Lighting Design - Weekly Blog

Week 5

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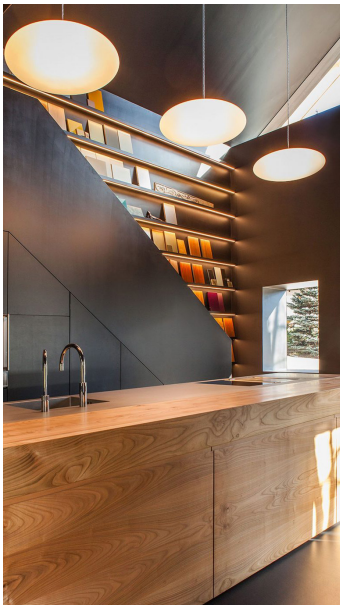
Artificial Lighting

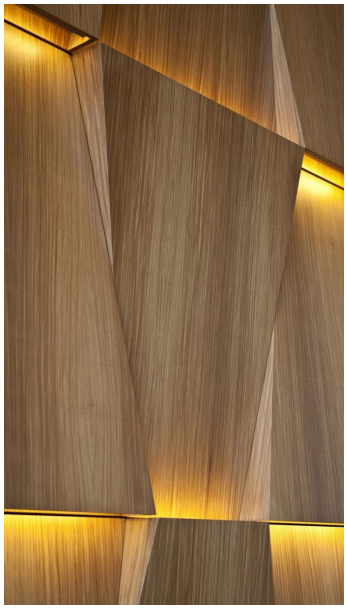
Exploring Luminares

Lighting design in any architectural project can make or break a space; it can serve to bring out uniqueness of the design or its unfavourable side.

Successful projects consider atmospheric intensions and how lighting (both artificial and natural) can produce the desired results early in the design process. It is made more deliberate rather than a technical afterthought. Lighting design has the potential to create different ambiances to shape a space. In addition, it can communicate, and modify messages from the designers to the consumers.

There are several components like aesthetic quality (the sculptural and artistic value), the technical aspect of making a space usable and complying with lighting level standards, and bringing consumer satisfaction, well-being, and enjoyment.





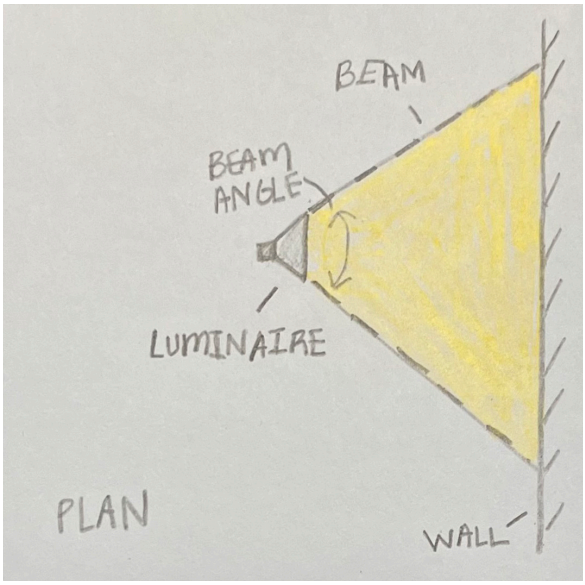
There are several lighting techniques that can be used. Direct lighting points the source directly to a desired space. Indirect lighting does not illuminate the desired surface directly; the source of illumination is pointed at a surface that absorbs and reflects beam. It results in a soft glow and lack of shadows. Diffused lighting is when the luminous flux is interrupted by a diffusing element to soften and change the original source. It distributes light homogeneously for a tranquil effect. Effecting lighting is when the illumination source is embedded in the ceiling, wall, or other element like a column or beam. This is meant to highlight the illumination source itself. Accent lighting is used to bring attention to a specific object or area. Wall washing aims to highlight an architectural aspect. It uses a strip of embedded lights at the top or bottom to result in light “washing” over the whole wall. Light grazing is similar to washing, but its intent is to highlight a unique texture on a vertical surface.

