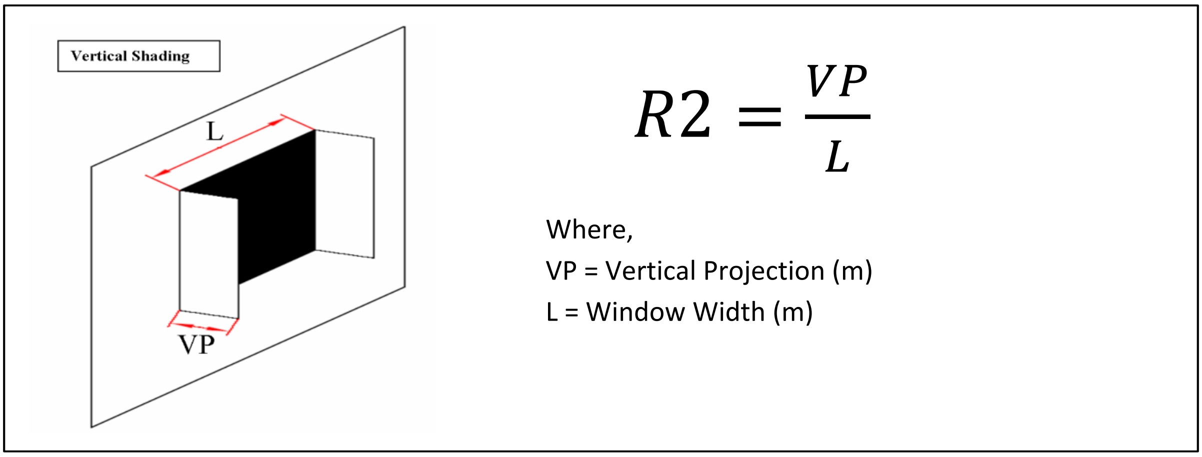

Figure 6.3.3.1: Definition of R2 ratio for Vertical Shades

The SHGC of using vertical shades in this climate is provided in Table 6.3.3.1. These numbers are derived from energy simulation studies. It can be seen from the table that the differences of SHGC value from the use of vertical external shade for different orientations are split between north/south vs. east/west façade orientation. The SHGC values of north/south façade are notably lower than the east/west façade with the use of vertical shading devices.

R2	**1.65**	**1.00**	**0.60**	**0.35**	**0.10**	**0.00**
SHGC North	0.70	0.73	0.77	0.82	0.93	1.00
SHGC South	0.70	0.73	0.77	0.82	0.93	1.00
SHGC East	0.75	0.78	0.82	0.87	0.95	1.00
SHGC West	0.74	0.77	0.81	0.86	0.95	1.00

Table 6.3.3.1: SHGC Vertical Shades, R2

Chart 6.3.3.1 below, provides the energy reduction for each orientation of the building, assuming a single clear glazing is used. The energy reduction can be estimated from this chart with information of the glazing area, orientation of the window and R2 ratio. This chart is created from the combination of Table 6.2.1.1 and Table 6.3.3.1. Although the SHGC values are lower on the north/south façade when compared to the east/west façade, the energy reduction is similar for all façade orientation with the same R2 ratio. Refer to Chapter 5 for more details on the influence of SHGC reduction for different façade orientation.

In addition, vertical shades provide a maximum energy reduction of 38 kWh/m² (m² of glazing area) per year as compared to horizontal shades providing energy reduction up to 91 kWh/m² (m² of glazing area) per year. This indicates that horizontal shades are approximately 2.4 times more effective than the use of vertical shades for the same shading ratio used. Moreover, vertical shading devices requires 2 pieces of shades (one on the right side and one on the left side of the window), while horizontal shading devices requires only 1 piece of shade (at the top of the window) to provide these energy reduction potential.

