

THE ART OF ARCHITECTURAL DAYLIGHTING

Immeasurable & Measurable Dimensions of Daylighting

Mary Guzowski, Professor, School of Architecture, University of Minnesota

“A great building, in my opinion, must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable.” - Louis Kahn, 1973, Pratt Institute

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Biophilic Net-Positive Design Project

About Resources Design Integration Project Events Living Labs News

BIOPHILIC DESIGN seeks to connect our inherent need to affiliate with nature in the modern built environment. - Stephen R. Keller

NET-POSITIVE DESIGN is often used as short-hand for buildings that generate more resources/energy than they consume... Adding [positive] value to an ecological system means increasing its systemic capacity to generate, sustain and evolve increasingly higher orders of vitality and viability for life of a particular place. - Pamela Mang & Bill Reed

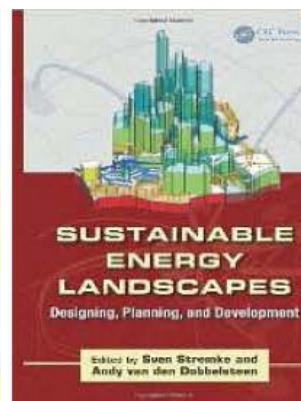
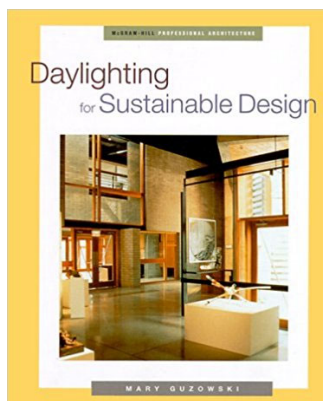
BIOPHILIC NET-POSITIVE DESIGN PROJECT: A "Living Lab" collaboration in research, teaching & practice

The *Biophilic Net-Positive Design Project* is a collaboration between faculty in architecture, interior design, and landscape architecture to explore the intersections between new theories and practices in biophilic and net-positive design, including their relationships to sustainable, resilient, regenerative, and socially responsible and equitable design. The project explores the potential of developing a *Biophilic Living Lab* at the University of Minnesota to improve health and environmental benefits across design scales and disciplines.

2020-2021 Project Events Schedule

BIOPHILIC & HEALTH DESIGN RESOURCES

- CREATING BIOPHILIC DESIGN
- The Global Impact of Design on the Workplace



6 (7) DAYLIGHT PATTERNS: Poetic + Pragmatic Design Integration

Comments – Questions – Integration with your current work?

INTEGRATED LIGHT

Placed Light

Choreographed Light

ATMOSPHERIC LIGHT

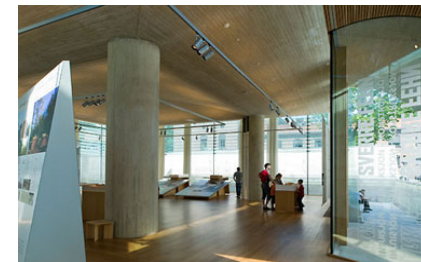
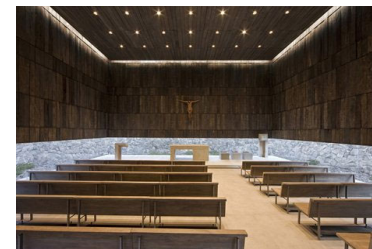
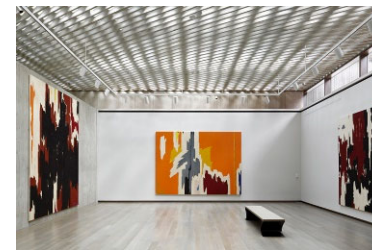
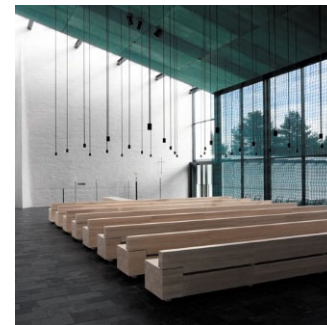
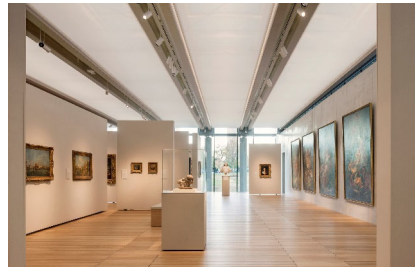
STRUCTURED LIGHT

SCULPTED LIGHT

Material Light

BIOPHILIC Light

(FILL IN THE BLANK) LIGHT



THE ART OF ARCHITECTURAL DAYLIGHTING

Immeasurable & Measurable Dimensions of Daylighting

1. INTEGRATED LIGHT

Daylight Toolkit: A Robust Design Process

- *Clyfford Still Museum: Allied Works Architecture*

2. OVERVIEW (6)

DAYLIGHT PATTERNS

Discussion

- *Comments, Questions, Application*



Henning Larsen: Eystur Town Hall (Nick Lehoux); Olafer Olsson: ARoS, Aarhus (ArchDaily: top; Wall Street Journal: bottom);

INTEGRATED LIGHT: Integrating Poetics & Performance

Daylighting Design Process: Intentions, Methods & Tools



CLYFFORD STILL MUSEUM, Denver Colorado, USA; Allied Works Architecture Credits: Raul Garcia (left), Jeremy Bittermann (right)

CLYFFORD STILL MUSEUM: Allied Works Architecture

“A great building, in my opinion, must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable.”

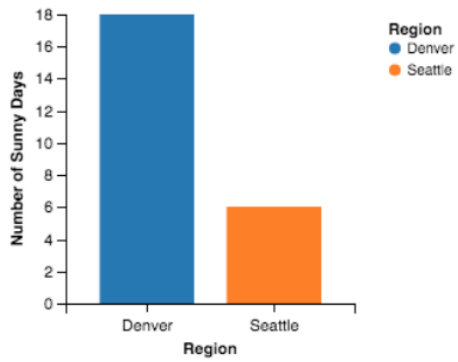
- Louis Kahn, 1973 lecture at Pratt Institute

“Moments of wonder are what we all want. . . The attempts are from an analytical point of view [from Arup] and the leaps we [Allied Works] have to make beyond analytics to try to find the quality.”

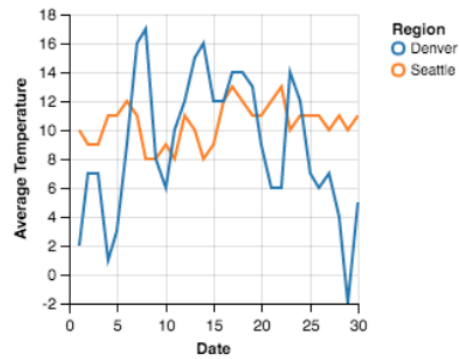
- Brad Cloepfil, Allied Works Architecture

Site & Context

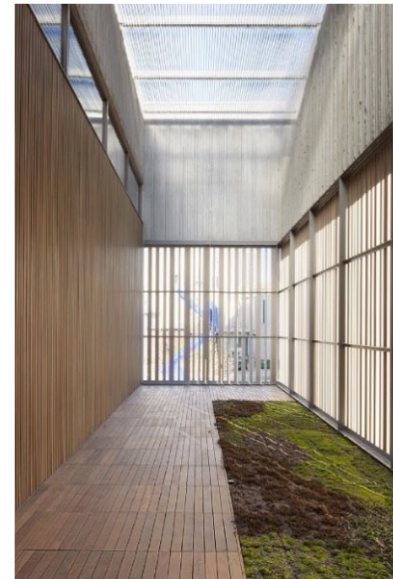
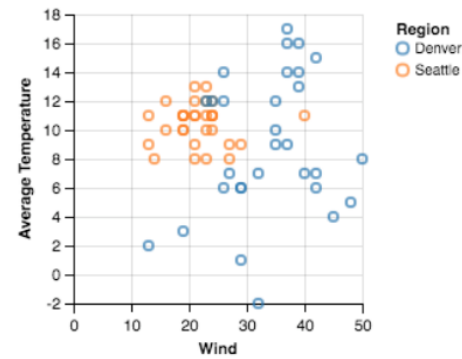
Sunny Days



Daily Temperature

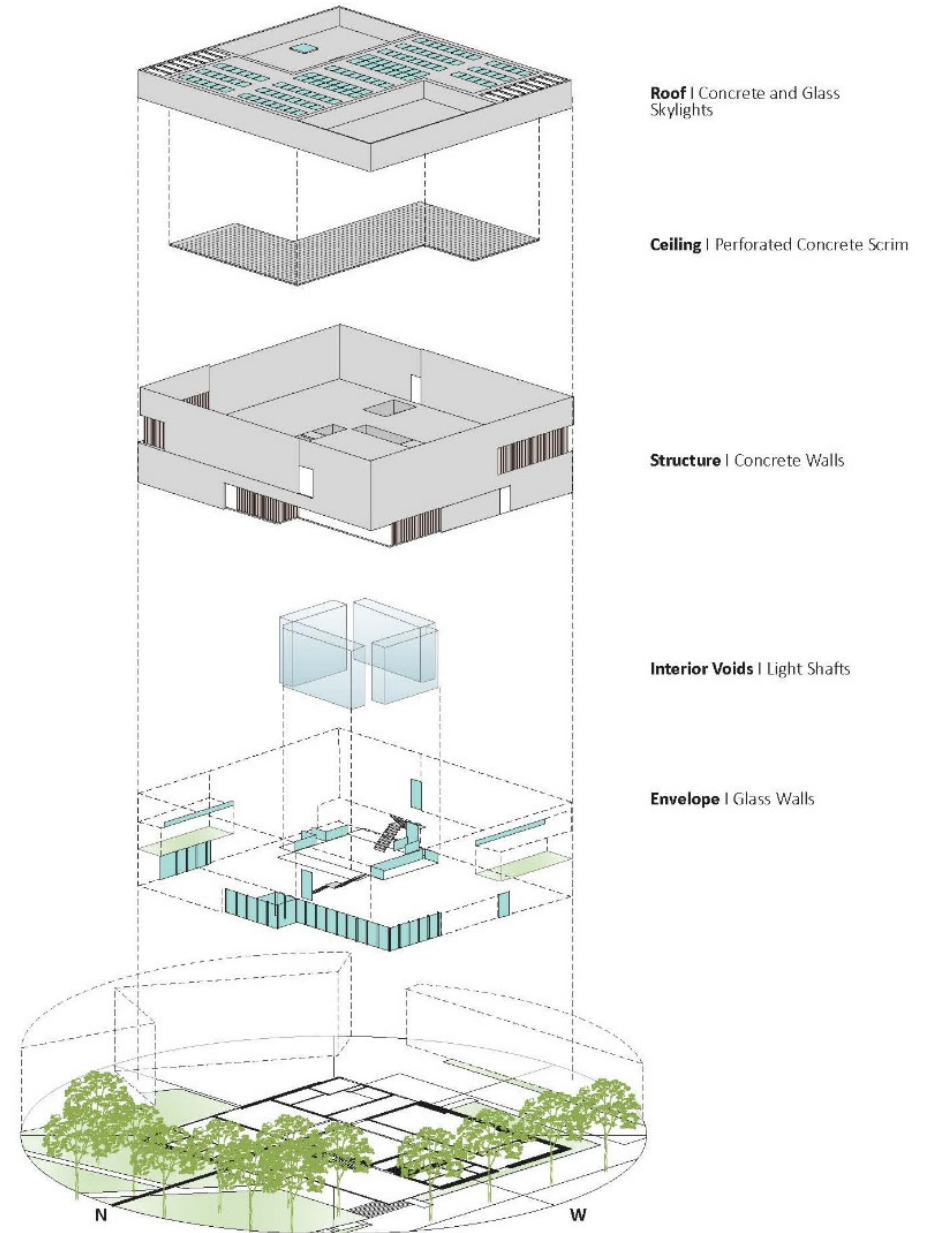
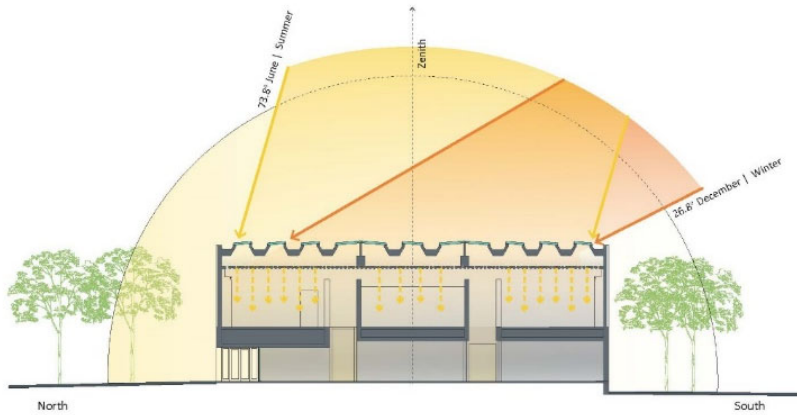


Temperature & Wind



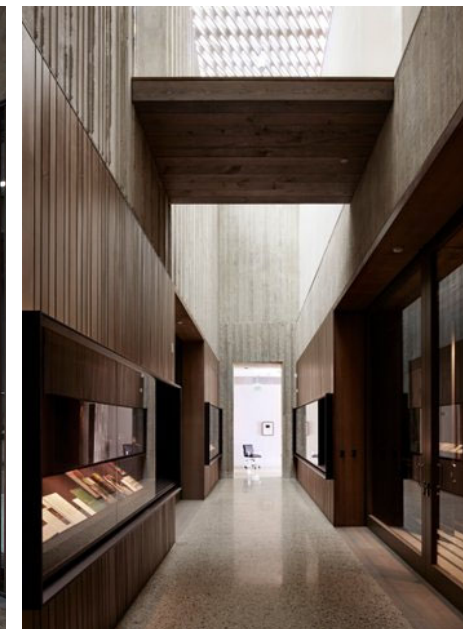
(Credits: Bottom Left: Denver Infill; Top and lower center; Jeremy Bittermann; lower right: Clyfford Still Museum Video)

Building Massing



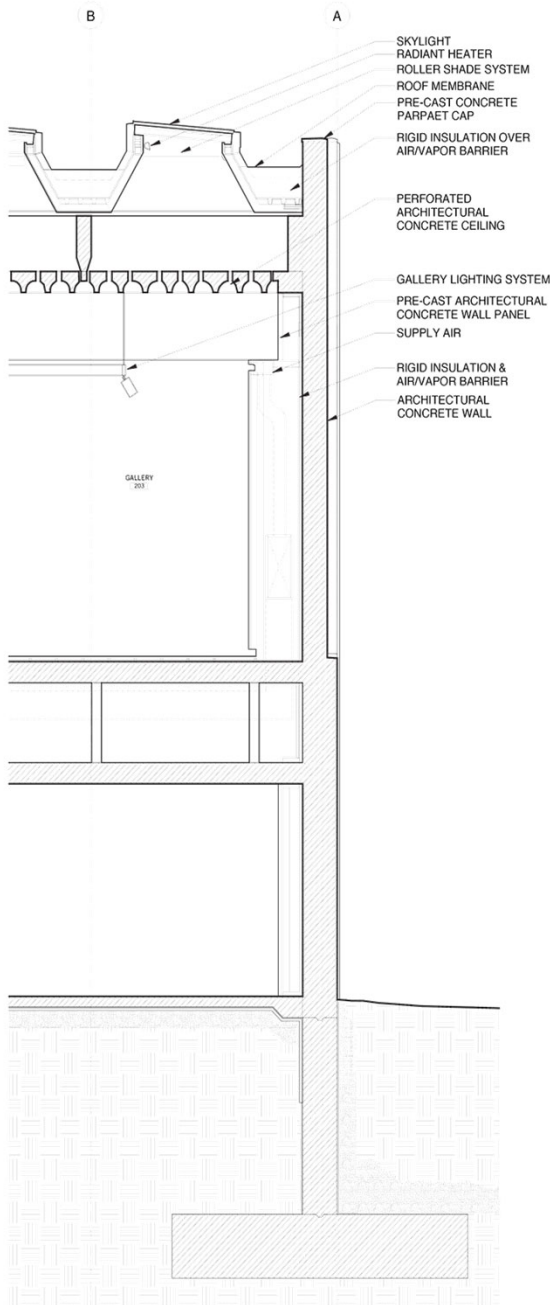
Site and building view looking south (photo) and ground and second level plans (top). (Photo Credit: Jeremy Bittermann; Plans: Allied Works Architecture; Diagrams: Mary Guzowski and Fiona Wholey)

