Case Study #1 – "A Daylighted Room"

For this mini–Case Study assignment you will investigate daylighting in a major room in a building. The room that you choose may be local (for hands-on study) or remote (for computer or physical modeling). Make sure you choose a building that is either easily accessible or is well-documented.

Your Case Study will consist of six parts:

(1)	Introduction – include the names of your group	[0 PTS]
(2)	Building description	[2 PTS]
(3)	Performance analysis – questions A & B below	[6 PTS]
(4)	Building redesign – question C below	[3 PTS]
(5)	Redesign performance analysis – revisit questions A & B below	[6 PTS]
(6)	Conclusion	[3 PTS]
(7)	Extra Credit	[3 PTS]

Investigation questions:

A. Is the space adequately daylighted?
   a. Are the illumination levels uniform?
   b. Does the average footcandle in the space meet the required level for tasks being conducted in this space? (Reading, Computer Work, Workshop, Classroom, etc..)
B. Does the daylighting in the space have the potential to save energy?
   a. Is there enough daylight available in the space to reduce the electric lighting levels for daylight harvesting?
   b. If yes, where would you place photocontrols for daylight harvesting?
C. How can the daylighting scheme be improved?
   a. If it can't be improved, explain why.

   Use appropriate methods to investigate each of these questions.

You will present your Case Study in lab on February 8 as a digital slide show, limited to 20 slides and 15 minutes. Points [2 PTS] are deducted for exceeding these limits.

Suggested methods (use those appropriate to your Case Study):

Question A – Adequate Daylighting: [describe how the light is distributed in the space]. Guidelines for adequate daylight factors are given in The Green Studio Handbook Table 4.4, page 84.

1. If you can visit your Case Study building, use illuminance meters (Light Meter) to perform a lighting sweep of the space. Calculate daylight factors for each measurement.
2. Or...Use Revit Insight, Rhino Honeybee, or SketchUp w/ Radiance. Any of these methods will give you data to interpret or analyze light distribution in space.

Question B – Energy Savings: Use IECC 2018 section C405 for building code lighting budgets for various building types.

1. If you can visit your Case Study building, inventory the electric light fixtures and controls schemes in the space. If you can't, then estimate the number of fixtures. Calculate how much energy is being consumed by lighting.
    a. Count the number of fixtures in the space.
    b. Determine the total wattage of each fixture.
    c. Number of fixtures X Total Wattage of fixture = Lighting Watts.
        i. Divide by 1,000 to get kW (Kilo-Watts).
    d. To determine Lighting Power Density (LPD).
        i. Lighting kW/Area = LPD.
    e. Determine your building or space's operating hours.
        i. When is the building open and closed (business hours)?
        ii. 8am to 5pm (9 hours) X Working days 260 = 2,340 hours/year.
    f. Determine your building or space's lighting kWh.
        i. Lighting kW X Operating Hours = Lighting kWh.
    g. Determine the cost of operating the lighting system in your building or space.
        i. Lighting kWh X Average Utility Cost Per kWh = Cost
        ii. 1,228.5 kWh X $0.08 = $98.28
2. Calculate how much energy can be saved by turning the lamps off when daylight is adequate.
    a. Determine the estimated number of hours adequate daylight is available during each season from InsideOut exercise B2.
    b. OR determine the estimated number of hours adequate daylight is available from your sDA simulation.
        i. An sDA simulation uses 3,650 hours per simulation. So, if you have an sDA 300/50 43% THEN you have 1,825 hours of adequate daylight.
            1. [3,650 hours X 0.5 = 1,825 hours]
            2. HOWEVER, only 43% of the building or space meets this requirement, THEREFORE, we can't reduce the lighting load unilaterally.
        ii. Separate your lighting Wattage into two categories, non-daylight harvesting and daylight harvesting.
        iii. Calculate the kWh for each category using the appropriate operating hours then add them together to determine your new total kWh.

   c. Determine the estimated energy savings from Daylight Harvesting.
      i. Non-Daylight Harvesting kWh + Daylight Harvesting kWh = Total kWh.
      ii. Base Total kWh – New Total kWh = Energy Savings.
3. You should have three total calculations for your building or space's lighting kWh.
   a. Base Case – use no daylighting.
   b. Case 1 – Daylighting as designed.
   c. Case 2 – Daylighting redesign (for question C below).

<u>Question C</u> – Daylighting Redesign: [redesign for better daylighting and more energy savings]. InsideOut exercises A2 through F2 and Appendix F are available as references.

1. Perform the climate and site analysis in InsideOut exercise B2 OR use Sun, Wind, & Light Architectural Design strategies.
2. Perform the program analysis in InsideOut exercise C2 and use the rules-of-thumb in InsideOut exercise D2.4 & D2.5 to establish the parameters for your daylighting design.
3. Use methods from questions A & B to show how well your design performs.

<u>Extra Credit Question</u>

Recalculate question B considering a different type of lighting either Fluorescent or LED. If your space or building's lighting system uses fluorescent lighting, then perform the calculations if they were LED fixtures. Vice versa if your building's lighting system uses LED.

1. What are the key differences between the kWh of each system?
2. Assume a 20% reduction in kWh for daylight harvesting.
3. Which system would you consider for energy efficiency and why.