

Eclairage par le soleil et le ciel:  
dynamique temporelle et  
perception par les occupants

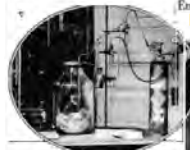
Le Temps de la Lumière  
UEE - PENS-313  
Prof. Marilyne Andersen | Dr. Bernard Paule |  
Dr. Sergi Aguacil | Evelyne Aebischer

## NOW THE WINDOWLESS BUILDING WITH ITS OWN CLIMATE

By C. F. TALMAN Francis Keally, Architect  
New York Times: 1937; Aug 10, 1939; ProQuest Historical Newspapers: The New York Times  
pg. XX4

## NOW THE WINDOWLESS BUILDING WITH ITS OWN CLIMATE

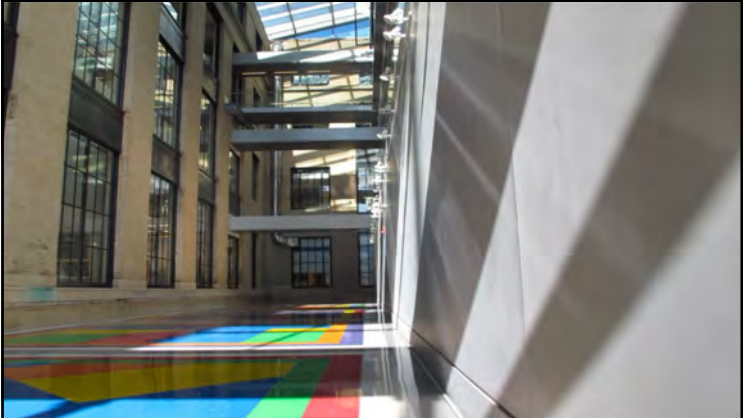
Engineers Promise Germ-Free Atmosphere and Artificial Sunlight for  
Those Who Must Spend Much of Their Lives at Work Indoors



**T**he new skyscraper, which will be the first windowless building in the world, is being built in New York City. It is a 20-story building, and it will be the first building of its kind in the world. The building is being built by the architect, Francis Keally, and the engineers, C. F. Talman and Francis Keally. The building is being built in New York City, and it will be the first building of its kind in the world. The building is being built by the architect, Francis Keally, and the engineers, C. F. Talman and Francis Keally. The building is being built in New York City, and it will be the first building of its kind in the world. The building is being built by the architect, Francis Keally, and the engineers, C. F. Talman and Francis Keally.

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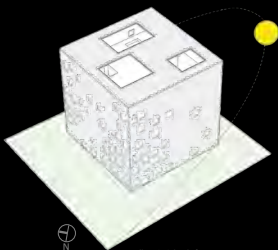
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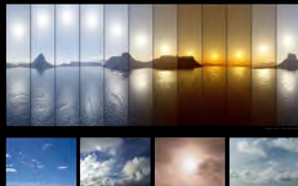
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### daylight for buildings



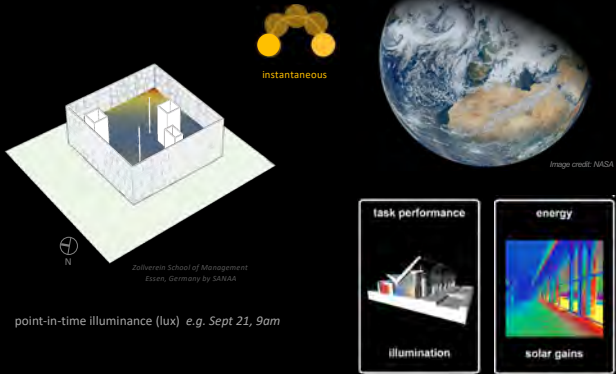
Zalvernia School of Management  
Essen, Germany by SANAA



