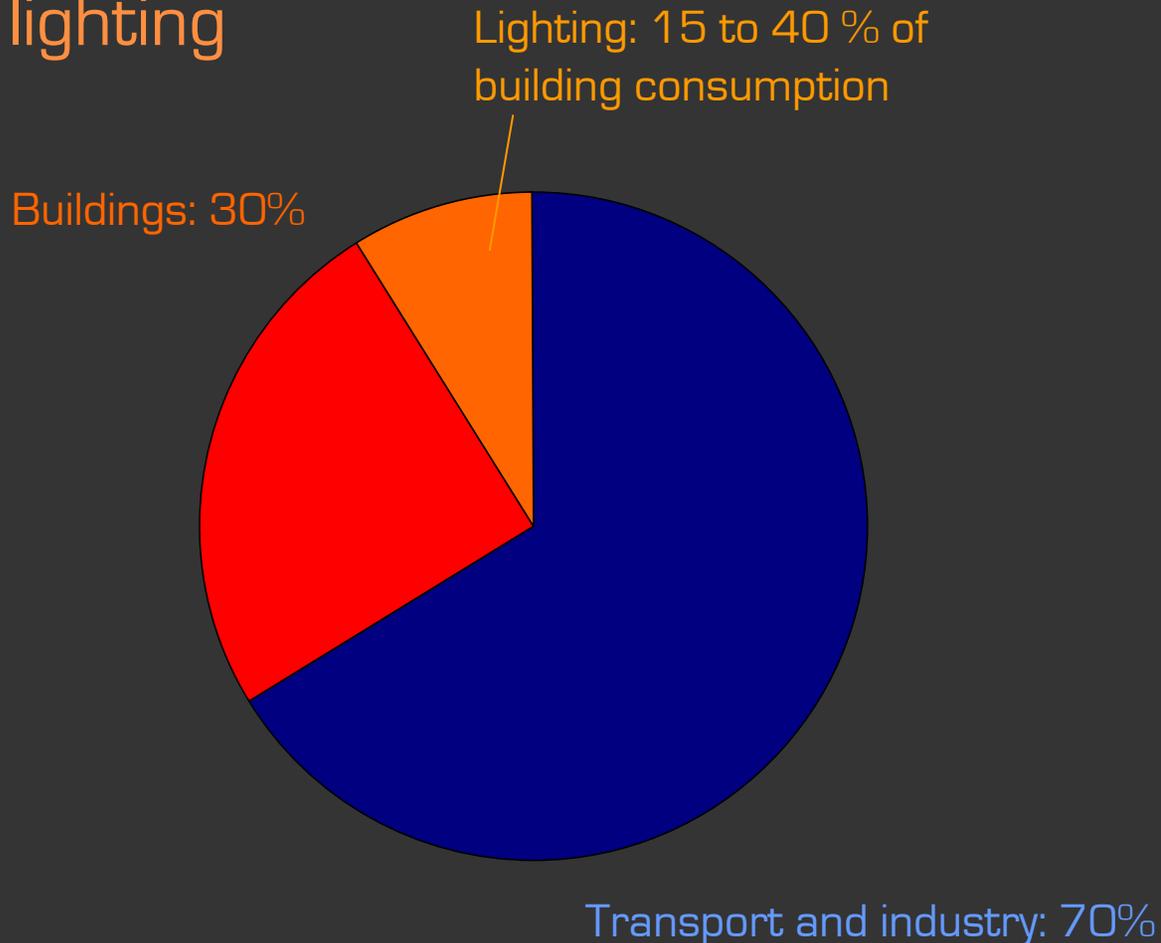


Daylighting for sustainability

► Energy savings

- electric lighting



Daylighting for sustainability

- ▶ Energy savings
 - electric lighting
 - solar gains management

Daylighting for sustainability

- ▶ Energy savings
- ▶ Visual comfort
 - visual performance
 - color rendering
 - aesthetical effects

Daylighting for sustainability

- ▶ Energy savings
- ▶ Visual comfort
- ▶ Connection to outside
 - view
 - biological needs

