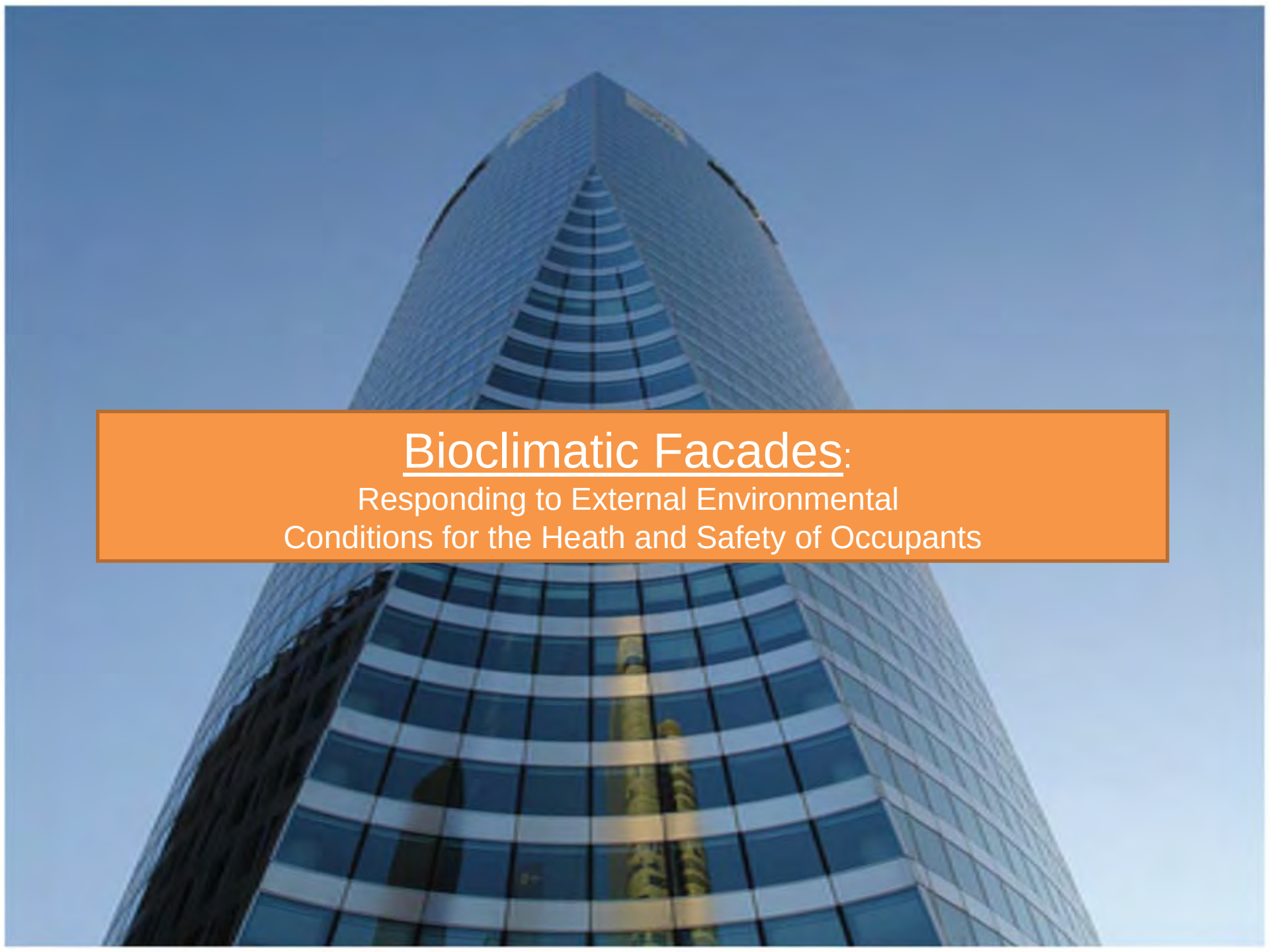

Bioclimatic Facades:

Responding to External Environmental Conditions for the Heath and Safety of Occupants

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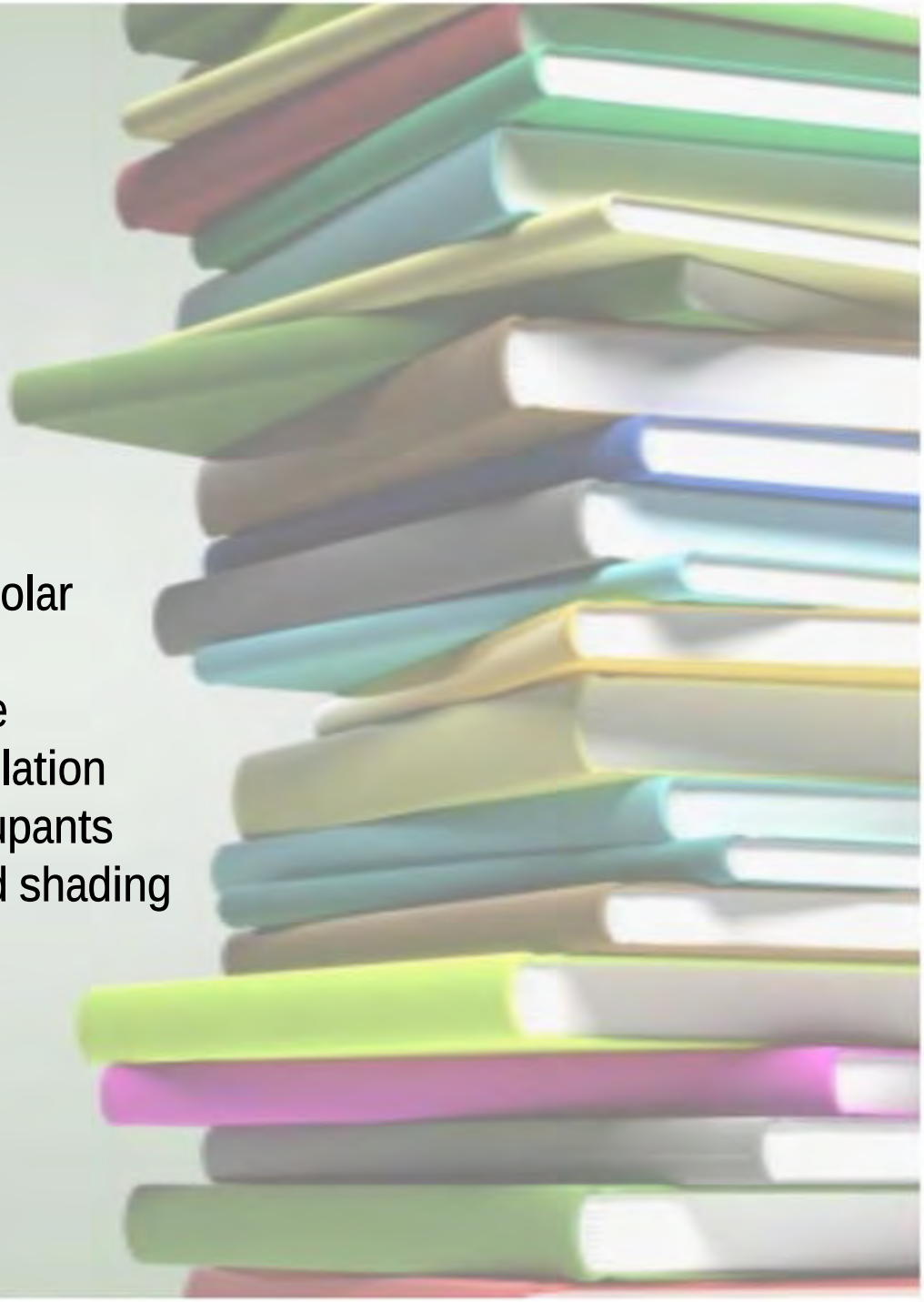
Learning Objectives

Attendees will be able to:

1. Define solar control, Ecliptic Path, Solar Irradiance, and Luminance
2. Understand Bioclimatic Architecture
3. Discover how natural light and ventilation effect the health of a building's occupants
4. Determine the benefits of automated shading



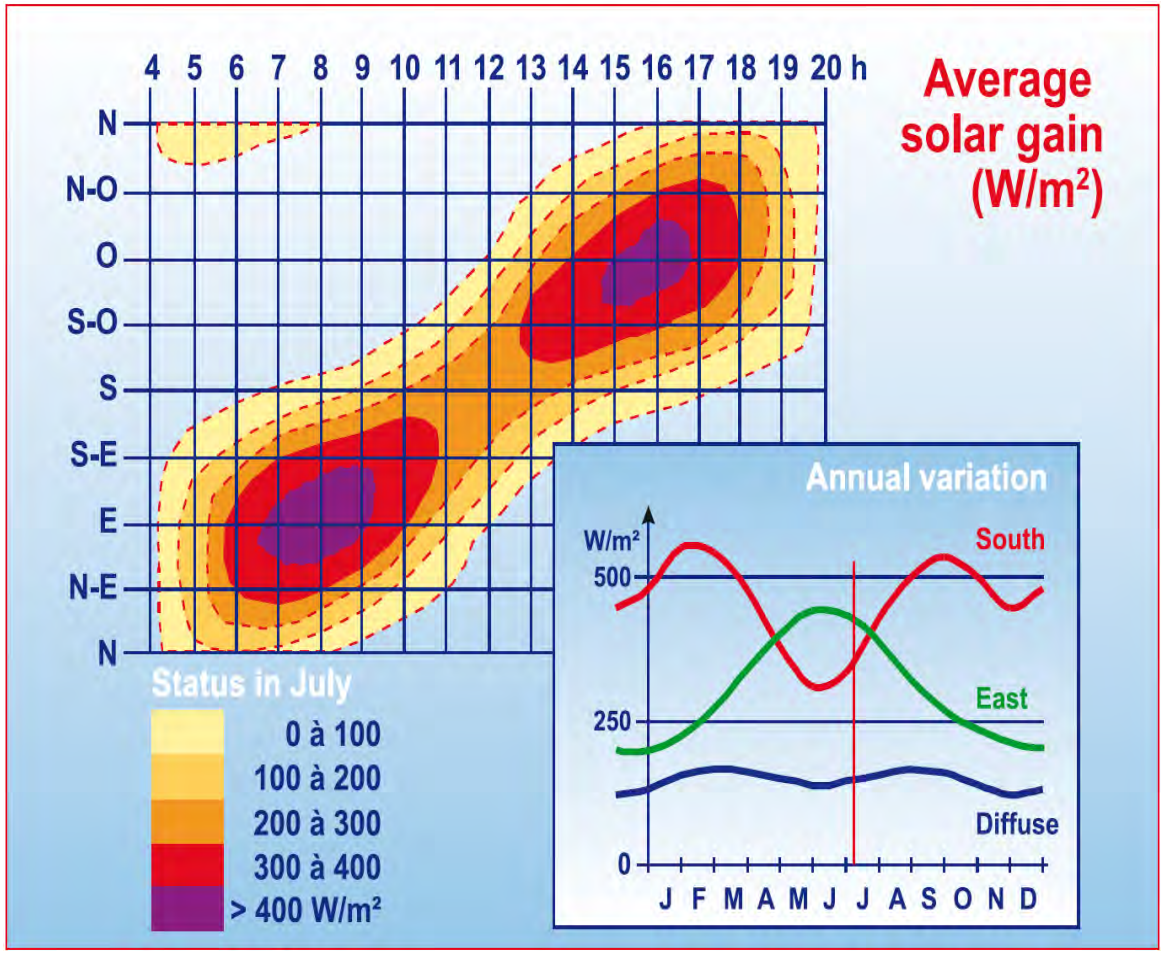
What is Solar Control?

The management of natural light

- Why solar control?

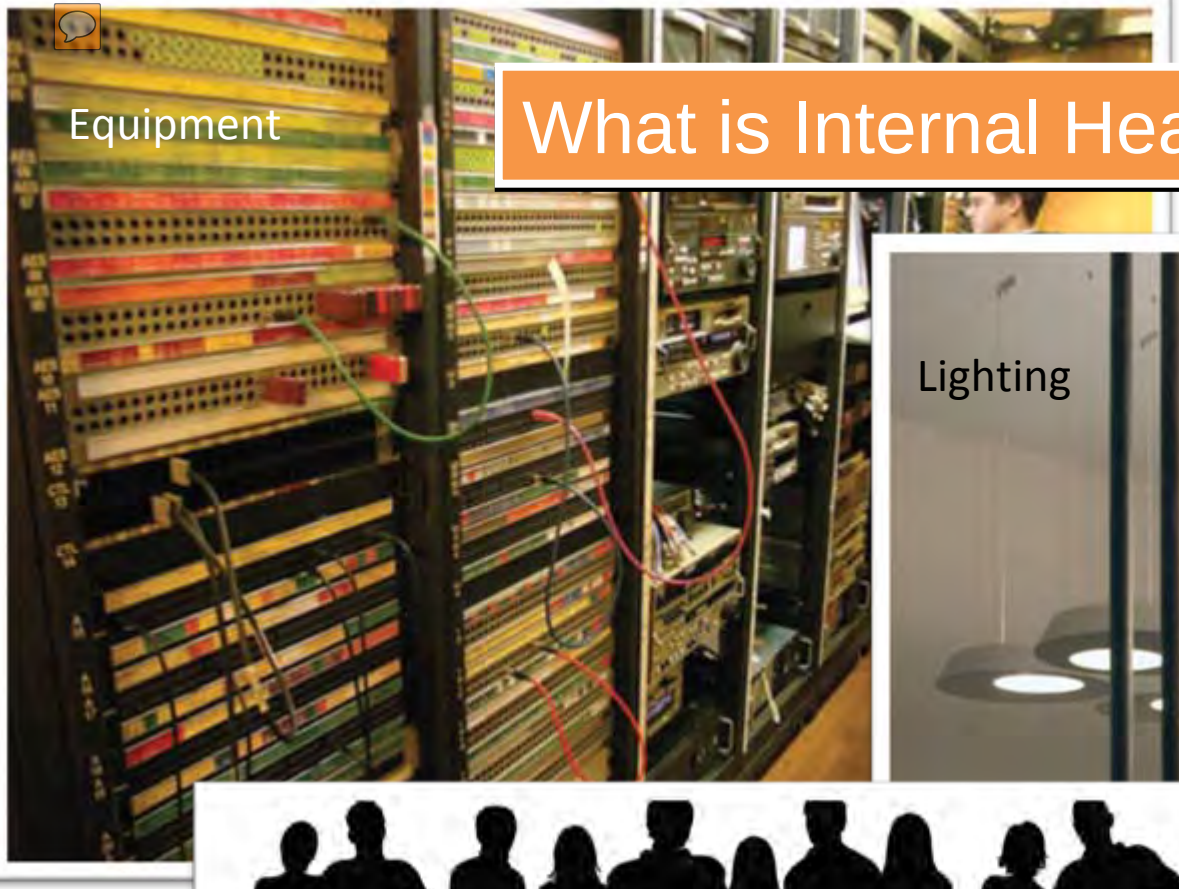
Why Solar Control?