Photo Sources:
Arch20, https://www.arch2o.com/the-power-of-artificial-lighting-in-architecture/
The Decorative Spaces, https://www.thedecorativesurfaces.com/en/artificial-lighting/

Task 1: Review Beam Quality

Beam Angle and Optics

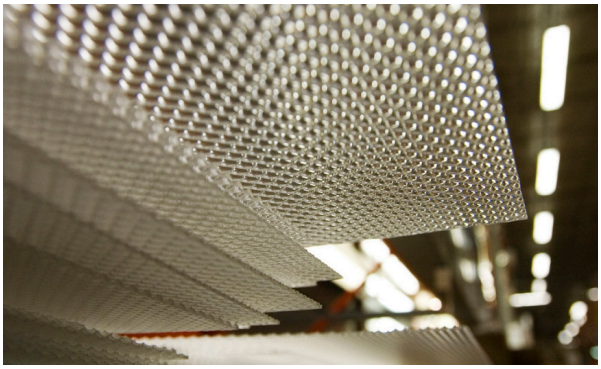
The first task studied beam angles and optics. A beam angle is a measurement of how light is emitted or distributed. A regular bulb will have a beam angle of 360-degrees. Flood lights have a larger beam angle, about 90-degrees, while spotlights generally have a beam angle of 40-60-degrees. The smaller the angle, the more pointed the light will be.



Optics is the study of how light behaves and interacts with matter. This pertains to anything from the fixture itself, to the placement, to how the consumer sees it. One technique in bulbs is a reflector that directs light to a source. Materials like aluminum have very little absorption qualities and are often used in a bulb. Another technique is prismatic diffuser. Light passes through transparent, textured surfaces to distribute the source. There is more of an even distribution.

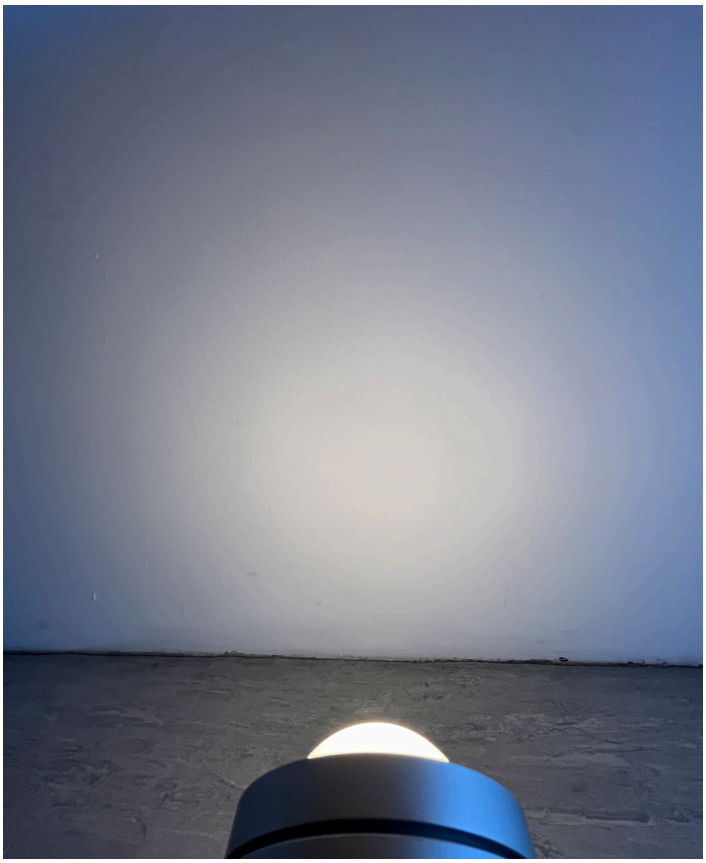
Aluminum Reflector (left)
Photo Source: IndiaMart, SGCW

Prismatic Optics (Right)
Photo Source: All Plastics



Luminare 1 - Soft, Warm, Defused

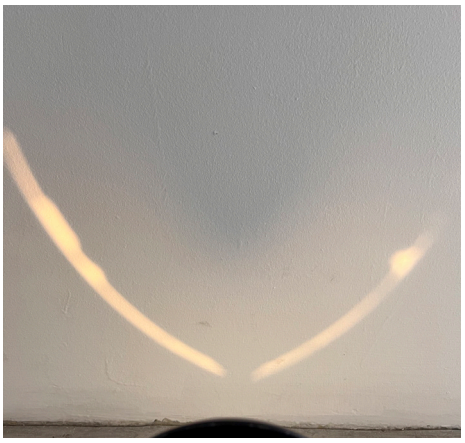
The first luminare is a circular dome with an opaque glaze over the surface of the source. The bulb itself has a warm glow and is quite soft. When it is pointed at the wall, there is a round central spotlight with a soft gradient. It most likely uses an aluminum reflector. See Task 4 for more details.



