



DELTA

Demonstration and Evaluation of Lighting Technologies and Applications • Lighting Research Center

# DELTA Portfolio

*Lighting Case Studies* ▲ *Volume 1, Issue 3*



450 South Salina Street  
Syracuse, New York

**Type:**

An office building  
adapted from a retail store

**Site Sponsors:**

New York State  
Energy Research and  
Development Authority

Niagara Mohawk  
Power Corporation



# Project Profile

The 50,000 square foot (4600 square meter) five-story office building at 450 South Salina Street in downtown Syracuse, New York, was originally constructed in 1911 as a furniture store, but was gutted and remodeled into an office building in 1992-93. The architecture firm of Quinlivan, Pierik, & Krause (QP&K) redesigned the building to house 3-1/2 floors of offices leased to the New York State Department of Labor, and 1-1/2 floors of design offices for their own employees and workspace for the John P. Stopen Engineering Partnership (JPS) engineering firm. On the architecture/engineering floors, most employees work in individual or shared workstations. Most Department of Labor employees work at individual desks.

In the QP&K and JPS offices on the top two floors, the lighting was designed to accommodate the visually demanding tasks of architects and

engineers: it is adequate for detailed paper drafting, yet limits glare to allow for the comfortable viewing of computer screens. The visual appearance of the space is important for QP&K's image, since the building serves as an example of the firm's abilities in adaptive reuse projects. They chose to retain and accentuate the building's original structure, windows, stair railings, and other elements.

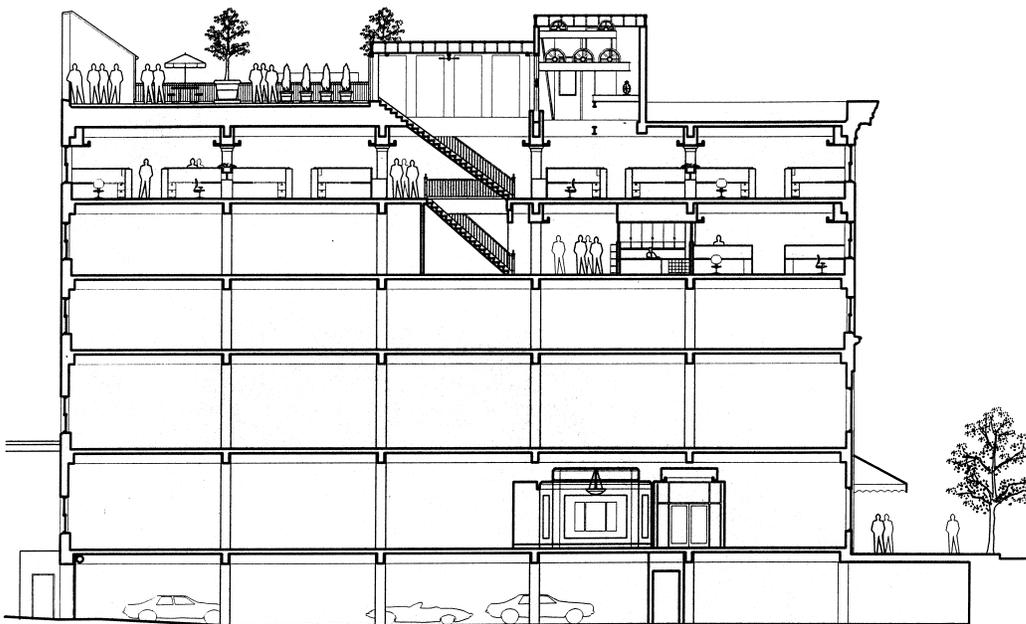
The lighting specified for the Department of Labor includes recessed 2' x 4' troffers with parabolic louvers, F32T8



*Exterior view of 450 South Salina Street*

lamps, and electronic ballasts. In the design offices, the lighting includes cove uplights with 40-W long twin-tube compact fluorescent lamps and electronic ballasts, and compact fluorescent downlights and wallwashers with 13-W quad compact fluorescent lamps and magnetic ballasts. Accent lighting is provided by track lighting; the track heads were salvaged from the furniture store and use PAR38 incandescent lamps.