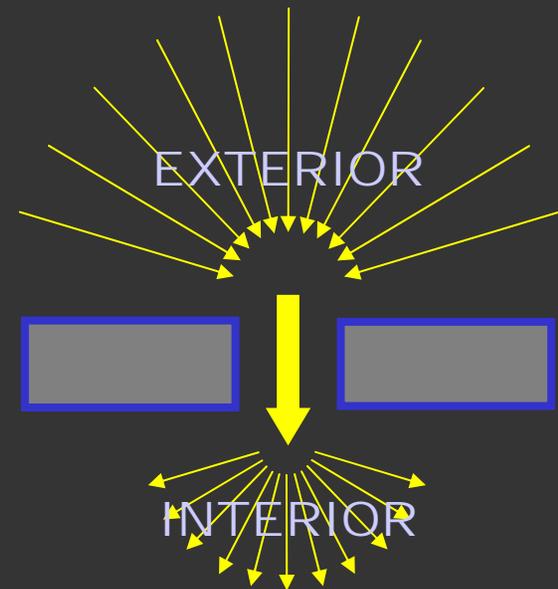
Daylighting for sustainability

- ▶ Energy savings
- ▶ Visual comfort
- ▶ Connection to outside
- ▶ Productivity

Daylight as a design factor

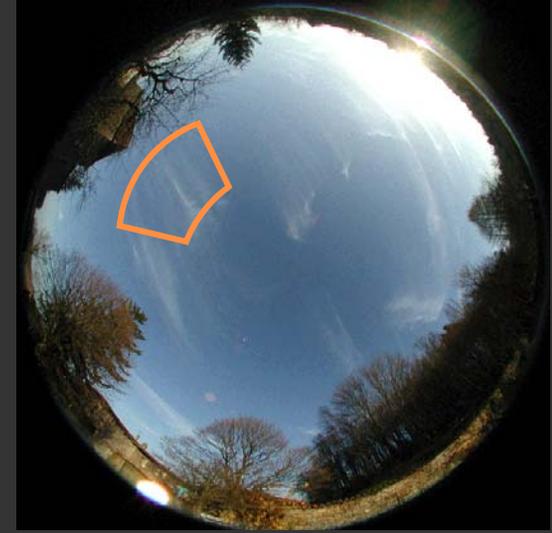
▶ Three aims when using natural light

- Collect
- Transport
- Distribute



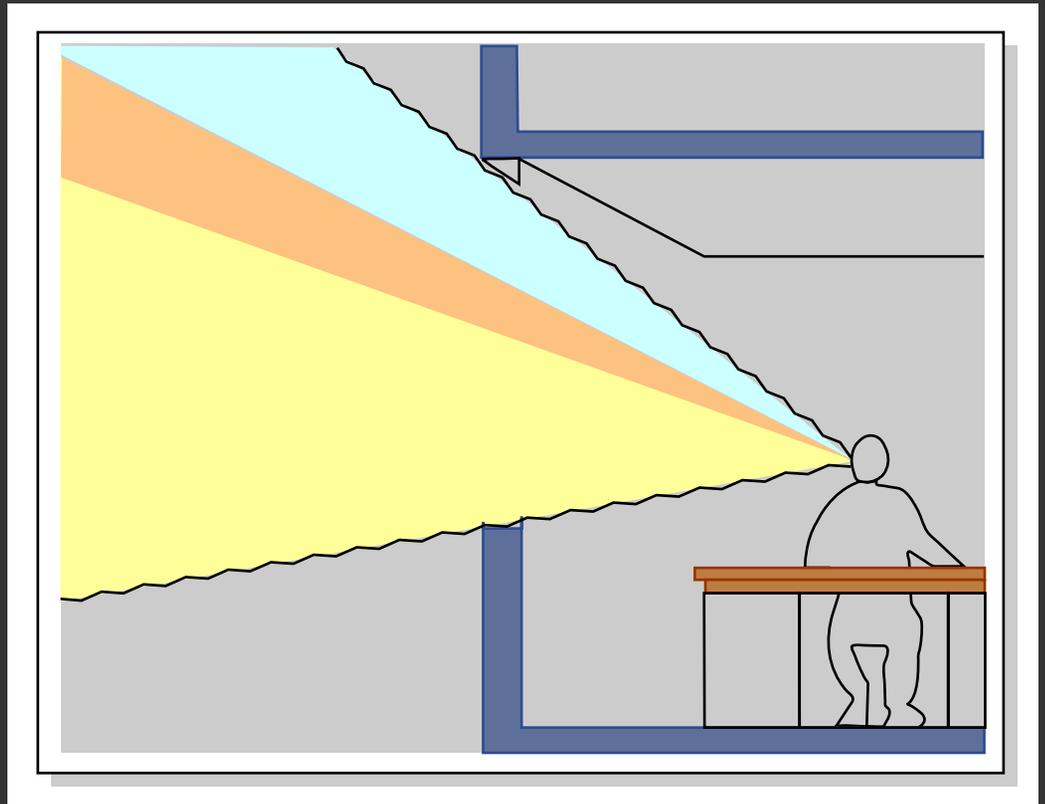
