Biophilic and Daylit Building Design Solutions

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What is Biophilia?

The concept of biophilia implies that humans hold a biological need for connection with nature on physical, mental, and social levels and this connection affects our personal well-being, productivity, and societal relationships. – *Sheeps Meadow, 2004*

Bio	connected with life and living things
philia	denoting fondness, especially an abnormal love for a specified thing

loosely translated as

Love of Nature

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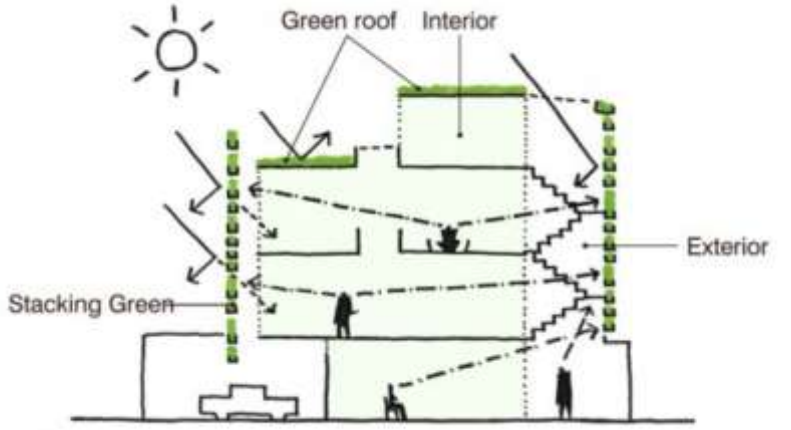
Example of Biophilia

Fallingwater
by Frank Lloyd Wright

Kampung House
(Vernacular Malaysian Architecture)

Example of Biophilic building (Vietnam)



The people can feel the greenery illuminated by sunlight from everywhere of this house

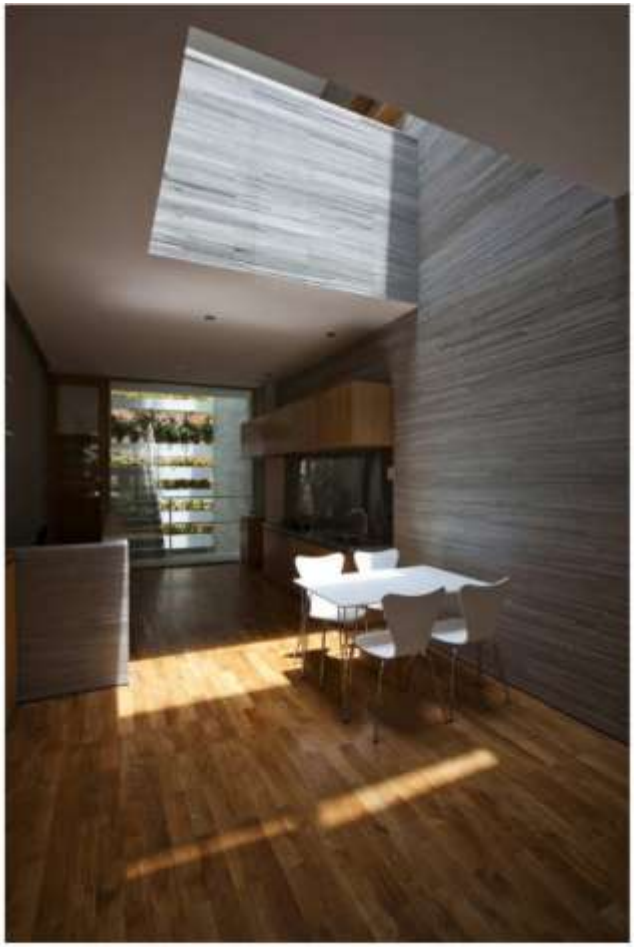
Section Diagram

Stacking Green

Greenery, daylight, air flow and views are important to this reinvented tube-house in Ho Chi Minh Vietnam, by architect Vo Trong Nghia. The award-winning project – without Green certification – addresses well being at the building and argues for the same at the urban scale.