Occupancy sensors control almost all lighting in the building, turning lights on when a space is occupied and shutting lights off when unoccupied. The total connected lighting power density in the building is 1.45 W/ft<sup>2</sup>, but the occupancy sensors cut that load down to 1.25 W/ft<sup>2</sup> during a typical day. Employees in both the architecture/engineering offices and in the Department of Labor offices reported a high level of satisfaction with the lighting and controls.



0 5 10 20  
BUILDING SECTION

*Section through 450 South Salina Street*

## ● *Lighting Objectives for the Whole Building*

- To create an effective lighted environment using energy-efficient lamps and luminaires.
- To minimize energy use through automatic controls.
- To reduce energy use in order to qualify for the utility energy investment loan program and energy rebates.

## ● *Additional Lighting Objectives for the Design Offices*

- To create a pleasant visual environment with good task visibility and visual comfort for employees who perform both paper drafting and computer-aided design (CAD) work.
- To integrate the lighting into the architectural design.
- To use the windows on the east and west sides of the building to provide a pleasant view to the outdoors and introduce daylight with glare control. Workstation partitions are kept low to preserve views to windows.
- To provide task lighting in workstations so that employees have the option of increasing the illuminance on visually demanding tasks.
- To preserve a reference to prior use of the building by expressing certain original architectural elements, including beams, girders, columns, stairs and railing, elevator machinery, and concrete floors.
- To demonstrate responsible reuse of materials by retaining track lighting from the original furniture store.

## ● *Additional Lighting Objectives for the Department of Labor Offices*

- To create a pleasant visual environment for employees by providing good task visibility and visual comfort for both paper tasks and VDT use.
- To satisfy New York State lighting criteria for Department of Labor offices.

## ▲ *Lighting and Control Features*

- ▲ **Energy efficiency.** T8 and FT40 lamps driven by electronic ballasts are the primary sources of illumination.
- ▲ **Low brightness luminaires.** Cove uplights and luminaires with deep-cell parabolic louvers are the principal luminaires.
- ▲ **Occupancy sensors.** These trim lighting use when spaces are unoccupied.
- ▲ **Flexible task lights.** Individual employees control their own supplementary task lighting.
- ▲ **Window shades.** Direct glare is reduced with open-weave shades which preserve the view.
- ▲ **Programmable time clock.** Building floodlights and walkway lights are programmed to switch on and off automatically.

# Techniques

## Project Specifications

Principal light sources used are F32T8 4' (1220 mm) rapid-start lamps with a color-rendering index (CRI) of 75 and a correlated color temperature (CCT) of 4100K (cool); and FT40 23" (570 mm) rapid-start lamps, 80 CRI, 4100K. Most downlights and wallwashers use 18-W and 13-W CFQ lamps, 80 CRI, 2700K (warm). F32T8 and FT40 lamps are operated on instant-start, reduced-harmonics electronic ballasts for energy efficiency. Normal power factor magnetic ballasts are used to drive the small compact fluorescent lamps. Most accent lighting is provided with 130-V, 75-W PAR38/FL lamps.

The plans show two typical areas of the building: the first floor (Department of Labor) and fifth floor (QP&K).



