Architectural Engineer for a Day

Introduction

An Architectural engineer designs key aspects such as sustainability, energy efficiency and structural integrity of the building systems and built environment with mathematical and scientific skills. Are you interested in knowing more about scientific principles in building design and sustainable living? Or consider a career in an industry which thrives to increase sustainability, safety, and comfort by designing structures to meet the changing needs of society? Then, be an Architectural Engineer for a Day to get insights into the associated engineering challenges and solutions.

Background

The design and positioning of windows and glazing, together with the orientation of the building and even the geographical location will all affect the amount of natural light and solar gain (heat gain) entering a building. In this activity, you will design a simple house to optimise the lux level (light intensity) by varying window-wall ratio using different orientations and dimensions of the windows.

This task aims to design and visually illustrate the impact of glazing dimensions, positioning, and orientation on a small dwelling. Before you get started, here are some interesting facts that should support your design approach:

- East/West-facing windows tend to be the brightest in the morning/evening, respectively, and the light will be more of a warm golden tone.
- In the northern hemisphere, south-facing windows get a lot of direct sunlight and tend to be the brightest during the day. This can sometimes raise the temperature of your building since the solar irradiance is the hottest of the day.
- In the northern hemisphere, north-facing windows tend to not have much direct sunlight at all, and therefore will be a darker but even-lit room. North facing windows are perfect for people that do not like too much direct sunlight.
- The converse is true for locations in the southern hemisphere, as the sun tracks in the northern sky.
- South/North-facing windows will have more of a cooler-toned light.
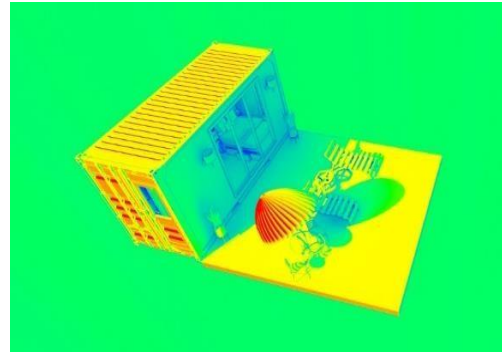
Note: Figures for illustrative purpose only

The Task

The task is consisting of two activities. Activity 1 helps you to design a house or dwelling using SketchUp and optimise the design to achieve the targeted lux level withing the structure. Activity 2 is to measure the lux in your environment using mobile devices and analyse if the conditions are optimum. Supporting video on how to progress with SketchUp can be accessed here.

Activity – 1: Design a simple house.

The objective of this activity is to design a simple house with windows on SketchUp to achieve optimal lux levels of 500 lux. You can optimise your design by playing around with various window orientations and dimensions. All shapes and sizes of windows are welcome as this will give you more insights into how various window-wall ratio affects the lighting and solar gain.
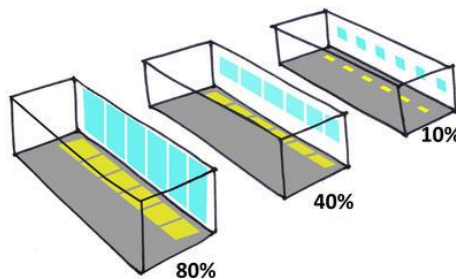

