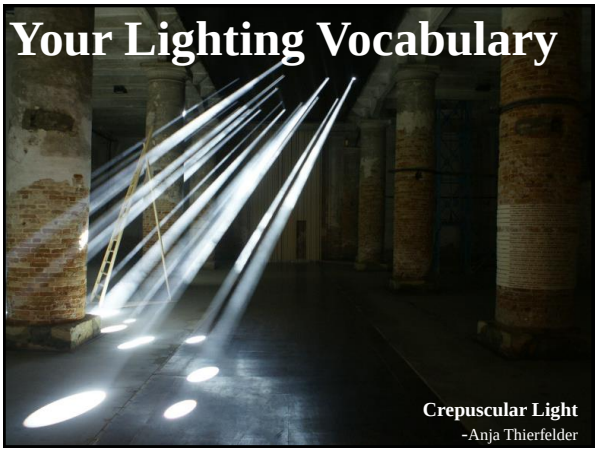
Your Lighting Vocabulary



Crepuscular Light
-Anja Thierfelder

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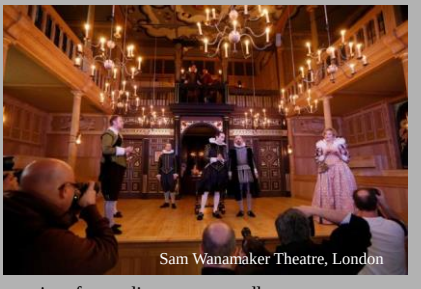
Luminous Intensity



Sam Wanamaker Theatre, London

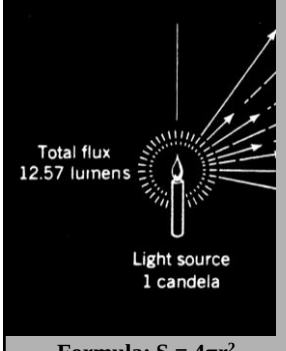
Based on the intensity of an ordinary wax candle

1 candlepower or candela (cd)

Candlepower

2

Luminous Flux



Quantity of light measured in Lumens

Definition:
1 lumen falls on 1 square foot of a 1 foot radius sphere with a 1 candela source at its center

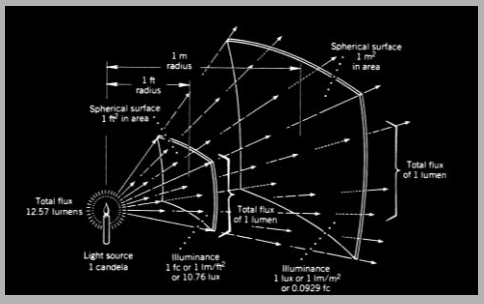
Since the surface area of a 1 foot radius sphere is 12.57 sqft, a 1 candela source creates 12.57 lumens

Formula: $S = 4\pi r^2$

Lumens

3

Density of Luminous Flux



1 footcandle = 1 lumen/ sq. foot
1 lux = 1 lumen/ sq. meter
(International)

Footcandles (Lux)

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Illumination

Measured with an illuminance meter in footcandles or lux

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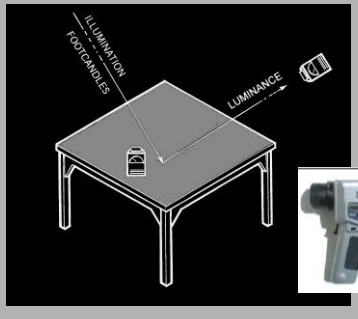
Luminance (surface brightness)



Measured with a luminance meter in footlamberts or cd/m².