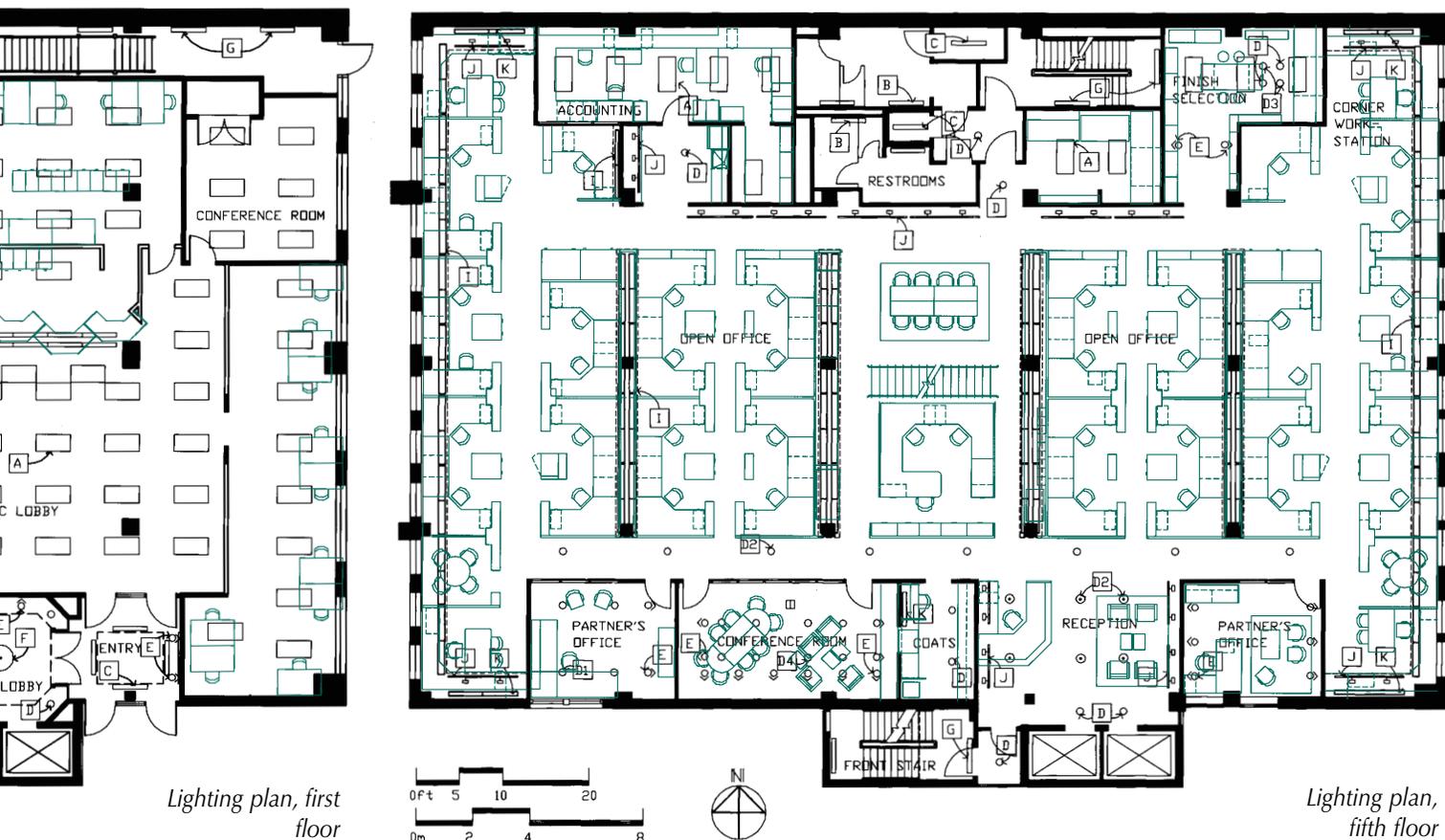
- A** 2' x 4' (.6 m x 1.2 m) recessed troffer with three fluorescent lamps and 3" (76 mm) depth 18-cell semi-specular parabolic louver. Three-lamp instant-start electronic ballast. Lamps: F32T8/RE741.
- B** Wall-mounted up/downlight, 4' (1220 mm) long, with opaque front and prismatic acrylic lenses on top and bottom. Steel housing with white-painted finish. Mounted 7' (2.1 m) above the floor. Two fluorescent lamps in cross section. Two-lamp instant-start electronic ballast. Lamps: F32T8/RE741.
- C** Striplight with two fluorescent lamps in cross section, surface mounted. Two-lamp instant-start electronic ballast. Lamps: F32T8/RE741.