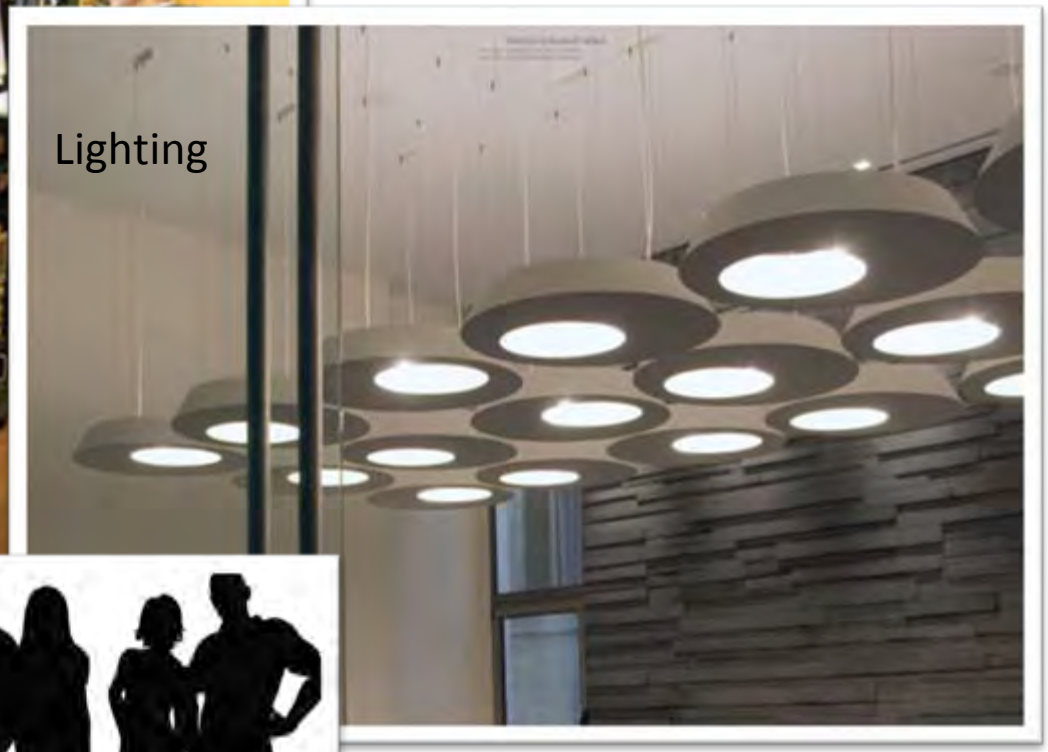
What is Solar Gain?



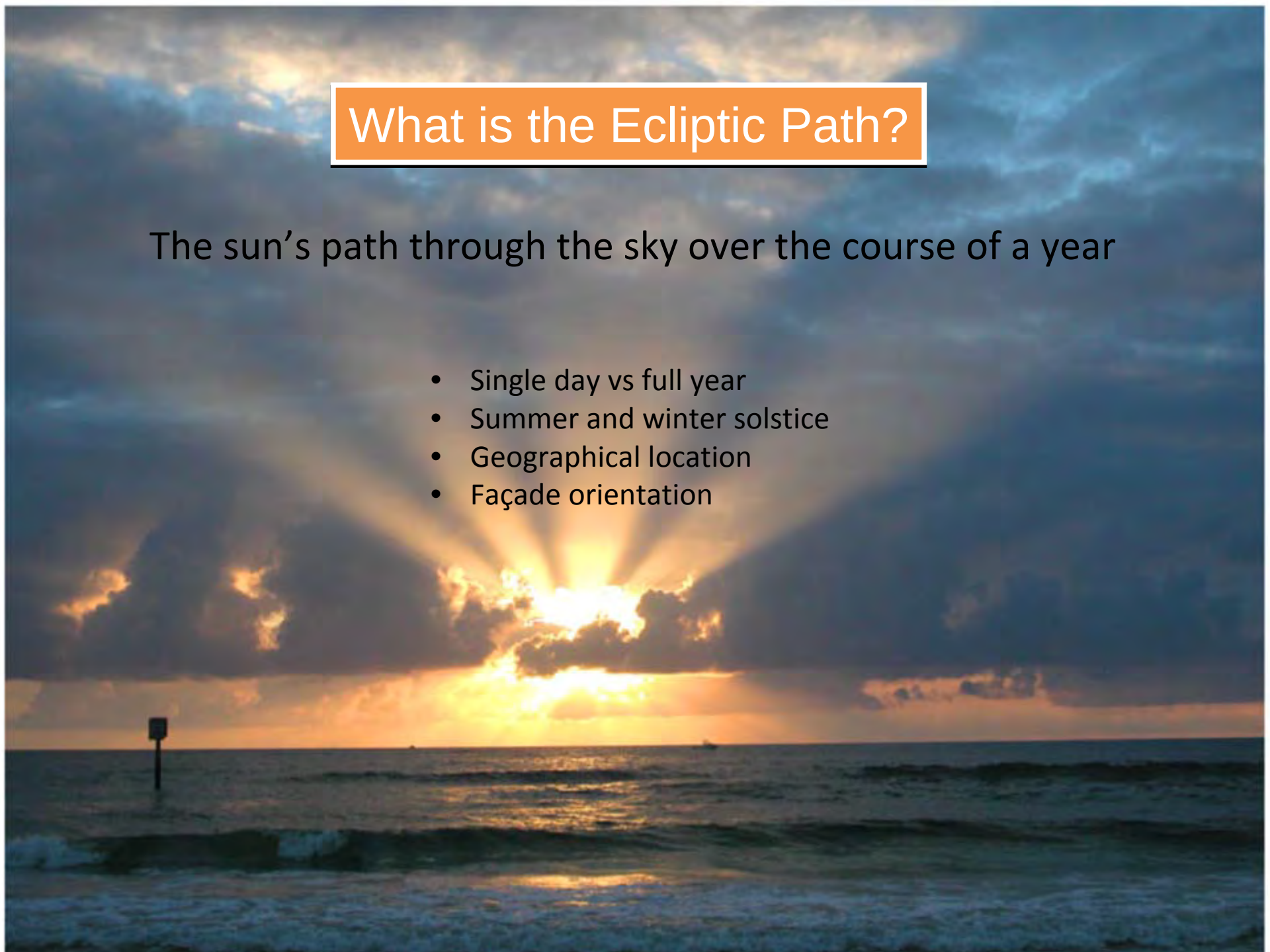
Heat is primarily transmitted through windows, which varies depending on the sun's relative orientation to the wall it strikes.

What is Internal Heat Gain?





The Ecliptic Path, Solar Irradiance, and Luminance

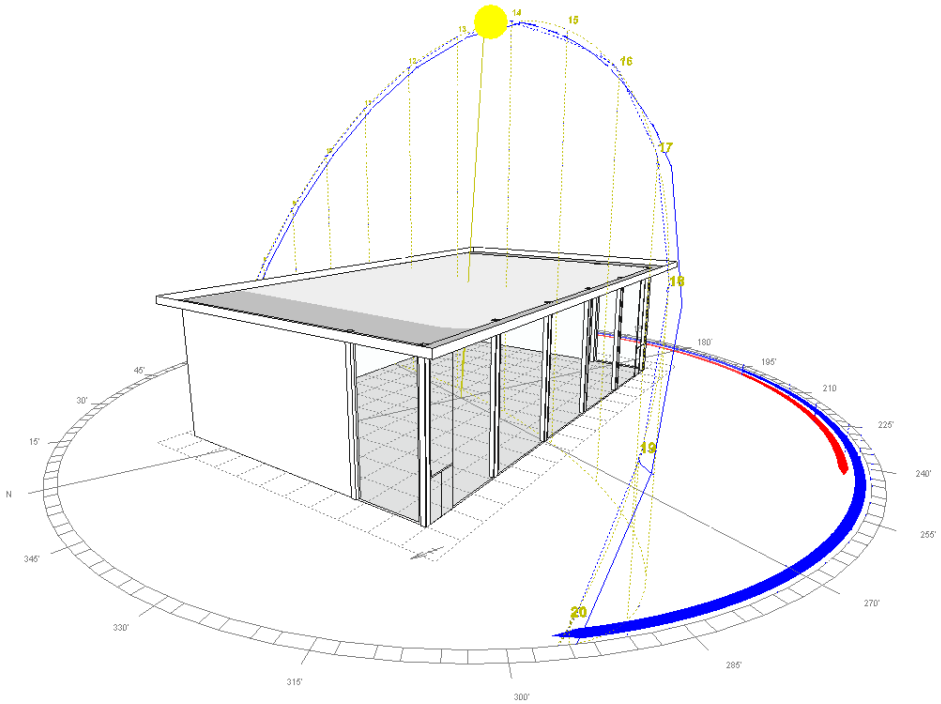


What is the Ecliptic Path?

The sun’s path through the sky over the course of a year

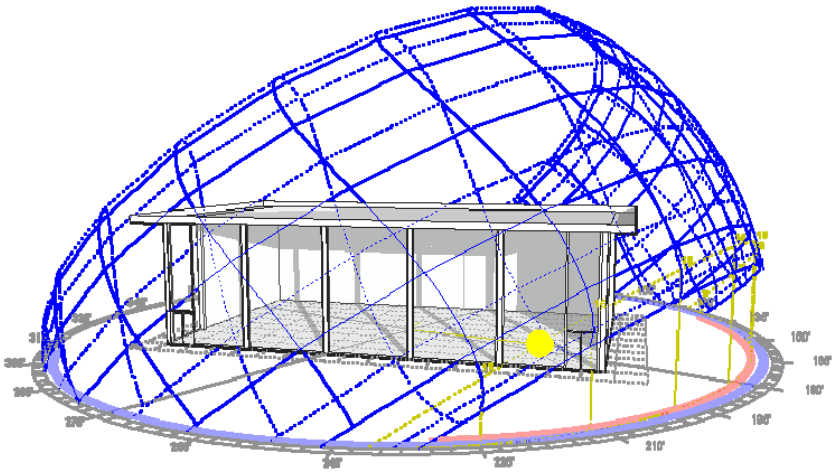
- Single day vs full year
- Summer and winter solstice
- Geographical location
- Façade orientation

