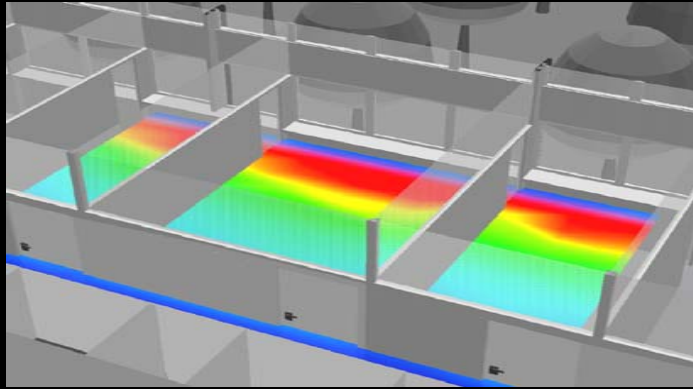
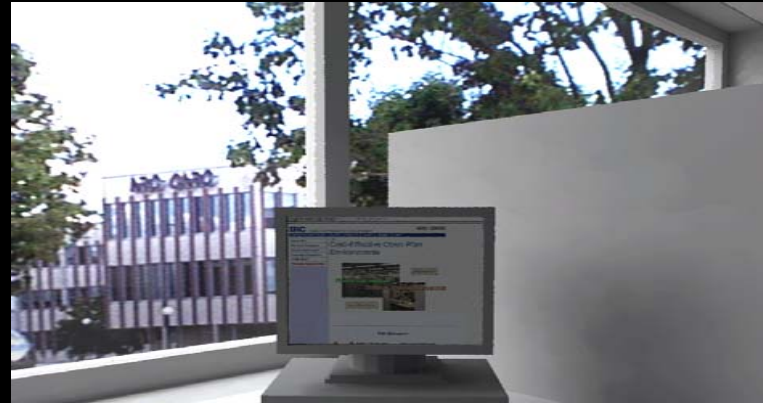


Natural Light in Design

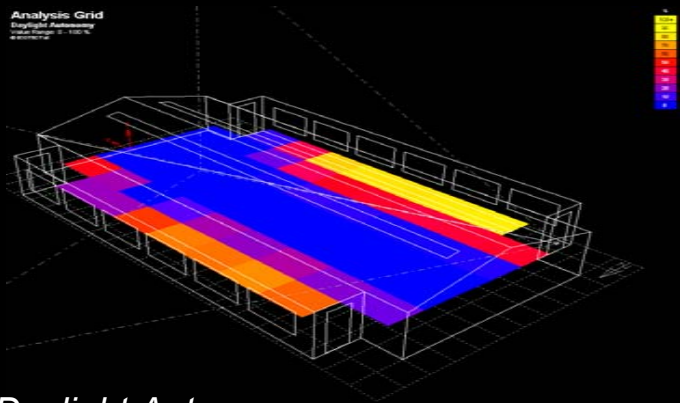
Using simulation tools to explore realistic daylight-responsive solutions



