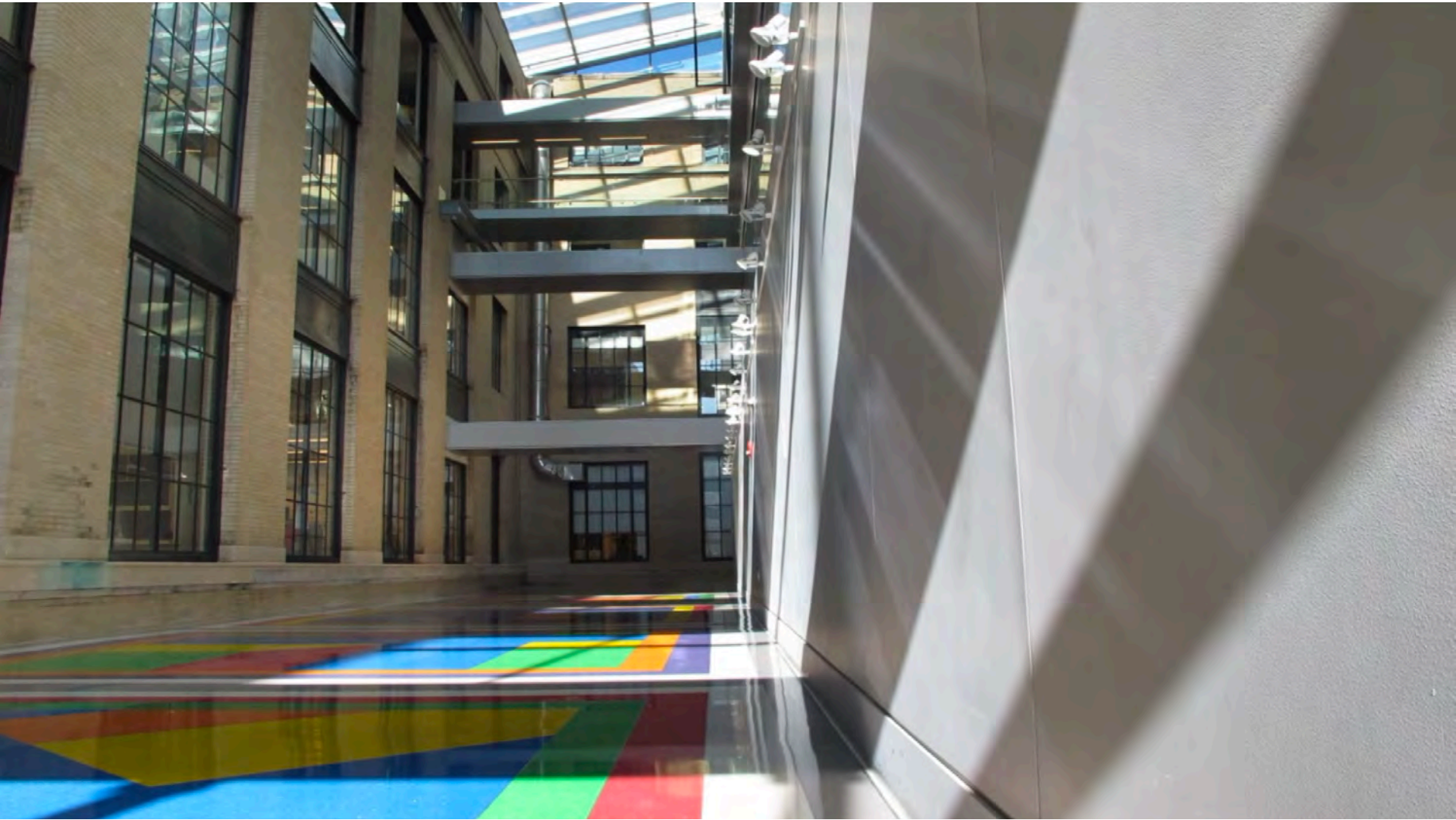


Eclairage par le soleil et le ciel:  
dynamique temporelle et  
perception par les occupants

Le Temps de la Lumière  
UEE - PENS-313

Prof. Marilyn Andersen | Dr. Bernard Paule |  
Dr. Sergi Aguacil | Evelyne Aebischer

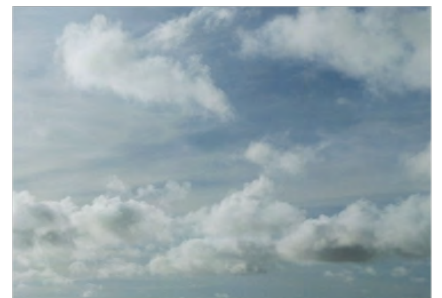
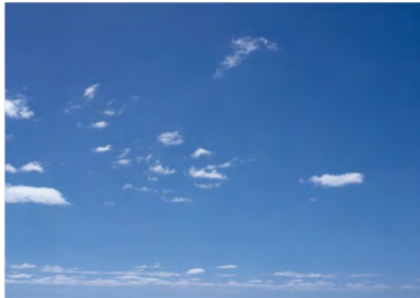
# DAYLIGHT IS FAMILIAR, BUT NOT ALWAYS INTUITIVE



# Seasonal and daily dynamics



Image credit: StevenRutledge



# Weather and time dynamics

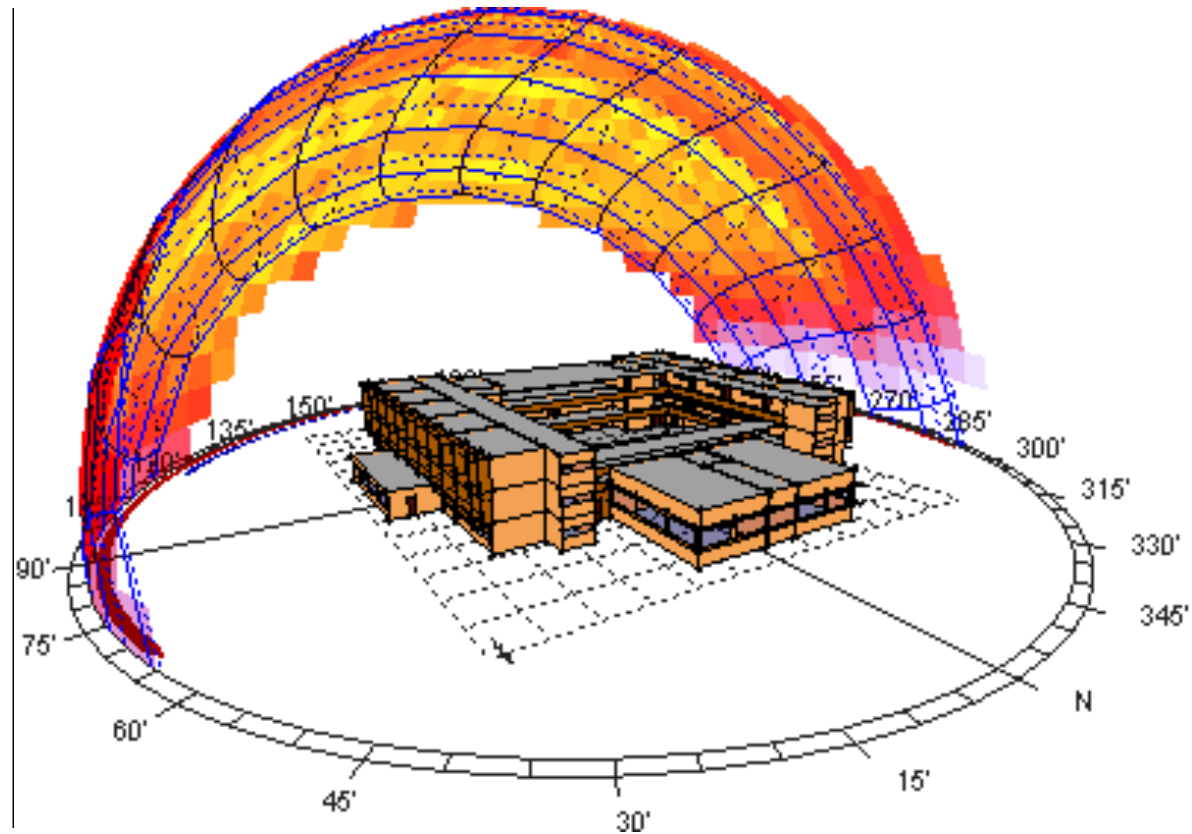
influence of cloud cover (and time of day) on visual perception of environment