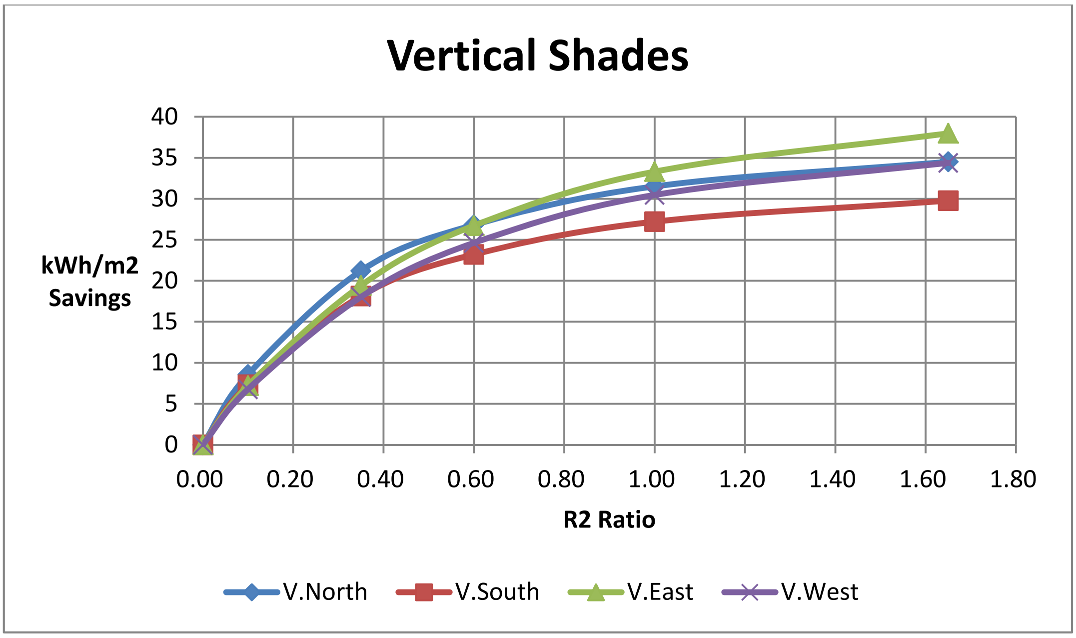

Chart 6.3.3.1: kWh of energy savings per glazing area due to the provision of Vertical Shading Devise

6.3.4 *Combined Horizontal and Vertical Shades*

The default MS1525 (2007), definition of combined horizontal and vertical shading device is used in this section.

The SHGC values of combined horizontal and vertical shades are provided in Table 6.3.4.1 below.

R1	**1.50**	**1.00**	**1.00**	**1.00**	**0.80**	**0.80**	**0.60**	**0.60**	**0.40**	**0.40**	**0.40**	**0.20**	**0.20**	**0.20**
R2	**1.00**	**1.60**	**0.90**	**0.30**	**1.30**	**0.40**	**1.30**	**0.40**	**1.60**	**0.90**	**0.30**	**1.20**	**0.50**	**0.20**
North	0.38	0.38	0.41	0.51	0.41	0.50	0.43	0.52	0.46	0.49	0.59	0.55	0.62	0.71
South	0.37	0.37	0.40	0.50	0.40	0.49	0.42	0.51	0.46	0.49	0.59	0.56	0.62	0.71
East	0.33	0.35	0.39	0.48	0.39	0.49	0.44	0.54	0.50	0.54	0.63	0.62	0.69	0.77
West	0.38	0.38	0.41	0.51	0.41	0.50	0.43	0.52	0.46	0.49	0.59	0.55	0.62	0.71

Table 6.3.4.1: SHGC of Combined Horizontal and Vertical Shades, R1 & R2

6.3.5 *Estimating Energy Reduction*

It was found from the simulation studies that the factors derived in Chapter 5 for reduction of SHGC in single glazing can be used to estimate the peak cooling load and energy reduction for the external shading devices. Table 5.6.2.1 is reproduced below for ease of looking up the data. Refer to Chapter 5 for more details.

Orientation	**North**	**South**	**East**	**West**
Energy Reduction (per year) Per Glazing Area Per SHGC Reduction (kWh/m2.shgc of glazing area)	115.54	100.69	150.14	130.56
*RM Reduction (per year) Per Glazing Area Reduction Per SHGC Reduction (RM/m2.shgc of glazing area reduced)	40.44	35.24	52.55	45.70
**Peak Cooling Load Reduction Per Glazing Area Per SHGC Reduction (kW/m2.shgc of glazing area)	267.86	144.14	310.24	355.82

Table 5.6.2.1: Energy and Peak Load Impact of Reducing of SHGC, in Single Glazing

*A simplified energy tariff of RM 0.35 per kWh is used.