Luminous Journey: shadow & darkness



Material Light

Clyfford Still Museum, Denver, CO: Allied Works Architects

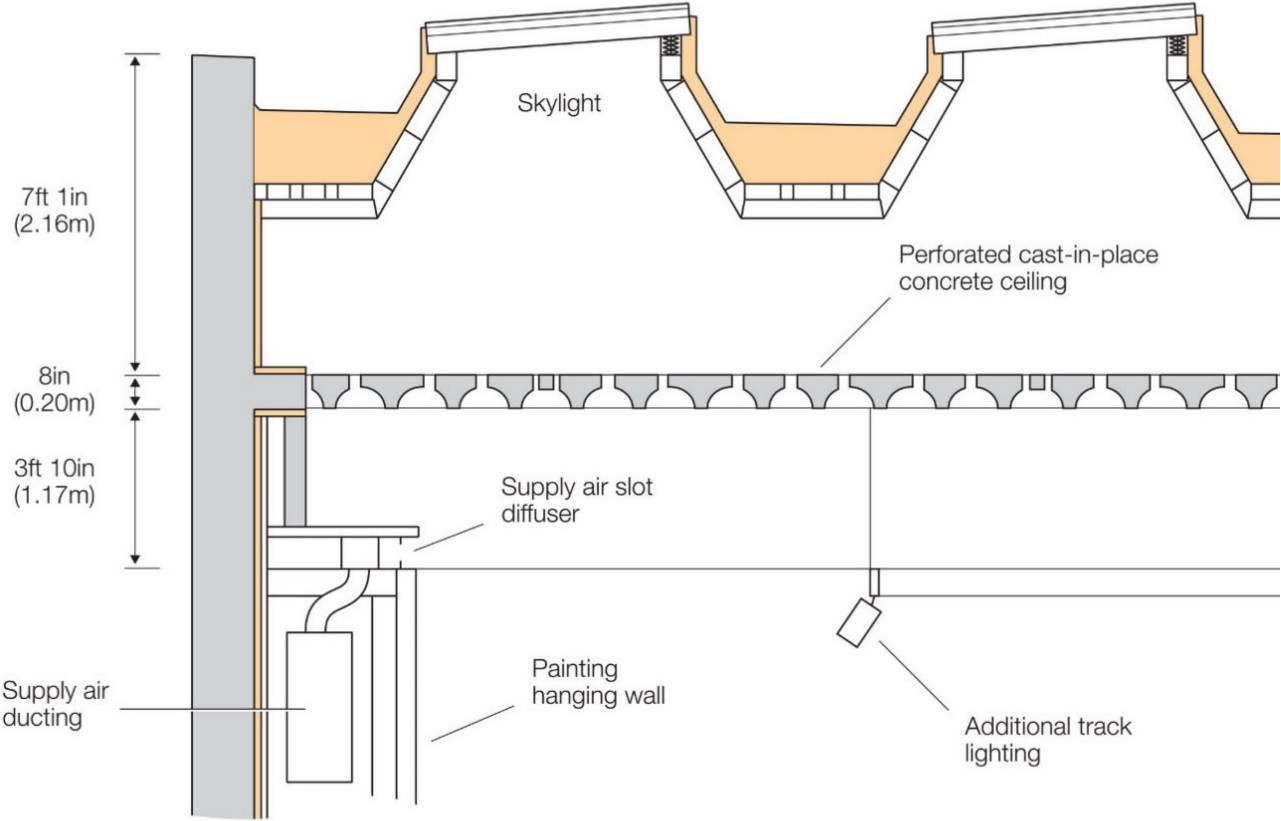


*Acts of Architecture:
Liquid Light and the Iconography of Silence*



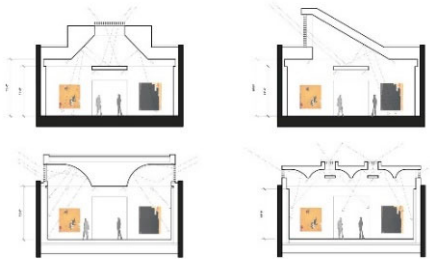
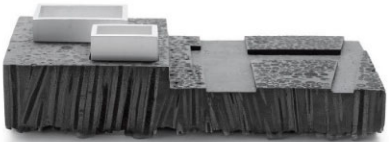
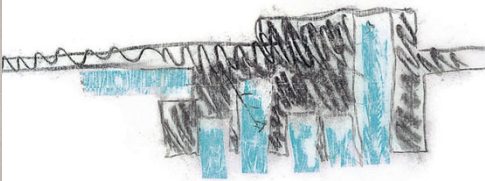
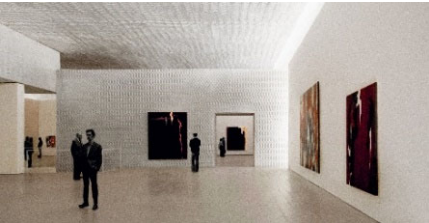
Gallery Lighting: Daylight & electric integration

Layered light

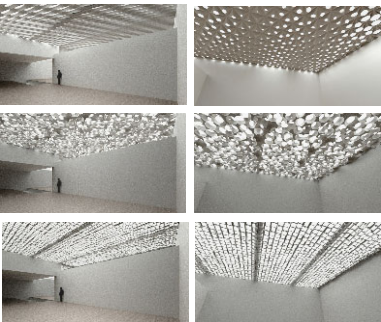
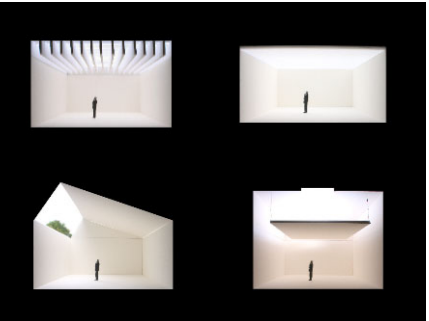
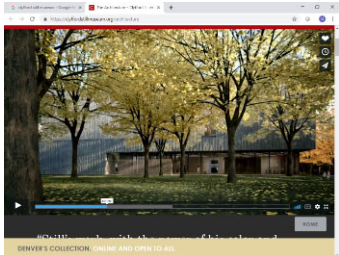
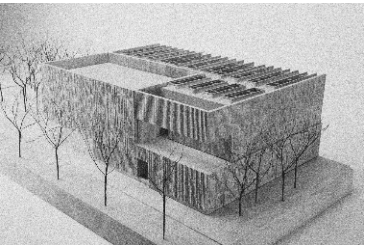


Daylighting Design Process: Intentions, Methods & Tools

Integrating Poetics & Performance



Place
Site
Climate
Program
Experience
Performance
Aesthetics
Time
Seasons
Comfort
Energy
Economics
Codes
Health
Maintenance
Other...

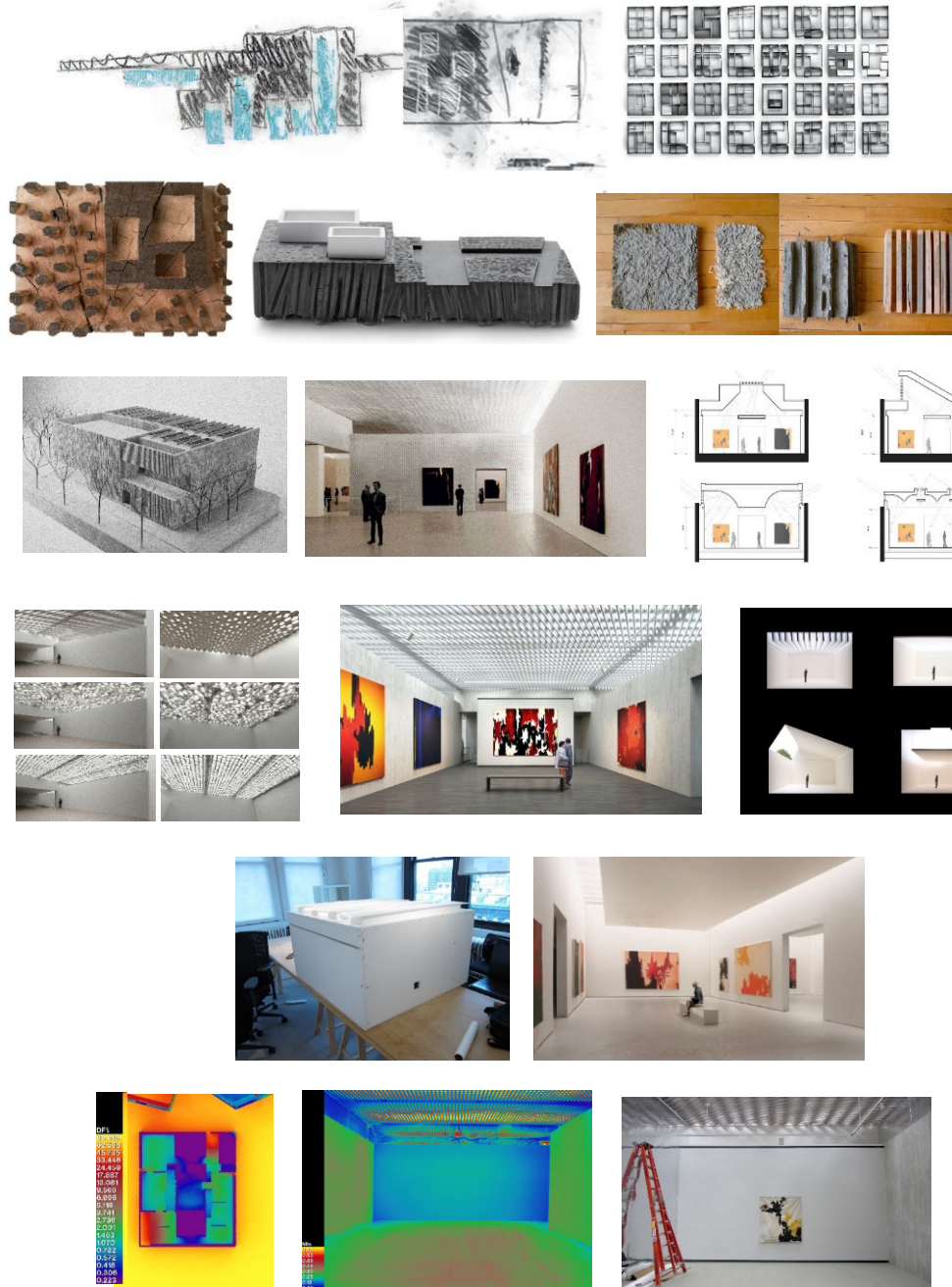


Daylighting Design Process: Intentions, Methods & Tools

Integrating Poetics & Performance

Qualitative Immeasurable

- Atmosphere, mood
- Place
- Weather
- Climate
- Choreography
- Luminous effects
- Materials
- Color
- Aesthetics
- Senses
- Health
- Wellbeing
- Other..



Quantitative Measurable

- Amount of light
- Distribution of light
- Comfort
- Glare
- Thermal comfort
- Solar control & shading
- Electric lighting
- Systems integration
- Energy
- Carbon & GHG
- Circadian rhythms
- Health
- Other...

Daylighting Design Process: Intentions, Methods & Tools

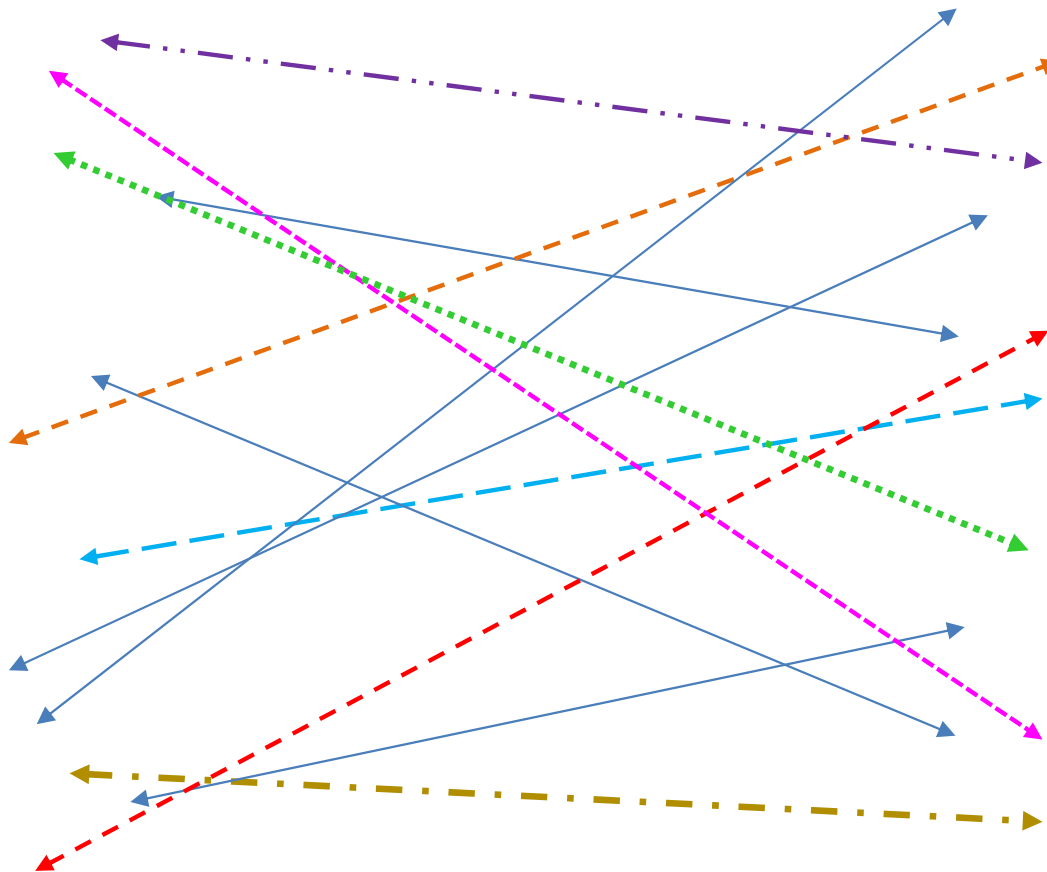
Integrating Poetics & Performance

Qualitative Immeasurable

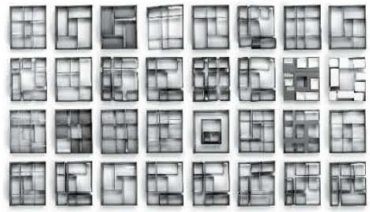
- Atmosphere, mood
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- Materials
- Color
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Quantitative Measurable

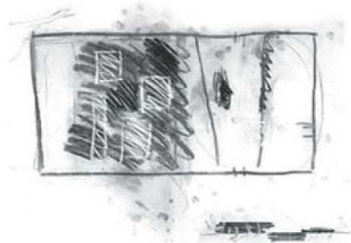
- Amount of light
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- Circadian rhythms
- Health
- Other...