Because the source is a dome, the light is distributed at a 360-degrees beam angle. When it is directed at the wall, the light is distributed throughout the surface.

This would be an ideal luminare for ceiling lights. Overhead lighting risks causing unattractive shadows on occupants, as well as general glare due to harsh spotlights. Using a luminare like this would mitigate this because the source is distributed to a wider area. Out of all of the luminares tested, this one had the largest beam angle and largest distribution area.

Luminare 2 - Low Levels, Path, Decorative



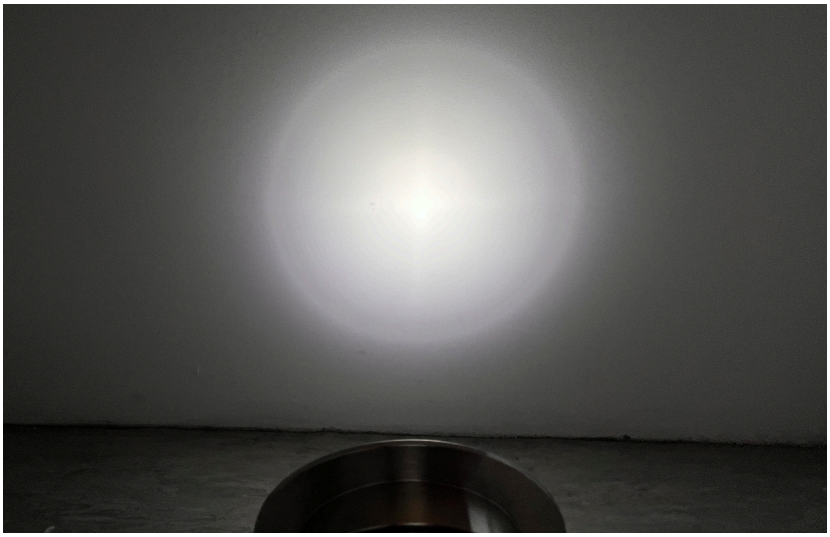
The second luminare is used for low-level lighting for paths or stairs. The image to the left shows a potential application. The source is exposed horizontally through two slots on half of the cylinder-type shape show in the image above (left).

When the beam is held upright, the beam angle is 180-degrees, The light is very dim and soft (middle image). This is because the path lighting is used for exteriors at night use to provide an attractive landscape feature and guide occupants along a paved path. A bright light with a small beam angle would cause glare. In addition the source would not be spread over the path, which could cause people to trip over obstacles the luminares are trying to highlight.

When the top is pointed at the wall, the slots create a unique pattern. The beam of the pattern does not spread. The contrast between the two conditions is surprising to me. I would have thought the source would be more distributed when the top is pointed at the wall.

Fixture 3 - Bright, Harsh, Spotlight

The third luminare is a spotlight. The source is white and very powerful, painful when you look at it for too long. The source angle is very small, about 35-40-degrees. There are three bulbs, but there appears only one beam on the wall. This is most likely because the bulbs are angled in just the way to overlap and form a perfect circle.



The quality is sharp and harsh. Potential applications could be under-counter lighting, flashlights, or a vehicle headlight (scaled larger)

Luminare 4 - Angled, Soft, Natural

The fourth luminare has a diffuser that is reminiscent of a tulip. The bulb uses prismatic optics and has a homogeneous spread of light. The bulb is about 1.5 cm, and the beam is directed along the diffuser, where it is angled in an ellipse shape (i.e., not a perfect circle). The beam angle is about 60-degrees. The source is white, but not as white as the bulbs in the third and fifth luminare that also use a whiter bulb.

There is a central ray on the wall that defuses quite rapidly. The images below show the beam when the luminare is oriented and rotated in two different ways. The luminare could be used for accent lighting and highlighting a object. The photo on the left would be best for up lighting, and the orientation on the right would be best for down lighting scenarios, and the photo on the bottom

