4 Auditorium Lighting

Introduction

One of the unique features of the Medical Office Building is its Auditorium. Located on the ground floor of the building, the auditorium is a general meeting place for stockholder conferences, employee workshops, and press conferences. The space is designed to be divided into three parts when necessary to allow for multiple smaller presentations, but is generally used as a whole space. The current lighting system of the auditorium (Figure 4-1) consists mainly of downlights assisted by recessed lighting in the coves to improve the light at the ceiling. This is a conventional and effective lighting solution to general use spaces such as this auditorium. However, a conventional system may not always be the best solution.

Figure 4-1 The existing lighting of the auditorium

Solution Overview

A direct-indirect lighting system may be able to create the same environment as the downlight system with coves. Properly placed, this system would not have a serious impact on the architecture, and would likely require less fixtures, making the maintenance of the space easier. However, this system may create an undesirable lighting effect for the presenter. In order to reap the benefits of a direct-indirect system and still maintain the quality lighting needed for presentations, a combined system is proposed. This combined system would include direct-indirect luminaires for the general lighting, and adjustable downlights for the presenter.

Design Criteria

The value of the lighting redesign is largely a decision of aesthetics. However, the system must still meet requirements for quality and energy consumption. The new lighting system will be deemed acceptable if it:

- Provides an environment with sufficient light quality (as set forth by IES)
- Consumes less than 1.0 W/ft^2

Based on these criteria, the system will be deemed acceptable. A direct comparison to the existing lighting system for cost and luminance was not possible due to insufficient information. However, a rough estimate of costs will also be considered using typical wattage values of downlights.

Lumen Method Analysis

The standard method for determining the level of luminance in a space through hand calculations is the Lumen Method. A worksheet in the IES Handbook (Appendix V) assists designers in using this method to decide how many luminaires to place in a given space. It is still left to the designer to select the luminaire and ensure that they are properly placed in the room based on the manufacturer's data for spacing. The luminaire chosen for consideration in this design was Lithonia's Avante Surface/Suspended luminaire. With the luminaire and room both known, the lumen method may be begun.

The first piece of information asked for in the lumen method is the lumens per a luminaire, 5700 for the Avante. The next piece of information involves the dimensions and reflectance of the room. Because the actual values of the reflectance were unknown, values of 80%, 50%, and 20% were chosen for the ceiling, walls, and roof respectively. These values represent average numbers for the materials in the room and are likely conservative because the existing lighting system takes advantage of indirect lighting, which requires higher reflectance. Once the values of the room are known, it is necessary to calculate the cavity ratios for the zones of the room. The cavity ratio for a space is defined as:

$$CR = \frac{5h(W + L)}{W * L} \qquad (4\text{-}1)$$

Once the cavity ratios have been determined, and the reflectance known, it is possible to determine the coefficient of utilization (CU) of the luminaire. The process involves the use of charts and tables found in the IES Handbook, the reproduction of these charts found in Electrical Systems in Buildings by S. David Hughes were used for this analysis. According to these charts the CU for the room is 0.74. Further charts and tables help to define the light loss factor, which is 0.63. At this point the only piece of information needed to complete the calculation is the required luminance, which is between 2 and 20 foot-candles for auditoriums.

Choosing the high end value of 20 foot-candles leads to the requirement of 39 luminaires. Spacing 39 luminaires evenly across the auditorium would be difficult, so 40 luminaires were chosen instead. The illuminance from 40 luminaires is 20.7 foot-candles, which is better than the most stringent requirements of IES.

System Layout

The Lumen Method analysis determined that 40 luminaires would be necessary to provide the desired illuminance in the auditorium. The spacing criteria of the manufacturer states that the luminaires must be within 1.14 their height above the work plane along the lamp, and 1.43 their height above the work plane perpendicular to the lamp. In the case of the auditorium, the work plane is the floor, which is roughly 15'-6" below the luminaire. This means that the luminaires should be arranged in at least a 3x5 pattern to fill the 61' x 84' area. With 40 luminaires, the nearest comparable arrangement is 5x8. This pattern is shown in Figure 4-2, with the lights shifted away from the south wall, where presentations occur.