- D** Recessed downlight with open, clear polished aluminum cone. 6-3/4" (172 mm) diameter aperture, with two horizontal compact fluorescent lamps. Magnetic ballasts. Lamps: CFQ13/RE827.
- D1** Recessed downlight with open, clear, polished aluminum cone. Two compact fluorescent lamps, magnetic ballasts. 8" (200 mm) diameter aperture. Lamps: CFQ18/RE827.
- D2** Pendant-mounted cylinder downlight, with 7" (180 mm) tall by 12" (300 mm) diameter white-painted housing. 10" (25 mm) diameter aperture with two horizontal compact fluorescent lamps. Open, clear polished aluminum cone. Magnetic ballasts. Lamps: CFQ13/RE827.

- D3-6** Recessed downlight with 6" (150 mm) diameter aperture. Clear polished aluminum cone. Incandescent lamp.  
 D3 Lamp: 150-W PAR38/FL  
 D4 Lamp: 50-W PAR20/FL/halogen  
 D5 Lamp: 52-W A-lamp  
 D6 Lamp: 150R40/GRO (grow lamp)

- E** Recessed wallwasher with 6-3/4" (170 mm) aperture and open, asymmetrical clear polished cone. Two compact fluorescent lamps, angled 45° down from horizontal. Magnetic ballasts. Lamps: CFQ13/RE827.

- F** Pendant-mounted decorative uplight for building lobby, with compact fluorescent lamps. Translucent white acrylic bowl with polished brass stems and accents. Magnetic ballasts. Lamps: (8) CFQ13/RE827.



Lighting plan, first floor

Lighting plan, fifth floor

**G** Wall-mounted up/downlight, 4' (1220 mm) long, with two fluorescent lamps in cross section. Mounted 7' (2.1 m) above platforms in stairwell. Extruded aluminum housing with U-shaped acrylic diffuser. Instant-start electronic ballasts.  
Lamps: F32T8/RE741.

**H** Task light mounted to design office workstation desktops. Flexible arm with dual-source swivel head, which fully shields lamps from view. Incandescent A-lamp switched separately from circline fluorescent lamp. Fluorescent lamp driven by magnetic ballast.  
Lamps: 60-W A-lamp and 22-W FC8T9/CW.

**I** Cove uplight with asymmetrical reflector system designed to minimize lamp socket shadows. 4' (1220 mm) and 8' (2440 mm) lengths using long twin-tube compact fluorescent lamps run end to end to fit architectural cove opening. Two-lamp instant-start electronic ballasts.  
Lamps: FT40/RE841.

**J** Surface-mounted light track and incandescent track heads, reused from original furniture store.  
Lamps: 75PAR38/SP (130 V).

**K** Small-profile undercabinet light with sheet-metal housing and L-shaped acrylic prismatic lens. Magnetic ballast.  
Lamps: Two F13T5/CW.

### Wattage

Input wattages for luminaires include ballast watts and are estimated from manufacturers' published literature. All calculations were based on the following values:

*T8 fluorescent lamps (electronic ballast)*  
F32T8 (4'): 87 W per 3-lamp ballast  
F32T8 (4'): 58 W per 2-lamp ballast

*FT rapid-start long twin-tube fluorescent lamps (electronic ballast)*  
FT40/T5 (2'): 68 W per 2-lamp ballast

*Compact fluorescent lamps (magnetic ballast)*  
CFQ13: 17 W per lamp  
CFQ18: 25 W per lamp

*Incandescent lamps*  
150PAR38/SP: 150 W at 120 V  
75PAR38/SP (130 V): 66 W at 120 V  
50PAR20/FL/halogen: 50 W at 120 V  
52A19: 52 W at 120 V  
150R40/GRO: 150 W at 120 V



# Details

## Department of Labor Offices

Lighting in the Department of Labor offices, located on the first three floors and half of the fourth floor of the building, is provided by 2' x 4' recessed troffers (type A) with F32T8 lamps and electronic ballasts. Desktop illuminances range from 57 to 121 footcandles (fc) (610 to 1300 lux [lx]) in second floor offices, and from 55 to 113 fc (590 to 1220 lx) in a typical fourth floor office suite. This complies with the New York State requirement that a minimum of 55 to 75 fc (590 to 810 lx) be provided on work surfaces in Department of Labor offices.



