A Study on Daylight Performance Through Various Complex Shading Devices in Kuala Lumpur, Malaysia

Introduction

- Malaysia receive great amount of daylight.
- However buildings, especially office buildings were designed more for outside appearance.
- Issue: designer/architect were not taking advantage of the amount of daylight as to reduce the use of electric energy.
- Supposedly; create image of Malaysian architecture while providing enough lighting; satisfactory visual comfort for the office worker and reduce energy usage.
- Natural light in working environment is important for health and safety, where feasible, but this should not include heat and glare.

Background

- Several researchers have promoted the idea of the design of sun shading suitable for the Malaysian climate.
- Three most common main shading device designs; horizontal, vertical and horizontal-vertical (egg-crate) shading device.
- The study by Ku Azhar (1996) indicates that an egg-crate shading device is generally effective in all orientations in protecting a window from solar radiation.
- Building with geometrical shading devices measured by Zuraini (2004) indicated that the interior daylighting condition ranged from underlit to very underlit.

Aim and Objectives

- To measure the daylight performance through the complex shading devices in Kuala Lumpur for working environment.
- To evaluate subjective response of the occupants that experiences the luminance level in related building; office.

Methodology

The study will focused on 3 case studies:

Building 1: Dewan Bandaraya Kuala Lumpur (DBKL) Building, Jalan Raja Laut, Kuala Lumpur

Building 2: Wisma Tek Lee, Jalan Tun Perak, Kuala Lumpur

Building 3: The Menara Multipurpose, Capital Square, Jalan Munshi Abdullah, Kuala Lumpur

Assessment methods:

- **Observation** (condition of office workers in the building with identified shading device)
- **Field measurement** (daylight illumination on workspace is measured)
- **Questionnaire survey** (to analyze office workers perception and satisfaction of the lighting condition)

Assessment on the lighting performances will be based on the recommended daylight illumination established by IESNA.

Building Type	Location	Average Daylight Factor (%)	Minimum Daylight Factor (%)	Glare Index	Illumination *(lux)*
General Office Building	General Offices	3	1.0	23	200 - 750
	Open Plan Area	5	2.5	19	300 - 500
	Staff Room	5	2.5	23	200 - 750

Result and Analysis

Case Study 1: Dewan Bandaraya Kuala Lumpur (DBKL) Building, Jalan Raja Laut, Kuala Lumpur

Building Image

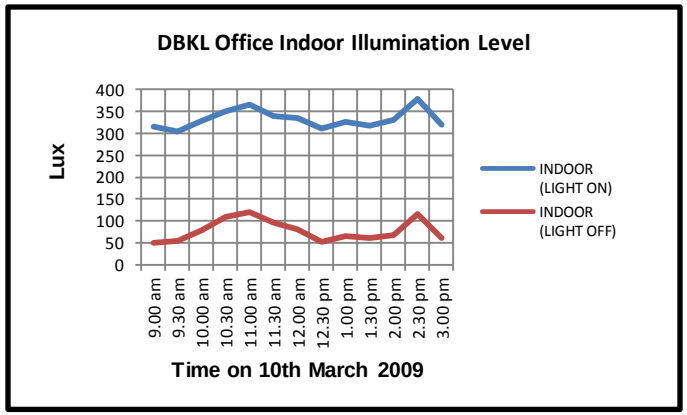
1- Observation

•Shading device: an angled horizontal slab with deeply recessed windows. Tinted glazing.

•Adequate daylight to light up workstations near window.

•Unfiltered excessive brightness from outside cause (unpleasant glares).

•Consequent: to use internal shading device (blinds) to reduce the unpleasant glare.

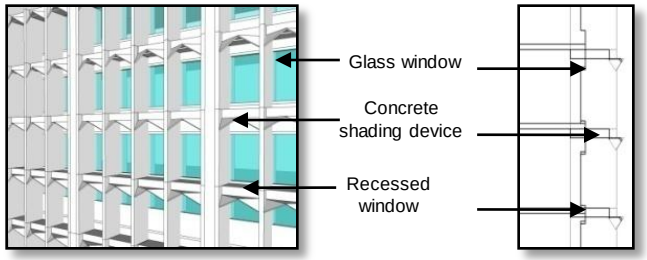


Daylight Illumination Level

2- Field Measurement (Illumination Level)