Single Day vs Full Year

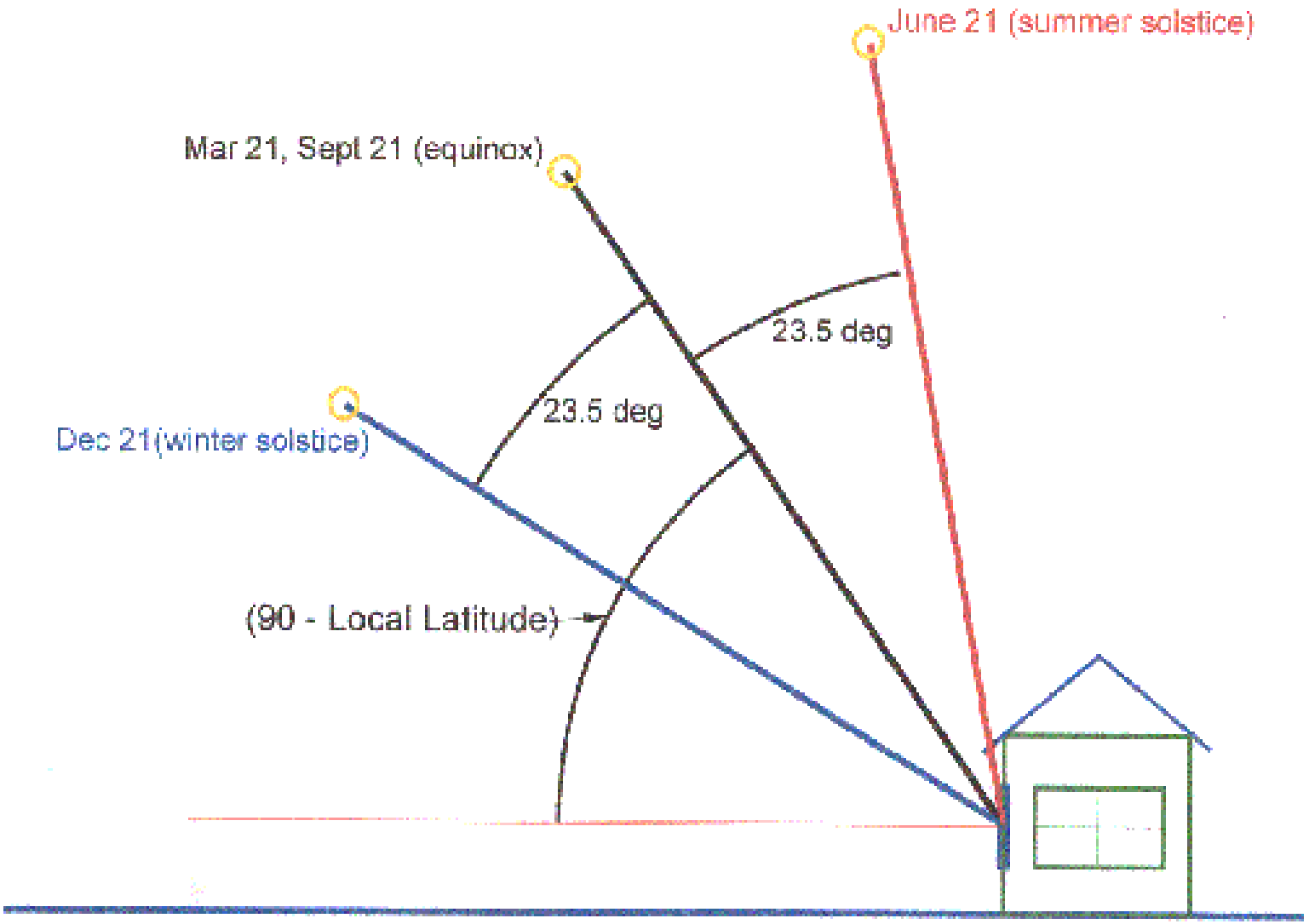


Solar Movement – Single Day

Solar Movement – Full Year

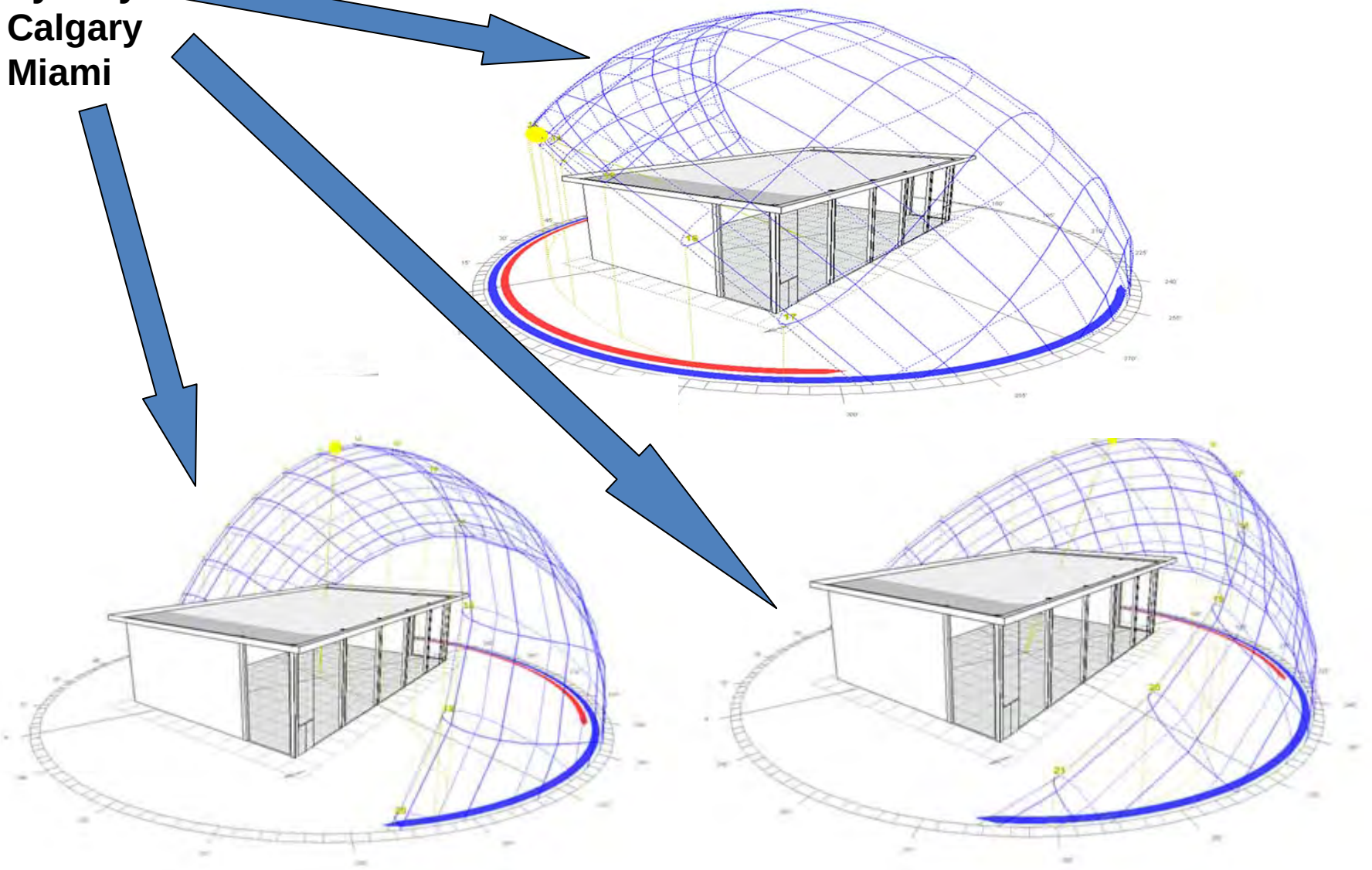


Summer and Winter Solstice

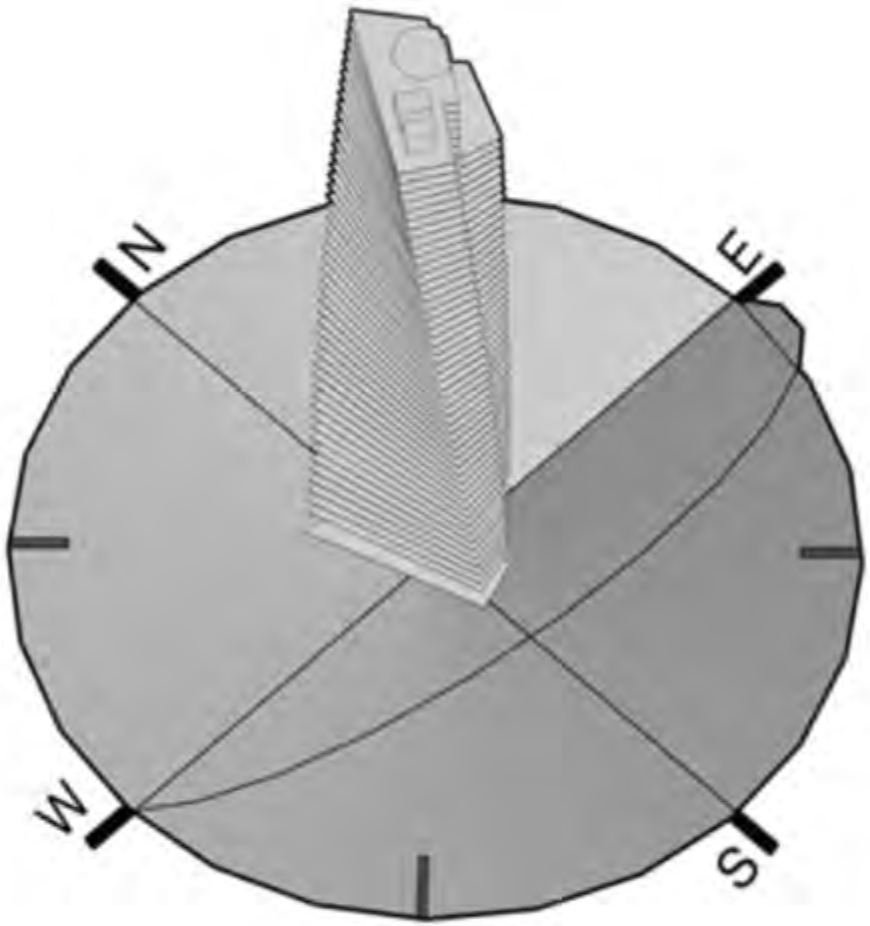


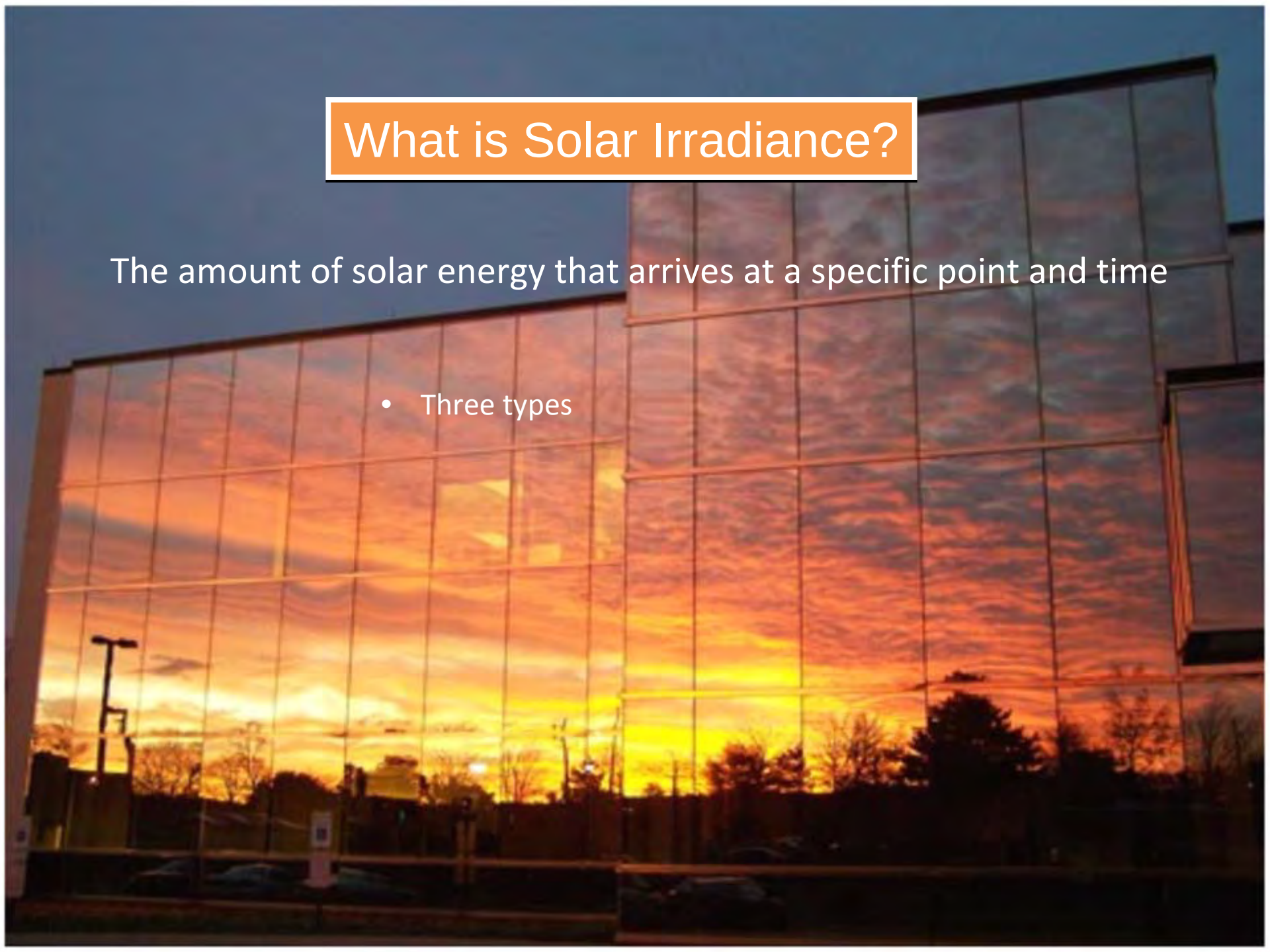
Geographic Location

Sydney
Calgary
Miami



Facade Orientation





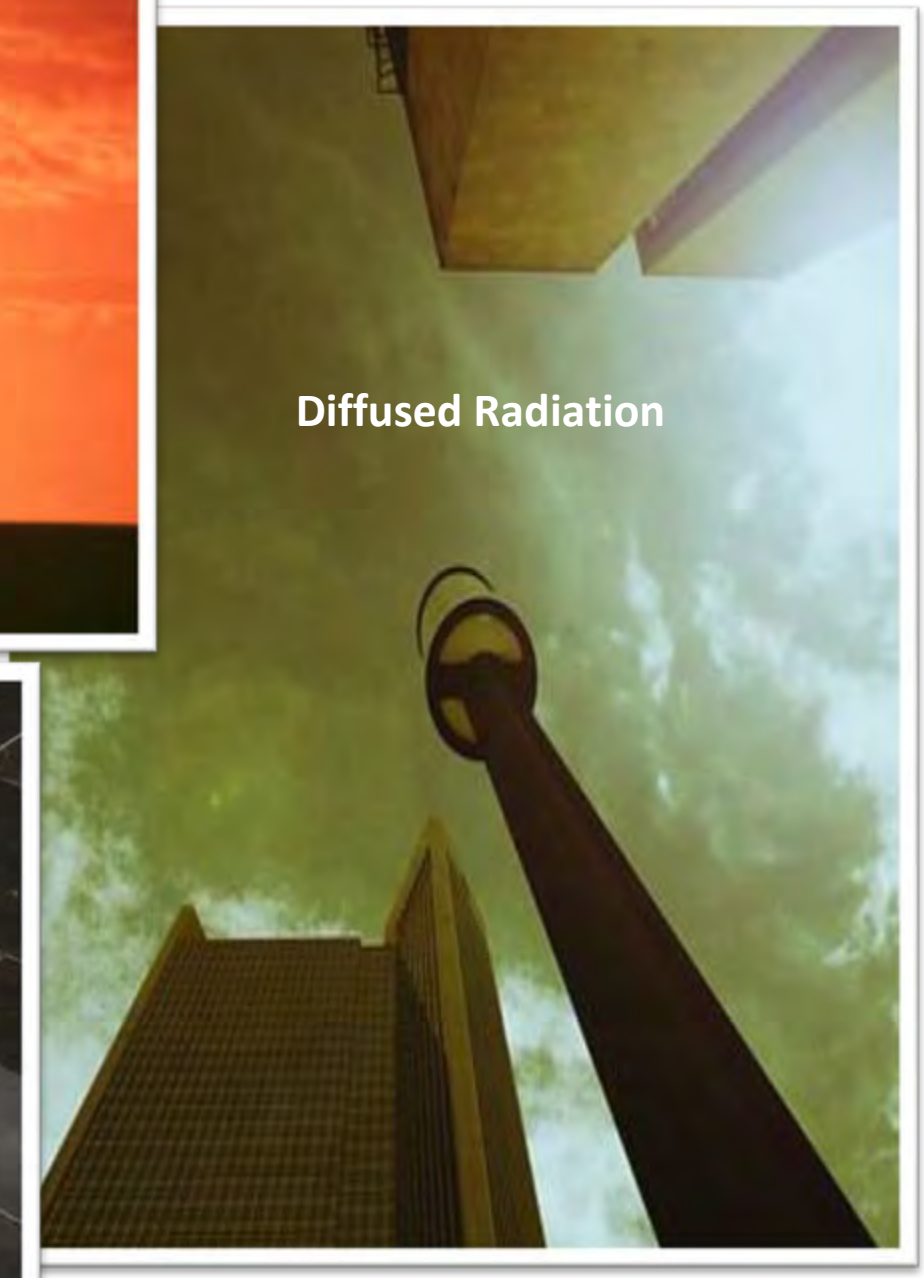
What is Solar Irradiance?

