

NUS MSc INTEGRATED SUSTAINABLE DESIGN
10TH ANNIVERSARY WEBINAR SERIES. AUG 16 - AUG 30, 2021

CATIE RYAN BALAGTAS

Director of Projects at Terrapin | Co-Founder of SouthFARM

24 AUGUST 2021

Biophilic Design for Health and Well-being

This is the print screen of the video of Catie Ryan Balagtas from 24.08.21, presented in the EPFL-ENV-462 lesson on Biophilic Design on Monday, 28 April 2024.

Retrieved from YouTube: <https://www.youtube.com/watch?v=8G1uQrjGvZ0>



APPLYING BIOPHILIC DESIGN



HEALTH & WELLBEING IN THE BUILT ENVIRONMENT

TERRAPIN BRIGHT GREEN





BIOPHILIA HYPOTHESIS

“Biophilia...

is the innately emotional affiliation
of human beings to other living
organisms....

Life around us exceeds in
complexity and beauty anything
else humanity is ever likely
to encounter.”

Edward O. Wilson
The Biophilia Hypothesis

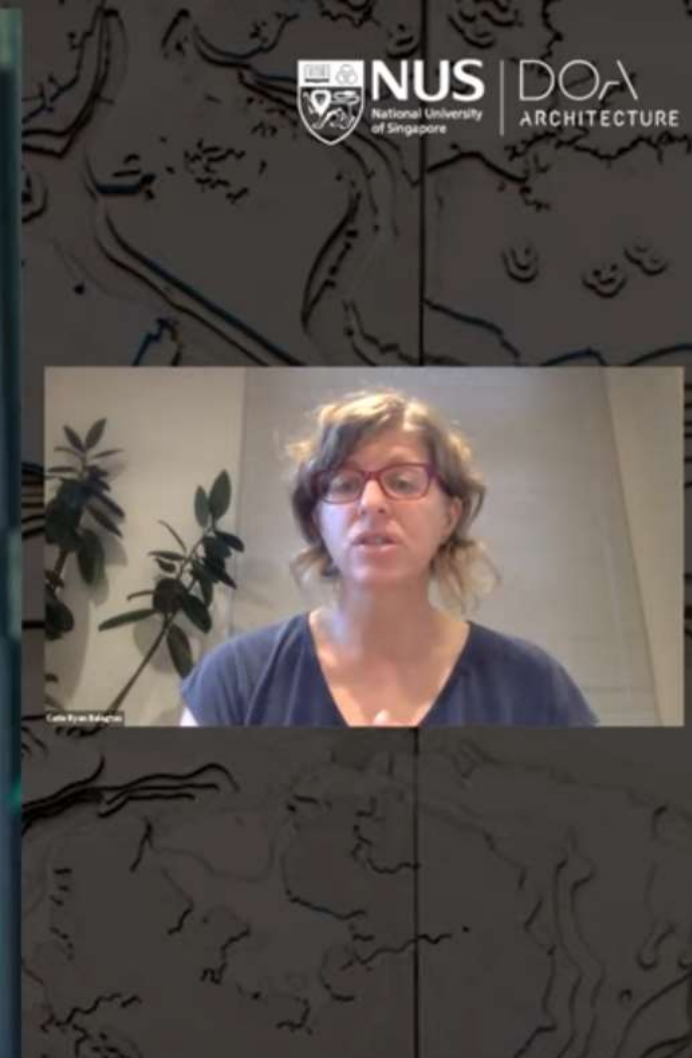
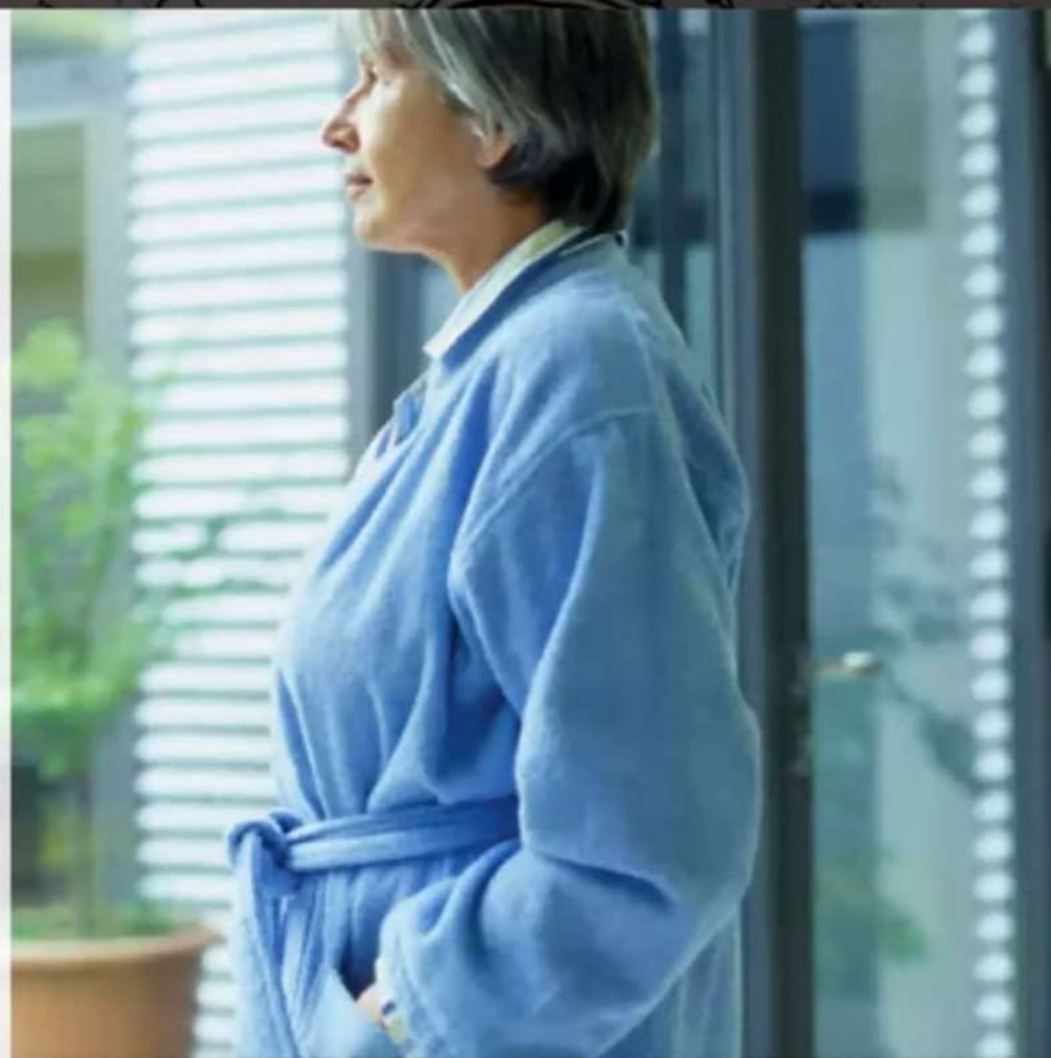
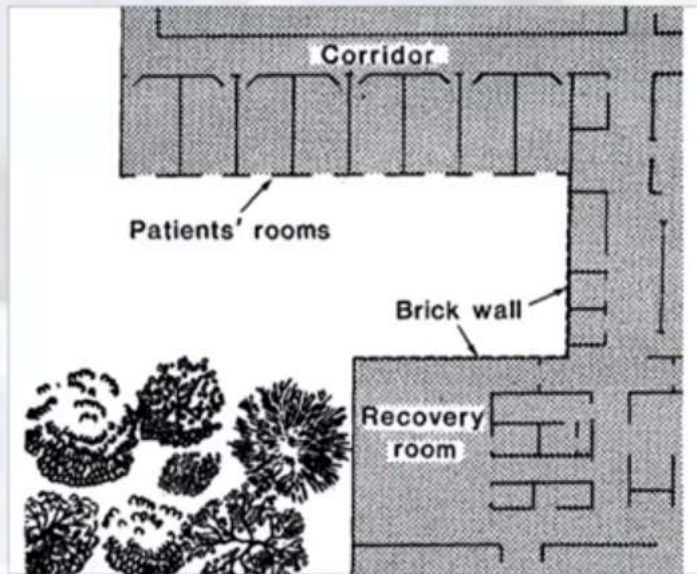
© TERRAPIN BRIGHT GREEN



