Open Office Plan

Function and Orientation

The open office plan on the top floor of the Westwood Community church holds 14 cubicles and doubles as the circulation space for the entire top floor. The area around the open office space has conference rooms, executive offices and guidance offices, so the focus on circulation for this space is even greater than for most office spaces.

The cubicles in the open office space will likely hold VDTs and will be used for writing, drawing and computer tasks.

Access to the open office plan is gained from two stairwells and an elevator, all of which are along the east wall of the plan.

Space Characteristics

As is shown in the AutoCAD drawing on the right, the open plan office space is a rather large room. The majority of the room has a ceiling height of 12’. However, the left-most portion of the room has a raised ceiling that goes up to 27’6”. This ceiling raise corresponds to the green lines on the floor plan, and is obviously represented in the upper left hand corner of the AutoCAD drawing. In addition, the wall along the outside of this raised ceiling area is comprised of 8 large windows.

Material Properties

The open office plan is carpeted with a broadloom carpet and its ceiling and wall are simply painted gypsum board. The office is to be equipped with 14 cubicles and perhaps some additional tables and chairs where the ceiling is raised.
Design Needs

Because there is not a whole lot of flexibility in an open office lighting plan, the space is an excellent opportunity to retain energy efficiency. Low wattage fixtures used in an effective manner can help save energy costs while still fulfilling all necessary requirements of office lighting.

However, just because energy can be used efficiently in an open office plan does not mean that the room should be bland and boring. Occupants will spend up to ten hours a day sitting in the office space. Therefore, it is a good idea to create a quality, positive lighting environment. Daylight, color and light patterns can greatly enhance the psychological health of the office. As a result, it is the duty of the lighting designer to create not just an efficient plan, but a buoyant one as well.

Design Criteria (as suggested by the IES handbook)

*Appearance of Space and Luminaires* – Because it is also used as a circulation space, the appearance of the open office space must be clean and attractive. In order to keep a clean appearance and reduce clutter, illuminance on the ceiling should be kept fairly low and constant.

*Color Appearance* – The color rendering index in the room should be at least 70.

*Light Ratios* – In an area where tasks will be performed over a long period of time, and glare and uneven patterns can become an irritation, specific light ratios should be adhered to.

- Light ratios cannot exceed: 3 to 1 on task and the VDT
- 10 to 1 on task and distant surroundings
- 4 to 1 between bright and dark spots on ceiling

*Modeling of Faces or Objects* – Although not as important as in a conference room, there is still a fair amount of face-to-face interaction in the open office plan. As a result, some concern should definitely be spent on the modeling of people's faces in this environment. This issue can be remedied by making sure there is a either a diffuse lighting system or plenty of inter-reflection throughout the room.

*Horizontal Illuminance* - approximately 50 fc on work plane

*Vertical Illuminance* - minimum of 5 fc on walls
Existing Design

The open office plan is lit rather simply. It utilizes two types of parabolic troffers, both of which are direct luminaries. These fixtures are used not only to light the open plan, but the surrounding offices and workrooms surrounding the open plan as well. Some of the parabolic troffers (6 of 38) are designed with an emergency back-up light, used in case the building voltage drops below eighty percent. Near the far left wall are wedge shaped wall sconces used for decorative accent.

This layout places enough light throughout the room and has a power density of 1.23 W/ft², which just barely falls within the 1.3 W/ft² limit.

Re-Design

For the open office plan, two separate designs will be tested and compared.

The first relies on hanging pendant fixtures, with a semi-uplit distribution. These fixtures rely partially on indirect light to light the office cubicles. However, they place a greater amount of light on the office ceiling and create a more interesting lighting space.

The second design replaces the pendant fixtures with recessed 2’x4’ parabolic troffers. These diffuse fixtures are direct, but are VDT compliant.

