

Technical Case Study

Re-designing a library lighting system

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Case Study

Lighting for Multi-Family & Hospitality

Executive Summary

LED lighting has brought new expectations around brightness in many types of commercial and municipal spaces. Meeting these new expectations in an existing building isn't always as straightforward as swapping out lamps or throwing in retrofit kits. Sometimes a thorough re-design is needed. Particularly in a library setting where light and comfort are of the highest importance.

This case study follows the process and outcome of designing and implementing a new LED lighting system for a municipality's key gathering hub, its central library. The project demonstrates Enlighten's lighting design and technical expertise and ability to strategically provide value opportunities while fulfilling design intent and ensuring proper application-specific illumination. We will review the below issues resolved and steps taken in working towards well balanced outcome:

- a) HID Systems: Maintenance Nightmare
- b) Up Lighting: More is Not Better
- c) HID to LED Conversions: Square Peg Round Hole
- d) Complete Re-design: Achieving Functional, Beautiful Light
- e) Wireless Controls: Future Proofing Dynamic Floorplans



Library 2nd Floor After

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System Overview:

In its original design, this municipal library had achieved a high level of architectural excellence. The 2nd floor was one of the town's marquis spaces. However, the lighting system was out of date, out of function, and no longer displaying the space to the level of quality it deserved.

The base layer of light on the Library's 2nd floor was mainly supplied by two sets of light fixtures. The first was a series of indirect post-top lights. These lights were originally intended to spill some light onto the ceiling and re-direct some light back towards the floor and task plane. The second was over one-hundred shielded spotlight luminaires. These fixtures were intended to provide both up lighting onto the feature ceiling and architectural lighting of brick archways.



Left: Indirect Post Top Fixtures intended to spill some light onto ceiling and reflect most light back down to task plane

Right: Spot Luminaires intended to provide archway and ceiling uplight. Overall system state and lighting poor before conversion

Finishes on the 2nd floor include dark commercial carpet, specular metallic ceiling, red brick columns and archways, and light grey drywalled trusses. Ceiling heights range from 20' near the landing to 50' towards the east wall. The east wall is 100% glazed providing significant daylighting eastern half of the 2nd floor. This glazed wall is also the space's maximum luminance point during the day.

Issue #1: HID Systems

Maintenance Nightmare = Poor Lighting

It is common knowledge that older high-intensity discharge (HID) systems are less energy efficient. What some do not realize is how poorly they provide illumination over their lifespans. HID lamps are typically very bright out of the box. However, their lifespans are quite unpredictable and often short. Furthermore, ballasts and lamps can be challenging to access and replace. Because of these maintenance difficulties, HID systems are often putting

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out a fraction of their originally designed illumination in just a few years. This problem is exacerbated if the facilities department does not have the resources to continually keep up with these maintenance requirements.

Upon initial survey, Enlighten found approximately half of the indirect post top lights to be non-functioning and 100% of the spot lights to be non-operable. Yes. That is correct. 100% of the spotlights were out. Both of these sets of luminaires were difficult to access requiring a specialized lift and the removal of a significant number of the 2nd floor's bookshelves. Thus, the reason maintenance had not been able to be performed.



100% of the 118 spot lights were not functioning!

To help resolve some of these issues, Enlighten would recommend long life post-top fixtures (L70 > 150,000) with integrated surge protection and glass lenses to prevent yellowing. For the spotlights, we would recommend commercial grade PAR30 LED lamps. These lamps provided much longer warranty periods, higher L70 hours, and increased lumen output compared to standard LED PAR30's.

Issue #2: Uplight

More is not better

This Library was designed with higher levels of up light. So much so that some occupants complained of glare from the ceiling. Much of this library's 2nd floor was previously lit with indirect lighting aimed upwards towards the ceiling or other reflection surfaces intended for re-direction towards the floor. Unfortunately, in combination with the maintenance issues discussed in Issue #1, little light was making its way down to the floor and task planes. Upon initial survey of the space, only between 3 and 8 footcandles were found on the task plane during the middle of the day. Work surfaces and the space in general felt dimly lit especially in reference to the high luminance emitted from the large east-facing windows. To do so, we set the goal of reaching 30 foot candles on the task plane. With more emphasis on improving task plane illumination Enlighten recommended lowering up-light ratios around 20%.