Drawing by Vo Trong Nghia

Stacking Green
Vo Trong Nghia - Green façade
Image by Hiroyuki Oki



Stacking Green
Vo Trong Nghia - Daylit Interior
Image by Hiroyuki Oki

Visual connection to nature & greenery from all rooms

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Biophilia is real

- **“What is the most attractive office space?”**
  Along the façade with a view out

- **When asked to**
  “Draw your favorite place”
  96% of the kids drew an outdoor location

- **20% more self-discipline**
  for teenage girls with greenery outside their home

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We are Hardwired for Biophilia…

Affective responses toward environmental settings are not mediated by cognition but stem from a rapid, automatic, and unconscious process by which environments are immediately liked or disliked... because of the hardwired emotional affiliation with certain natural elements, nature-based architecture can awaken fascination for natural forms – *Joye, 2007*

…yet, we spend **90%** of our time indoors

…so, better make it worthwhile through biophilic design

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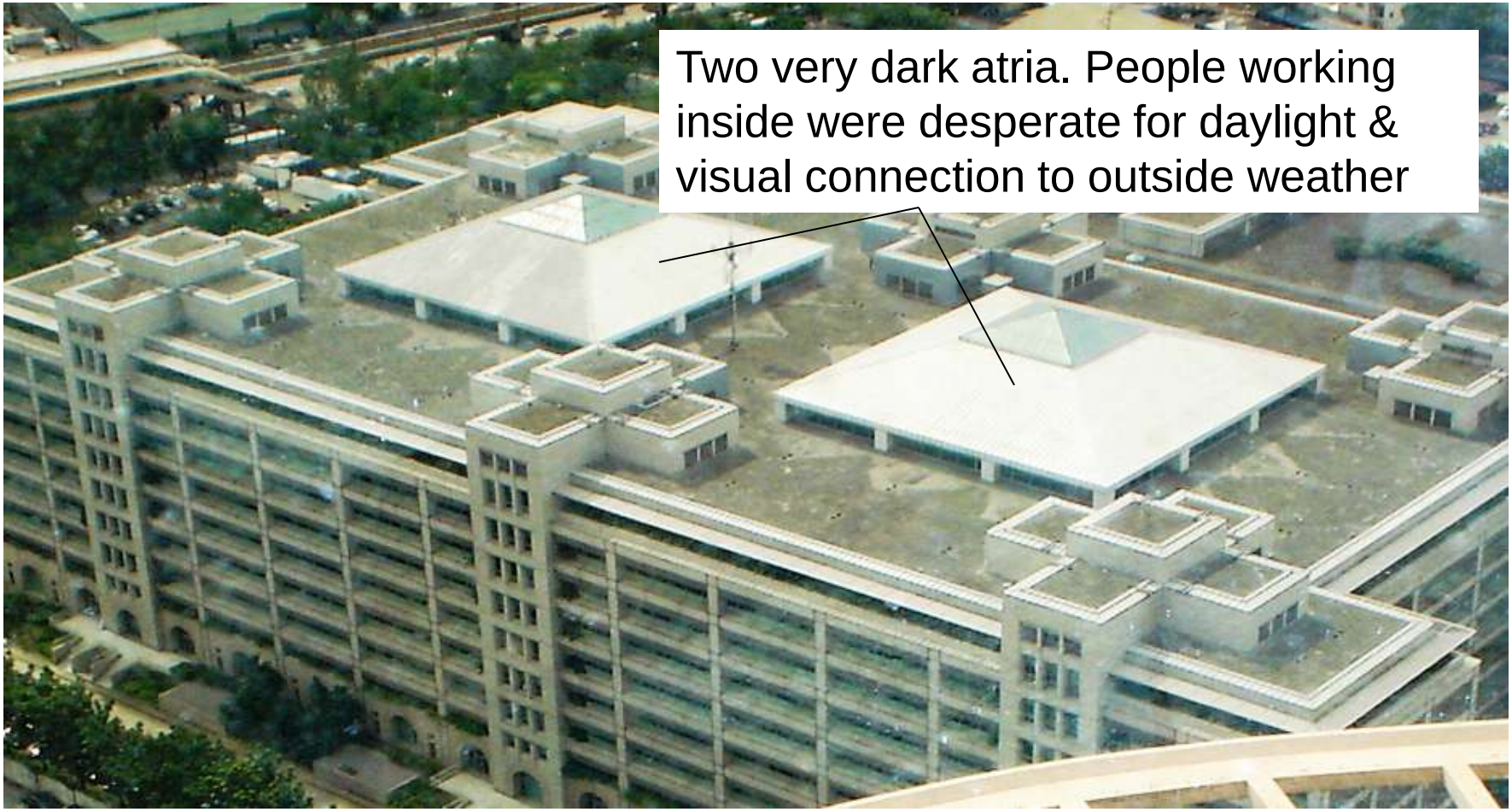
Biophilic atrium retrofit case study:
Asian Development Bank, Philippines



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Biophilic atrium retrofit case study:
Asian Development Bank, Philippines

BEFORE

AFTER

Survey after the retrofit showed that 92% of the occupants preferred the retrofitted atrium.