Design Tools



Paper massing models



Pencil sketches



Plaster models: photographs inside & out



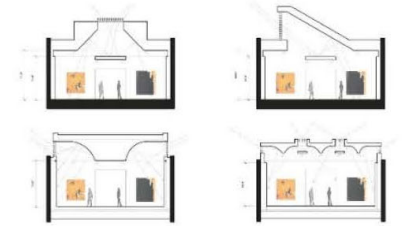
Site model



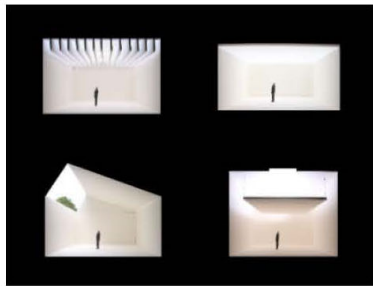
Plaster model



Concrete material studies



Sectional strategies



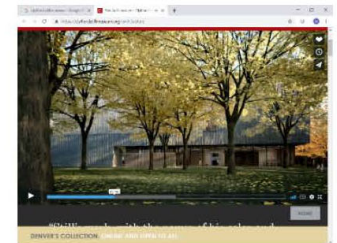
Simple physical daylight models



Maxwell Render digital studies



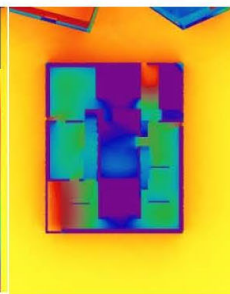
Sketches



Video



Radiance Studies (Arup)



Physical Models (Arup)



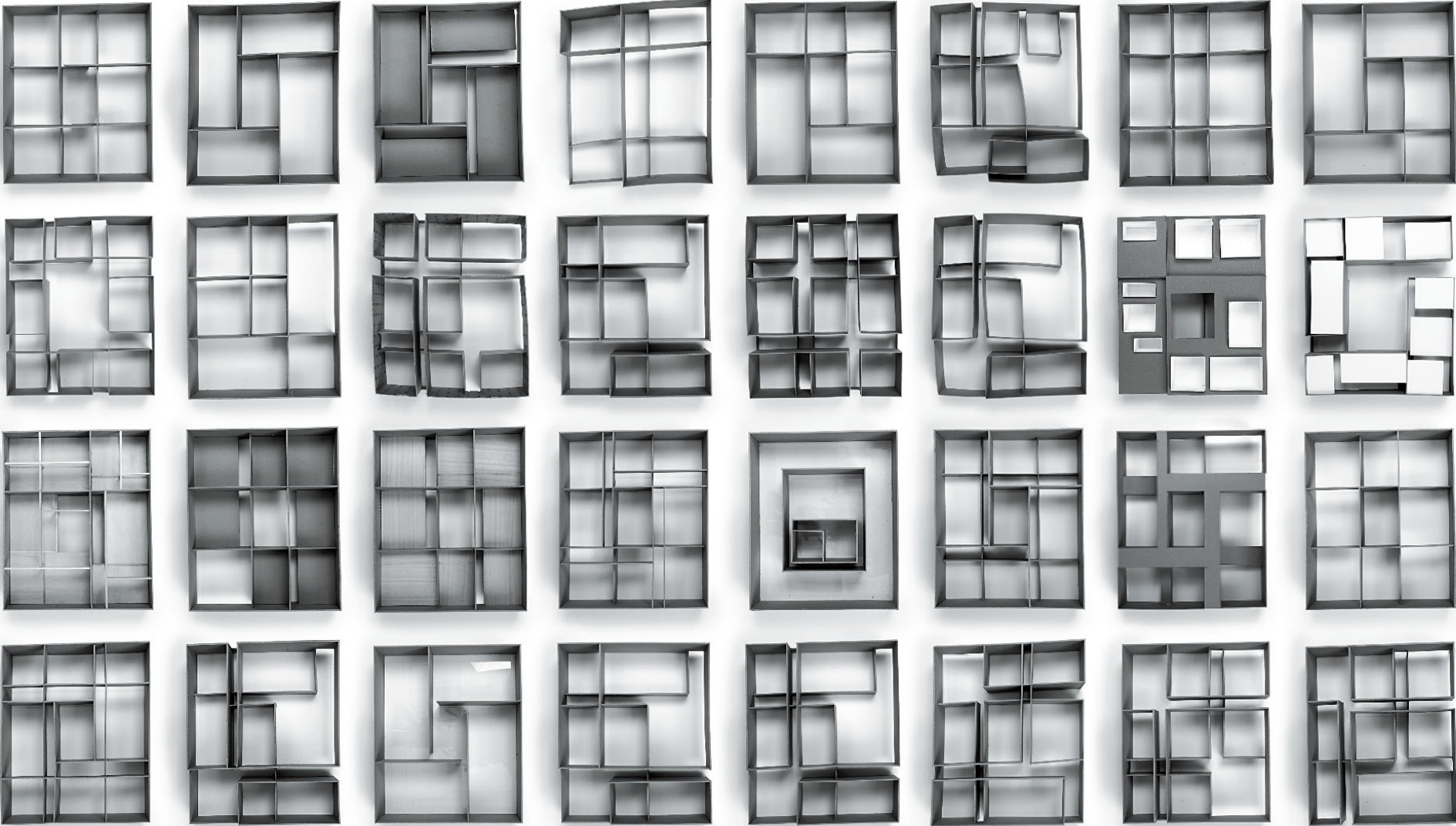
Large Scale Interior Model



Full Scale Mock-up

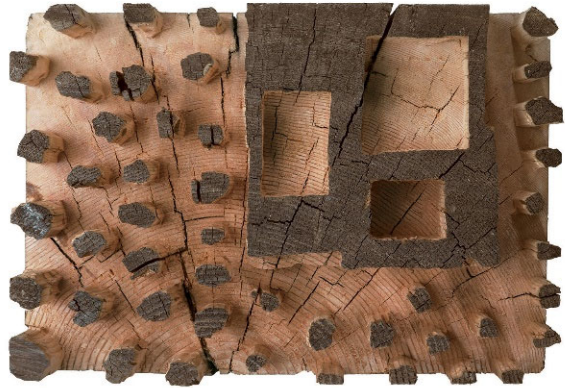
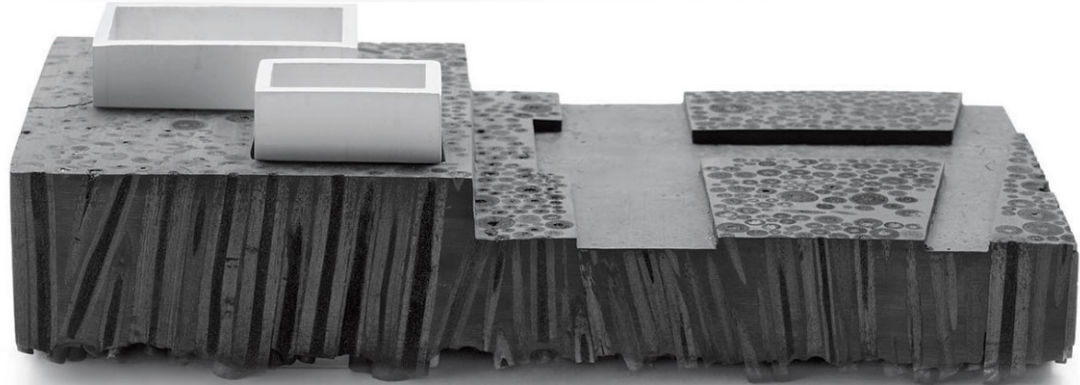
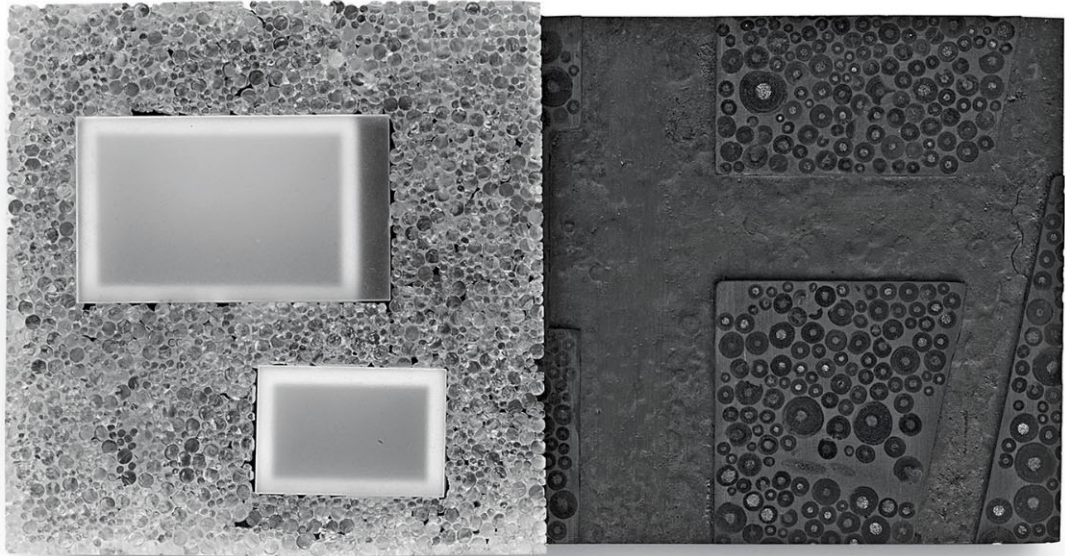
Massing Studies

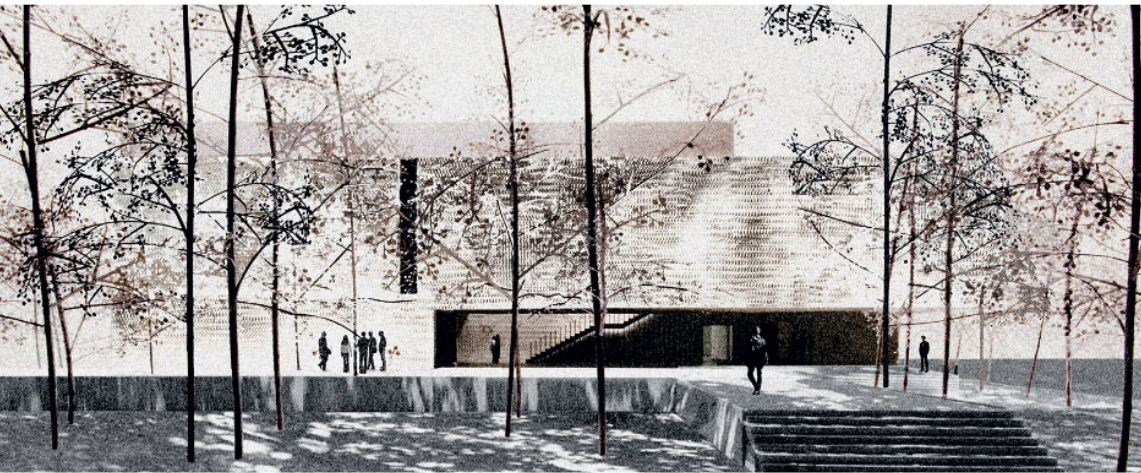
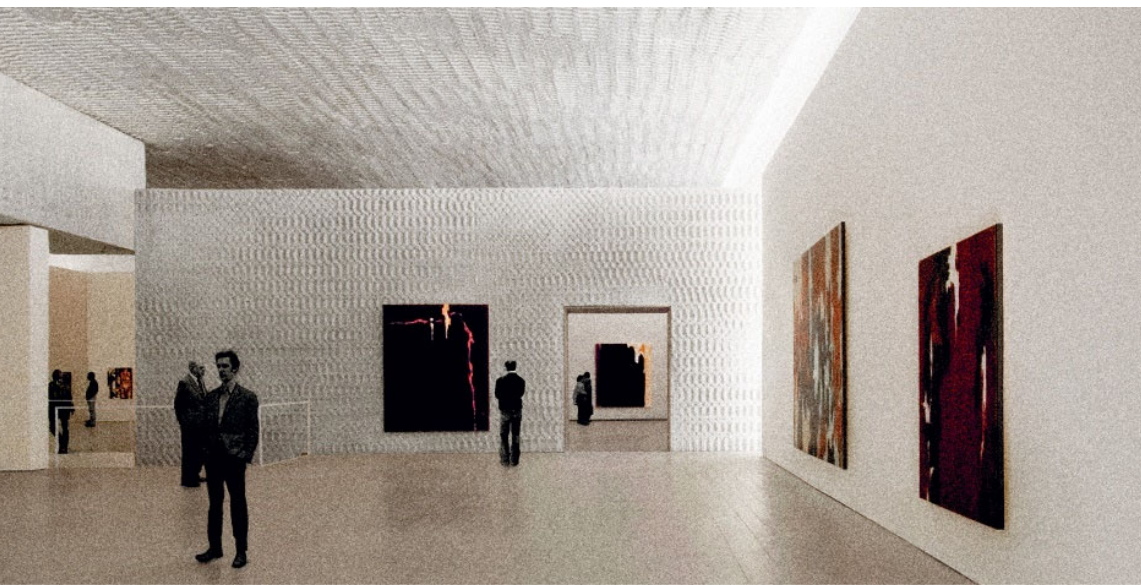
Paper Models