Issue # 3: HID to LED Conversions

Square Peg; Round Hole

HID systems utilized a round lamp emitting light in a 360-degree plane. Fixture enclosures were typically square or rectangular and best described as "shoebox" in shape. LED light sources tend to be rectangular, thin plates adhered to thick aluminum heat sinks. "Pizza box" is an easy way to describe the typical shape of an LED light source. Because of their different form factors, it can be difficult to fit an LED retrofit kit inside an HID fixtures that emits sufficient light. This was certainly the case with the Library's existing post-top indirect lights. For the sake of completeness, we tested a retrofit kit but were never able to achieve more than 10 foot candles on the task plane. A solution for the spotlight fixture was much more straight forward: remove the old PAR30 HID lamp, bypass the ballast, and install a new high-life, high output LED PAR30 lamp.

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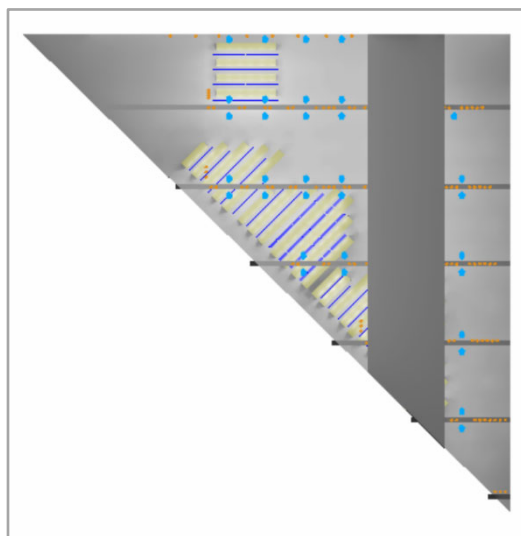
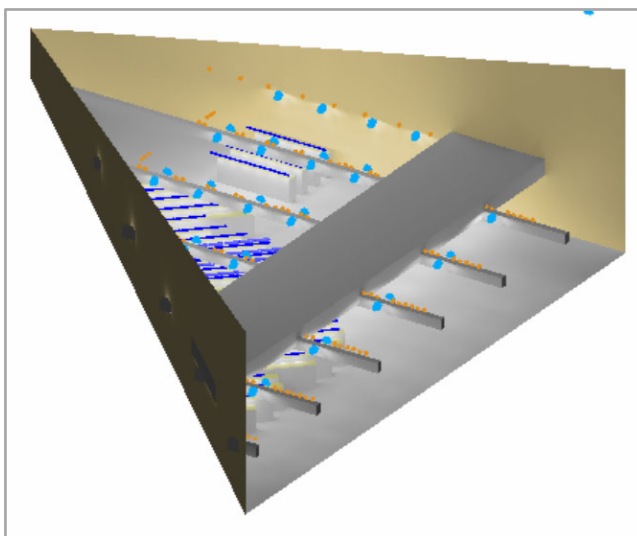
Solution: System Redesign

More than just foot candles: uplight, downlight, glare, and luminance ratios

The inevitable solution was a whole new fixture and approach was needed to replace the old indirect post tops. This new luminaire would provide 100% downlight thus making 30 foot candles much more achievable. Moreover, a forward throw pattern was utilized in order to keep too much light from being directed back onto the truss wall, raising potential glare issues, and not targeting light towards the task plane efficiently. To complement the red brick tones, 3000K was utilized.

Converting from the old indirect post top fixtures meant that some of the previous up light would be loss. It then became more critical to repair and convert the spotlights which would provide 100% of the up light. Even with 30 foot candles on the task plane, a dark ceiling would make the space feel dim and exacerbate glare for the higher lumen post tops.