Only heard 1 complaint: "Give me even more daylight please!"

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Biophilic elements in the Law

- “Right to Light” [UK law]

Right to light is a form of easement in English law that gives a long-standing owner of a building with windows a right to maintain the level of illumination. It is based on the **Ancient Lights** law.[1] The rights are most usually acquired under the Prescription Act 1832. Neighbours cannot build anything that would block the light without permission.
Once a right to light exists, the owner of the right is entitled to "sufficient light according to the ordinary notions of mankind": *Colls v. Home & Colonial Stores Ltd* (1904).

- Mandatory daylight requirement for work spaces [Danish law]

  The daylight factor must be 2% or higher at workspaces

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Biophilia in Green Building Tools?

Asian Green building tools reviewed

1. Green Mark (Singapore): RB version 4.1 + NRB version 4.1
2. GBI (Malaysia): RNC version 1.02 + NRNC version 1.02
3. Greenship (Indonesia): All buildings, version 1.1
4. BERDE (Philippines): VRD version 1.1.0 (2013) + CB version 1.1.0 (2013)
5. Lotus (Vietnam): R version 2.0 + NR version 2.0
6. BEAM Plus (Hong Kong): All buildings, version 1.1 (2010.04)
7. CGBL(China): Residential version 2006 + Commercial, version 2006
8. EEWH (Taiwan): EEWH-RS version 2007 + EEWH-BS version 2007
9. TREES (Thailand): All buildings, version 1.1
10. CASBEE (Japan): All buildings, 2011 Edition
11. KGBC (South Korea): Multi-unit residential version 2002 + Others version 2002
12. GREENSL (Sri Lanka): All buildings, December 2010
13. GRIHA (India): SVA GRIHA, version 2013 + All buildings, version 3
14. LEED (India): All buildings, version 2011

Study by: Kishnani et al. (2012)

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Biophilia in Green Building Tools?

Findings of Asian Green building tools review

- All tools seem to say that greenery and water are important, but almost none link these to the occupant well-being
  - e.g. use greenery to reduce urban heat island effect, but not for biophilic purposes
  - e.g. harvest rainwater to reduce potable water, but not for biophilic purposes

- The tools are not deeply biophilic

- Biophilic principles are undervalued
  - missing
  - (mis)placed in a category other than well-being

Study by: Kishnani et al. (2012)

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Biophilia in Green Building Tools?

Most and least biophilic tools

Percentage of achievable credits that are linked to natural system or biophilic features

1. *Green Mark (Singapore): RB version 4.1 + NRB version 4.1*
2. *GBI (Malaysia): RNC version 1.02 + NRNC version 1.02*
3. *Greenship (Indonesia): All buildings, version 1.1*
4. *BERDE (Philippines): VRD version 1.1.0 (2013) + CB version 1.1.0 (2013)*
5. *Lotus (Vietnam): R version 2.0 + NR version 2.0* ← **Highest score 18%**
6. *BEAM Plus (Hong Kong): All buildings, version 1.1 (2010.04)*
7. *CGBL(China): Residential version 2006 + Commercial, version 2006*
8. *EEWH (Taiwan): EEWH-RS version 2007 + EEWH-BS version 2007*
9. *TREES (Thailand): All buildings, version 1.1* ← **5% or less**
10. *CASBEE (Japan): All buildings, 2011 Edition*
11. *KGBC (South Korea): Multi-unit residential version 2002 + Others version 2002*
12. *GREENSL (Sri Lanka): All buildings, December 2010*
13. *GRIHA (India): SVA GRIHA, version 2013 + All buildings, version 3*
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Study by: Kishnani et al. (2012)

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Biophilia & Economic Sen$e

There's great economic value in the positive effects of biophilic design on well-being, stress reduction and enhanced learning