Massing Studies

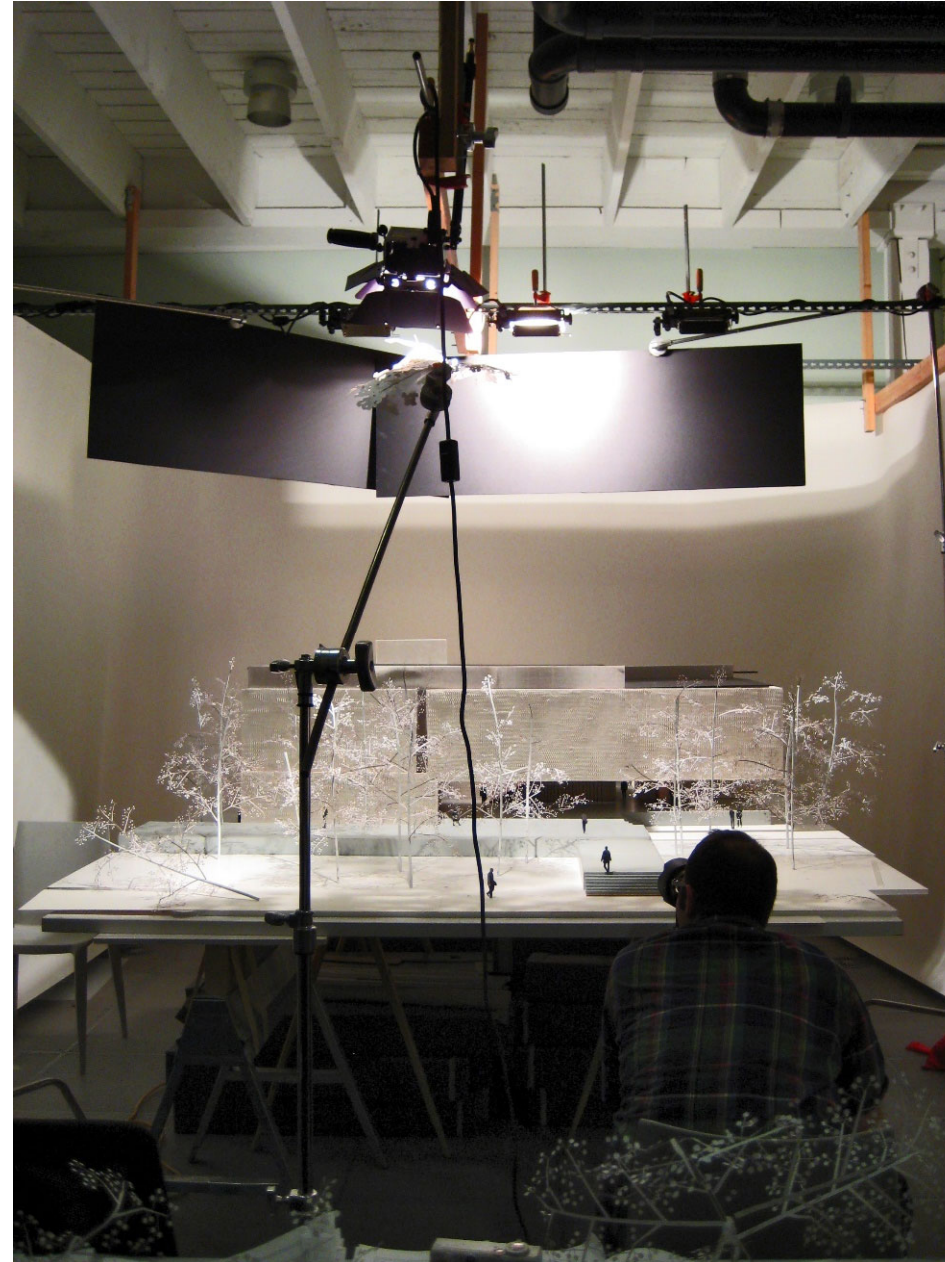
Wood & Plaster Models





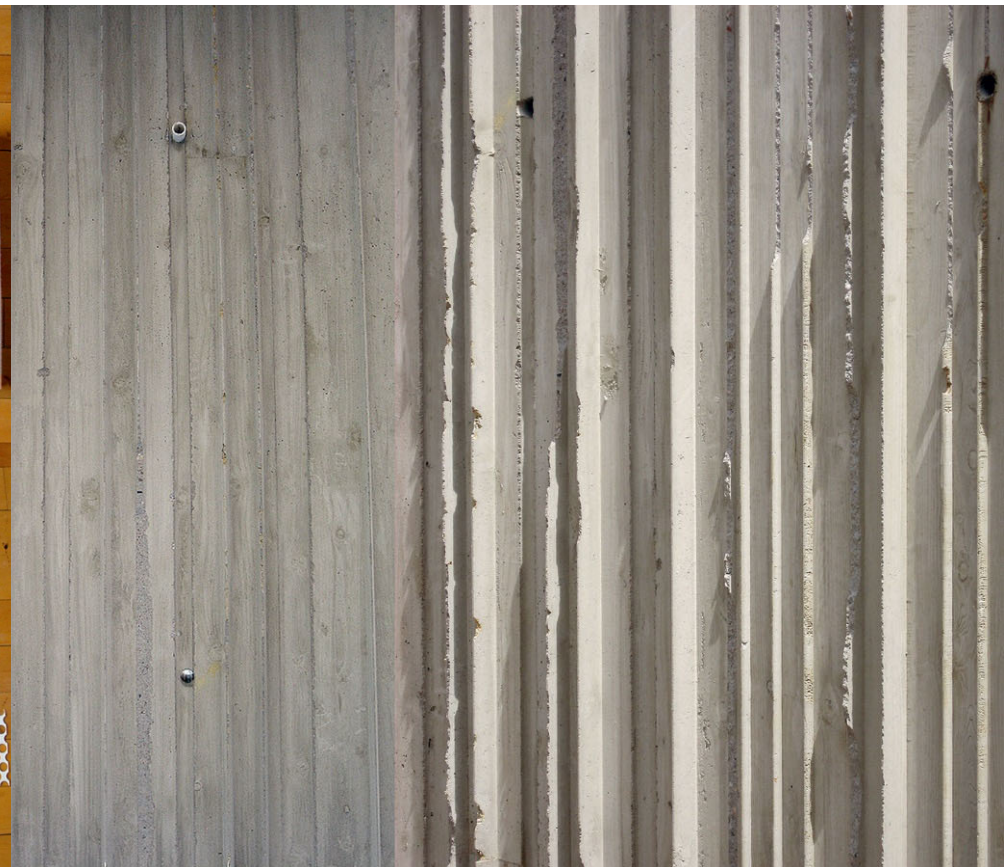
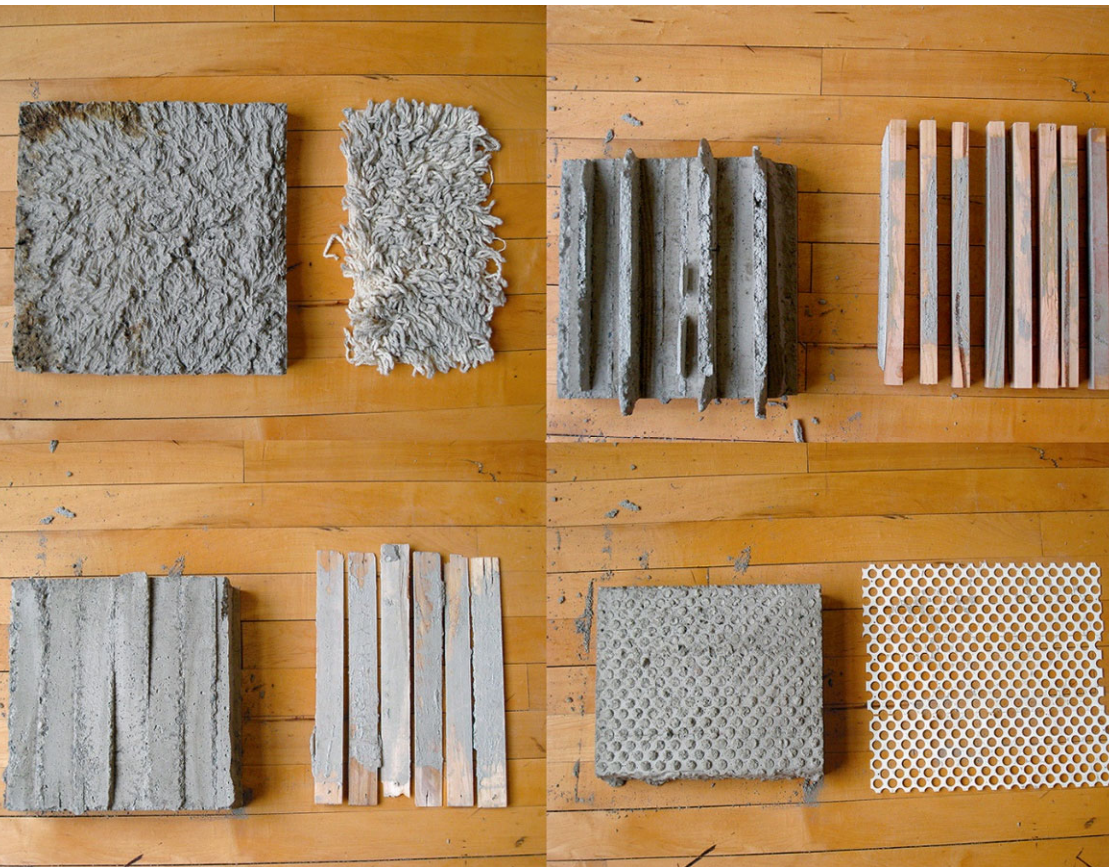
Plaster Model

Photography



Credits: Allied Works

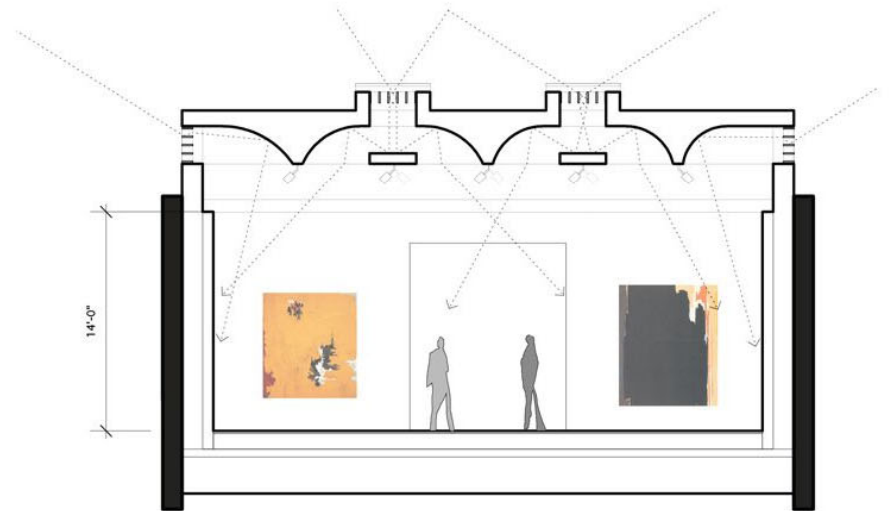
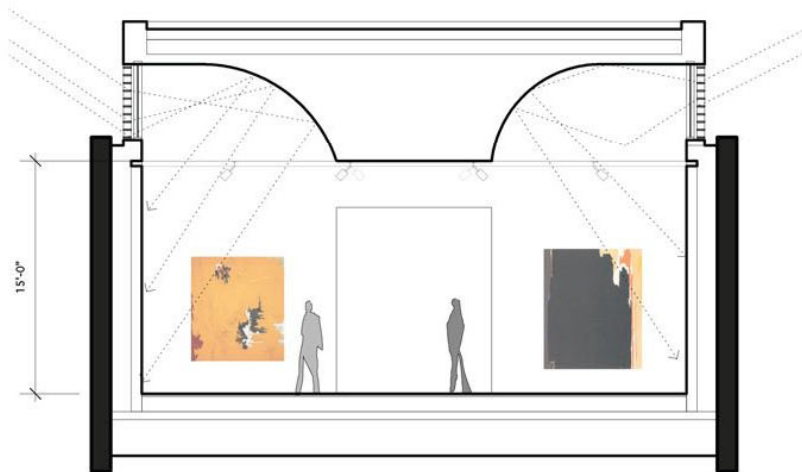
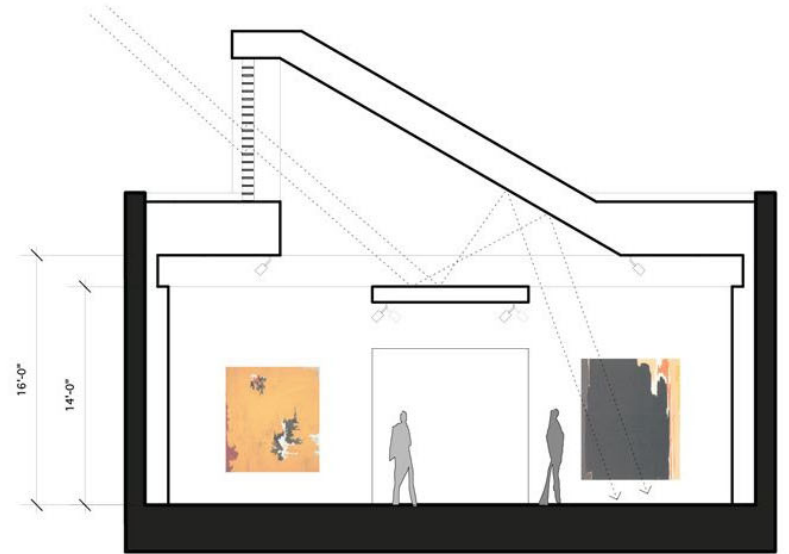
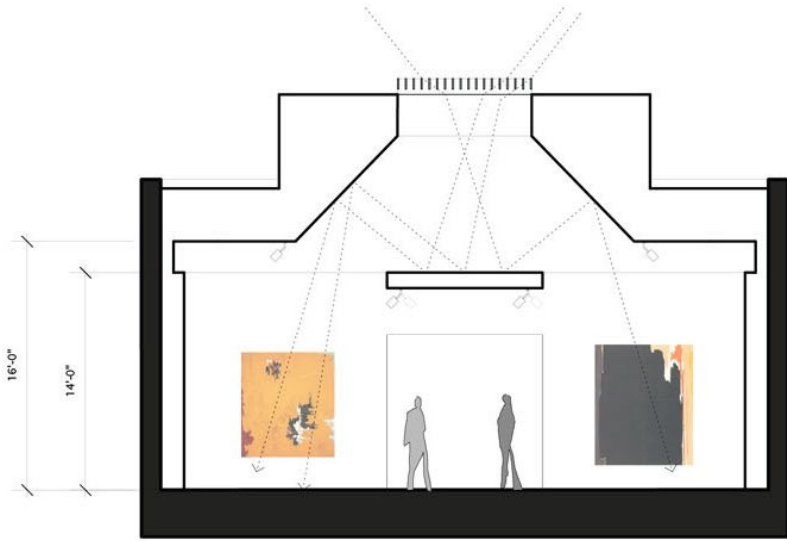
Material Experiments



Material studies in concrete (Credits: Allied Works)

