ARE 361: Fundamentals for Lighting Design
HW #7: Light Sources
Assigned: Period 8.2
Due: Period 9.2

ASSIGNMENT SUMMARY
This exercise is intended to reinforce your understanding of light source characteristics.

LEARNING OBJECTIVES
• Be able to recall the primary performance characteristics of the major families of light sources (e.g., filament, fluorescent, metal halide, high pressure sodium, LED).
• Identify examples from your local built environment where these sources are in use.

READING
Review Chapter 8 Light Sources and Lamps, from Designing with Light by Jason Livingston.
Review Chapter 13 Light Sources: Application Considerations, from the IES Lighting Handbook 10th Edition. Review the handouts posted to Canvas and your lecture notes.

QUESTIONS
1. Nearly all designed environment use lighting, which means that we are nearly always in the presence of engineered products that covert electricity to light. You are asked to be conscious of that reality by observing the light sources that are employed to illuminate the environments where you spend your time. You are asked to take six photographs; use of a cell phone camera is fine. The photographs should illustrate examples of the built environment illuminated by these light sources:
   a. Daylight
   b. Filament (this might be difficult to find)
   c. Fluorescent (could be linear, screw based, or pin-based)
   d. Metal halide
   e. High pressure sodium
   f. LED
   Possibly, you will need to take a walk around campus or around the area where you live with the explicit goal of seeking environments that employ these light sources. Present the six images on one 8 ½ × 11 sheet of paper, organized in a 2 × 3 matrix. You may use either portrait or landscape orientation. Consider the layout and presentation of the images, presenting them as you would in a professional context. Label each photograph.

2. Sketch a SPD for a white-light LED that generates light using a blue-pump + phosphor. Label the axes with quantities and units. Note that this type of LED is also called a phosphor converted LED (PC-LED).

3. Briefly, why are LEDs replacing virtually all other types of electric light sources? (Hint: Refer to the table in the last question and compare the performance of LEDs to other light sources).
4. Identify the following three lamp shapes (Note: Not to scale).

5. Complete the following table. Note that the IES Handbook 10th edition was written 10+ years ago and the performance ranges for LEDs (and OLEDs) are out of date. The performance ranges for other sources are unchanged.

<table>
<thead>
<tr>
<th></th>
<th>Filament</th>
<th>Linear Fluorescent</th>
<th>Metal Halide</th>
<th>High Pressure Sodium</th>
<th>LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminous Efficacy ranges from?</td>
<td>~ 6-25 LPW</td>
<td></td>
<td></td>
<td></td>
<td>About 50 LPW to more than 200 LPW.</td>
</tr>
<tr>
<td>Life in hours ranges from?</td>
<td>Approx. 6,000 - 24,000 hrs (20,000 hrs typical)</td>
<td></td>
<td></td>
<td></td>
<td>From a few thousand hours to more than 100,000 hours.</td>
</tr>
<tr>
<td>Lumen Maintenance ranges from?</td>
<td>~ 65 - 80%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumen output decrease is due to?</td>
<td>Phosphor degradation and cathode sputtering.</td>
<td>Loss of metal halides over time by diffusion through arc tube.</td>
<td>Loss of sodium over time by diffusion through arc tube.</td>
<td>Phosphor degradation and material changes in LED die.</td>
<td></td>
</tr>
<tr>
<td>Starting and warm up takes about how long?</td>
<td>Depends upon ballast type, but less 5 seconds and usually closer to 1 second.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrike takes about how long?</td>
<td>~ 1 minute (typical), instantaneous with instant restrike versions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What type of auxiliary gear is required? | None, or a transformer, depending on the type. |  |  |  
---|---|---|---|---
Is dimming easy, moderately easy, or complicated? | Complicated | Complicated |  |  
Correlated Color Temperature (CCT) ranges from? | 2,700 to 7,500 K |  |  | Essentially unconstrained. At least 1,000 K to 17,000 K 
CIE General Color Rendering Index (CRI) ranges from? | 99+, except for filament sources that use a colored glass bulb. | ~ 21 is typical, but 85 is possible with color improved versions |  |  
What is the sensitivity to ambient temperature? | None | High |  |  
How good or poor is color consistency and color stability? | Excellent | Fair |  |  

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