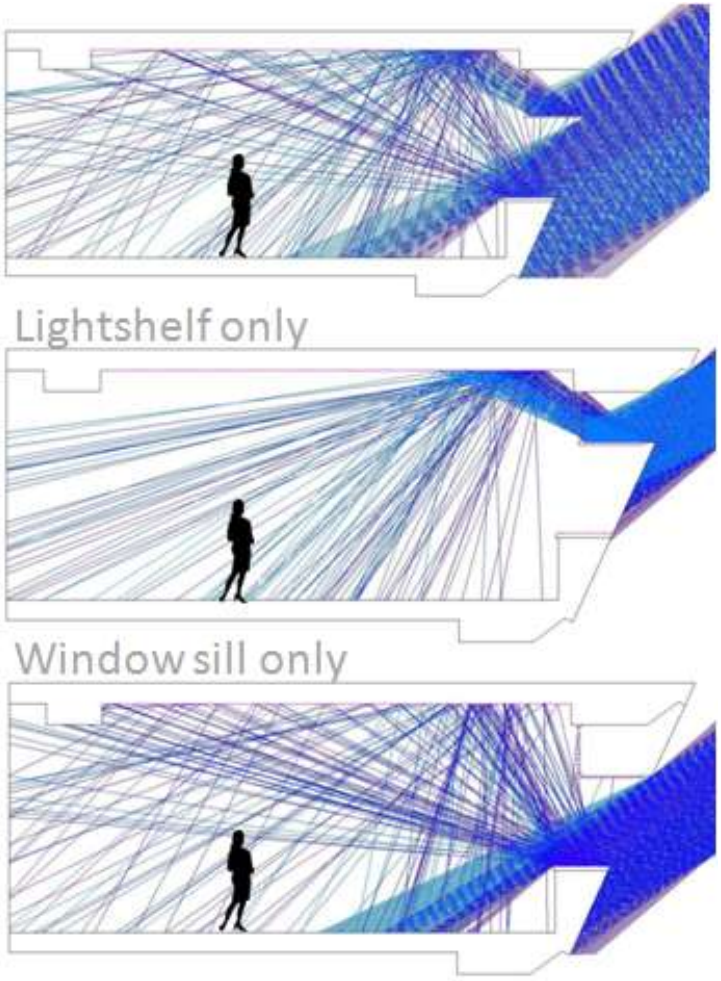
Application of Innovative Daylighting in High-rise Buildings (Malaysia)



Gregers Reimann

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Singapore | Malaysia | China

Contents

1. Successful existing daylit tropical office buildings

2. Innovative daylight design for tropical high-rise offices

3. New daylight technologies

Remember, we are in a part of the world where the sun is the enemy, and not a friend.

Case study no. 1

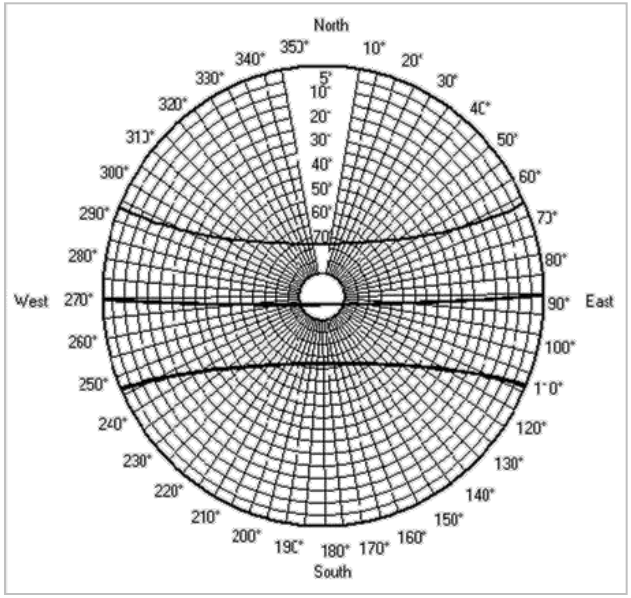
Energy Efficient Office case study in Bangi:

GEO BUILDING

(MALAYSIA, 2007)

Good Orientation for Daylighting

Solar chart for Kuala Lumpur (3.15° North)



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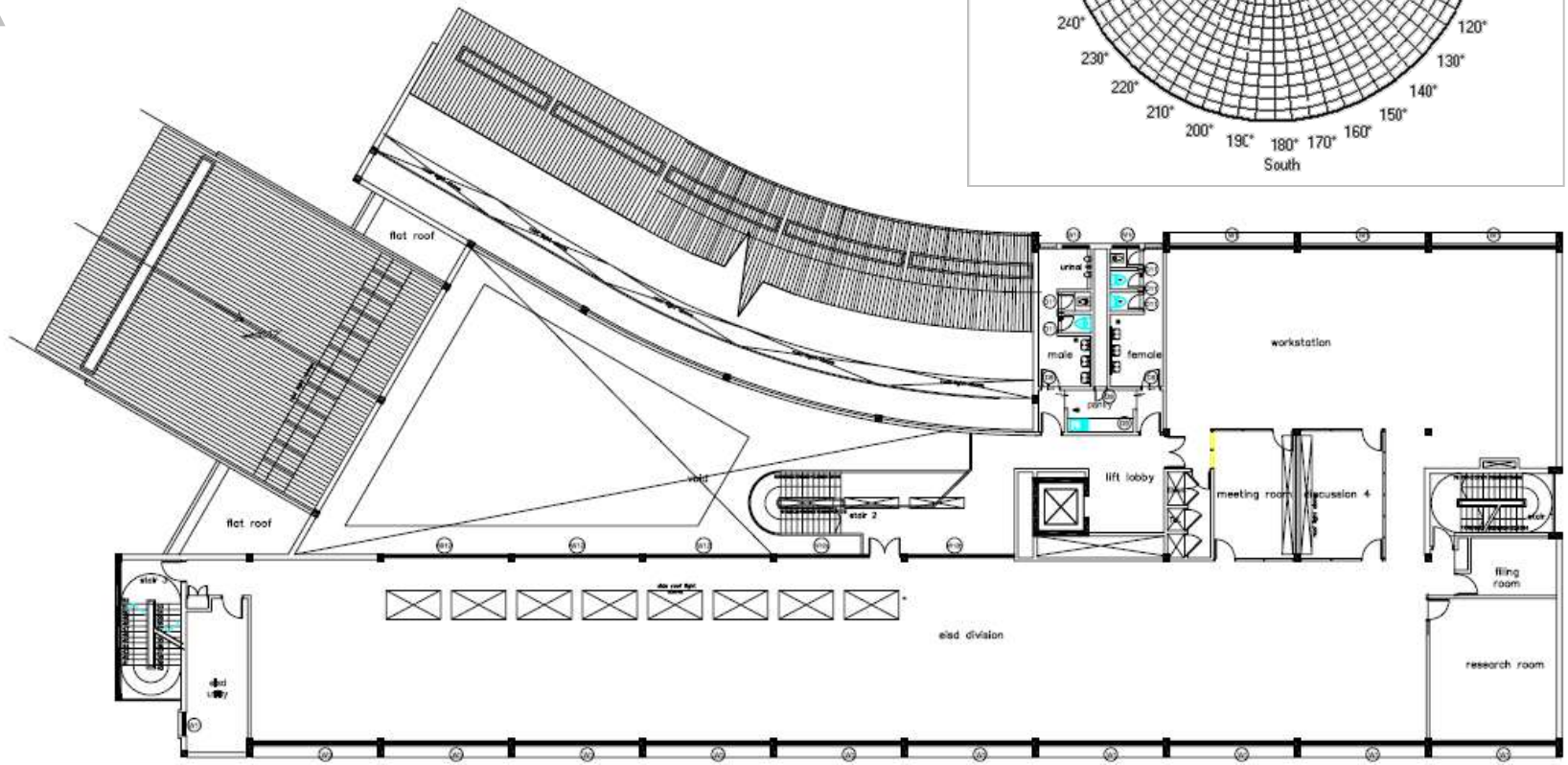
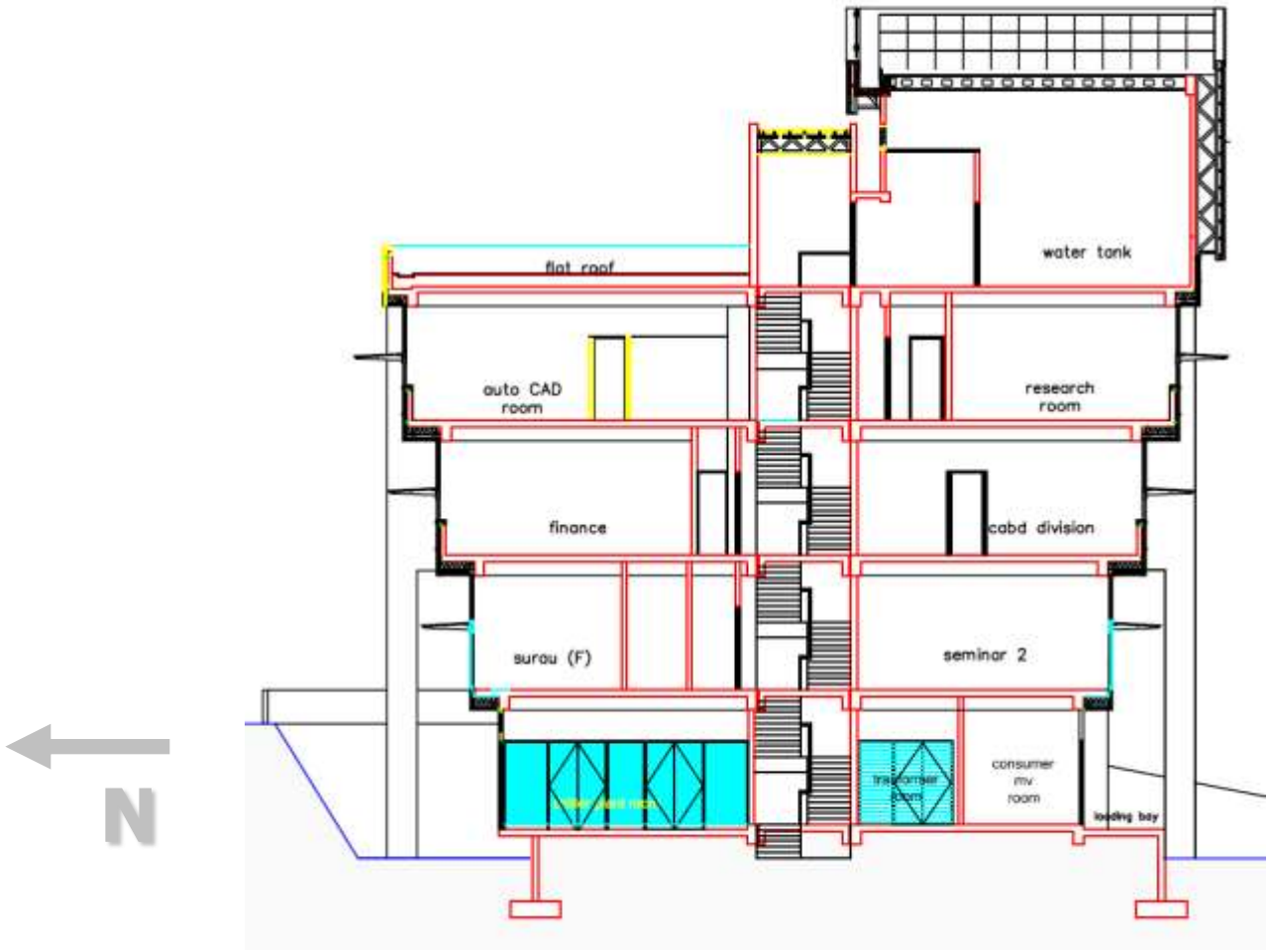