Daylight as a design factor

- ▶ Three aims when using natural light
 - Collection



Daylight as a design factor

- ▶ Three aims when using natural light
 - Collection



Daylight as a design factor

- ▶ Three aims when using natural light
 - Collection

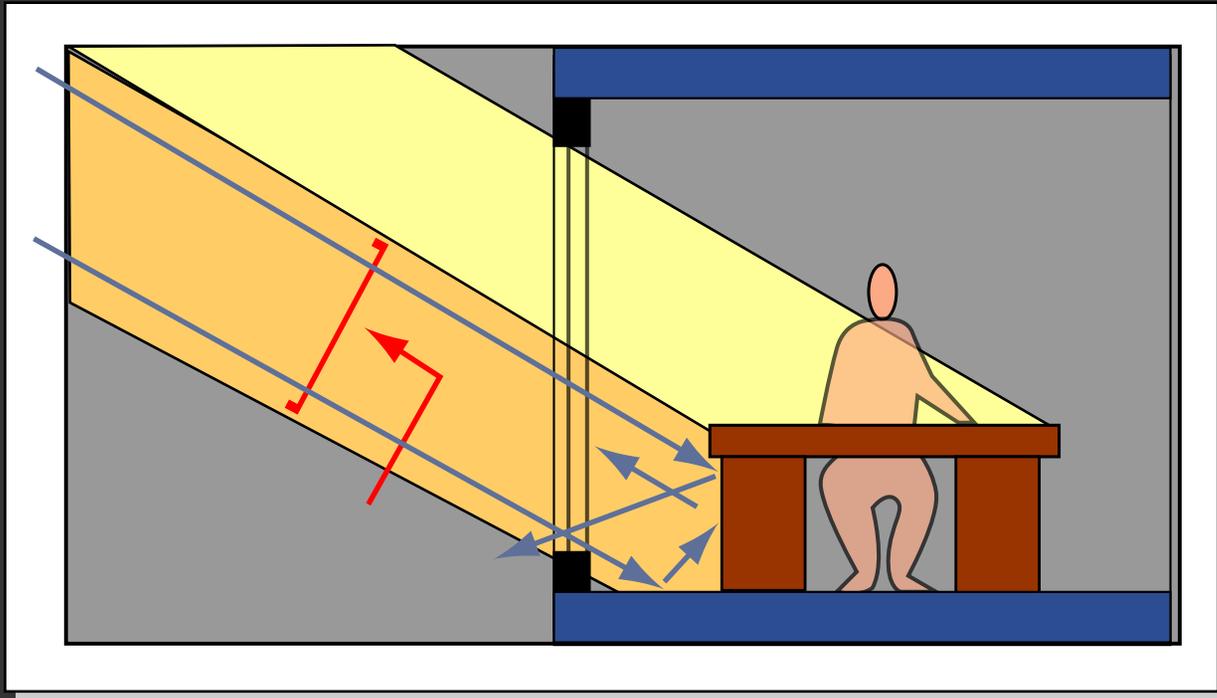
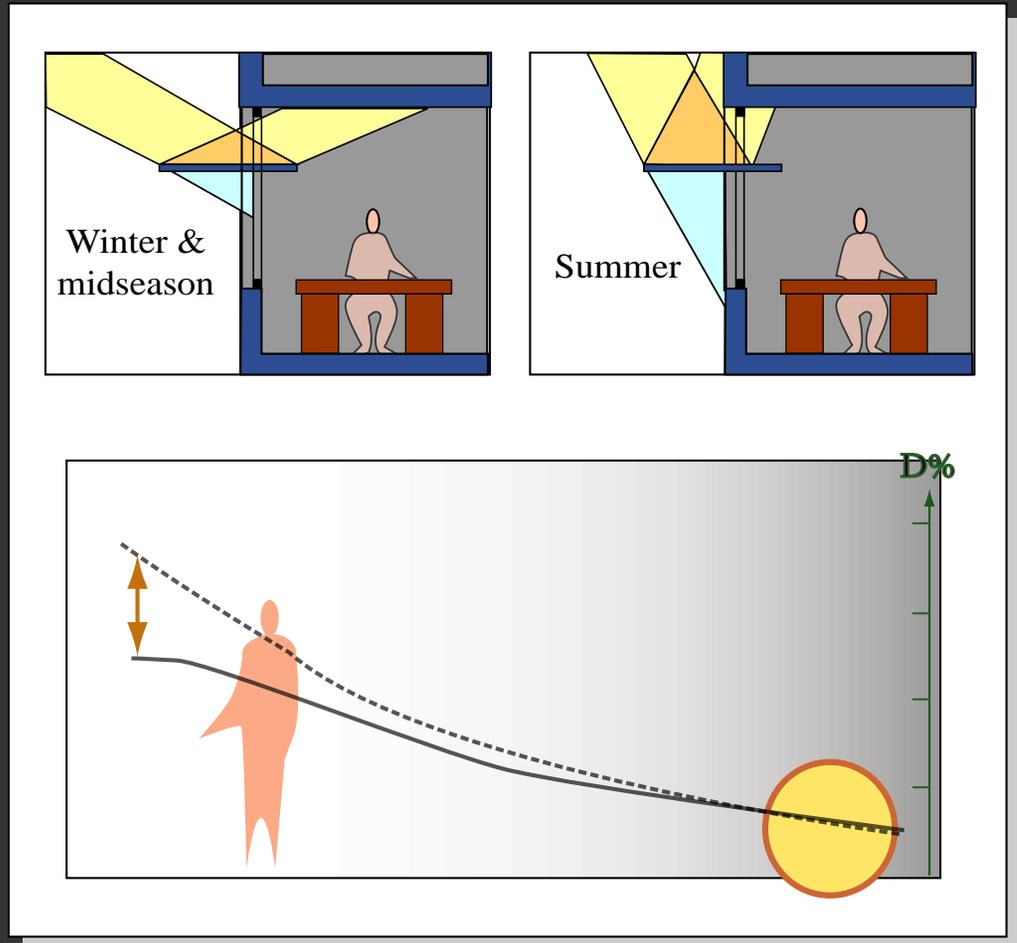