The design portion of the office space report will be split up into two separate sections: one for the pendant design, and one for the troffer design. At the end of the section will be a quick comparison of the two systems.
System #1: Pendants

Re-Design

The first lighting design for the open office plan consists of five parts:

A. Hang T8 fluorescent pendants over the cubicles in the center of the room.
B. Use recessed wallwashers to wash the walls between the office doors along both hallways flanking the open space.
C. Hang two pendants in the raised ceiling. The pendants should drop 20' and give off enough light to place 50 fc on the conference table.
D. Place a standing floor lamp at both corners next to the window in order to supplement daylight.
E. Build a small cove surface along the bottom of the raised ceiling. Place wallwashers with blue gel inside the cove to wash the raised wall with blue light.

Controls

Every other wallwasher and the outer two rows of pendants will be backed up with battery packs in the case of emergency.

With the exception of the incandescent lights in the floor lamps, all lamps in the room will be placed on dimmable ballasts.

Circuit E is will tie into an already existing circuit on the top floor.

Circuit D will utilize a daylight sensor. As the sun goes down, the wallwashers on circuit D will turn on and slowly replace the daylight. At night, the blue wallwashers will glow as is seen in the accompanying Lightscape renderings.
Lighting Summary

Design #1 removes all troffers that existed in the original plan.

Designing the new lighting layout brought two separate concerns for the space: should the workspace be lit jointly with the circulation space? And if not, how should light separate the two functions?

Through trial and error, it came to be seen that trying to light the entire office plan in the same manner was rather ineffective. Not only did it seem to waste energy, it created a fairly plain atmosphere. It could be said that the original design of the space, which utilized troffers throughout the entire space, also could not rectify this problem.

As a result, the new lighting process involved lighting the work stations (the cubicles and conference table) in a separate manner than the rest of the space.

For design #1, pendants were placed over all workstations. This design created a distinct boundary between work space and circulation space. It also placed a sufficient amount of light on the work surfaces and creates a fairly even wash along the wall behind the workstations.

Unfortunately, the pendants appeared rather distracting and unnecessary for the space. In addition, they created an unsightly brightness pattern along the ceiling of the space. While dropping the fixtures further would help to alleviate this pattern, they could not be dropped much further before they would start interfering with the cubicle tops.

The pendants over the tables did not suffer from these problems. Because the space over the conference table is so grand, the hanging pendants create a much more expected, comfortable feel to the space. Combined with the standing floor lamps, the pendants create a living room feel to that portion of the room. The appearance of this space goes a long way toward improving the psyche of the workers.

Wallwashers are placed along both hallways in the space. These wallwashers help to open up the space and pull people who enter the space towards one of the perimeter offices. In addition, these wallwashers unconsciously guide someone sitting at a cubicle towards an exit in the case of an emergency. Some practice was needed to place these wallwashers where they would not blind people exiting the offices, but the proposed solution is guaranteed to avoid this problem.

Finally, the cove built at the raised portion of the wall shines blue light on the raised wall. This is done for a number of reasons. First of all, without lighting this wall, the space becomes very dark and enclosed. Lighting the wall opens the space up and makes working at the conference table much less threatening.

Also, by lighting the wall blue, the space appears to emulate the afternoon sky. Above the level of the floor lamps and pendants, the blue light acts as the sky, while below the lamps is warm sunlight that is easy to work under.

In addition, the blue light creates a more interesting, attractive environment for everyone working on the upper floor. Workers at the cubicles will likely find the blue glow from the corner of the room much more calming than flat white walls.

Finally, when viewing the Westwood Community Church from the exterior, the blue glow from the wallwashers can be seen in the upper windows of the office space. While this will be more completely shown in the exterior façade analysis, it is safe to assume that this creates a very interesting effect for those viewing the church at night.
Renderings

View of office plan when exiting stairwell

View of Office Plan when leaving Side Office
View of Office Plan from Corner Conference Room
Important Light Levels

Light Levels on the cubicle surfaces between 40 and 45 footcandles. However, for many of the cubicles, the variance was unfortunately much greater.

The light level on the conference table was approximately 50 footcandles.

The illuminance on the VDT screen is approximately 25 fc, while the illuminance on the task surface (desk space) is approximately 50 fc. This ratio (50/25) falls within the 3:1 maximum mandated by the IES handbook.