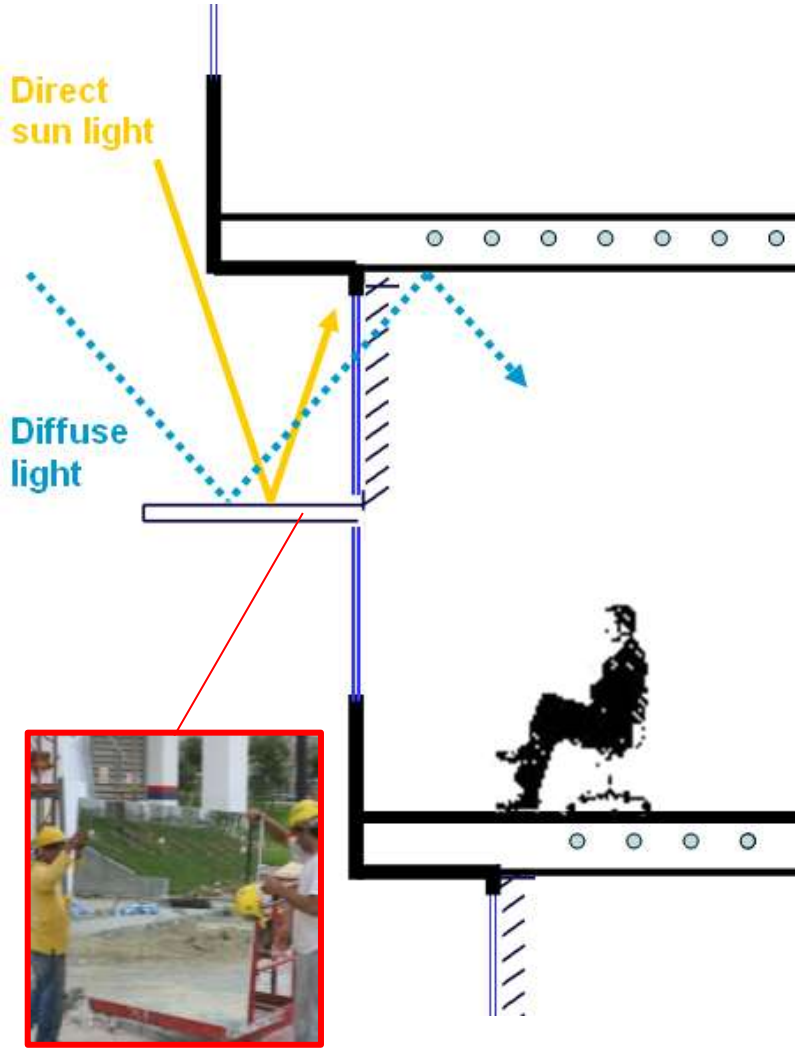
Step-in Design (Self-Shading)



Daylight Facade with Mirror Lightshelves

MIRROR LIGHTSHELVES:

Direct Sunlight Cut Off, Only Diffuse Light Enters Rooms



Mirror lightshelf

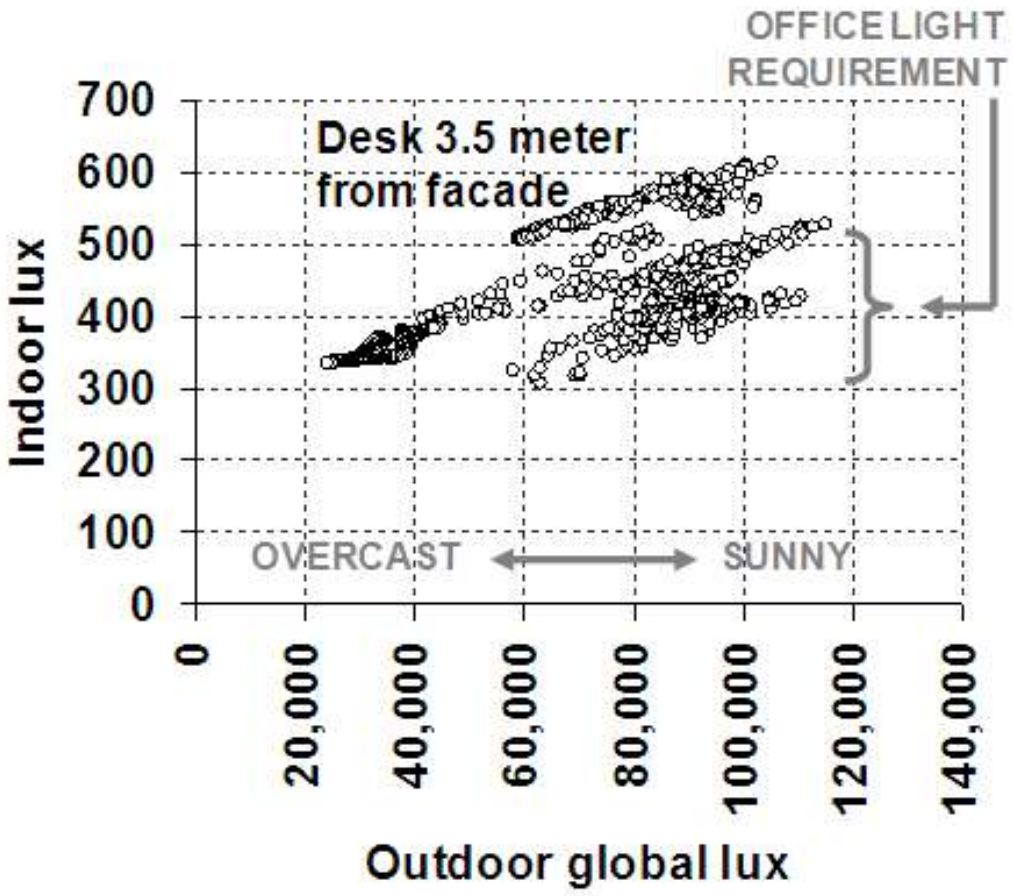
Photo taken on 12 June 2007 (North facade)

Split Window Design with Fixed Blind inside Double-Glazed Unit

Blind encapsulated in double glazing, no maintenance needed. Looks as good as new after seven years and counting….!

Semi-specular tannenbaum reflector in the ceiling. Maintains inward light reflection without causing glare to the occupants. Translucent cubicle walls parallel to the façade ensures daylight passage to table top.

Daylight & Lighting Energy Measurements



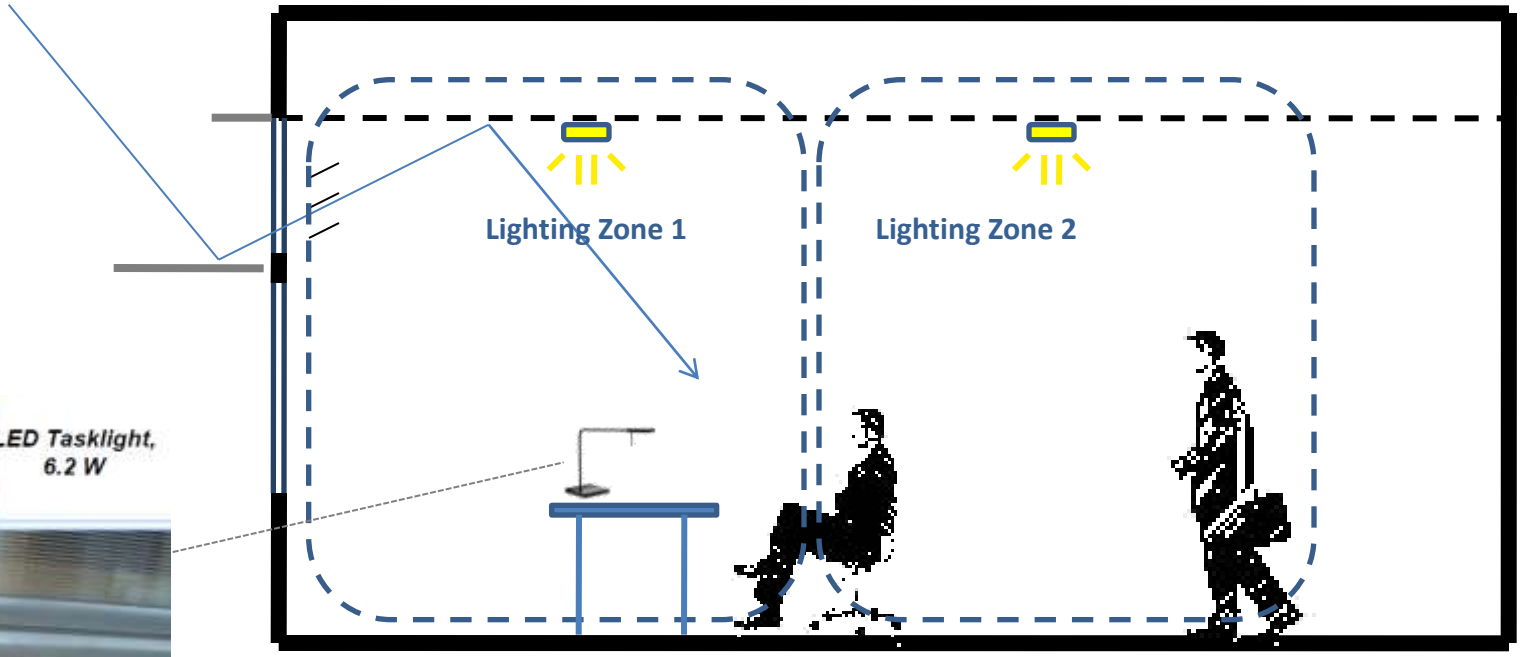
1. Occupants prefer working in daylight
2. Electrical lighting consumption is 25 times lower than the code requirement