Image by MIT OCW.

Daylight as a design factor

▶ Three aims when using natural light

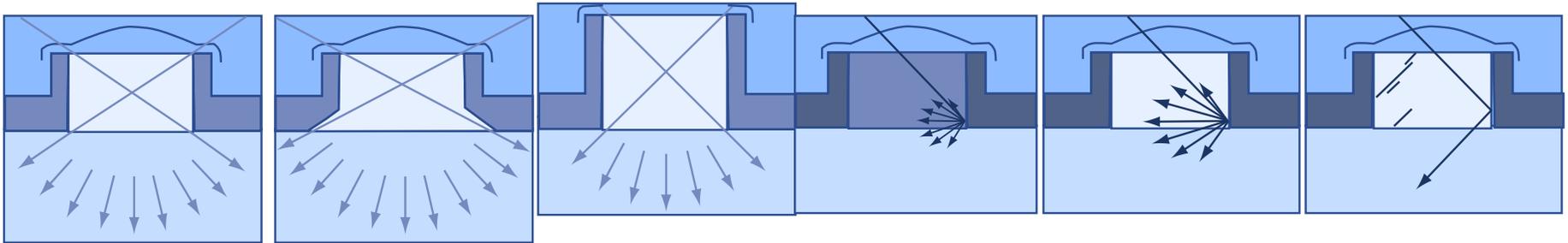
- Collection
- Transport



Daylight as a design factor

▶ Three aims when using natural light

- Collection
- Transport



Daylight as a design factor

▶ Three aims when using natural light

- Collection
- Transport
- Distribution

Daylight as a design factor

- ▶ Main parameters in daylight availability
 - Climate and weather



Daylight as a design factor

► Main parameters in daylight availability

- Climate and weather
- Sun course (latitude, time/date)