Figure 1: Window-wall ratio illustration

1. Click here to access SketchUp.
2. Start with a Rectangle, and push/pull it up to from a box, then create a roof by drawing a line on the roof between midpoints. Use the move tool on this line, pull it up (in the blue direction) to make a pitched roof as shown in figure 2.
3. Add a rectangle on the "gable end," to make a door. Modify it to the shape you want.
4. To remove the door face, right-click on it and choose Erase; you can now see into the house.
5. Like the door, now its time to design some windows for your house. Of course, windows do not have to be rectangles! Use line and make some strange shape for a window. Be sure that you see "On Face" while making lines, or the lines might end up sticking out of the house (refer figure 3).
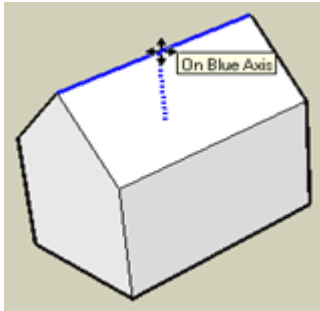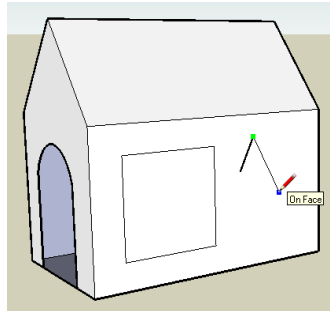
Figure 2: Pitched roof example

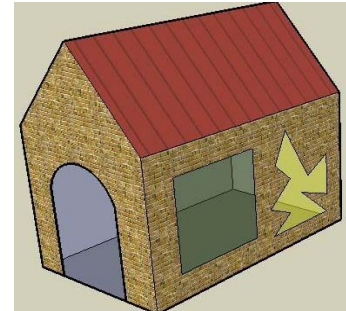*Figure 3: 'On Face' pop up description*

Figure 4: Simple house design example

6. Now colour your house, starting with the roof. Click the Paint Bucket tool to open the Materials window (Colours on the Mac). Open the "Roofing" folder and click one of the swatches.

7. For the windows, you can use colours in the "Glass and Mirrors" folder.

8. In SketchUp, the True North is located along the green axis. An effortless way to remember it is to go in 'Plan View' and see that the green axis is pointing up towards the True North.

For detailed instruction and demonstration on the above activity, click here.

Enscape software will be used to model your design and predict the amount of sunlight entering the dwelling. Click here to see how it works and use the insights it provides to improve your initial design.

When you are happy with your design, save your model in the 2018 version of SketchUp and upload to the Padlet.

Activity – 2 Measure lighting in your environment

In labs, dedicated equipment called Lux meters are used to measure light intensity. At home, you can do the same using your mobile phone. Install a suitable Lux Meter app, and measure light intensity at different environments. Figure 5 shows optimum lux recommended for respective environment. Try this and report back on your findings by posting to the Padlet.
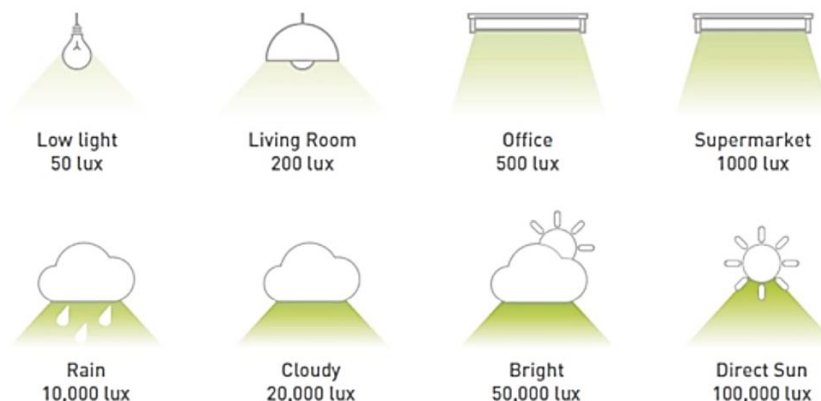

Figure 5: Different environments and optimum lux level

Record your participation

- After completing the task and posting your work to the Padlet, ensure that you complete this form to record your participation to acquire your Certificate of Participation.

Post a photo or comment on social media or use the QR code to access our Padlet:
https://padlet.com/t_s_o_donovan/EngineerForADay

Connect with **Engineer for a Day** at Heriot-Watt University

EfaD@hw.ac.uk   @HWU_Engineer   @HWU_Engineer   Engineer for a Day