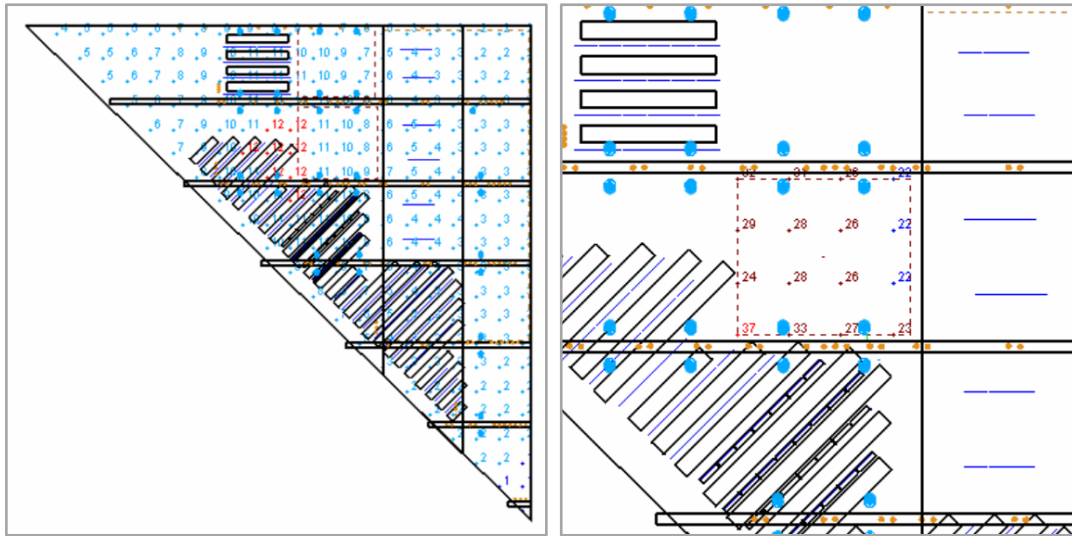
In order to confirm this new lighting would achieve the intended illumination goals, Enlighten provided 3D photometric analysis projecting task plane illuminances and vertical surface luminance ratios.



Left: 3D Photometric Analysis Perspective | Right: 3D Photometric Analysis Aerial