First floor open office at the Department of Labor

The luminaires have 3" (76 mm) deep, semi-specular parabolic louvers that provide a controlled, widespread downward distribution of light. The louvers limit the

amount of light visible at high angles to limit reflected glare on VDT screens, while the semi-specular finish produces a soft glow at normal viewing angles. This glow helps the space look more cheerful because it adds brightness to the view of the ceiling, and it tends to soften the scallop of light falling on walls. The layout of 2' x 4' luminaires works well because rows of luminaires are placed within 2 to 3' (0.6 to 0.9 m) of walls. The resulting wall brightness helps avoid the "cave effect" that often occurs in offices where luminaires fitted with parabolic louvers are mounted more than 3' from the walls.

## Reception area of design firm

The reception area of the QP&K design offices welcomes visitors with a company logo mounted on the wall behind the reception desk. Pendant-mounted luminaires with compact fluorescent lamps (type D2) provide ambient light. Track lighting (type J) provides display lighting and highlights the company logo.

Vertical illuminance of the logo wall varies from 29 to 49 fc (310 to 530 lx), depending on the location and direction of the track heads. This produces a scalloped light pattern near the top of the walls. Illuminance on the reception desk averages 17 fc (184 lx).

enters the interior space, all employees have views of the exterior windows on the east and west sides of the building. On the top floor, a small amount of daylight from the skylight above the center stairway contributes a pleasant sense of brightness.

Ambient lighting is produced with asymmetrical uplights (type I) using FT40 lamps, mounted in architectural coves. Coves are located on either side of ceiling beams, which occur 24' (7.3 m) on center. This cove lighting provides 23 fc (250 lx) on desk surfaces with no direct glare because the light source is concealed.