Illuminance is light striking a surface
Luminance is light reflecting off a surface

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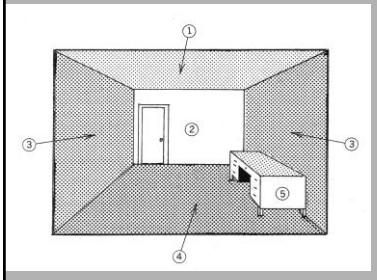
Reflectance (ρ) & Transmittance (t)



For a reflector:
f.l. = f.c. x reflectance
Or
For a transmitter:
f.l. = f.c. x transmittance

Reflectors vs. Transmitters

White Reflects ~ 90%; Clear Transmits ~90%

Black Reflects ~4%; Tinted Transmits ~4%

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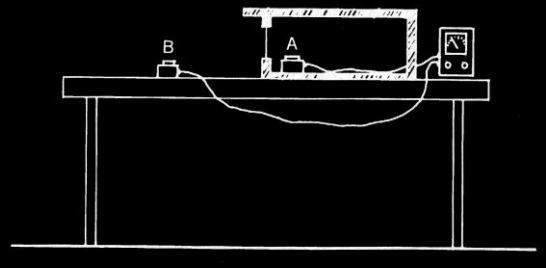
Daylight Factor (DF)...

Here A/B x 100 = DF



- **Percentage of Interior Light vs. Exterior Light**
- **DF = Interior f.c./Exterior f.c. x 100**

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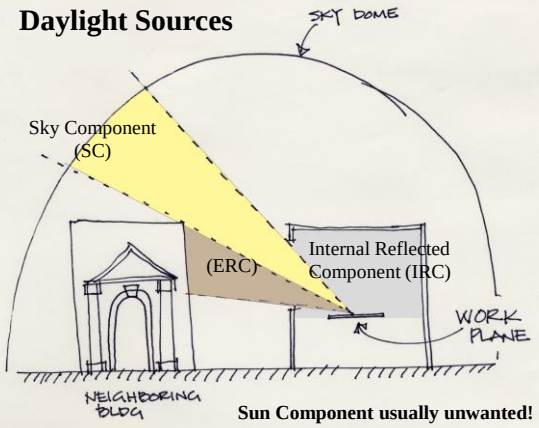
Daylight Sources



Sun Component usually unwanted!

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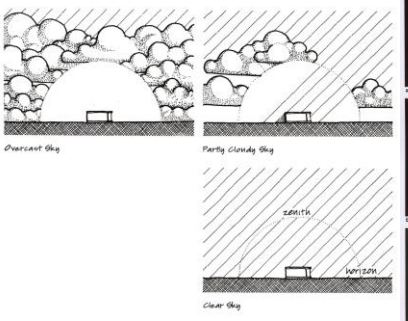
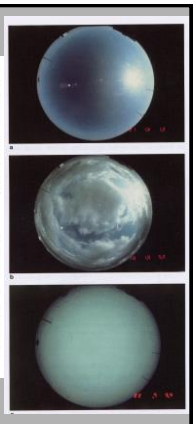
Daylighting Sky Conditions





Design for worst case and best case…

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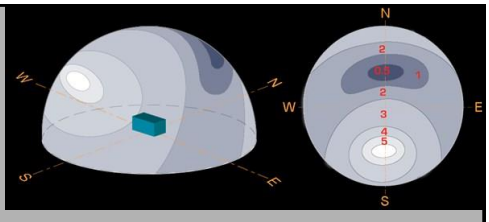
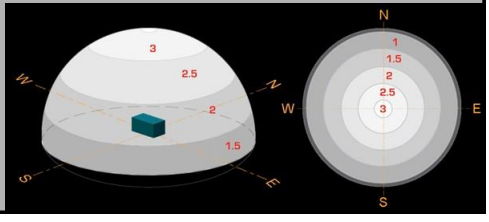
Sunny Sky



Cloudy Sky



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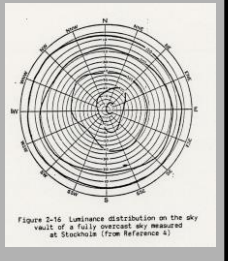
Domes with oculi simulate cloudy skies!