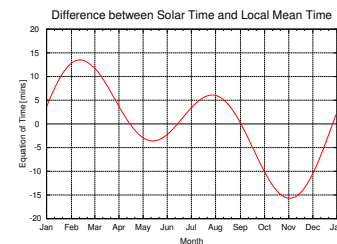
Image courtesy from B. Paule - West view from EPFL campus

# Sun course

stereographic projection to evaluate direct sunlight potential

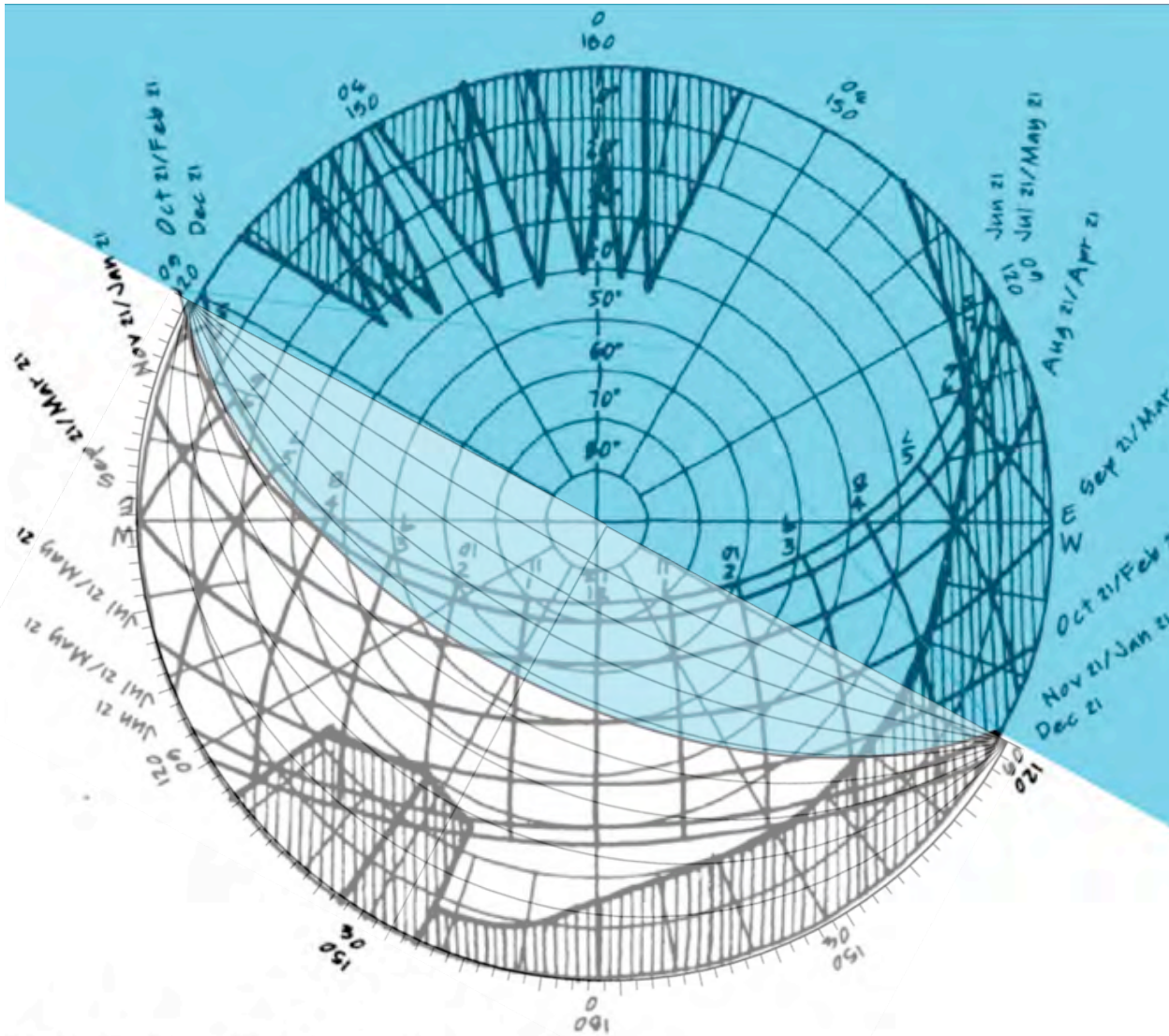


**! difference between solar time and legal time !**

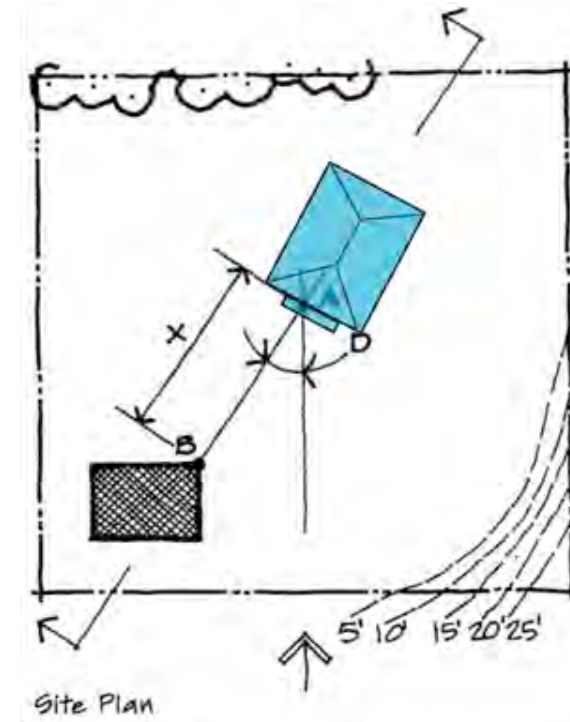
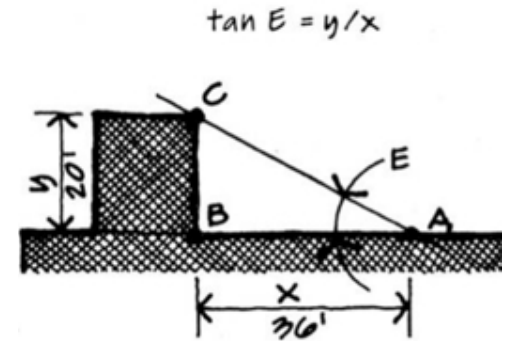