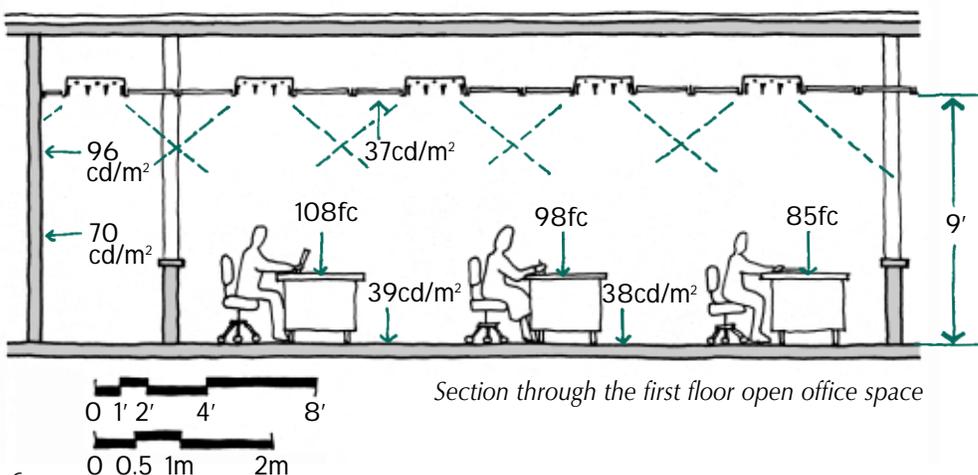


Reception area of QP&K

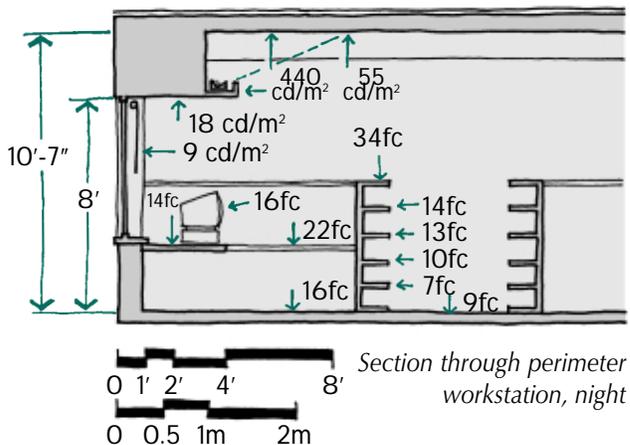
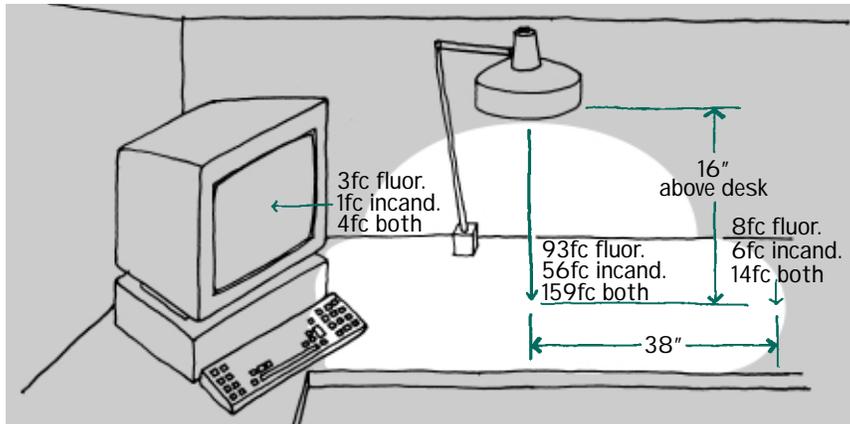
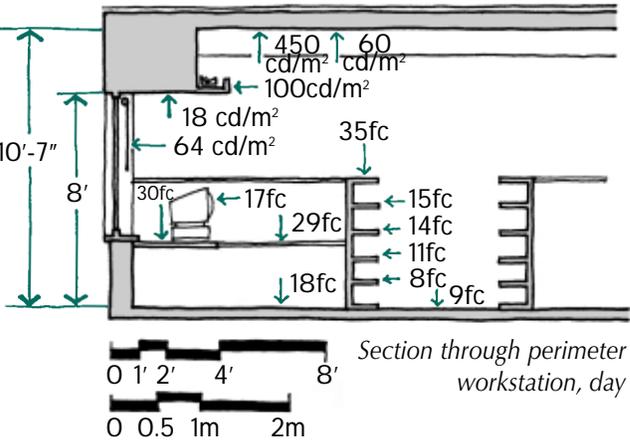
Illuminance on the work surfaces of the perimeter workstations ranges from 22 fc (240 lx) at night to much higher levels when daylight is available.

## Open offices of the design firm

Employees in the large, open office work in cubicles with low partitions, 57" (1400 mm) high. Although almost no daylight



Perimeter workstation in design offices, day



separately switched incandescent and fluorescent lamps. This arrangement allows individuals to direct light onto visually demanding tasks while keeping the VDT screen free of distracting glare. DELTA observed that a maximum of one third of the 39 task lights were found to be on at any given time during the workday. Task lighting can add an additional 159 fc (1700 lx) to the desktop.

Light distribution in workstation from task light employees most often set them at the half-open position.

A 23-story building, located to the west of 450 South Salina Street, blocks most of the late afternoon direct sun, so few people complain of afternoon glare. On the east side, however, the skyline is open, and low-angle morning sun can still cause glare. Even though the solar shades block most of the offending rays, a few employees reported that the sun is uncomfortably bright in the early morning.

Most employees work on both VDT screens and paper tasks, including reading and drafting of architectural and engineering drawings. Each workstation has a flexible arm task light (type H) containing

Cove uplighting (type I) is switched by ultrasonic occupancy sensors. Twelve occupancy sensors monitor the 6200 ft<sup>2</sup> (576 m<sup>2</sup>) open office space. Typically, the cove uplighting is on throughout the workday and often into the evening, because there is almost continual activity in the open offices. As designed, the lighting in unoccupied bays will switch off at night even when there are people working in adjacent bays.