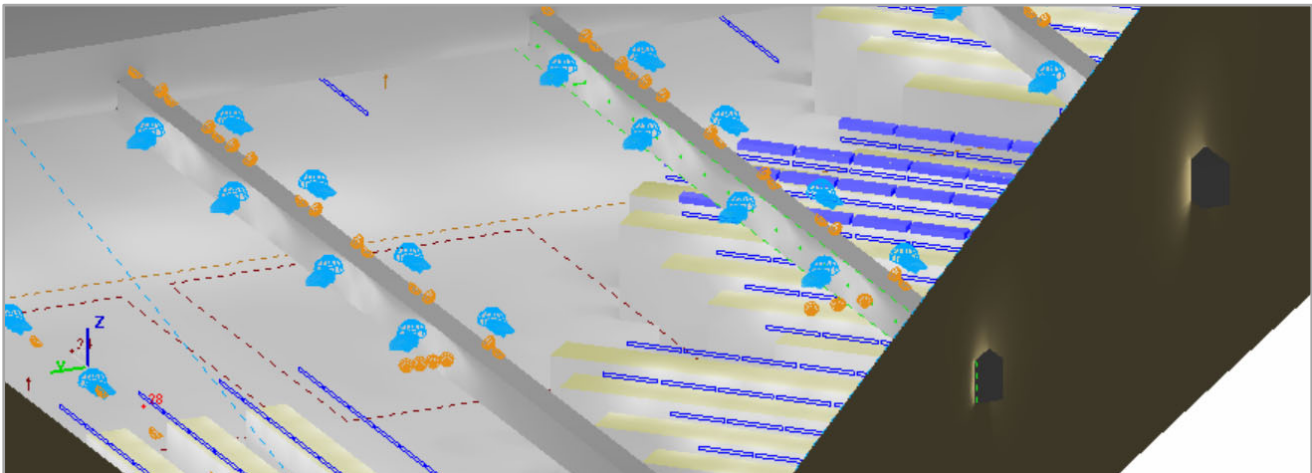
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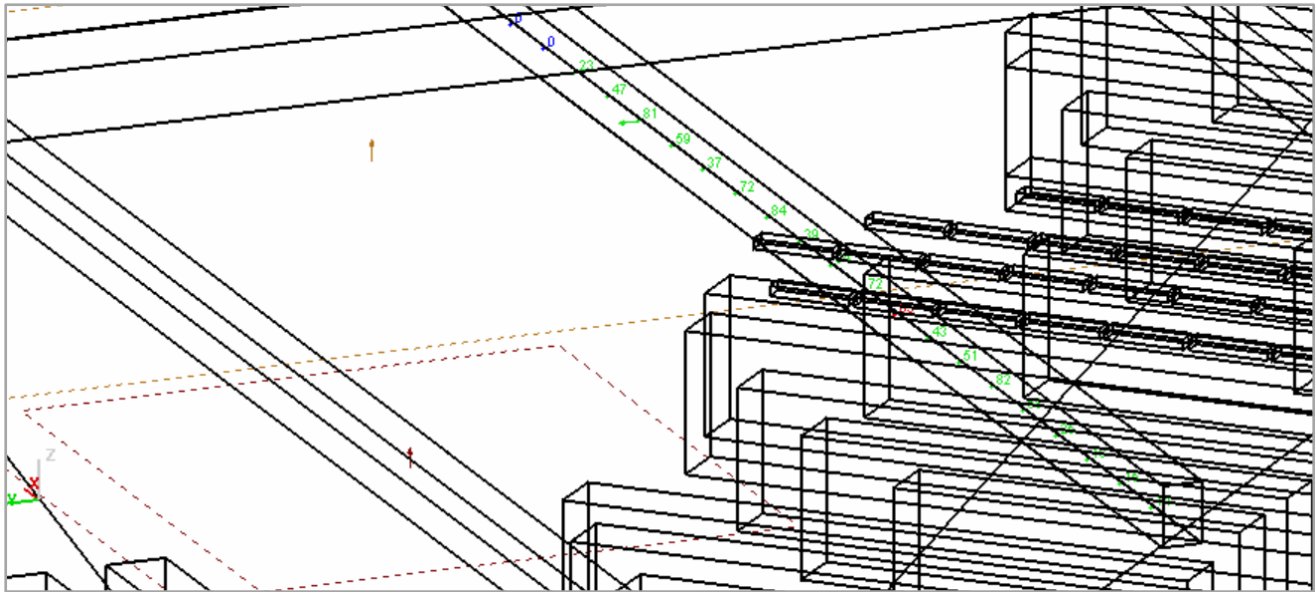
Left: Ceiling Point Illuminance Analysis | Right: Test Task Plane Point Illuminance Analysis

LED light sources are inherently glary if proper design measures are not fulfilled. The small, highly efficient diodes emit a significant amount of light out of a small surface which is essentially the root of all glare problems (i.e. too much light out of too small of surface in reference to surrounding light levels). Several steps were taken to address this issue. First, a custom heavy frosting was applied to the post-top fixture's glass lens. Second, Enlighten strongly recommended repairing the spot lights in order to increase the surrounding spaces reference brightness. Bringing up the luminance levels in the rest of the space would decrease the difference between the luminance levels emitted from the post-top fixture's lens and the surrounding areas, thus reducing the glare from the fixture. Next, Enlighten recommended a 0-10V dimming control so that the wattage, task plane foot candles, and luminaire lumen/glare output could be finely balanced. Finally, a thorough sampling process was undertaken, so the client and their architect could see and test these recommendations.