sun course and weather patterns



## daylight for task illumination (and solar gains)

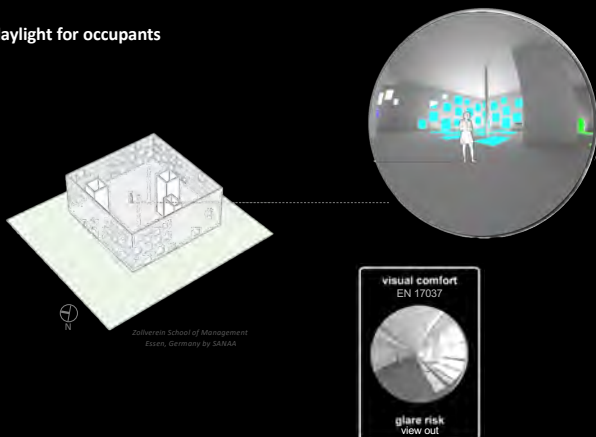


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## daylight for occupants

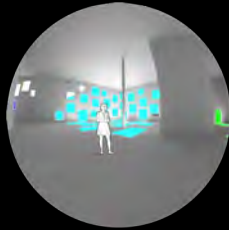


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## daylight for occupants



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## BEYOND ILLUMINATION

where and when healthy, stimulating, and comfortable light will occur ...

### ILLUMINATION

adequate  
task lighting



+

### VITALITY

physiology



### COMFORT

acceptability



### EMOTION

psychology



... **dynamically** over time & space

## ILLUMINATION

adequate  
task lighting

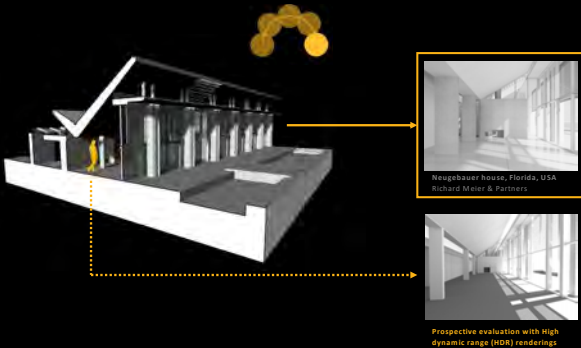


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## daylight dynamics: sun course and latitude



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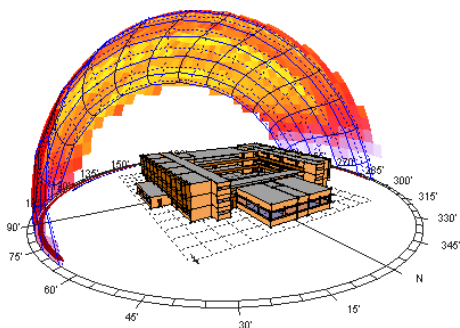
Renderings by: S. Rockcastle

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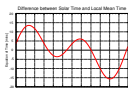
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## Sun course

stereographic projection to evaluate direct sunlight potential

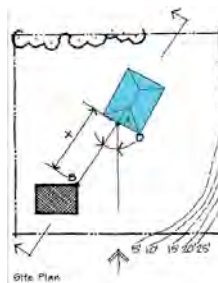
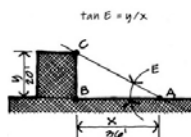
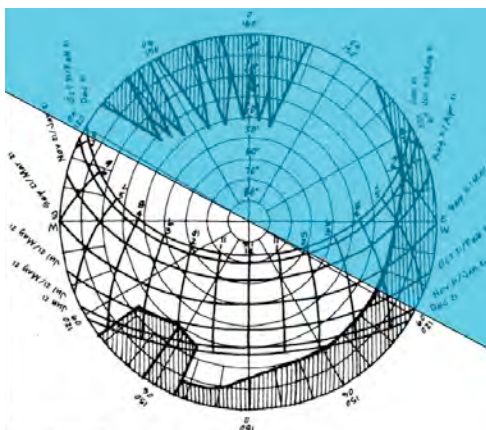


! difference between solar time and legal time !



## Using a stereographic projection

impact of urban/natural obstructions – ONE façade orientation at a time !



## Using an artificial sun

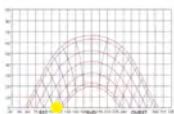
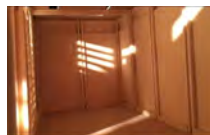
shadow analysis with heliodons



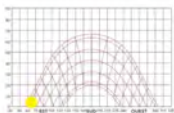
manual heliodon (intuitive)

## Using an artificial sun

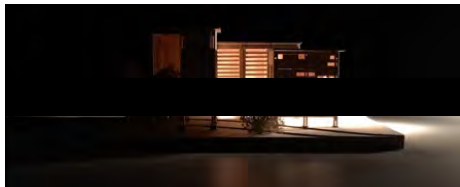
shadow analysis with heliodons



winter



summer



## Using the real sun

shadow analysis with sun pegs (gnomons)



## Designing with daylight (sun+sky)

basic principles

- **orientation** as a driver for façade design



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## Designing with daylight (sun+sky)