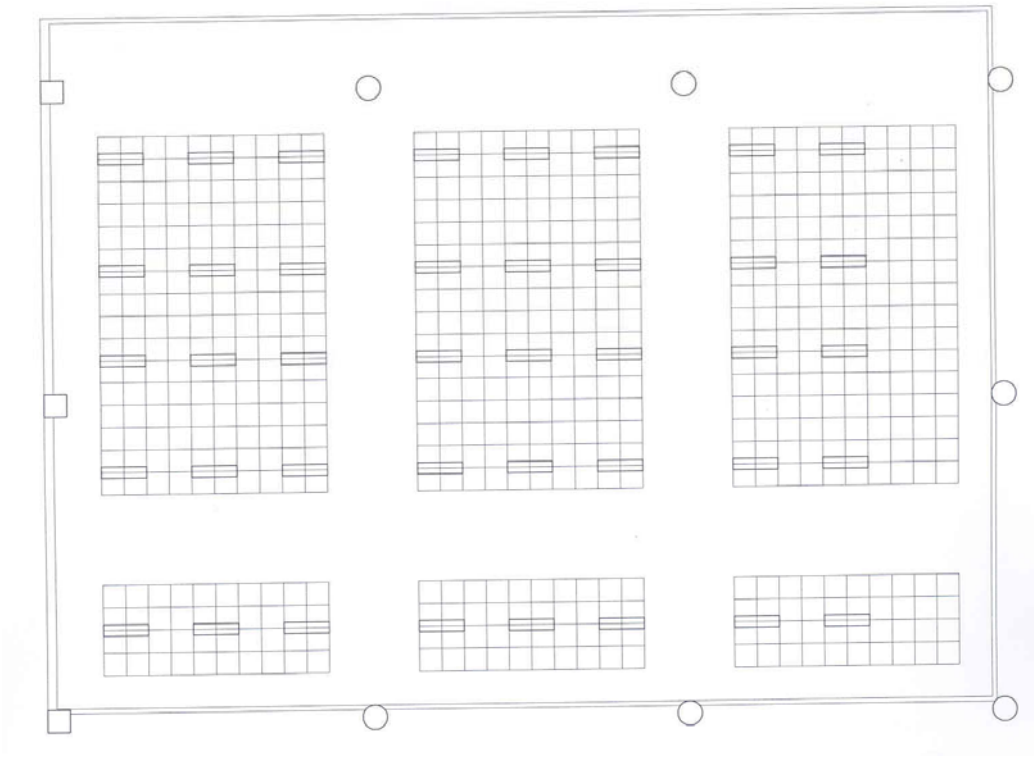

Figure 4-2 Layout of the direct-indirect lighting system

Task Lighting Layout

The goal of the task lighting within the space is to provide more lighting options for the presenter. As there are no calculable requirements for this space, the proposed design must be judged solely on appearance. Because of the projector, it is important to keep light off of the walls, in order to prevent washing the images. At the same time, having light on the podium can be dramatic and helpful to the speaker. Another nice touch for presentations would be having some simple stage lighting to control color and brightness at the podium. This could be hidden in the coves, which are

no longer used in the direct-indirect system. The final design, with a single downlight for the podium and a small set of basic stage lights in the cove is presented in Figure 4-3.

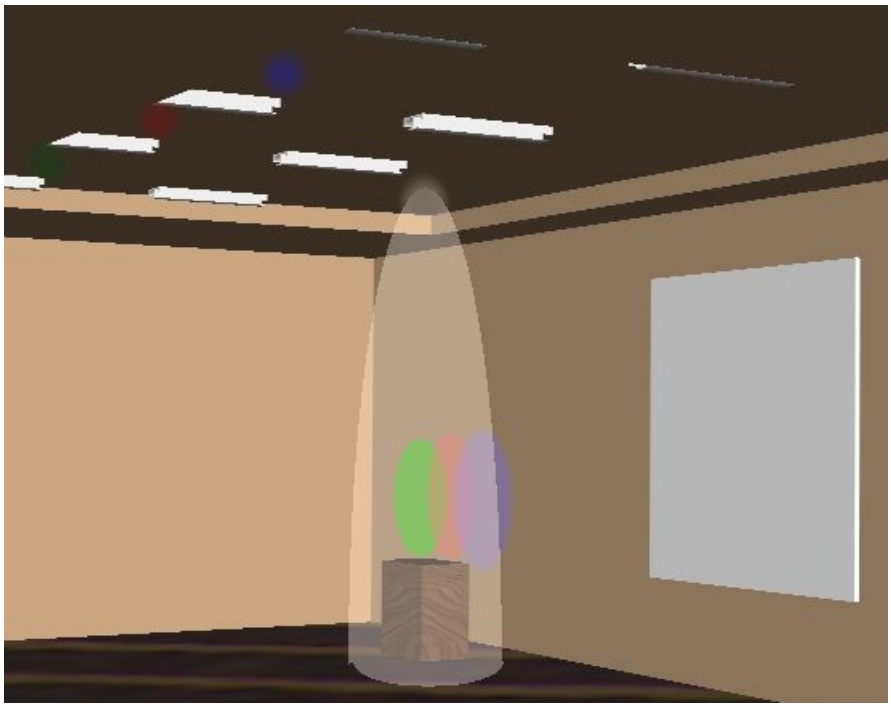

Figure 4-3 Rendering of the proposed task lighting design

Conclusions

The analysis of the new lighting system has shown that the auditorium will have a lighting level acceptable for auditoriums. An evaluation of the power usage also reveals that for the Avante Luminaires alone the power density is only .45 W/ft2. Since the system meets both of the design criteria it is an acceptable alternative. In addition to meeting the design criteria, the new system may also be of greater value. The current design uses 112 downlights. Using data for a typical Lithonia downlight with compact fluorescent bulbs (~25 W per downlight) the current power density would be .55 W/ft2. The energy savings alone are ample justification to change the system, but even more money could be saved because only a third of the luminaires and ballasts would have to be installed.

The additional savings resultant from the new system can be used to justify the expense of the presenter specific task lighting. Given that this lighting adds value to the auditorium space and can be bought back by savings in the general lighting system, there is no financial reason why the new system should not be chosen. However, the new system does place luminaires in the auditorium space, and although they are a small intrusion, they do somewhat detract from the overall appearance compared to the original design. The final evaluation of this system should rest with the owner and their perception, as the difference in cost is relatively small.