Luminare 5 - Track, Adjustable, Bright

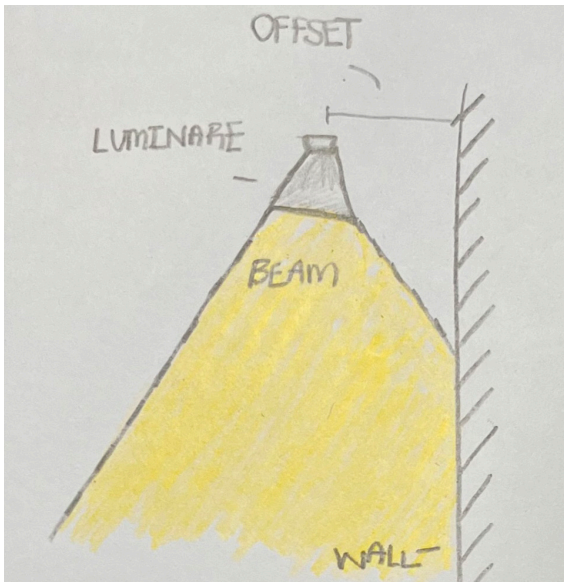
The final luminare studied is a recessed light with a trim that uses an aluminum reflector to shape the beam. The light is white and very bright. Up close, the beam causes much glare. When it is recessed from the ceiling, it is able to spread over a larger distance, and the discomfort is mitigated. The beam angle is about 65-degrees. It could also be used as a track light.

The luminare is adjustable and can be angled. This allows for flexibility and adaptability in a space. This is conducive to recessed ceiling fixtures because they are more tedious to replace compared to other types of lighting. If the program and/or organisation of a space changes, the luminares can be adjusted to areas that need more direct lighting than others.

Task 2: Review Offsets and Scallops

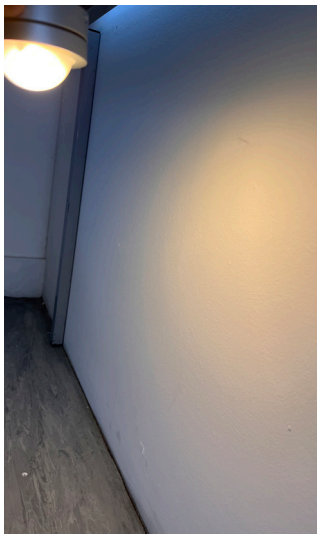
Spread, Shape, and Texture

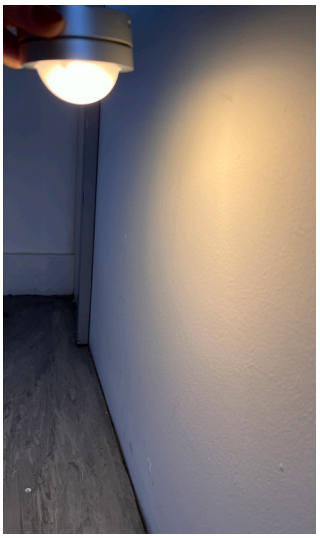
The second task studied fixtures suspended vertically, looking specifically at the offset and scallops. In this exercise, each of the fixtures were observed with a 16cm and 8cm offset.



Scallops are created in downlighting schemes. The row of lights closest to the wall have overlapping beams and form soft “humps” that ascend down the wall. The more defused the light source, the softer the scallops will be. The offset is the distance from the centre of the source to the wall and impacts the size, strength, and shape of the scallop; a smaller offset will cast more light on the wall and create a more defined, concentrated scallop. When made intentionally, scallops can create a dramatic and elegant backdrop. If the aim is to highlight multiple objects with their own spotlight, scalloping can emphasise symmetry and even spacing.

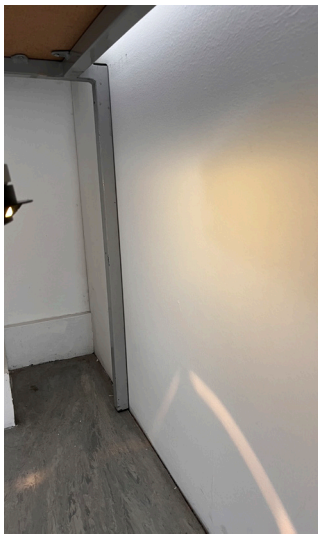
Luminare 1





When hung vertically, the first luminare has a similar soft and warm glow. The light spreads homogeneously on the wall in a wide oval. When the luminare is placed closer to the wall, more of the light is reflected, and the wall itself becomes a source of light.