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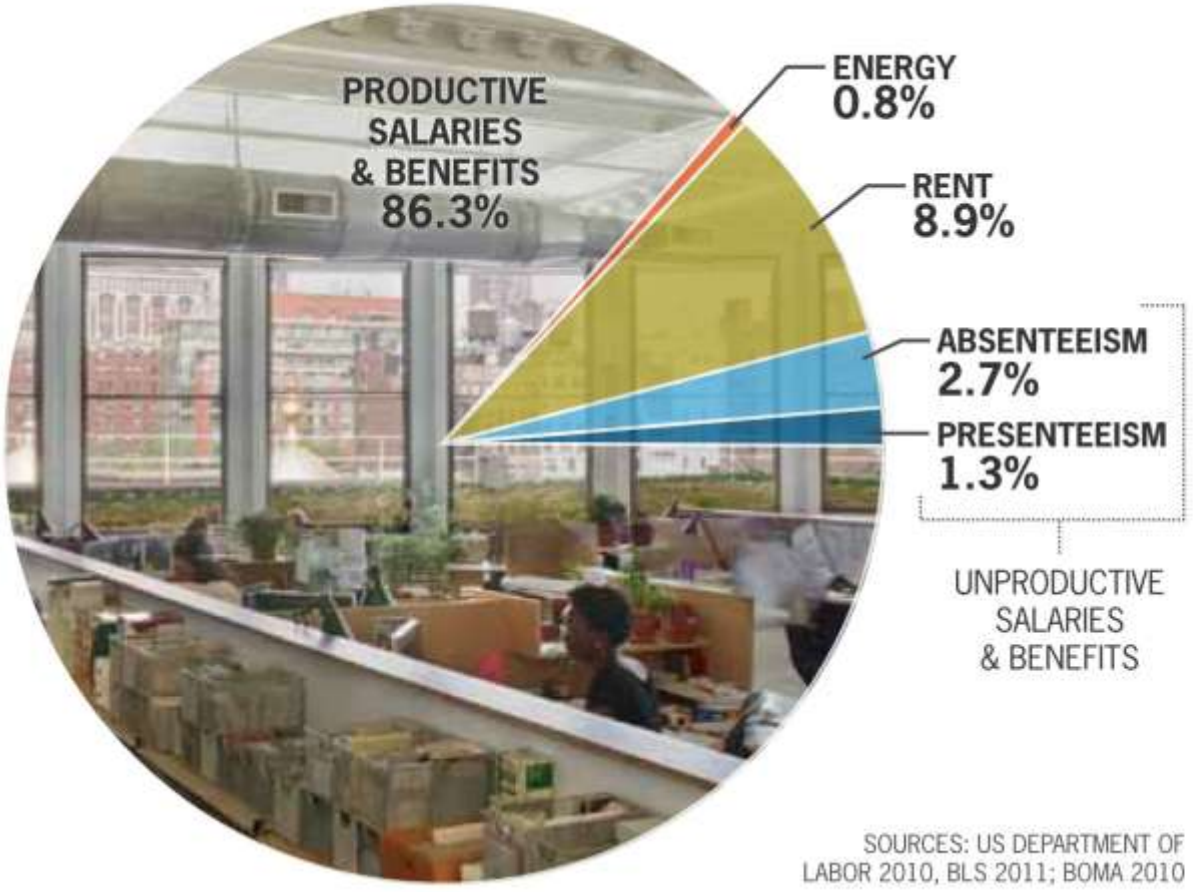
Biophilia & Economic Sen$e



SOURCES: US DEPARTMENT OF LABOR 2010, BLS 2011; BOMA 2010

BIOPHILIA CAN RE-ENGAGE LOSSES FROM UNPRODUCTIVE OPERATING COSTS

*More than 90% of a company's operating costs are linked to human resources, and **financial losses due to absenteeism and presenteeism account for 4%**. Commercial spaces that give occupants access to nature serve as a release to outside stresses, and tend to cause less environmental stress themselves. It makes fiscal sense for companies to try to eliminate environmental stress that cost them thousands of dollars per year in employee costs.*

Graphics credit: Catie Ryan for Terrapin Bright Green

There's great economic value in the positive effects of biophilic design on well-being, stress reduction and enhanced learning

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Biophilia & Economic Sen$e

Biophilic retrofit of call center (Sacramento, US)

- Employees with a view to the outside could take 6-7% more calls than employees without a view

- The call center was retrofitted to give everybody a view out (more office space, different seating arrangement, operable windows)
- Cost: USD 1000 per employee
  Savings: USD 2990 per employee
  Payback time: **4 months**

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Biophilia & Economic Sen$e

Improved student learning

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Biophilia & Economic Sen$e

Hospitals patients recover faster

HEALING VIEWS

Patients with a view to nature, instead of a nondescript wall, are more likely to experience hospital stays that are 8.5% shorter, with fewer negative observational comments from nurses, and significantly fewer strong, post-surgical analgesics. – *Ulrich, 1984*

Patients can discharge 8.5% faster from hospital

Khoo Teck Puat Hospital
(Singapore)

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Biophilia & Economic Sen$e

Significant increase in property value

PEOPLE WILL PAY

58%

MORE FOR A PROPERTY WITH A VIEW TO WATER

OR

127%

MORE FOR A LAKEFRONT PROPERTY

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Biophilia & Economic Sen$e

Retail spaces

Retail customers judge businesses surrounded by nature and natural features to be worthy of prices up to 25% higher than businesses with no access to nature. – *Albee Square, Brooklyn, NY, 2010*

- Customers were willing to pay more for products when sold in a green retail setting:
  +20% higher for convenient shopping (e.g. sandwich)
  +25% higher for general shopping (e.g. jacket, watch)

- For a retail store chain in California with 73-stores, skylights were installed and sales increased by 40%

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Daylit ‘biophilic’ buildings in Malaysia

The GEO office building, Greentech Malaysia HQ, Bangi

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.

