Case Studies of Energy Efficiency Driving the Operations of Green Buildings

Case Studies: Office buildings | Industrial buildings | New & Retrofits

Gregers Reimann

Managing director, IEN Consultants
Energy Efficiency & Green Building Consultancy

gregers@ien.com.my | +60122755630
Singapore | Malaysia | China

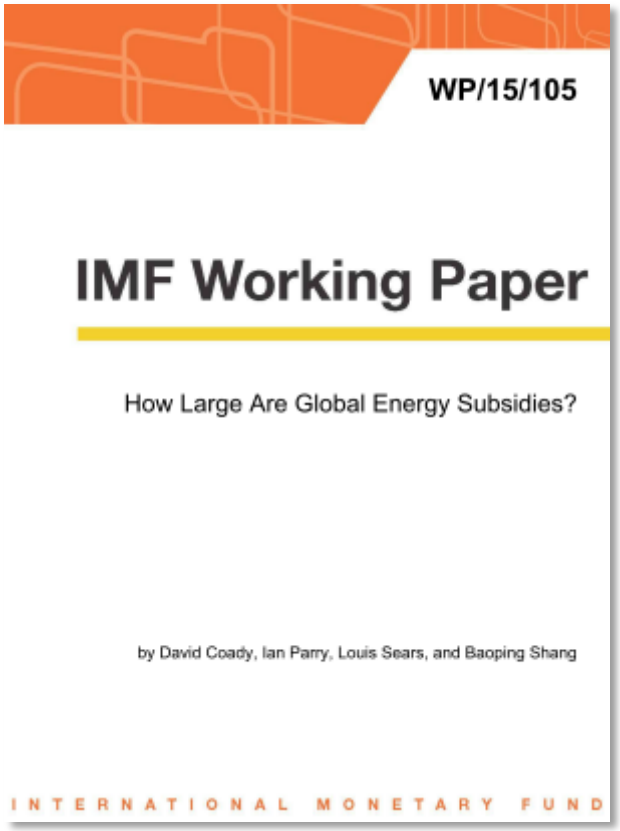
Key Barrier to Energy Efficiency:

Energy is Too Cheap

The annual 'hidden cost' of Fossil Fuels is:

USD5.3 trillion

corresponding to
6.5% of the global GDP



International Monetary Fund report (2015)

Nevertheless,
People Already Want Lower Energy Bills

Cartoon of a real conversation I had when explaining my job as Energy Efficiency Consultant

The Star newspaper, Malaysia, 16 August 2013

Buildings & Energy

Buildings are like a leaky bucket with lots of unnecessary wastages

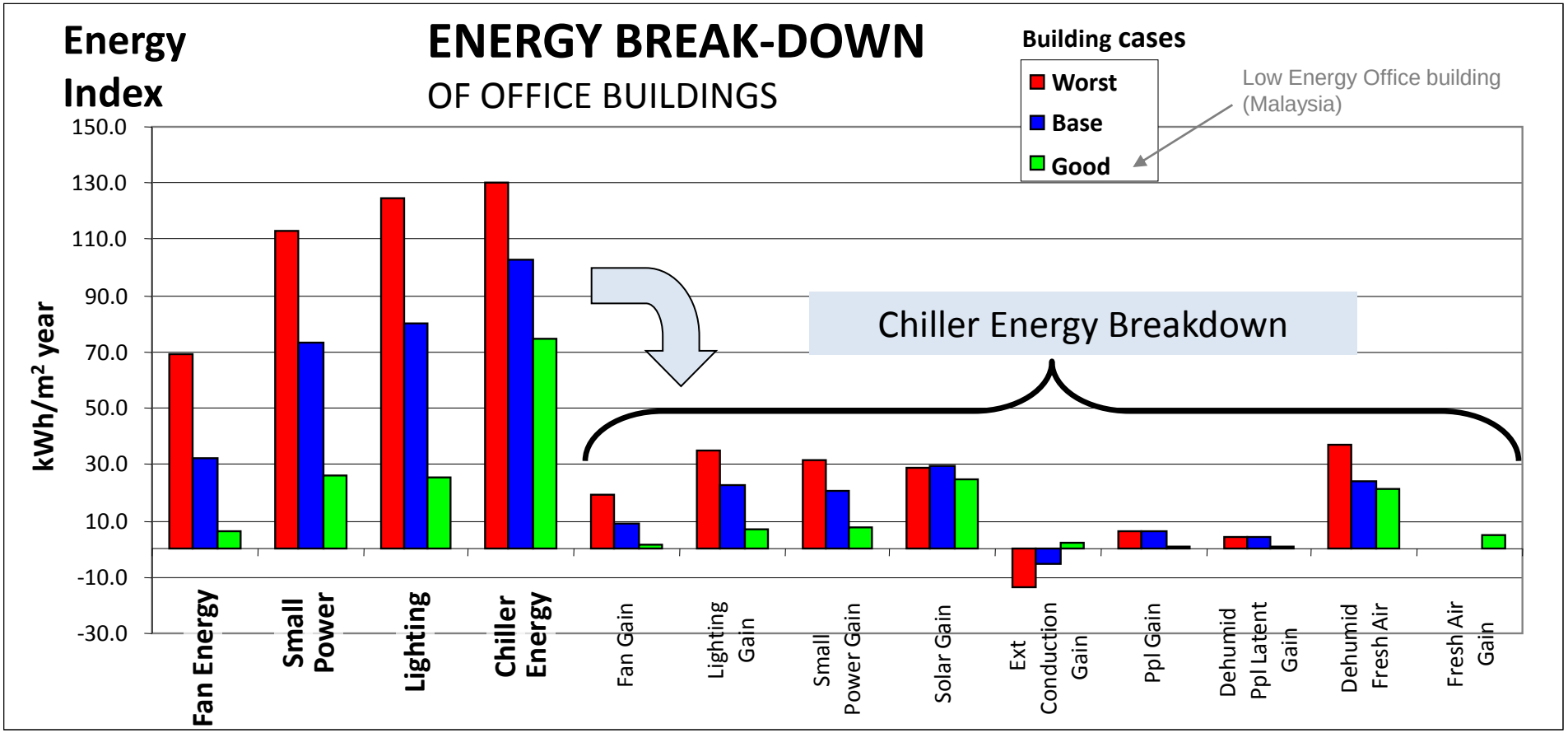
ENERGY SUPPLY
(renewable) energy

ENERGY STORAGE
electric cars/batteries/thermal

ENERGY DEMAND

Let's plug the holes!

Ask not just for an energy efficient cooling system, but also **“Why do I need cooling in the first place?”**



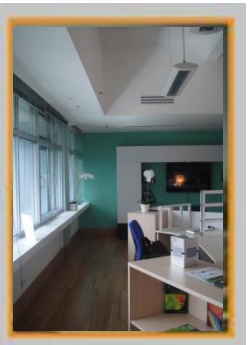
Energy Efficient Buildings with Good Payback time

Case studies from the South East Asian countries

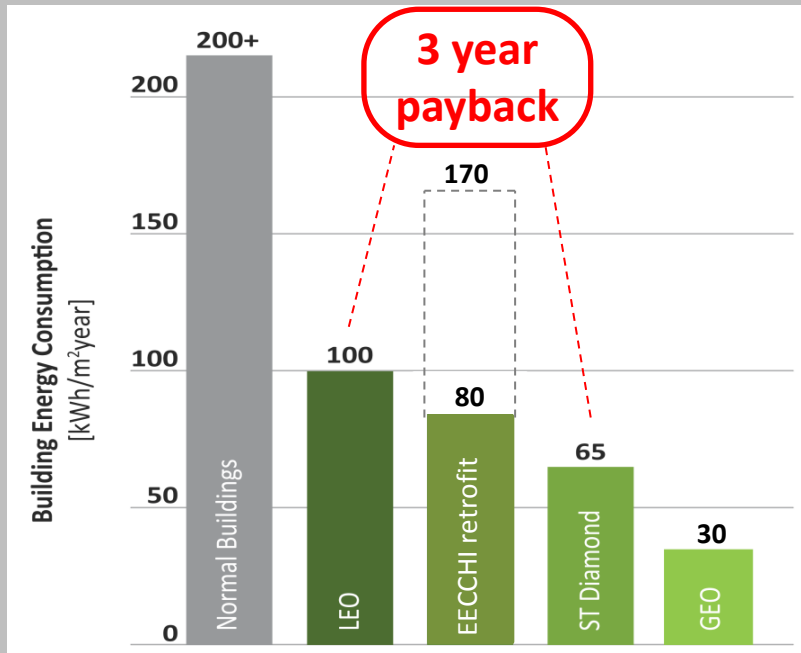
LEO Building

GEO Building

ST Diamond Building



EECCHI retrofit



Energy Consumption of Green Office Buildings

Measured data for New and Retrofitted Buildings by IEN Consultants

Completed year:	**2004**	**2010**	**2010**	**2007**
Low energy bill (2017):	**yes**	**?**	**yes**	**yes**