Daylight design by IEN Consultants

Measured lighting consumption during office hours is only **0.56 W/m²** (or 0.052 W/square foot) based on 6 months data

Daylight Responsive Lighting Control

Works really well in conjuction with task lighting



Lighting Control

- Automatic off (light sensor and/or occupancy sensor)
- Manual on (people press the wall switch)
- Individually controlled task light (table lamp)

Transparent / Transluscent Walls Parallel Not to Block Daylight
+ No Suspended Ceiling with Slab Cooling (high 3.6 m floor to ceiling height)

Roof Lights taking in diffuse soft daylight from the North

Transparent PV atrium roof

- PV sandwiched in low-e glass
- 13% transparent area

Daylight factor in atrium about 1 – 1.5%

Nice light pattern through PV atrium roof

Case study no. 2

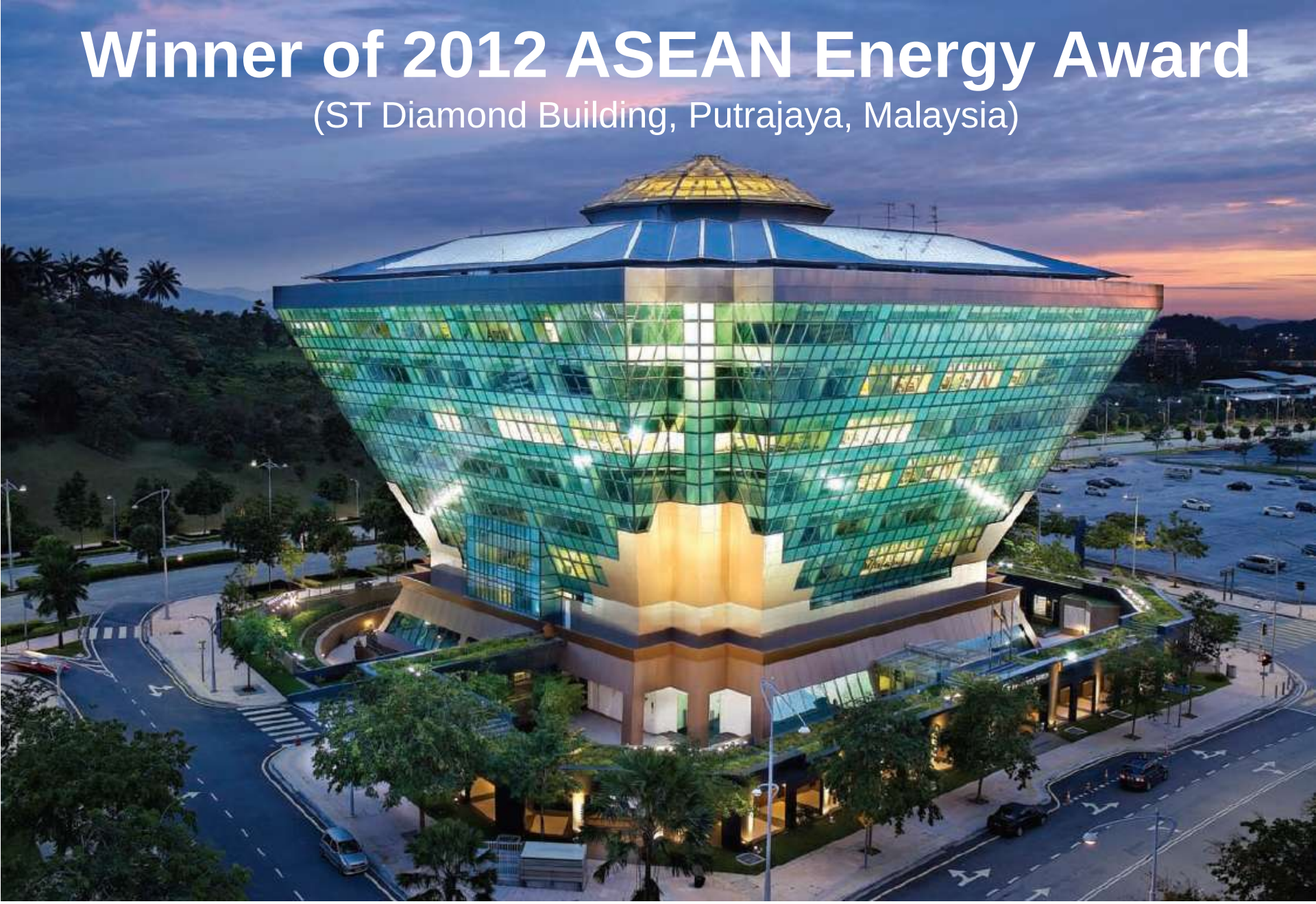
Green Office case study in Putrajaya:

DIAMOND BUILDING

(MALAYSIA, 2010)

Winner of 2012 ASEAN Energy Award

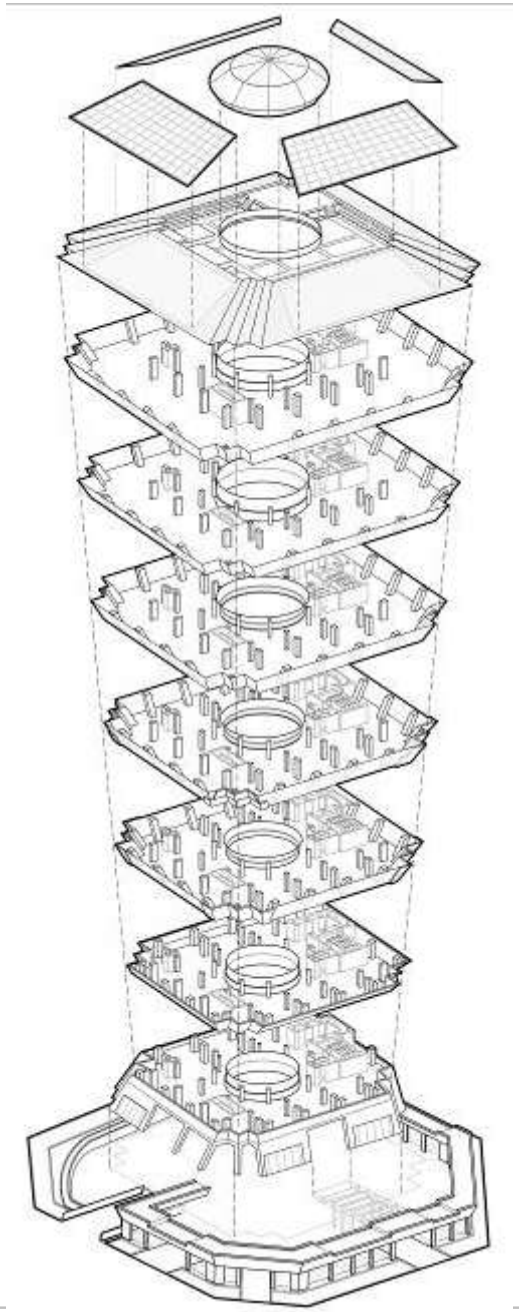
(ST Diamond Building, Putrajaya, Malaysia)

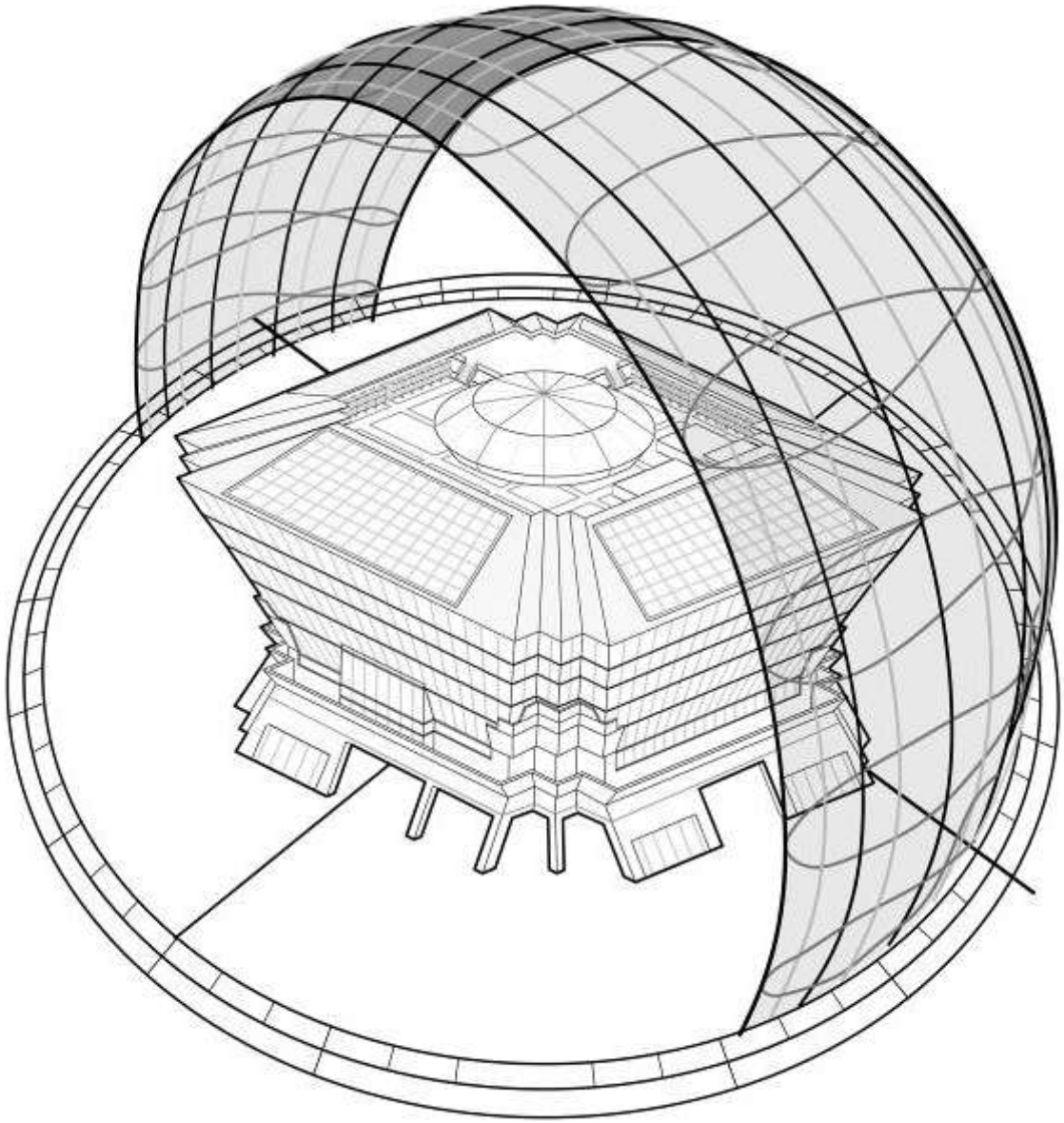


I|E|N CONSULTANTS

Architects: Soontorn Boonyatikarn (Thailand)
and NR Architect (Malaysia)
Energy efficiency and sustainability: IEN Consultants