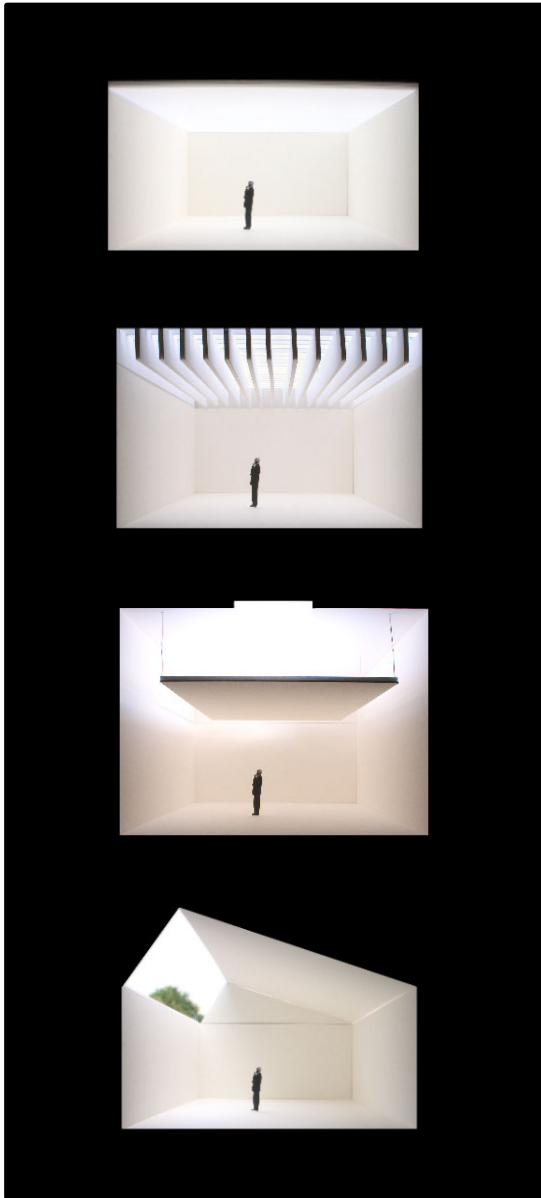
Architectural Drawings

Sectional Studies



Physical Models

Schematic Design

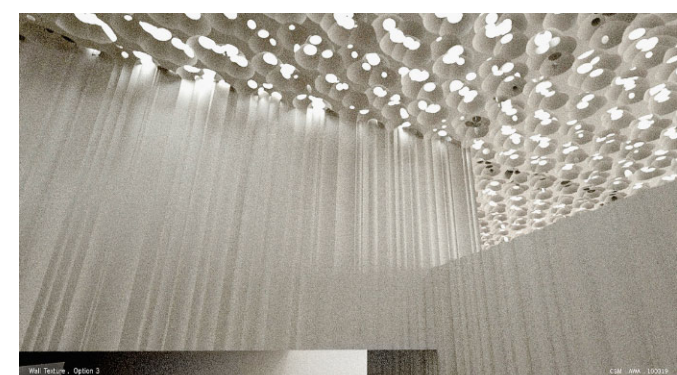
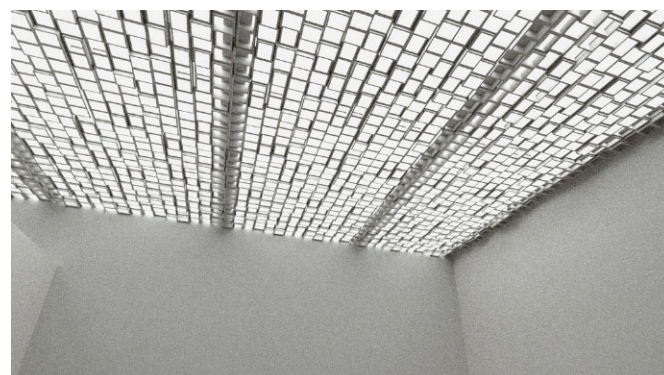
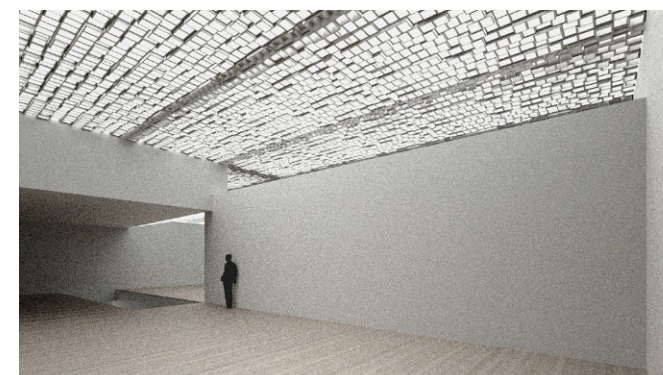
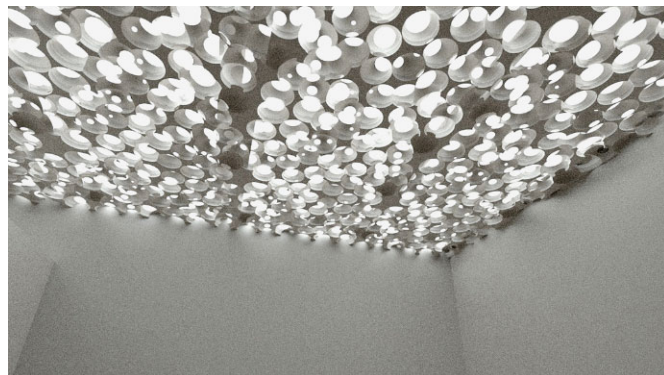
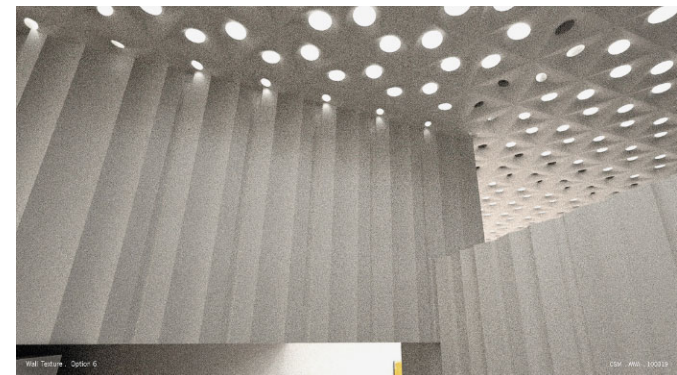
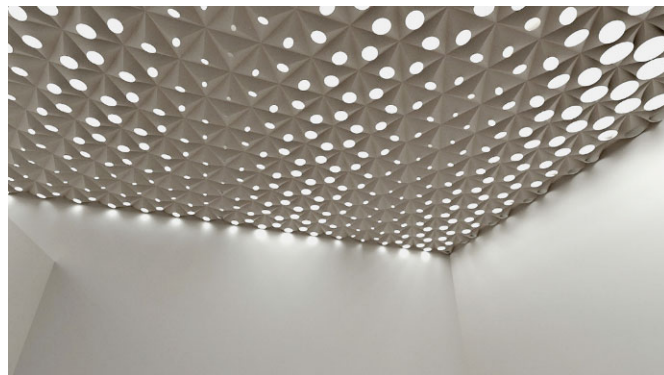


Credits: Allied Works and Arup

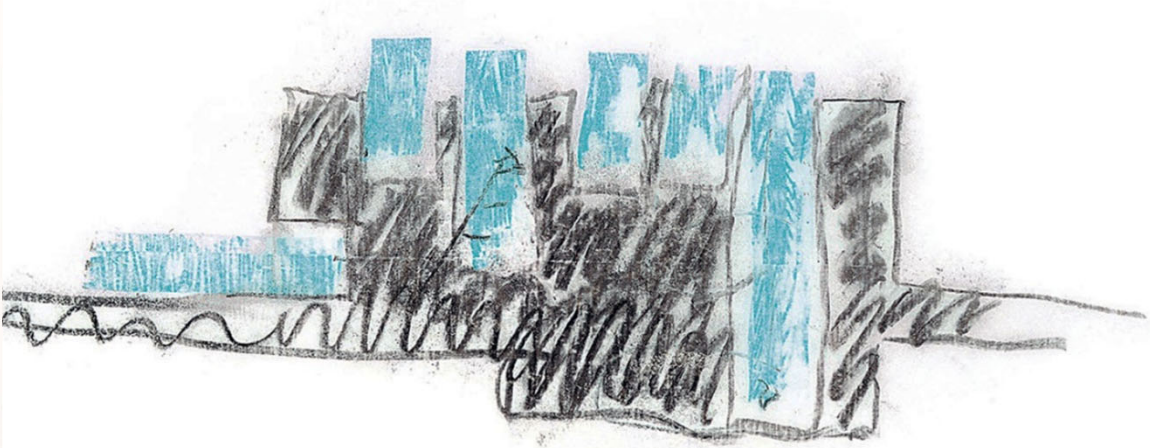
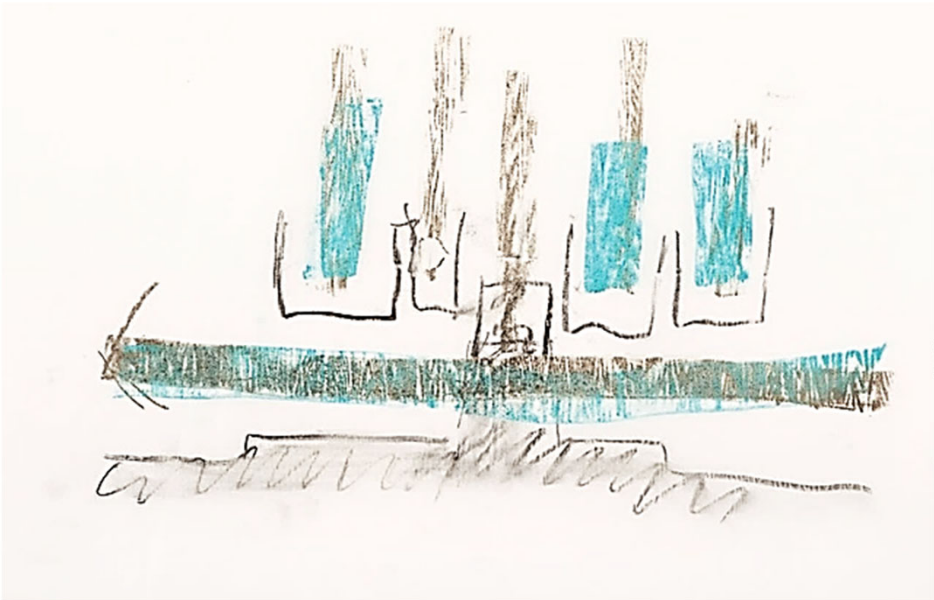
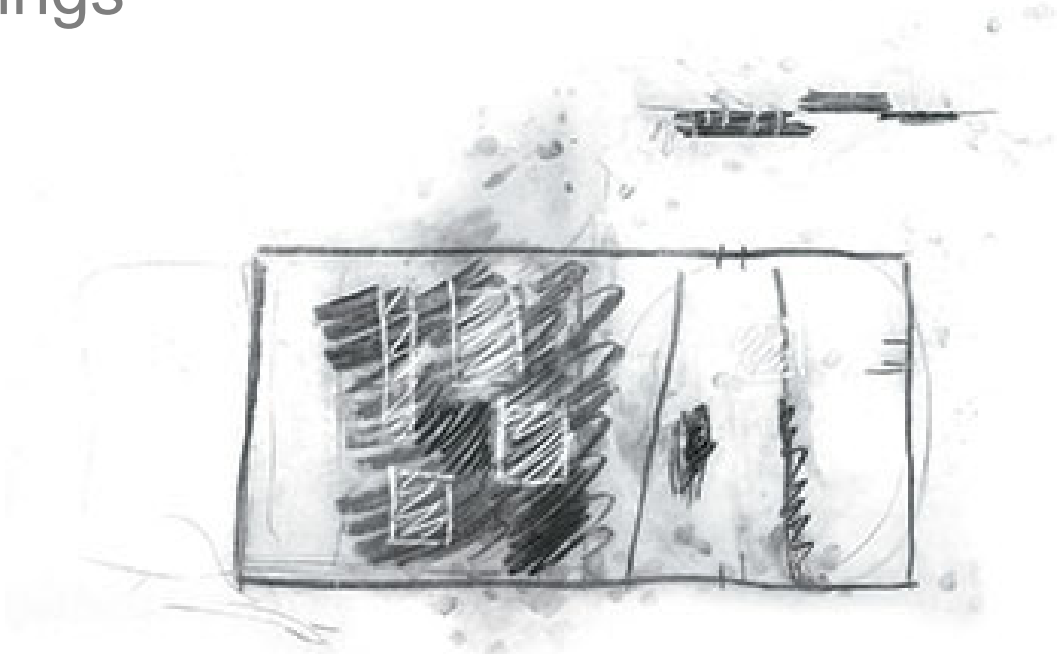
Digital Studies

Iterative Explorations

Maxwell Render



Pencil & Charcoal Renderings



Renderings & Photoshop

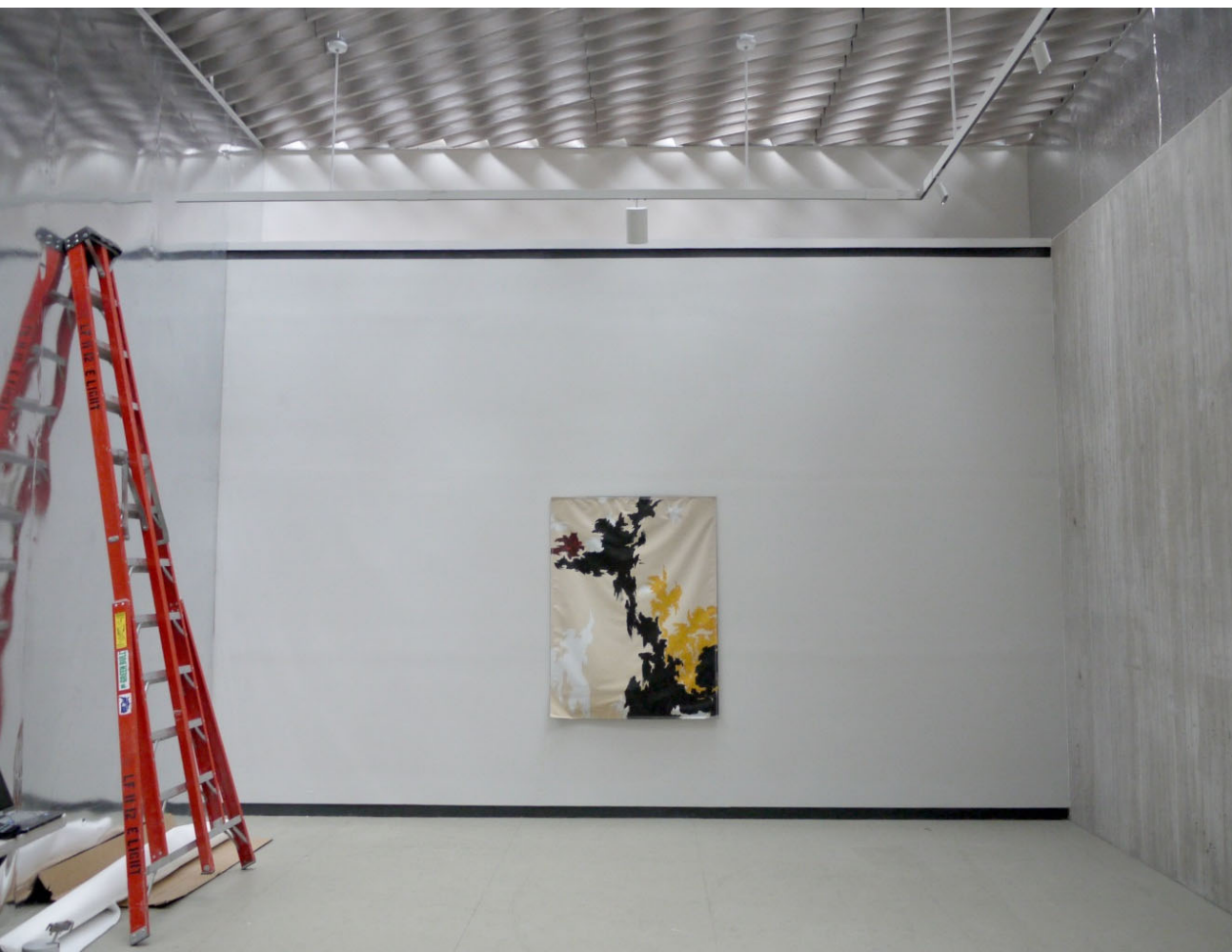
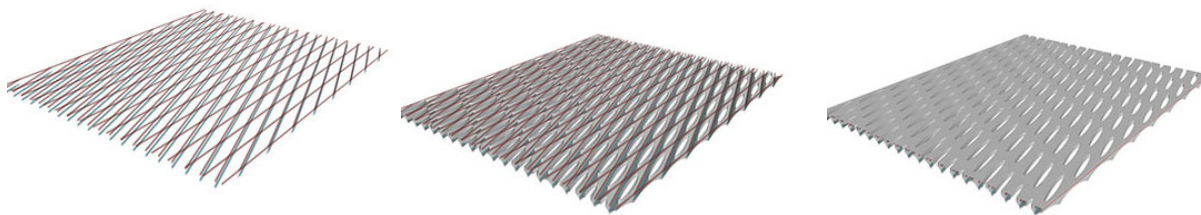
Left: Maxwell Render +Photoshop; Right: Built Gallery



Left: Maxwell Render; Right: Built Gallery (Credits: Left: Allied Works; Right: Jeremy Bittermann)