GREEN HELPS PEOPLE HEAL ULRICH STUDY, 1984

A view to nature equals...

- Shorter hospital stays
- Fewer negative comments
- Fewer strong analgesics



SCIENCE OF BIOPHILIA

PROSPECT & REFUGE THEORY

People prefer unimpeded **view of expanse** with a **covered back and canopy overtop**.

Seminal Publications

The Experience of Landscape.
Appleton, 1975

The relation between perceived sensory dimensions of urban green space and stress restoration.
Grahn & Stigsdotter, 2010

© TERRAPIN BRIGHT GREEN

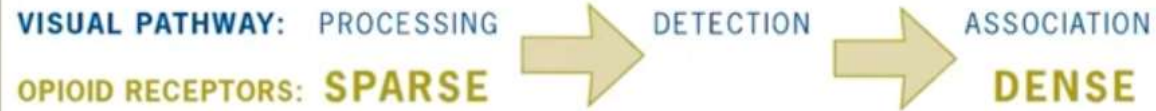


VISUAL PROCESSING

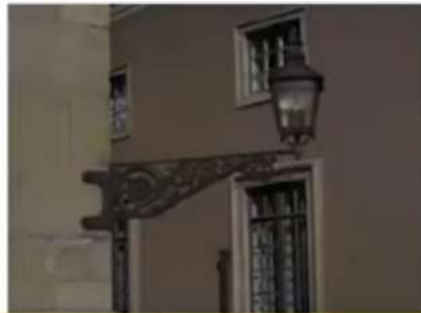
SCIENCE OF BIOPHILIA

Complex, dynamic natural scenes trigger a greater pleasure response in the brain.

The more associations we can make, the easier something is to process.



SPARSE



DENSE

Seminal Publications

Perceptual Pleasure and the Brain.
Biederman & Vessel, 2006

© TERRAPIN BRIGHT GREEN



SCIENCE OF BIOPHILIA

FRACTAL FLUENCY

Fractal patterns allow **easier visual processing**

- Visual Preference
- Mid-range complexity elicit **restoration & relaxation**
- High complexity can engender **stress**

Seminal Publications

Investigations of human EEG response to viewing fractal patterns. Hagerhall et al., 2008

The Implications of Fractal Fluency for Biophilic Architecture. Taylor et al., 2018

© TERRAPIN BRIGHT GREEN



SCIENCE OF BIOPHILIA

ATTENTION RESTORATION THEORY

Viewing nature puts the brain into a state of soft fascination.

- Restores attention functioning capacity
- 40 seconds of viewing nature is enough

Seminal Publications

The Restorative Benefits of Nature Kaplan, 1995

40-second green roof views sustain attention: The role of micro-breaks in attention restoration Lee et al., 2015

© TERRAPIN BRIGHT GREEN



SCIENCE OF BIOPHILIA

PSYCHOACOUSTICS & NATURE SOUNDS

Water and other nature sounds outperform white noise in:

- Perceived ability to mask noises
- Cognitive performance enhancement
- Perceived tranquility

Bird song promotes:

- Feelings of safety
- Positive consumer behavior

Seminal Publications

Effects of Five Speech Masking Sounds on Performance and Acoustic Satisfaction. Haapakangas et al., 2011

Of cricket chirps and car horns: The effect of nature sounds on cognitive performance. Van Hedger et al., 2019

Sound and safe: The effect of ambient sound on the perceived safety of public spaces. Sayin et al., 2015

© TERRAPIN BRIGHT GREEN



SCIENCE OF BIOPHILIA

ALLIESTHESIA

Temperature differentials across the body can lead to a **pleasure response**.