The amount of solar energy that arrives at a specific point and time

- Three types


Direct Radiation


Reflective Radiation


Diffused Radiation


What is Luminance?
The measurement of the intensity of light traveling in a given direction

What is Bioclimatic Architecture?

Design based on using solar energy and local climate to provide thermal and visual comfort of the occupants.

- **Bioclimatic facades**
- **Harnessing natural light**
- **Thermal comfort**
- **Visual comfort**

Bioclimatic Facades

Location, location, location…

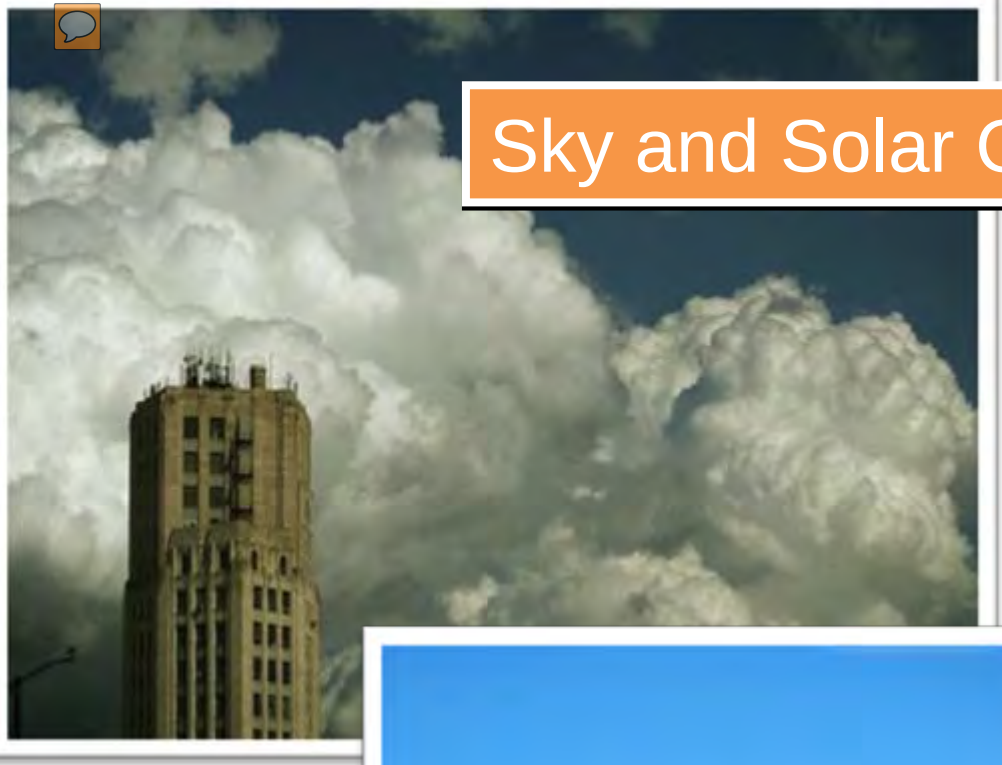

Shaded

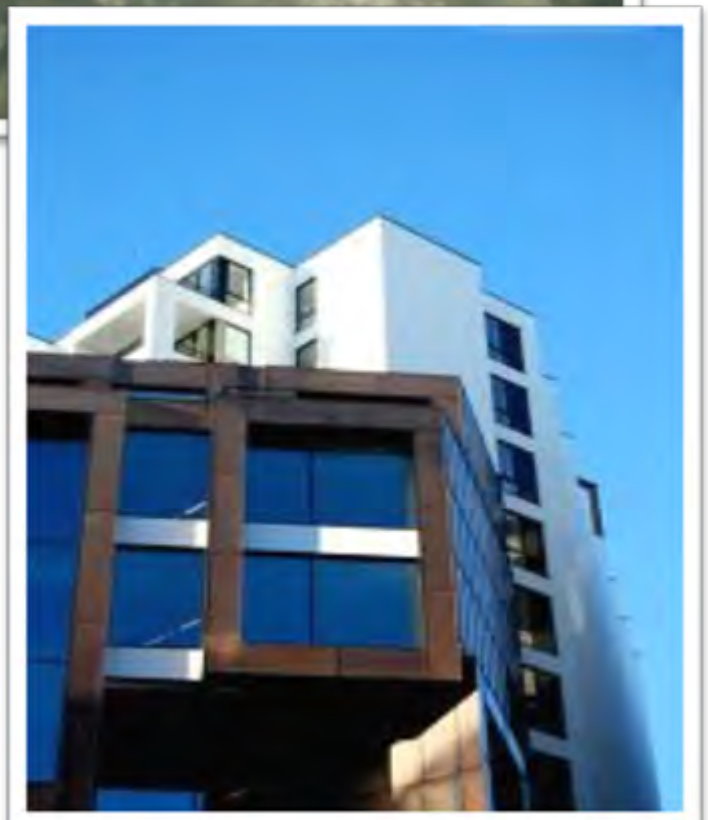

Full Exposure


Glare

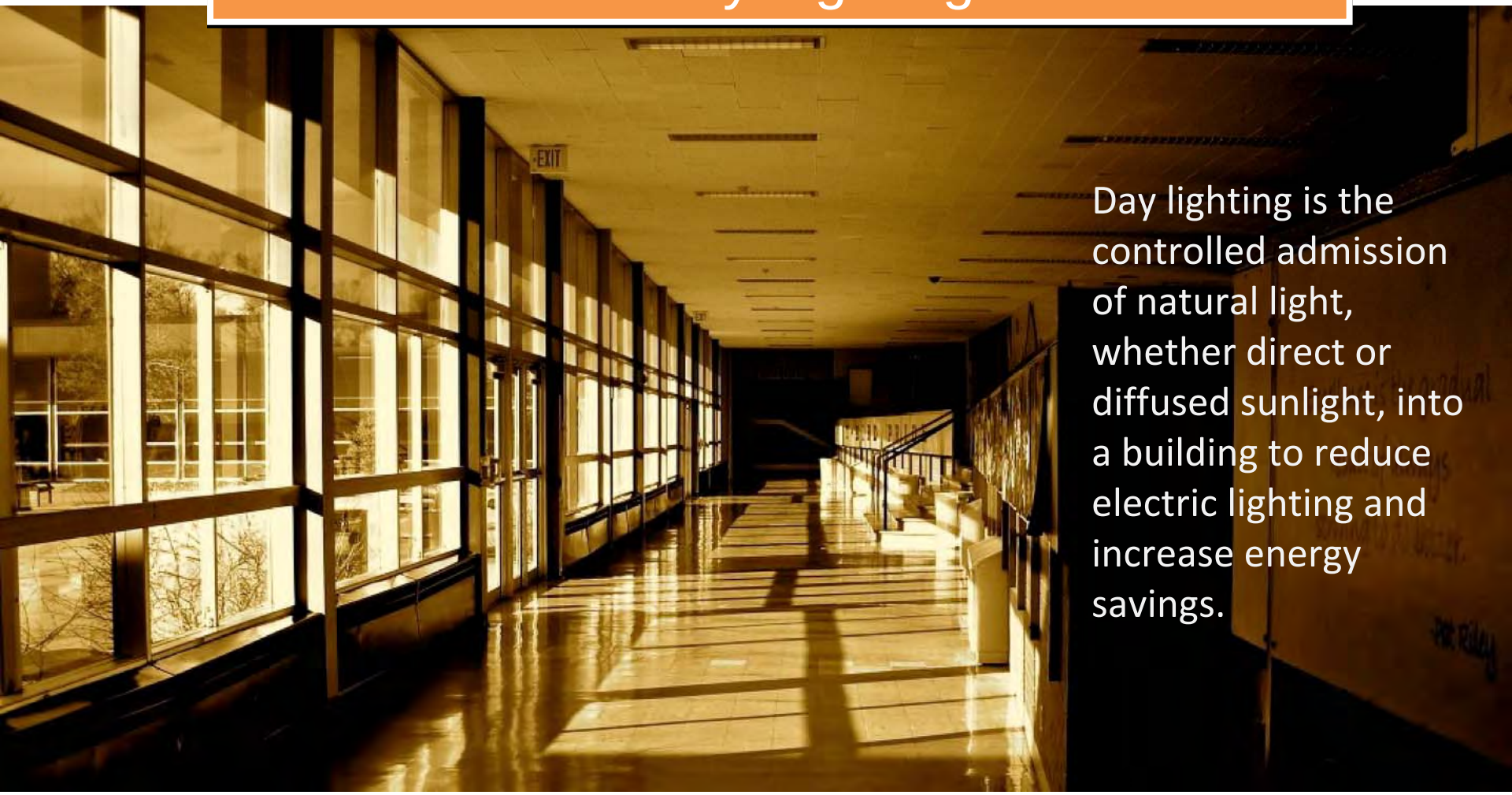

Summer
Time of Year

Sky and Solar Conditions





What is Natural Day Lighting?



Day lighting is the controlled admission of natural light, whether direct or diffused sunlight, into a building to reduce electric lighting and increase energy savings.

Harnessing Natural Light

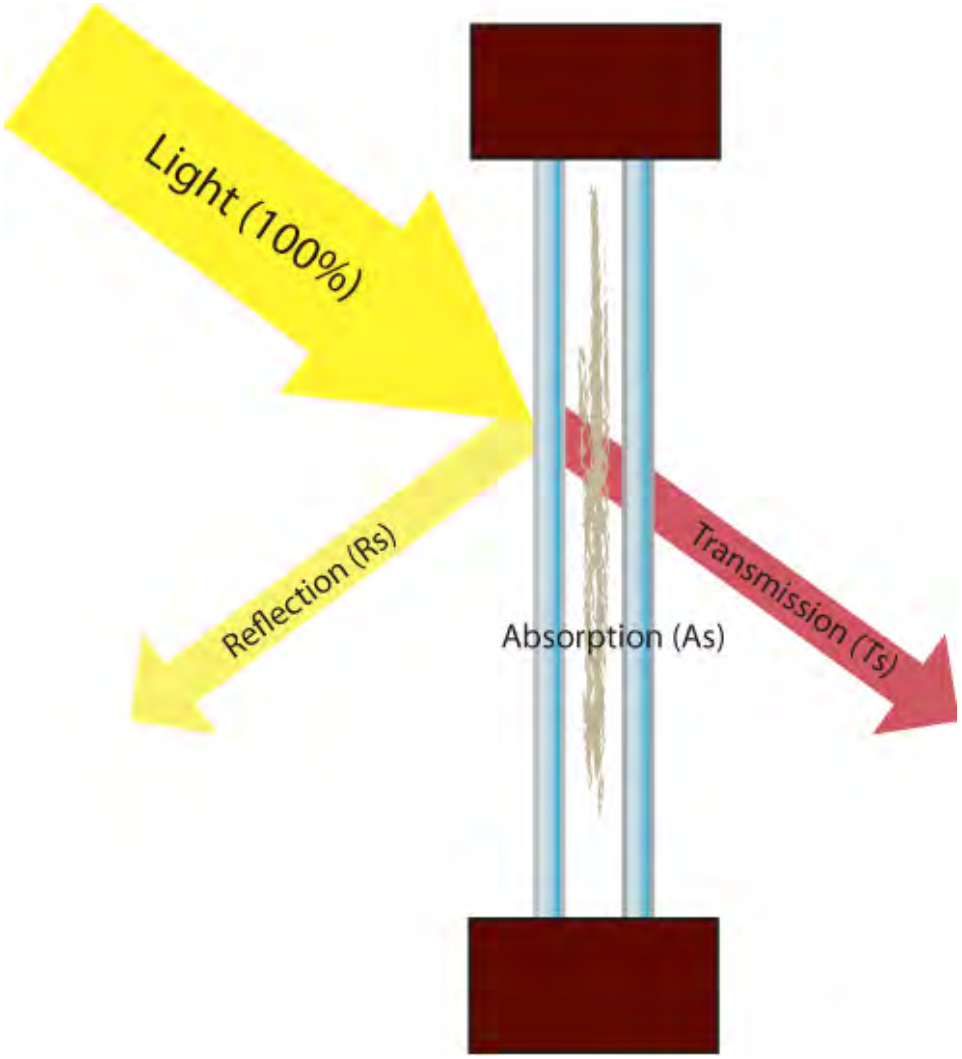
- **Solar Energy**
- **Thermal Comfort**
- **Visual Comfort**