Full-scale Material Mock-ups

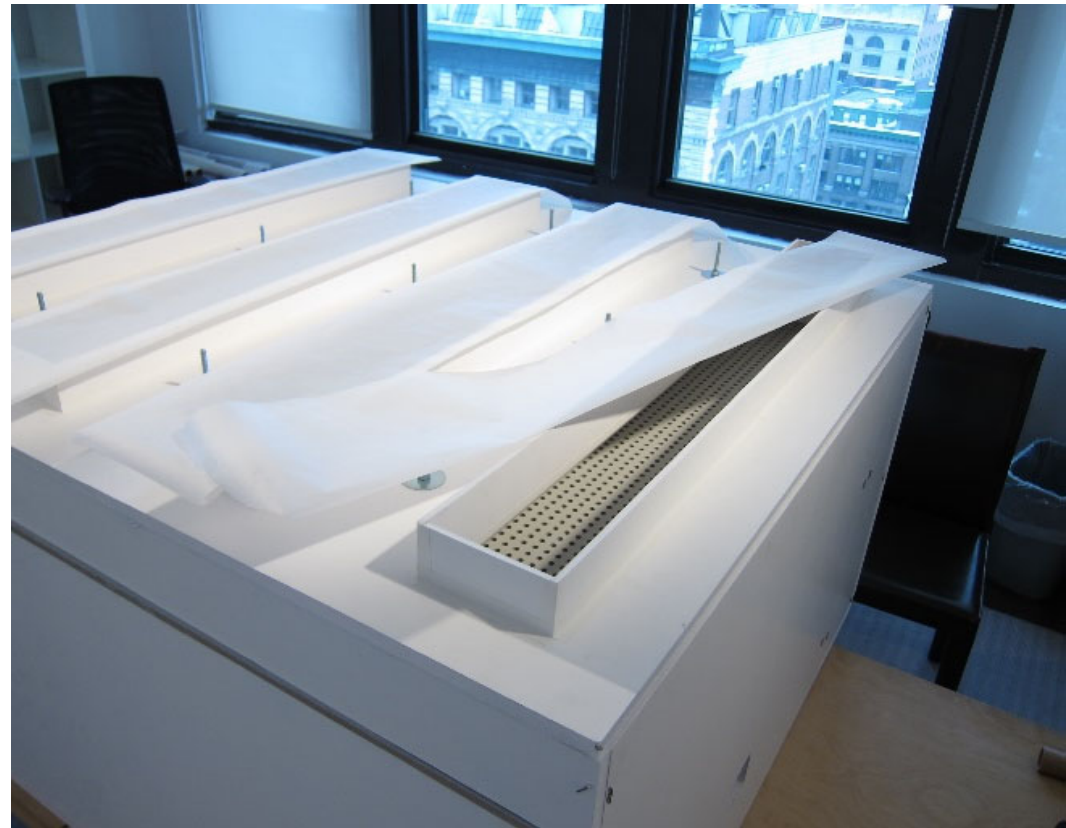
Details & Partial Gallery Mock-up



Credits: Allied Works and Arup

Large Scale Daylight Models

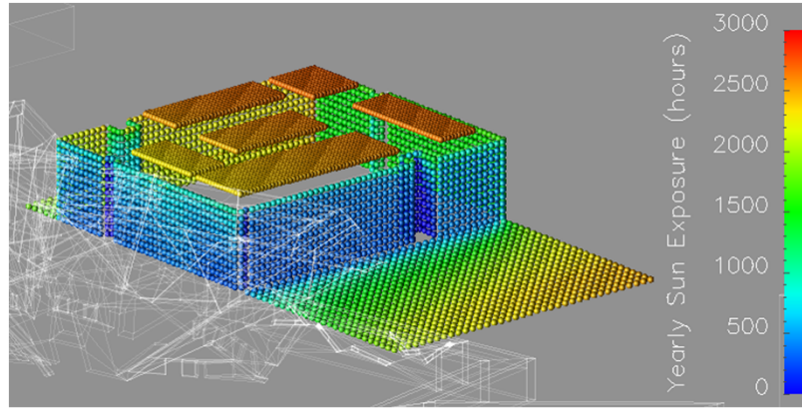
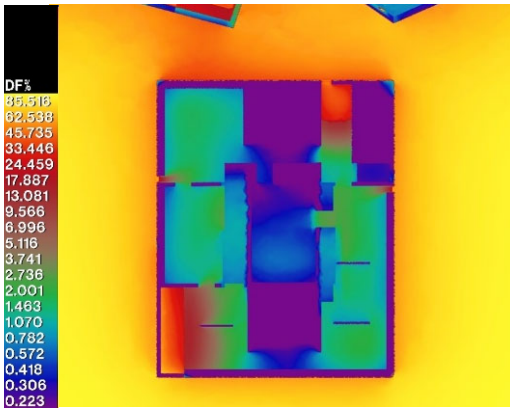
Quantitative & Qualitative Analysis: Arup



Credits: Allied Works and Arup

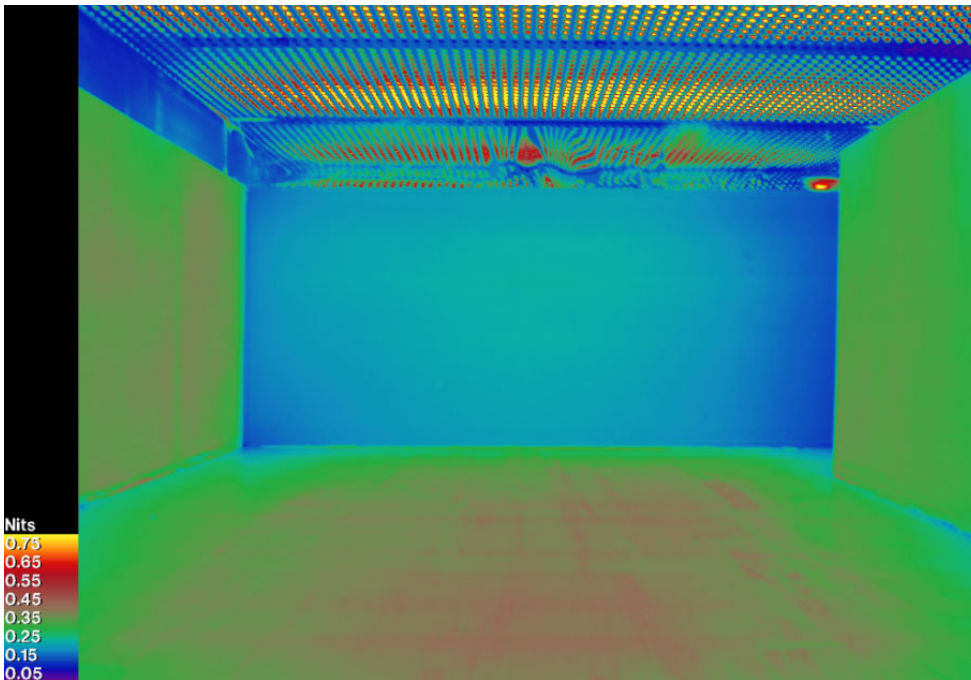
Radiance Studies

Arup



“The approach was based on cumulative exposure on the art for a typical year instead of maximum illuminance at any one time.”

- Christopher Rush, Arup



Radiance studies (Credits: Arup and Allied Works)

Full Scale Mock-up – Digital Studies – Physical Models

Left: Full Scale Mock-up

Right Top: Maxwell Render

Right Bottom: Daylight Model



Left: Full Scale Mock-up, Right Top Right: Maxwell Rendering, Bottom Right: Physical Model Interior (Credits: Left: Arup; Right: Allied Works)

Video Animations

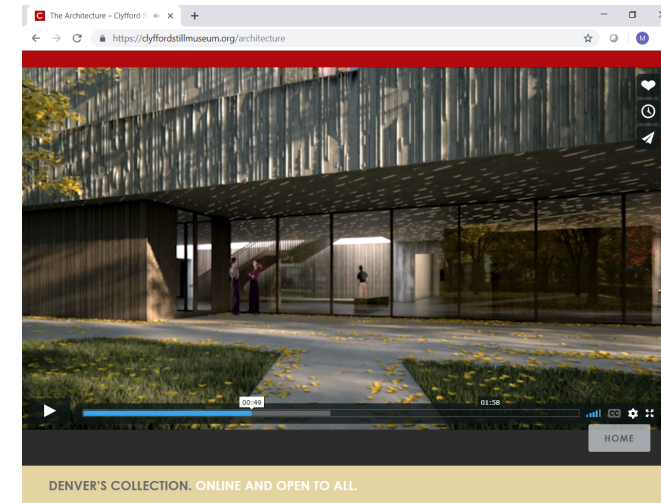
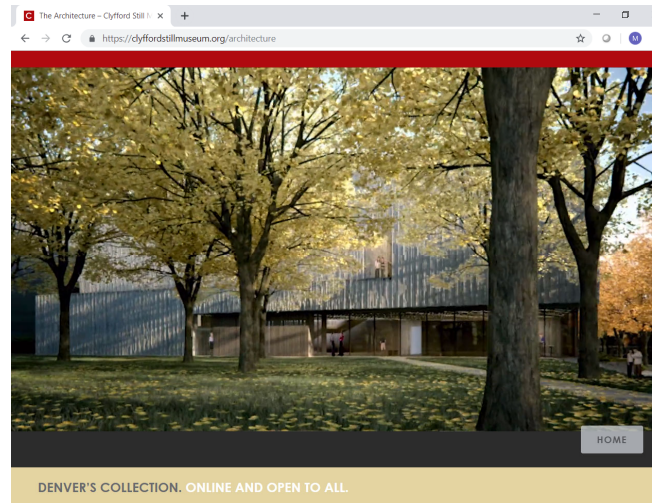
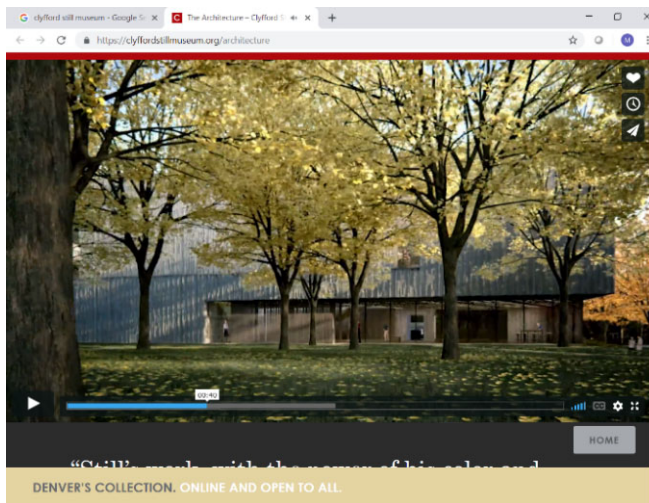
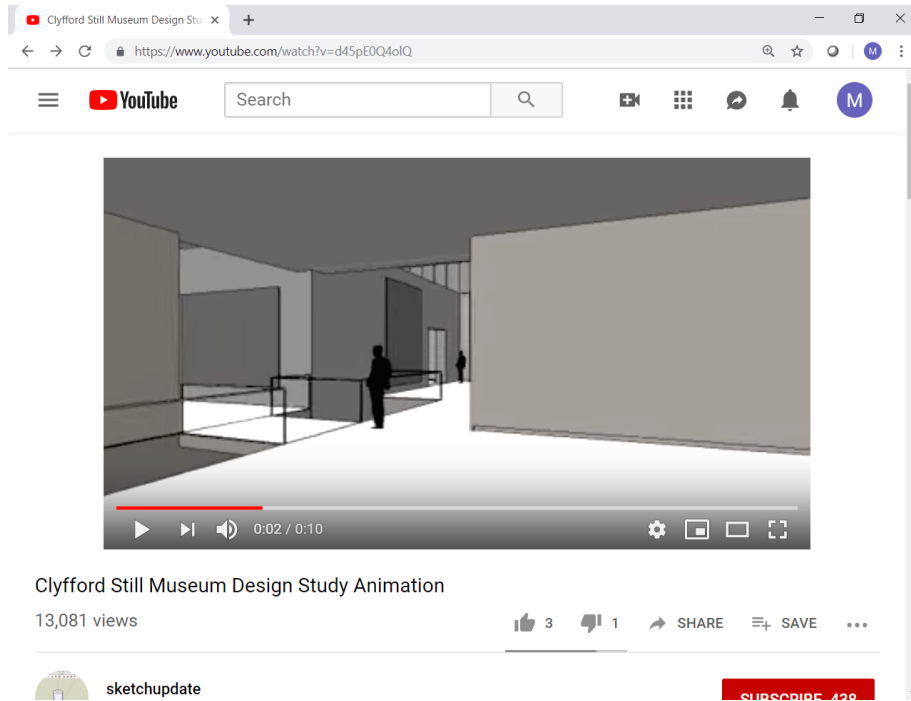
Design Study Animation Allied Works Architecture:

<https://www.youtube.com/watch?v=d45pE0Q4oIQ>

Acts of Architecture:

Liquid Light and the iconography of Silence

<https://clyffordstillmuseum.org/architecture>



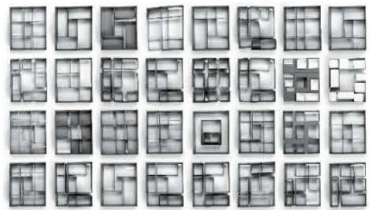
Credits: Allied Works Architecture and Clyfford Still Museum

QUESTIONS

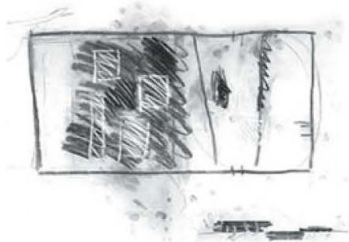
- How might you integrate daylight with other design methods?
- What tools are you currently using? Strengths & limitations?
- What daylight tools and methods might you add in a current project?

Design Tools

(Credits: Allied Works Architecture & Arup)



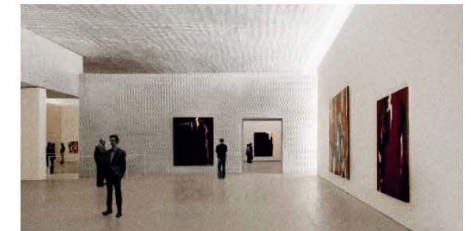
Paper massing models



Pencil sketches



Plaster models: photographs inside & out



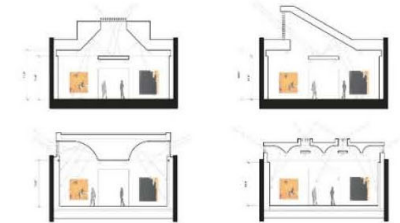
Site model



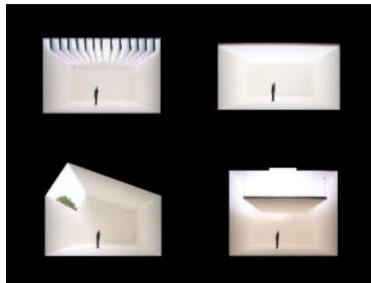
Plaster model



Concrete material studies



Sectional strategies



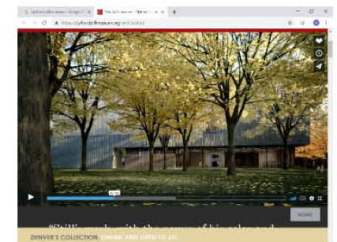
Simple physical daylight models



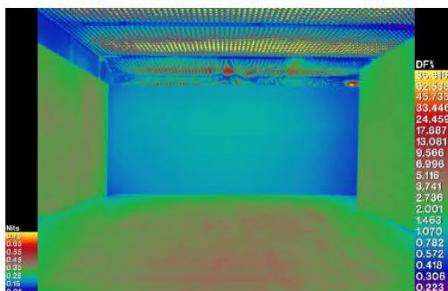
Maxwell Render digital studies



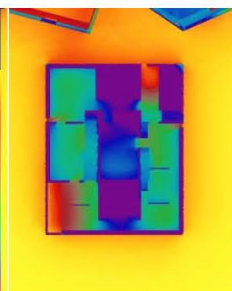
Sketches



Video



Radiance Studies (Arup)



Physical Models (Arup)