Often preferable to remaining in homeostasis

Seminal Publications

Revisiting an old hypothesis of human thermal perception: alliesthesia. de Dear, 2011

Perception of Transient Thermal Environments: pleasure and alliesthesia. Parkinson, de Dear, Candido, 2012

© TERRAPIN BRIGHT GREEN



15 PATTERNS OF BIOPHILIC DESIGN

1. VISUAL CONNECTION W/ NATURE



2. NONVISUAL CONNECTION W/ NATURE



3. NON-RHYTHMIC SENSORY STIMULI



4. THERMAL & AIR FLOW VARIABILITY



5. PRESENCE OF WATER



6. DYNAMIC & DIFFUSE LIGHT



7. CONNECTION W/ NATURAL SYSTEMS



8. BIOMORPHIC FORMS & PATTERNS



9. MATERIAL CONNECTION W/ NATURE



10. COMPLEXITY & ORDER



11. PROSPECT



12. REFUGE



13. MYSTERY



14. RISK/PERIL



15. AWE



© TERRAPIN BRIGHT GREEN



HEALTH OUTCOMES MATRIX

NATURE INSIDE: TOOLKIT F

Nature in the Space

Natural Analogues

Nature of the Space

© TERRAPIN BRIGHT GREEN

15 PATTERNS	STRESS REDUCTION		COGNITIVE PERFORMANCE		EMOTION, MOOD & PREFERENCE
Visual Connection with Nature	Heart rate Blood pressure	Parasympathetic system activity	Mental engagement Attentiveness		Attitude Motivation Neurological Rumination Future Discounting
Non-Visual Connection with Nature	Blood pressure Stress hormones		Cognitive performance Creativity		Perceived mental health Tranquility Pain management
Non-Rhythmic Sensory Stimuli	Heart rate Blood pressure	Sympathetic system activity			Dwell time Attention Exploration
Thermal & Airflow Variability	Comfort		Task performance		Pleasure (alliesthesia)
Presence of Water	Overall stress Heart rate	Blood pressure	Cognitive performance Creativity		Positive emotional responses Tranquility Preferences
Dynamic & Diffuse Light	Circadian system functioning	Visual comfort	Cognitive performance Behavioral performance		Attitude
Connection w/ Natural Systems	Overall health				Perception of environment
Biomorphic Forms & Patterns			Learning outcomes		View preference
Material Connection with Nature	Heart Rate Variability	Blood pressure Stress hormones	Task performance Creativity		Material preference Self-reported calming effect
Complexity & Order	Perceptual and physiological	Stress responses	Environmental navigation Learning outcomes	Brainwave response	View preference
Prospect	Overall stress				Visual interest & sustained attention Perceived safety Comfort
Refuge					Comfort Perceived safety
Mystery					Pleasure response
Risk/Peril					Peasure response
Awe	Stress related symptoms				Pro-social behavior Attitude Overall happiness





NATURE IN THE SPACE

VISUAL CONNECTION
W/ NATURE

NON-VISUAL CONNECTION
W/ NATURE

NON-RHYTHMIC
SENSORY STIMULI

PRESENCE OF WATER

DYNAMIC & DIFFUSE LIGHT

THERMAL & AIRFLOW
VARIABILITY

CONNECTION W/ NATURAL SYSTEMS

See "14 Patterns of Biophilic Design" publication for photo credits, unless otherwise noted.



6

DYNAMIC AND DIFFUSE LIGHT

Leverages varying intensities and color of light and shadow that change over time to create conditions that occur in nature.

Think...

Dappled light on the forest floor
Diurnal changes in light color

Consider...

Circadian effective lighting design
Sky views
Luminance ratios
Light from multiple sources
Partition translucence
Fractal patterns