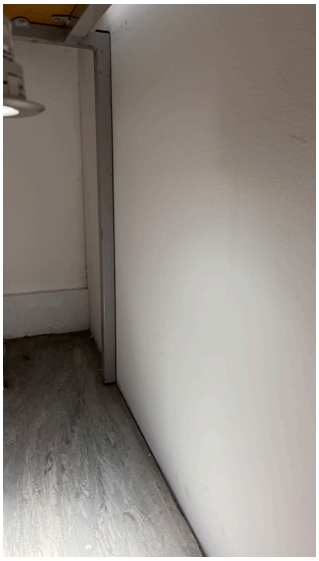
Luminare 2

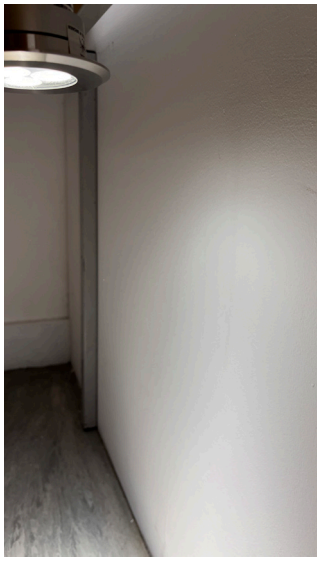


The second luminare behaves in an interesting way when directed at the wall and hung upside down. The until the other luminares studied, this one has a similar orientation as task 1, aside from the fact that is it upside down.

The beam reflected on the wall consists of both the long, defused, soft, and dim area, as well as the unique pattern. It would be interesting to see this luminare in a finalised lighting design scheme to study if and how the designer incorporated the V-shaped pattern into the design intent.

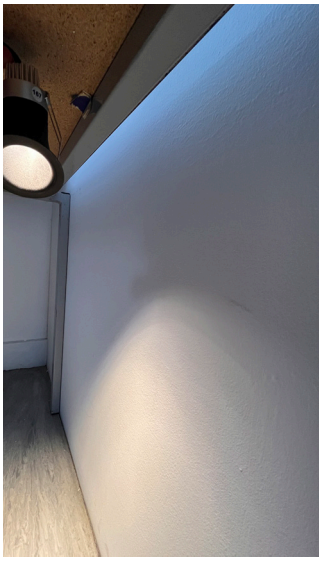
Luminare 3





Because the third luminare has a relatively small beam angle and serves more as a spot light, little of the source reaches the wall. Moreover, much of that light could be what is reflected off the floor. Nevertheless, this luminare results in the brightest space during this task.

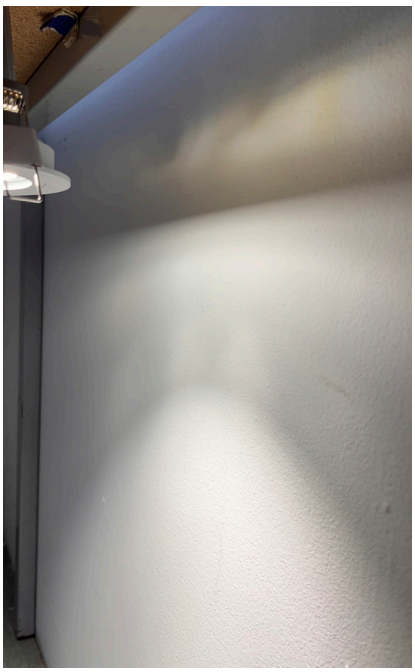
Luminare 4



The behaviour of the fourth luminare is highly dependent on the way the diffuser is rotated. If the side with the opening is oriented towards the wall, it results in a wide ray that spreads along the surface. If it is oriented in the opposite direction, the light is directed away from the wall, and very little reaches it.

The photos above show the luminare facing the camera. The majority of the light is directed at the floor, particularly in the first instance with the larger offset. The scallop it creates is no symmetrical at this orientation, but it is when the beam is facing the wall.

Luminare 5



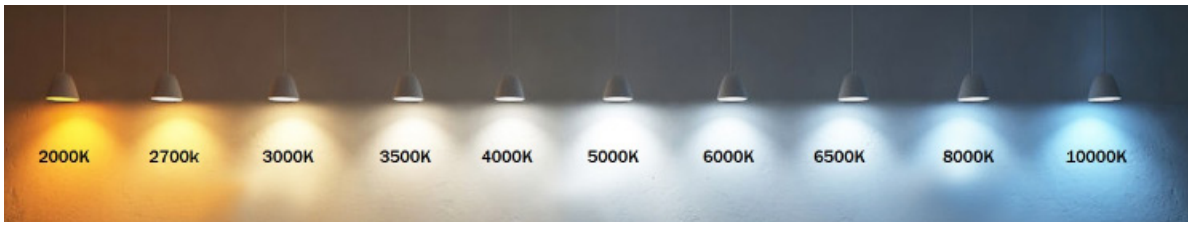
The final luminare has an interesting behaviour when studied in this way. It is designed to be recessed with the top portion hidden from the space. In this scenario, light that shines through the base is also reflected on the wall.

