Biophilic and Daylit Building Design Solutions

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What is Biophilia?

**Bio**
connected with life and living things

**philia**
denoting fondness, especially an abnormal love for a specified thing

loosely translated as

**Love of Nature**

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
Example of Biophilia

Fallingwater
by Frank Lloyd Wright

Kampung House
(Vernacular Malaysian Architecture)
Example of Biophilic building (Vietnam)

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

Visual connection to nature & greenery from all rooms

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

Stacking Green
Vo Trong Nghia - Daylit Interior
Image by Hiroyuki Oki
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
We are Hardwired for Biophilia...

...yet, we spend 90% of our time indoors

...so, better make it worthwhile through biophilic design

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
Biophilic atrium retrofit case study: Asian Development Bank, Philippines

Two very dark atria. People working inside were desperate for daylight & visual connection to outside weather.
Biophilic atrium retrofit case study: Asian Development Bank, Philippines

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

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


• Mandatory daylight requirement for workspaces [Danish law]

The daylight factor must be 2% or higher at workspaces
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)
8. EEWH (Taiwan): EEWH-RS version 2007 + EEWH-BS version 2007
9. TREES (Thailand): All buildings, version 1.1
11. KGBS (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)
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)
Biophilia in Green Building Tools?
Most and least biophilic tools

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There’s great economic value in the positive effects of biophilic design on well-being, stress reduction and enhanced learning.
Biophilia & Economic Sense

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

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.

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

Graphics credit: Catie Ryan for Terrapin Bright Green
Biophilia & Economic Sense

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
Biophilia & Economic Sense

Improved student learning

Windowless classroom test scores dropped by 17%

Children progressed through school curricula 20-26% faster when learning in daylit environments.
Biophilia & Economic Sense

Hospitals patients recover faster

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

Khoo Teck Puat Hospital (Singapore)
Biophilia & Economic Sense

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
Biophilia & Economic Sense

Retail spaces

- 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%

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
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.
Daylit ‘biophilic’ buildings in Malaysia
The GEO office building, Greentech Malaysia HQ, Bangi

1. Occupants prefer working in daylight

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

Measured lighting consumption during office hours is only 0.56 W/m²
Daylit ‘biophilic’ buildings in Malaysia

The ST Diamond building, Putrajaya

**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.

Fixed louvers allows daylight to enter and blocks glare

Daylight and view to outside preserved
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

![Graph showing kWh/m² year comparison before and after retrofit]


Better Places for People

MGBC
Daylit ‘biophilic’ building in Indonesia

The EECCHI office retrofit, Jakarta

BEFORE

Energy
170 kWh/m² yr

Comfort
26-31 °C
75 RH (%)

Noise
57 dB

Daylight
No

View out

AFTER

80 kWh/m² yr

24-26 °C
55 RH (%)

53 dB

Yes
Daylit ‘biophilic’ building in Malaysia
The MMK high rise office, Damansara Perdana

Innovative daylight duct from facade
Daylit ‘biophilic’ building in Malaysia

The MMK high rise office, Damansara Perdana

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

• Humans are naturally drawn to nature

• Biophilic design is important

• Biophilic design make economic sense

• Biophilic design is arguably under-represented in green building tools in Asia

• Several good examples of good, glare-free daylit designs in Asia
Thank you

ANY QUESTIONS?

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