Bibliotéque National, Paris
—Henri Labrouste

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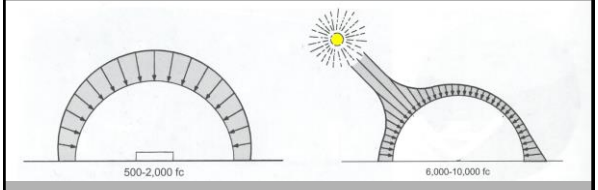
Design Guidelines—Sky Component

1. **Exclude Sun or use for drama**
2. **Skylight in cloudy climates**
3. **Sidelight in clear climates**



Cloudy Day
- Less Light
- Most Light From Above

Clear Day
- More Light
- Most Light from...
  - Horizon
  - Sun

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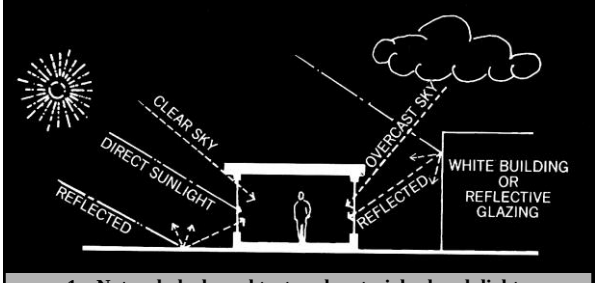
Design Guidelines—ERC



1. **Natural, dark, and textured materials absorb light**
2. **Neighboring buildings can be significant**

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Design Guidelines—IRC

1. **Walls and ceiling most important**
2. **Use surfaces to distribute light**

David Lawrence Convention Center, Pittsburgh —Rafael Viñoly Architects

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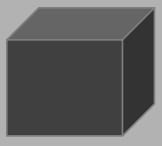
The Importance of Reflected Light

Imagine a 5,000 lumen source in two rooms with 1,000 sqft of surface area.

Room 1 has 80% reflective surfaces.

Room 2 has 20% reflective surfaces.



How much brighter is room 1? (4x?)

"Ambient Illumination: A Thought Experiment" by Kit Cuttle.

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We don't **see** incident light, we see **reflected light**.

So, in Room 1 5,000 lumens x 0.8 = 4,000 lumens
In Room 2 5,000 lumens x 0.2 = 1,000 lumens

But that's only the effect of direct light on the surfaces, the surfaces reflect light to each other, increasing the luminous flux.

	Room 1	Room 2
Initial Flux (F)	5,000 lumens	5,000 lumens
1st Reflection	4,000	1,000
2nd Reflection	3,200	200
3rd Reflection	2,650	40
… Total [F/1-ρ]	25,000 lumens	6,250 lumens

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Surface Illuminance

Now we can determine the average surface illuminance of the two rooms by dividing the total flux (lumens) by the surface area of the room.

Room 1 25,000 lumens/1,000 sqft = 25 f.c.
Room 2 6,250 lumens/1,000 sqft = 6.25 f.c

Surface Luminance

But that's the light that strikes the surfaces, we see the reflected light as surface brightness:

Room 1 25 f.c. x 0.8 = 20 f.l.
Room 2 6.25 f.c. x 0.2 = 1.25 f.l.

So, Room 1 appears 16 times brighter!

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The Bright Room!

One Lux Studio, Bernhardt Design

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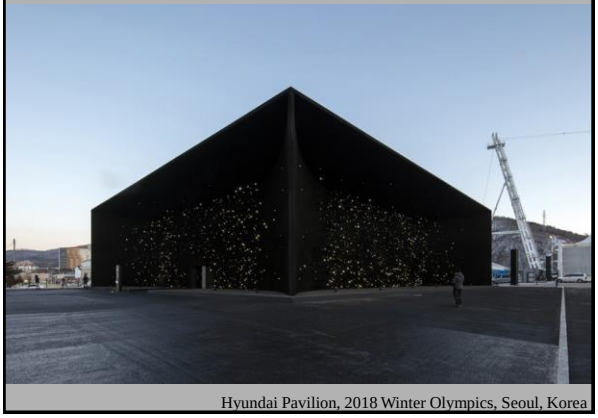
The Dark Façade! (99% black)