In the pattern displayed on the wall, you can see the beams pointing down from three different paths. There is a clear point where they intersect and form a cohesive, uninterrupted scallop.

Task 3: Compare CCT and CRI

Appearance, Colour, and Vibrancy

The third task studied colour temperature (CCT) and colour rendering index (CRI). The CCT of an LED indicates the colour temperature of the light. Specifically, it describes the temperature at which a black body would need to be heated to glow the same colour. Colder temperatures result in more of a red and orange hue, and warmer temperatures exhibit a whiter, bluer aura. If you have ever looked at a starry sky and noticed the stars are different colours, this is a reflection of their CCT and the temperature they are burning at. The CRI is the display colour of certain objects under the light source. It is measured on a scale of 0-100, where 100 indicates that the colours are displayed as "true", or what they would appear as under natural sunlight.



CRI, Low (poor quality) to High (good quality) (left)
Photo Source: Lux Technology Group

CCT, Cold (warm light) to Hot (cold light) (above)
Photo Source: The Lightbulb Company

The task asked us to create a scene with various objects and compare how they appear under two different luminares.

The photo to the left shows the scene lit using luminare 4, one of the coldest coloured luminares tested. Based on the diagram above, the CCT is around 2800 K. Compared to how they appear on an overcast day, the colour rendering is much more yellow. This may be different when studying the object in sunlight

Luminare 4

Luminaire 3

The photo to the right shows the scene lit using luminare 3. The bulb is much warmer than luminare 4, and the objects appear to be whiter and brighter. In addition there is glare from the reflection on the plastic book cover and aluminum cylinder. While the objects appear brighter, the colour rendering more similar to the cloudy day conditions. It would be interesting to carry the test using a similar-temperature bulb (around 5000 K) with a smaller intensity.

Task 4: General Luminare Review

Appearance, Colour, and Vibrancy

After performing the previous tasks, a general luminare summary and review was conducted. The following summarises the qualitative and an estimation of some of the qualitative characteristics of each one studied.

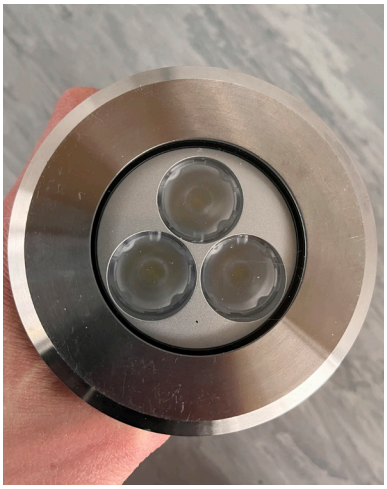
Luminare 1

- Size:
  - Bulb diameter= 5 cm
  - Trim width = 1 cm
- Applications:
  - Recessed light
  - Wall mounted
  - Under-counter
- Glare:
  - Minimal
  - Most likely does not require covering

Luminare 2

- Size:
  - Diameter = 8cm
  - Height = 10 cm
- Applications:
  - Outdoor path lighting
- Glare:
  - No glare
  - Source spreads to light path

Luminare 3



- Size:
  - Bulb diameter (each) = 1 cm
  - Height = 7 cm
  - Inner-circle diameter = 4 cm
  - Trim = 1.5 cm
- Applications:
  - Flashlight
  - Under-counter
- Glare:
  - High

Luminare 4

- Size:
  - Bulb diameter= 1.5 cm
  - Radius of defuser= 4 cm
  - Height = 6 cm
- Applications:
  - Accent lighting
  - Decorative wall art
  - Track lighting
- Glare:
  - Occurs when in-contact with bulb
  - Non-existent from a distance

Luminare 5

- Size:
  - Bulb diameter = 4 cm
  - Height = 7 cm
  - Trim width= 1 cm
  - Angle trim width= 2 cm
- Applications:
  - Angled Recessed with trim
- Glare:
  - Occurs under direct, close contact
  - From a distance, glare is minimal
- Gear:
  - Adjustable angle trim