Solar Energy

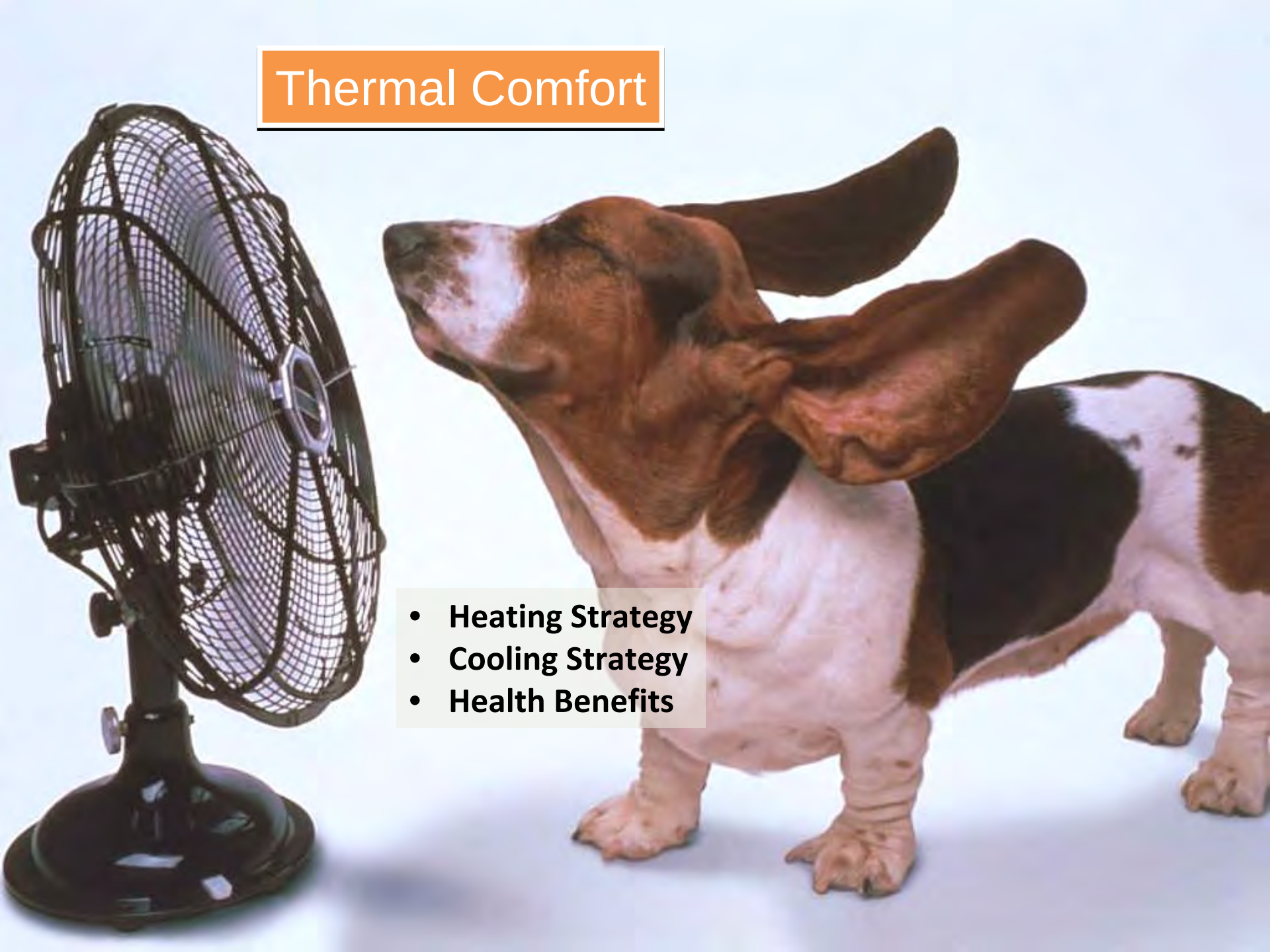
Solar Energy and Heat Gain

As = solar absorption
Rs = solar reflection
Ts = solar transmission

As + Rs + Ts = 100%

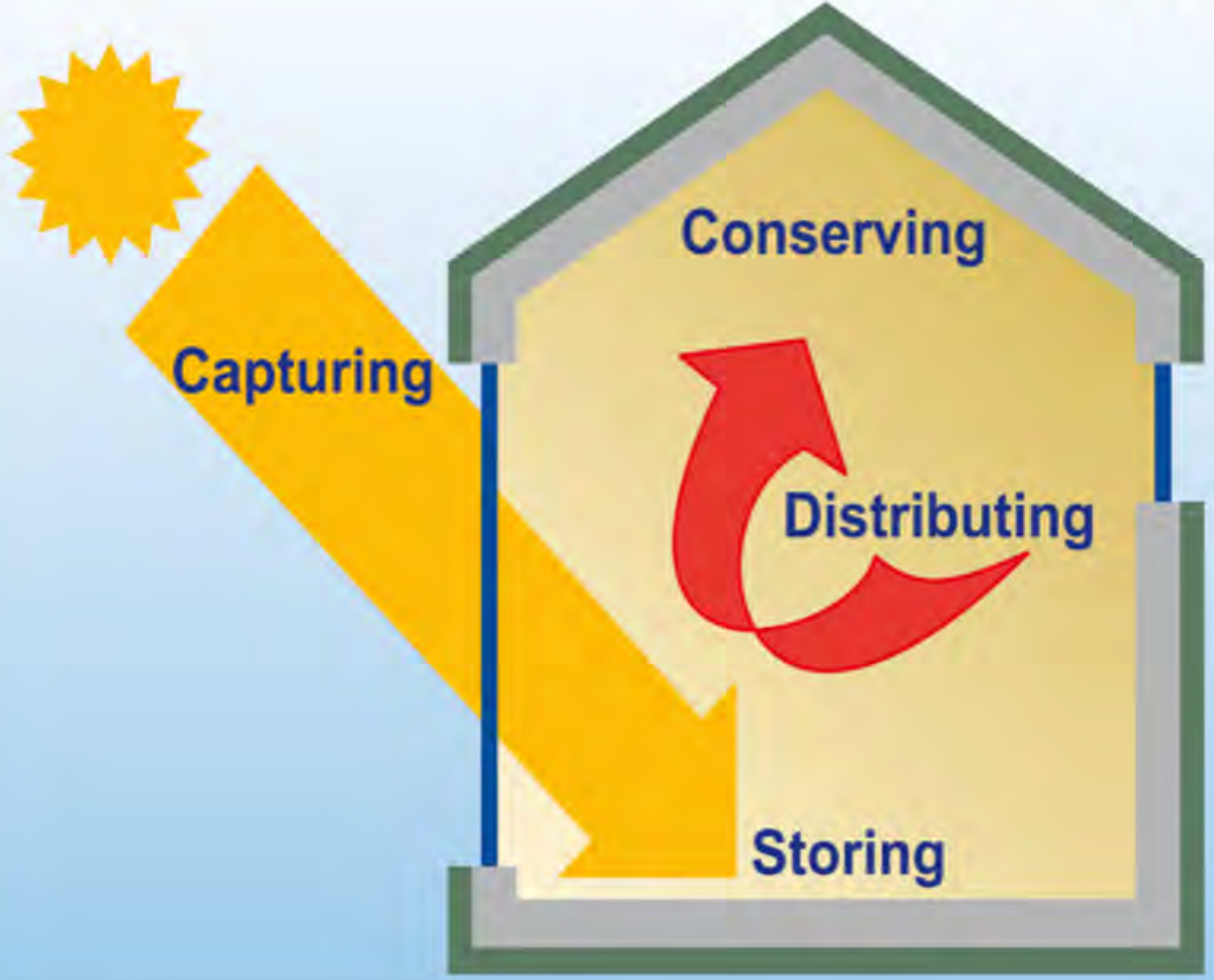


Thermal Comfort

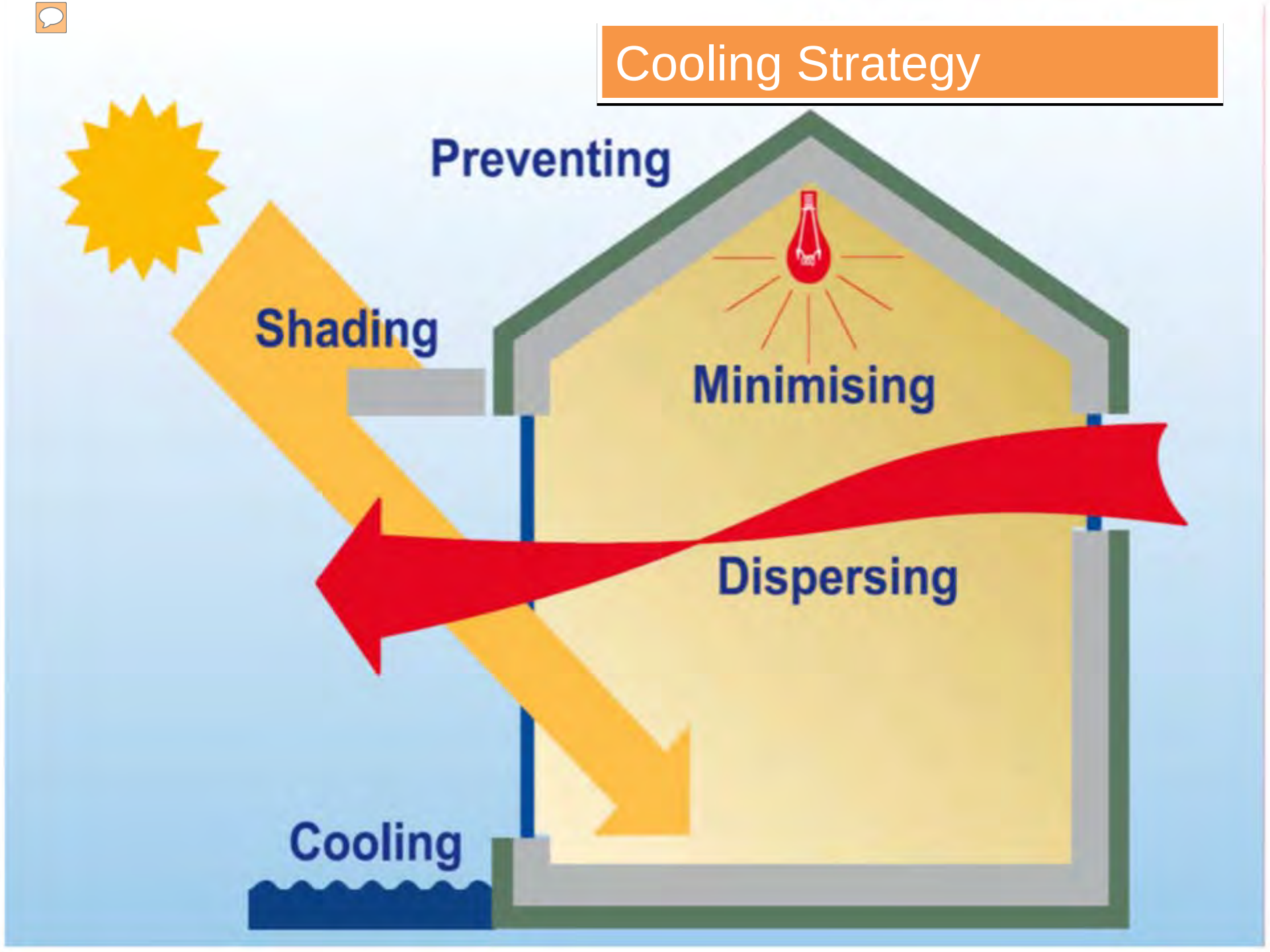


- **Heating Strategy**
- **Cooling Strategy**
- **Health Benefits**

Heating Strategy



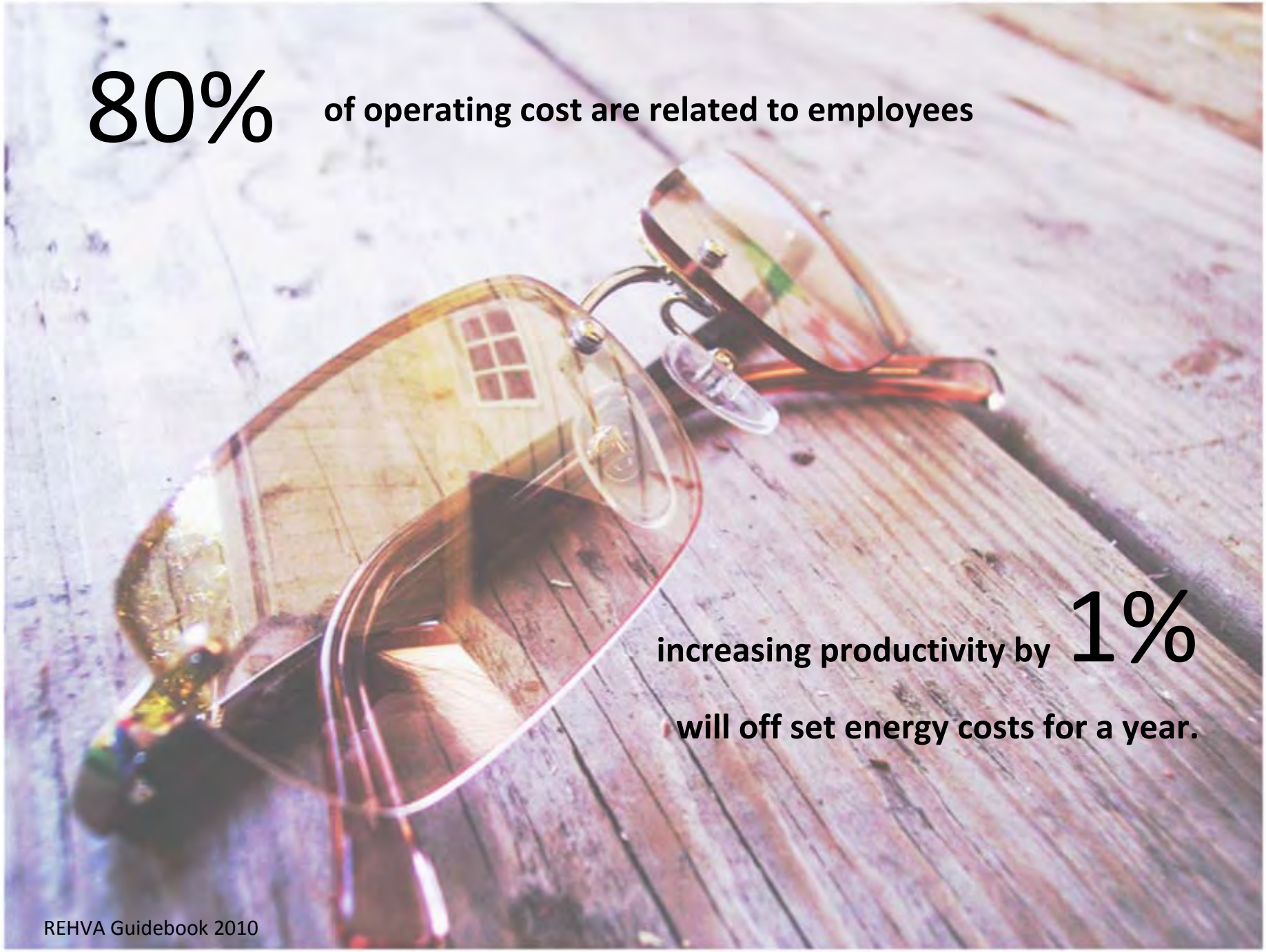
Cooling Strategy

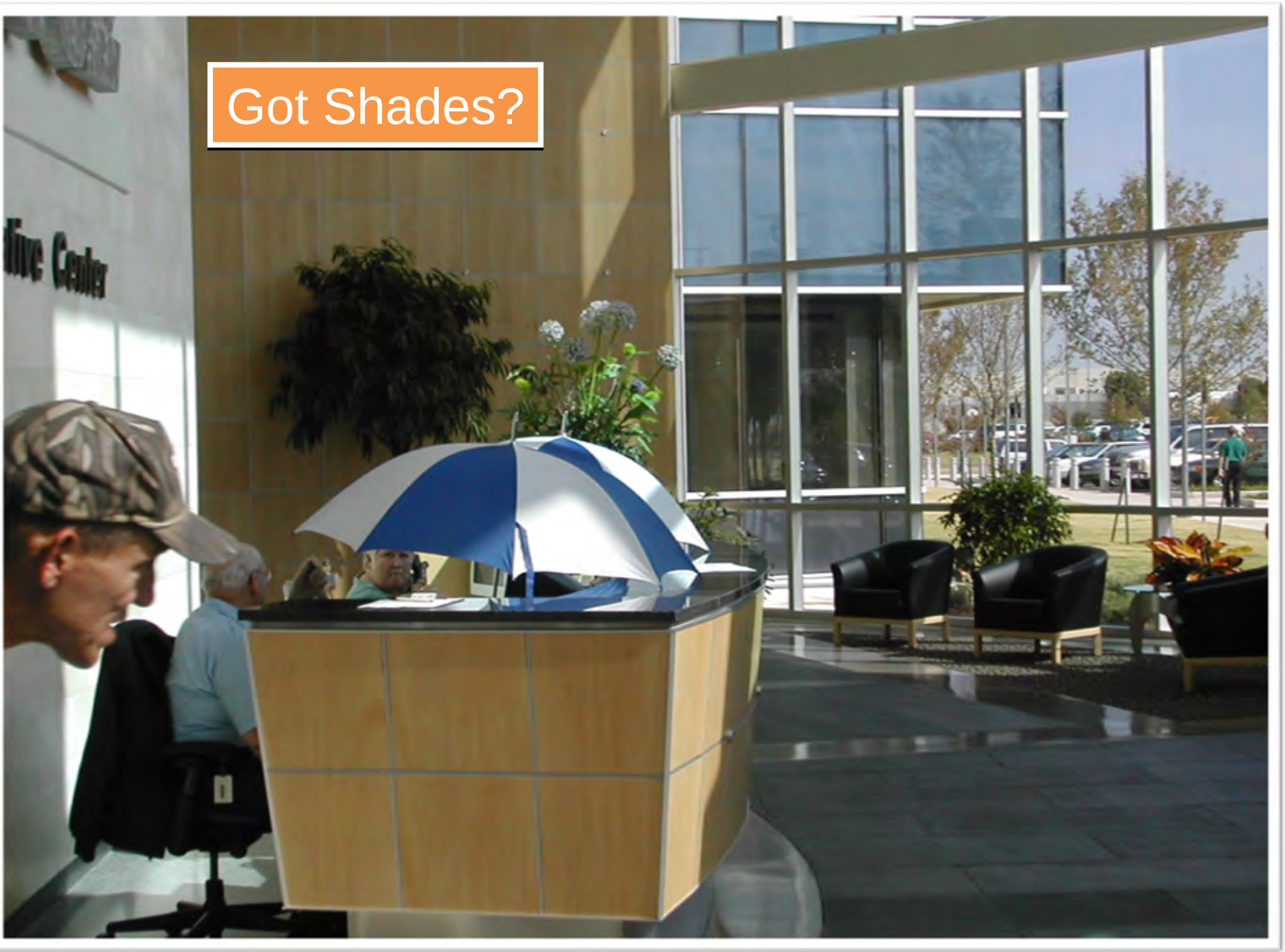


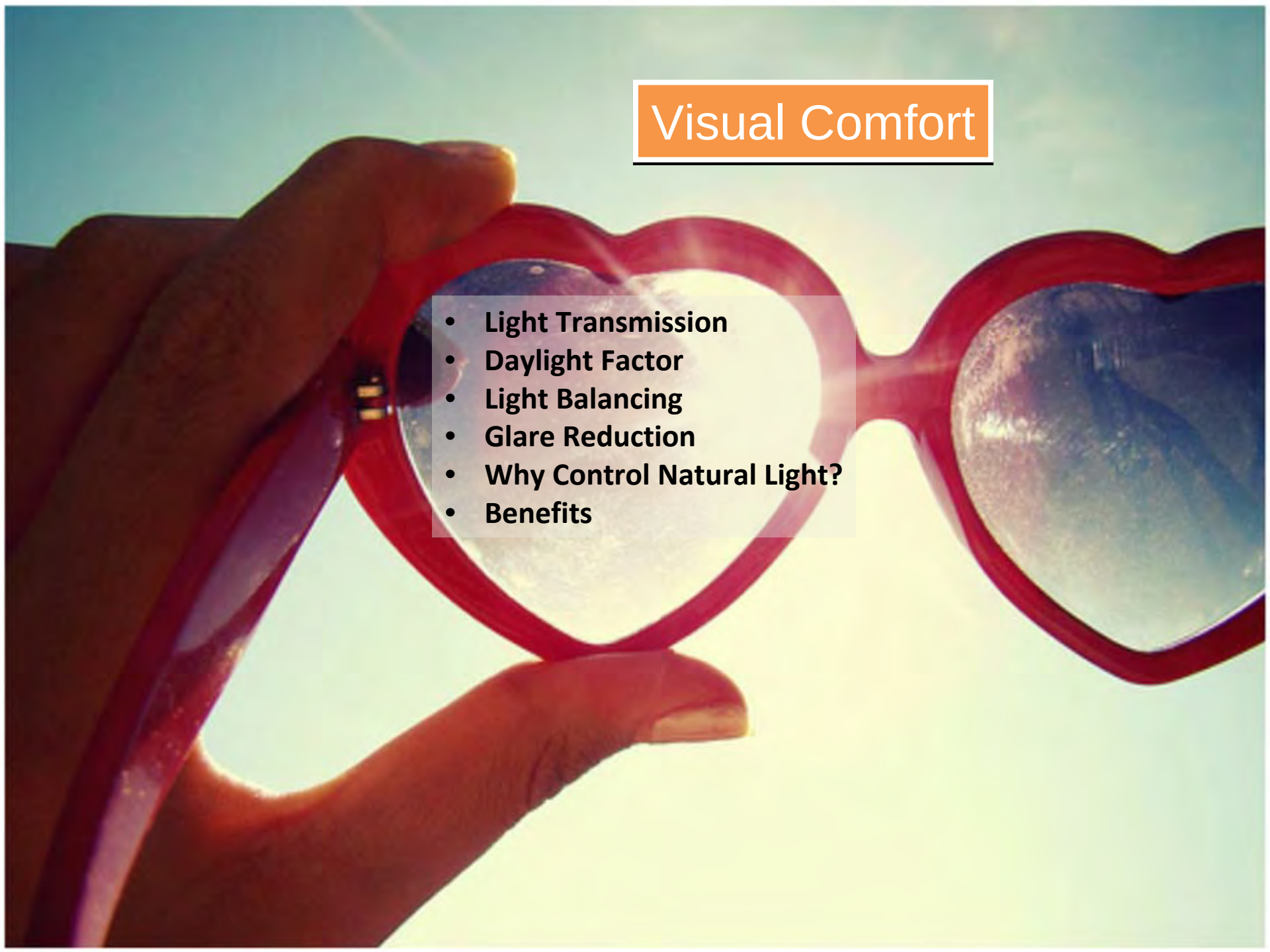
Benefits of Thermal Comfort *