Hyundai Pavilion, 2018 Winter Olympics, Seoul, Korea

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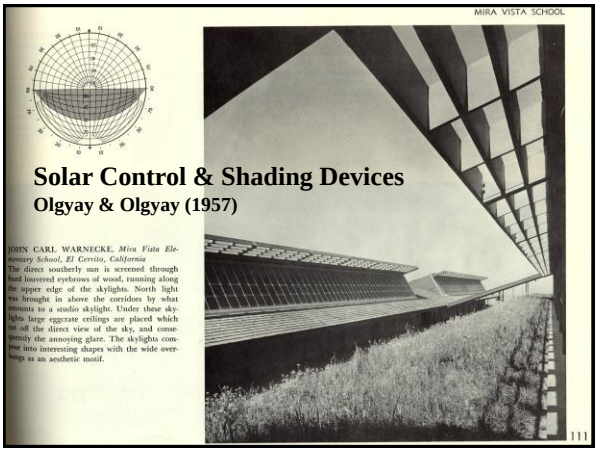

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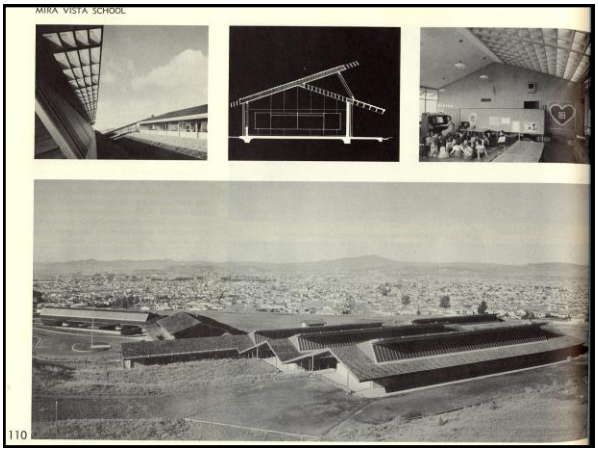

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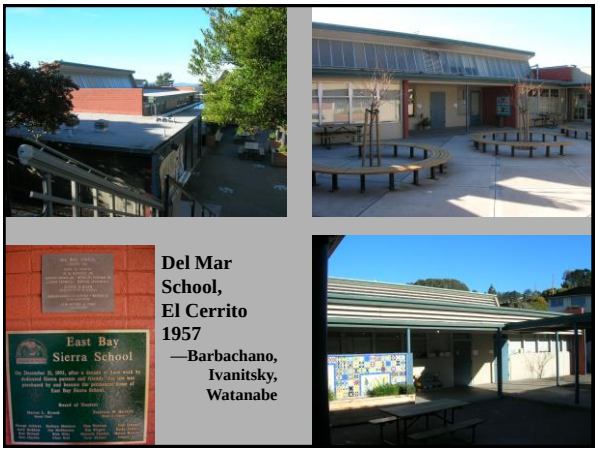

Del Mar School, El Cerrito 1957
—Barbachano, Ivanitsky, Watanabe

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PROSPECT SIERRA SCHOOL
Burz Heinrich
Head of School
Jo Bradley
Elementary School Head
Devoe Anderson
Director of Development
Ken Cheitlin
Trustee
Jim Cuthbertson
Trustee
George Donaldson
Trustee
Mike Ferguson
Trustee
Vickie Gilliland
Trustee
Susan Kaufmann
Business Manager
Barbara Monierre
Trustee
Priscilla Myrick
Trustee

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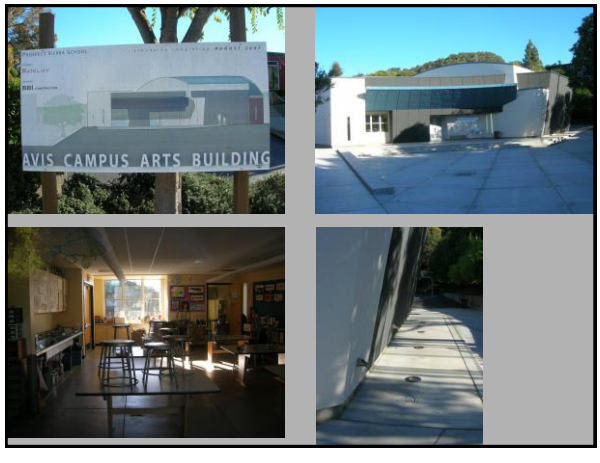
AVIS CAMPUS ARTS BUILDING

