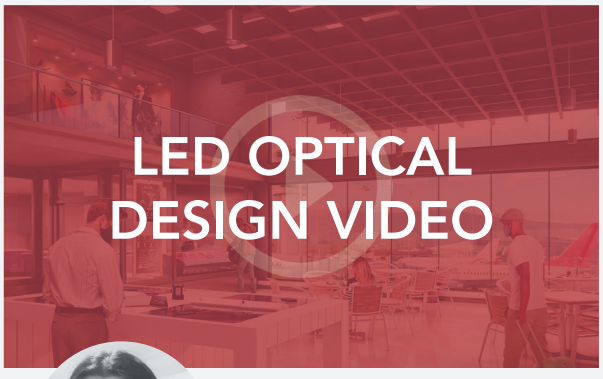
LED OPTICAL DESIGN EXPLAINED

1 What is LED optical design?

The application of knowledge of optics and how they perform to incorporate those optics to design and build devices that make light do something useful.



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2 Why does optical design matter and how does it translate into improved lighting for spaces?

Optical design matters in that it allows us to improve on the performance of luminaires by allowing us to create specific distributions and enhance the performance of light sources such as LED. Being able to manipulate the way light is delivered allows us to create better environments for end users, by making it so that the lighting addresses their needs for the specific tasks they are trying to achieve when using the space.

3 What are the different LED chips available?

There are various types of LED packages. Chips is the general term used for individual LED modules but they fall into a few different categories:

- **Low Power** – Mainly used as signal lights in electronic devices, do not produce significant enough amounts of light to be used for lighting fixtures.

- **Mid Power/Chip Scale Package** – Used in groupings to create lighting arrays for light fixtures. Usually used in conjunction with diffuse lenses or for indirect lighting applications. We see these most often in linear & large format fixtures such as round profile fixtures.
- **High Power** – similar to mid power but produce more light and heat. Distinguished by the silicone dome that covers them & are generally used with TIR Optics to create specific lighting distributions. Most often seen in projectors and outdoor lighting applications. Requires a heatsink.
- **Chip On Board/COB** – High brightness, concentrated source, that is a larger format than mid or high power LED's, it has higher light output because of its size but also creates more heat so it is used in larger format lighting fixtures as it requires a heatsink and larger optical devices (TIR Lenses and Reflectors). Used projectors, downlights and exterior lighting that requires a point source type distribution.

4 What is the difference between COB and SMD LED chips?

As noted in the LED package answers, mid power LEDs are smaller format and would need to be grouped together in larger quantities to achieve the same lumen output as a COB. Because of their concentrated format COB also produce more heat.

5 Why would I choose to use a fixture with COB over a fixture with high powered LEDs?

The choice would have to be based on the specific performance and characteristics of the light fixture you need and the application it is intended for. In the presentation we covered the LED packages and went over the advantages of each and in what way they are used in lighting fixtures so that you could see what the uses of each entail so that designers can make more educated choices on which fit their particular needs. It is a purely subjective choice though.

6 How do optical cones and reflectors affect the output of light?

Cones is another term used for reflectors that pertains to downlights and the form the reflector takes for those types of fixtures. The way reflectors affect the distribution of light has to do with factors like finish (specular, diffuse, etc..), finish color (black, white, light/dark), as well as texture of the reflector surface (smooth or faceted). A specular finish that has a light colored finish will create more reflectance and the faceting can serve to either focus or spread the light out. The later determines the beam angle/distribution such as spot or flood.

7 What are TIR optics?

TIR optics pertain to lens optics with specific distribution attributed to them. The initials stand for total internal reflectance/refraction pertaining to the way the light is affected when it passes through the optic through the concept of refraction which bends the light and reflected while inside the lens.

8 What is the difference between a TIR lens and reflectors?

Starting with materials TIR lenses are usually made our of a polycarbonate material, while reflectors are usually made out of metal. TIR lenses affect the light right at the source because they are placed over the LED, so the light has to travel through the lens and is therefore being directed by it completely. Reflectors are only able to affect the light that bounces off them, so they cannot completely control it because not all the light coming out of a source will touch the reflector. Therefore TIR lenses tend to be more precise in creating specific and more controlled light distribution.

9 Can we achieve the same type of distribution with TIR lenses that we achieve with linear lenses?

Not for every application since TIR Lenses are usually placed right above the LED and can therefore control the individual output of the LED they are placed over. Linear lenses sit at a bit of a distance from the LED, so they are not able to control all of the light being generated by the source but they can still created directionality so while they are less efficient they can still affect distribution, just not as well as TIR lenses.

10 How do color finishes affect the distribution of light and what are the best choices to keep things clean in the space?

Color finishes for reflectors, trims and baffles affect the distribution of light to a certain extent but what we get affected by the most in regard to this is the perception of the light at the ceiling plane. A lighter color finish will

call more attention to the ceiling plane by creating brightness at the light aperture, while a dark or back finish will create what we refer to a quiet ceiling by muting the reflectance at the aperture while still allowing for good light distribution.

11 How would efficiency by effected by different material and systems?

Efficiency in a luminaire is affected by materials in regard to a few factors. For instance, with diffusers the more opaque the material, the less efficient the fixture because it decreases how much light gets through. In regard to reflectors efficiency gets affected by the aperture size as well as the texturing of the reflector surface and sometimes event the finish chosen for the reflector. An efficient luminaire is seen as being one where the maximum amount of light being created by the source is delivered out of the fixture in the best way possible to ensure that in not only addresses the task requirements.

When it comes to systems this gets more complex. Usually dimming systems are put in place to make the lighting as a whole work more efficiently. However, there are times when if the right components have not been put in place, or not positioned correctly, it can negate or cancel out how efficient a system is. For instance if you are using daylight sensors to ensure that lighting addresses changes throughout the day, but the sensors are placed in a location where they will not be effective at gauging drops in daylight penetration.