Assignment 3 – Physically Based Rendering

Task 3.1: Assign Material Properties (Individual Assignment)

For this assignment you will conduct a daylight simulation of the classroom as in the previous assignment and compare your results to the measurements that you took in Task 2.3. In order to do so please translate the reflectance and transmittance values from Task 2.2 into Radiance materials and assign them to the appropriate layers in your Rhino model. While preparing your simulations, please refer to the simulation checklist on page #3 and convert your "architectural' Rhino file into a file that is suitable for daylight simulations. Please resubmit your Rhino file and a description of the changes made to the original "architectural model" (use the following naming convention for the files, A31_LastName.PDF or .3DM).

Task 3.2: DIVA Visualization and Illuminance Simulation (Individual Assignment)

Conduct a DIVA/Radiance visualization from the view point of where you took your HDR photograph and calculate the illuminance across a grid of sensors for the sky conditions under which you took your measurements in Task 2.3. The analysis grid of upward facing sensors should be 0.85 m above the floor and have a resolution of 0.5m by 0.5m.

As simulation parameters use: ab 4 ad 1500 ar100 20 aa 0.1 av0 0 0
(These parameters will be further explained in future lectures.)

Use the following radiation levels for the Perez sky model for the time when you took your measurements. Compare your results and comment on your findings.

Solar Date and Time			Direct Horizontal Radiation [Wm^{-2}]	Diffuse Radiation [Wm^{-2}]
2	21	8.5	3	79
2	21	8.583	3	85
2	21	8.666	20	119
2	21	8.75	222	88
2	21	8.833	196	104
2	21	8.917	200	109
2	21	9	333	60
2	21	9.083	207	120
2	21	9.167	238	114
2	21	9.25	219	128
2	21	9.333	102	166
2	21	9.417	195	148
2	21	9.5	336	97
2	21	9.583	424	61
2	21	9.666	421	69
2	21	9.75	409	80
2	21	9.833	350	114
2	21	9.917	387	168
2	21	10	443	81
2	21	10.083	296	154
2	21	10.167	183	198
2	21	10.25	273	172
2	21	10.333	308	163

2	21	10.417	506	73
2	21	10.5	504	78

Please resubmit your simulated Rhino file and a comparison of measured and simulated illuminance following the format of table 3.1. You can also use the **Excel Table 3.1 Posted on** the course site. (Please name your files using the following name: A32_LastName.3DM.)

Table 3.1 Comparison of Measured and Simulated Illuminance

Sensor Number	Measured Illuminance [lux]	Simulated Illuminance [lux]	Relative Error $[(E_m-E_s)/E_m]$
1	xxx	xxx	x
2	xxx	xxx	x
3	xxx	xxx	x
.....	...	..	..
12	xxx	xxx	x

* Sensor number one should be the sensor closest to the windows.

Table: Daylight Simulation Checklist.

Before you start	Did you decide which daylighting performance metrics to simulate and how to interpret the results?
	Do you have a general idea of what the results should look like? E.g. a mean daylight factor in a standard sidelit space should lie between 2% and 5%; interior illuminance should lie between 100 lux and 3000 lux and daylight autonomies should range from 60% to 90% throughout the space.
	Have you verified that the simulation program that you intend to use has been validated for the purpose that you intend to use it for, i.e. that the simulation engine produces reliable results *and* that the program supports the sky models related to your performance metric of choice? (An example would be the old CIE overcast sky for daylight factor calculations.)
	Have you secured credible climate data for your building site? (This is only required for climate-based daylighting performance metrics.)
Preparing the scene	Did you model all significant neighboring obstructions such as adjacent buildings and trees?
	Did you model the ground plane?
	Did you model wall thicknesses, interior partitions, hanging ceilings and larger pieces of furniture? Try to model all space dimensions at least within a 5cm tolerance. Façade details should be modeled with a 2cm tolerance.
	Did you consider window frames and mullions by either modeling them geometrically or by using reduced visual transmittances for windows and skylights?
	Window glazings: - Did you check that all window glazings only consist of one surface? Several CAD tools model double/triple glazings as two/three closely spaced parallel surfaces whereas daylight simulation programs tend to assign the optical properties of multiple glazings to a single surface. - Did you check that all windows are 'inserted' into the wall planes and not "overlaid" on the wall surfaces? Several CAD tools suggest that you can create and visualize a window in many different ways, one simply being the placement of a window surface on top of a wall surface which case end up with two coplanar surfaces. As a result the simulation program will either ignore the window or somehow 'guess' which surface to consider.
	Did you assign meaningful material properties to all scene components?
	Did you model any movable shading devices such as venetian blinds? If yes, do the results make sense?
Setting up the simulation	Make sure that you set up your project files correctly. This may involve: - Checking that your project directory and file names do not contain any blanks (" "). - Verifying that all sensors have the correct orientation, i.e. work plane sensors are facing up and ceiling sensors are facing down. - Setting the resolution of the work plane to 0.5m x 0.5m or 1ft x 1ft and placing it around 0.85m above the floor. - Selecting simulation parameters that correspond to the 'scene complexity'. To do so you should consult the technical manual of your simulation program. - Selecting the correct sky model (CIE, Perez, etc.).

*) For a scene of low complexity (typical sidelit space with a standard window) the Radiance simulation parameters should be: ab= 4; ad =1500; ar=100, as=20; aa = 0.1; av=0 0 0.

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