- Increases productivity
- Improves performance of office tasks
  - -Low temperatures decrease dexterity
  - -High temperature reduce activity
- Reduces the prevalence of Sick Building Syndrome
- Increases overall happiness of building occupants

* Federation of European Heating, Ventilation, and Air Conditioning Association (REHVA) Guidebook 2010


80%
of operating cost are related to employees
increasing productivity by 1%
will off set energy costs for a year.
REHVA Guidebook 2010

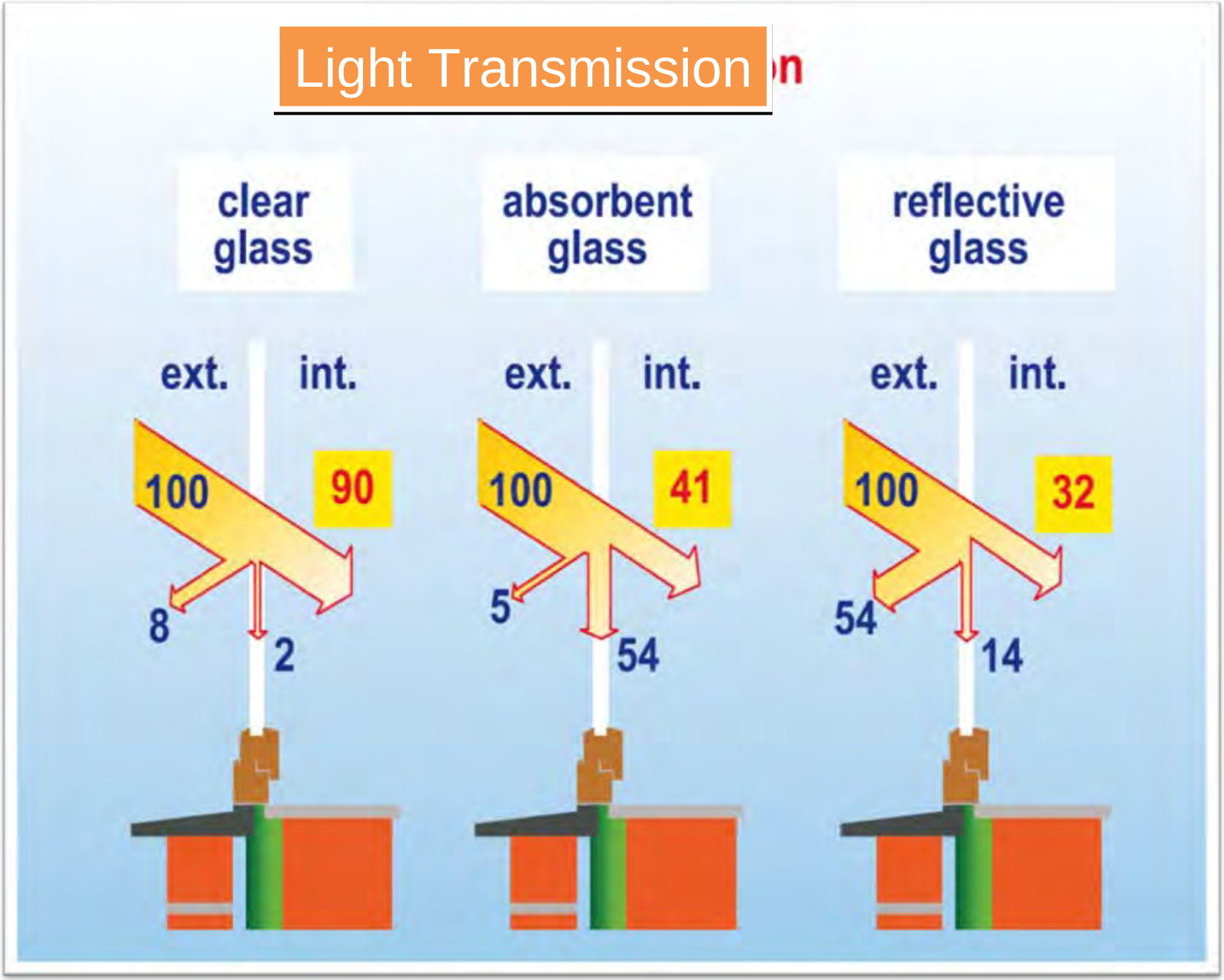

Got Shades?