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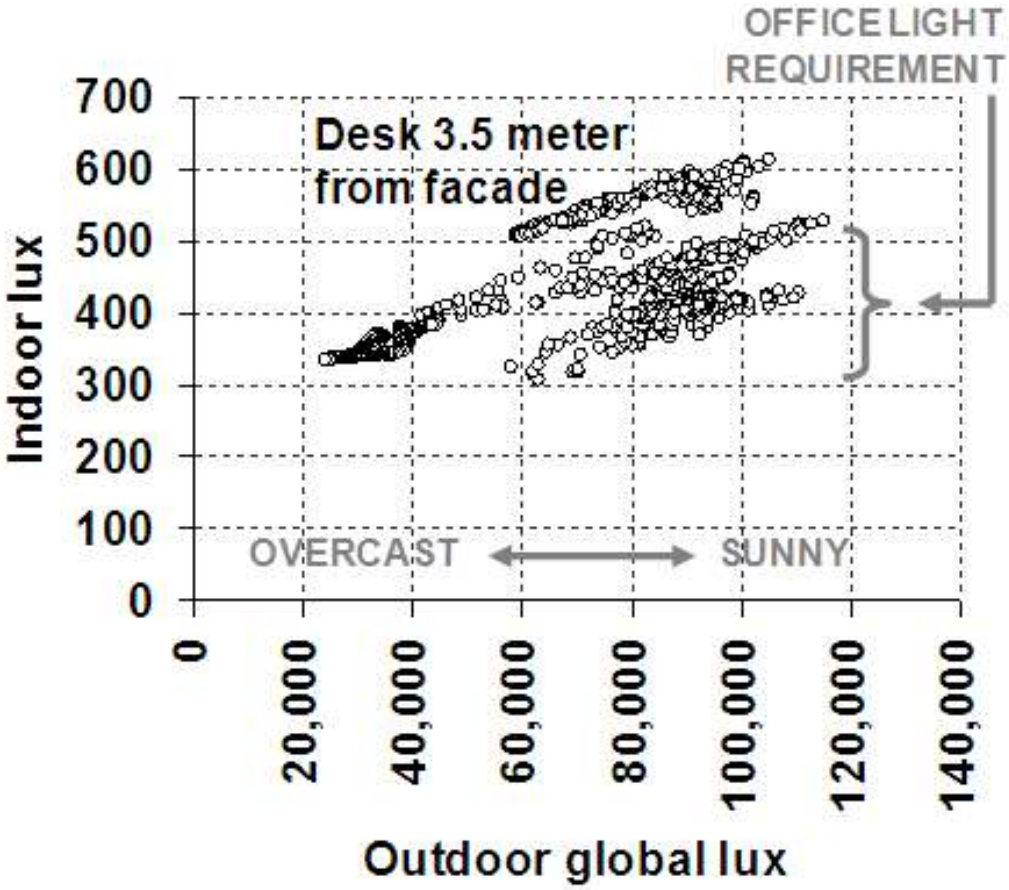

Measured lighting consumption during office hours is only 0.56 W/m^2

1. Occupants prefer working in daylight

2. Electrical lighting consumption is 25 times lower than the code requirement


Daylight design by IEN Consultants

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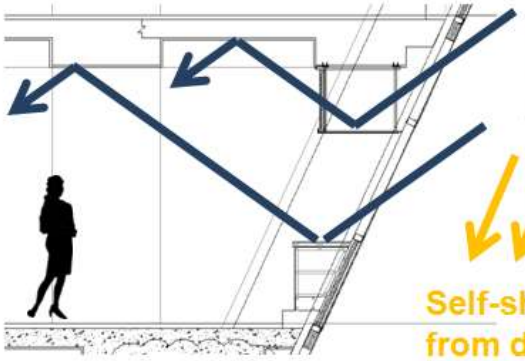
Daylit ‘biophilic’ buildings in Malaysia

