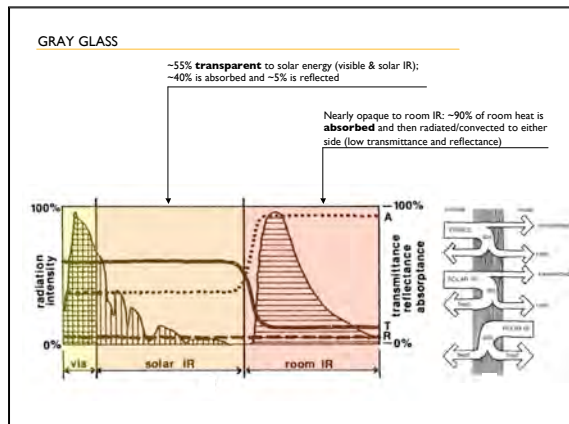
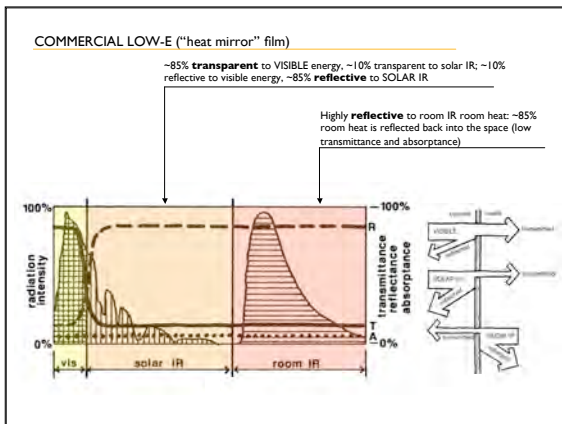
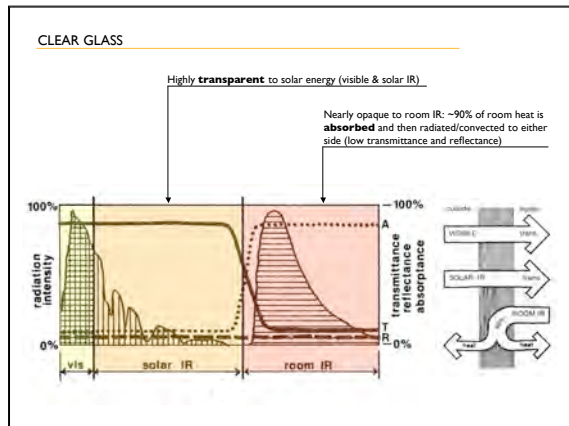
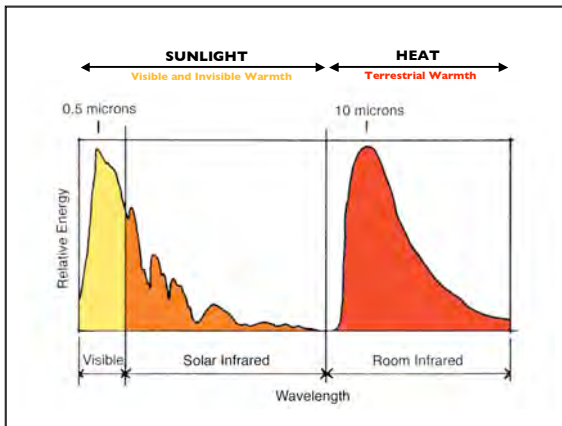


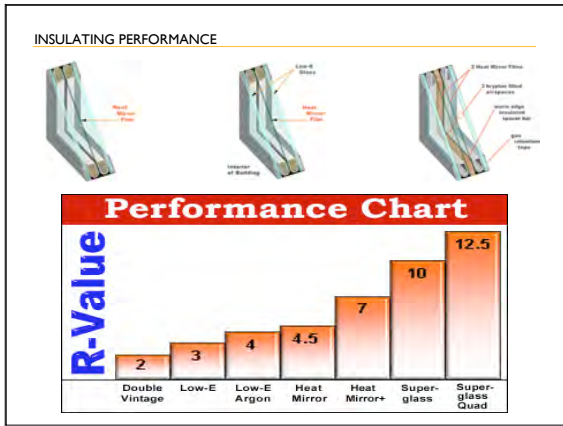


**announcements 5/29/08**

**Final Exam Alternate Time:**  
**Wednesday, 6/11**  
**4:30 - 6:20**  
**Smith (SMI) 304**

**Final Exam Assigned Time:**  
**Friday, 6/13**  
**4:30 - 6:20**  
**Gowan 201**





**SHGC**  
(0 - 1) The ratio of total transmitted solar heat (full spectrum) to solar energy (incident) on the outside of the glass.

**U-Factor**  
(0 - 1) The ratio of transmitted visible light to the visible light (incident) on the outside of the glass.