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Case study no. 1

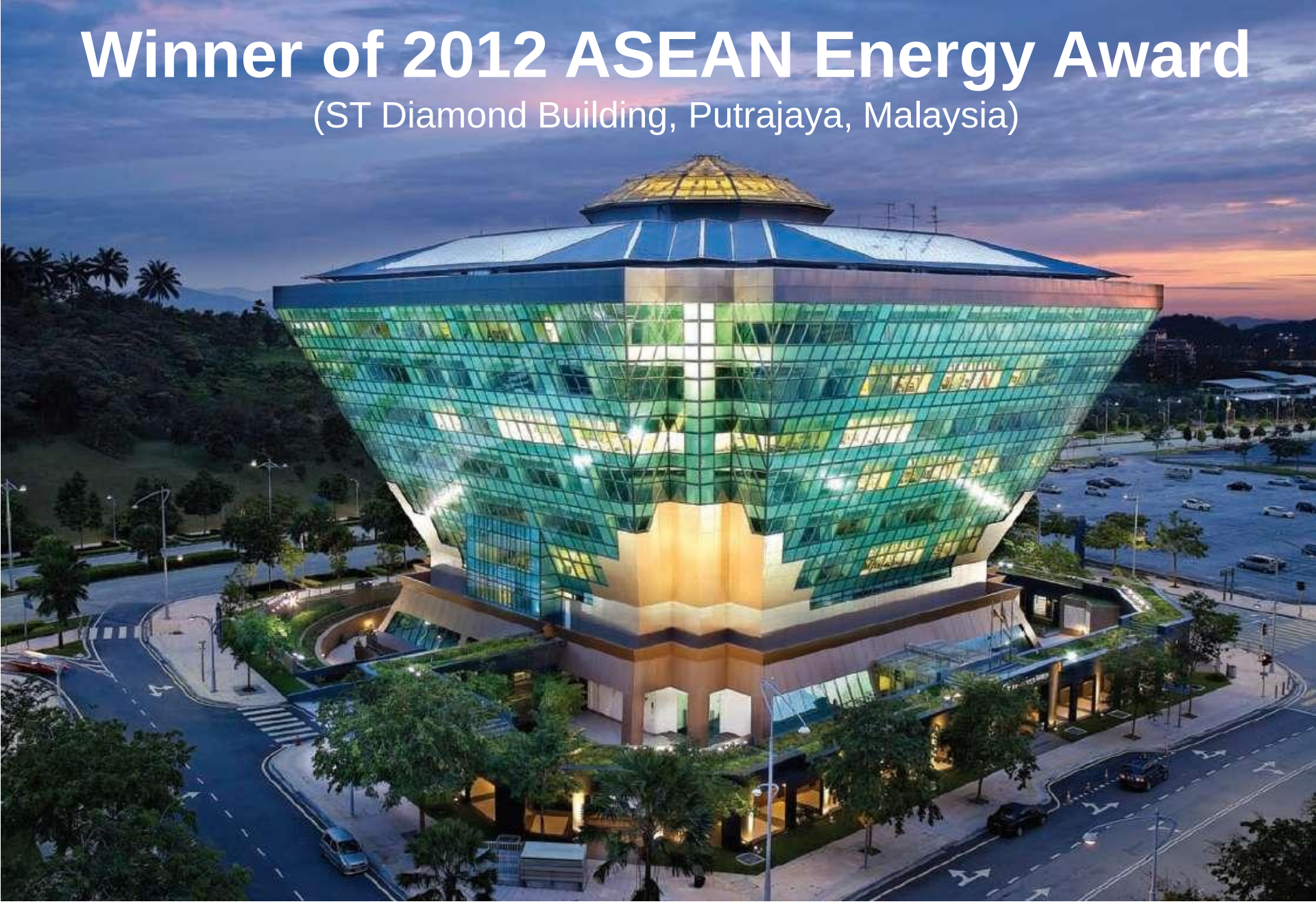
Green Office case study in Putrajaya:

DIAMOND BUILDING

(MALAYSIA, 2010)

Winner of 2012 ASEAN Energy Award

(ST Diamond Building, Putrajaya, Malaysia)



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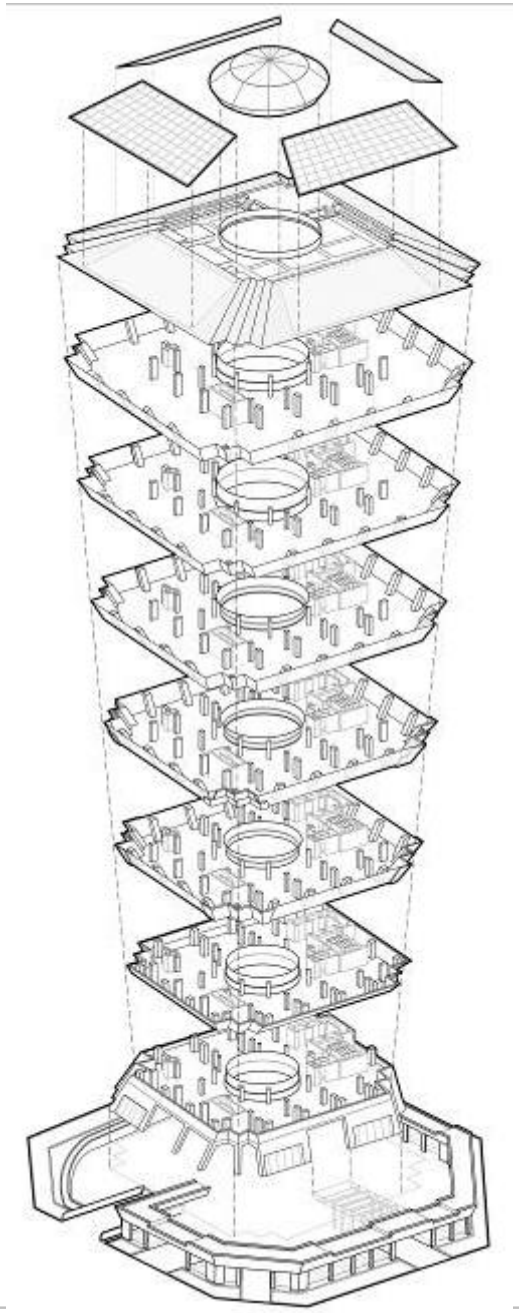
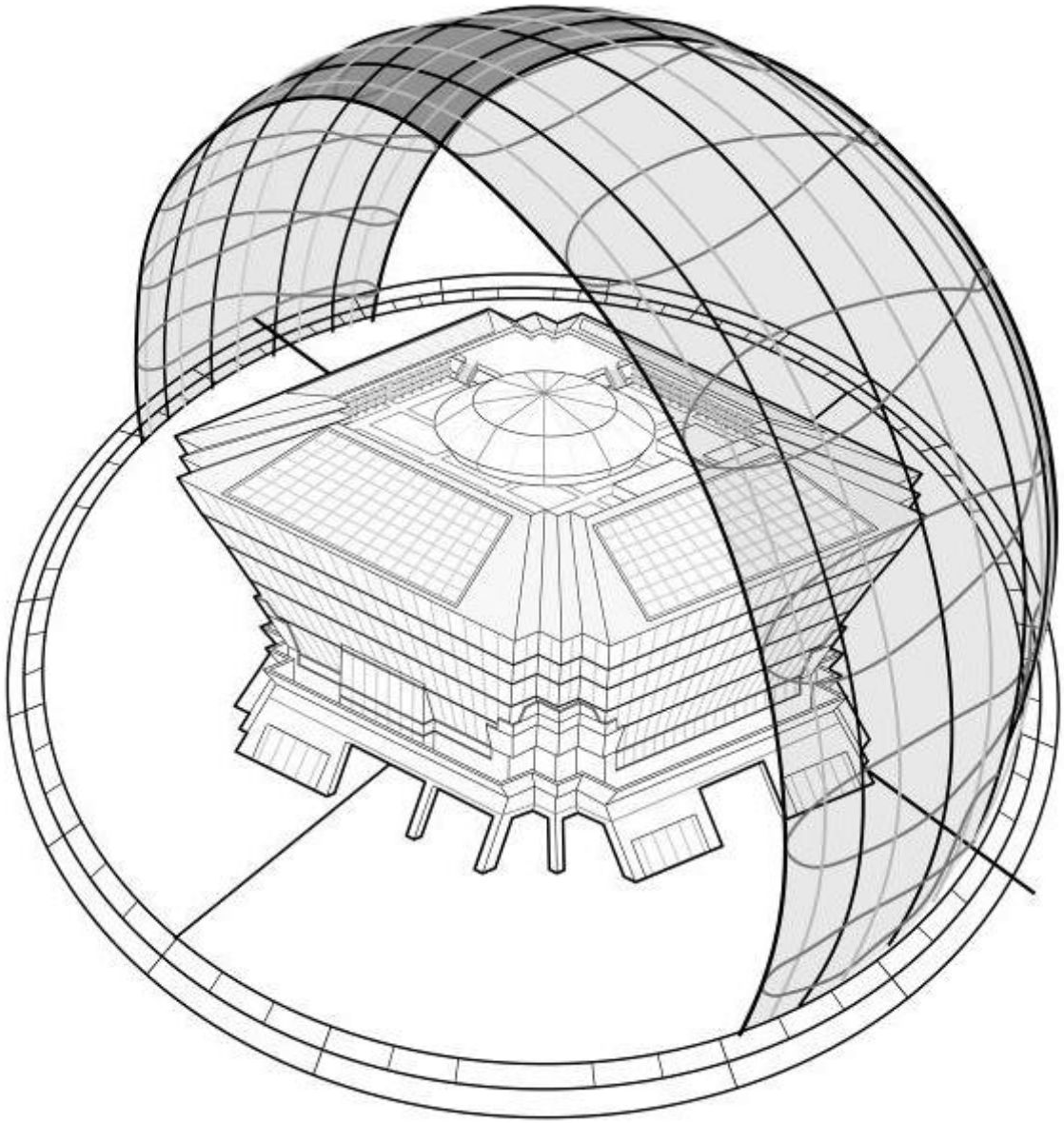
Architects: Soontorn Boonyatikarn (Thailand)
and NR Architect (Malaysia)
Energy efficiency and sustainability: IEN Consultants