# Using a stereographic projection

impact of solar protections (shading mask) – angular referential (dimensionless)



Plot of Site Obstructions



# Using an artificial sun

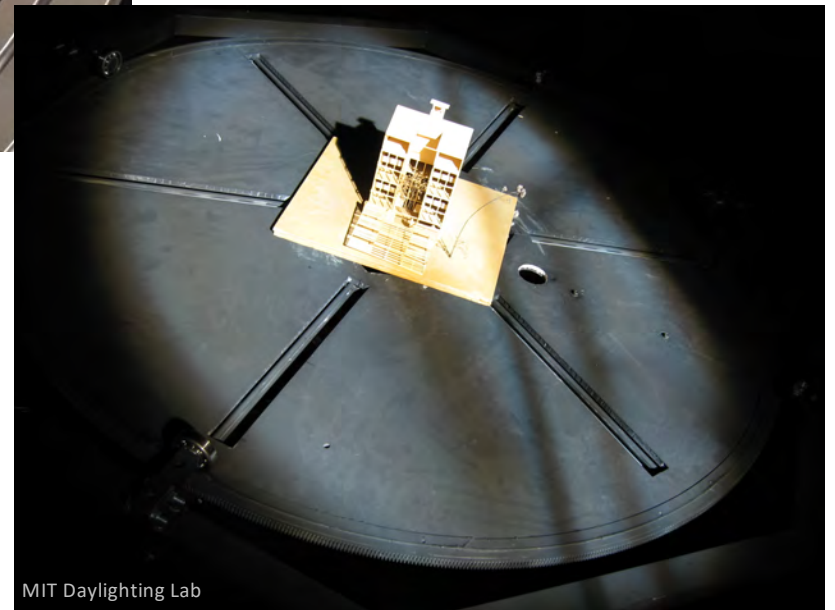
shadow analysis with heliodons



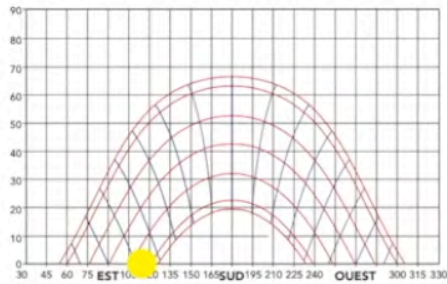
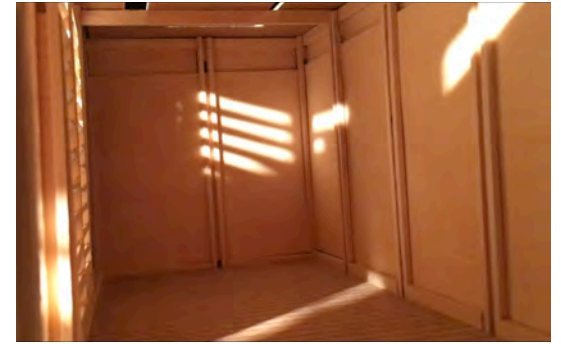
manual heliodon (intuitive)



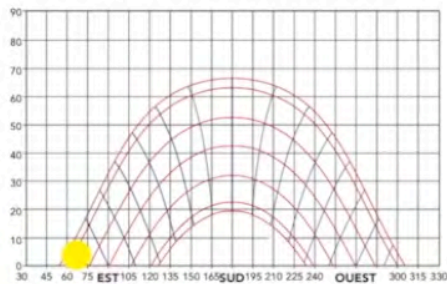
motorized heliodon



# Using an artificial sun shadow analysis with heliodons



winter



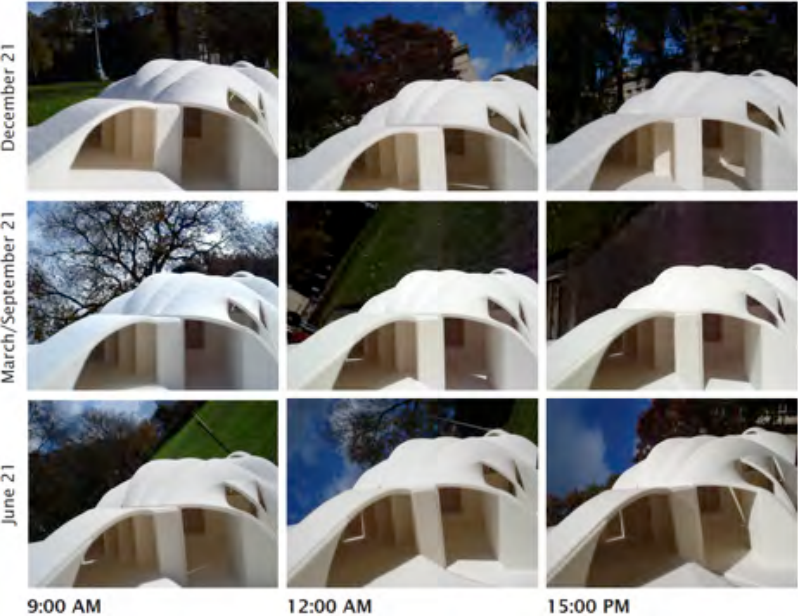
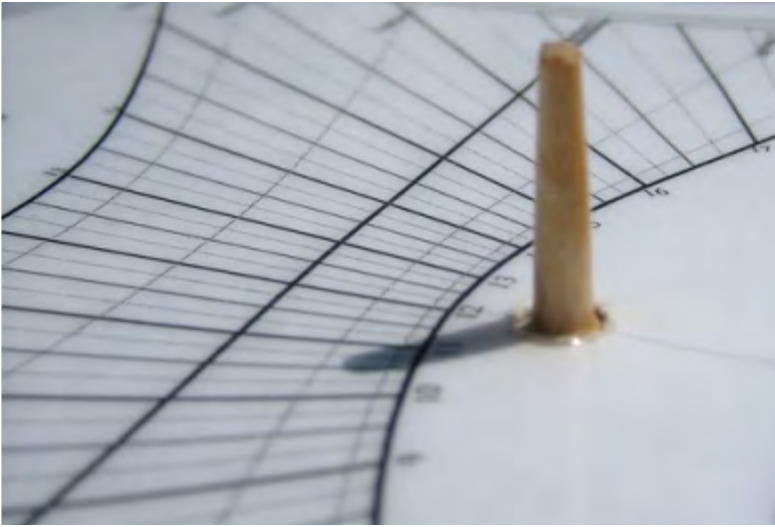
summer





# Using the real sun

shadow analysis with sun pegs (gnomons)



# Designing with daylight (sun+sky)

## basic principles

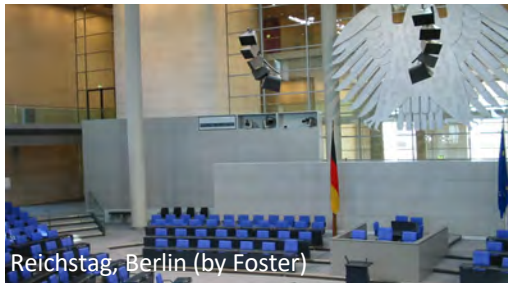
- **orientation** as a driver for façade design