Mechanical & Electrical: Primetech Engineers
Contractor: Putra Perdana Construction
Client: Malaysian Energy Commission

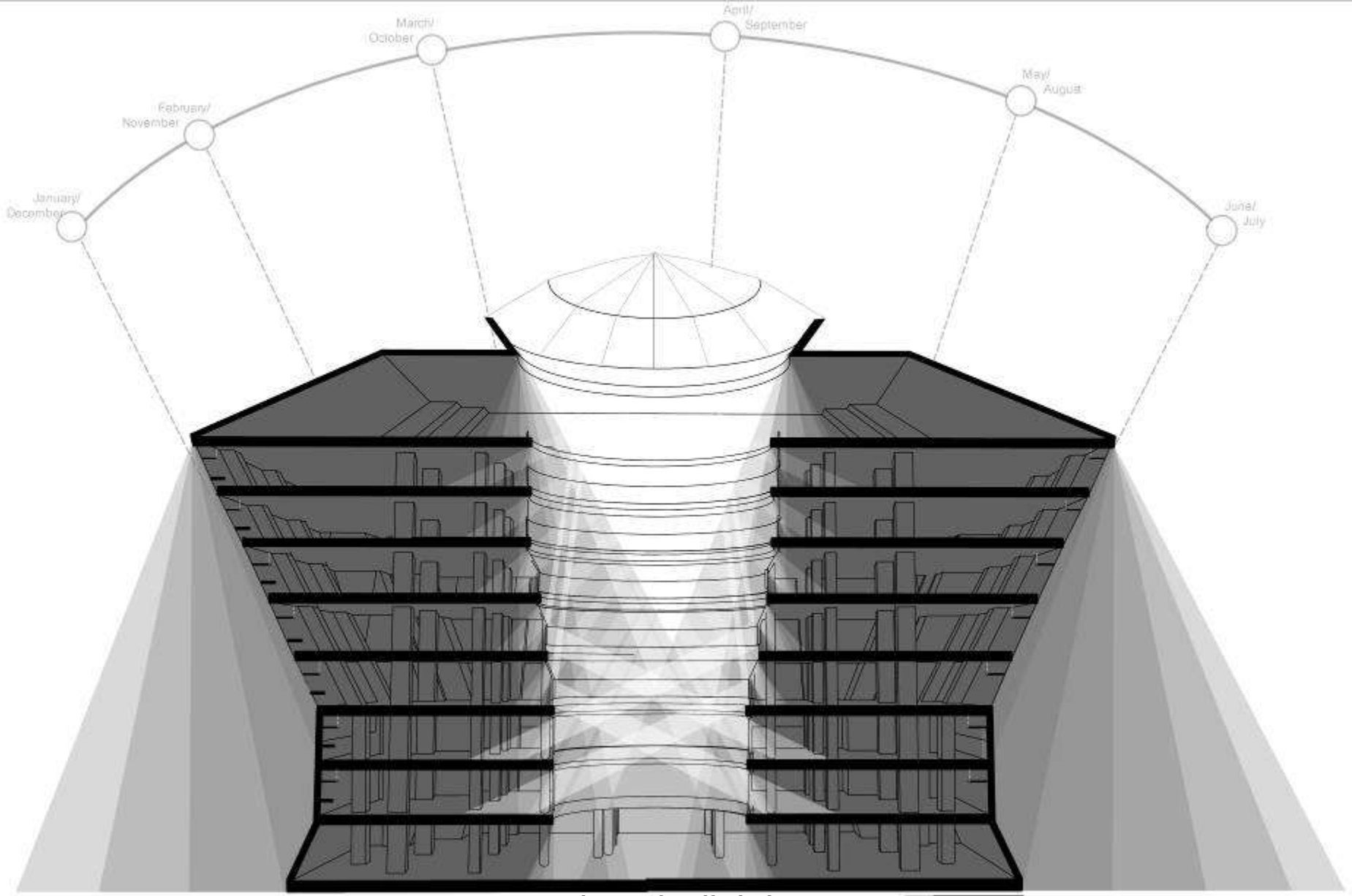




Self-shading facades

I|E|N CONSULTANTS

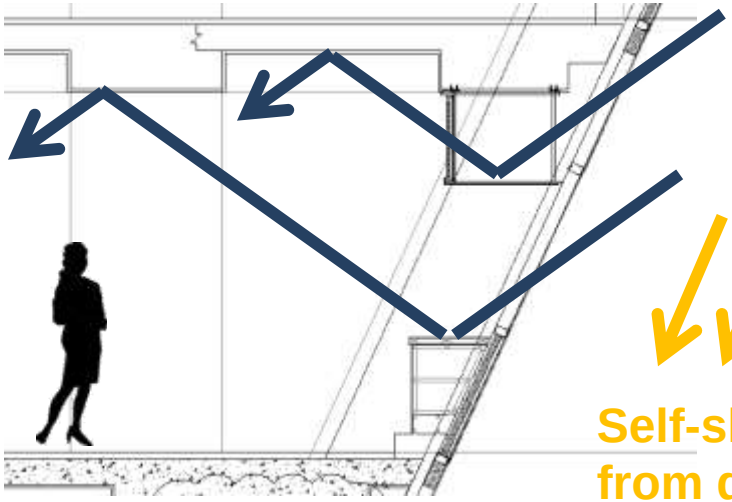
Source: Greening Asia – Emerging Principles for Sustainable Architecture.



Atrium daylighting

I|E|N CONSULTANTS

FACADE

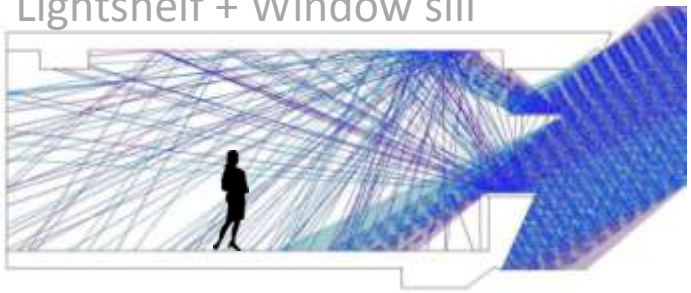


Diffuse light deflected into room by lightshelf and window sill

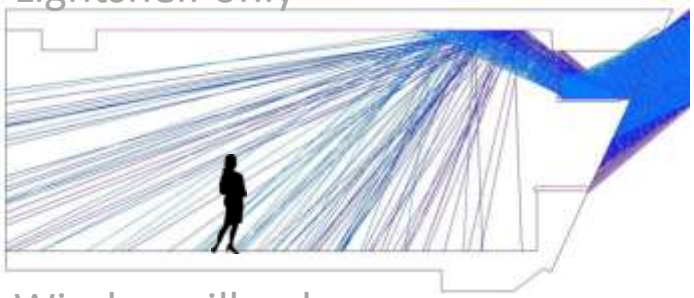
Self-shaded facade from direct sun

LIGHT REFLECTIONS FROM:

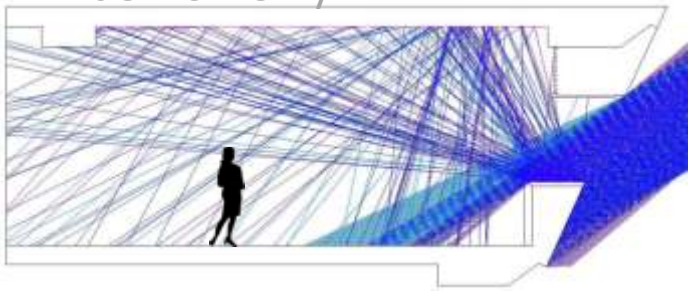
Lightshelf + Window sill



Lightshelf only



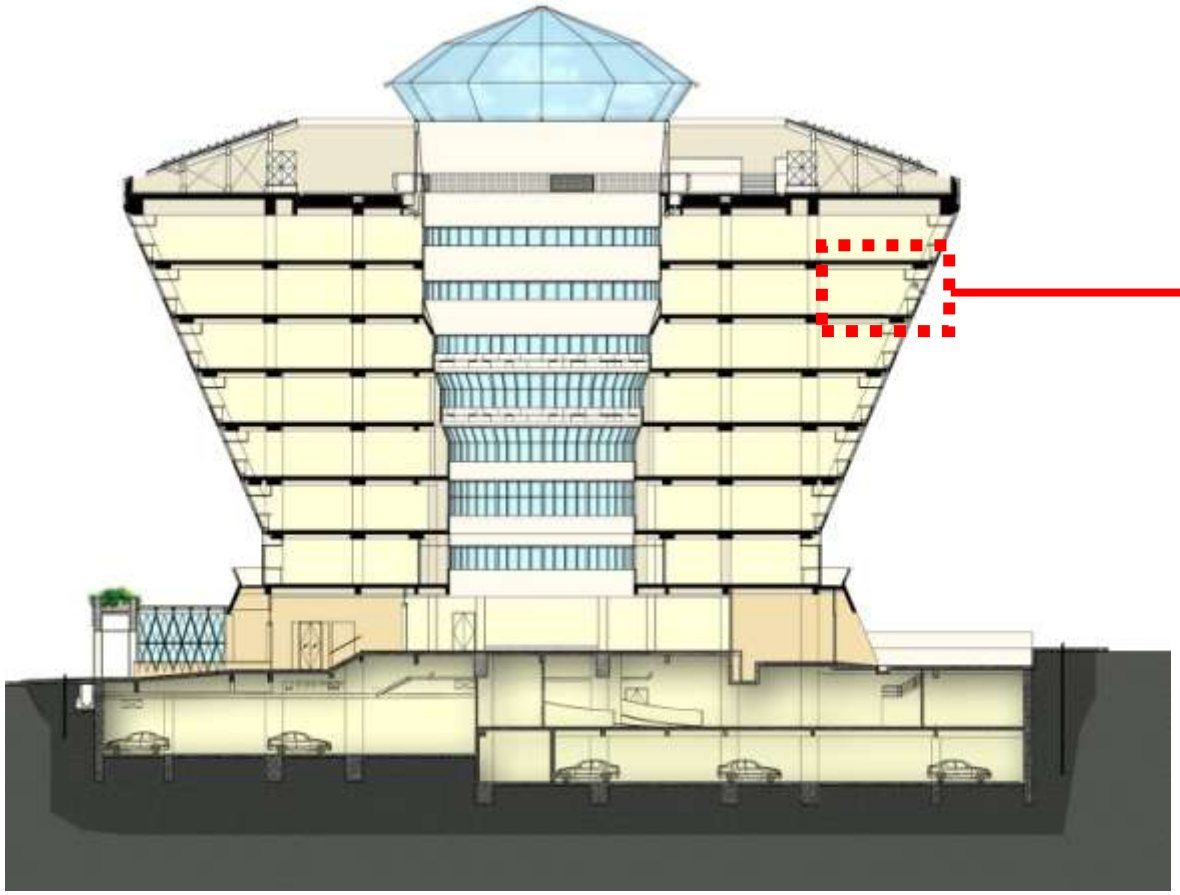
Window sill only



Façade Daylight Design

The building is 50% daylit. The façade daylighting system consists of a mirror lightshelf and a white painted window sill. Both deflect daylight onto the white ceiling for improved daylight distribution until 5 meters from the façade + 2 additional meters of corridor space. Installed office lighting is 8.4 W/m2, but 1-year measurements show consumption of only **0.9 W/m2** showing high reliance on daylighting

Day-Lighting- Office



Mirror lightshelf

Fixed blinds for glare control

Daylight reflected onto ceiling

Case study no. 3

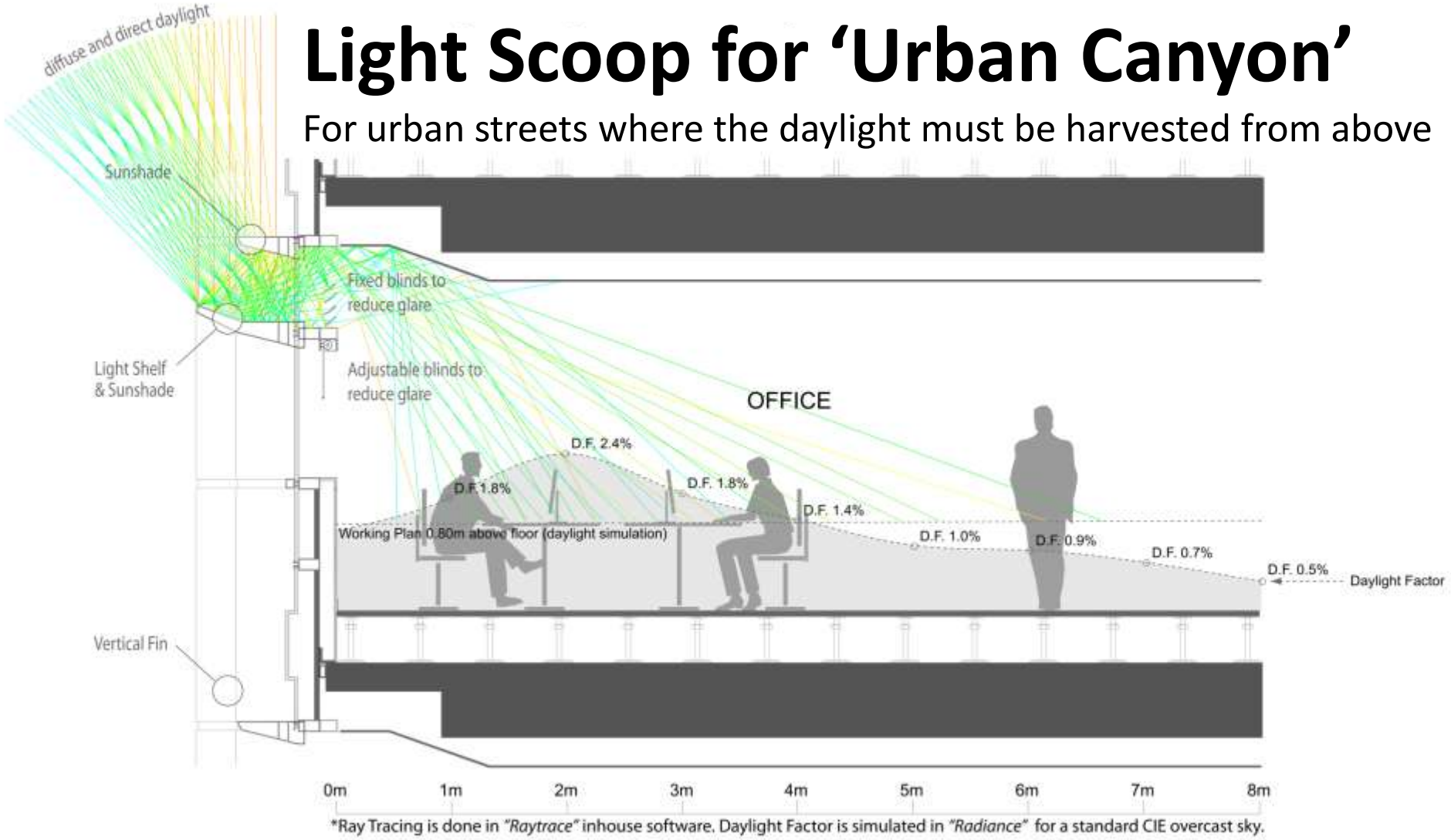
Facade daylighting scoop system for ’urban canyon’

PUBLIC MUTUAL BANK TOWER

(KUALA LUMPUR, 2016)

Light Scoop for ‘Urban Canyon’

For urban streets where the daylight must be harvested from above



*Ray Tracing is done in *"Raytrace"* inhouse software. Daylight Factor is simulated in *"Radiance"* for a standard CIE overcast sky.

On an average day: Daylight Factor of 1.0% = more than 300 lux from 11am to 4pm
Daylight Factor of 0.5% = more than 200 lux from Noon to 3pm

Ongoing project in Kuala Lumpur, completion 2016

Case study no. 4

Innovative daylighting facade for high-rise building

MMK OFFICE TOWER

(KUALA LUMPUR, 2015)

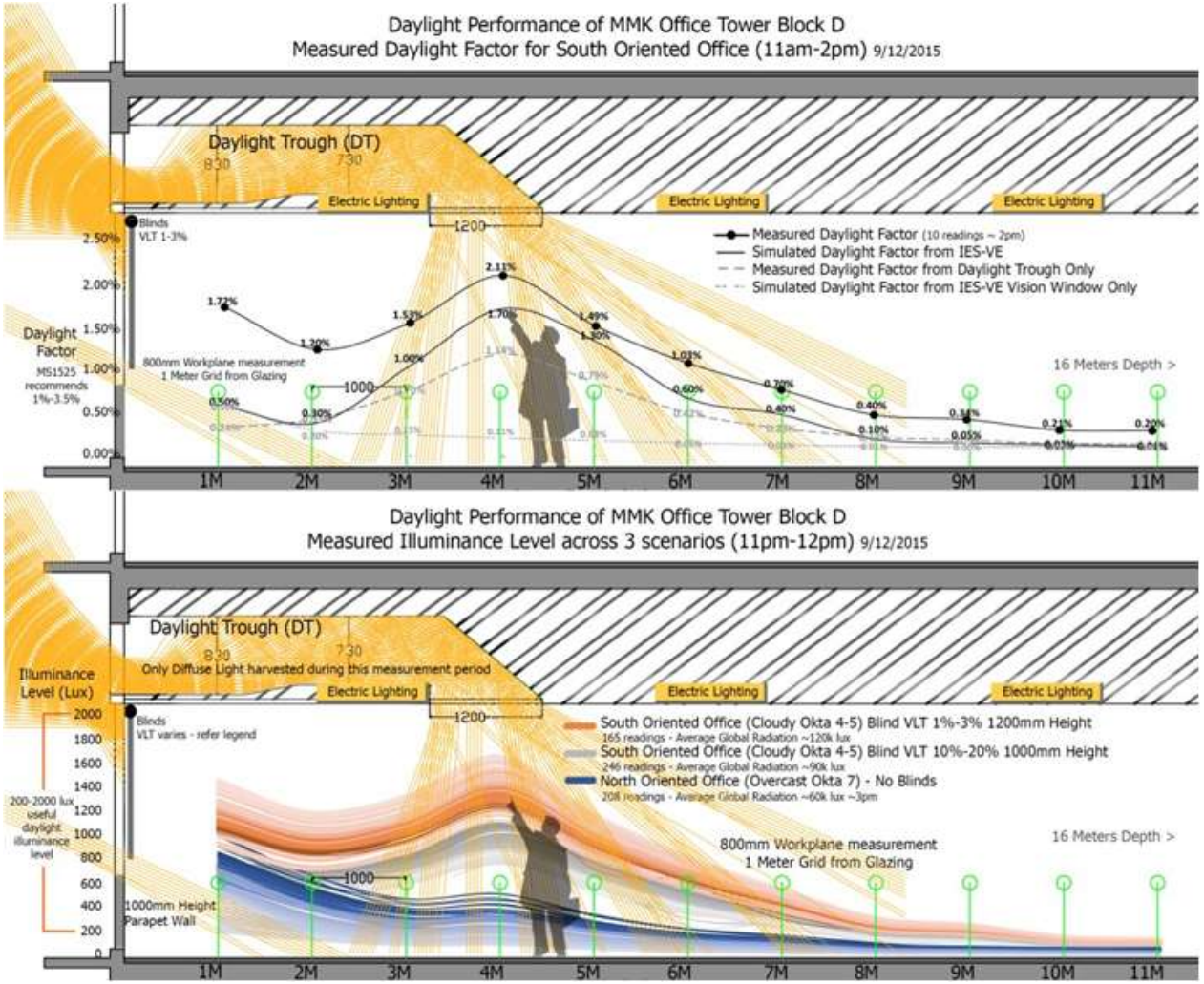
Innovative façade daylighting

The MMK high rise office tower @ Damansara Perdana, Malaysia

Video of Daylight Trough

Short video of the daylighting system installed above the suspended ceiling (play)