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





Self-shading facades

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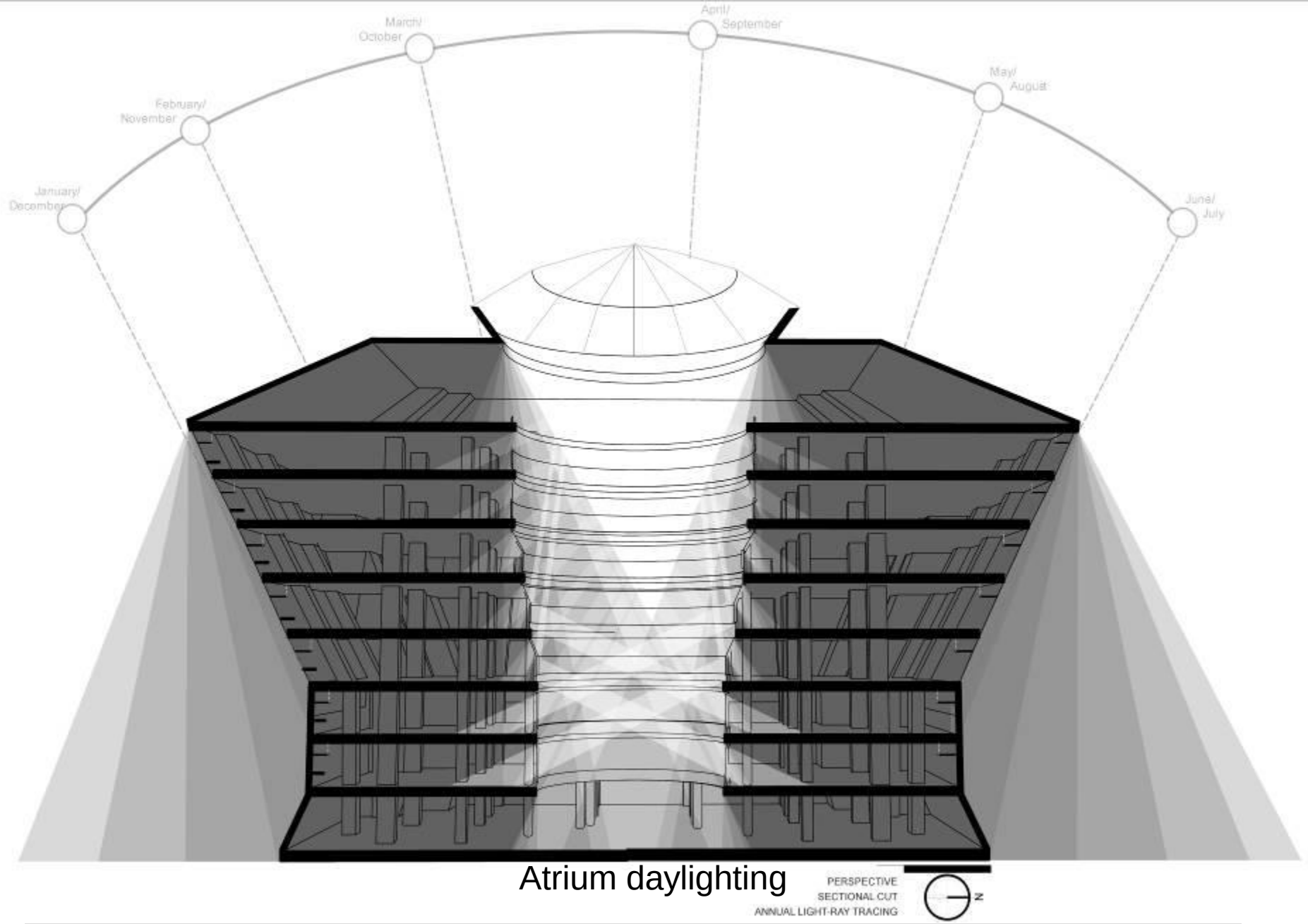

Atrium daylighting

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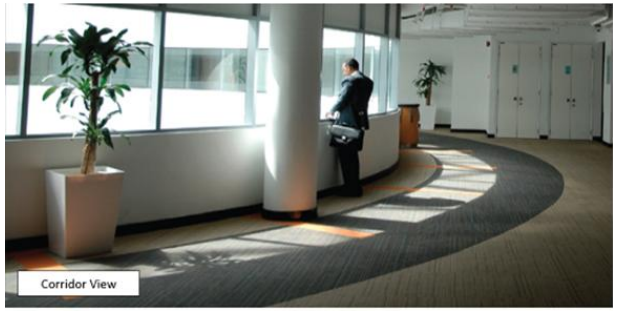
Source: Greening Asia – Emerging Principles for Sustainable Architecture.

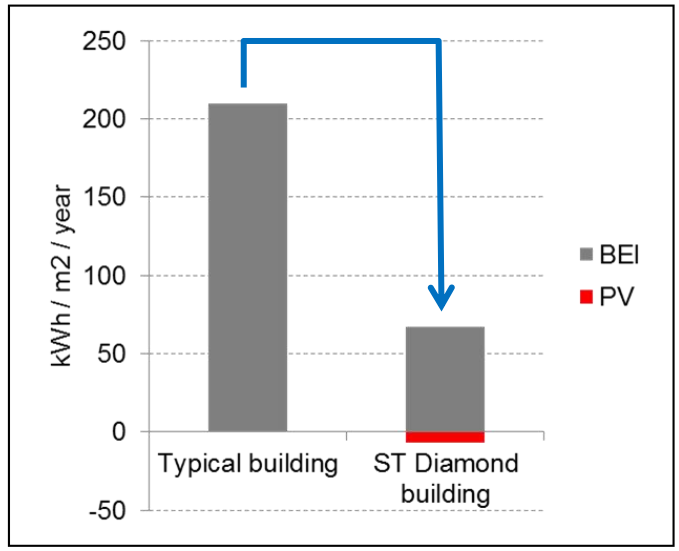
1/3 Energy Consumption



Key Data
Gross Floor Are: 14,000sqm
Year of Completion: 2010
Building Energy Intensity: 69kWh/m2*year
Total Construction Cost: RM60mil
Additional EE Cost: 3.2%
Payback Period: **< 3years**
IRR: 34% (based on 7year Lease Term)

GBI **Platinum**

Green Mark **Platinum**

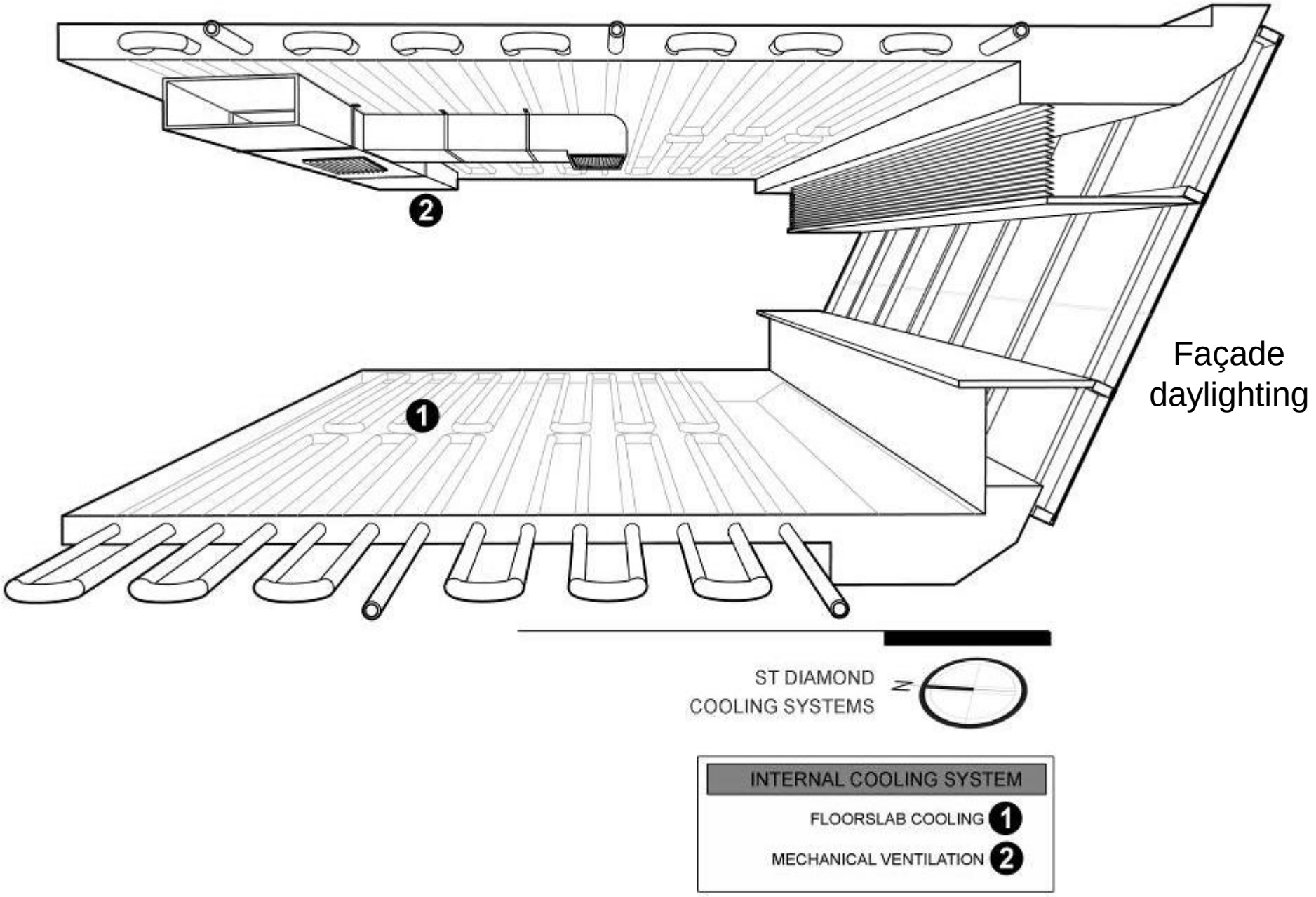


AWARDS:

2012 ASEAN energy award **Winner**

&

2013 ASHRAE Technology Award (2nd place)



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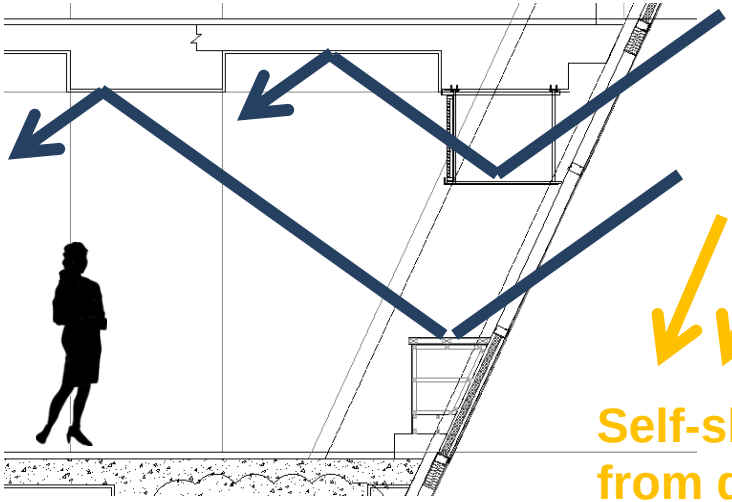
FACADE

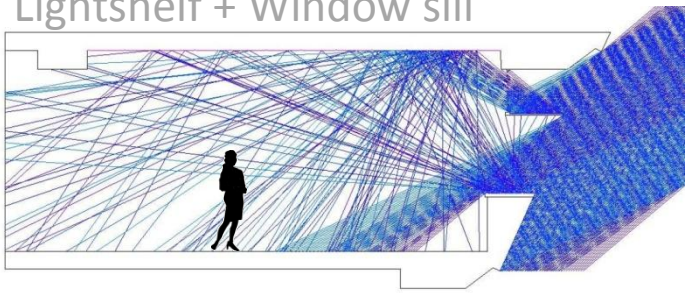


Diffuse light deflected into room by lightshelf and window sill

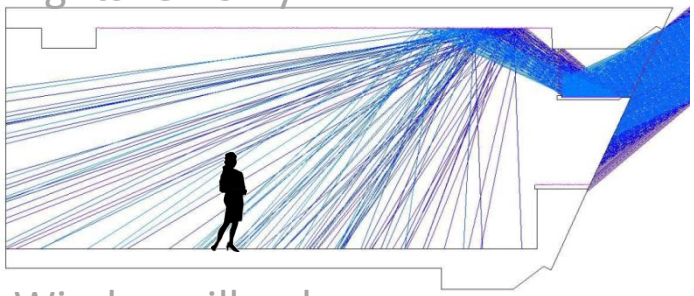
Self-shaded facade from direct sun

LIGHT REFLECTIONS FROM:

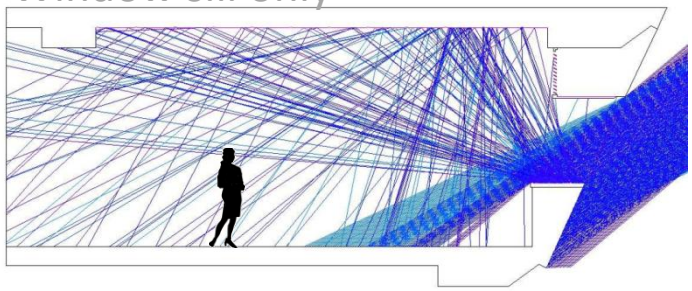
Lightshelf + Window sill



Lightshelf only



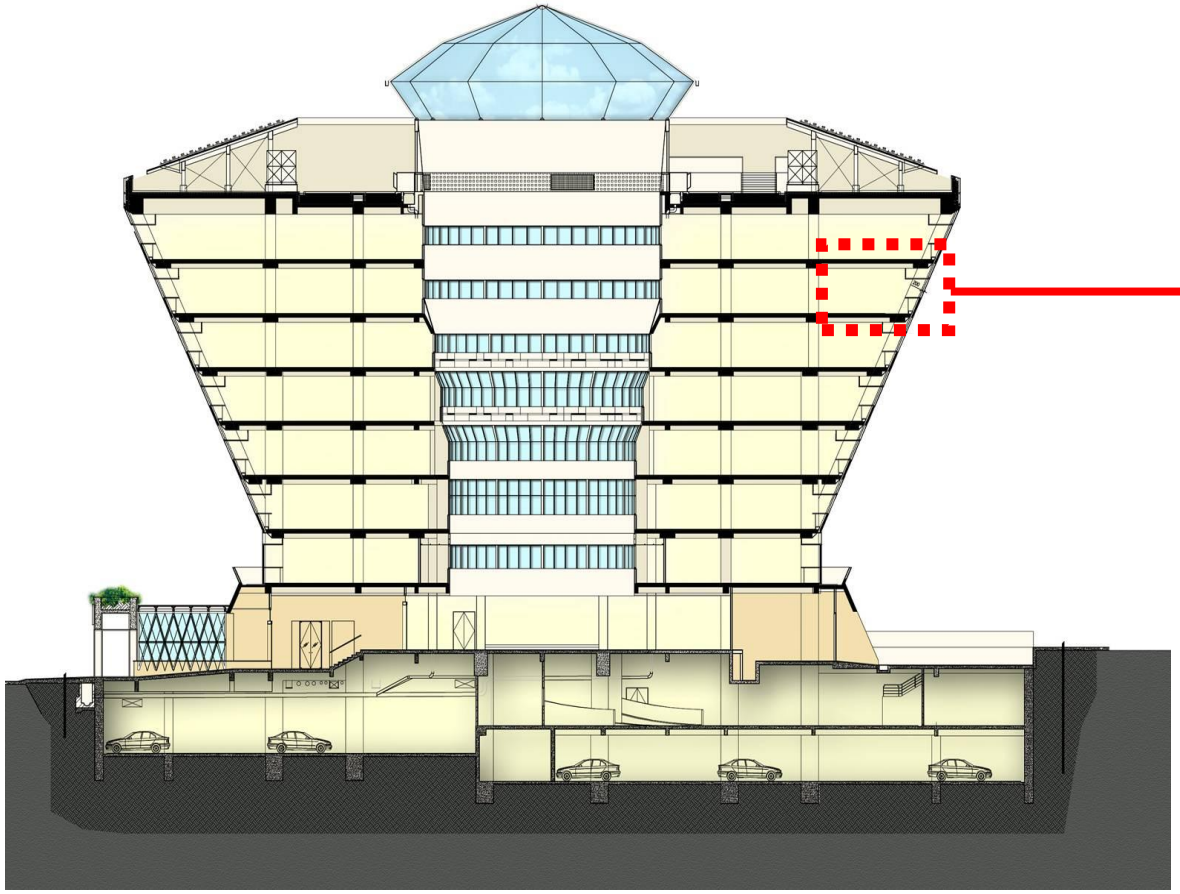
Window sill only



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. Some people worked down to 33 lux without switching on the lighting.

Day-Lighting- Office



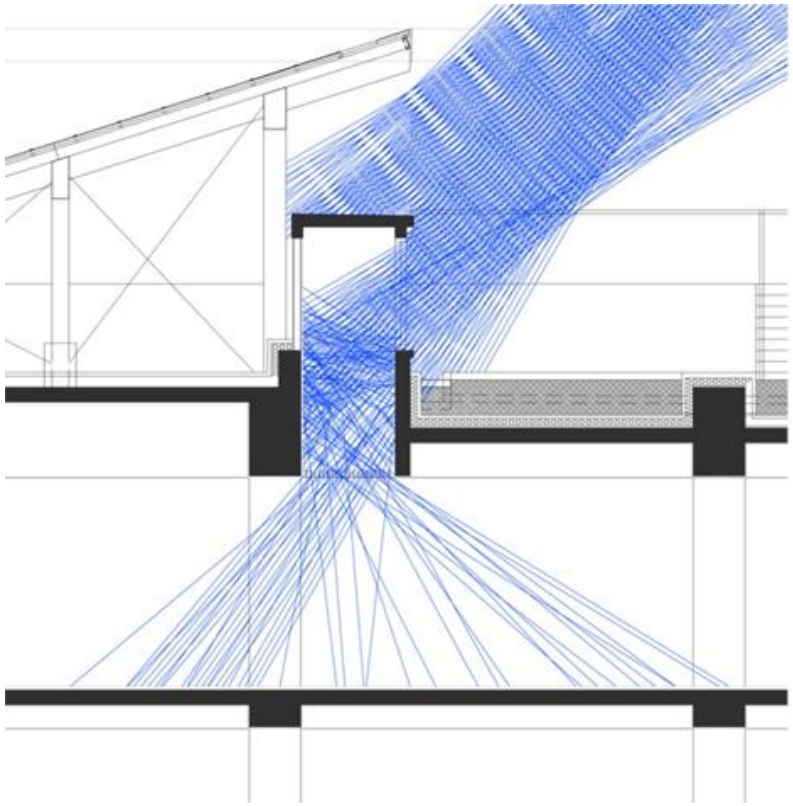
Mirror lightshelf

Fixed blinds for glare control

Daylight reflected onto ceiling

Daylight Skylight through Roof

Take in diffuse light only



Floor Slab Cooling in ST Diamond Building

Floor slab cooling system embedded in RC slab

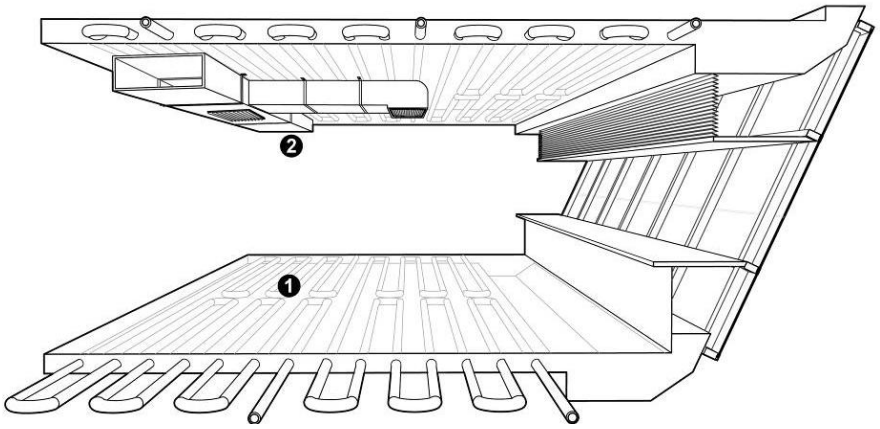
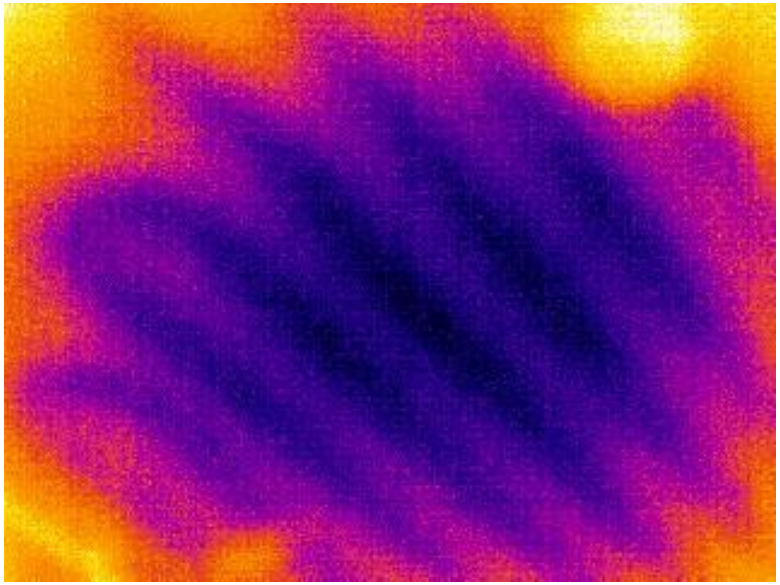
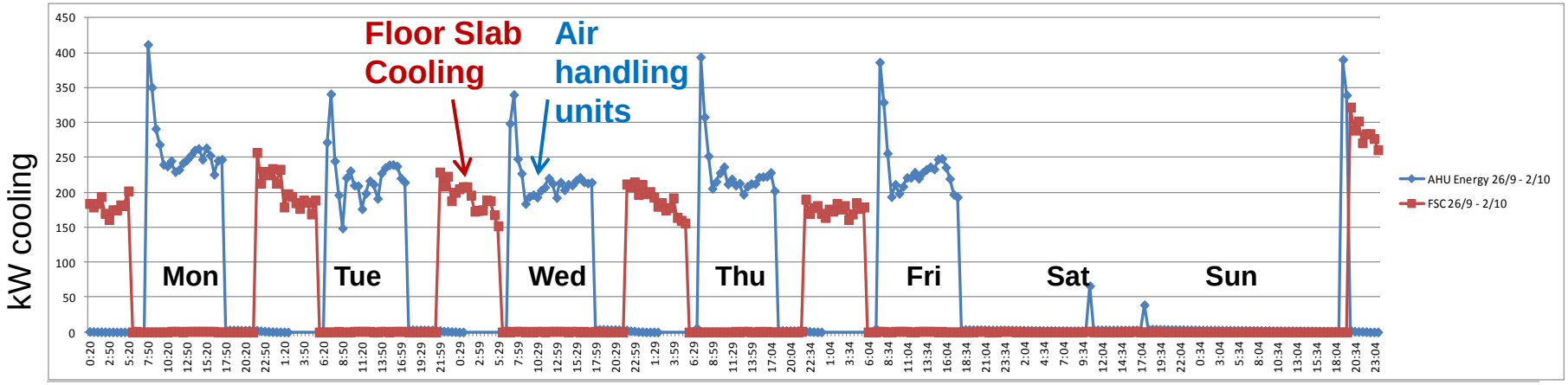