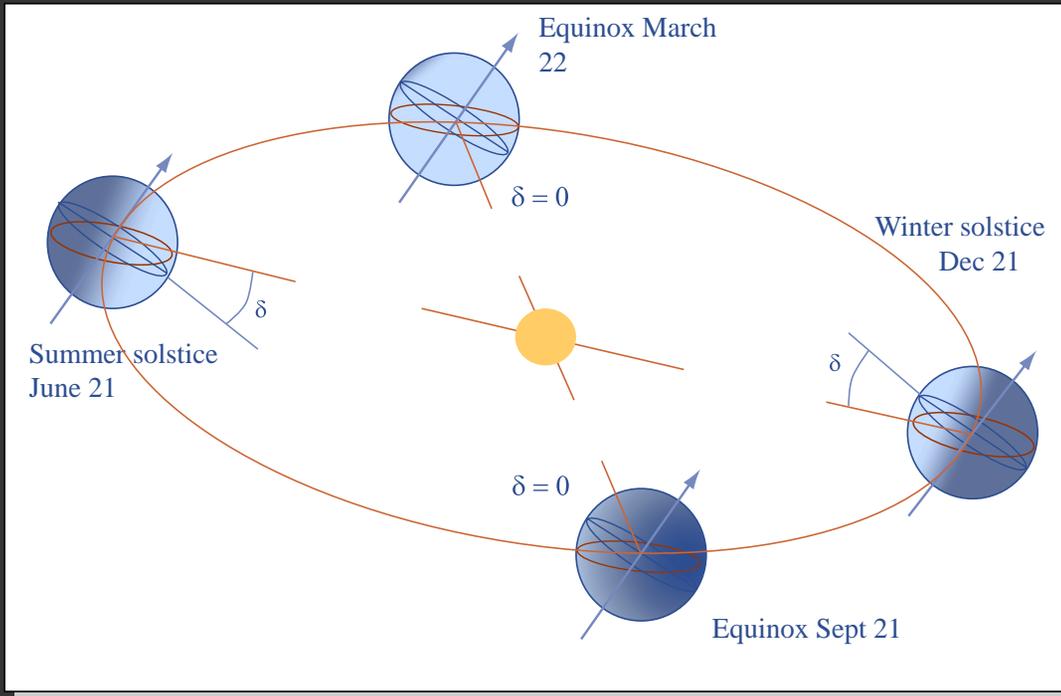


Image by MIT OCW.