** Only applicable for buildings with glazing area distributed evenly on all orientation.

6.4 Internal Shading Devices

Both external and internal shades control heat gain. In general, external shades are more effective than internal shades because they block the solar radiation before it enters the building. When using an internal shade, such as blinds or a curtain, the short-wave radiation passes through the glass and hits the shade. Depending on the colour and reflectivity of the shade, some percentage will be reflected straight back out the window, but the rest will be absorbed by the shade itself, effectively heating it up.

The energy from the hot internal shade is then given off as long-wave radiation, half into the room space and half towards the window. Unfortunately, due to the greenhouse effect, long-wave radiation is trapped between the glass and the internal shade, heating the air within this space. This heated air will rise, exit at the top and draw in cooler air from below, creating a form of convection cycle that continually draws cool air from the bottom of the space, heats it up and pushes it out into the room.

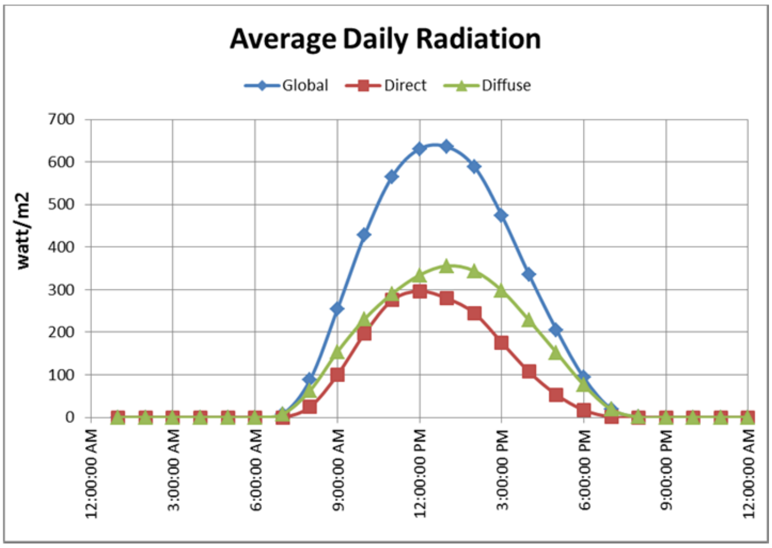

Figure 6.4.1: Average Daily Radiation Data for Subang Test Reference Year

However, if the right type of internal shades is used in this tropical climate zone, it can outperform external shading devices. To understand this, it is useful to revisit the distribution of direct and diffuse solar radiation in Malaysia climate.

The Malaysian Test Reference Year solar radiation data, Chapter 2, showed that the average daily diffuse radiation is higher than the direct radiation. Over the entire year, on a horizontal surface, the sum of diffuse radiation is 44% higher than sum of direct radiation. The total solar heat gain received by a window is the sum of both direct and diffuse radiation.

On any vertical surface, without any external shading devices, only 50% of diffuse solar radiation is captured by the window because it is only exposed to half the sky dome. If the same window is added with external shading devices, the percentage of diffuse solar radiation captured by the window is dependent on its view factor of the sky and ground reflected diffuse radiation. Due to the fact that typical external shading devices are designed to prevent heat gain from direct solar radiation while maintaining a good view out of the building, the reduction of diffuse shading will not be as significant.

Moreover, it is fairly easy to design external shading devices that will provide full (or near full) protection from direct radiation without affecting the view out from the building. However, it is almost impossible to design external shading devices to provide full (or near full) protection from diffuse radiation without significantly affecting the view out.