Illustration courtesy of:
Greening Asia – Emerging Principles for Sustainable Architecture.
Copyright: Nirmal Kishnani, 2012. Publisher: FuturArc



Thermographic image of floor slab cooling in ST Diamond
Picture courtesy of: PS Soong, Pureaire



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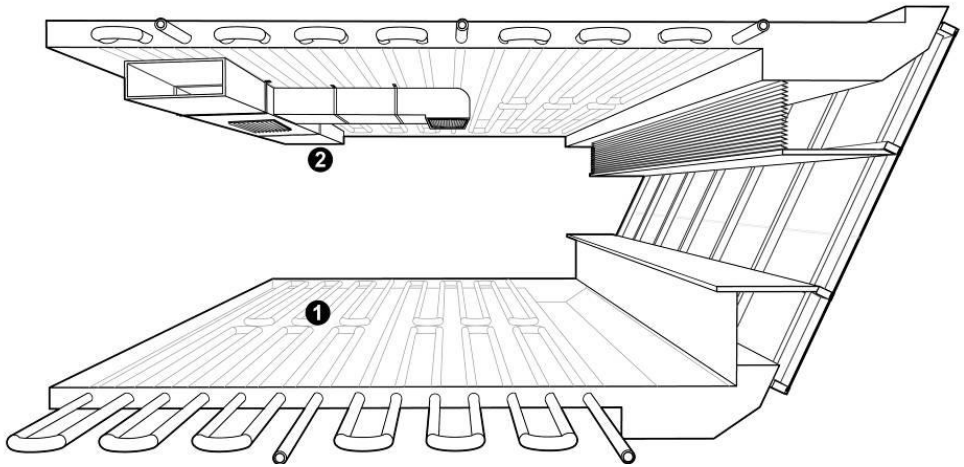
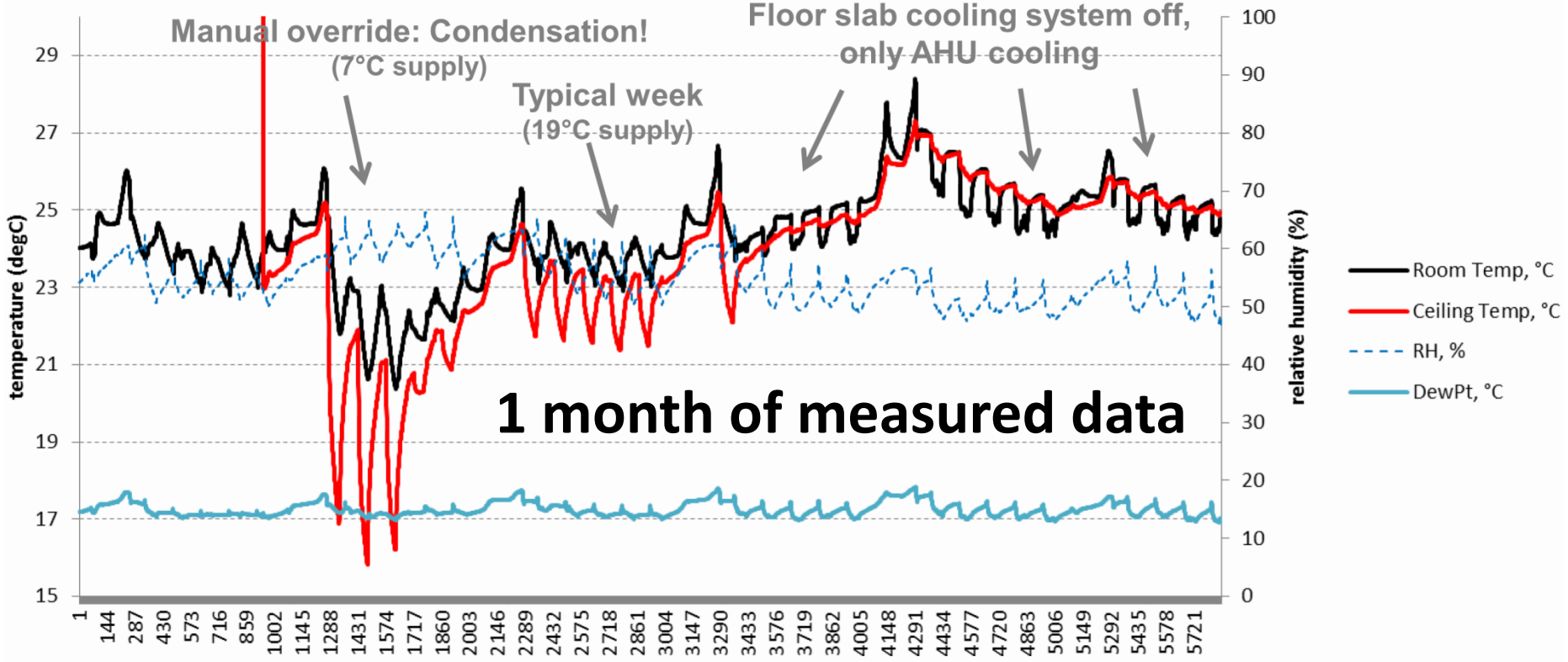


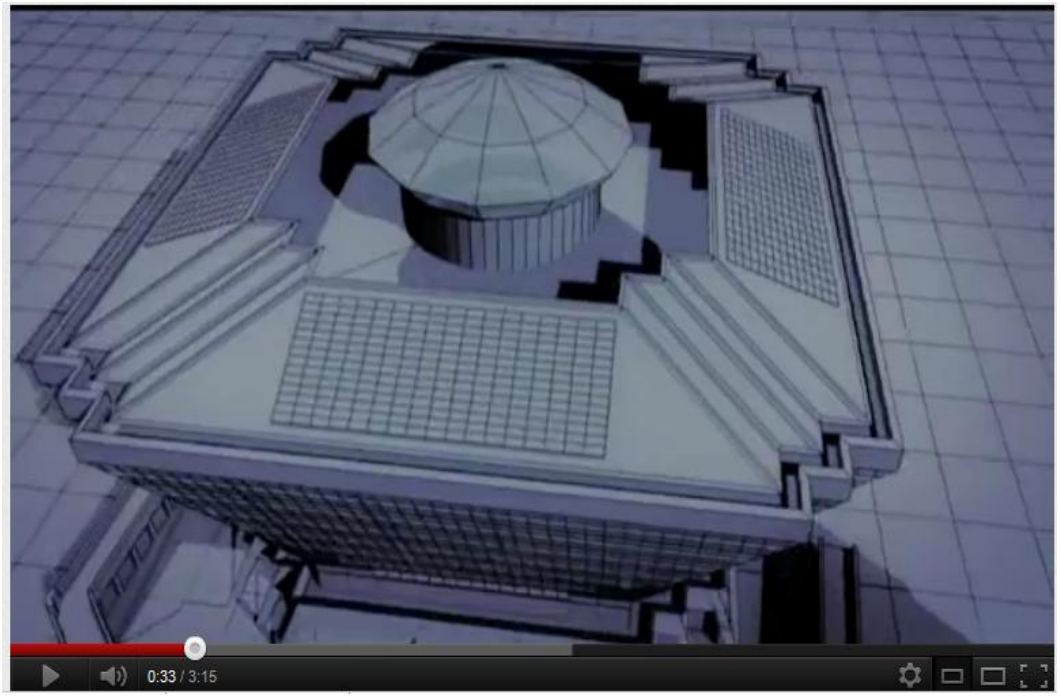
Source: Greening Asia – Emerging Principles for Sustainable Architecture.