Improved Physiological Response

Positively impacted circadian system functioning
Increased visual comfort

Improved Cognitive Functioning

Improvements to cognitive and behavioral performance

Emotions, Mood & Preference

Positively impacted attitude and overall happiness

© TERRAPIN BRIGHT GREEN



NATURAL ANALOGUES

BIOMORPHIC FORMS & PATTERNS

MATERIAL CONNECTION W/ NATURE

FEDERAL CENTER SOUTH, BLDG 1202, SEATTLE, WA, ZGF © ZGF Architects

COMPLEXITY & ORDER

Images by Sharon Ang from Pinabay

SCIENCE OF BIOPHILIA

ECONOMICS OF NATURE IN THE SPACE



PATH: VIEWS TO NATURE



RESTORED ATTENTION



IMPROVED PERFORMANCE



HEALTHY ROI

Seminal Publications

Biophilia in the Workplace Heschong, 2003; Loftness, 2015

Biophilia in Hospitality Browning et al., 2016

Biophilia at Schools Dadvand et al., 2015

© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

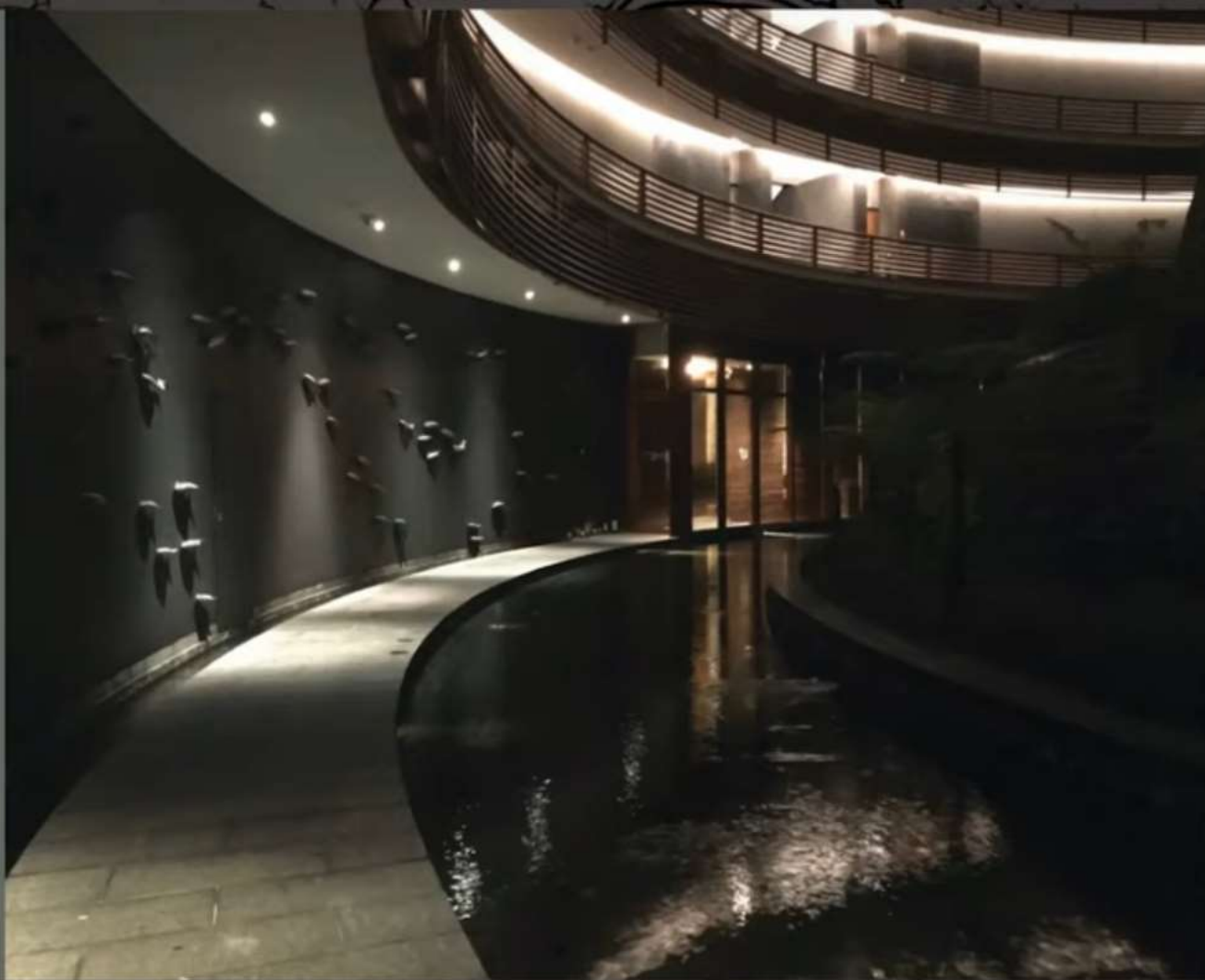
HOSPITALITY

Auriga Spa, Sentosa

- Representational Nature
- Presence of Water
- Mystery



FOSTER + PARTNERS, 2009
CAPELLA SENTOSA HOTEL & RESORT
SENTOSA ISLAND, SINGAPORE
PHOTO: CATIE RYAN; INSET COURTESY OF DEZEEN
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

HOSPITALITY

Sasanqua Spa

- Visual Connection
- Diffuse & Dynamic Light



CLODAGH DESIGN, 2001
KIAWAH ISLAND, SOUTH CAROLINA USA
PHOTOS: DANIEL AUBRY
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

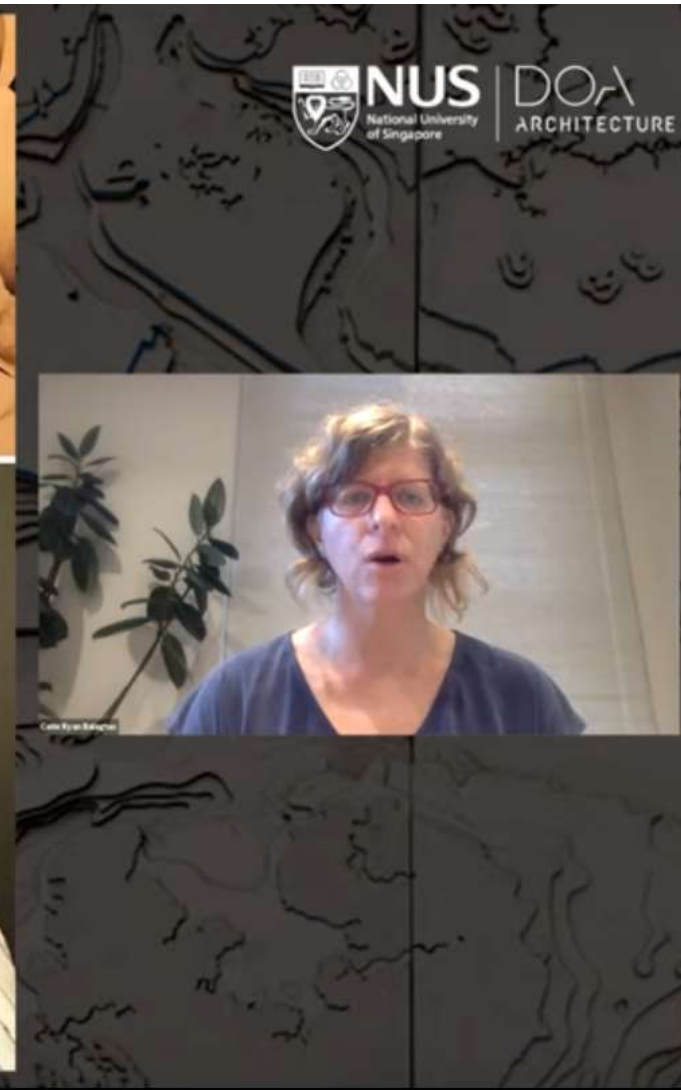
RESIDENTIAL

WCs at Montgomery Street

- Natural Analogues
- Tactile Connection



OWNER DESIGNED, 2018
JERSEY CITY, NEW JERSEY USA
PHOTOS: CATIE RYAN
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