### basic principles

- **orientation** as a driver for façade design
- **harvesting** daylight (collect-transport-distribute) from access to sky



22/02/2017 Reichstag, Berlin (by Foster)



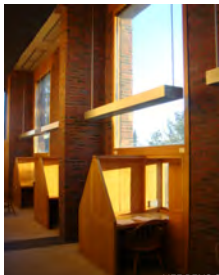
USE PENS-313 | 01-10-2017 Relation par le soleil et par ciel - Genzyme HQ, Cambridge MA (by Behnisch)  
ciel - Marilyne Andersen, LIPID-EPFL

## Designing with daylight (sun+sky)

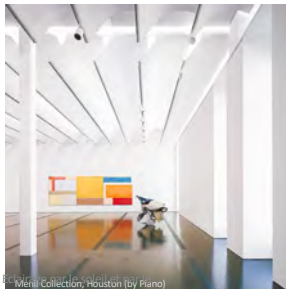
### basic principles

- **orientation** as a driver for façade design
- **harvesting** daylight (collect-transport-distribute) from access to sky
- **ambient vs. task** illumination (with glare control)

rule of thumb : **depth of penetration = window height x 2**



22/02/2017 Eyster Library, New Hampshire (by Kahn)



USE PENS-313 | 01-10-2017 Relation par le soleil et par ciel - Menil Collection, Houston (by Piano)  
ciel - Marilyne Andersen, LIPID-EPFL



## comfort

*builds on minimal and maximal requirements*



SG Foyer, EPFL (rendering by K. Chamblott)

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## visual and thermal comfort

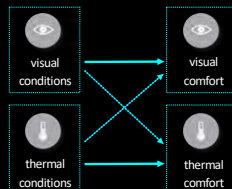
*perceived interactions*

Dr. Giorgia Chinazzo  
LIPID PhD+PostDoc alumnus  
PostDoc at Northwestern University, USA



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SwissTech Convention Center / Richter Dahl Rocha & Associés



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## visual and thermal comfort

*perceived interactions*



Your Rainbow Panorama by Studio Olafur Eliasson

- does thermal perception depend on **color of light**?



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## visual and thermal comfort

*perceived interactions*



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Rolex Learning Center / SANAA

- does thermal perception depend on **color of light**?
- does thermal perception depend on **brightness**?
- does visual perception depend on **temperature**?



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# visual and thermal comfort

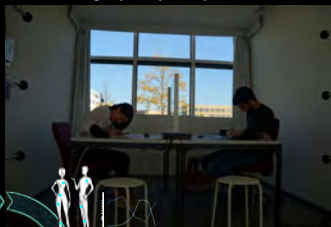
## interaction effects



color of light & temperature



light quantity & temperature



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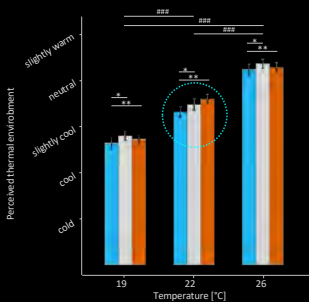
# visual and thermal comfort



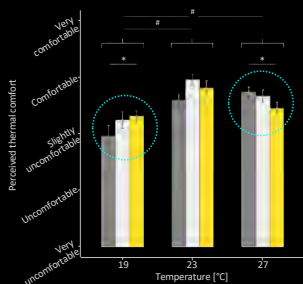
impact of visual environment on thermal perception

impact of brightness on thermal comfort

color of light & temperature



light quantity & temperature



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## visual and thermal comfort

*impact on thermal perception of a visual experience*



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## emotion

*most tangibly connected with architectural experience*



*Dominus Winery by Herzog & De Meuron, California*

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## emotion

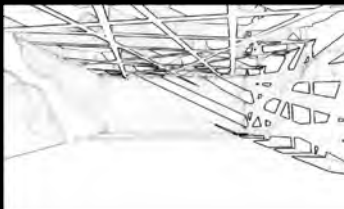
*perceptual effects and visual interest in daylight architecture*

Prpf. Siobhan Rockcastle

LIPID PhD-PostDoc alumnus

Co-Founder of OCULIGHT

Asst. Prof. at University of Oregon, USA



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## spatial contrast

*dynamic spatial and temporal qualities of daylight*



Institut du Monde Arabe  
Jean Nouvel

Serpentine Pavillon  
Toto Ito

Neugebauer house  
Richard Meier & Partners

First Unitarian church  
Louis Kahn

Menil gallery  
Renzo Piano



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## spatial contrast

subjective rating of rendered architectural spaces (online survey)