Large Scale Interior Model



Full Scale Mock-up

THE ART OF ARCHITECTURAL DAYLIGHTING

Immeasurable & Measurable Dimensions of Daylighting

1. INTEGRATED LIGHT

Daylight Toolkit: A Robust Design Process

- *Clyfford Still Museum: Allied Works Architecture*

2. OVERVIEW (6)

DAYLIGHT PATTERNS

Discussion

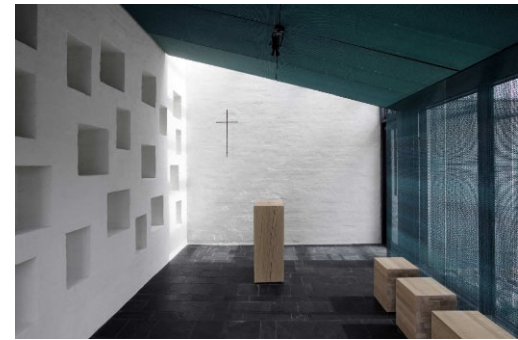
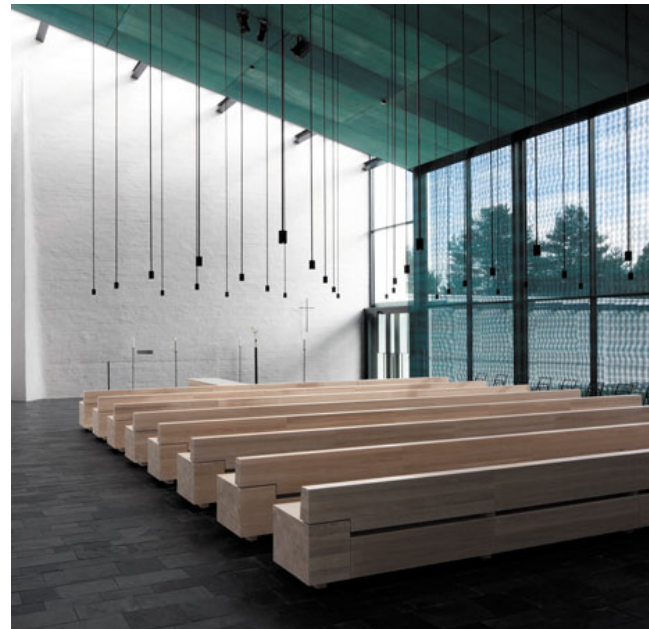
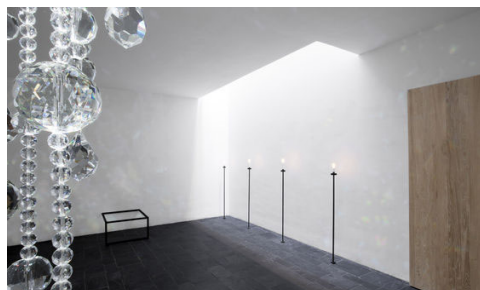
- *Comments, Questions, Application*



Henning Larsen: Eystur Town Hall (Nick Lehoux); Olafer Olsson: ARoS, Aarhus (ArchDaily: top; Wall Street Journal: bottom);

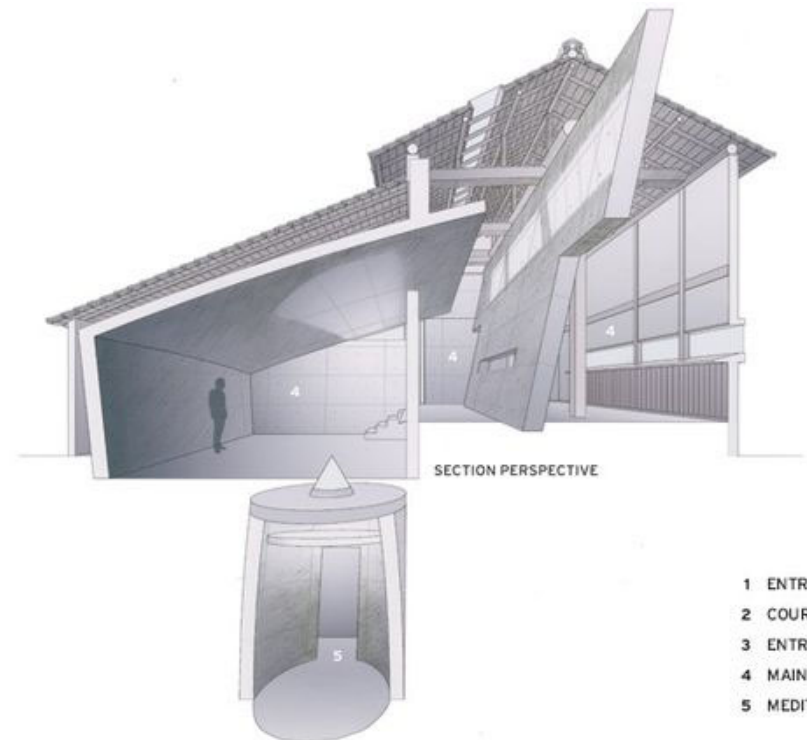
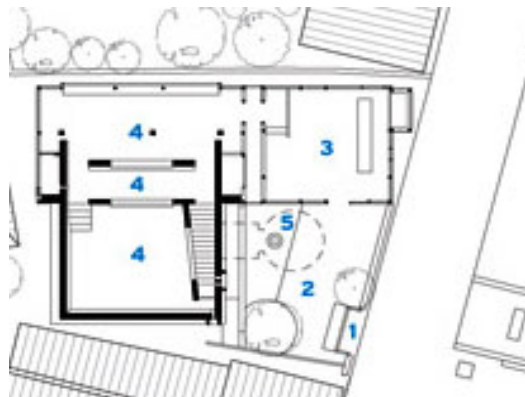
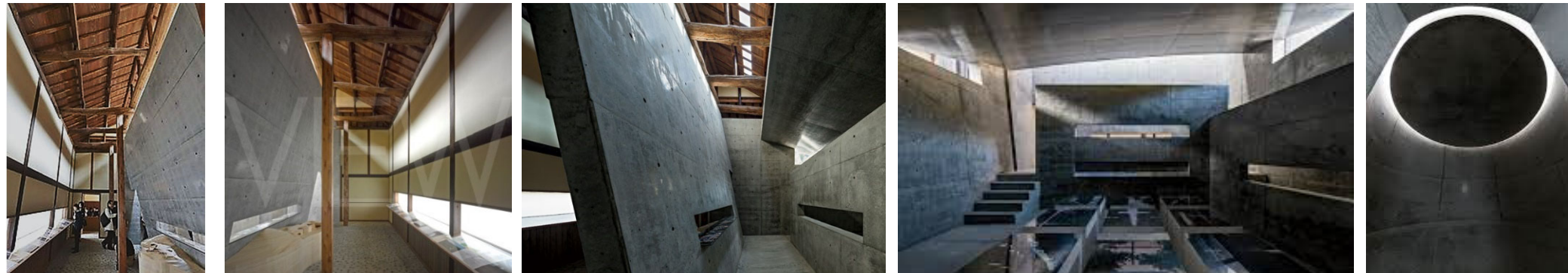
Placed Light

Avanto, Chapel of St. Lawrence, Vantaa, Finland



Choreographed Light

Tadao Ando, Ando Museum, Honmura, Japan



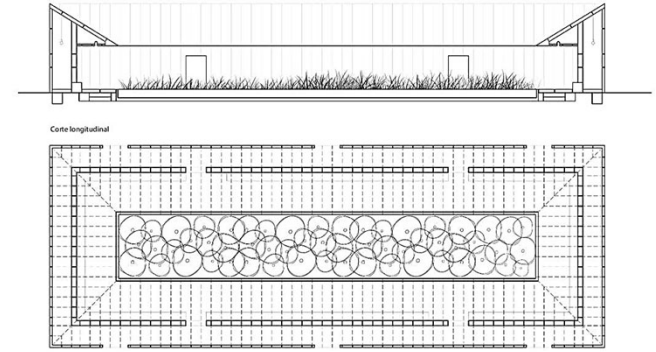
- 1 ENTRANCE GATE
- 2 COURTYARD
- 3 ENTRANCE GALLERY
- 4 MAIN GALLERY
- 5 MEDITATION CHAMBER

Atmospheric Light

Peter Zumthor & Piet Oudolf: 2011 Serpentine Gallery

Arup: Ed Clark

Kensington Garden, London, England

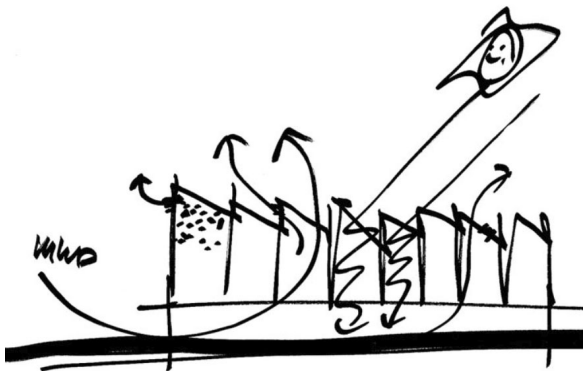
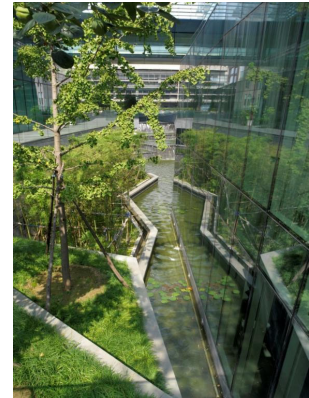


Sculpted Light

Mario Cucinella: Top: SIEEB, Beijing China; Bottom: ARPAE: Ferrara, Italy



SIEEB, Beijing China



ARPAE: Ferrara, Italy



Source: (Moreno Maggi Photographer, MCA.)

Form Follows Light and Performance Follows Form

Climate, site, seasons

Passive heating, cooling & ventilation

Comfort & health

Renewable energy systems

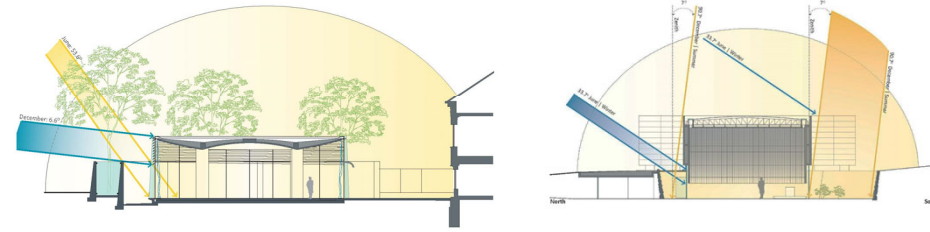
Solar Control & shading

Site, landscape & biophilia

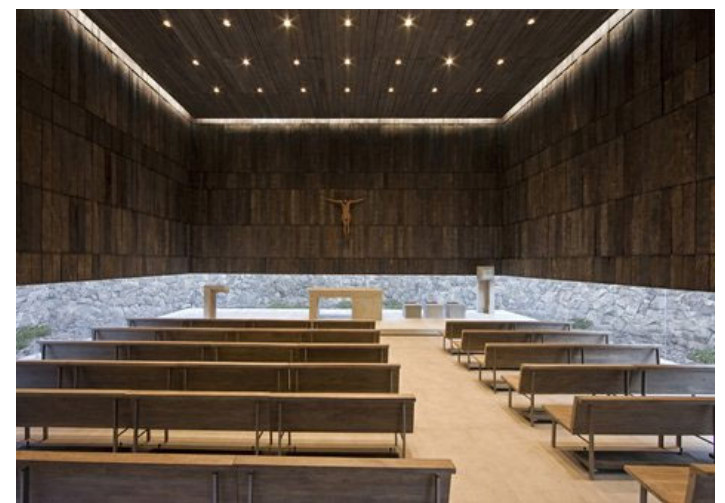
- Responsive envelopes Other integration? Water, food, resilience...

Structured Light

Top: Sverre Fehn, National Museum, Oslo, Norway
Bottom: Undurraga Deves, Chapel of Retreat, Chile



Sverre Fehn, National Museum, Oslo, Norway



Undurraga Deves, Chapel of Retreat, Chile

Material (& Biophilic) Light

Maggie's Center, Lanarkshire, Scotland, Reiach + Hall



Biophilic Light _ 15 Patterns of Biophilic Design: Daylighting Opportunities

Maggie's Center, Lanarkshire, Scotland

Reiach + Hall Architects

Johnathan Spiers, Spiers Major, Daylighting

Rankinfraser Landscape Architecture



“ I was interested in whether we could make a very modest building, a building that made people feel comfortable, a simple goal. We had no real intention to create a masterpiece or an icon. We were interested in creating a very different atmosphere from the hospital. **Most of our interest was on materials, light—particularly daylight—and gardens. And how we use the building related to the outside and to living things like grass and trees.**”

--Neil Gillespie
Reiach and Hall

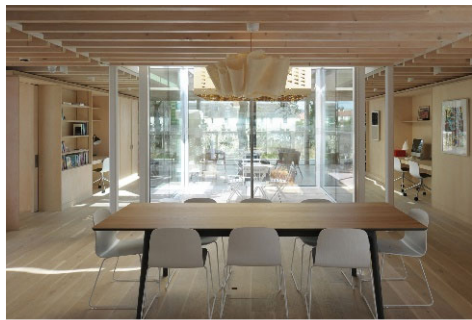
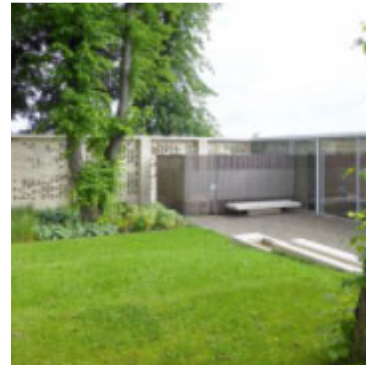
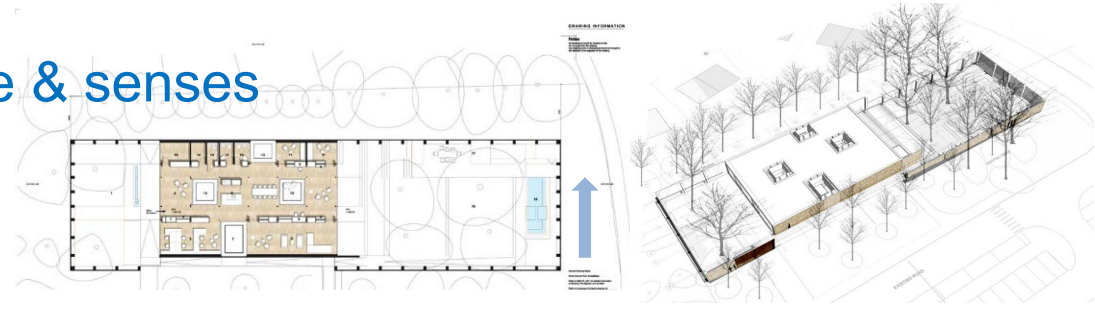
Biophilic Light _ Integrate place, time & senses