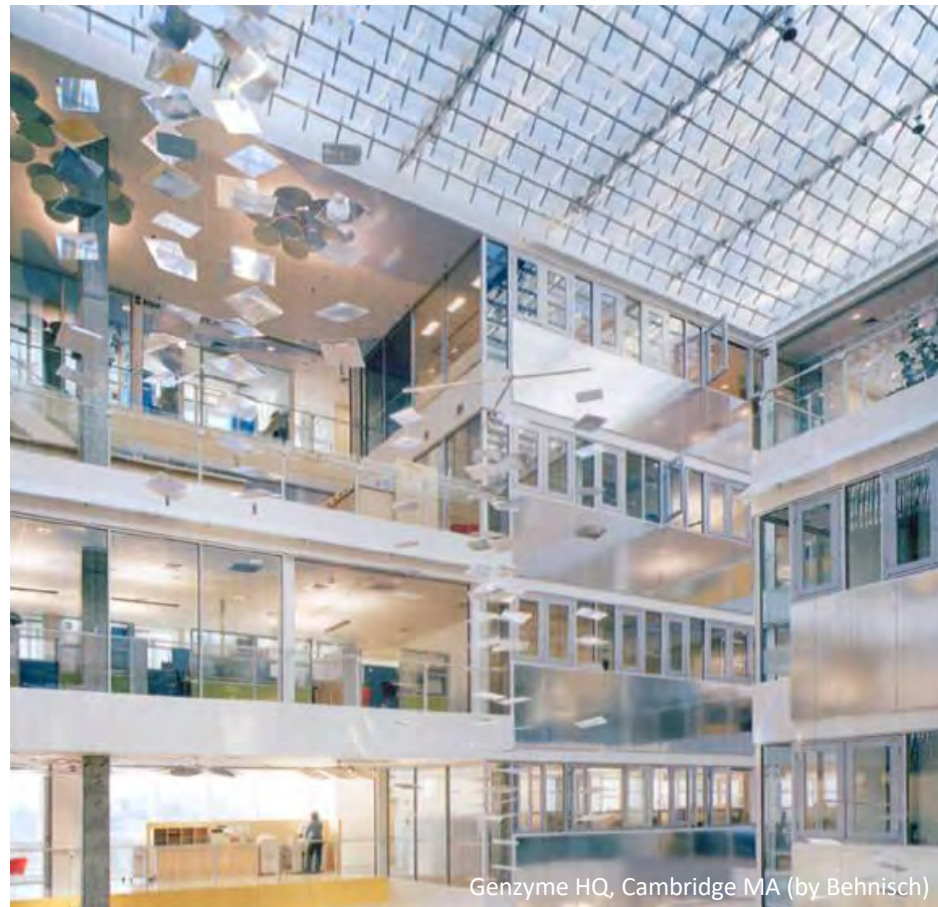
# Designing with daylight (sun+sky)

## basic principles

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



Reichstag, Berlin (by Foster)



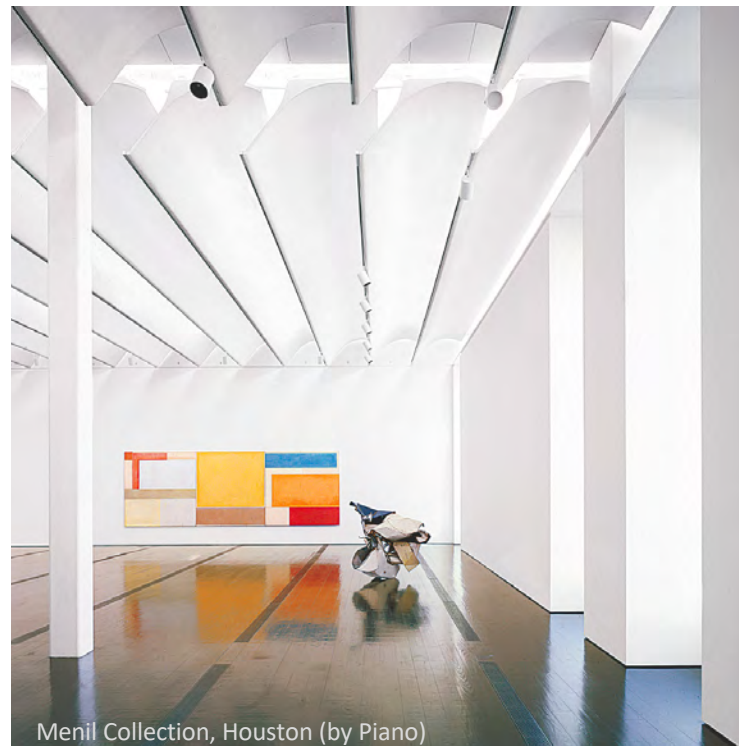
Genzyme HQ, Cambridge MA (by Behnisch)

