NGA *thirsty thursty* THURSDAY Quench your thirst for knowledge!

Health & Wellness Benefits of Daylighting



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May 16, 2019

MARK YOUR CALENDAR FOR THESE OTHER UPCOMING EVENTS

Texas Glass Association May 17, 2019 Waco, TX

Thirsty Thursday – Bird-Friendly Glazing (Standard Updates) June 20, 2019 webinar

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GlassBuild America September 17 - 19, 2019 Georgia World Congress Center | Atlanta, Georgia

Overview

- Some Biology
 - Circadian Rhythms & light
 - Body's response to views
 - Some data
 - Healthcare
 - Schools
 - Offices
- Global Health: The impact of our built environment



Circadian Rhythms

- Internal process regulating sleep/wake cycle & other body functions
- Cycle: ~24 hours
- "built-in" but entrained/adjusted by cues from environment (e.g. light)
- Eyes transmit "light" info to the "clock" in the brain
- Disruption of circadian cycles (misalignment with light-dark cycle) impacts health
 - Shift workers
 - Chronic jet lag



https://en.wikipedia.org/wiki/Circadian_rhythm#/media/File:Biological_clock_human.svg



Alertness/mood

Immune system

Metabolism

Hormone production

Light at the Wrong Time: Risks









Disrupted Sleep



Heart Disease



Cancer

Ø

Impaired Immune System

https://www.sciencedirect.com/science/article/pii/S004896971731759X#f0030



Reduce Blue Light at Night

Suppresses melatonin production

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Daylight is a drug....

.....And nature is the dispensing physician

~Deborah Burnett, Burnett-Benya Consulting

It's not just about daylight



Views Matter... Views of Nature Matter Even More....

Nature holds the key to our aesthetic, intellectual, cognitive and even spiritual satisfaction – E.O. Wilson

Image © David Oakey, Urban Retreat

Views of nature

Reference: The Global Impact of Biophilic Design in the Workplace

https://greenplantsforgreenbuildings.org/wp-content/uploads/2015/08/Human-Spaces-Report-Biophilic Global_Impact_Biophilic_Design.pdf

Key Findings

In studying the impact of biophilia in the workplace:



Window views of greenery and water were linked to lower stress levels compared to greater levels of stress for employees without a window.





The global trend shows offices that provide natural light, live plants, greenery and water features had a significantly higher level of employee well-being.

Nature-resembling colors such as green, blue and brown positively impacted employee well-being vs. gray colors having a significant negative impact on employees' stress levels.

Work environments with a sense of light and space creates greater levels of well-being.

https://www.buildings.com/news/industrynews/articleid/21800/title/biophilia-study-employee-health-wellness

The Data

Healthcare Schools Offices





Productivity & Health Benefits. The Business Case for Green Building, World Green Building Council, 2013, pg. 67



The Data

Healthcare Schools Offices



The Positive Power of Sunlight for Healing

'I had rather have the power of carrying my patient about after the sun, according to the aspect of the rooms, if the circumstances permit, than let him linger in a room when the sun is off. People think that the effect is on the spirits only. This is by no means the case. The sun is not only a painter but a sculptor.'



Florence Nightingale (1820-1919)



Healthcare

- 50+ studies demonstrate the positive influence of daylight and views
- Patients, visitors and staff



"Larger windows should be provided to permit more exposure to daylight and restorative nature views in patient rooms and the other spaces where depression, pain and stress are problems" – Ulrich

Roger Ulrich "Biophilic Theory and Research for Healthcare" in Biophilic Design 2008



Reduced Hospital Stays

- Ulrich's seminal study on post-op recovery time¹ **8.5% shorter stays**
 - Patients with view of nature released after 7.96 days compared to 8.71 days
 - Average expenditure per diem for hospital stay post op is \$5,059 (2004)
 - 44,993 major procedures in the US in 2007 with average 4.8 day stay
 - Average reduction in stay is 0.41 days
 - Savings could be of the order of ~\$93M per year
- Mental health hospital stays
 - Stays were **2.6 days longer** (16.7 vs 19.5) for patients without a view and daylight²
 - Stays were **3.7 days shorter** for bipolar patients in rooms with direct morning sun compared to those who had none³.
 - \$11,720 to treat each case of bipolar disorder⁴

[1] Ulrich (1984), [2] Beauchemin, [3] Benedetti (2001), [4] Begley (1998)



Other Patient Impacts

- Reduction in pain medication use/cost
 - Patients exposed to more daylight/view to nature consistently suffer less pain
 - In one study patients exposed to 46% more daylight took 22% less pain medication per hour and accumulated 21% less pain medication cost per stay¹
- Improved outcomes
 - 40% of patients in windowless ICUs developed Post-Op delirium compared to 18% in spaces with windows²
 - Increased number of infant jaundice cases when windows covered or shaded.³
 - Alzheimer's patients show lower agitation levels with higher exposure to daylight

[1] Walch et al (2005), [2] Collins et al (1975), [3] Ulrich (2008)



Impact on Medical Staff

- Reduced Stress
 - Nurses exposed to daylight for 3 or more hours/day reported less stress (Alimoglu)
 - Nurses with access to daylight/views showed reduced fatigue and reduced stress (Zadeh)
- Reduced risk of circadian rhythm disruption
 - Better weight management
 - Reduced risk of cancers
 - Improved mood and reduced depression
- Decreased sick days up to 6.5%
- Reduced medication dispensing errors
 - Adverse drug events cost \$2B annually.
 - A 1996 study reported presence of windows reduced errors by 40%.
- Improved alertness
- Improved task performance



Healthcare Benefits: Daylight and Views

- Reduced costs
- Improve patient outcomes, shorten lengths of stays
- Attract new patients
- Recruit/retain existing staff
- Reduce medical errors
- Energy conservation
- \$93M could be saved annually by providing patients views¹



[1] The economics of Biophilia, Terrapin Bright Green LLC, 2012 (assume 0.41 day reduced hospital stays)



And yet...