RESIDENTIAL

One Columbus Place

- Visual Connection with Nature
- Refuge
- Gathering Spaces



COOKFOX ARCHITECTS DCP, 2018
NEW YORK CITY, NEW YORK
PHOTOS: COOKFOX
© TERRAPIN BRIGHT GREEN

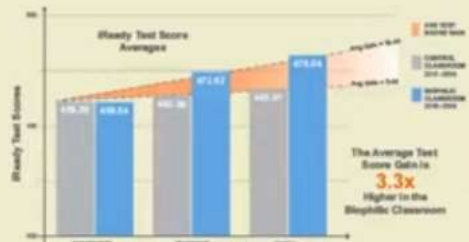


NATURE INSIDE CASE STUDY

EDUCATION

Green Street Academy

- Biomorphic Patterns
- Visual Connection with Nature
- Dynamic & Diffuse Light



CRAIG GAULDEN DAVIS ARCHITECTS, 2018
BALTIMORE, MARYLAND USA
RENDERING: CGD ARCHITECTS
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

RETAIL

SeeSaw Coffee

- Multisensory Connection
- Prospect
- Mystery



NOTA ARCHITECTS, 2018
CHAOYANG JOYCITY, BEIJING, CHINA
PHOTOS: NOTA ARCHITECTS
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

HEALTHCARE

Maggie's Centre Leeds

- Visual Connection
- Diffuse & Dynamic Light
- Biomorphic Forms
- Mystery



HEATHERWICK STUDIO, 2020
WITH BALSTON AGIUS LANDSCAPE
ST. JAMES'S UNIVERSITY HOSPITAL
YORKSHIRE, UNITED KINGDOM
PHOTOS: HURTON + CROW
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

COMMUNITY

Calgary Public Library

- Material Connection
- Prospect
- Risk



SNØHETTA, 2018
CALGARY NEW CENTRAL LIBRARY
CALGARY, ALBERTA CANADA
PHOTOS: MICHAEL GRIMM
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

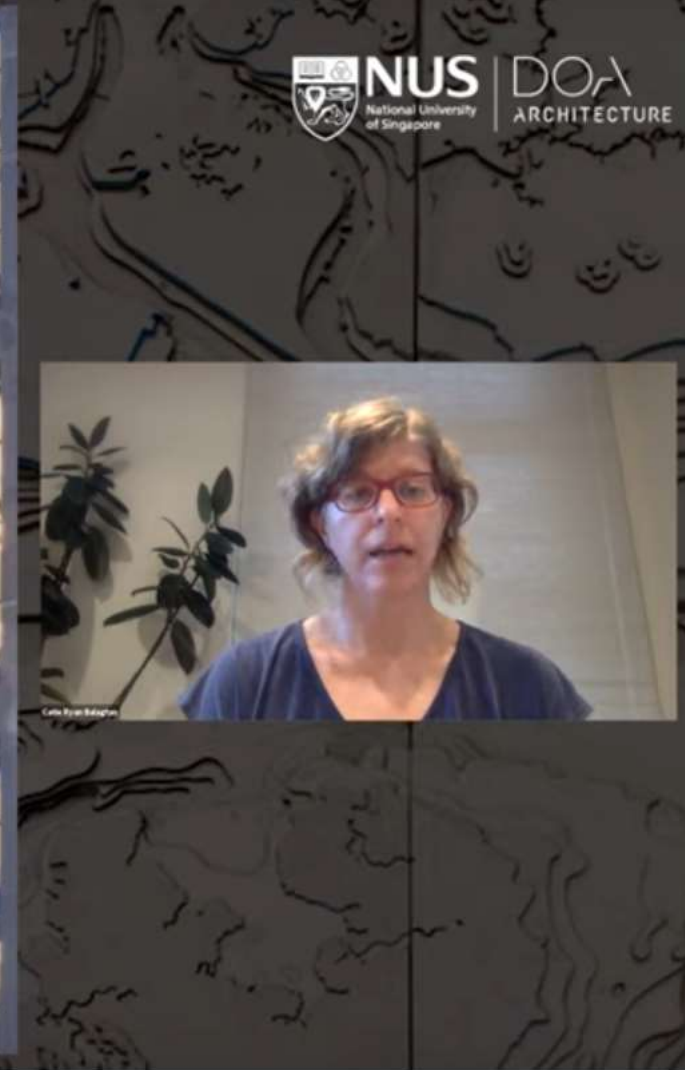
COMMUNITY

Zeitz MOCAA

- Biomorphic forms
- Awe



HEATHERWICK STUDIO, 2017
ZEITZ MEUSEUM OF
CONTEMPORARY AFRICAN ART
CAPE TOWN, SOUTH AFRICA
PHOTOS: IWAN BAAN
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