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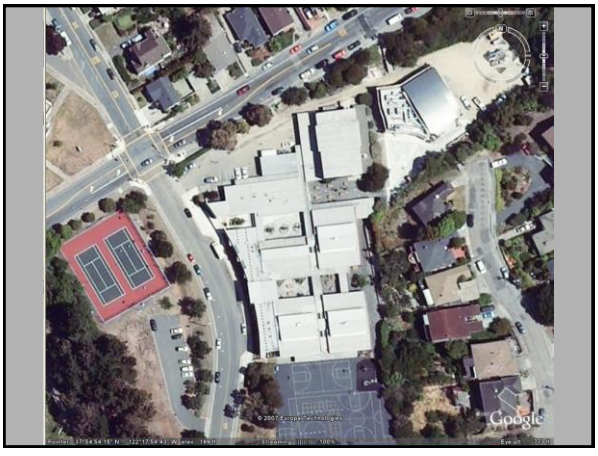

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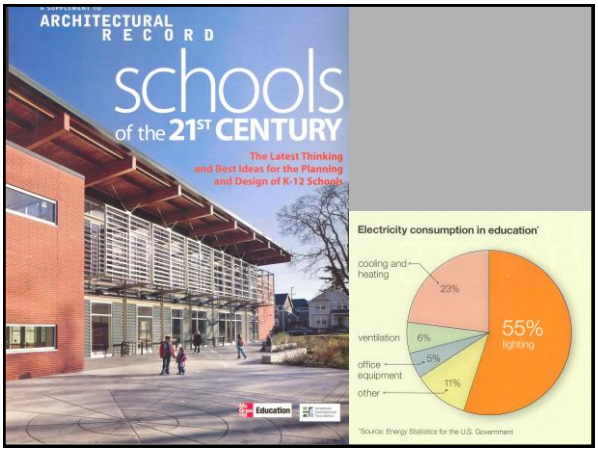

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Rosa Parks Elementary School
Portland, OR

—DOWA Architects

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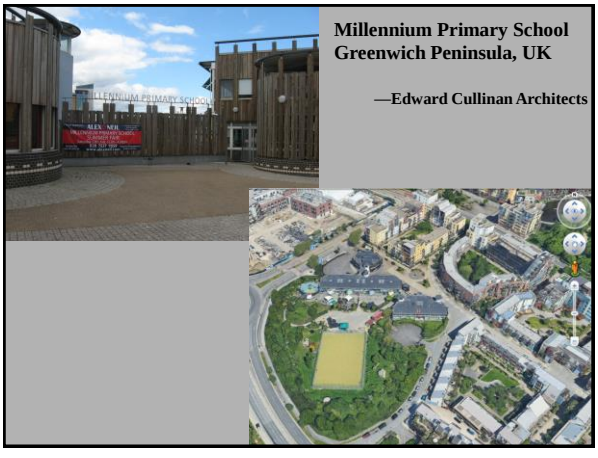

Millennium Primary School
Greenwich Peninsula, UK

—Edward Cullinan Architects

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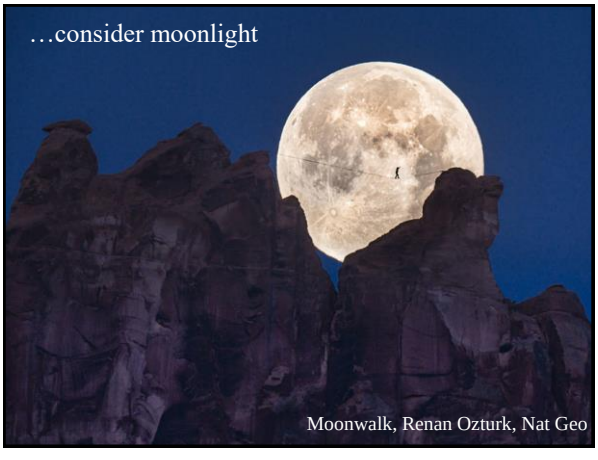
…consider moonlight
Moonwalk, Renan Ozturk, Nat Geo

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Moon Arches
Zach Cooley, Natl Geo

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