- Lowest indoor (+ electrical light); at 9.30am: 305 lux
- Highest indoor (+ electrical light); at 2.30pm: 379 lux
- Lowest indoor (daylight only); at 9.00am: 51 lux
- Highest indoor (daylight only); at 11.00am: 121 lux

Interior view



Structure of Sun- shading Device-Window

3- Questionnaire Survey

Q1: Satisfaction on glare (light on)

76%; no glare from electrical lighting

Q2: Satisfaction on glare (light off)

72%; can focus on their tasks

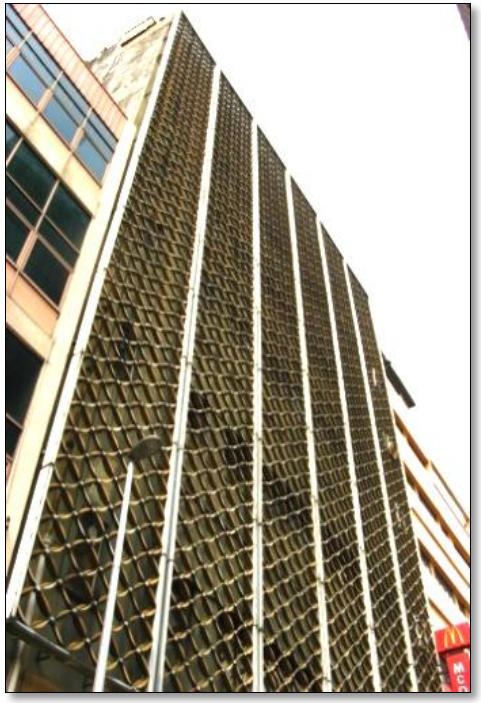
Q3: Satisfaction on brightness (light on)

80%; electrical lighting is adequate to help them doing their work

Q4: Satisfaction on brightness (light off)

76%; daylight did not help focusing on their task especially reading and writing.

Case Study 2: Wisma Tek Lee, Jalan Tun Perak, Kuala Lumpur

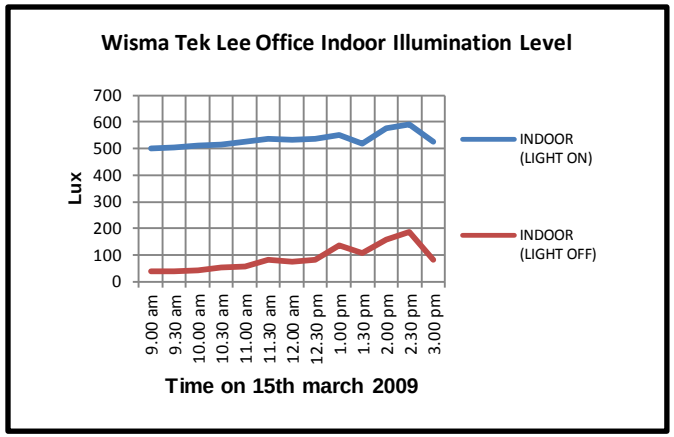


1- Observation

•Shading device: pineapple-skin shape - minimize the amount of daylight entering the window

•The proportion of the space divided by the shading patterns is important as the overall window proportion in determining the aesthetic effect of the fenestration.

•Glare was not obvious at the window but the contrast of light (light and shadow) on the computer screen create visual discomfort

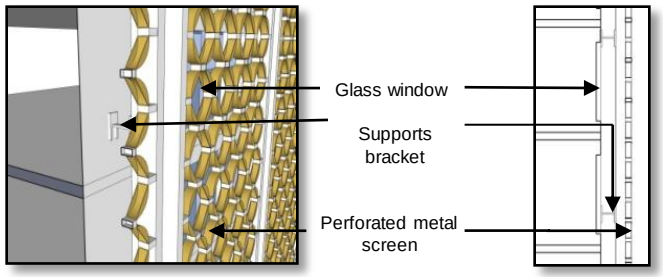


Daylight Illumination Level

2- Field Measurement (Illumination Level)

- Lowest indoor (+ electrical light); at 9.00am: 501 lux
- Highest indoor (+ electrical light); at 2.30pm: 590 lux
- Lowest indoor (daylight only); at 9.00am: 37 lux
- Highest indoor (daylight only); at 2.30pm: 206 lux

Interior view



Structure of Sun- shading Device-Window

3- Questionnaire Survey

Q1: Satisfaction on glare (light on)

84%; no distracting glare from artificial lighting

Q2: Satisfaction on glare (light off)

84%; intolerable glare from daylight - distract tasks

Q3: Satisfaction on brightness (light on)

88%; electrical lighting is adequate for doing tasks

Q4: Satisfaction on brightness (light off)

68%; daylight entering the working area is bright enough which helps their visual comfort on the tasks.