**Visible Transmittance**  
(0.1 - 0.3) A measure of infiltration - the lower the value the better; use this for comparison.

**Air Leakage**  
(1 - 100) A measure of how well a window resists condensation - the higher the better.

**Condensation Resistance**

ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./F-P)	Solar Heat Gain Coefficient
<b>0.35</b>	<b>0.32</b>
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./F-P)
<b>0.51</b>	<b>0.2</b>
Condensation Resistance	
<b>51</b>	

**Low-E Coatings**

**High Solar Gain**  
"residential low-e"

U-Factor = 0.29  
SHGC = 0.71  
71% of solar heat gain transmitted  
VT = 0.78  
78% of visible light transmitted

**Generally more appropriate for:**  
colder climates  
heating dominated  
envelope dominated  
passive solar heating

**Moderate Solar Gain**

U-Factor = 0.27  
SHGC = 0.58  
58% of solar heat gain transmitted  
VT = 0.78  
78% of visible light transmitted

**Low Solar Gain**  
"commercial low-e"

U-Factor = 0.25  
SHGC = 0.29  
29% of solar heat gain transmitted  
VT = 0.78  
78% of visible light transmitted

**Generally more appropriate for:**  
warmer climates  
cooling dominated  
internal load dominated

[www.efficientwindows.org](http://www.efficientwindows.org)

A tool to estimate the annual energy for **heating and cooling** (only) of a house that has:

- 2000 sf floor area
- 300 sf windows (15% of floor area), equally distributed on four sides

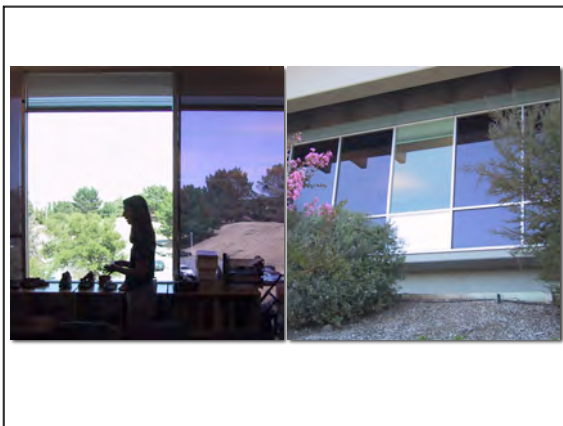
**Southwall Glazing Products: Specifications**  
<http://www.southwall.com>

Product/Glass Type	Transmittance		Reflectance		U value hr ft <sup>2</sup> /Btu	SHGC Solar Heat Gain Coefficient	Relative Heat Gain Btu/sqft/yr
	Daylight Total %	Solar Total %	Daylight Ext. %	Solar Ext. %			
Clear Double Insulating Glass	81	69	16	16	0.49	0.75	182
HM 88/Clear	72	47	19	19	0.26	0.57	136
HM 88/Clear	55	26	33	35	0.25	0.36	85
HM 22/Clear	20	9	70	71	0.24	0.14	35
HM 88/Bronze	54	36	13	18	0.26	0.45	110
HM 88/Bronze	41	21	21	34	0.25	0.28	70
HM 22/Bronze	16	7	40	71	0.24	0.12	33
HM 88/Azurite	62	28	15	19	0.26	0.36	88
HM 88/Azurite	47	19	26	34	0.25	0.26	65
HM 22/Azurite	17	6	52	71	0.24	0.13	34
HM 88/EverGreen	61	30	15	18	0.26	0.38	94
HM 88/EverGreen	48	20	25	34	0.25	0.27	68
HM 22/EverGreen	17	6	51	71	0.24	0.13	34