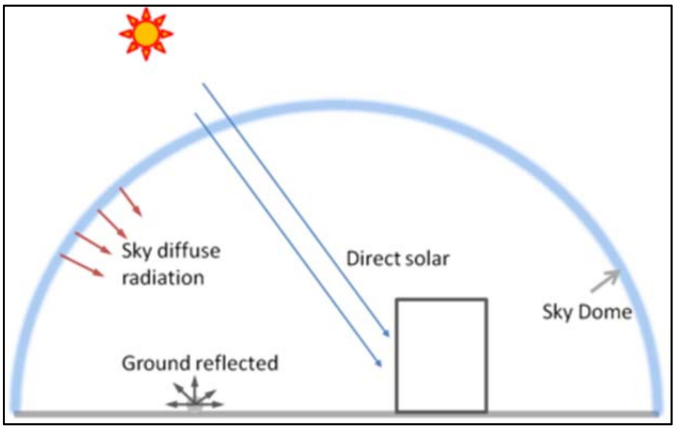

Figure 6.4.2: Principals of Direct and Diffuse Radiation

6.4.1 Reflective Internal Blinds

As mentioned earlier, the uses of internal shading devices are in general, less effective than the use of external shading devices. However, it was shown by R.McCluney and L.Mills that internal shading devices that reflect solar heat gain back out of the window provides significant reduction of Solar Heat Gain Coefficient (SHGC).[1] Internal blinds that are highly reflective towards the window will reject the solar radiation out of the window before it is absorbed by the interior furnishings or building materials. A SHGC value as low as 0.2 (with a blind surface reflectance of 0.8) was reported by R.McCluney and L.Mills from the use of such internal blinds on a single clear glazing. In comparison, the lowest SHGC provided by external shades in this climate is 0.33 on the Eastern façade and it requires the use of significantly large combined horizontal and vertical shading devices to achieve it (which can be quite unsightly!).

It should also be noted that reflective internal blinds work best with single clear glazing that allows the reflected solar radiation from the reflective blind to exit the interior space. In buildings with good glazing properties (those with low SHGC), the amount of heat that can be rejected out by

[1] Effect of Interior Shades on Window Solar Gain, by R. McCluney and L.Mills, Proc. ASHRAE Transaction, Vol. 99, Pt. 2, 1993, pp. 565-570.

reflective blinds are reduced due to the properties of the glazing that hinders the solar heat transmission, either by absorption or rejection of solar radiation. However, the use of good glazing properties would have reduced the heat gain into the building, reducing the need for a good reflective internal blind to be used.

6.4.2 SHGC OF INTERNAL SHADES

The SHGC of internal shades are not easily available from blind/curtain suppliers in Malaysia. Moreover, SHGC of internal shades are dependent on the type of glazing it is combined with. One known method to obtain exact SHGC values of internal blinds with the glazing used is through the use of calorimeter measurement methodology. This method is both time consuming and economically unattractive.

An alternative is to use the tables provided by ASHRAE. ASHRAE Fundamentals handbook provides a number of tables on SHGC of various internal blinds based on the type of glazing it is combined with. A selection of SHGC of internal shading devices is provided in Table 6.4.2.1.

From Table 6.4.2.1, it can be summarized that dark coloured internal shades have higher SHGC values than lighter coloured internal shades, indicating that solar heat gain of dark blinds and curtains are higher than lighter coloured internal shades. In addition, the same internal reflective shade which provides a low SHGC internal blind value of 0.25 when used with single clear glazing (SHGC glazing of 0.81) has different SHGC internal blind value of 0.64 when used with Bronze Low-e Double Glazing (SHGC glazing of 0.26). This indicates that the effectiveness of internal blinds is dependent on the type of glazing used. User of Table 6.4.2.1 should be aware of this and not use the 1st SHGC value found for type of internal shades used.

Again, it is also possible to use the factors found in Table 5.6.2.1 to estimate the peak cooling load and energy reduction of the fenestration unit based on the total reduction of SHGC.

6.4.3 IMPORTANT CONSIDERATIONS FOR INTERNAL SHADES

The use of internal shades to reduce solar heat gain in building is a legitimate energy efficiency solution to a building with poor glazing properties. However, there are important considerations that need to be addressed when internal blinds are used for this purpose.

1. **Dependability**. It may not be 100% dependable that internal blinds will be used during peak solar gain hours.
    a. Automatically operated internal blinds may provide good solar gain protection during peak solar gain hours but lack the flexibility often preferred by building occupants.
    b. Manually operating internal blinds are subjected to a wide range of possibilities caused by the building occupants and this diversity in effective use should be considered when evaluating the performance.
2. **Durability**. External shading devices are normally built to withstand the lifetime of the building and it is out of reach of accidental damages by building occupant. However, internal blinds are normally less durable and need to be replaced when damaged by normal wear and tear or by accidental damages by building occupants.