Visual Comfort

- Light Transmission
- Daylight Factor
- Light Balancing
- Glare Reduction
- Why Control Natural Light?
- Benefits

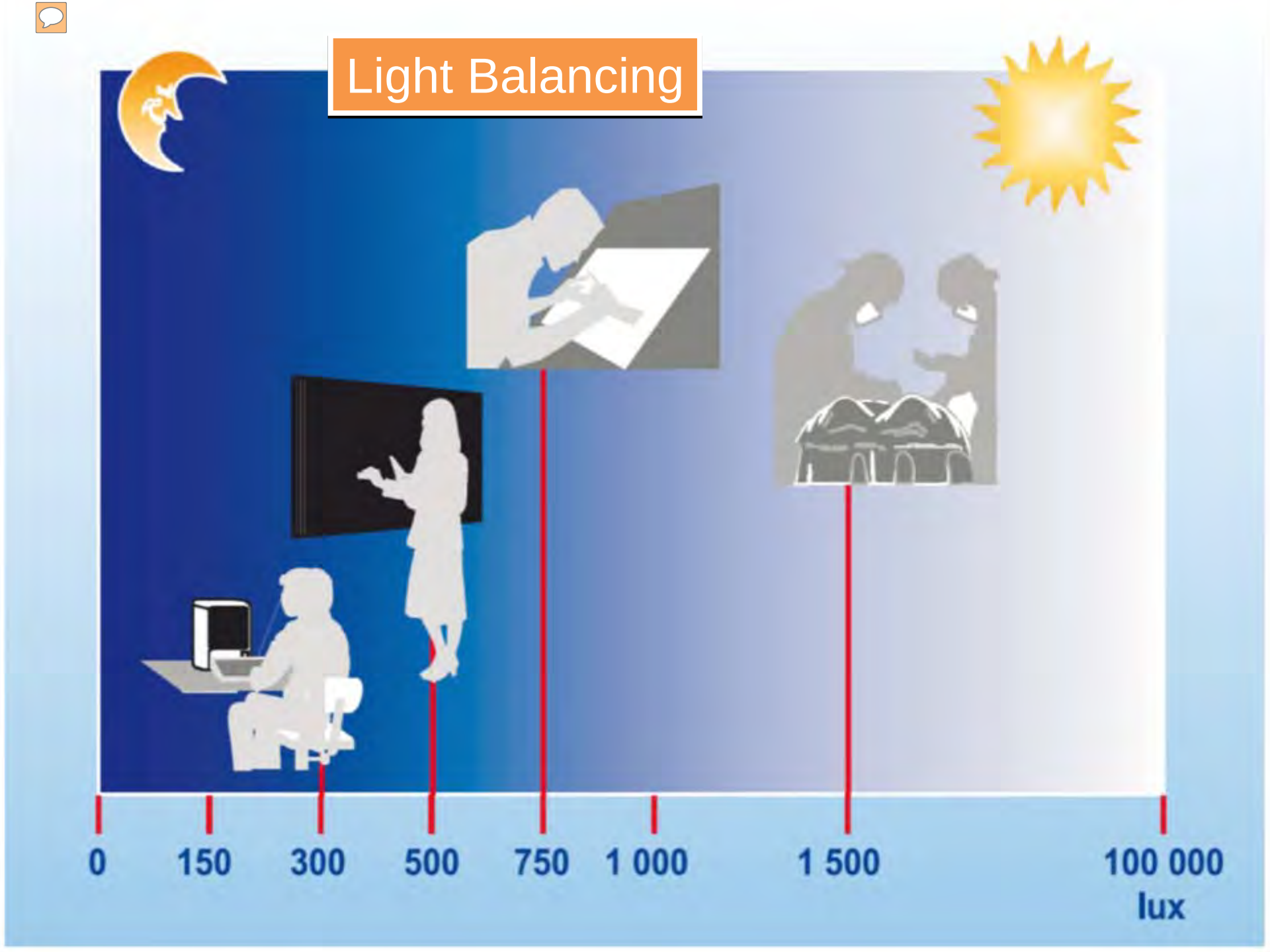
Light Transmission



Daylight Factors

Assess the internal natural lighting levels in order to determine if they will be sufficient for the occupants to carry out their normal duties.

Light Balancing



Glare Reduction

With automated shades

Why Control Natural Light?

- Comfort
- Aesthetics
- Privacy
- Energy Savings
- UV Protection
- Health
- Safety

Benefits of Visual Comfort *

- Increased worker productivity (3.75% CMU 2004)
- Major health complaints are 20 to 25% less for persons close to exterior windows.
- Access to windows and daylight resulted in 15% less absenteeism
- Office workers perform 10 to 25% better on tests of mental function and memory recall
- Glare is associated with negative performance

* REHVA Guidebook 2010

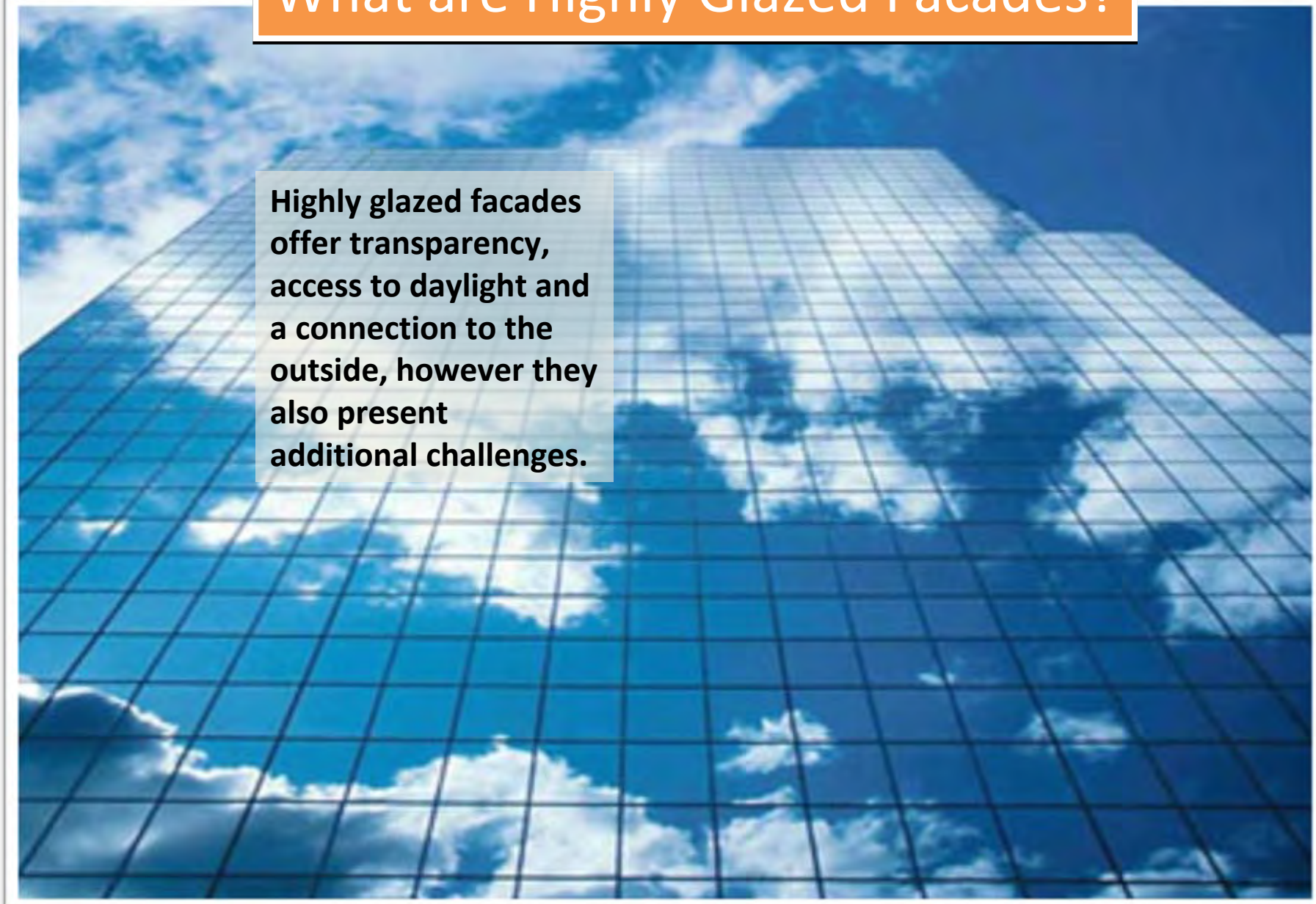

Adequate natural daylight in classrooms showed a
20%-25%
increase in learning rate.
REHVA Guidebook 2010

Windows

- Highly Glazed Facades
- Pros & Cons of Glazing
- Natural Ventilation
- Types of Ventilation
- Benefits of Fresh Air


Got Windows?

What are Highly Glazed Facades?



Highly glazed facades offer transparency, access to daylight and a connection to the outside, however they also present additional challenges.

Pros & Cons of Glazing

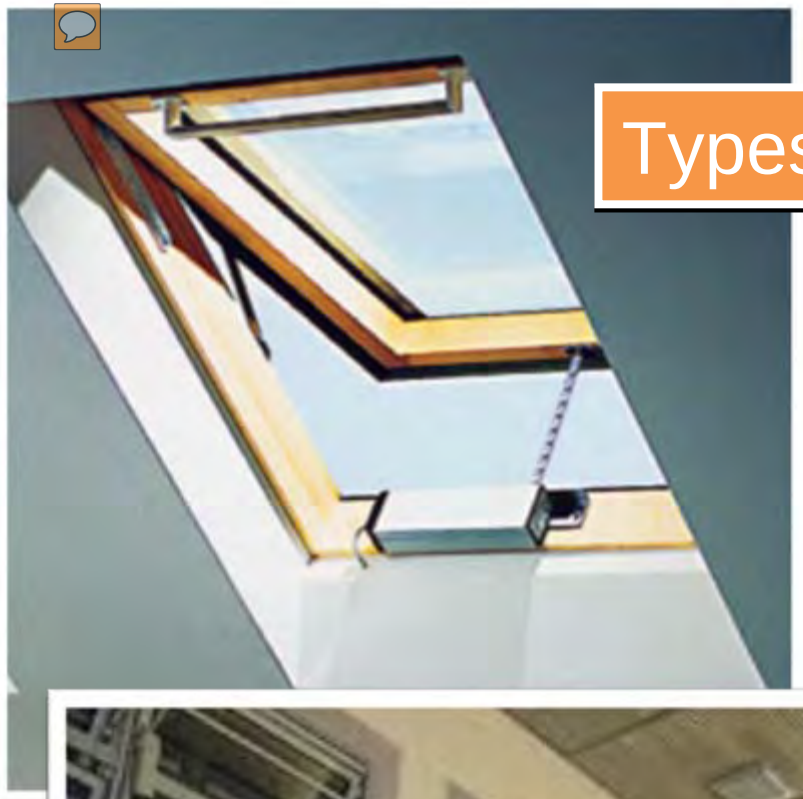
+ Better exposure to views
+ Greater transmission of natural light

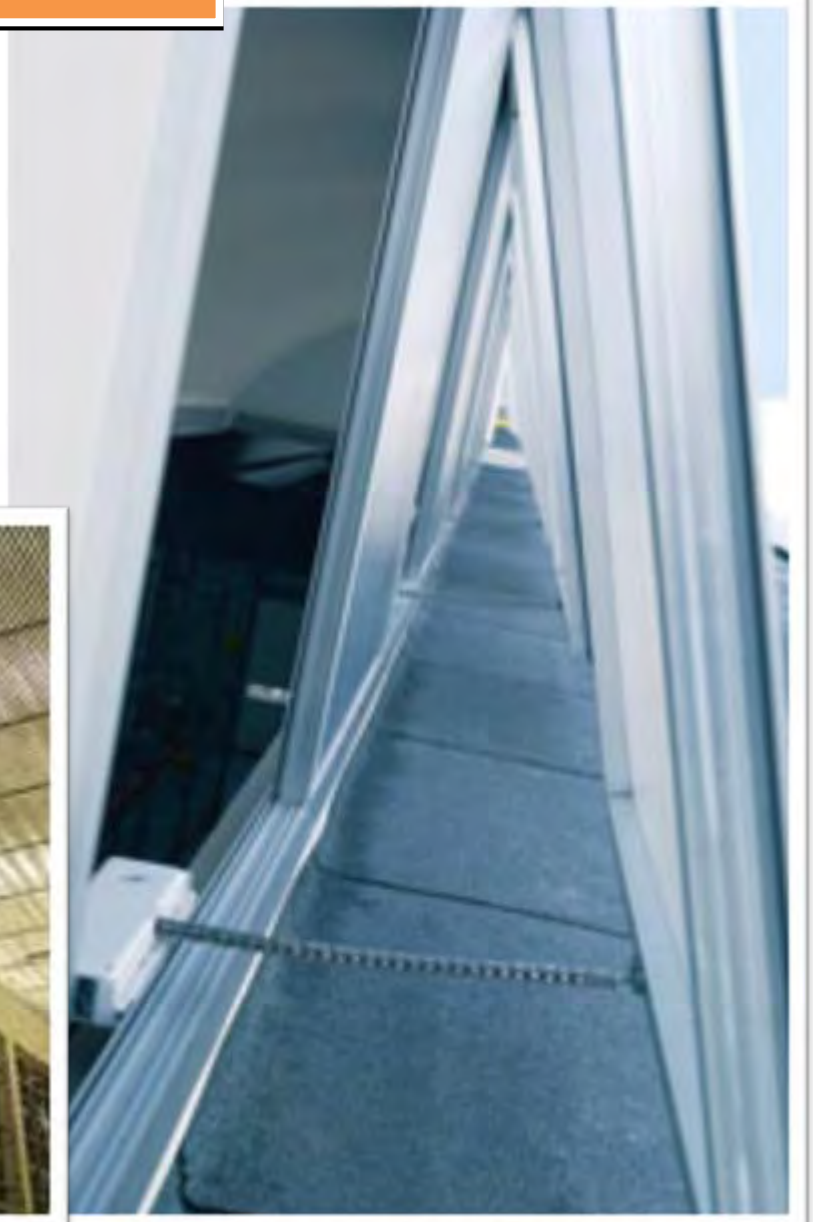
- High potential to solar gain and glare, both indirect and direct
- Increases the need for solar protection and integration

Why is Natural Ventilation Important?