In State-of-the-Art US hospitals only 44% of occupants have access to daylight

Only 20% of the floor area is within 15ft of the window

Most windows are in patient rooms where codes require them. The staff remains in the interior with no access to daylight and views



The Data

Healthcare **Schools** Offices



Impact of Daylight and Views in Schools

Improved Health & Growth
Better mental and physical health

Less dental decay, improved eye sight, increased growth, improved immune system

Increased Attendance

September

- Both student and teacher
- Increased Student Achievement
 - 21% improvement in test scores in fully day-lit classrooms (Nicklas & Bailey 1997)
- 20% and 26% faster learning rates in Math and English (HMG, 1999)
- Improved Behavior
 - Students in windowless classrooms are more hostile, hesitant, and maladjusted
 - Students in windowless classrooms tend to be less interested in their work & complain more
- Teacher Retention
- Energy Savings

Teachers: Windows in Schools

"When I've had it with the kids and I can't answer another question, I just take a minute, look out the window at the view, and then I'm OK. I'm calm and ready to go back into the fray"

(Teacher from Capistrano School District, Heschong Mahone Group Report, 1999).

Image © Project-ray, www.project-ray.com



Students: Daylighting in Schools

"schools could be saving up to one month of instructional time for the reading and math curriculum that could be used for other areas of learning."

Heschong Mahone Group study of daylighting in schools



The Data

Healthcare Schools **Offices**



Offices

- Productivity
- Reduced absenteeism
- Attraction & retention

¹Heschong Mahone Group, Inc. (2003). Windows and Offices: A Study of Office Worker Performance and the Indoor Environment –CEC Pier 2003.

²Cheung et al. Impact of workplace daylight exposure on sleep, physical activity and quality of life, 2013

³ Elzeyadi Daylighting – Bias and Biophilia, 2011

⁴ Edwards & Torcellini – A literature review of the effects of natural light on building occupant, 2002

Windows vs no Windows

- 7-12% increase in call processing¹
- 16% improvement on cognitive tests¹
- 15% more time on primary tasks¹
- Better quality of life scores, vitality, sleep, efficiency²
- 46 mins more sleep a night²
- Less sick leave³
- 200% decrease in turnover⁴
- Tripling of job applicants⁴



But....

All the positive benefits disappear if the occupant experiences thermal or visual discomfort



https://commons.wikimedia.org/wiki/File:Goose_bumps.jpg



Thermal Discomfort

10% reduction in performance at 59°F & 86°F¹





...a small increase in air temperature...of 74°F to 76°F was seen to slow worker performance by 2%³

Thermal discomfort also lowers satisfaction with other IEQ factors²

¹2006 analysis of 24 studies (REHVA Guidebook)

² Geng et. al. The Impact of thermal environment on occupant IEQ perception and productivity, Building and Environment, 121, 2017.
³Windows and Offices: A Study of Office Worker Performance and the Indoor Environment, California Energy Commission by Heschong Mahone Group



Impact of Glare

"...in this model we also see Glare from Window as a negative influence, reducing performance by **17%**.

Thus this negative effect of Glare from Window could be a **self-canceling effect of the benefits from the Primary View**"



Windows and Offices: A Study of Office Worker Performance and the Indoor Environment, California Energy Commission by Heschong Mahone Group

https://www.energy.ca.gov/2003publications/CEC-500-2003-082/CEC-500-2003-082-A-09.PDF



"We have a deep hereditary affinity for the natural world and modern life and the built environment increasingly isolates us from it." – Nick Baker

http://www.fau.usp.br/aut5828/Conforto_Termico/Baker_2000_Plea_We_Are_All_Outdoor

Animals.pdf

The Windowless Office



http://www.strangefarmer.com/content/item/188564.html

http://corbettbarr.com/say-goodbye-to-the-cubicle-for-good/

We spend 90% of our time indoors! Under constant output artificial lights



Leading causes of death in the US

Impacts due to our built environment?

- Circadian disruption?
- Lack of views of nature?





Chronic Disease Epidemic

Mental health disorders and cardiovascular diseases:

- Predicted to be <u>top 2 illnesses</u> worldwide by 2020 (WHO)
- Stress is a prime contributor to both!
- Views to nature reduce stress
- **Obesity** and **Diabetes** epidemics
 - Circadian disruption: Negative impact on metabolism

We spend 90% of our time indoors!

And the built environment has a significant impact on these issues





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Helpful Resources and References

- 1. NGA webpage: glasswebsite.com/daylighting
- 2. Daylighting GIB [FM04-12 (2019)]



Thirsty Thursday May 16, 2019

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