# Designing with daylight (sun+sky)

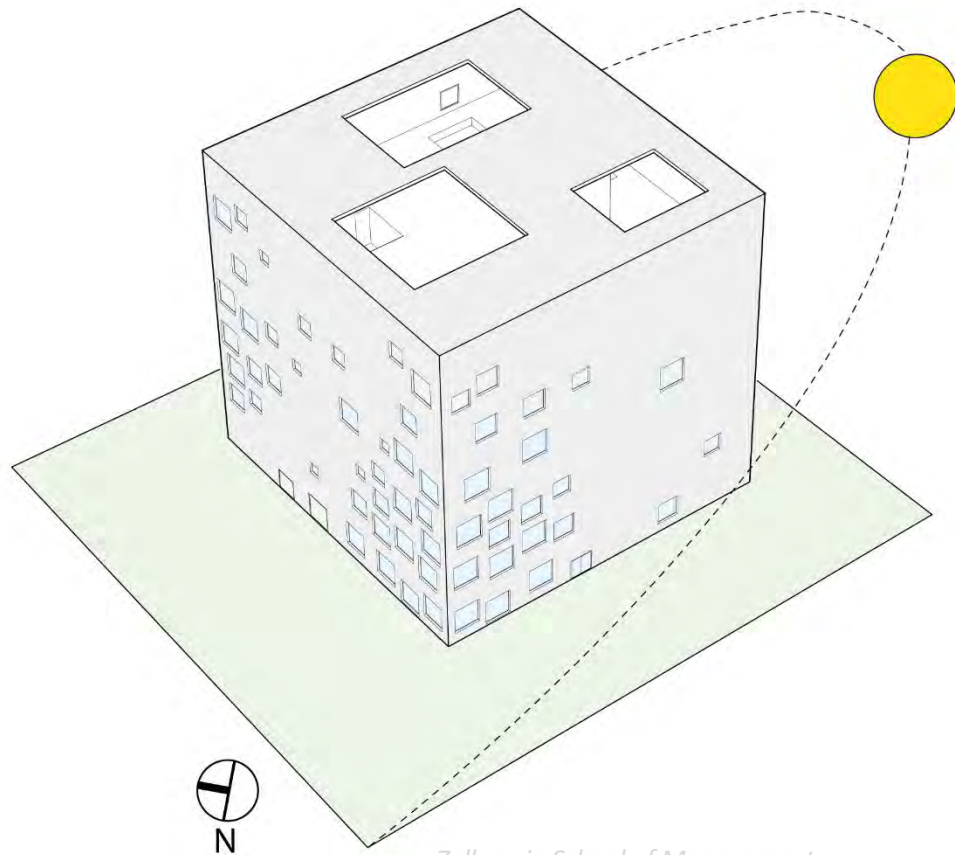
## basic principles

- **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**



# outside dynamics



Zollverein School of Management  
Essen, Germany by SANAA



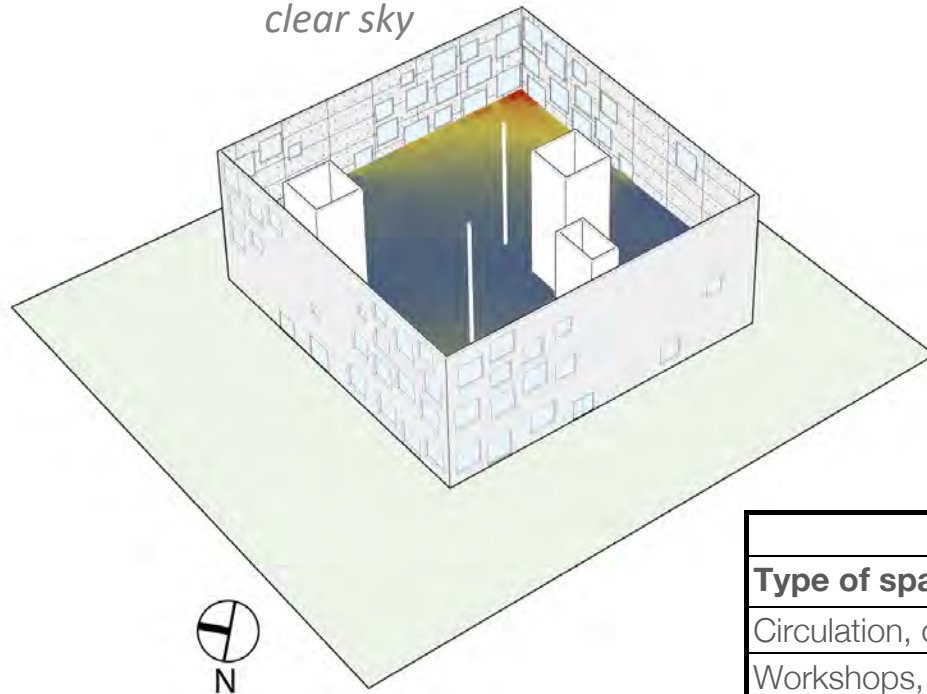
OEKK building, Landquart GR (Zumthor, Bearth&Deplazes)



seasonal management

# «measuring» daylight

illuminance (lux)  
 February 27, 1:30pm  
 clear sky



## Task illumination metrics

instantaneous

- *illuminance (lux)*

Full moon



0.01 lux

Overcast sky



8'000 - 20'000 lux

Sunny sky

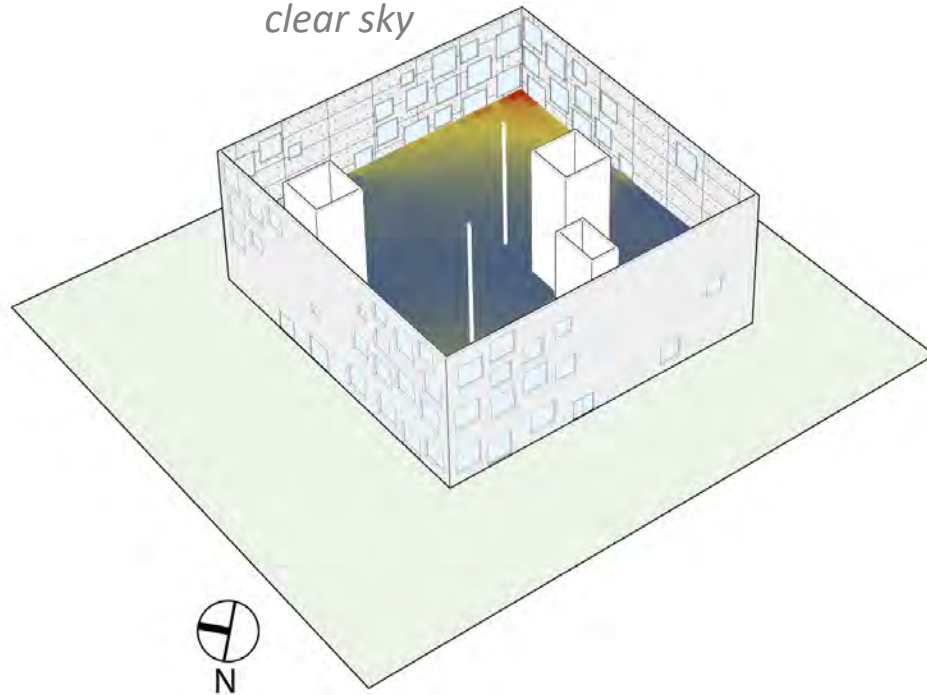


30'000 - 100'000 lux

Type of space and function	Illuminance [lux]		
	Min	Mid	Max
Circulation, corridors, theatres...	50	100	200
Workshops, retail centres ...	200	300	400
Schools, offices, writing, computer work...	300	400	500
Delicate work, drawing, technical tasks...	500	750	1000
Precision workshops, visual quality control	1000	to	5000

# «measuring» daylight

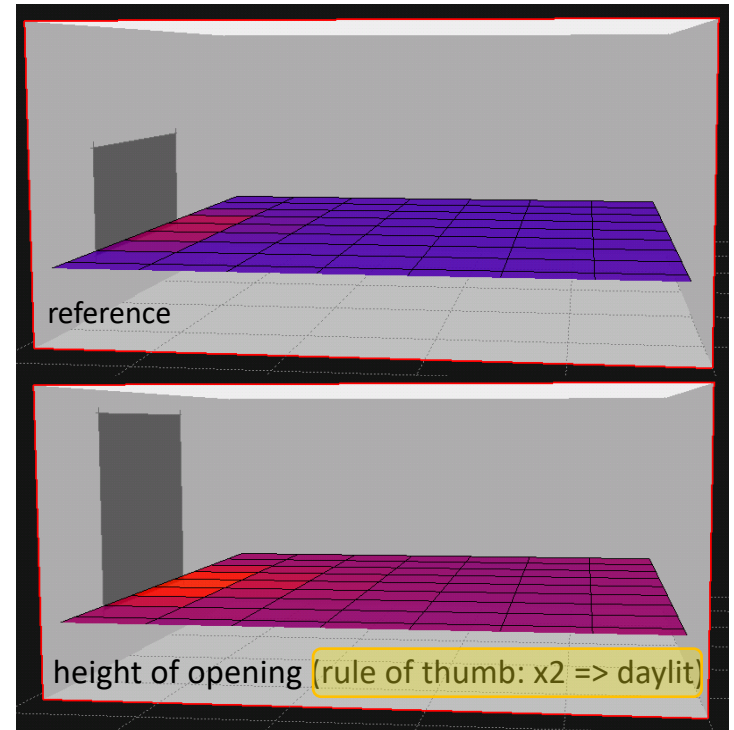
illuminance (lux)  
February 27, 1:30pm  
clear sky