+ effect of sky (weather)



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## perception of daylight patterns

irregularity linked to positive impressions

Prof. Kynthia Chamilothoni  
LIPID PhD+PostDoc alumnus  
Asst. Prof. at TU Eindhoven, The Netherlands



Demonstration of the experimental setup by G. Chinazzo



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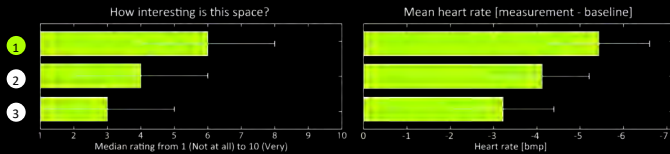
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## perception of daylight patterns

*irregularity linked to positive impressions  
and measurable calming effect*



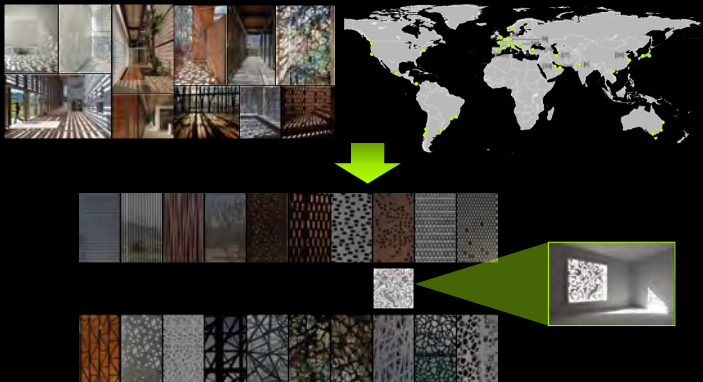
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## façade patterns

*inspiration from worldwide architecture*



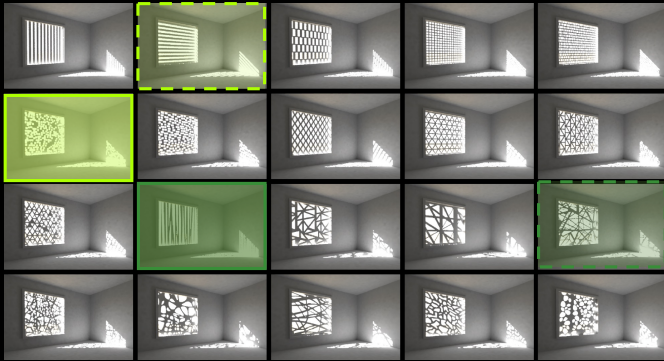
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# façade patterns and daylight composition

consensus on pattern attributes (from designers)



POSITIVE ■ most exciting ■ most calming  
NEGATIVE ■ least exciting ■ least calming



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# assessing human response to daylight patterns

VR immersion



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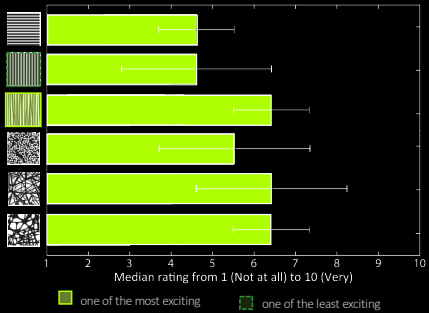
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# daylight patterns and psycho-physiological human response

how exciting is this space?



Appraisal from 415 participants from 3 locations in Europe  
(138 in Greece, 127 in Switzerland, 150 in Norway)



significant effect of pattern **independently**  
of sky/sun, context, size or location!

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## vitality

physiological human needs



Drawing by M.L. Amundador

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## vitality

*non-image-forming pathways*



SENSITIVITY



CIRCADIAN RHYTHMS

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## vitality

*impact of light exposure on well-being*



HEALTH IMPACTS



ALERTNESS

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# vitality

biological time

Dr. María Amundadóttir  
 LIPID PhD alumnus  
 Co-Founder of OCULIGHT  
 Data Scientist and Entrepreneur, Iceland



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 Image Source: Amundadóttir, 2016