**High Performance Glass • Applications**

Boulder Public Library

Azurite Skylight • Saudi Arabia



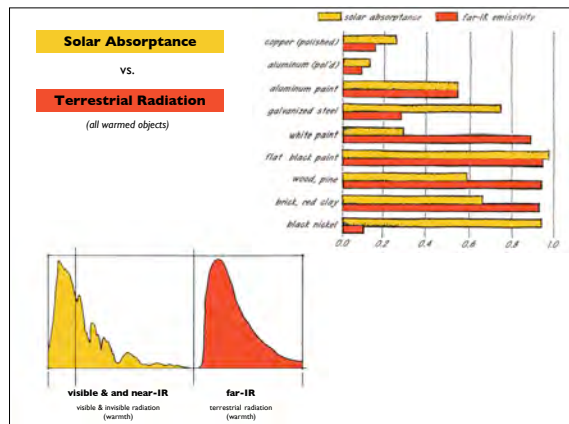
**Properties of Surfaces**

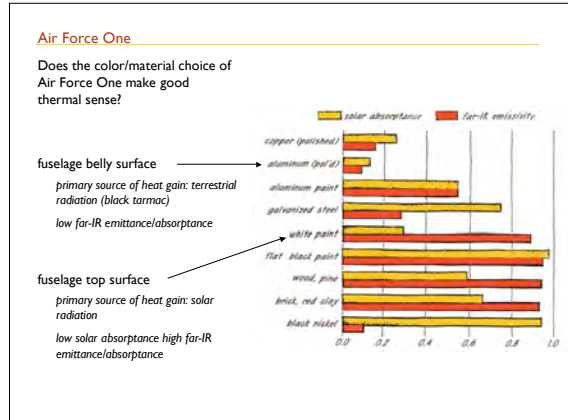
**Optical Properties**  
When radiant energy strikes a surface it is either reflected, transmitted or absorbed.

**Thermal Properties: EMISSIVITY**  
Emissivity is the measure of the ability of a surface to emit radiation at a given surface temperature.

**KIRCHHOFF'S LAW**  
At any given temperature\*, or region of the radiation spectrum, a surface's emissivity is exactly equal to its absorptance.

**EMITTANCE = ABSORPTANCE\***



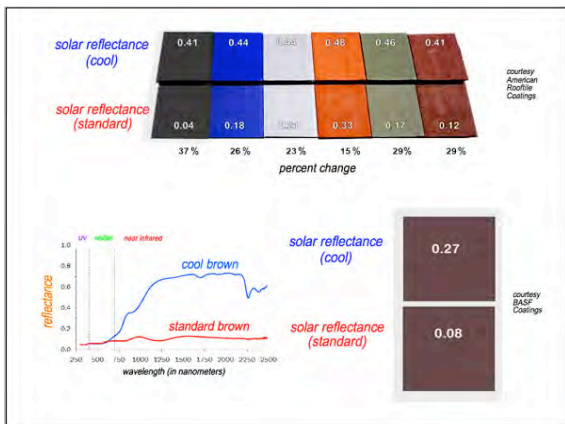
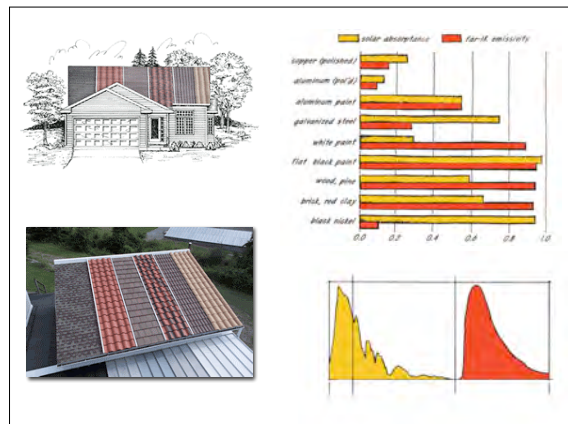


### Cool Roofs

Americans spend about \$40 billion annually to air condition buildings - one-sixth of all electricity generated in this country!

Building a cooler color shingle or other roof material starts with finding cooler pigments. For a given color, the ideal pigment is one that reflects as much as possible of the invisible radiation in the near-infrared range.