## Task illumination metrics

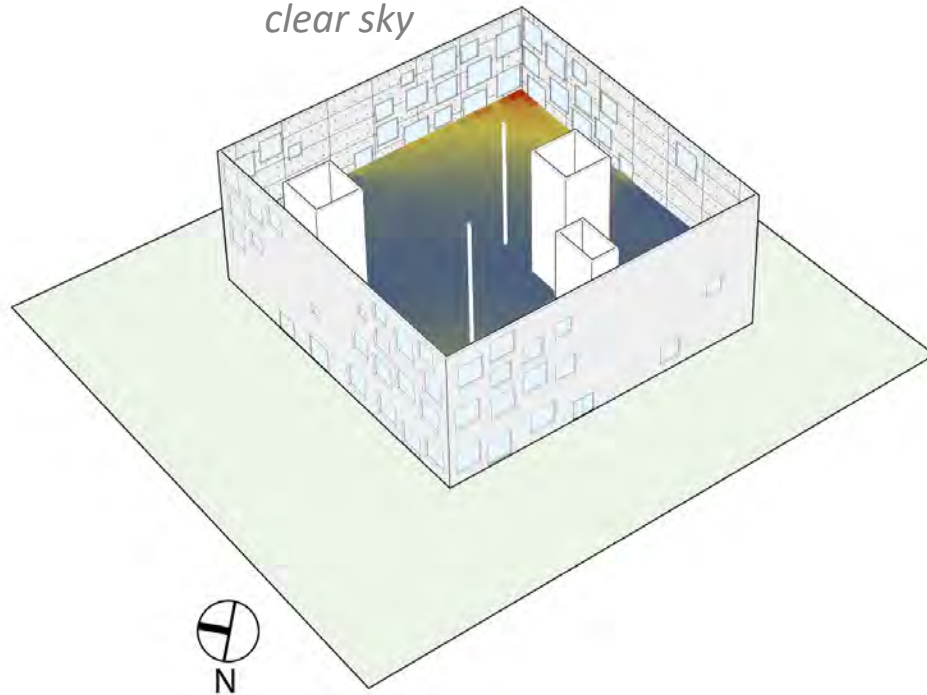
instantaneous

- illuminance (lux)



# «measuring» daylight

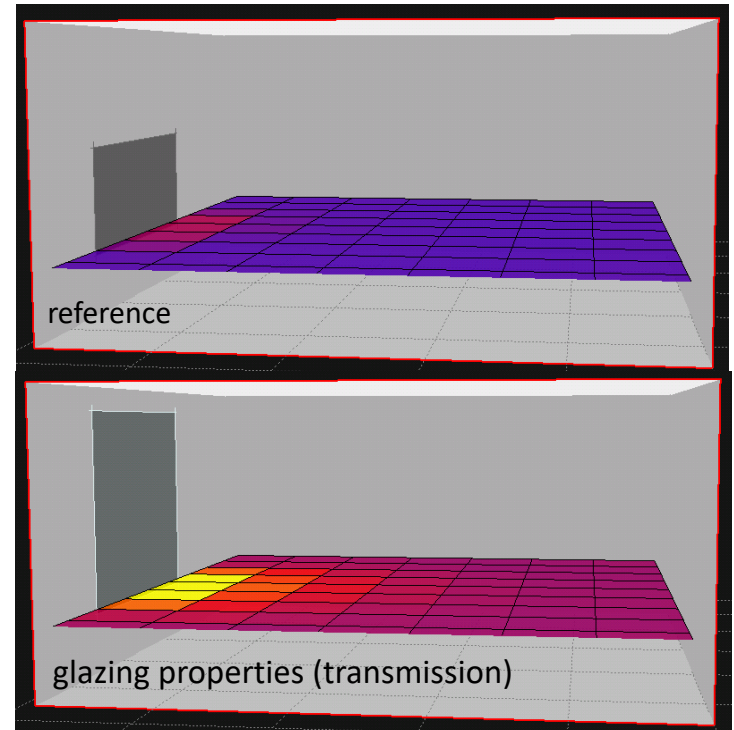
illuminance (lux)  
February 27, 1:30pm  
clear sky



## Task illumination metrics

instantaneous

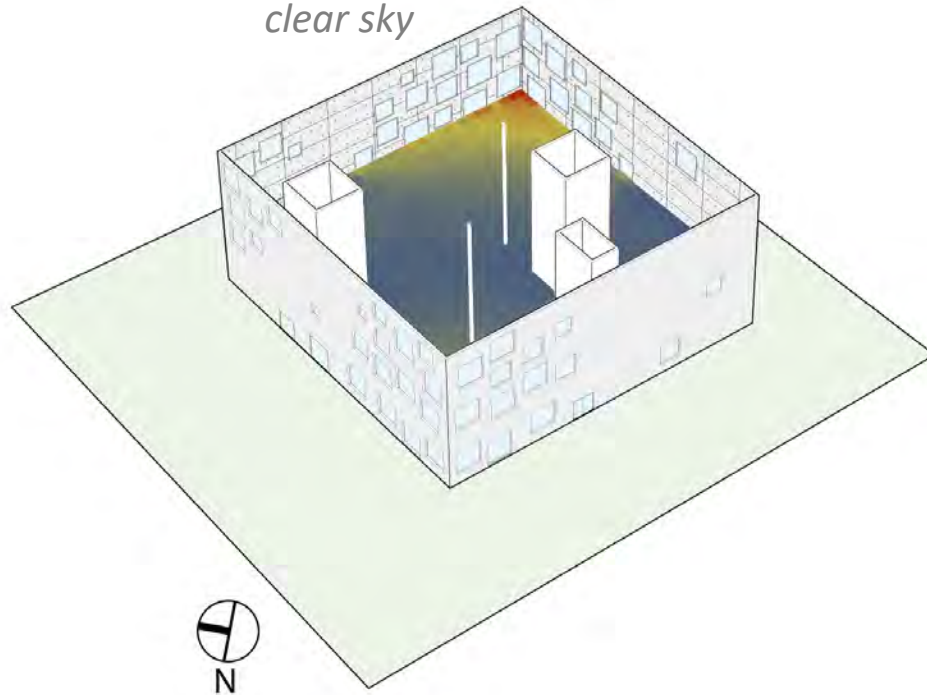
- *illuminance (lux)*





# «measuring» daylight

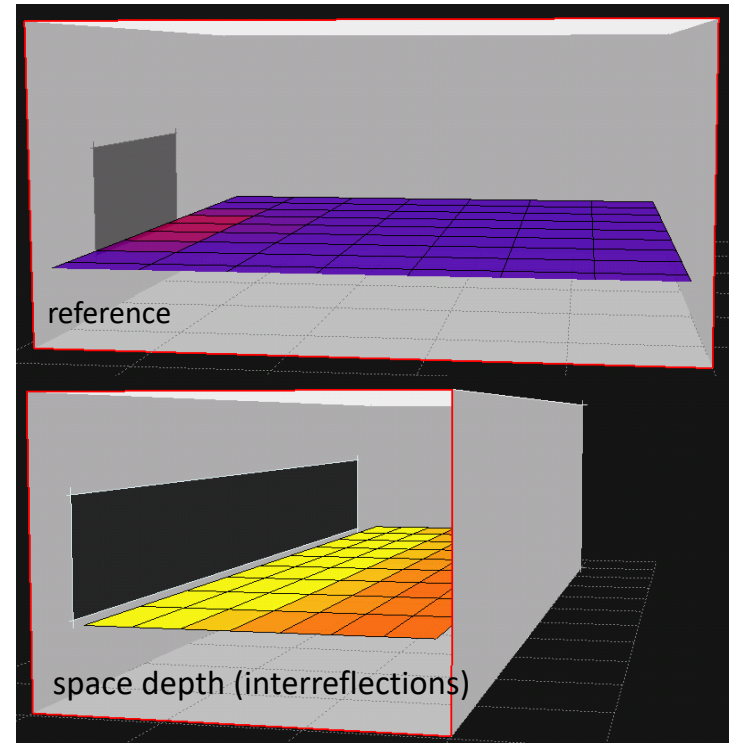
illuminance (lux)  
February 27, 1:30pm  
clear sky