6mm Single Glazing					SHGC of Draperies, Roller Shades and Insect Screens					SHGC of Roller Shades and Insect Screens					
Ashrea ID	**Descriptions**	**VLT**	**SHGC glazing**	**LSG**	**Dark Closed Weave**	**Light Closed Weave**	**Dark Open Weave**	**Light Open Weave**	**Sheer**	**White Opaque**	**Dark Opaque**	**Light Gray Translucent**	**Dark Grey Translucent**	**Reflective White Opaque**	**Reflective White Translucent**
1b	Clear	88%	0.81	1.09	0.71	0.46	0.8	0.65	0.73	0.35	0.65	0.62	0.72	0.32	0.25
1d	Bronze	54%	0.62	0.87	0.74	0.55	0.82	0.71	0.77	0.47	0.69	0.68	0.76	0.45	0.39
1f	Green	76%	0.6	1.27	0.74	0.56	0.83	0.71	0.78	0.48	0.7	0.68	0.76	0.46	0.4
1h	Grey	46%	0.59	0.78	0.74	0.56	0.83	0.72	0.78	0.49	0.7	0.69	0.76	0.47	0.41
Low-e Double Glazing, e=0.02 on surface 2					**SHGC of Draperies, Roller Shades and Insect Screens**					**SHGC of Roller Shades and Insect Screens**					
Ashrea ID	**Descriptions**	**VLT**	**SHGC glazing**	**LSG**	**Dark Closed Weave**	**Light Closed Weave**	**Dark Open Weave**	**Light Open Weave**	**Sheer**	**White Opaque**	**Dark Opaque**	**Light Gray Translucent**	**Dark Grey Translucent**	**Reflective White Opaque**	**Reflective White Translucent**
25b	Clear	70%	0.37	1.89	0.89	0.72	0.93	0.82	0.86	0.66	0.86	0.83	0.89	0.61	0.57
25c	Bronze	42%	0.26	1.62	0.9	0.76	0.94	0.85	0.88	0.71	0.88	0.86	0.9	0.68	0.64
25d	Green	60%	0.31	1.94	0.9	0.76	0.94	0.84	0.88	0.7	0.88	0.85	0.9	0.67	0.62
25f	Blue	45%	0.27	1.67	0.9	0.76	0.94	0.84	0.88	0.72	0.87	0.85	0.9	0.66	0.62

Table 6.4.2.1: A Selection of Ashrae SHGC values of Internal Shades[2]

[2] 2009 Ashrae Fundamentals, F15, Fenestration, Table 13.

3. **View out.** Certain internal shading system may prevent view out of the building. View out of building is a very important aspect of visual quality in buildings. A building that does not provide adequate view out provides a very dull and trapped feeling for the building occupants.
4. **Brightness control.** Blackout blinds, translucent blinds, perforated blinds are some features that can be used to control brightness in building. When daylight is harvested, it become more important to ensure that the internal blind selected allowed the right amount of light into the space for daylight harvesting. Too little or too much light can cause a daylight harvesting feature for the building to fail during operation.
5. **Glare Protection.** Due to the bright cloudy skies found in tropical climate, internal shades are very well used in Malaysia for glare protection. It should also be highlighted that it is possible to provide glare protection while allowing daylight harvesting in building because these are two (2) different issues altogether. Refer to Chapter 4 for details.
6. **Thermal Comfort.** While immediate use of a dark coloured blind may bring instant thermal comfort temporarily, its dark colour properties will absorb solar heat and will eventually reach up to temperatures above 35°C even in an air-conditioned space. This hot blind will then increase the mean radiant temperature of the space, increasing thermal discomfort for the building occupants. Alternatively, a light coloured blind will reject a part the solar heat out of the window again and have lower eventual blind temperature. In addition, there are blinds with low-e (emissivity) properties that can be used to reduce mean radiant temperature from windows.
7. **Privacy.** Blinds that are translucent may provide daylight into space but may not meet the building occupant's privacy requirement. Carefully considerations need to be made to ensure that the privacy need of building occupants are met when using internal blinds to provide daylight into space.

___________________________________End of Chapter 6_______________________________________