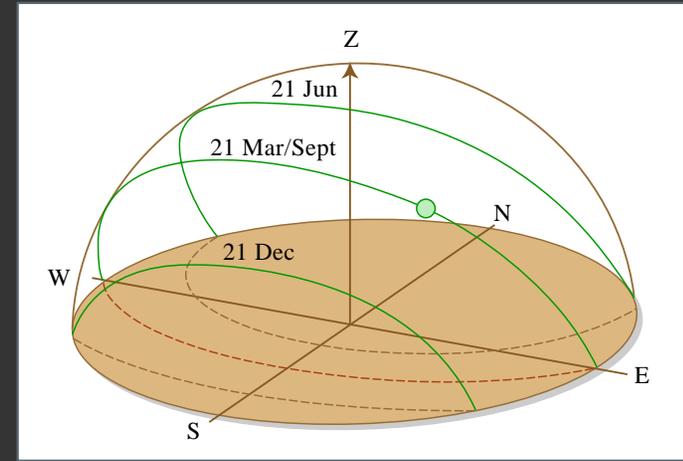


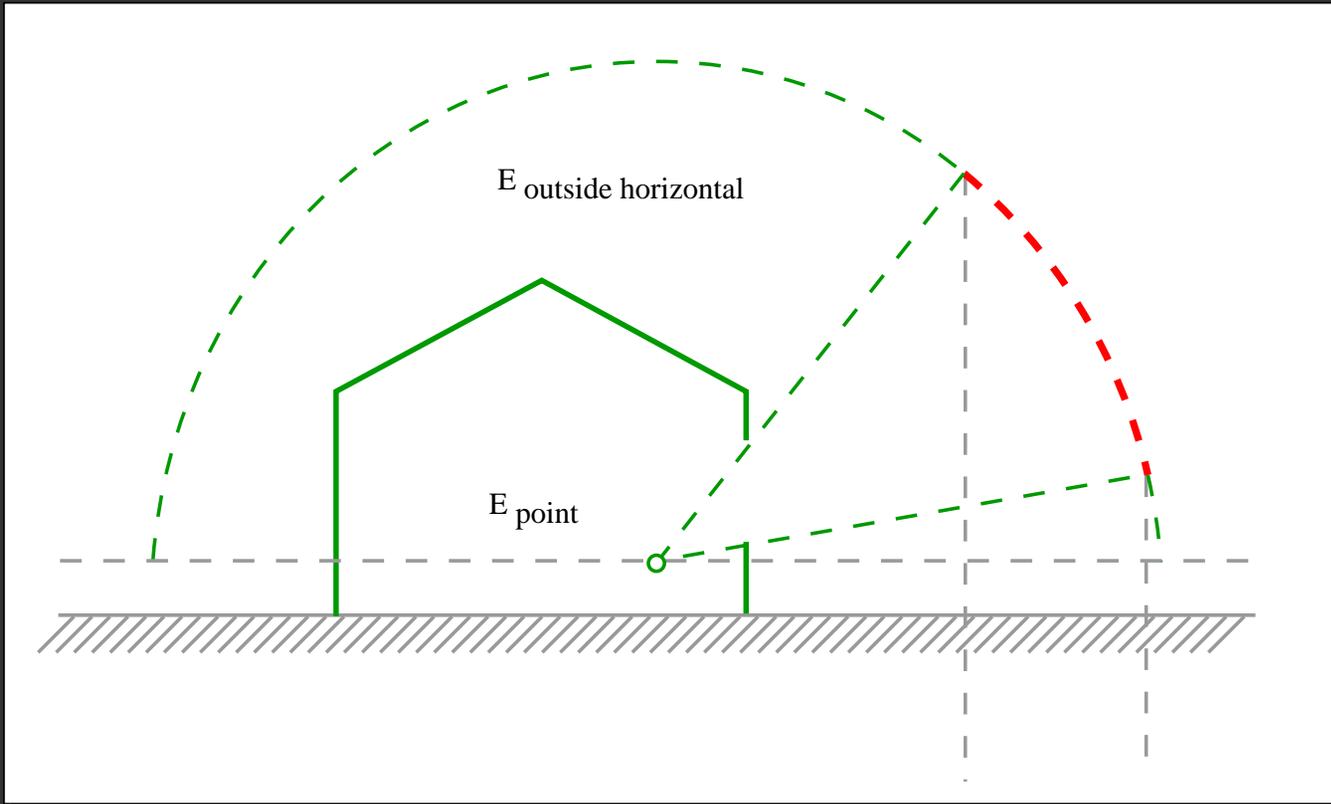
Image by MIT OCW.

Daylight as a design factor

- ▶ Main parameters in daylight availability
 - Climate and weather
 - Sun course (latitude, time/date)
 - Sun and sky access
 - orientation, mask, design of opening

Daylight Factor

- ▶ $DF = (E_{\text{point}} / E_{\text{outside horizontal}}) * 100\%$
 - only for an overcast sky !



Daylight Factor

► $DF = (E_{\text{point}} / E_{\text{outside horizontal}}) * 100\%$

- only for an overcast sky !

below 1% → dark, only suitable for storage areas

1% to 2% → low illumination, suitable for circulation areas

2% to 4% → moderate, for living spaces

4% to 7% → medium, for office work

7% to 12% → high, for precision tasks

over 12% → very high, for exceptional light requirements

(Emerging) dynamic daylighting metrics

▶ Daylight Autonomy (DA)

- percentage of working hours when a minimum work plane illuminance is maintained by daylight alone

▶ Useful Daylight Illuminance (UDI)

- divides working hours into either < 100 lux, 100 to 2000 lux (Useful Daylight Illuminance) or > 2000 lux

▶ CHPS criteria

- continuous DA $>40\%$, $>60\%$ and $>80\%$ (resp. 1, 2 and 3 credits) for 60% of work plane

Daylight as a design factor

- ▶ What do we want to do?
 - maximize daylighting, but avoid glare
 - maximize solar gains in winter
 - protection from solar gains in the summer and fall

Daylight as a design factor

▶ How do we do it?

- siting and orientation
 - Mount Angel Library and Seinäjoki Library by A. Alto

Photographs and floor plans removed due to copyright restrictions.

Daylight as a design factor

▶ How do we do it?

- siting and orientation
- sizing and positioning
 - openings and room depth

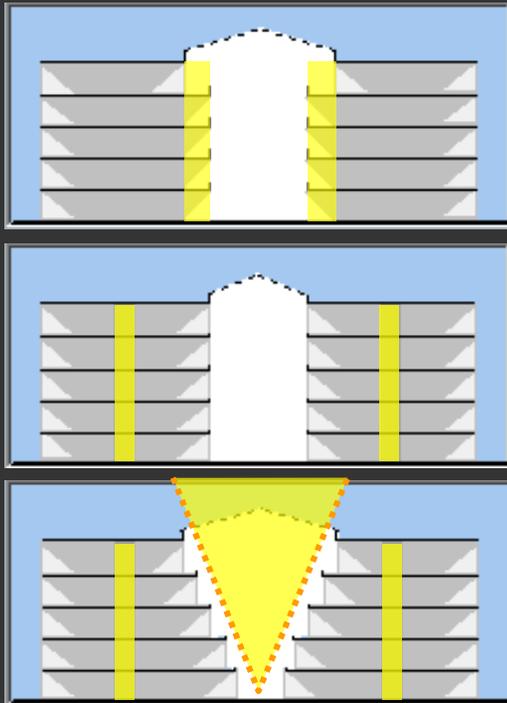
Sahara West Library and Museum by Meyer et al.