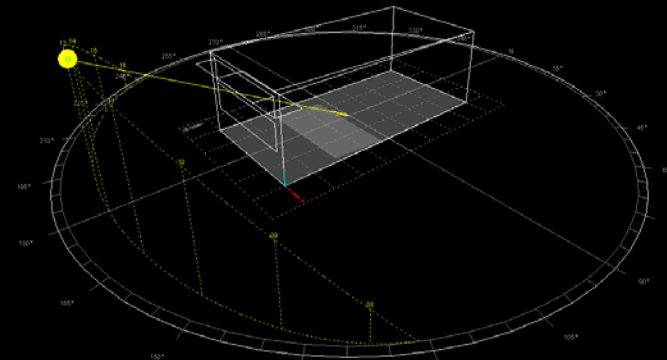
Daylight Factor



Visual Comfort



Daylight Autonomy



Avoidance of Direct Sunlight

Radiance Materials

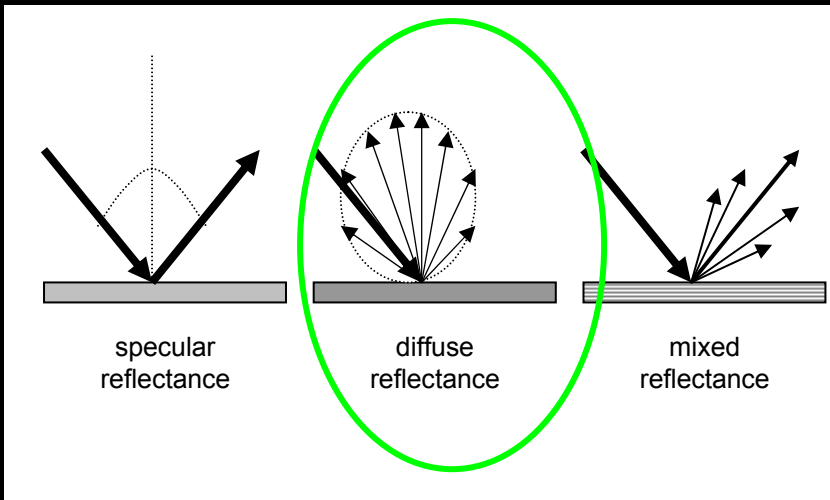
Christoph Reinhart, Ph.D.

Overview – Radiance Materials

Wednesday, Jan 25th 2006

time slot	Content	instructor
Tue 9.30	MISC: announcements, design project teams organization	MA
Tue 10.00	<ul style="list-style-type: none">▪ Hands-on exercises: Review yesterday's content (CR) Boyle Buildings and Technologies (inc. advanced materials) (MA)	MA, CR, all
	<ul style="list-style-type: none">- Introduction to advanced Radiance materials, Ecotect's RADTOOL (CR)	
Tue 11.00	coffee break	
Tue 11.15	<ul style="list-style-type: none">▪ Hands-on exercises: Import Geometries and Materials from other programs (SketchUp, AutoCAD)	CR, all
Tue 12.15	- Specialty topics (to be suggested by participants before the workshop)	MA, CR, all
Tue 13.00	lunch (on your own & design teams should discuss their projects)	
Tue 14.00	<ul style="list-style-type: none">▪ Hands-on exercises: Participants start working on their own models (Participants will have the opportunity to discuss their project ideas with the instructors.)	all
Tue 15.45	coffee break	
Tue 16.00	<ul style="list-style-type: none">▪ Continue previous activities	all
Tue 17.30	end second day	

Plastic Material I



For a perfectly diffuse surface (Lambert surface) holds:

$$L = \frac{E\rho}{\pi}$$

E.g. paper, drywall

Plastic Material II

```
void plastic PlasterCeiling
0
0
5 0.965 0.965 0.965 0.02 0
```

The screenshot shows the ECOTECT software interface with the 'Properties' panel for a 'PlasterCeiling' element. The 'Building Element' is set to 'CEILING'. The 'Values given per:' dropdown is set to 'Unit Area (m²)'. The 'Solar Absorption (0-1)' property is highlighted with a blue selection bar and has a value of 0.44. Other properties include U-Value (5.16), Admittance (4.96), Transparency (0), Thermal Decrement (1), Thermal Lag (0.3), Thickness (12 mm), and Weight (5 kg). The 'Set Reflectance' table shows internal and external reflectance values for Colour, Emissivity, Specularity, and Roughness.

Set Reflectance	Internal	External
Colour:		
Emissivity:	0.9	0.9
Specularity:	0.1	0.1
Roughness:	0	0

The screenshot shows the 'Color' dialog box in ECOTECT. It features a grid of 'Basic colors' and a 'ColorSolid' color wheel. The 'Custom colors' section is empty. The 'ColorSolid' section shows the following values: Hue: 160, Sat: 0, Lum: 232, Red: 246, Green: 246, Blue: 246. The 'Add to Custom Colors' button is visible at the bottom.

Only internal properties used for Radiance.

Red/Green/Blue: (246/255)=0.965

Specularity_{Radiance} = 0.2 * Specularity_{Ecotect}

Plastic Material III

Typical reflectance values:

- floors 30%
- wall 50%
- ceiling 60 - 80%

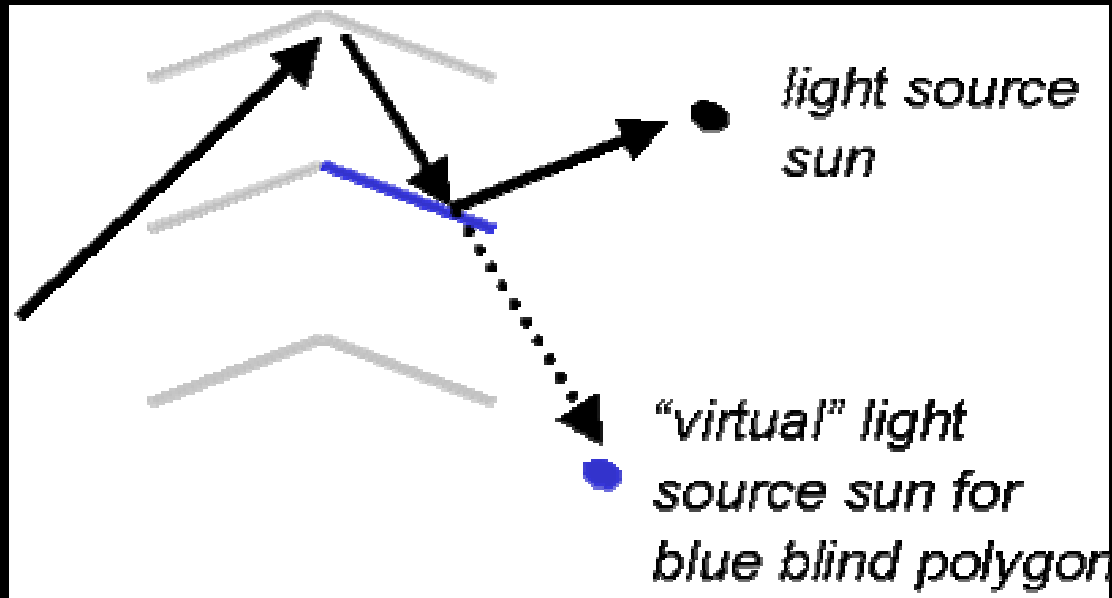
Typical specular values:

- matt 0
- glossy 0.02

Simple measurement to estimate reflectance values:

- Luminance meter + reference sample + overcast sky

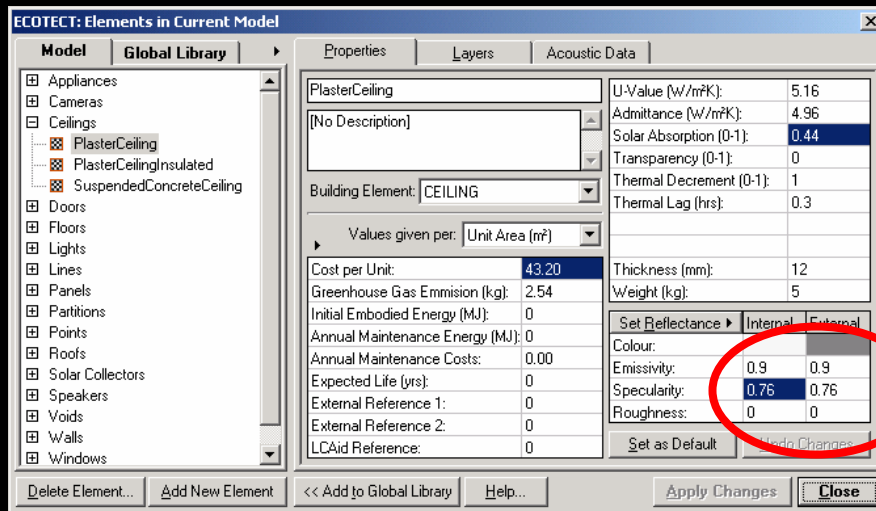
Mirror Material I



Virtual light sources

Mirror Material II

```
void mirror PlasterCeiling
0
0
3 0.965 0.965 0.965
```



If Specularity_{Ecotect} > 0.75 => mirror material

Red/Green/Blue: (246/255)=0.965

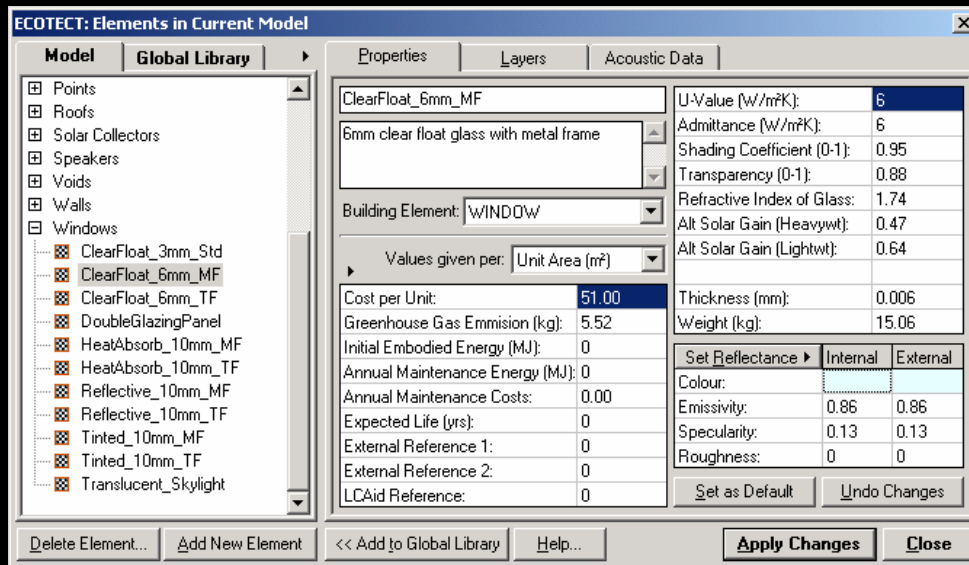
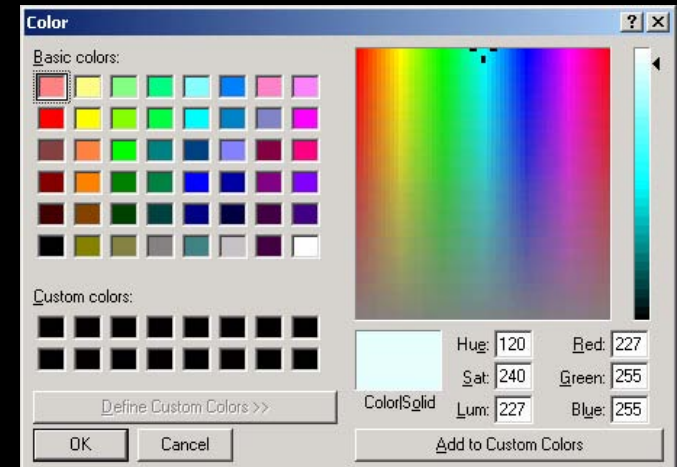
Material Glass

```
void glass ClearFloat_6mm_MF
```

```
0
```

```
0
```

```
3    0.661 0.742 0.742
```



Red: $(227/255)*TN(0.88)$

Material Trans I

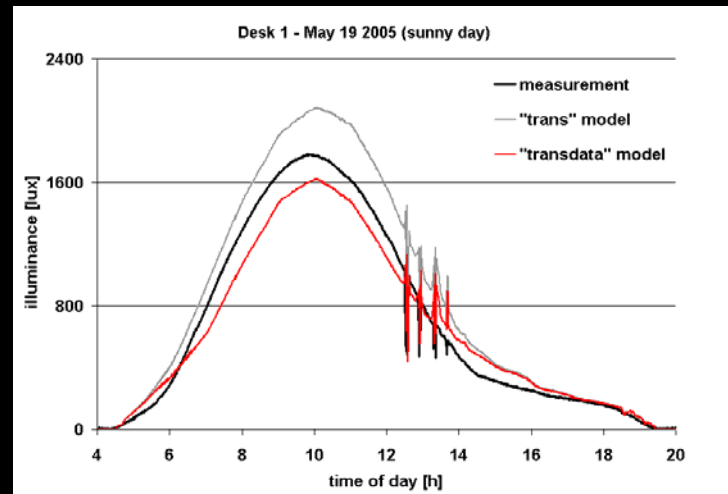
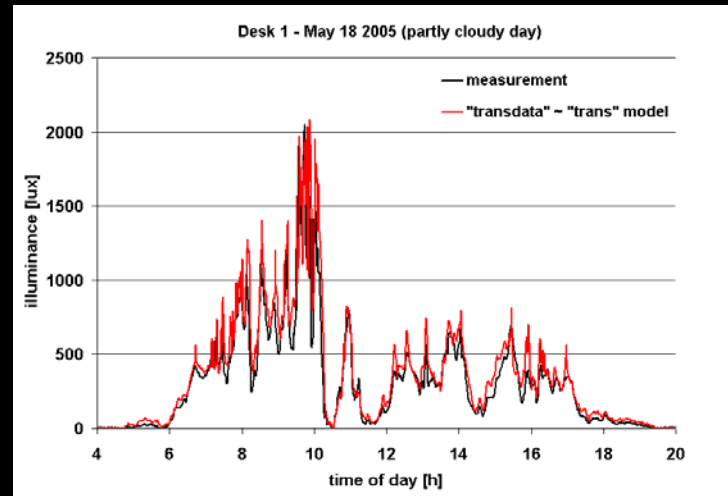
```
void trans PANEL
0
0
7 0.48913 0.48913 0.48913 0.08 0 0.5333 0
# A1      A2      A3      A4      A5 A6      A7
```

>> material database

Material Trans II



Energy & Buildings Reinhart, Andersen 2005 (in review)



Need for a quality controlled material database.