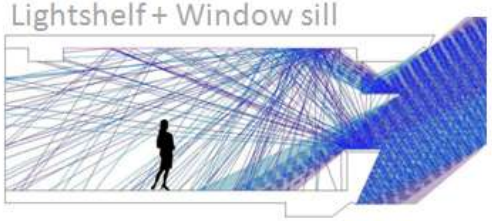
The ST Diamond building, Putrajaya



FACADE

LIGHT REFLECTIONS FROM:

Lightshelf + Window sill



Lightshelf only

Window sill only

Fixed louvers allows daylight to enter and blocks glare

Daylight and view to outside preserved

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

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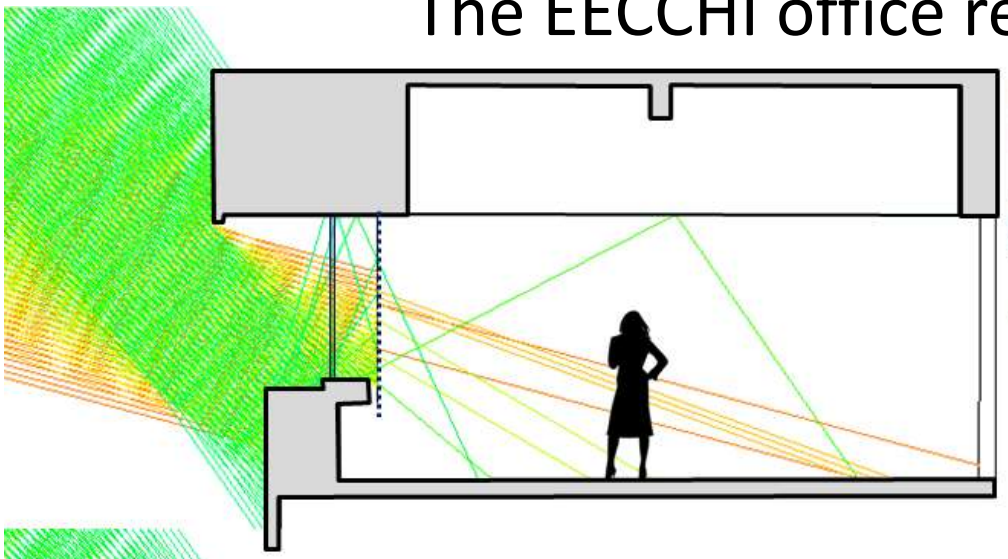
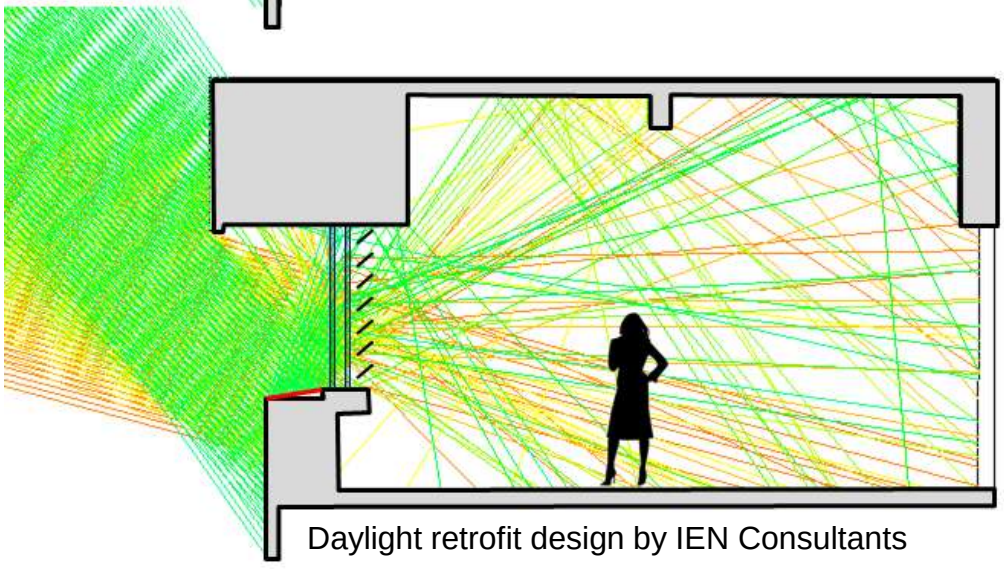
Daylit ‘biophilic’ building in Indonesia