N.-D. du Haut by Le Corbusier - Exeter Library by Kahn

Daylight as a design factor

▶ How do we do it?

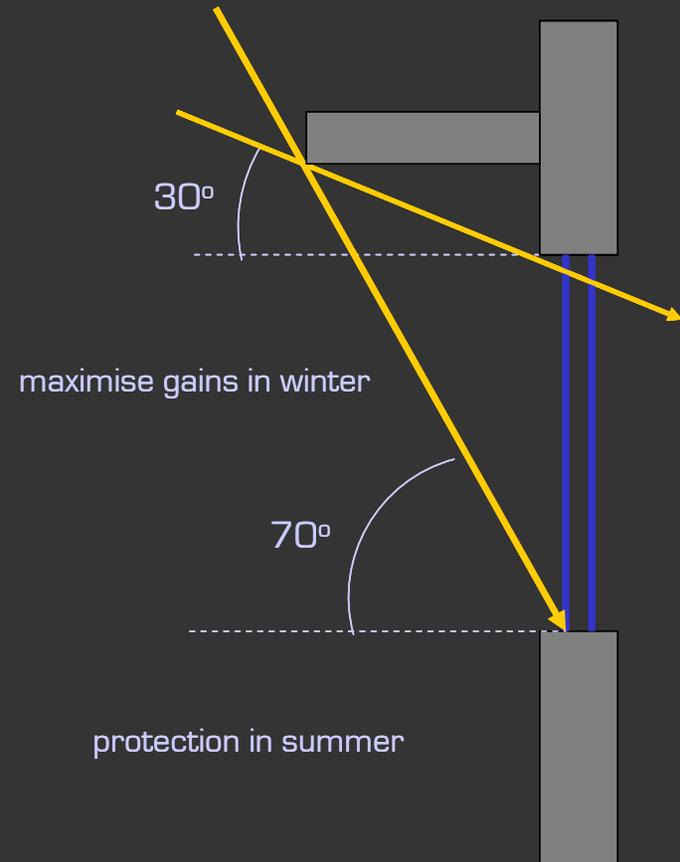
- siting and orientation
- sizing and positioning
 - Atrium
 - Genzyme HQ by Behnisch & Behnisch



Daylight as a design factor

► How do we do it?

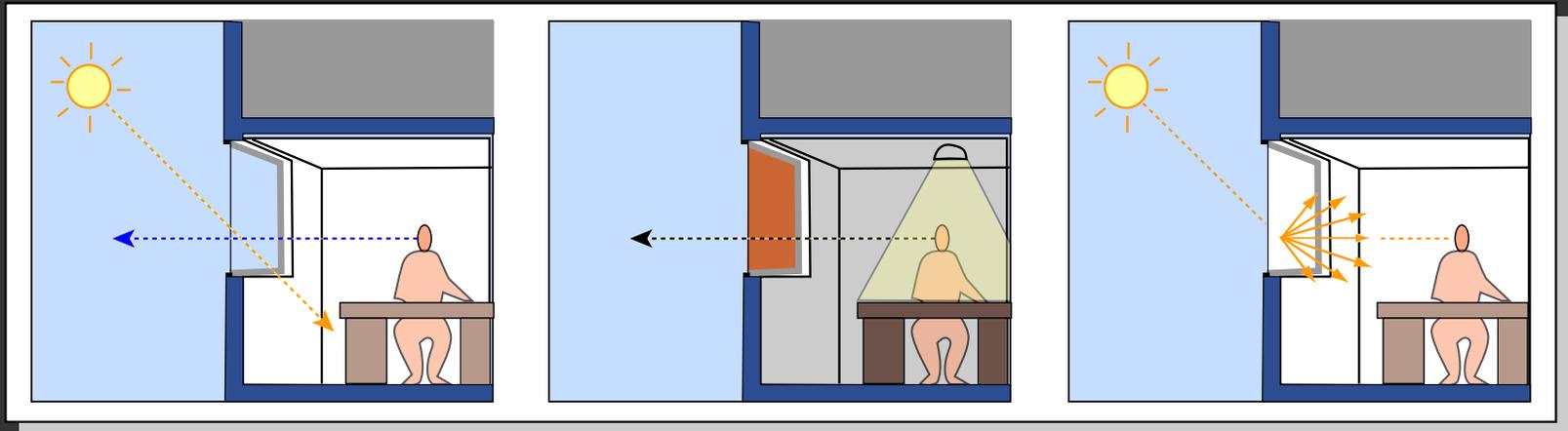
- siting and orientation
- sizing and positioning
- solar protections
 - fixed
 - mobile
 - orientation