COMMUNITY

512 W 22nd @ High Line

- Visual Connection
- Prospect
- Connection with Natural Systems

NEW YORK, NEW YORK USA
COOKFOX ARCHITECTS, 2019
PHOTOS: BRUCE DAMONTE

DILLER SCOFIDIO + RENFRO, PIET OUDOLF,
JAMES CORNER FIELD OPERATIONS, 2009
© TERRAPIN BRIGHT GREEN



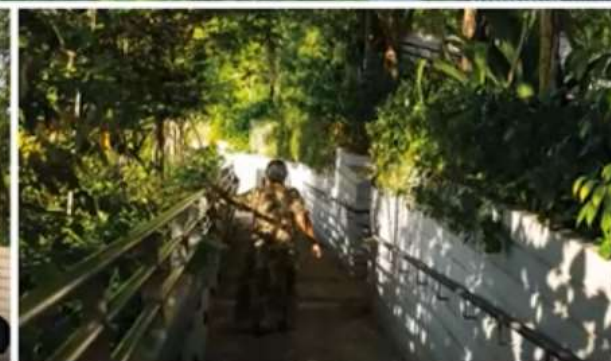
COMMUNITY

Kampung Admiralty

- Visual Connection
- Non-Visual Connection
- Complexity & Order
- Prospect



WOHA & RAMBOLL STUDIO DREISEITL
SINGAPORE, 2018
PHOTOS: RAMBOLL



NATURE INSIDE CASE STUDY

COMMUNITY

Transit Spaces & Places

- Diffuse & Dynamic Light
- Biomorphic Forms
- Complexity & Order
- Awe

SANTIAGO CALATRAVA

BROOKFIELD PLACE, 1992
TORONTO, ONTARIO CANADA
PHOTO: CATIE RYAN

WORLD TRADE CENTER OCULUS, 2016
NEW YORK CITY, NEW YORK USA
PHOTO: MAX TOUHEY
© TERRAPIN BRIGHT GREEN



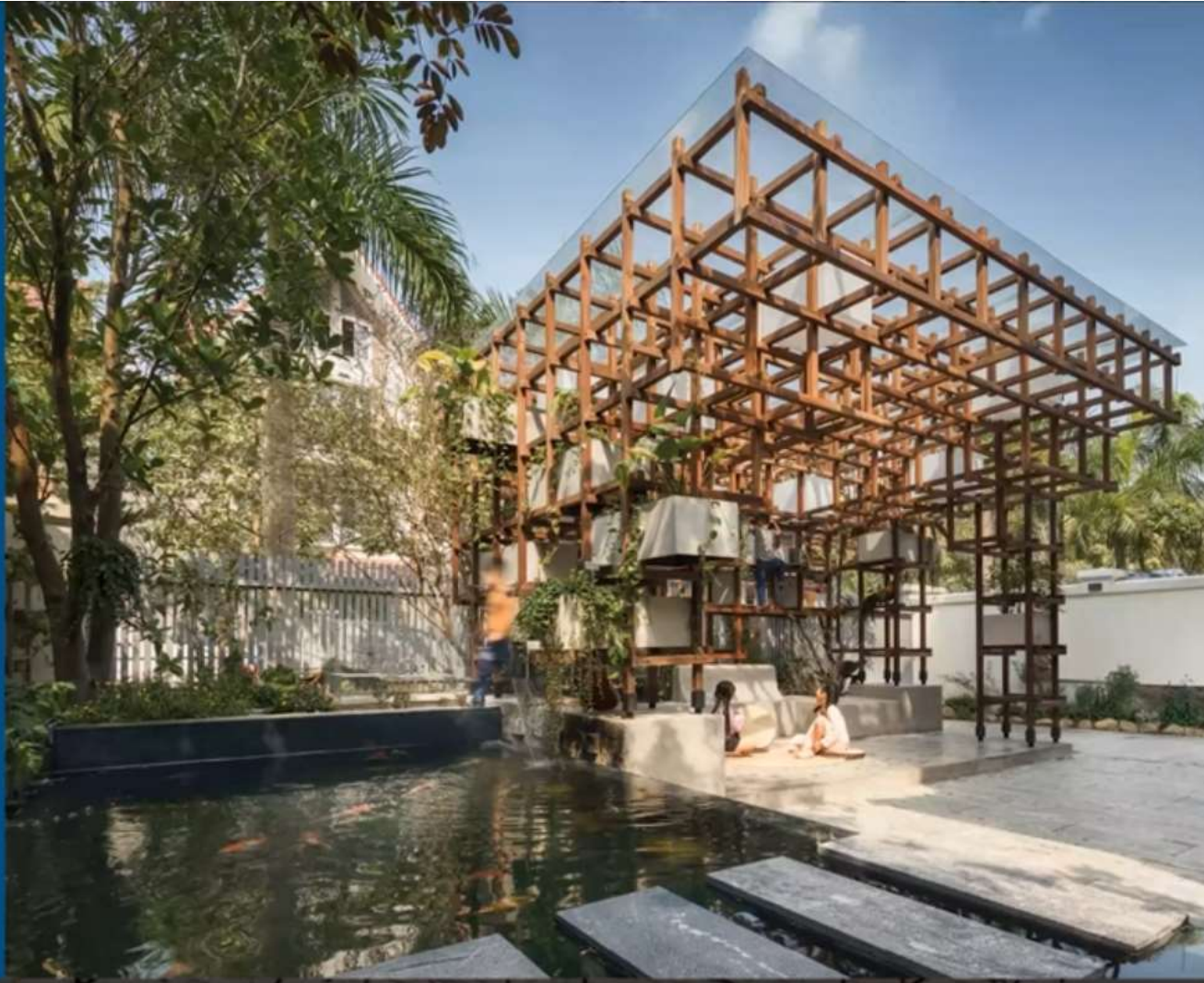
NATURE INSIDE CASE STUDY

COMMUNITY

VAC Library

- Multi-sensory Connection with Nature
- Presence of Water
- Connection with Natural Systems

FARMING ARCHITECTS, 2018
HANOI, VIETNAM
PHOTO: FARMING ARCHITECTS
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

URBAN PARK

Paley Park

- Presence of Water
- Refuge
- Diffuse & Dynamic Light



ZION BREEN RICHARDSON ASSOC., 1967
NEW YORK CITY, NEW YORK
PHOTOS: RITA TROMBIN (LEFT) AND
BILL BROWNING (RIGHT)
© TERRAPIN BRIGHT GREEN