7 meters daylight with blinds down

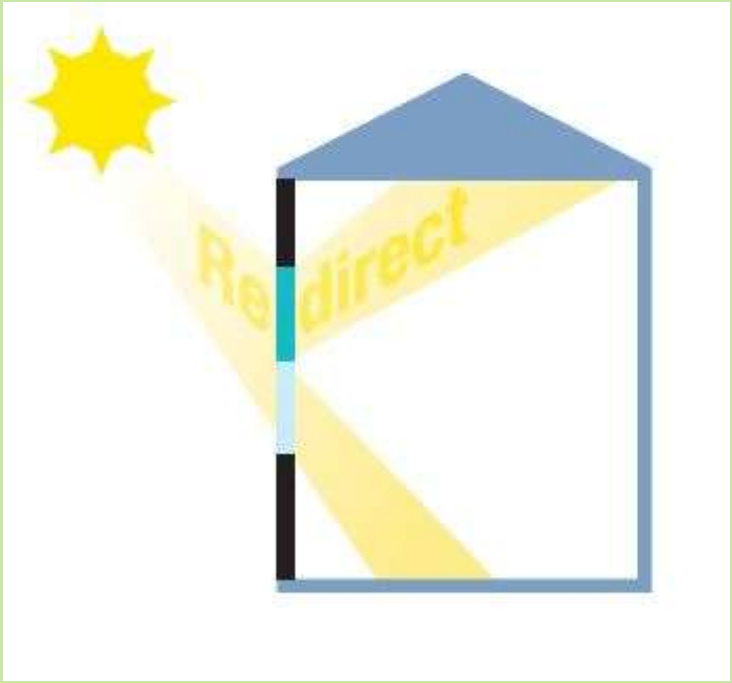


Daylight design by IEN Consultants

Measured daylight show that the first **7 meters** can be daylit, even when the blinds are fully engaged

Note: Building not yet occupied, so measurements done without any furniture

Case study no. 5



Innovative daylighting technology

REDIRECTING DAYLIGHT FILMS

(TEST INSTALLATION @ IEN OFFICE, 2015)

Window film instead of Lightshelf

This will solve the maintenance issue lightshelf cleaning

IEN CONSULTANTS

Photo from IEN Consultants office (Kuala Lumpur)
Test installation of two films from USA (3M) and from Taiwan

Window film instead of Lightshelf

Light redirection still effective with upward tilted venetian blinds

Photo from IEN Consultants office (Kuala Lumpur)
Test installation of two films from USA (3M) and from Taiwan

The Case for Daylighting

Our findings show that:

- People want daylighting
- Offices with daylighting are marketable
- Misconception that daylighting is hot, when it is actually the coolest light source
- Daylit spaces increase productivity and well-being of people

Let's avoid this!

Building in Taiwan

Good daylight design:

- Control solar heat gain
- Rely on diffuse daylight, not direct sunlight
- Control glare from direct sun and overcast sky
- Make indoor daylight distribution more uniform
- For offices, a daylight factor of 0.5 – 3.5% is appropriate

Thank you

How I commute in Kuala Lumpur
(video link)

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Singapore | Malaysia | China

Appendix slides

Energy Efficiency consultancy

Senior Consultant curriculum

Nationality: Danish
Language Skills: EN | DA
Based in: Kuala Lumpur, Malaysia

Education:
•MSc Energy Engineering (Technical University of Denmark)

Gregers REIMANN

Roles: **Energy Efficiency Consultant**

Gregers is the managing director of IEN Consultants, the pioneering green building consultancy in Malaysia, with offices in Singapore as well as China. He specialises in building designs that have good daylighting, are highly energy efficient and have excellent thermal and visual comfort.

Key project references during his 10 years of working in Asia include the Setia City Mall (first green certified shopping mall in Malaysia), the new IKEA in Kuala Lumpur (ongoing), ST Diamond Building (2012 ASEAN Energy Award winner) and the GEO Building designed to be a zero energy office building. Other green projects include the KLIA2 airport terminal, the KL Eco City, the Pertamina Energy Tower – the first skyscraper designed to be ZERO energy – and energy efficiency building retrofit works incl. daylight retrofitting of the Asian Development Bank in Manila.

Gregers has also been a technical reviewer for the EU Energy-Efficiency Buildings project and is newly appointed Chairman of the “Energy Efficient Buildings” committee under the EU-Malaysian Chambers of Commerce and Industries (EUMCCI).

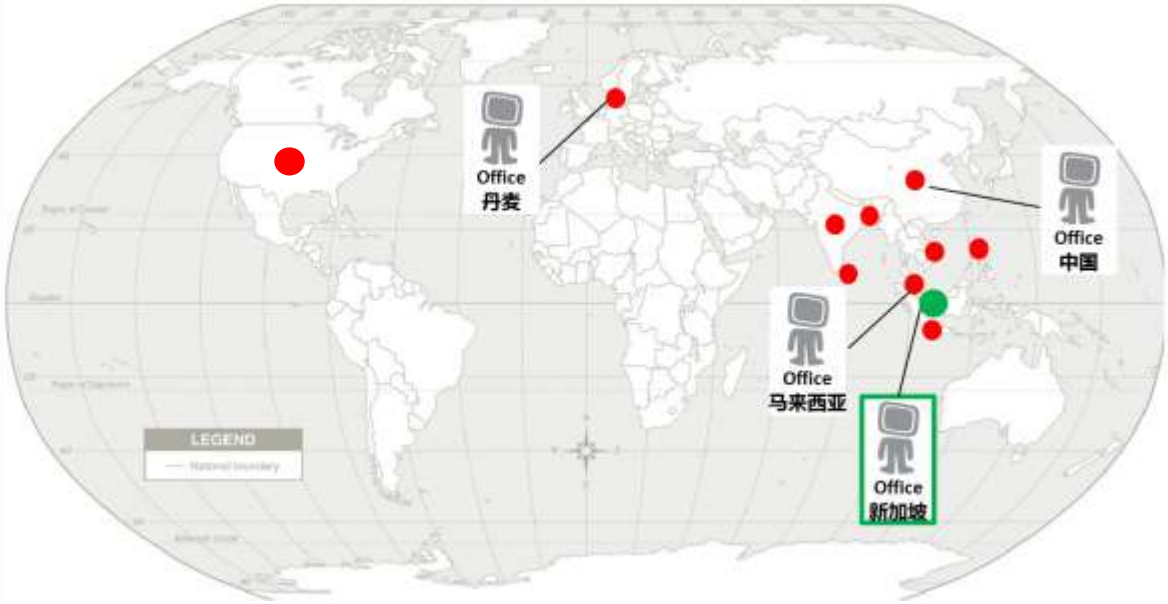
Gregers regularly contributes to green building articles and frequently guest lectures at universities internationally. He has a keen interest to pursue innovative and integrated design solutions bridging the gap between architects and engineers. Gregers is also ‘walking the talk’ with respect to green living habits, which includes commuting to work by a foldable electric bicycle that combines easily with public transport.

IEN Consultants

3.2 million square meters
of green building space

Gregers (MD) Poul (Founder)

Malaysia | Singapore | China



IEN Consultants Expert Staff

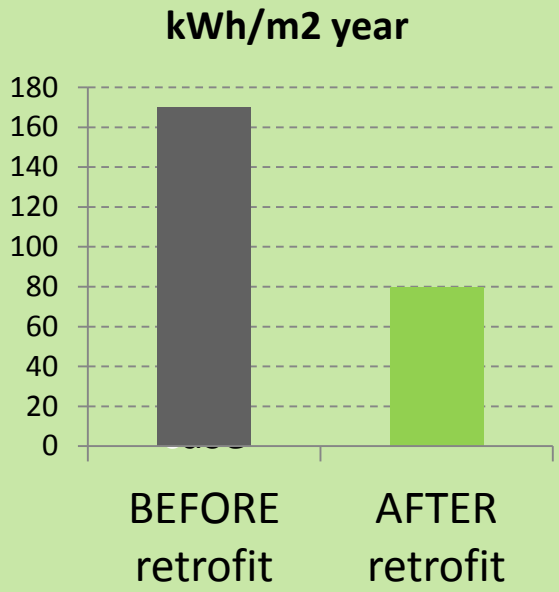
IEN Consultants

Hover the cursor over a person's head to see a short presentation and click to see a detailed personal description or click on a name in the list below.