The EECCHI office retrofit, Jakarta



BEFORE RETROFIT

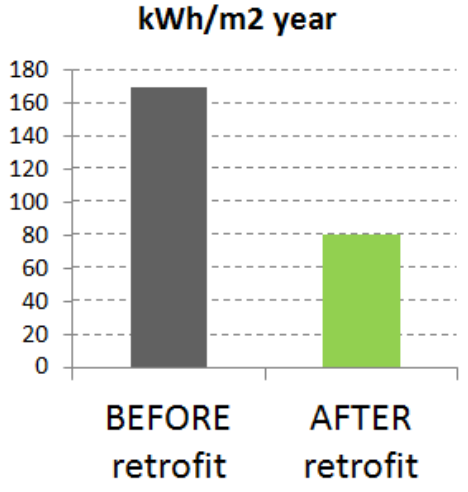
- Vertical blinds blocking most of the daylight
- Suspended ceiling



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



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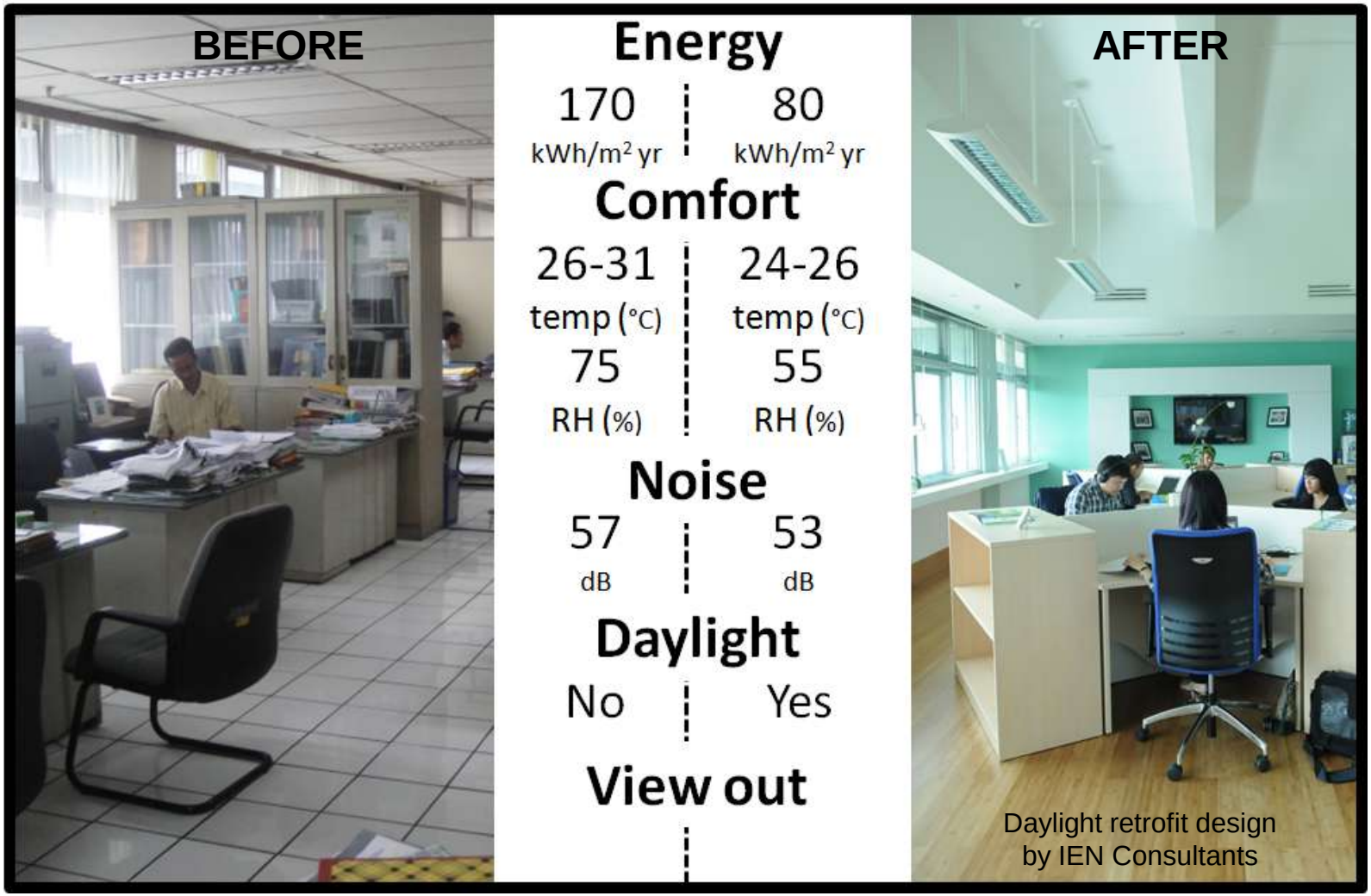
Daylit ‘biophilic’ building in Indonesia