## Task illumination metrics

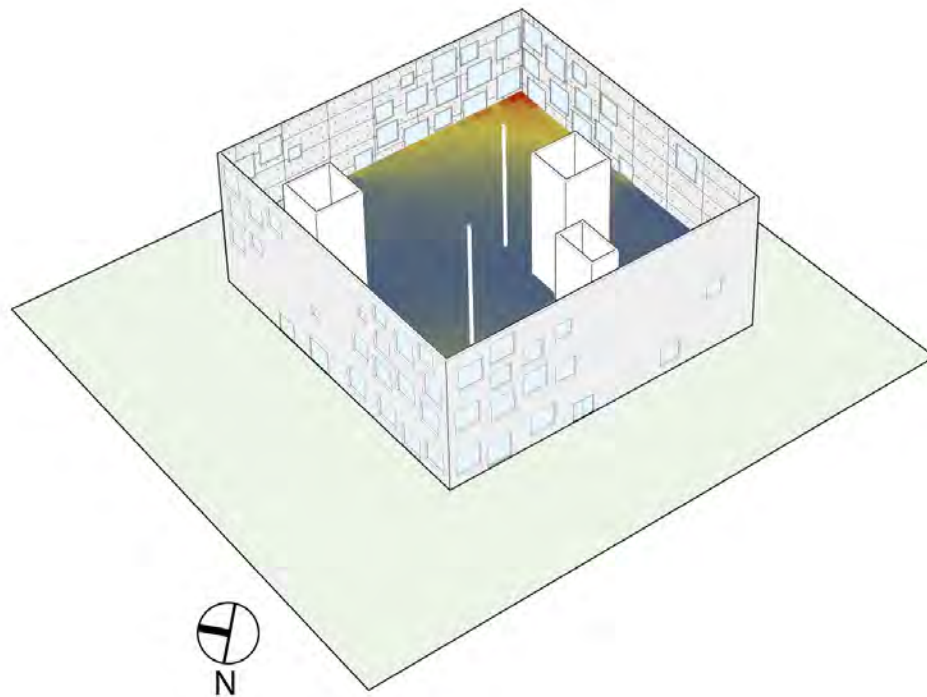
instantaneous

- *illuminance (lux)*



# «measuring» daylight

annual performance  
for given location



## Task illumination metrics

climate-based

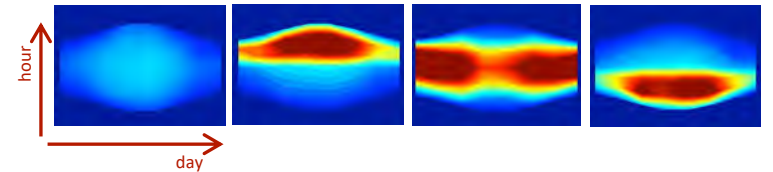
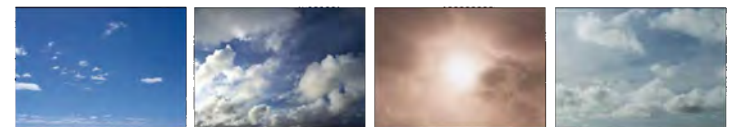
- *Daylight “Autonomy”*

- *Useful Daylight Illuminance (UDI)*
- *Spatial Daylight Autonomy (sDA)*
- *Annual Sunlight Exposure (ASE)*..