We are a diverse group of individuals

5 different degrees
6 different nationalities
4 LEED AP
8 GBI Facilitators

Case study no. 3

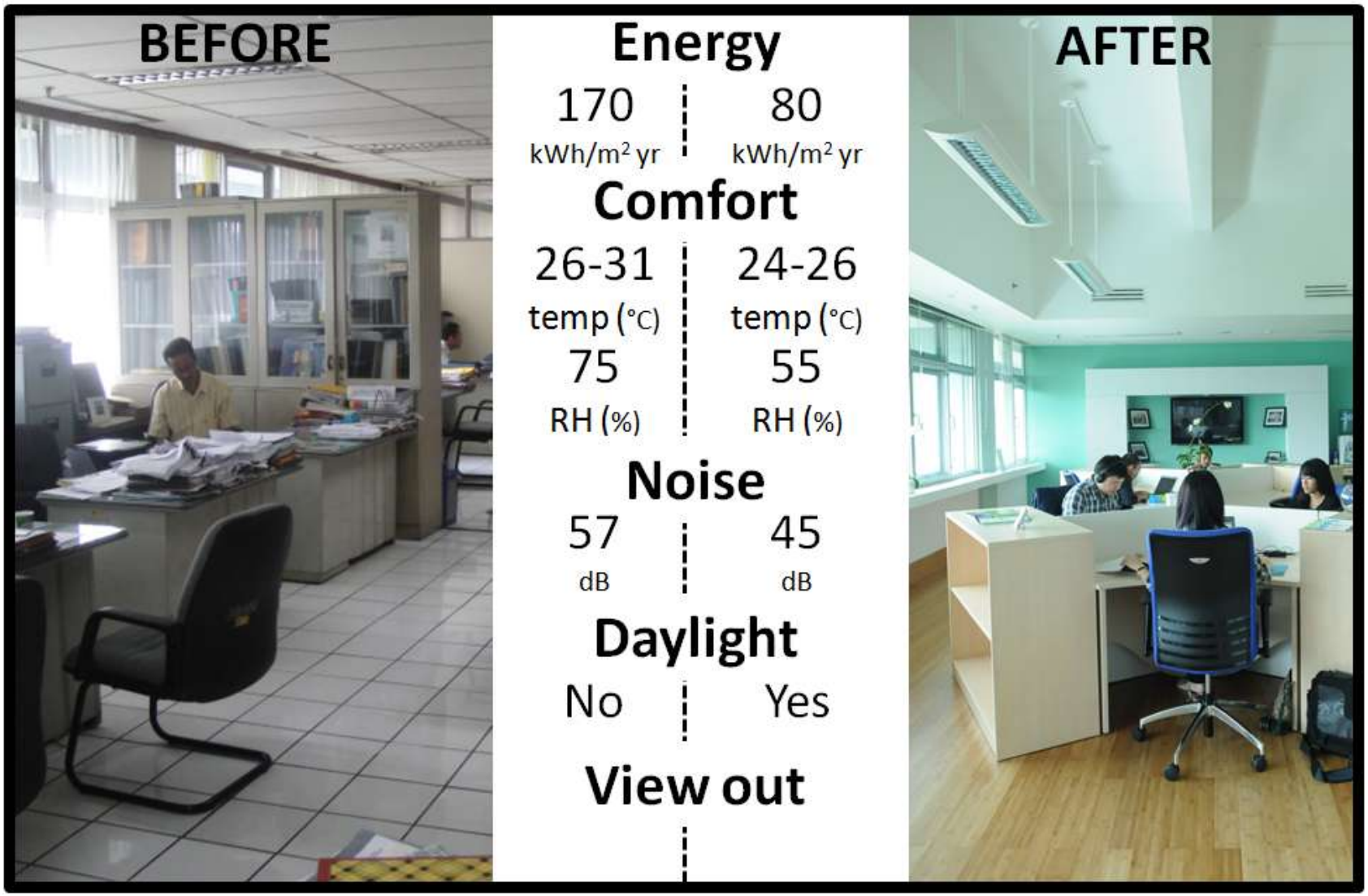


Energy Efficient Retrofit case study

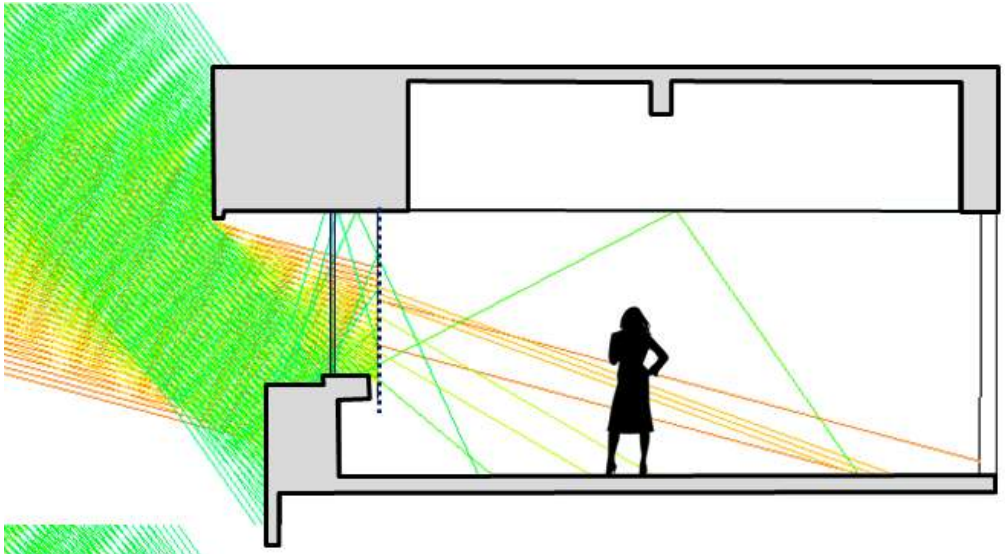
EECCHI OFFICE RETROFIT

(JAKARTA, 2011)

53% Measured Energy Savings

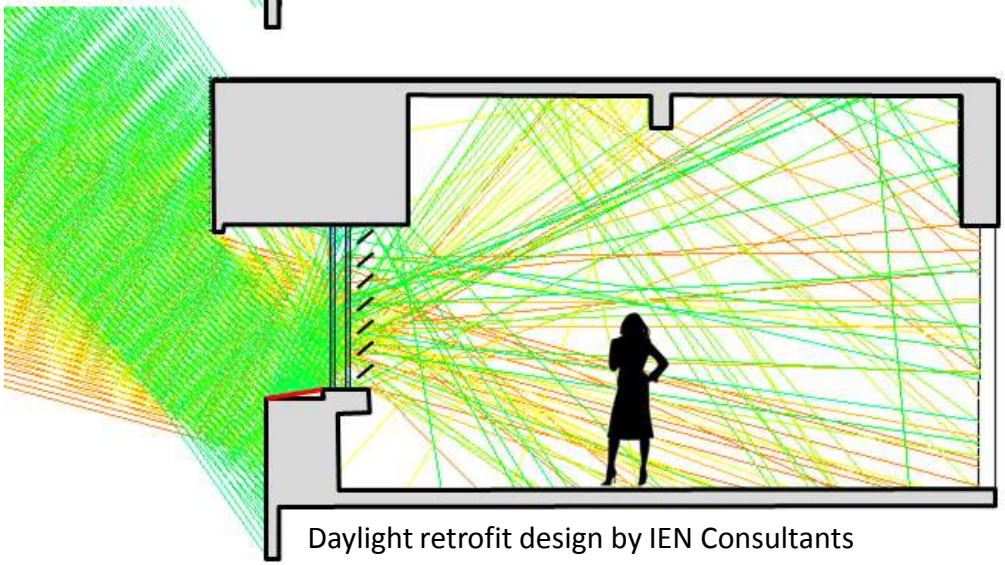


Retrofit & Improved Thermal Comfort



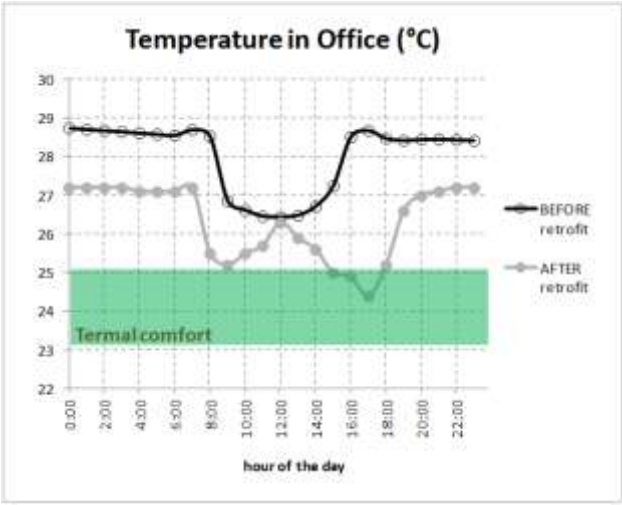
BEFORE RETROFIT

- Vertical blinds blocking most of the daylight
- Suspended ceiling



AFTER RETROFIT

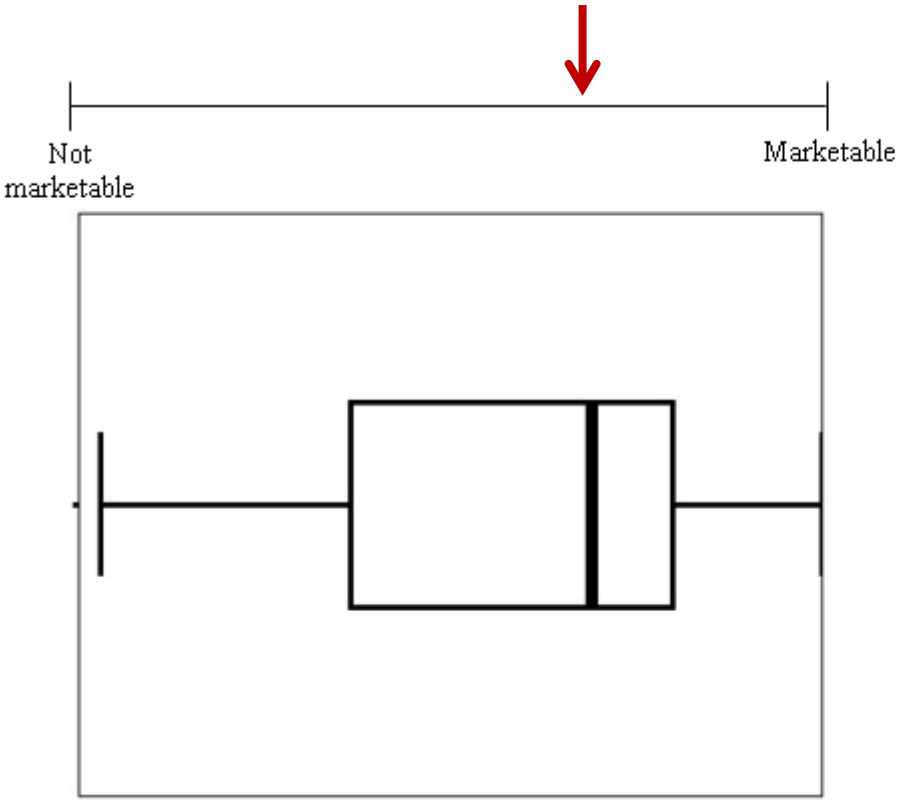
- Mirror lightshelf on external ledge reflecting diffuse daylight onto the high ceiling (suspended ceiling removed)
- Perforate venetian blinds
- Extra window pane



