BSESC—Lighting, Appliances, and Miscellaneous Loads

# Proficiency Level 3. Apply

## Learning Objective 3.1

Calculate the lighting power density for a simple home.

### Lecture Notes

The energy efficiency community has used **Lighting Power Density (LPD)** as one method to quantify the energy efficiency for lighting in a specific space. LPD is a good method for capturing the energy efficiency because it allows all types of lighting to be evaluated across a specific space. To calculate the LPD, you need to determine the size of the room (area) and the total energy in lighting.

$$LPD= \frac{\sum\_{}^{}lighting energy}{Area}$$

For example, consider a room that has an area of 10 m2. If you have eight lights, each rated at 10 W, you need to add up all the lights to get the total energy in watts. Since each of the eight lights has the same energy rating, in this case you can multiply. The LPD would be 8 W/m2 for this space.

$$LPD= \frac{\sum\_{}^{}lighting energy}{Area}= \frac{8∙10W}{10 m^{2}}=\frac{8 W}{m^{2}}$$

How will you determine the rated power in watts for each lighting product? Most products have the rated power on the original packaging or in the design specifications. If you are evaluating an existing building, you can check the base of the lighting product for manufacturer information about the lighting. You can measure the power using a wattmeter or appropriate multimeter; just make sure you are trained in the equipment to maintain safety.

Most commercial building energy codes use LPD based on specific space types to encourage energy-efficient lighting choices. Under the current code structure, the builder might choose to install eight lights rated at 10 W each, or 10 lights, rated at 8 W each (options 1 and 2 in Table 1). In this scenario, the builder may increase the number of lights as needed, but only if they are higher energy efficiency. Using this policy structure, it is reasonable that a builder will choose to install compact fluorescent lamps (CFLs) based on cost, even if the light-emitting diode (LED) products are more environmentally friendly.

Table 1. Lighting compliance options for an updated metric for energy efficiency (assumes the space is 10 m2)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Lighting Power Density** | **Installation Choices** | **Total Lighting** |
| Option 1 | 8 W/m2 | 8 lights, 10W each | 80 W/10 m2 |
| Option 2 | 8 W/m2 | 10 lights, 8 W each | 80 W/10 m2 |

For residential buildings, the idea of LPD is still important to consider as you design for energy efficiency. The way LPD is used in energy regulation is summarized in Table 2. Most codes require that the LPD must be lower than a specific threshold in commercial buildings. Often the threshold is determined by the type of room or space, since more lighting would typically be needed for a retail space than a storage room. In residential buildings, the requirements may be based on a percentage of fixtures rather than LPD.

Table 2. Summary of the trade-off structures for many model energy codes and policies

|  |  |  |
| --- | --- | --- |
|  | **Trade-off Base Unit** | **Method** |
| ASHRAE 90.1 (ASHRA, ANSI, and IESNA 2016)  | W/m2 or W/ft2 | Lighting Power Allowance |
| California Title 24 – Commercial (California Energy Comission 2019)  | W/ft2 | Lighting Power Allotment |
| IECC Commercial Lighting (International Code Council 2018a)  | W/m2 or W/ft2 | Lighting Power Allowance |
| IECC Residential (International Code Council 2018a) | % of Fixtures | Number of fixtures, 90% must be high efficiency |
| IgCC (International Code Council 2018b)  | W/m2 | Lighting Power Allowance |
| EU Manual of Standard Building Specifications (European Commission 2011)  | 8 W/m2 | Exception for special purpose rooms |

### References

ASHRAE, ANSI, & IESNA. 2016. *Standard 90.1*. <https://www.ashrae.org/technical-resources/bookstore/standard-90-1>

California Energy Commission. 2019. *Building Energy Efficiency Standards for Residential and Nonresidential Buildings*. Pub. L. No. Title 24. <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency>

European Commission. 2011. *Manual of standard building specifications*. <https://ec.europa.eu/oib/pdf/mit-standard-building-specs_en.pdf>

International Code Council. 2018a. *International Energy Conservation Code (IECC)*. <https://codes.iccsafe.org/content/iecc2018>

International Code Council. 2018b. *International Green Construction Code (IgCC)*. <https://www.iccsafe.org/products-and-services/i-codes/2018-i-codes/igcc/>

## Learning Objective 3.2

Estimate the plug loads for a simple home.

### Lecture Notes

Estimating the plug loads and appliance loads for a residential building can be helpful to improve energy efficiency.

1. Start by making a list of the types of small and large appliances that most home occupants would plug in. Consider thinking about each room or space separately.
2. For each plug load or appliance, estimate the typical power rating. You can use the labels on the back of most consumer appliances, or you can look up typical items on the internet. You may also be able to measure the plug loads physically using a plug meter.
3. Add up the total plug load estimate for the building.
4. Consider each item on your final list and determine if energy efficiency could be improved by specifying EnergySTAR® products or management with smart controls.

You may use a worksheet like the one below to keep track of your plug load calculations. In this example, we consider two common plug loads, a reading lamp and a coffee maker. While the coffee maker has a much higher power rating, the appliance is only used for a few minutes each day, but the lamps is operated every day for several hours.

Table 3. Example plug load calculations

|  |  |  |  |
| --- | --- | --- | --- |
| **Plug Load** | **Room** | **Rated Power [W]** | **Typical Operation [hours per day]** |
| Reading lamp | Living Room | 60 W | 5 |
| Coffee maker | Kitchen | 800 W | 0.3 |
| … |  |  |  |
| … |  |  |  |
| Total |  |  |  |

You can use this approach to understand how and where you may want to save energy. In this example, if your coffee maker has a small parasitic load, you could install a smart plug to shut the coffee maker off at 11 am automatically each day. In the same example, you could install a more efficient lighting product in the reading lamp, such as an LED.