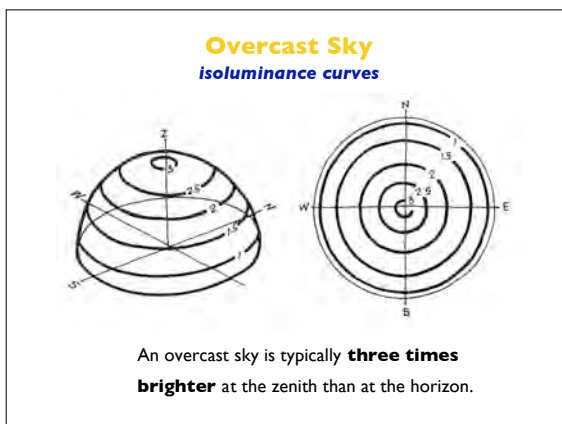
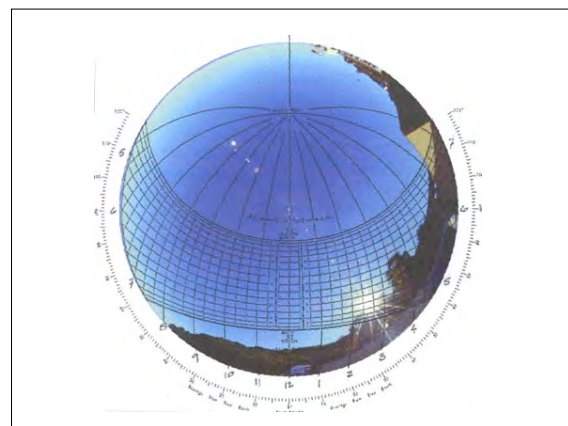
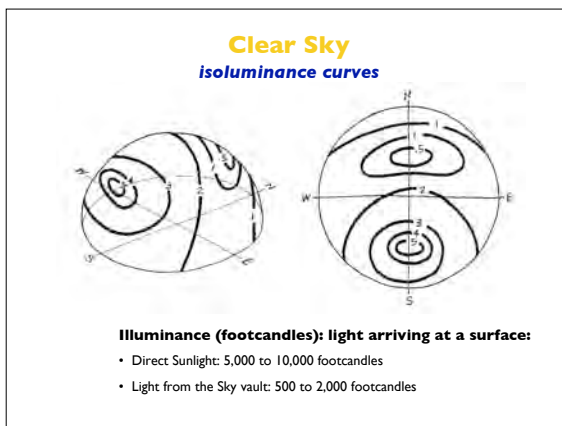
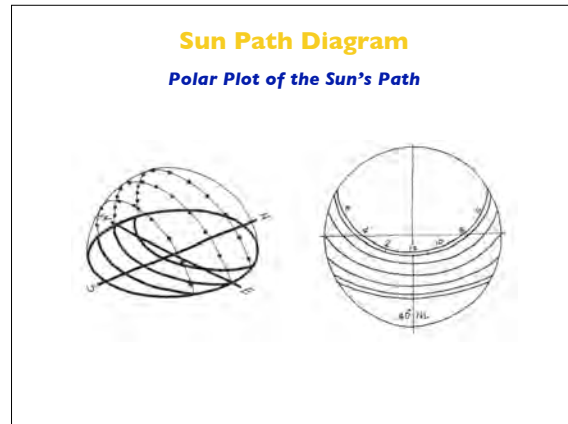
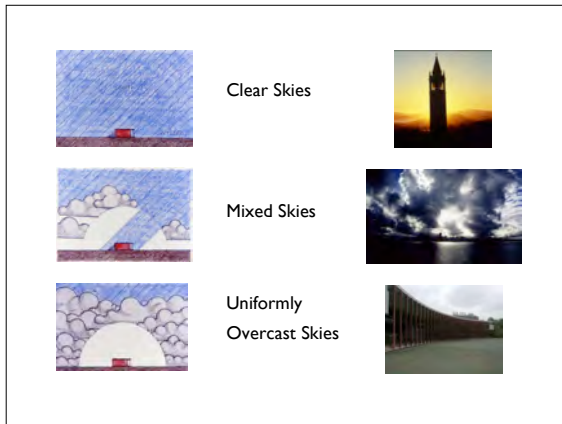
[www.energystar.gov](http://www.energystar.gov)



### FERRO COOL Color Guide

Cool Colors For Energy Saving Commercial Applications

FERRO logo and contact information.



**Measuring Light: 4 Terms**

1. Luminous Flux (lumens)
2. Luminous Intensity (candelas)
3. Illuminance (footcandles)
4. Luminance (candelas/ft<sup>2</sup> or candelas/m<sup>2</sup>)

### 1. Luminous Flux: Ø Lumens

This is the total energy produced by a light source  
**it is not direction dependent**

- The energy produced by 1 candle is:  $1 \text{ candle} \times 4\pi = 12.57 \text{ lumens}$
- An average 100 Watt light bulb produces 1750 lumens

### Efficacy of Various Light Sources

*Lumens per watt (energy or heat)*

Light Source	Efficacy (lumens/watt)
Sun (altitude = 7.5°)	90
Sun (altitude > 25°)	117
Sky (clear)	150
<b>Sky (average)</b>	<b>125</b>
Global (average)	115
Incandescent	16 - 40
Fluorescent (40 W, CWX)	50 - 80
High Pressure Sodium	40 - 140

### 2. Luminous Intensity: I Candela or cd

Luminous Intensity is the directional quantity of light:

- The energy from 1 candle "flowing" through one "solid angle" = 1 candela
- A solid angle is called a "steradian". There are  $4\pi$  steradians (12.57) in a sphere
- Luminous Intensity is **not distance dependent**

### 3. Illuminance: E Footcandles or fc

This is the concentration or "flux density" of luminous energy impacting a surface.

- $1 \text{ candle @ } 1 \text{ foot} = 1 \text{ footcandle}$
- **Illuminance is distance dependent**

### Inverse Square Law

*Illuminance as a function of distance*

$$E = I / d^2$$

**E = Illuminance (footcandle or fc)**  
**I = Luminous Intensity (candela or cd)**  
**d = distance**

### 4. Luminance: L candela/ft² or candela/m²

Similar to Illuminance, this is the energy reflected or transmitted by a surface, and described by the relationship:

**L = E x r (reflectance)**  
**and/or**  
**L = E x t (transmittance)**

Where **r** and **t** are values between 0 and 1