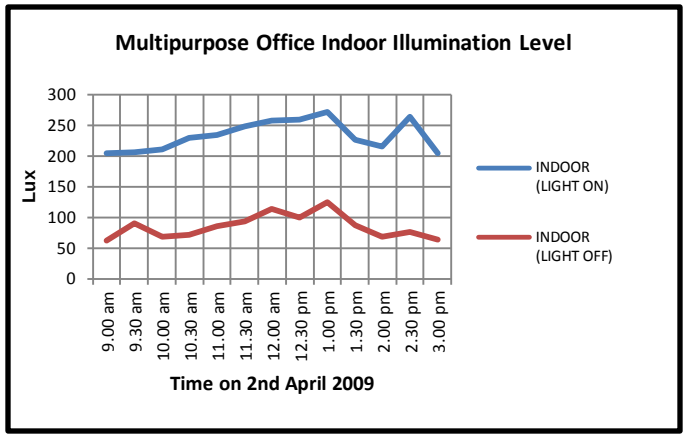
Case Study 3: The Menara Multipurpose, Capital Square, Jalan Munshi Abdullah, Kuala Lumpur

1- Observation

•The building is using quite deep and heavy egg-crate type of shading device all over its facades.

•The shading device is made of metal with slanted vertical and horizontal panel positioned in an angle.

•Both directions of slanted fins work together for optimum use of daylight.

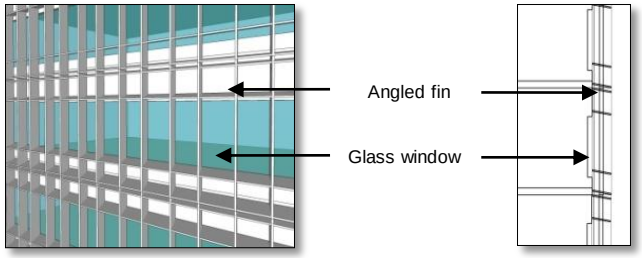


Daylight Illumination Level

2- Field Measurement (Illumination Level)

- Lowest indoor (+ electrical light); at 3.00pm: 204 lux
- Highest indoor (+ electrical light); at 1.00pm: 272 lux
- Lowest indoor (daylight only); at 9.00am: 63 lux
- Highest indoor (daylight only); at 1.00pm: 125 lux

Interior view



Structure of Sun- shading Device-Window

3- Questionnaire Survey

Q1: Satisfaction on glare (light on)

92%; pleasant artificial light when it is on

Q2: Satisfaction on glare (light off)

84%; tolerable glare - helps them in doing their tasks

Q3: Satisfaction on brightness (light on)

88%; electrical lighting is adequate

Q4: Satisfaction on brightness (light off)

76%; daylight only is not enough to help them doing their task especially reading and writing

Summary of Findings

Building	Sun Shading	Lowest-highest Daylight only (lux)	Lowest-highest with electrical lighting (lux)	Satisfaction level on the daylight performance	Existence of glare	Daylighting condition-Responding to Lighting Guideline
DBKL	Angled horizontal profile slab with vertical fins (concrete)	51 – 121	305 - 379	24%	no glare (daylight and electric lighting)	No
Wisma Tek Lee	Pineapple-skin	37 – 206	501 - 590	68%	glare from daylight distract workers' visual comfort	Yes for general office No for open plan office
Menara Multipurpose	Deep Egg-crate (metal fin)	63 – 125	204 - 272	24%	no glare (daylight and electric lighting)	No

Conclusion

- Daylight performance for all three case studies were considered low and underlit - low than the recommendation of open plan office - 300 lux.
- The lowest ranges is between 37lux to 63lux at all 3 case studies have made it difficult to do office task.
- Offices have to depend on electrical lighting for workers to perform their task and even meet with lighting guidelines.
- Investigation on workers perception - not really satisfied with the performance of daylight as glare has contributed to their visual discomfort while working.
- Out of 3 case studies, the 2nd case study –Wisma Tek Lee building may have potential to be developed and further studied due to the considerably appropriate amount of illumination during brightest day and more than 50% satisfied with the amount of daylight.

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