Maggie's Center, Lanarkshire, Scotland

Reiach + Hall Architects

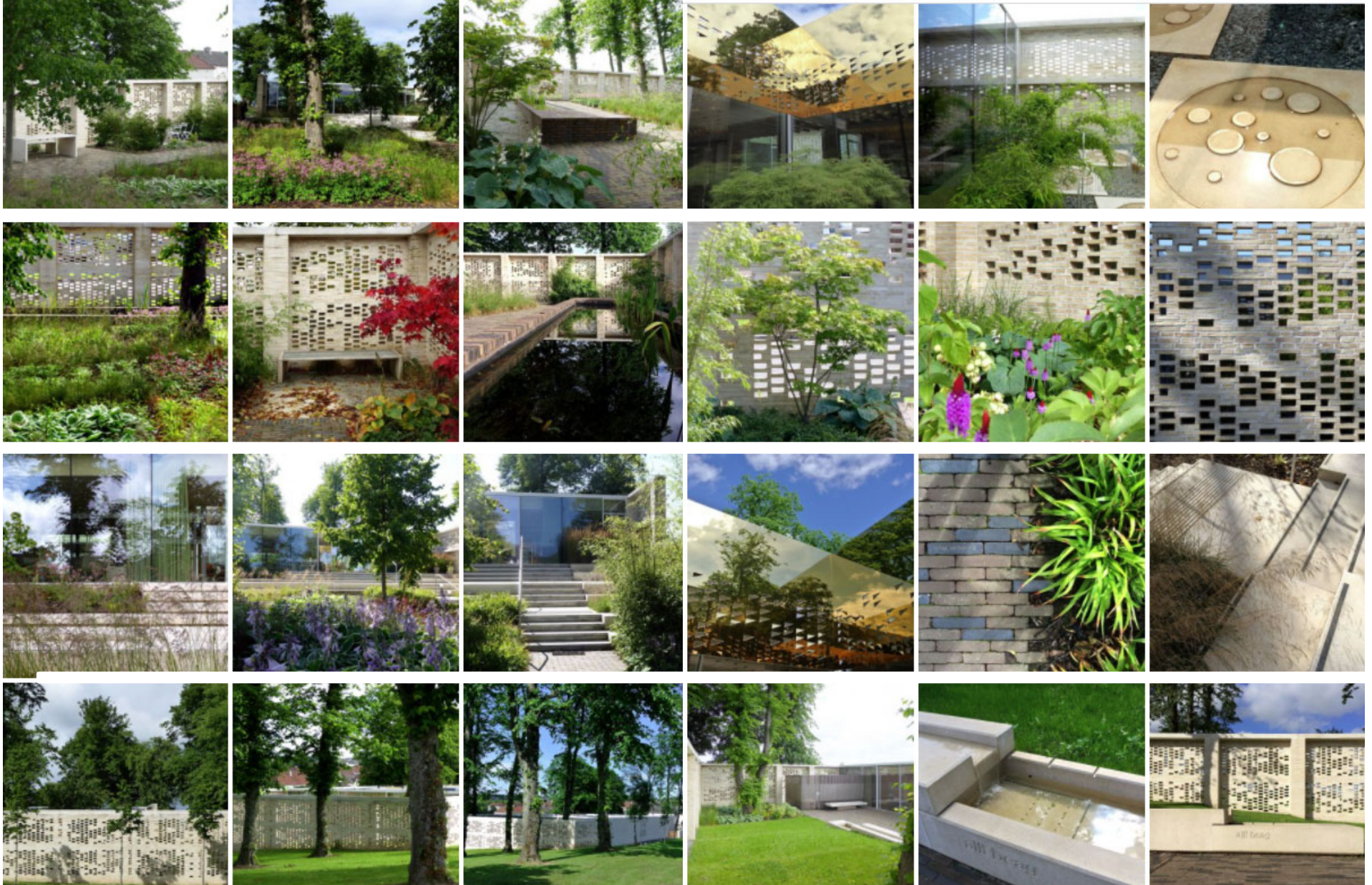
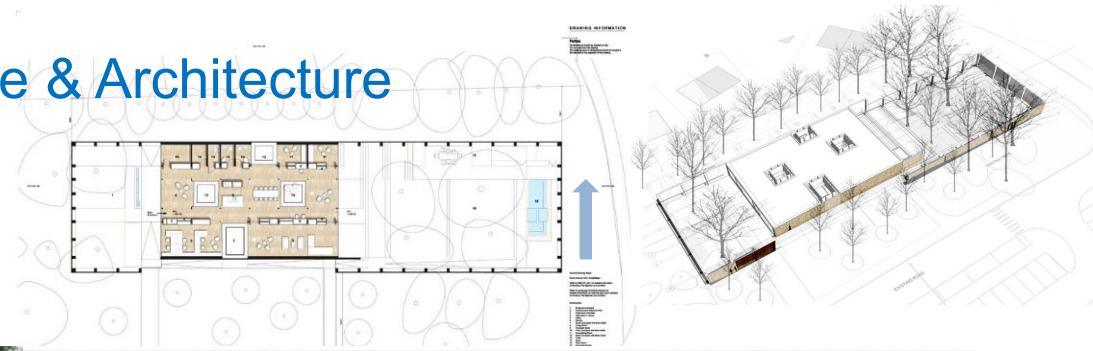
Jonathan Spiers, Spiers Major, Daylighting

Rankinfraser Landscape Architecture



Biophilic Light _ Integrate Landscape & Architecture

Maggie's Center, Lanarkshire, Scotland,
Reiach + Hall Architects
Jonathan Spiers, Spiers Major, Daylighting
Rankinfraser Landscape Architecture



Credits: <http://landezine.com/index.php/2018/08/maggies-centre-by-rankinfraser-landscape-architecture/>

14 PATTERNS OF BIOPHILIC DESIGN

Nature in Space Patterns _ Placed Light

Seasonal Light, Sensed Light, Passive Light, Integrated Light

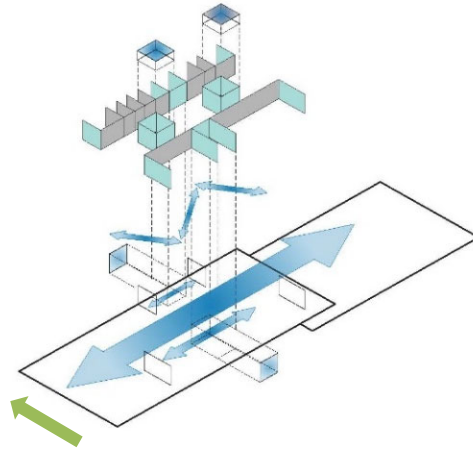
Nature in the Space Patterns

1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Airflow Variability
5. Presence of Water
6. Dynamic & Diffuse Light
7. Connection with Natural Systems



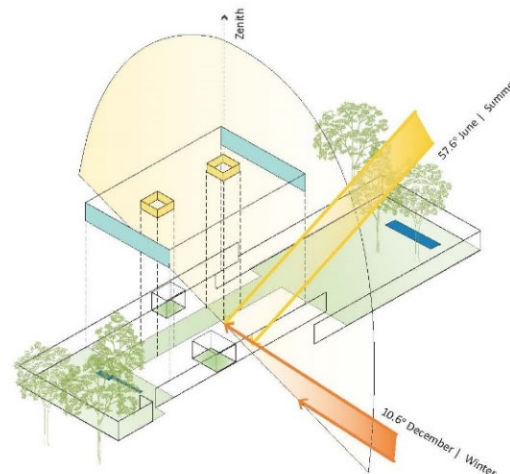
Natural Analogues Patterns

8. Biomorphic Forms & Patterns
9. Material Connection with Nature
10. Complexity & Order

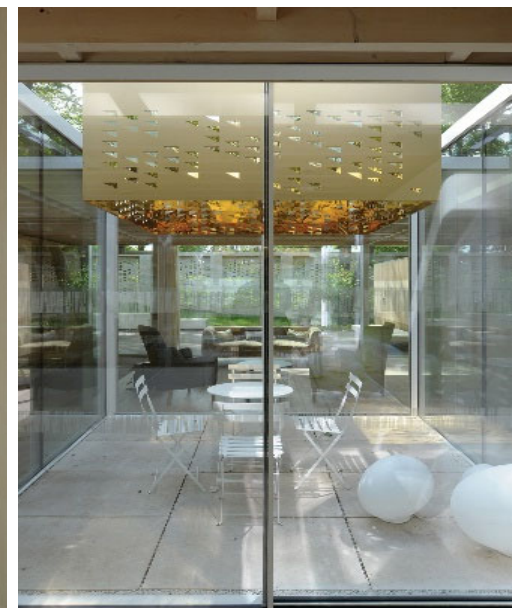
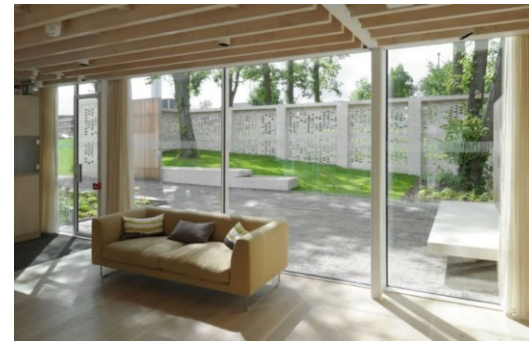


Nature of the Space Patterns

11. Prospect
12. Refuge
13. Mystery
14. Risk/Peril



15. +Awe



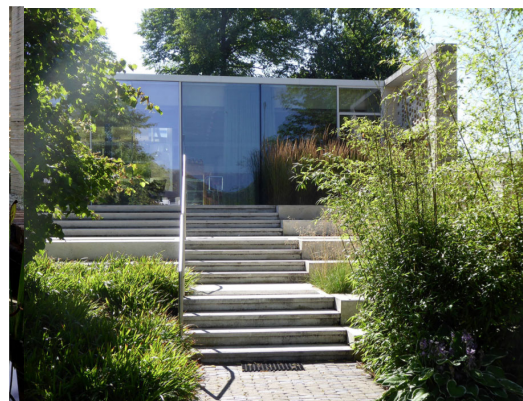
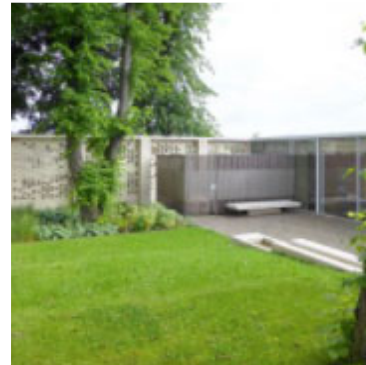
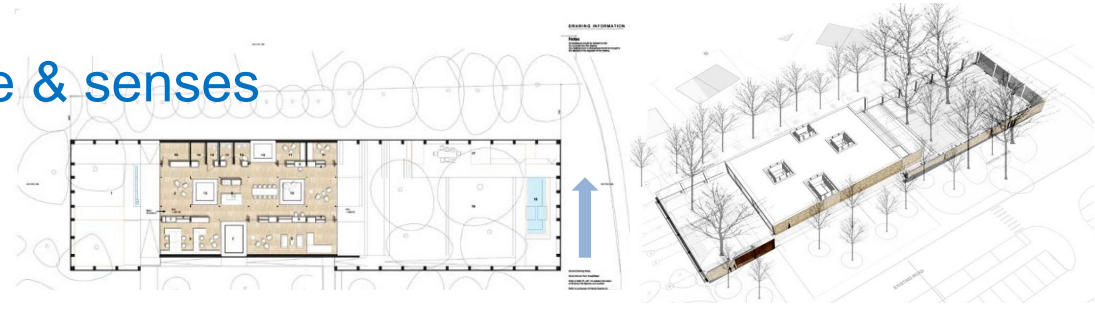
Biophilic Light _ Integrate place, time & senses

Maggie's Center, Lanarkshire, Scotland

Reiach + Hall Architects

Jonathan Spiers, Spiers Major, Daylighting

Rankinfraser Landscape Architecture

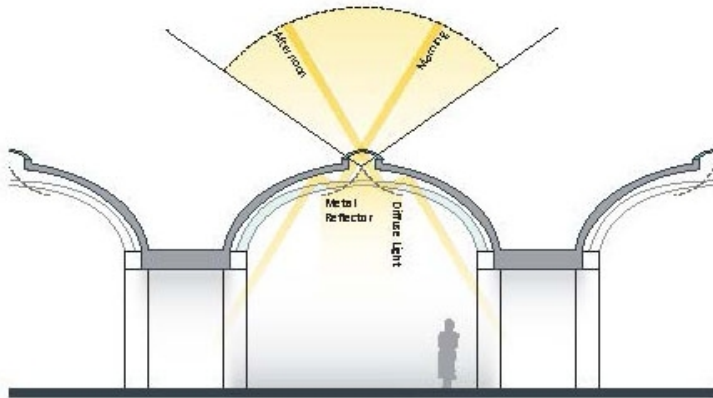


Integrated Light

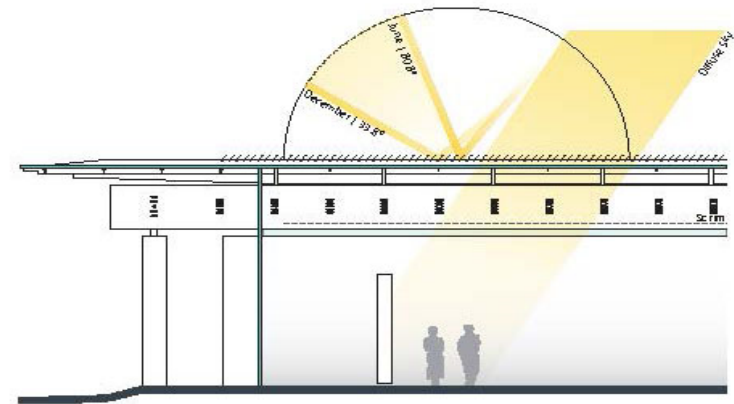
Louis Kahn & Renzo Piano:
Kimbell Art Museum, Fort Worth, TX

QUESTIONS

- Can you expand the role of daylighting?
- Integrate with other design issues & processes?
- Balance poetics & performance?



Kahn: west-east section



Piano: south-north section



KAHN: 1970



PIANO: 2013

6 (7) DAYLIGHT PATTERNS: Poetic + Pragmatic Design Integration

Comments – Questions – Integration with your current work?

INTEGRATED LIGHT

Placed Light

Choreographed Light

ATMOSPHERIC LIGHT

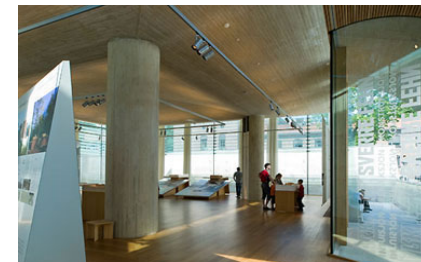
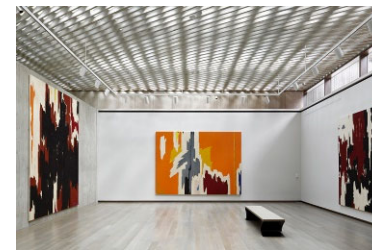
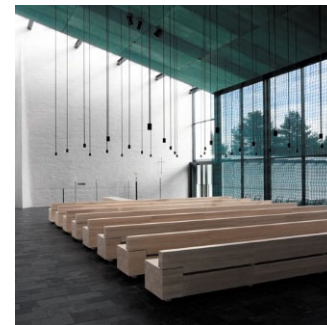
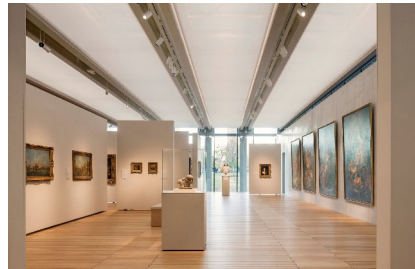
STRUCTURED LIGHT

SCULPTED LIGHT

Material Light

BIOPHILIC Light

(FILL IN THE BLANK) LIGHT



THE ART OF ARCHITECTURAL DAYLIGHTING

Immeasurable & Measurable Dimensions of Daylighting

Mary Guzowski, Professor, School of Architecture, University of Minnesota

“A great building, in my opinion, must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable.” - Louis Kahn, 1973, Pratt Institute

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Biophilic Net-Positive Design Project

About Resources Design Integration Project Events Living Labs News

BIOPHILIC DESIGN seeks to connect our inherent need to affiliate with nature in the modern built environment. - Stephen R. Keller

NET-POSITIVE DESIGN is often used as short-hand for buildings that generate more resources/energy than they consume... Adding [positive] value to an ecological system means increasing its systemic capacity to generate, sustain and evolve increasingly higher orders of vitality and viability for life of a particular place. - Pamela Mang & Bill Reed

BIOPHILIC NET-POSITIVE DESIGN PROJECT: A "Living Lab" collaboration in research, teaching & practice

The *Biophilic Net-Positive Design Project* is a collaboration between faculty in architecture, interior design, and landscape architecture to explore the intersections between new theories and practices in biophilic and net-positive design, including their relationships to sustainable, resilient, regenerative, and socially responsible and equitable design. The project explores the potential of developing a *Biophilic Living Lab* at the University of Minnesota to improve health and environmental benefits across design scales and disciplines.

2020-2021 Project Events Schedule

BIOPHILIC & HEALTH DESIGN RESOURCES

- CREATING BIOPHILIC DESIGN
- The Global Impact of Design on the Workplace

