4.401/4.464 Environmental Technologies in Buildings – Assignment 6

Instructor:	Christoph Reinhart
Due Date:	Friday of week 8
Type:	This is a group assignment.

Visual Comfort and Electric Lighting Study

The goal of this assignment is check your final daylighting design from Assignment 5 for potential areas of glare and remedy them as well as to design an electric lighting concept for your design. As a target level, the electric lighting should provide around 300lux on all key working surfaces and around 150lux in all circulation areas.

Task 1: Visual Comfort

Use the Annual Solar Exposure Metric to get a sense of where lighting levels in your building might exceed visual comfort levels. Decide whether the daylight in these areas needs to be critically controlled or not. For example, daylighting levels in the cafeteria or other common spaces can potentially be up to 2000lux without disturbing occupants. You may also argue that your furniture layout allows occupants to freely adapt their view positions. For at least one critical position in your building conduct a few daylight glare probability simulations – e.g. during equinox and winter solstice at 9am, noon and 3pm – to get an sense of the severity/occurrence of glare. Change your window layout and/or add a shading device if necessary and repeat your daylight availability analysis from Assignment 5 to ensure that daylighting levels in your updated space are still adequate.

Task 2: Lighting Concept

Pick a series of luminaires from a lighting manufacturer catalogue, download the IES files and place the luminaires throughout your building. Detailed instructions of how to do this are provided in DIVA/RhinoTutorial #5. You can also model electric lighting using DIVA GH. This will be demonstrated during Friday lab in week 7. For each luminaire provide the listed power, a perspective view from the lighting catalogue and a screenshot of the luminous intensity distribution. (You can download a simple IES file viewer for this.) An example is provided in Fig 1.

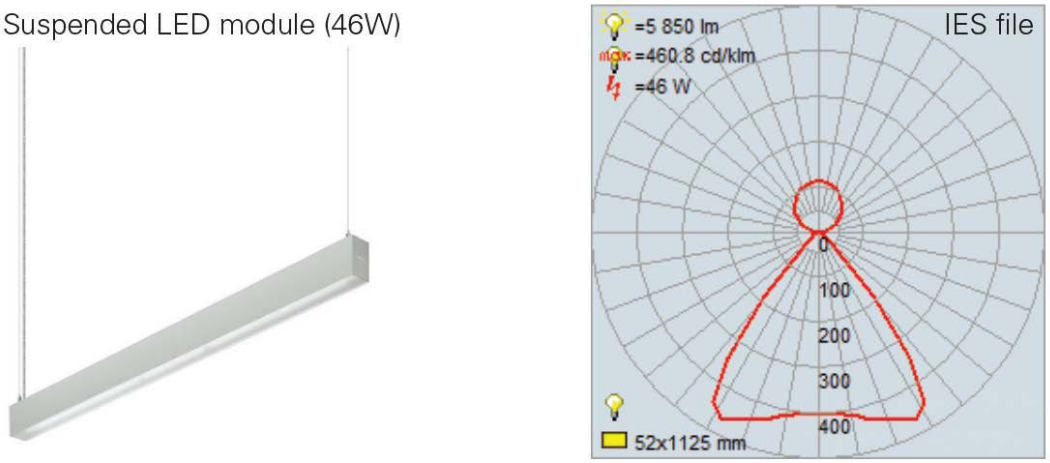

Fig 1: Perspective view of the luminaire plus luminous intensity distribution

Place the luminaires throughout the building and render a few perspective views of key positions in your building. As shown in DIVA GH Tutorial 03, you can create a series of views and animate through them. Readjust the lighting design until you are content with the result. An example rendering for the MIT reference office is shown below.

Fig 2: Perspective view of the MIT reference office at MIT equipped with six direct/indirect suspended LED modules

Once all luminaires have been placed, calculate the illuminance distributions

throughout your building at nighttime. Show the illuminance contour plot (Fig. 3) and ensure that your target illuminance levels are met throughout the building. Calculate the overall lighting power density for the buildings, i.e. the sum of all luminaire powers divided by the overall floor area.

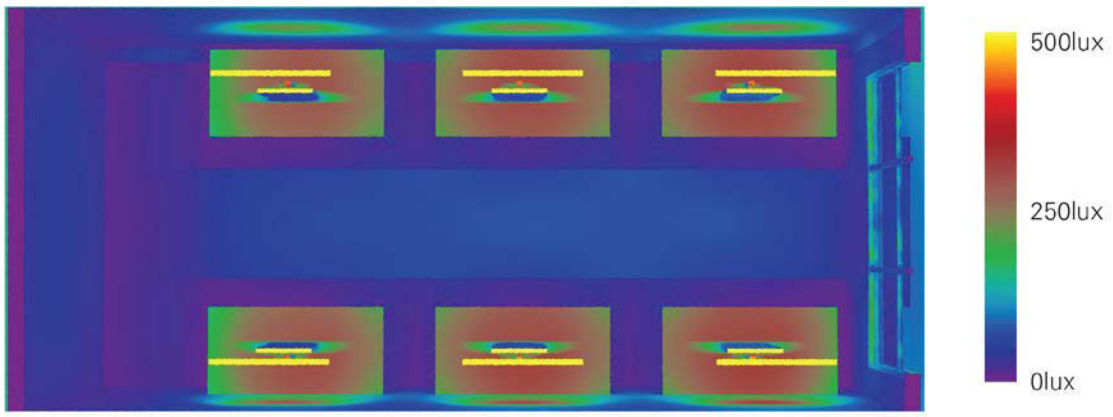

Fig 3: Perspective view of the luminaire plus luminous intensity distribution

Tip: For the electric lighting simulations make sure that your model units are in meter to match the IES-file dimensions.

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