- **Combat the symptoms of Sick Building Syndrome**
- **Lower incidence of sickness due to the presence of recycled air**
- **Reduces the need for air conditioning**

Types of Ventilation





Benefits of Natural Ventilation *

- **Higher levels of oxygen in fresh vs indoor air**
- **Oxygen levels impact worker performance and health**
- **Increases mental clarity**
- **Strengthens immune system**
- **Increases metabolism**

* REHVA Guidebook 2010

REHVA Guidebook 2010

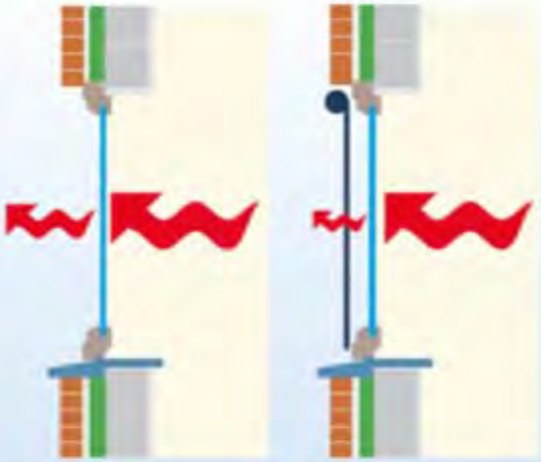

Solar Shading
•Objectives
•Safety
•Analysis
•Impact
•Automated Shading

Objectives of Solar Shading

Reduce Glare

Control Temperature

Eliminate Direct Exposure



Increase Insulation

Ensure Occupant's Privacy

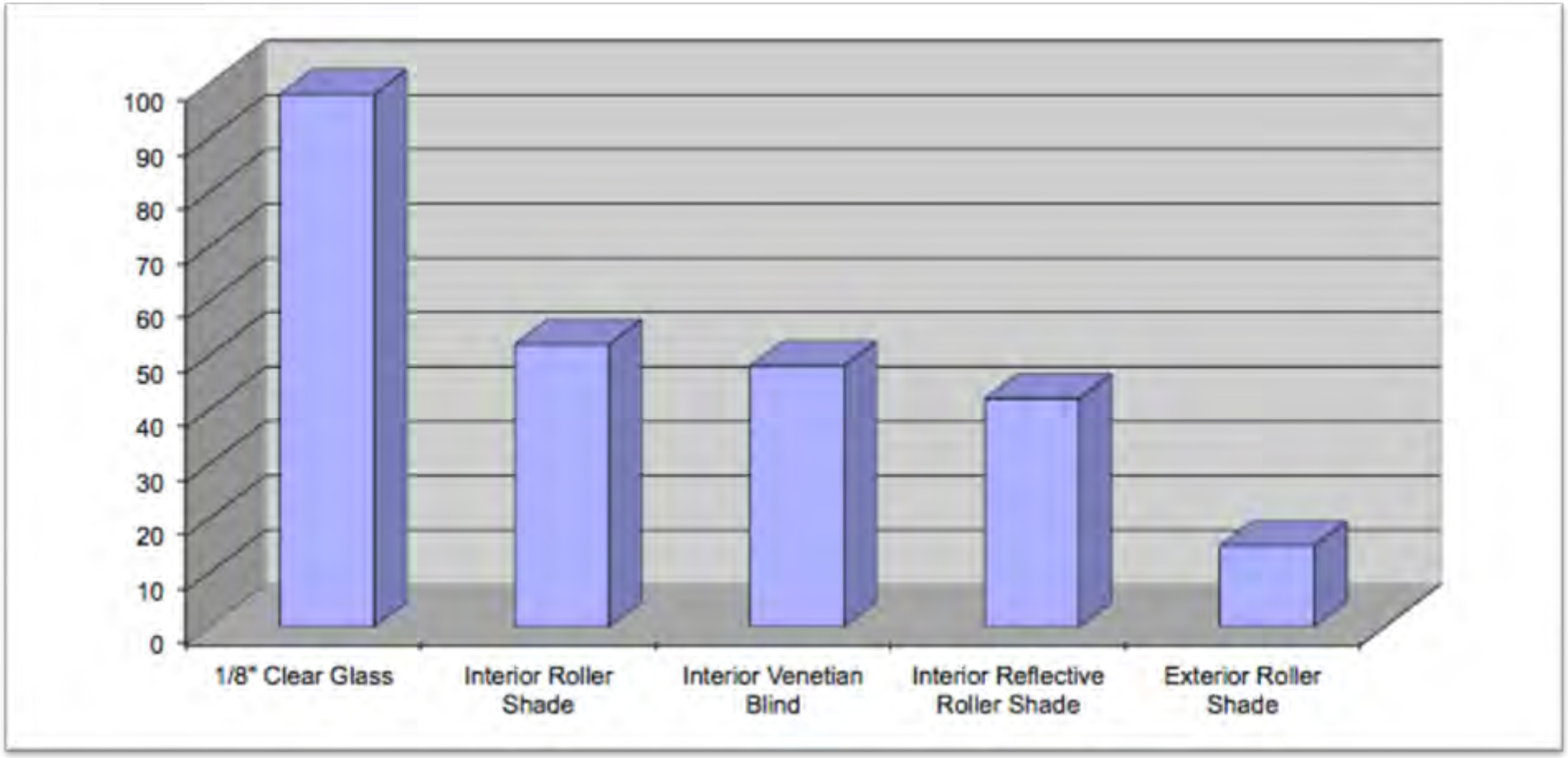
Prevent Fading

Aesthetic

Safety


Safety
Automated shades can provide **instant access** to windows in emergency situations

Shading Analysis

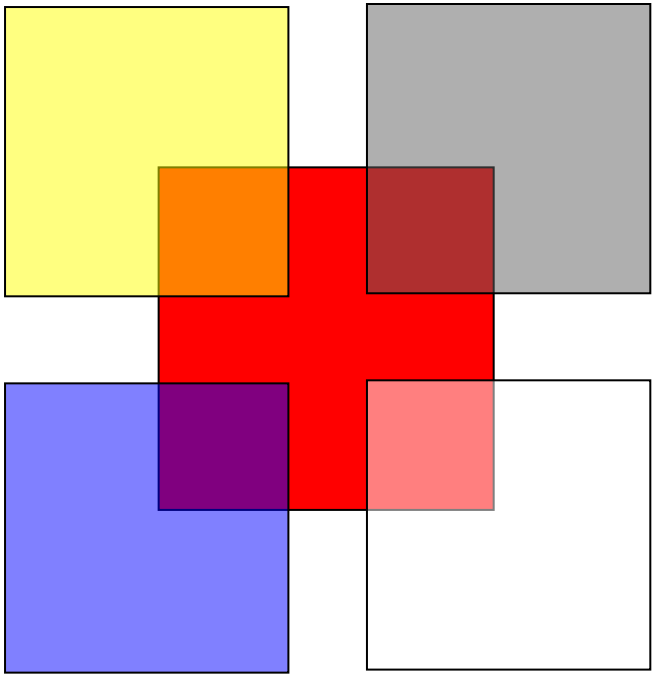


Impact of Solar Shading?

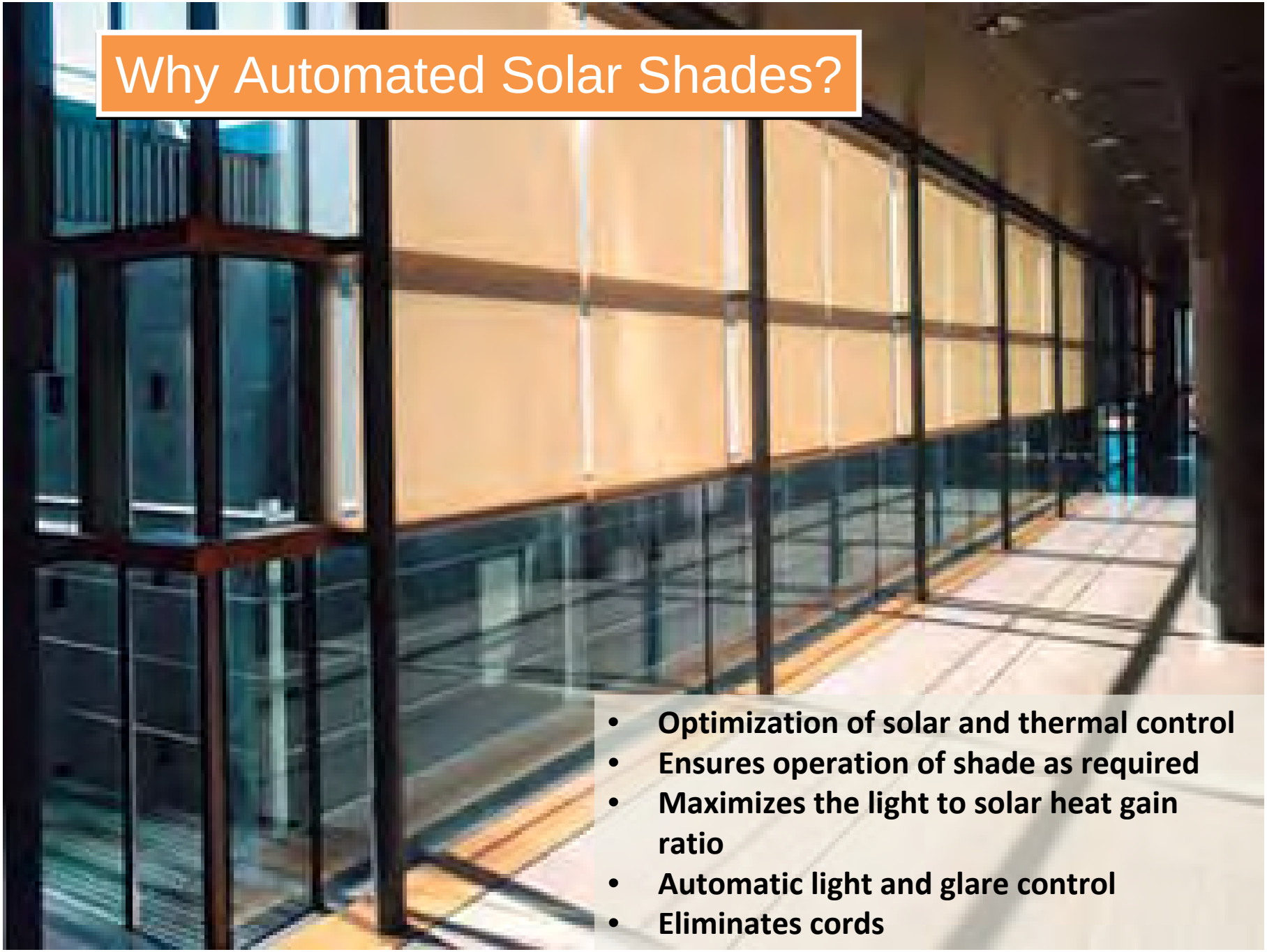
Aesthetics

Automated shading provides **controlled consistency** of external aesthetics at night.

Natural Daylight affects the **quality of colors** placed in a room by hitting them with the full color spectrum.



Why Automated Solar Shades?



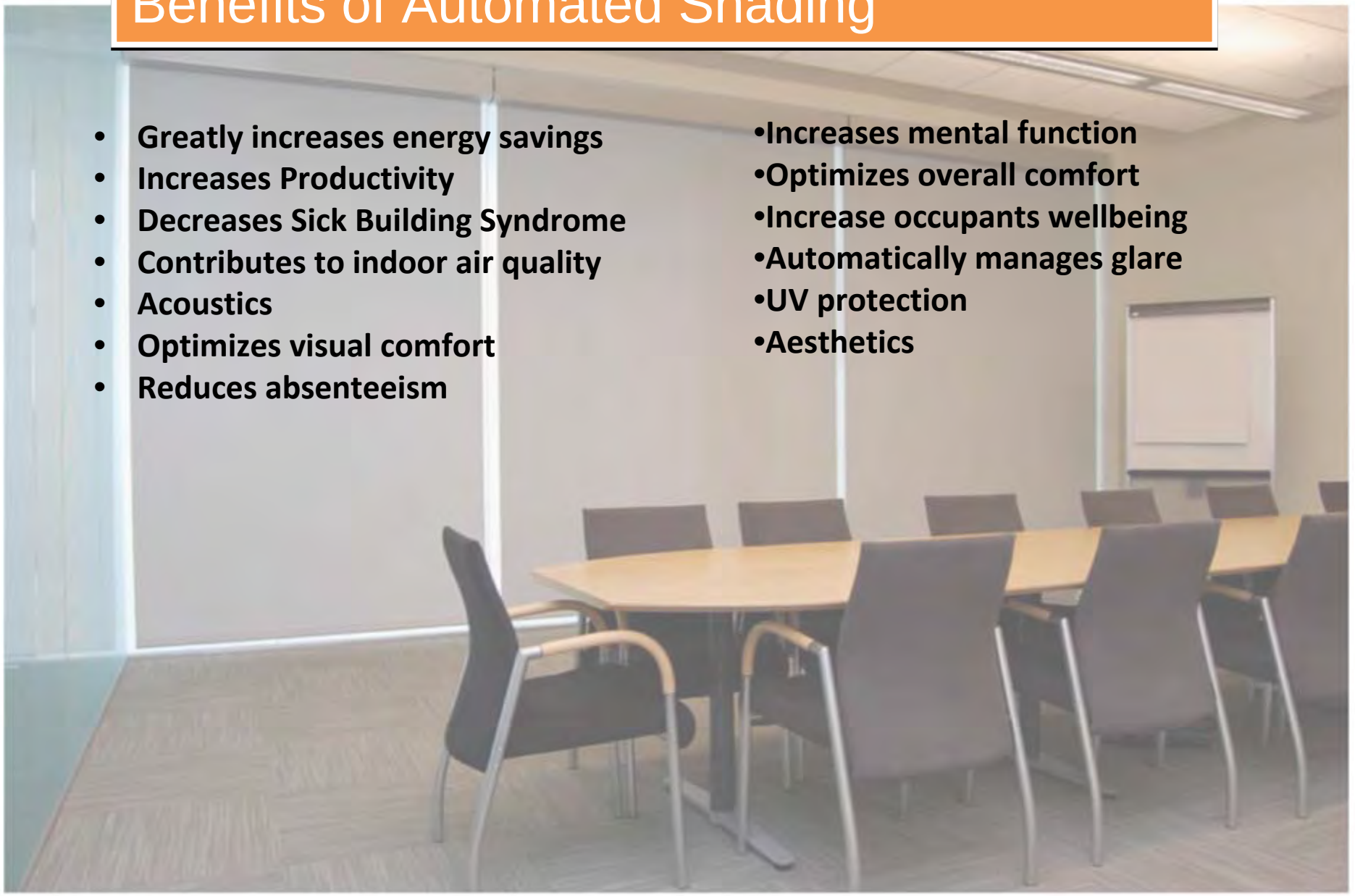
- **Optimization of solar and thermal control**
- **Ensures operation of shade as required**
- **Maximizes the light to solar heat gain ratio**
- **Automatic light and glare control**
- **Eliminates cords**

Industry studies

have shown that manual shades are only moved

once or twice a day, if at all…

Benefits of Automated Shading



- Greatly increases energy savings
- Increases Productivity
- Decreases Sick Building Syndrome
- Contributes to indoor air quality
- Acoustics
- Optimizes visual comfort
- Reduces absenteeism

- Increases mental function
- Optimizes overall comfort
- Increase occupants wellbeing
- Automatically manages glare
- UV protection
- Aesthetics


Questions?
This concludes the AIA Continuing Education Systems Program
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