ST Diamond Building: Floor slab cooling measurements

ST Diamond Building: Level 6, West, Hamidah room (8 Sept - 18 Oct, 2012)

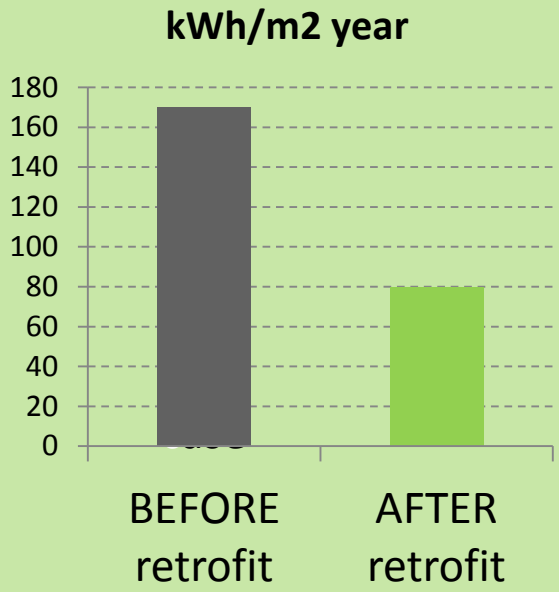


3-minute video



Sustainable Features of ST Diamond Building.
Available at YouTube:
http://www.youtube.com/watch?v=3H_sXCtDayc

Case study no. 2

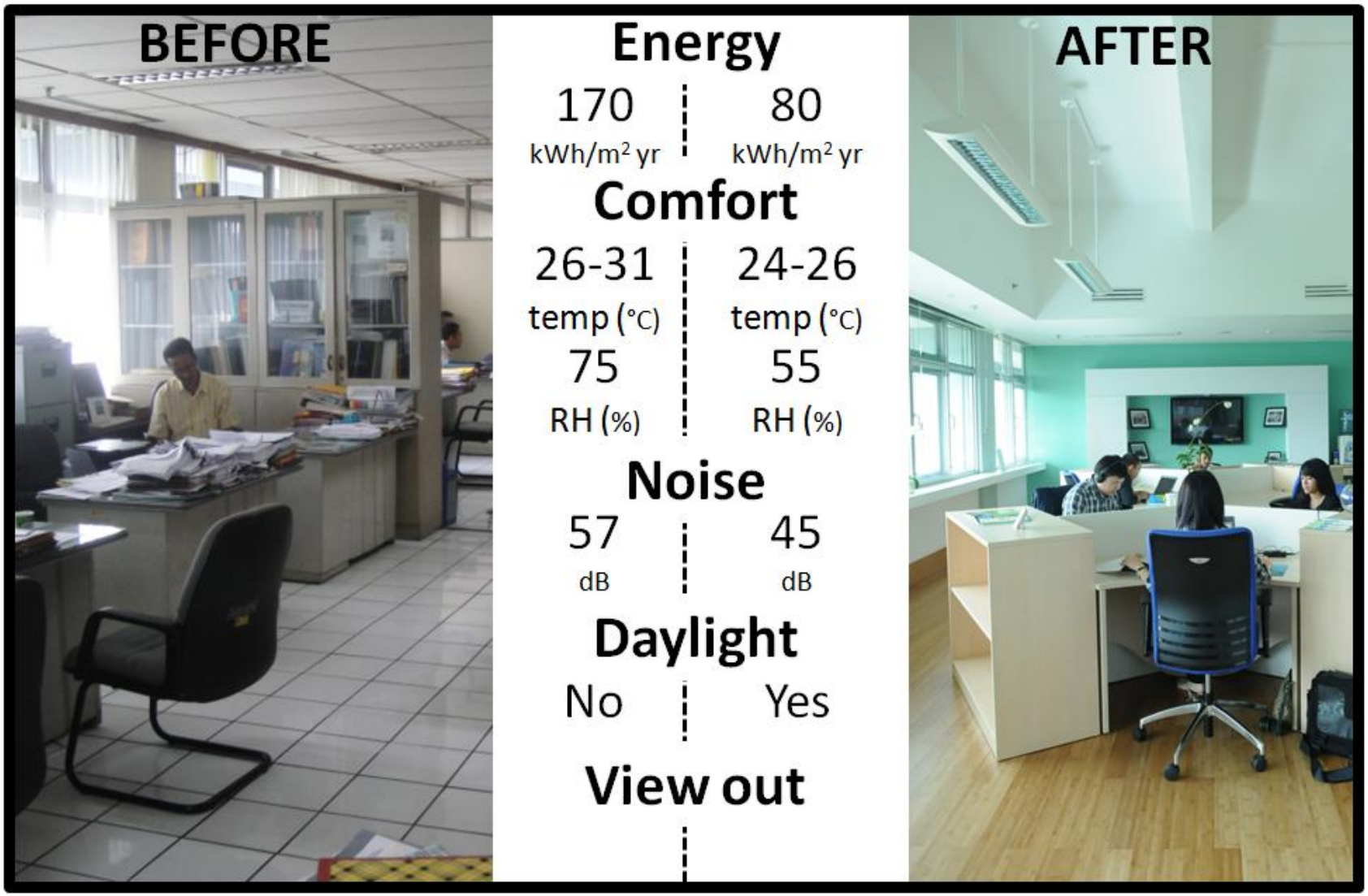


Energy Efficient Retrofit case study

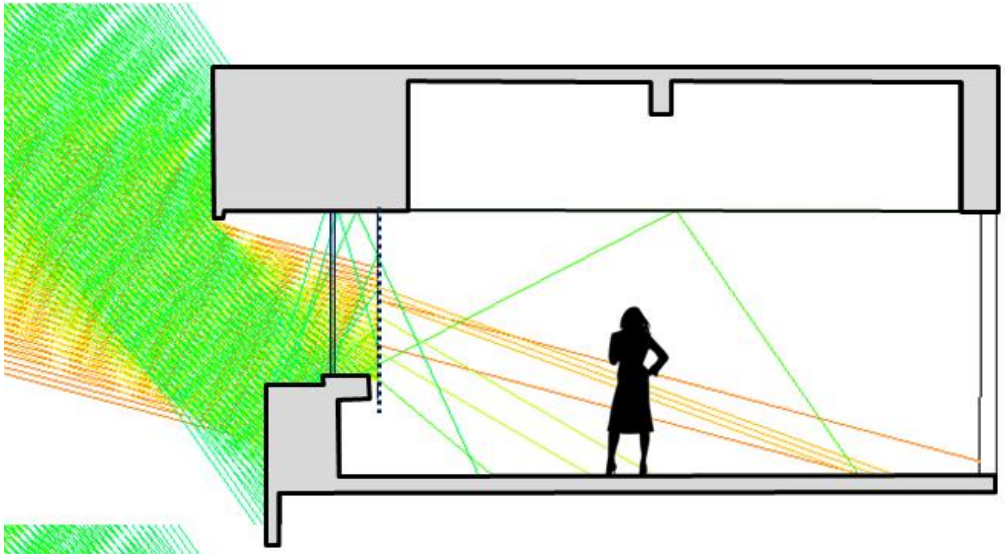
EECCHI OFFICE RETROFIT

(JAKARTA, 2011)

53% Measured Energy Savings

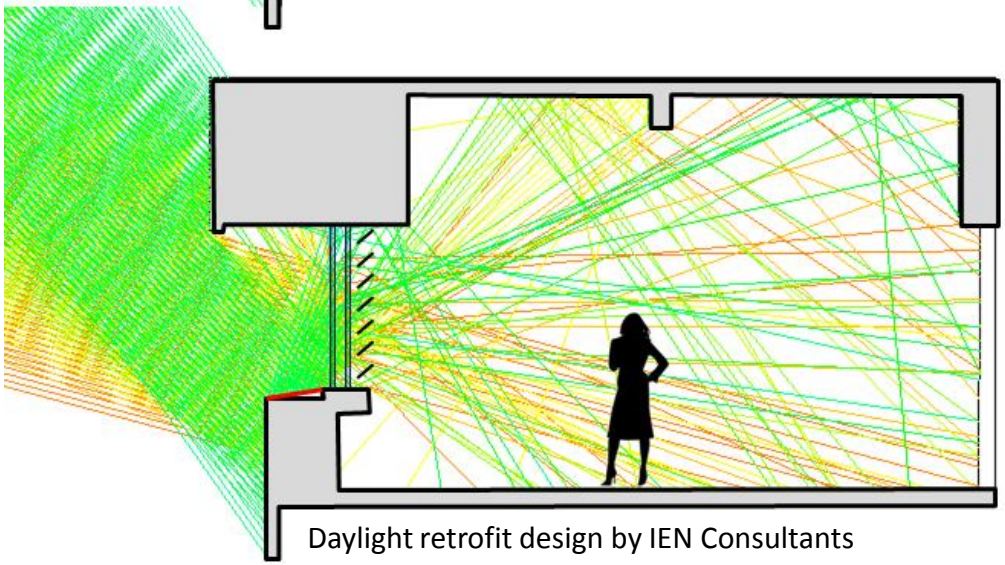


Retrofit & Improved Thermal Comfort



BEFORE RETROFIT

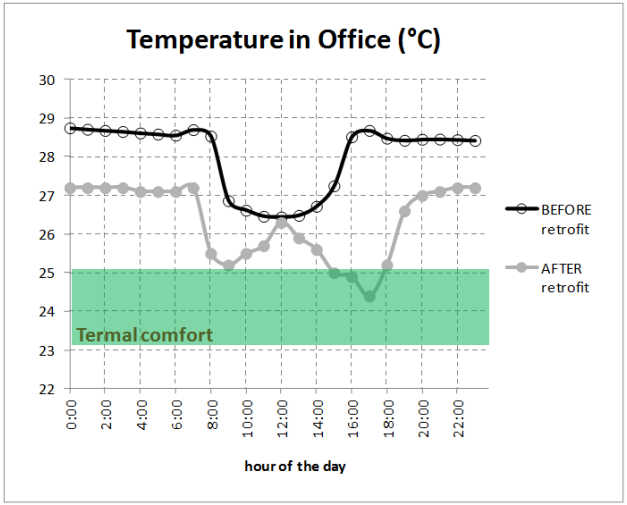
- Vertical blinds blocking most of the daylight
- Suspended ceiling



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



Case study no. 3

Energy Efficient factory in Penang:

PARAMIT – FACTORY IN THE FOREST

(MALAYSIA, 2016)