The ceiling illuminance reaches 55 fc directly above the pendants, while the surrounding areas have an illuminance level of 10 fc. This ratio of 55/10 exceeds the 4:1 ratio necessary to avoid glare on dark background VDTs.
Lamp Schedule

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<tr>
<th>Fixture Designation</th>
<th>Lamp Type</th>
<th>CCT</th>
<th>CRI</th>
<th># of Lamps</th>
<th>Input Power</th>
<th>Ballast Type</th>
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<td>A</td>
<td>T8 Fluorescent Pendant</td>
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<tr>
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Power Density

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<tr>
<th>Fixture Designation</th>
<th># of Fixture</th>
<th>Input Power</th>
<th>Total Power</th>
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<tr>
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<td>120</td>
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Total Power = 3031.8 W

Area of open office space: 3265 ft²
Power Density: 3031.8 W / 3265 ft² = .93 W

The original power density was 1.23 W/ft². The power density for design #1 is significantly less.
System #2: Recessed Troffers

Re-design

The second lighting design for the open office plan is almost exactly the same as the first system. The only difference is that the fifteen T8 pendants hanging over the cubicles have been replaced with fifteen 2’x4’ parabolic troffers.

Controls

The controls for the system #2 are exactly as in system #1. The only difference is that the outer two rows of troffers, not the outer two rows of pendants, will be backed up with battery packs.

Lighting Summary

Much like design #1, the second concept is designing the workspace and circulation space as two separate spaces.

However, in design #2, the pendants were replaced with the parabolic troffers originally used in the Westwood Community Church’s existing design. The intent of switching back to the troffers is to open the space above the cubicles back up and to reduce the brightness patterns that existed on the ceiling during design #1.

Aside from the switch from pendants to troffers, the remainder of design #1 stayed the same for design #2.
Renderings

View of the office plan when exiting stairwell

View of Office Plan when leaving Side Office
View of Office Plan from Corner Conference Room
Important Light Levels

The light levels on the cubicle surfaces range from 35 – 55 footcandles. While it is best to have 50 footcandles on the surface, areas of low illuminance can be filled in with light from a desk lamp.

The light level on the conference table is exactly the same as in design #1, approximately 50 footcandles.

The ceiling illuminance is approximately 18 footcandles in the center of the ceiling and 6 footcandles in the surrounding areas. This ratio is okay for the VDT screens.

There are approximately 20 fc on the VDT monitor and between 45 and 55 fc on the desk surface. This equals a ratio of 2.75:1, which just barely meets the maximum 3:1 ratio required by IES.
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2767.8 W

Area of open office space: 3265 ft²
Power Density: 2767.8 W / 3265 ft² = .848 W/ft²

The power density for design #2 is by far the least of all designs.
Design Comparison

While design #1 created a greater demarcation between the workspace and the circulation space and placed a greater amount of light on the room’s cubicles, the second design seems to be an overall more appropriate one.

Removing the pendants from the space really opens up the room and creates a more comfortable space. The pendants in design #1 were too noticeable and really appeared as if they would be distracting to workers in the space. Psychologically, the pendants seemed to confine the workers to their cubicle area. This obviously is good for productivity, but the psychological effects of this implicit confinement would likely override this productivity.

From a lighting standpoint, recessing troffers in to the ceiling makes the impact of the perimeter fixtures much greater. As you can see from the Lightscape renderings for design #2, the scallops on the wall are much more pronounced and coherent when the pendants aren’t blocking them. The same could also be said about the hanging Shaper pendants over the conference table. In addition to the increased impact of the room’s other fixtures, recessing troffers in to the ceiling also creates a more even wash throughout the room's surfaces. The light on cubicles, while being at a lower level than with the pendants, is much more even. On the ceiling, the contrast between dark and bright spots is more than cut in half.

From a psychological, architectural and electrical standpoint (the power density for design 2 is lower), the second design is clearly the more appealing design for the open office plan. As a result, this is the design that I would recommend implementing.

Appendices

See Appendix for Light Loss Factors, Ballast Information, Dimensioned Power Plan and Cut Sheets