The EECCHI office retrofit, Jakarta



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Daylit ‘biophilic’ building in Malaysia

The MMK high rise office, Damansara Perdana

Daylight design by IEN Consultants

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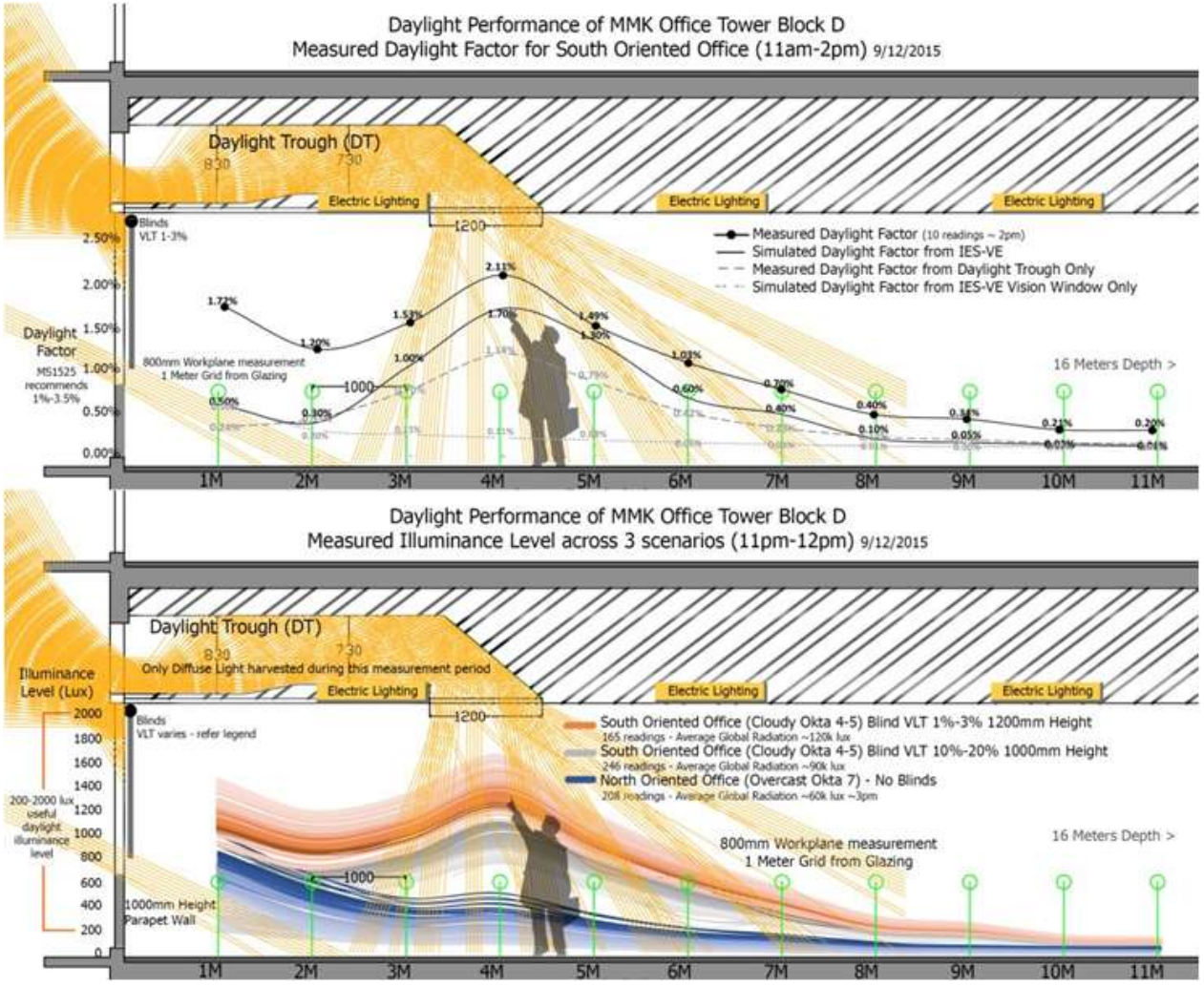
Daylit ‘biophilic’ building in Malaysia

The MMK high rise office, Damansara Perdana



Daylight design by IEN Consultants

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

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Concluding remarks

- Humans are naturally drawn to nature
- Biophilic design is important
- Biophilic design make economic sen$e
- Biophilic design is arguably under-represented in green building tools in Asia
- Several good examples of good, glare-free daylit designs in Asia

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Thank you

ANY QUESTIONS?

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