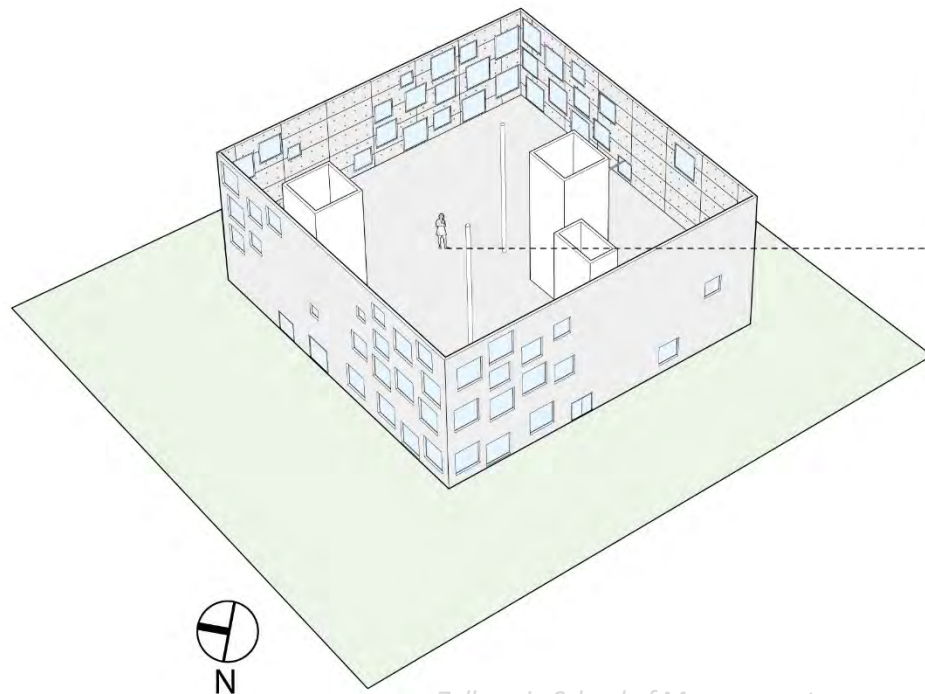
IES LM-83



Image credit: Oliver Plattner



BUT... people perceive daylight from an immersed view

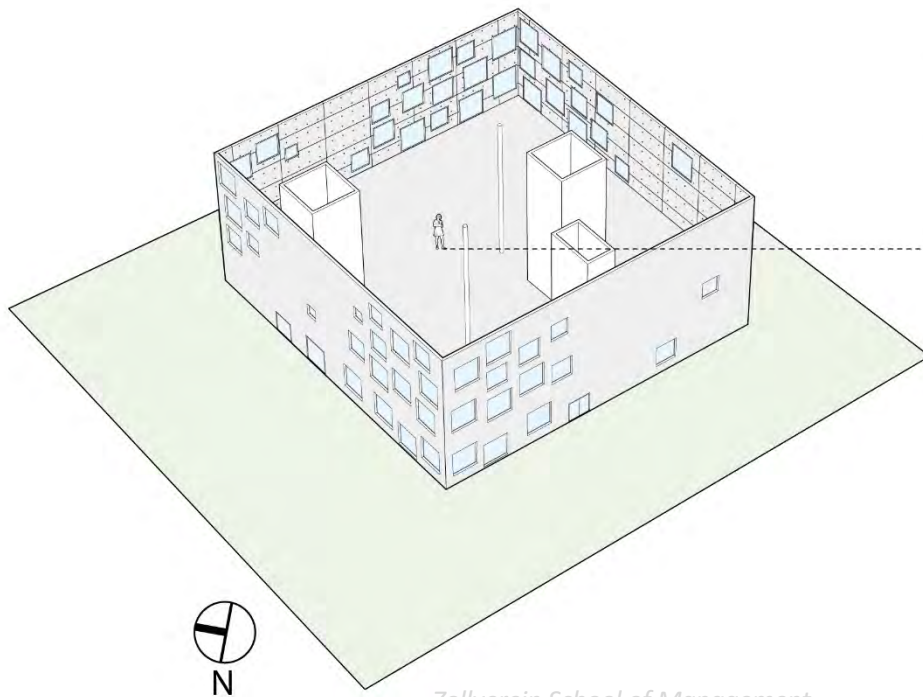


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Essen, Germany by SANAA*

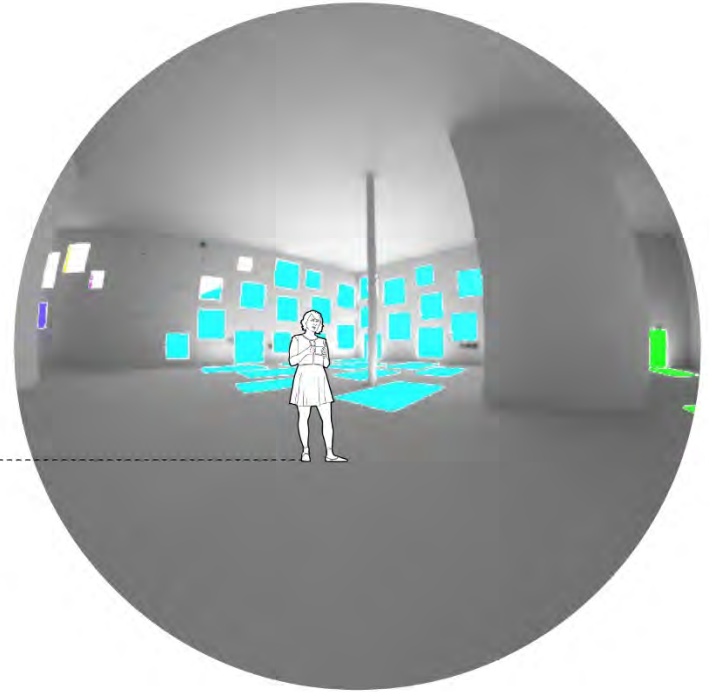


...and this view is constantly changing.

Today, there is only one (commonly used) way to evaluate that perception...



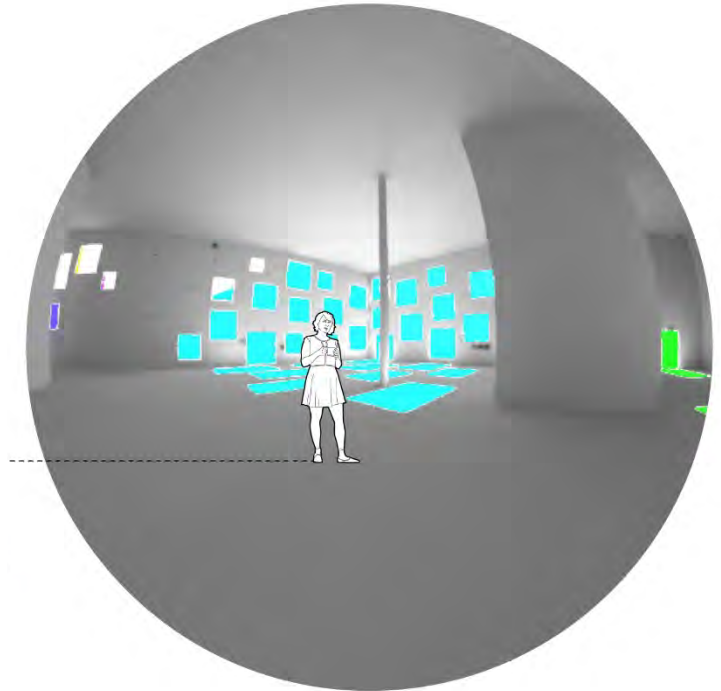
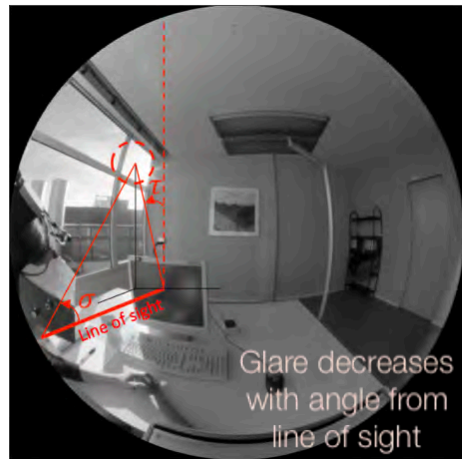
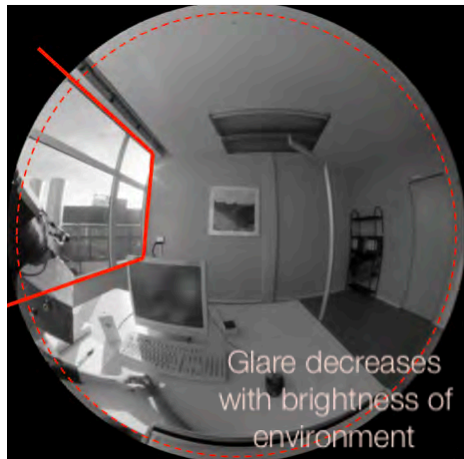
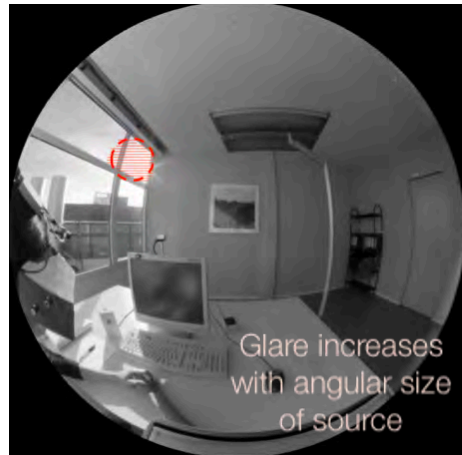
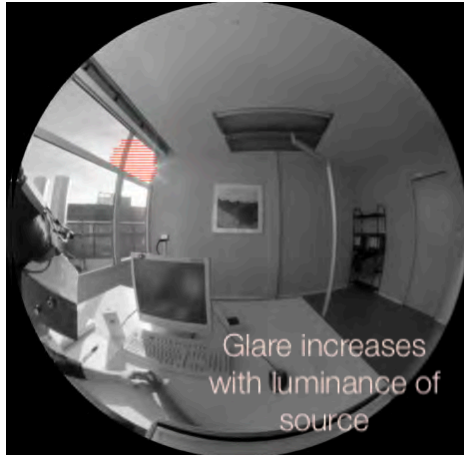
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...through **glare risk models**

- *Daylight Glare Probability (DGP)*
- *Daylight Glare Index (DGI)*
- *Unified Glare Rating (UGR)...*

Today, there is only one (commonly used) way to evaluate that perception...



...through **glare risk models**

- *Daylight Glare Probability (DGP)*

$$G = \left( \frac{L_s^{exp} \omega_s^{exp}}{L_b^{exp} P_i^{exp}} \right)$$