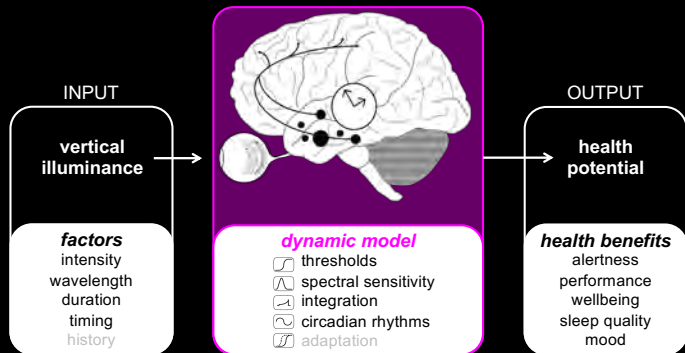
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# non-visual system

effects of ocular light exposure on human health

Dr. María Amundadóttir  
 LIPID PhD alumnus  
 Co-Founder of OCULIGHT  
 Data Scientist and Entrepreneur, Iceland



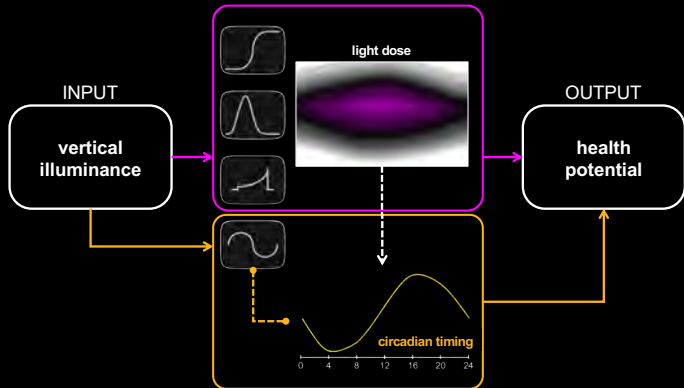
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## dynamic model

maximize the daily light dose without disturbing circadian timing



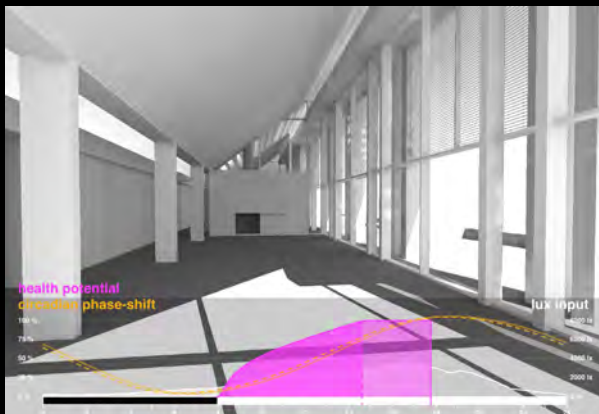
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## dynamic model

cumulative dose and daily cycle



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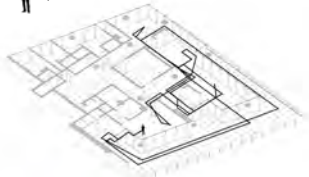
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# SPATIO-TEMPORAL OCCUPANT DYNAMICS

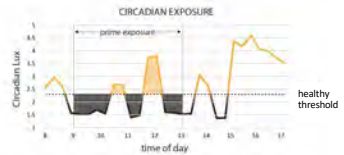
behavior analytics



perimeter dweller

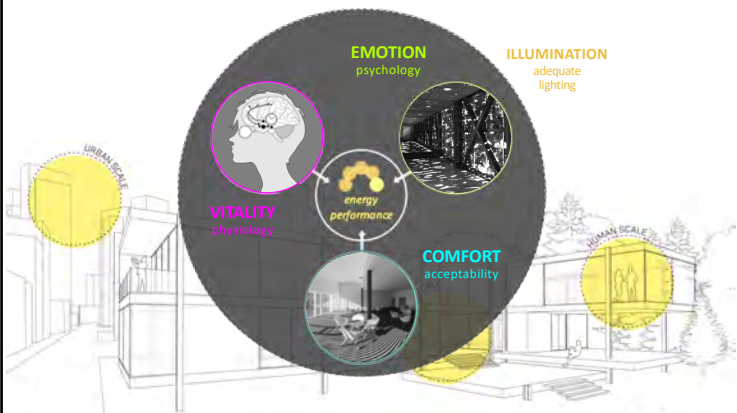


core dweller



Surf Club, Miami | Meier & Partners

# EVALUATING A BUILDING'S MULTIDIMENSIONAL DAYLIGHT QUALITIES



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