Daylighting

Objectives
• Learn the basic fundamentals of daylighting design
• Understand important aspects of window selection

What is daylighting?
• the practice of placing windows, or other openings, and reflective surfaces so that, during the day, natural light provides effective internal illumination.

Definition from Wikipedia
Light Requirements

- Light measured in foot-candle or lumen/SF
- Difficulty in having consistent lighting throughout room
What does it do?

• Increase light in building
• Energy savings
• Increase human performance

Important Aspects

• No need to add extra window area
• Proper Placement of windows
• Type of windows
• Shading

Window Placement

• South side – 0° azimuth
• Outside cover
Window Placement

- Orientation of building
- Window # on building face

Window Placement

- Higher on wall
  - Carries 1-2x height of window
  - Reduces glare
- High SRI colors for walls & ceiling

Light Placement

YES

NO
Type of windows

- Solar Heat Gain Coefficient (SHGC)
- Visible Light Transmittance (VT)
- Light to Solar Gain Ratio (LSG)

LSG = \frac{VT}{SHGC}

Window types

- Number of panes
- Low-E
- Low U factor
Shading

- Tree distance away from windows
  \[ d = \text{SAF} \times h \]
- \( d \) = separation distance, ft
- \( \text{SAF} \) = solar angle factor
- \( h \) = obstruction height, ft

Example

- Find the separation required to prevent shading windows 4 ft from ground level by a long 20\(^\circ\) high evergreen tree between 9 am and 3 pm during the winter heating season at 40\(^\circ\) north latitude.
Shading

- Overhang length
  \[ \text{OL} = \text{SAF} \times \text{CH} \]
- \( \text{OL} \): Overhang Length, ft
- \( \text{SAF} \): Solar Angle Factor
- \( \text{CH} \): Collector Height, ft

Example

- Find the length of overhang needed to completely shade a 4 ft high window (4 ft from the ground) at noon, May through July, at 40° north latitude.

Shading

- Sun Penetration
  \[ \text{Pen} = \text{SAF} \times \text{h} \]
- \( \text{Pen} \): Sun Penetration, ft
- \( \text{SAF} \): Solar Angle Factor
- \( \text{H} \): eave height, ft
Example

• Find the maximum sun penetration into a south facing wall with a 10 ft eave height between 9 am and 3 pm on June 21 and Dec 21 at 40° north latitude.

Shading

www.kibbleproducts.com/awnings.html

www.taylormadeawning.com/fixed.html
Shading

North

South

East

West

Skylighting

Skylighting

• 5% of roof area to light room
• Not recommended for warehouses in cold climates

Both pictures are from Metal Architecture, Oct 2008
More on the subject

- http://windows.lbl.gov/
- Energy Center of Wisconsin
- Energy Star