Daylight as a design factor

► How do we do it?

- siting and orientation
- sizing and positioning
- solar protections
- glazing selection



Daylight as a design factor

▶ How do we do it?

- siting and orientation
- sizing and positioning
- solar protections
- glazing selection
- framing

Daylight as a design factor

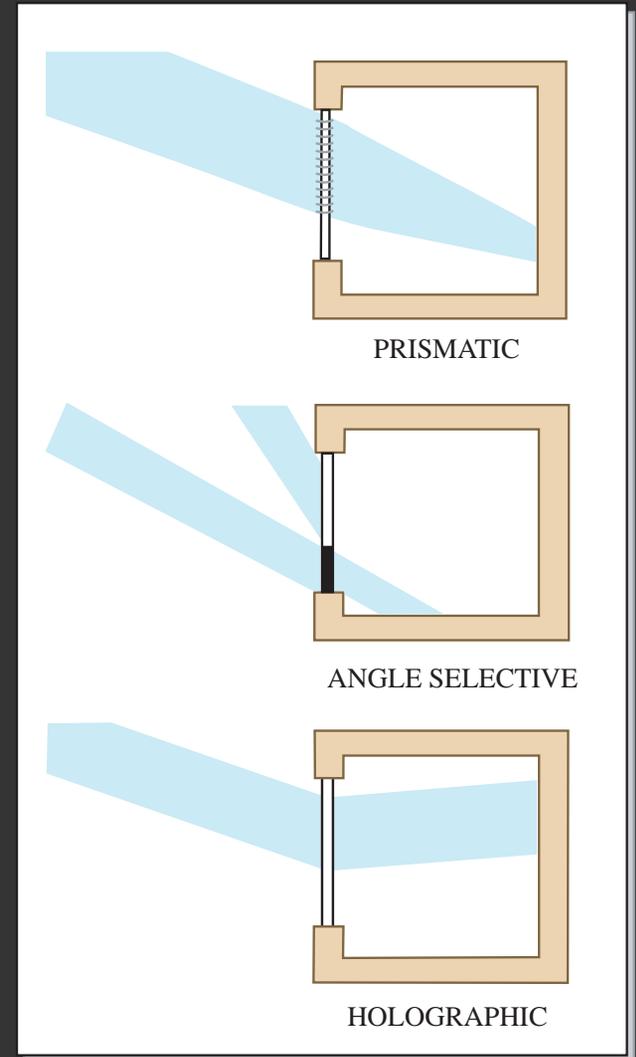
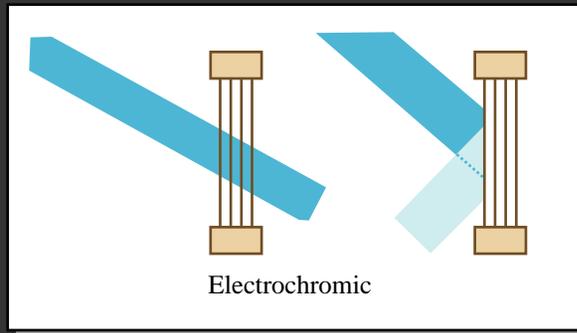
▶ How do we do it?

- siting and orientation
- sizing and positioning
- solar protections (fixed / mobile)
- glazing selection
- framing
- indoor surface colors

Daylight as a design factor

► How do we do it?

- siting and orientation
- sizing and positioning
- solar protections (fixed / mobile)
- glazing selection
- framing
- indoor surface colors
- advanced systems / materials



Images by MIT OCW.

Designing with Natural Light

- ▶ Reading assignment from Textbook:
 - "Introduction to Architectural Science" by Szokolay: § 2.3 - 2.4
- ▶ Additional readings relevant to lecture topics:
 - "Heating Cooling Lighting" by Lechner: Chaps 9 + 13