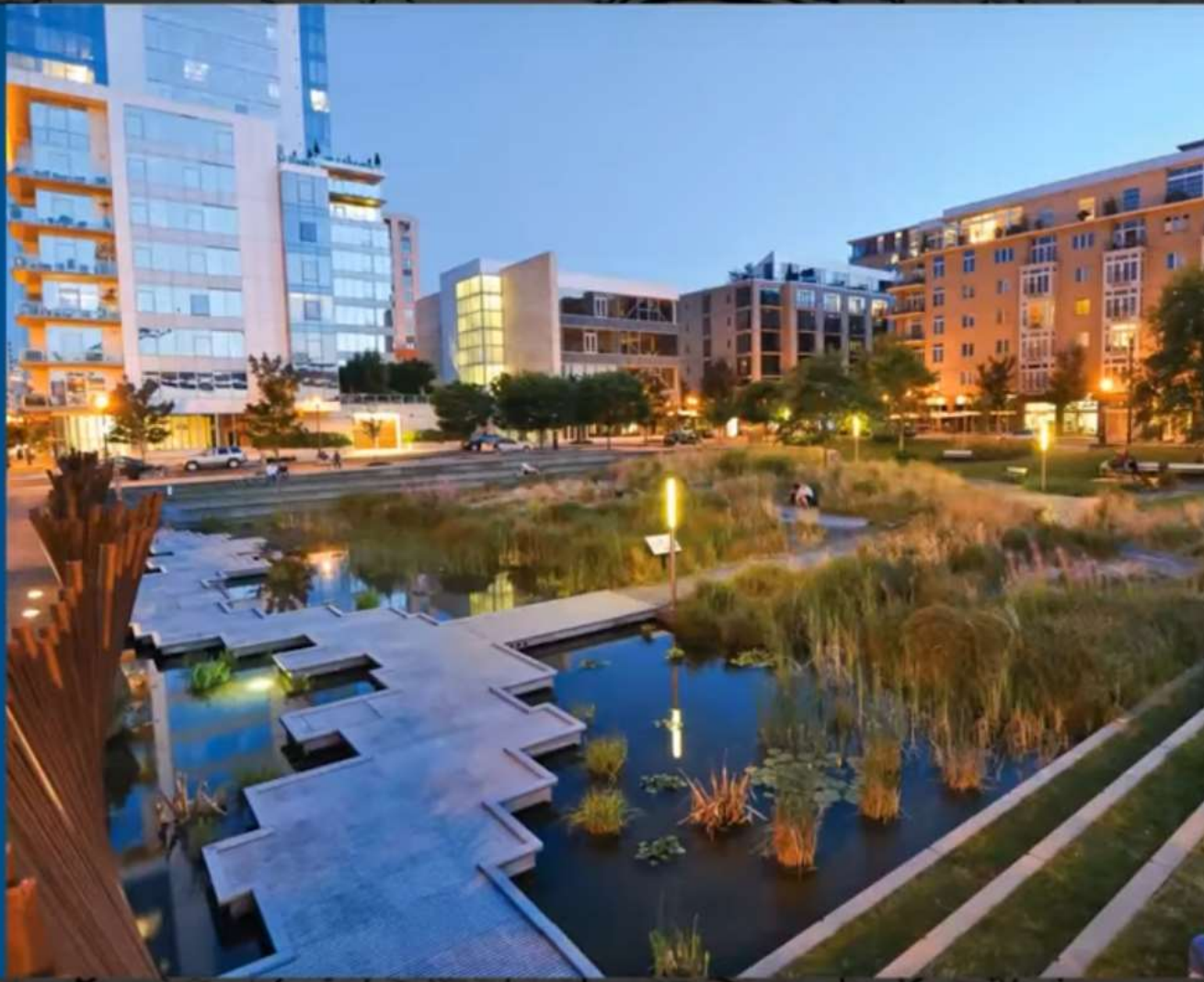
NATURE INSIDE CASE STUDY

URBAN PARK

Tanner Springs

- Visual Connection with Nature
- Presence of Water
- Connection with Natural Systems

STUDIO DREISEITL & GREENWORKS, 2010
PORTLAND, OREGON USA
PHOTO: GREENWORKS
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

WORKPLACE

Interface Base Camp

- Prospect
- Refuge
- Biomorphic Patterns



PERKINS+WILL, 2018
ATLANTA, GEORGIA
PHOTOS: CATIE RYAN
© TERRAPIN BRIGHT GREEN



WORKPLACE

641 Sixth Avenue



Before



After



NATURE INSIDE CASE STUDY

WORKPLACE

641 Ave of the Americas

- Visual Connections with Nature
- Prospect
- Connection with Natural Systems

NEW YORK, NEW YORK USA
COOKFOX ARCHITECTS, 2006
PHOTOS: BILYANA DIMITROVA
© TERRAPIN BRIGHT GREEN



NATURE INSIDE CASE STUDY

WORKPLACE

641 Ave of the Americas

Workplaces with the **lowest visual connection with nature** reported the **highest work related stress**.