Daylight retrofit design by IEN Consultants

Are daylit offices marketable? **YES**

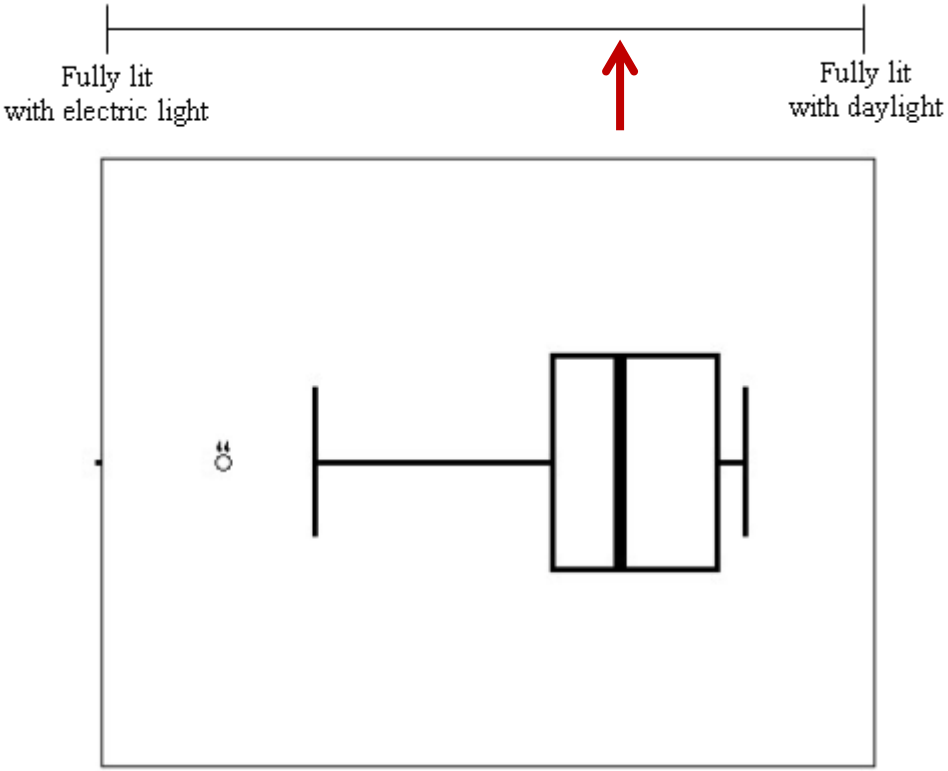
Would a **fully day lit office concept with supplementary electric lighting for heavily overcast days** be marketable to tenants?



Survey among 46 building professionals in Singapore (by Gregers Reimann)

Do people prefer daylit offices? **YES**

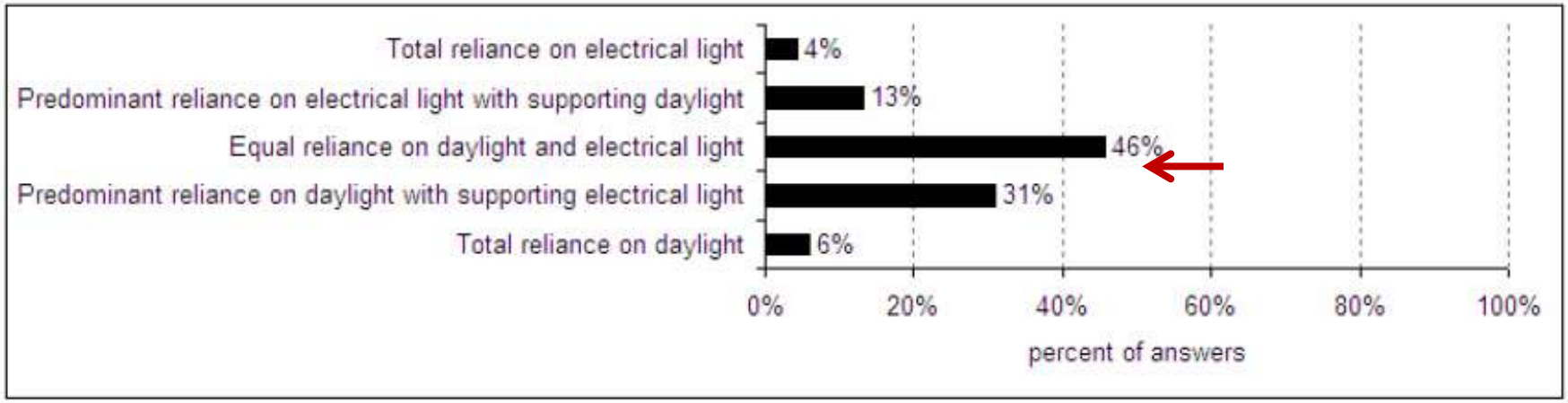
Suppose daylight can be controlled just like electrical lighting. If this is the case, please indicate how you believe **a typical office worker** would prefer to have his work place lit:



Survey among 46 building professionals in Singapore
(by Gregers Reimann)

Do people prefer daylit offices? **YES**

"Regarding the balance between electrical and natural light, which do you prefer?".



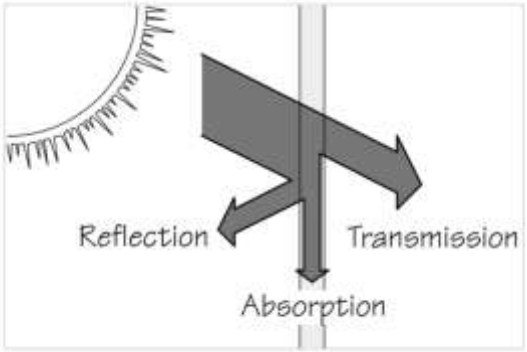
Survey among 569 office building occupant in Manila, Philippines (by Gregers Reimann)

MISCONCEPTION that daylight is ”hot”

- Daylight through normal glazing is **2.6 times cooler** than people think

- Daylight through high performance glazing is **4.9 times cooler** than people think

Solar Light interacting with Glazing



Reflection(%) + Transmission(%) + Absorption(%) = 100%

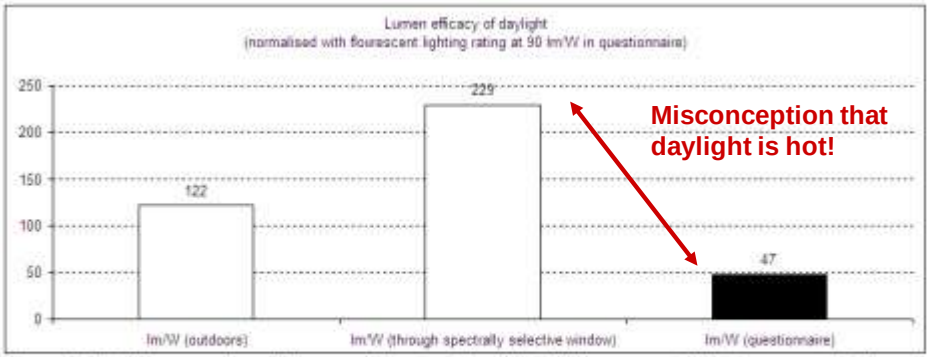
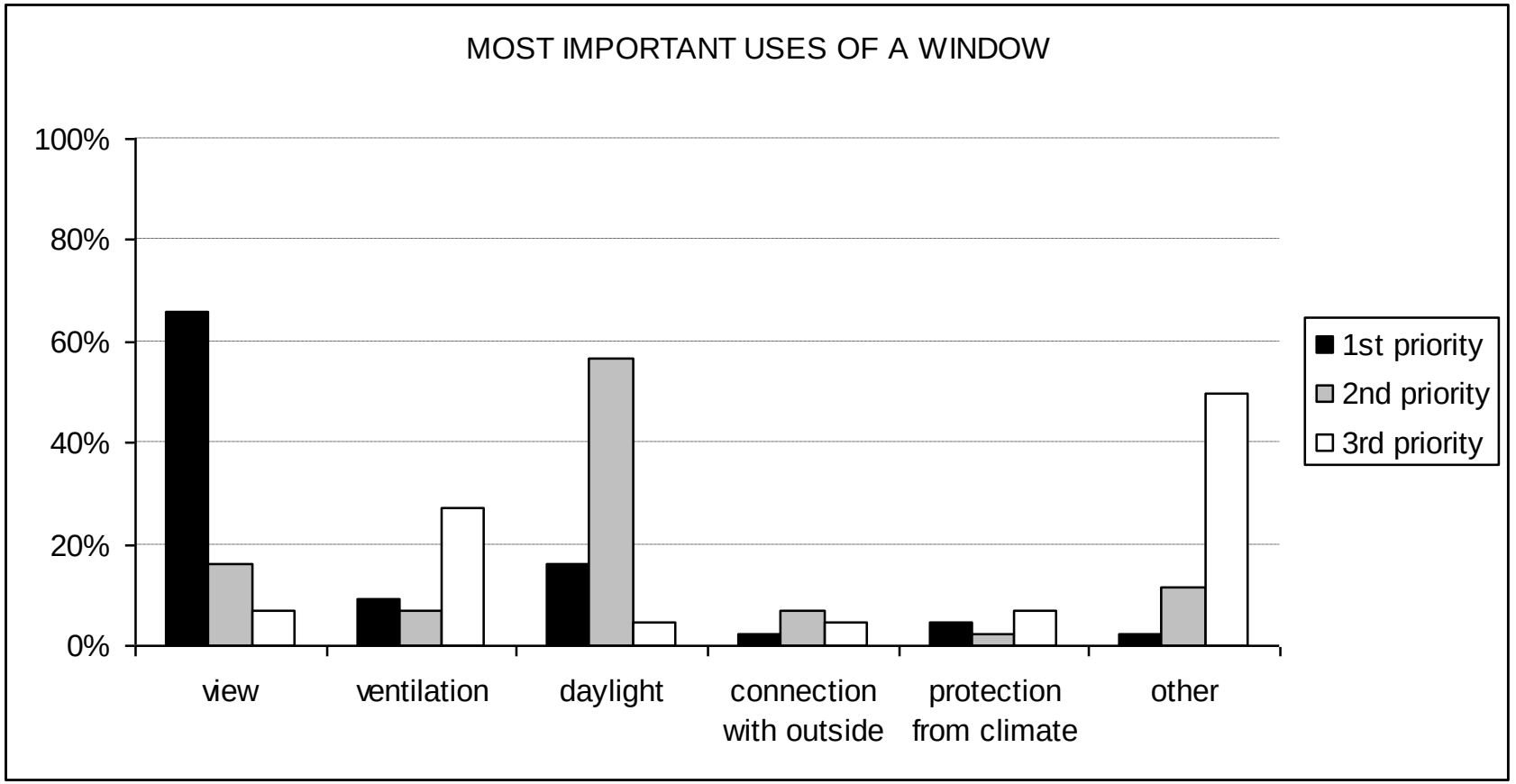


Figure 4.15: Misconception of lumen efficacy of daylight. If fluorescent light is assumed to have a lumen efficacy of 90 lm/W then the lumen efficacy of daylight was set to 47 lm/W, while in reality it is 160% higher at 122 lm/W (outdoors) or almost 400% higher at 229 lm/W when coming through a spectrally selective window.

Survey among 46 building professionals in Singapore (by Gregers Reimann)

What do people want from the window?
VIEW and **DAYLIGHT**



Survey among 46 building professionals in Singapore (by Gregers Reimann)