Natural Light in Design

using simulation tools to explore realistic daylight-responsive solutions

Massachusetts Institute of Technology IAP 2006 – 3 day Workshop
Course objectives

- Daylighting as a design criterium
- Ecotect, Daysim and Radiance as a tools-set to carry out daylighting analyses
- Understand and practice traditional performance metrics (daylight factor, avoidance of direct sunlight)
- Include emerging metrics based on dynamic annual daylight simulations in analyses (daylight autonomy)
- Apply learnt concepts to a design project
Daylighting for sustainability

- Energy savings
  - electric lighting

- Buildings: 30%

- Lighting: 15 to 40% of building consumption

- Transport and industry: 70%
Daylighting for sustainability

- Energy savings
  - electric lighting
  - solar gains management
Daylighting for sustainability

- Energy savings
- Visual comfort
  - aesthetical effects
  - color rendering
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

- 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)
Daylight as a design factor

- Main parameters in daylight availability
  - Climate and weather
  - Sun course (latitude, time/date)
  - Sun access (orientation & mask)
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
  - sizing and positioning
    - openings
    - room depth
Daylight as a design factor

How do we do it?
- siting and orientation
- sizing and positioning
- solar protections
  - fixed
  - mobile
  - orientation

30° maximise gains in winter
70° total protection in summer

maximise gains in winter
protection in summer
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
Daylighting case studies

- Berlin Reichstag
  - Norman Foster
- Genzyme Building
  - Behnisch & Behnisch
- Menil Collection, Workshop, Beyeler Foundation
  - Renzo Piano
- Kimbell Art Museum and Exeter Library
  - Louis Kahn
Daylighting case studies

- Collège La Vanoise, France
  - Philippe Barbeyer