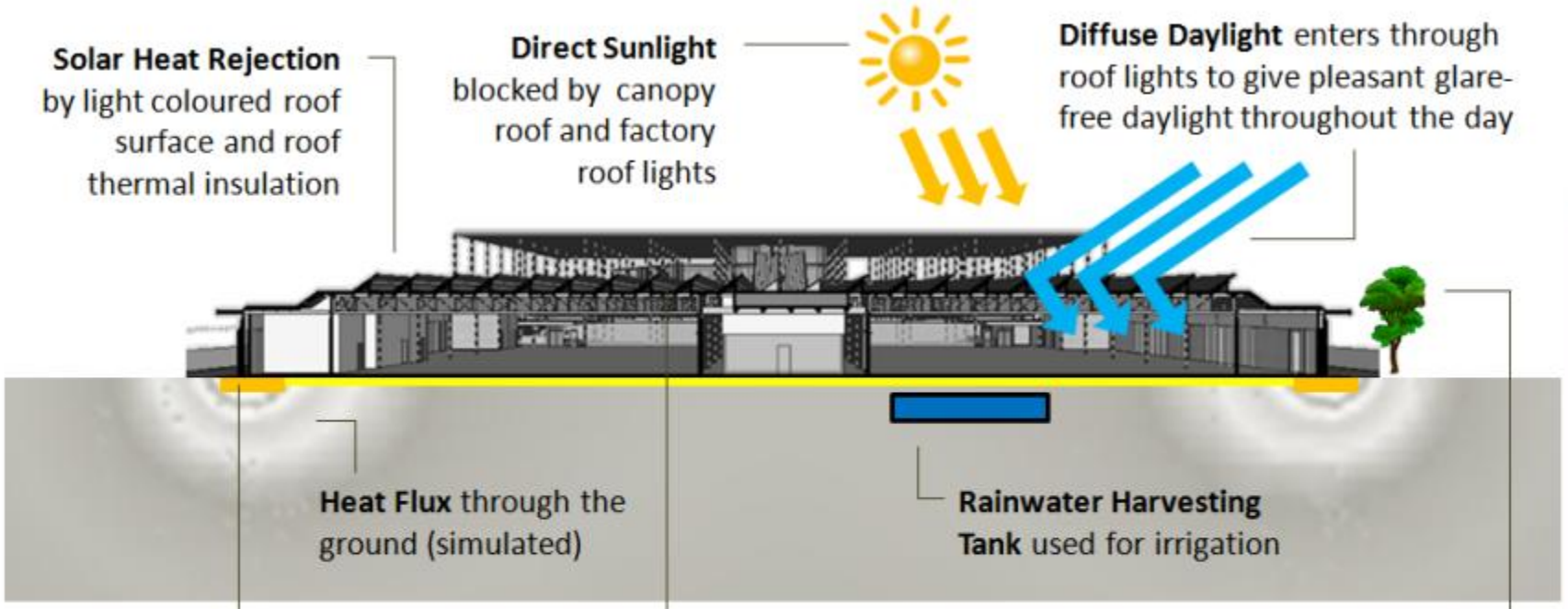
The client wanted Energy Efficiency

hence, contacted the Green Building Consultant before looking for an architect

In fact, the client identified the Green Building Consultant first, and then asked him to recommend the architect

Passive Design Features

PASSIVE DESIGN: **Designing with the Climate**



Extra Floor Insulation at building perimeter where the cooling loss through the ground is greatest, hence, maintaining cooling loss at just 1 W/m2

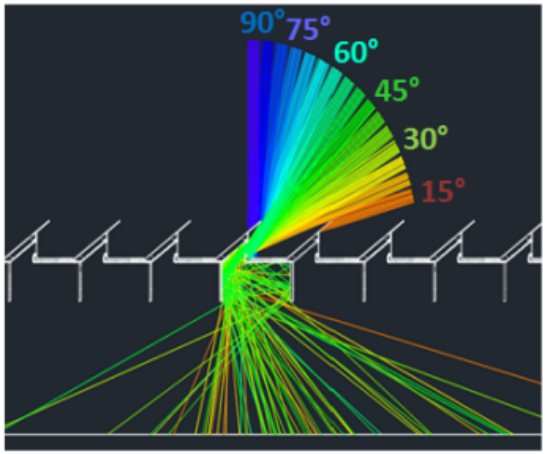
Low-emissivity Ceiling to maximise thermal stratification in the factory and reduce cooling loss by radiation from cooled floor to warm non-air-conditioned ceiling space

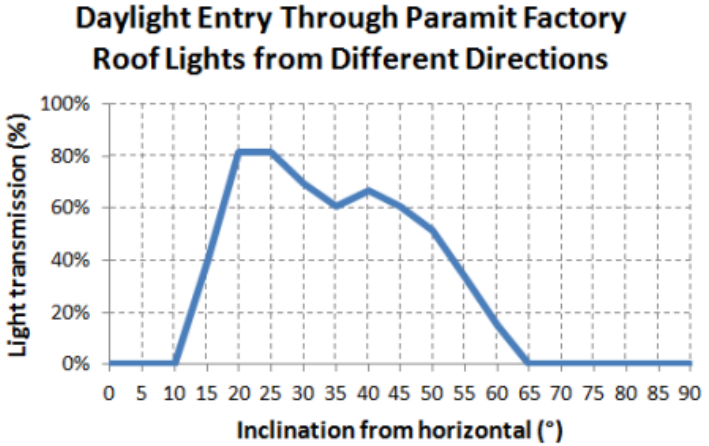
Greenery for biophilia (connection to nature) and extra solar and glare protection where needed

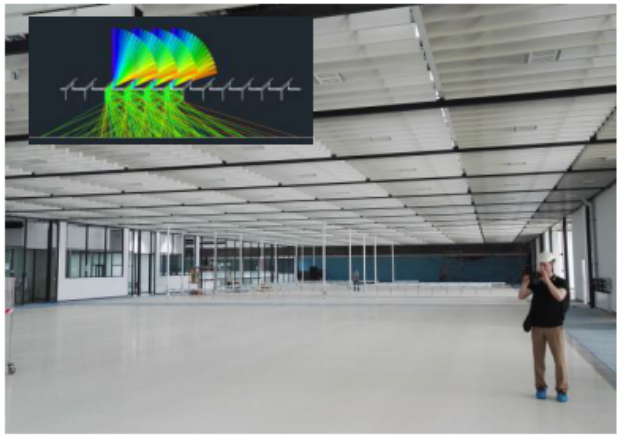
Designed for 100% Glare-free Daylight

SKYLIGHTS for FACTORY

The factory skylights were designed to rely on diffuse daylight from the sky, and not on direct sun light. The factory is located 5.3° North of the equator, and factory site is oriented in a near perfect East-West orientation. In order to minimise direct sunlight entry, the skylights were aligned with the factory and pointed North with a slight 22.5° angle to the West as dictated by the site. An internal deflector panel was added to diffuse any direct sunlight entering the skylights during certain times of the year.





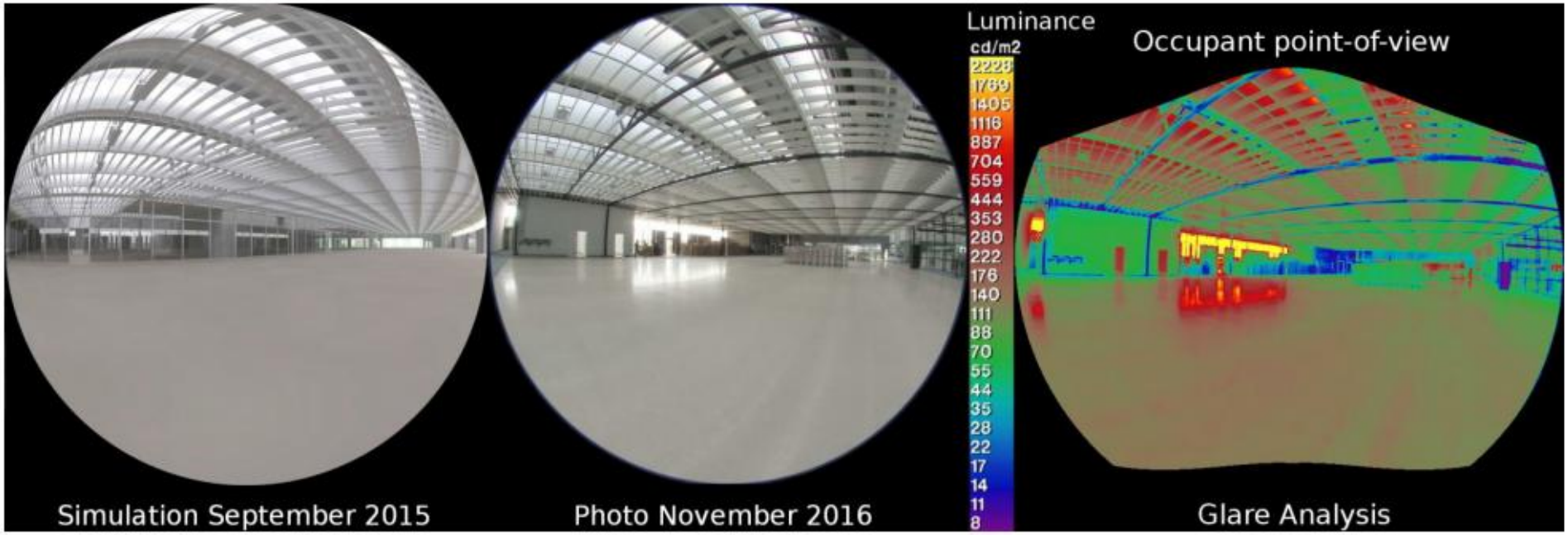


Raytrace simulation show that only low angle light (15-60° from horizontal) enters the roof light. Simulation and software by IEN Consultants

Design Simulation = Photo

DAYLIGHT without GLARE

Extensive annual hour-by-hour daylight simulations were undertaken to evaluate the daylight and glare levels. The skylight design was optimised, for example by moving them closer to each other, in order to achieve an evenly day-lit work environment without glare. The simulations and daylight measurements show that the factory floor achieves a daylight factor of 0.7-1.0%, with a measured lux level of 600-700 lux around 2 pm.



Good correlation between simulated results and subsequent photo. Tropical glare formula, developed by IEN Consultants, applied to the project.

1st Tropical Glare Formula

Published by IEN Consultants, February 2017

$$UGP = \frac{1}{\left(1 + \frac{2}{7}\left(\frac{1}{L_b}\sum_{i=1}^{n}\frac{L_s^2\omega_s}{P^2}\right)^{-\frac{1}{5}}\right)^{10}}$$

UGP : Unified Glare Probability (0-100%)
L_s : Luminance of the glare source (cd/m^2)
L_b : Background luminance (cd/m^2)
ω_s : Solid angle of the glare source (sr)
P : Position index
n: Number of glare sources

ELSEVIER

Building and Environment

Volume 113, 15 February 2017, Pages 107–120

Prediction of discomfort glare from windows under tropical skies

M.B. Hirning[a], G.L. Isoardi[b], V.R. Garcia-Hansen[b]
[a] IEN Consultants, Kuala Lumpur, Malaysia
[b] Queensland University of Technology, Brisbane, Australia

Link to the paper:
http://www.sciencedirect.com/science/article/pii/S0360132316303006