**Corner workstations** The corner open workstations are used by the firm's partners. In addition to the lighting from the cove uplighting system (type I), track lighting (type J) accents drawings or photos above the bookshelf, and fluorescent undercabinet lighting (type K) runs the length of the desk. These workstations also have flexible-arm task lights (type H). The



Perimeter workstation in design offices, night

Daylight is manually controlled at each window with roll-down solar shades constructed of a medium gray, open-weave fabric. When fully extended, the shades can block approximately 86% of the daylight; yet, the views to the outside are not obstructed, and the space still seems bright. A simple adjustment allows the shades to be positioned at any level.

Except when the sun is low in the sky,



Corner workstation in design offices



# Details

undercabinet lighting, track lighting, and flexible-arm task lights are manually switched, and each partner is careful to switch off these lights when leaving the workstation for any length of time.

## Fifth floor conference room

The fifth floor conference room is used intermittently for meetings, displays and pinups, and video presentations. A long



QP&K Conference room

glass wall with miniblinds separates this space from the open offices. Recessed round wallwashers (type E), centered 3' (0.9 m) from the walls and 4' (1.2 m) on center, light the wall paneling and pin-up space. These wallwashers are controlled with wall switches. Recessed downlights (type D3 and D4) provide lighting for table tops. These downlights use incandescent and halogen PAR lamps and are manually dimmed using wall controls. When this space is used for slide or video presentations, the wallwashers are switched off, and the downlights are dimmed to a low level for note-taking.

The conference room walls, designed for displays, have vertical illuminances on the upper walls that range from 14 to 26 fc (150 to 280 lx). Drawings exhibited there are easy to see. Illuminances on the conference table range from 28 to 56 fc (320 to 600 lx), while vertical illuminances on the faces of people seated around the conference table range from 14 to 21 fc (150 to 230 lx).

Lights are frequently left on during the day and late into the evening when the conference room is unoc-

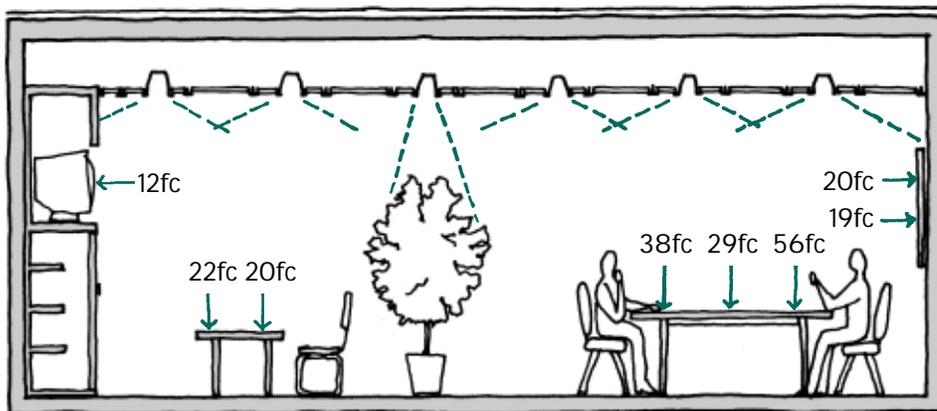
cupied, probably because no single person takes "ownership" of this shared space. Its periodic use makes the conference room a good site for an occupancy sensor, which would work in series with the manual controls to switch lights off when the room is unoccupied.

## Restrooms

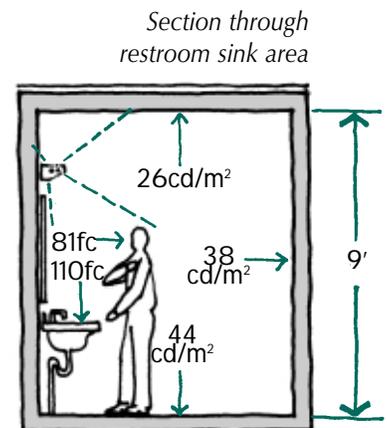
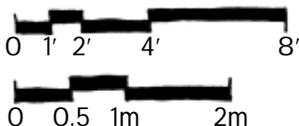
The restrooms are lighted with two direct/indirect luminaires (type B), one mounted above the mirrors and the other mounted above the toilets. With the interreflections from the light-colored surfaces, the space seems pleasant and bright.