NEW YORK, NEW YORK USA
COOKFOX ARCHITECTS, 2014
GRAPHICS: TERRAPIN BRIGHT GREEN
© TERRAPIN BRIGHT GREEN

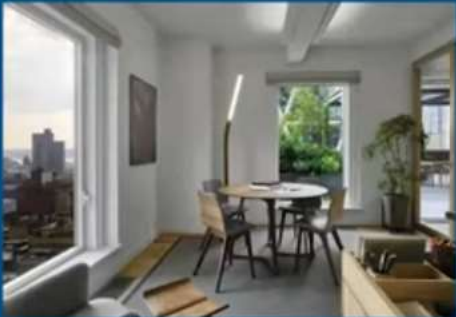


NATURE INSIDE CASE STUDY

WORKPLACE

250 W 57th Street

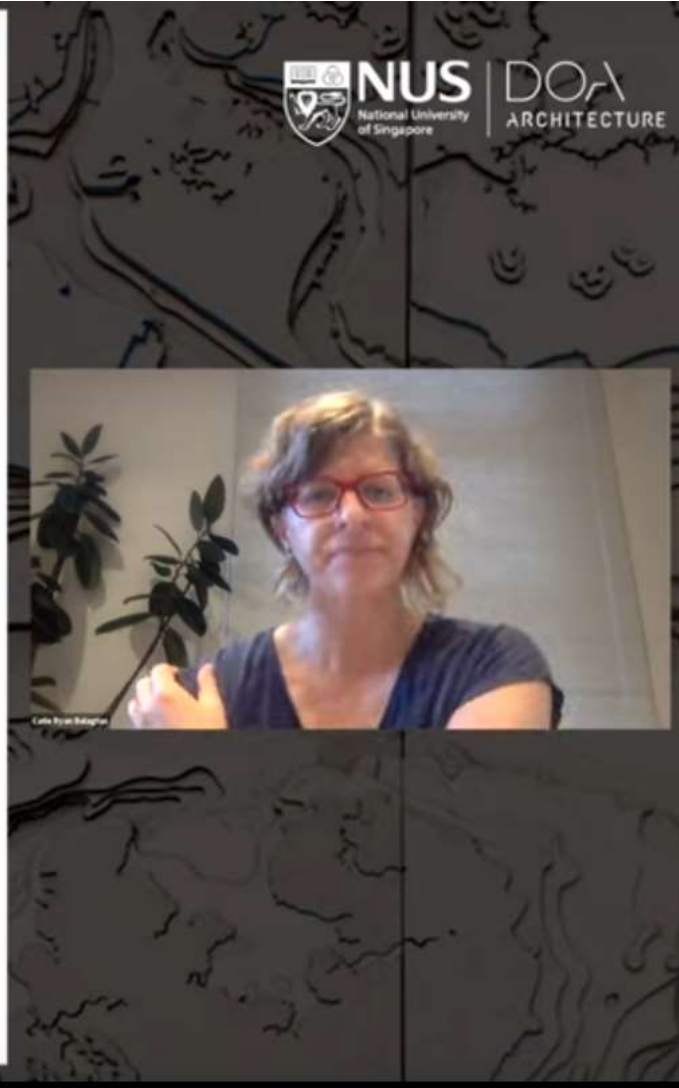
- Visual & Material Connections
- Prospect & Refuge
- Natural Systems



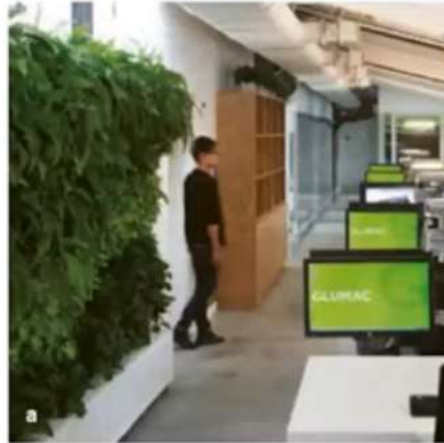
NEW YORK, NEW YORK USA
COOKFOX ARCHITECTS, 2017
PHOTOS: ERIC LAIGNEL
© TERRAPIN BRIGHT GREEN



Knowing what works...



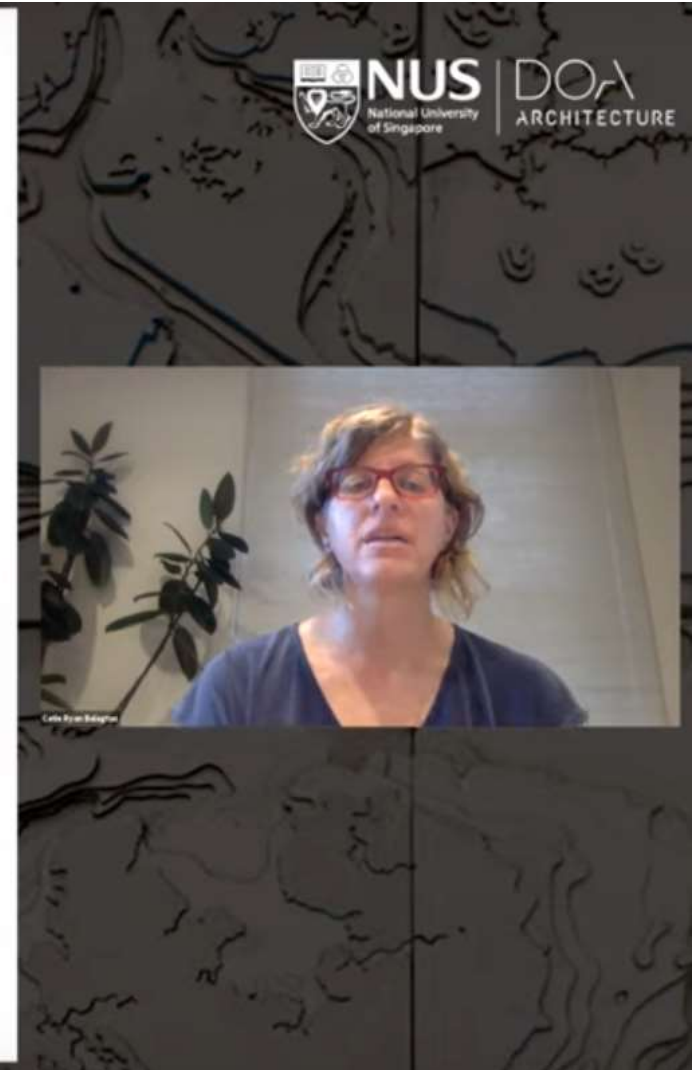
...and what doesn't work.



Before



After



3 RULES OF THUMB FOR BIOPHILIC DESIGN

1. MULTISENSORY EXPERIENCE

Positive perceptions of a place are stronger and more memorable when **multiple senses** are engaged in the experience:

- Olfactory & Haptic Stimuli
- Thermal Alliesthesia
- Psychoacoustics
- Perceptions of Time & Movement

2. EMOTIONAL CONNECTION

A picture may say a thousand words, but **personal experience** wins hearts and minds.

On precedent scouting trips, include destinations that highlight the biophilic design goals and opportunities to get buy-in from clients and project teams.

3. QUALITY OVER QUANTITY

There's no science showing correlation between quantity of design patterns and degree of health impact.

Better to **focus on a few** patterns and do them well.



DECISION TIMELINE FOR BIOPHILIA INTEGRATION

NATURE INSIDE: TOOLKIT B



© TERRAPIN BRIGHT GREEN