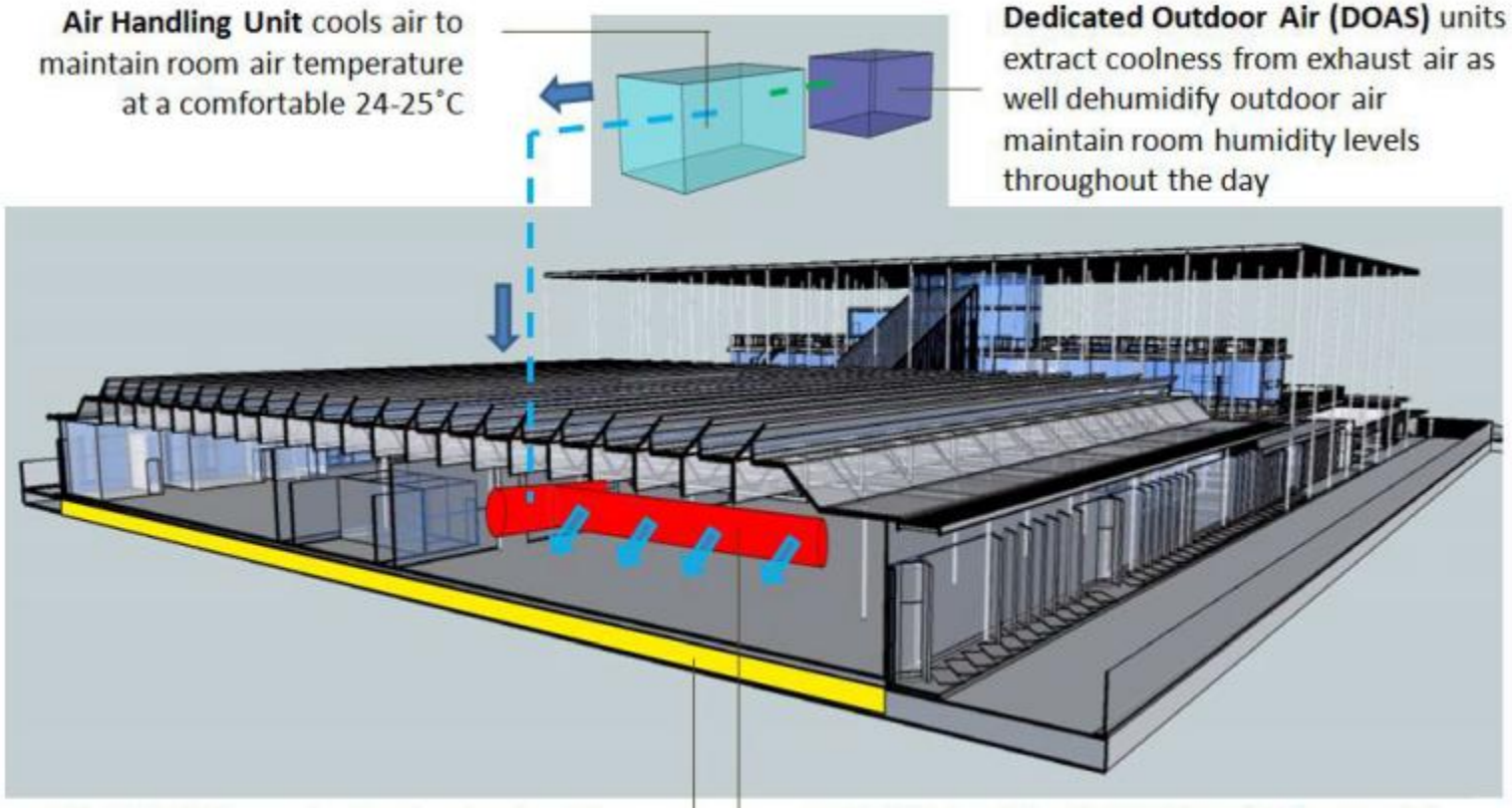
Active Design Features

ACTIVE DESIGN:

Innovative Cooling System for Production Area

Air Handling Unit cools air to maintain room air temperature at a comfortable 24-25˚C

Dedicated Outdoor Air (DOAS) units extract coolness from exhaust air as well dehumidify outdoor air maintain room humidity levels throughout the day



Cool Floor Slab - Cool water is circulated in embedded pipes within the floor to keep the floor continuously at a cool **20-22˚C**

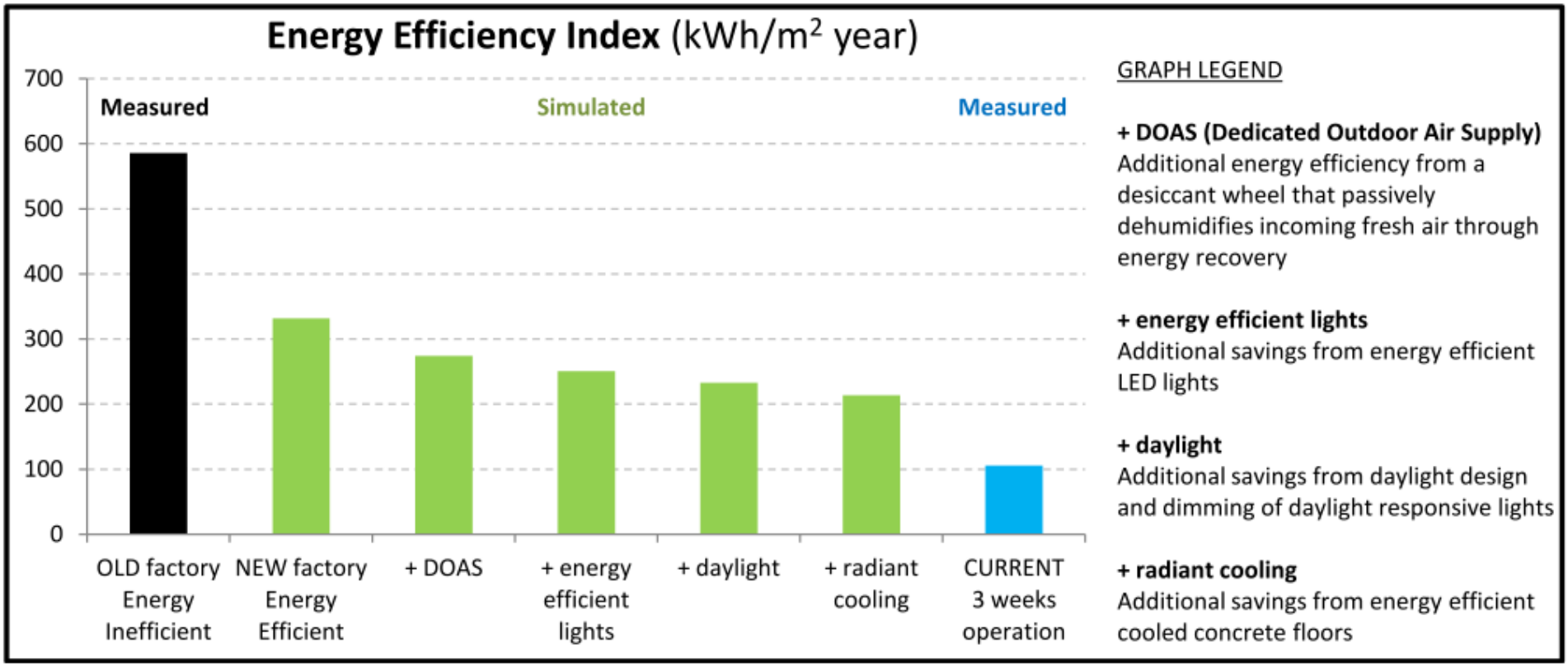
Cylindrical Fabric Air Supply Ducting provides even air distribution minimizing cool spots, hot spots as well as draft below air grilles

Energy Efficient Floor Slab Cooling

Chiller COP of 10. Supply water temperature 17°C

Photo by Lin Ho

Energy Consumption less than half!



Final comments for

PANEL DISCUSSION

Big potential
for energy efficiency in buildings

- Proven through case studies
- Attractive payback despite low energy prices
- But uptake is of energy efficiency is too slow

Drivers for more Energy Efficiency are:

1) Pay correct price for energy (‘polluter pays principle’)
2) Energy Labeling for Buildings (makes energy efficiency part of the conversation upon sale/rental)
3) Energy benchmarking information systems (people don’t like to pay more than their neighbour)
4) Government incentives, legislation and awareness campaigns to increase energy efficiency

Thank you

How I commute in Kuala Lumpur
(video link)

Gregers Reimann

Managing director, IEN Consultants

gregers@ien-consultants.com | +60122755630

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).

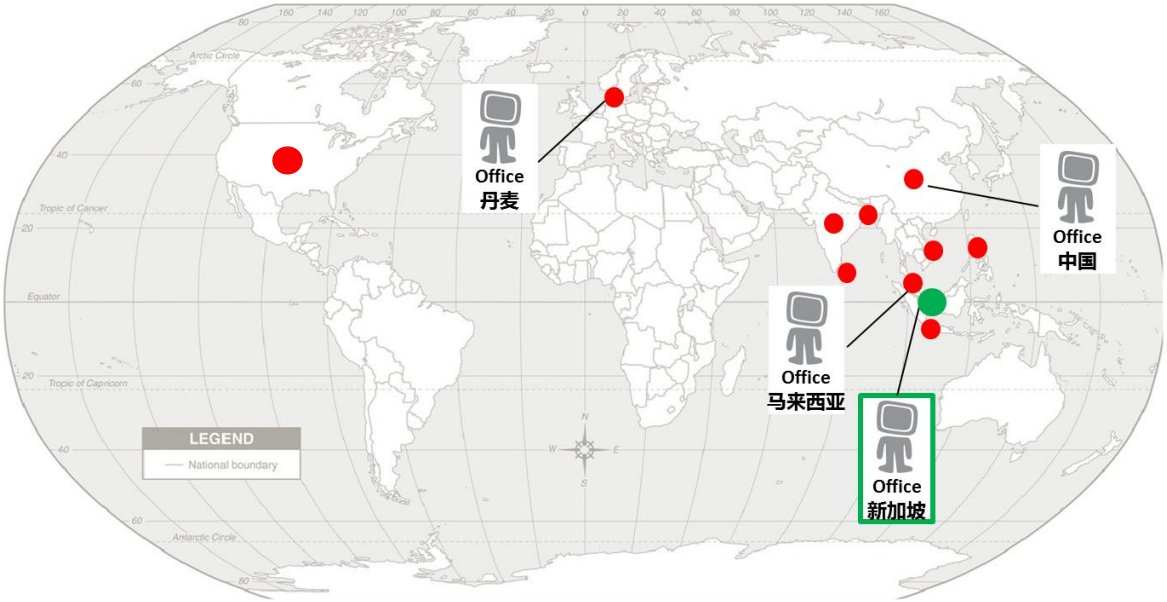
Gregers regularly contributes to green building articles and frequently guest lectures at universities internationally. He has a keen interest to pursue innovative and integrated design solutions bridging the gap between architects and engineers. Gregers is also ‘walking the talk’ with respect to green 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