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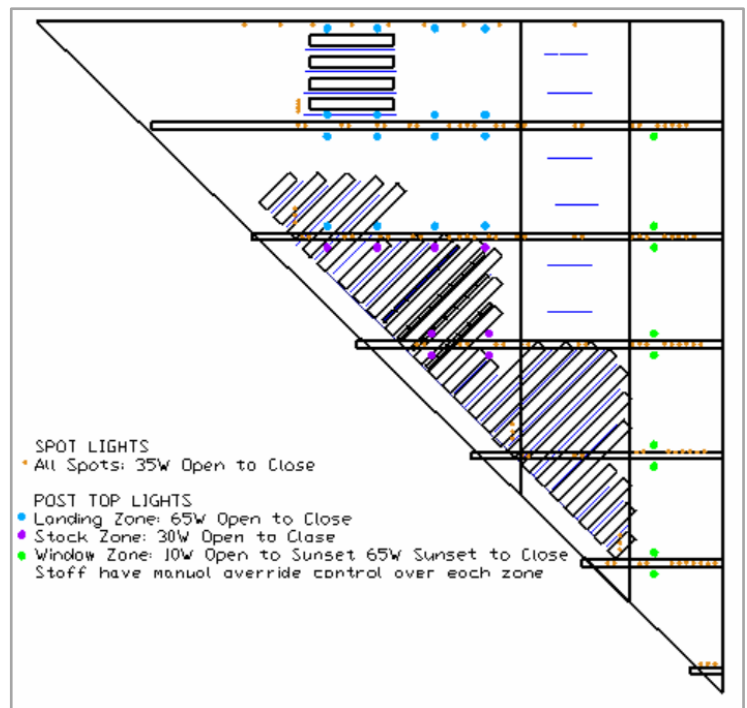
Top: Rendered Point Illuminance Analysis | Bottom: Numeric Point Illuminance Analysis

Futureproofing

Wireless controls for infinite tunability and configurability

Not every zone of the Library's 2nd floor needed the same amount of illumination. Some areas have supplementary illumination from windows or task lights. Furthermore, the floor plan is re-configurable, and the client is planning on re-arranging in the near term. The zones that need more light now may need less after the re-design. The ability to individually tune each of the post-top fixtures becomes especially useful under a dynamic floor plan scenario.

For these reasons and need for the glare-tuning, Enlighten recommended a 0-10V wireless dimming node added to each post top luminaire. This would allow the client to tune individual lights for optimal glare, dim groups of light for daylight times, dim groups of lights where other task lights were available, provide manual override functionality to Library employees, and re-arrange all these settings at any time in the future. The result is highly efficient well balanced, highly tunable, highly re-configurable automated lighting system.



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Outcome

The results speak for themselves. The 2nd floor is now beautifully lit returning it to its intended architectural excellence. We achieved the targeted 30 foot candles and did so at a fraction of the original system wattage. The ceiling is sufficiently bright, and the space feels amply lit. Furthermore, the client has a lighting system whose maintenance requirements will be far less than the previous one and thus average light levels much more stable. Finally, significant energy savings were achieved with the wireless dimming system and LED technologies.

“We had tested solutions from several different companies. None were sufficient to meet the Library’s architectural and functional requirements. Enlighten service, solutions, and expertise exceeded our expectations and the results speak for themselves.” –Library Director

Enlighten’s three main strengths are its technical and design expertise, its deep knowledge of the commercial lighting supply chain, and its commitment to project goals. Enlighten thrives on and enjoys projects where the outcome makes such a significant difference to a space’s feel and functionality. Great architecture requires great lighting and, the Library’s 2nd floor now has what it deserves.



Left / Before: Poor task plane illumination, high glare from operating post tops, no uplight from broken spot luminaires
Right / After: 30 foot candles on task plane, balance fixture glare compared to surrounding luminances, balanced uplight

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Contact

For questions on this case study or general lighting and control services contact the below. Enlighten is an LED lighting and advanced controls wholesaler and consultant. We partner with owners, designers, and engineers to provide and implement lighting solutions for commercial and industrial locations.

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