The upward component of the luminaire brightens the walls and ceiling. The lensed downward component directs light onto the individual standing in front of the mirror, providing a fairly uniform vertical illuminance on the body to make the face and clothing easy to see when reflected in the mirror.

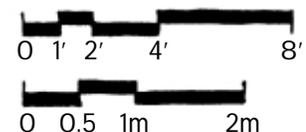
Lighting in the restrooms is switched with ultrasonic occupancy sensors, and because the restrooms are not in continuous use, the rate of switching is high, and lamp replacement is frequent. (See section on Controls.)



Section through conference room



Section through restroom sink area



# Project Evaluation

**Energy impact** Input watts from the manufacturer’s literature were used to calculate the lighting power density (LPD) for the entire office building. The maximum power density for all conditioned space in the building is 1.45 W/ft<sup>2</sup> (15.6 W/m<sup>2</sup>). During the daytime hours, the in-use power density is approximately 1.25 W/ft<sup>2</sup> (13.45 W/m<sup>2</sup>). The reduction is mostly due to occupancy sensor controls. The following table summarizes the power densities in the building, compared to ASHRAE 90.1 1989 energy standards and the New York State Energy Conservation Construction Code:

ranges from a few seconds to fifteen minutes, and most have been set for the longest possible time delay.

Occupancy sensors with different coverage patterns are used in corridors and smaller offices. A few passive infrared (PIR) occupancy sensors, which require an unobstructed sight line to moving occupants, are used in private offices and the back stairwell. PIR sensors are useful in spaces where movement in adjacent spaces could accidentally trigger lights to switch on. These sensors detect the movement of heat sources (i.e., occupants), and have lenses which can be masked to limit their area of “view.” The sensors in the

Many small rooms controlled by occupancy sensors also have switches to manually override the sensor controls when occupants wish to shut lights off for slide or video presentations.

The building manager reported to the DELTA team that F32T8 fluorescent lamps were lasting only six months in a few locations. These were spaces with intermittent use, such as restrooms and the back stairwell. Light loggers installed as part of the DELTA evaluation showed that occupancy sensors triggered the lamps to strike an average of 16 times a day in the back stairwell, and 32 times a day in restrooms. Although the energy savings due to occupancy sensors is significant, the nuisance of changing lamps outweighs the savings in the building manager’s view. The early lamp failure is probably due to the interaction between frequent switching and the instant-start fluorescent ballasts used. The advantage of instant-start ballasts is that they use less energy than rapid-start ballasts, because the lamp filaments are not constantly heated during operation. However, the voltage they apply to

## Building Areas and Lighting Power Densities

Space	Total area (ft <sup>2</sup> )	Total connected LPD	ASHRAE Allowed LPD (room by room method)	ASHRAE Allowed LPD (prescriptive method)	NY State Conservation Construction Code	In-use LPD during business hours
Design offices	14,316	1.90	2.14			1.44
Department of Labor offices	35,990	1.27	1.70			1.17
<b>Total Bldg.</b>	<b>50,205</b>	<b>1.45</b>	<b>1.82</b>	<b>1.65</b>	<b>2.40</b>	<b>1.25</b>

$1 \text{ m}^2 = 10.76 \text{ ft}^2; 1 \text{ W/ft}^2 = 10.76 \text{ W/m}^2$

**Controls** The New York State Construction Code (1991) mandates the use of automatic lighting controls for all new and renovated nonresidential spaces not intended for 24-hour use. Almost all luminaires in 450 South Salina Street are controlled by ceiling-mounted occupancy sensors. Most are ultrasonic sensors that emit an inaudible high-frequency wave and receive back the reflected waves. They interpret any change to the reflected wave pattern as human movement and respond by switching on the lights. Occupancy sensors are available with different coverage areas, have adjustable sensitivities and adjustable time delays. The time delay is the time between the moment at which no movement is detected until the lights are switched off. The sensors in this building have built-in

main office spaces and corridors are triggered frequently enough for the lights to remain on throughout the workday. The lights in the partners’ offices, the finish selection room, and the two conference rooms in the design offices frequently switch off during the day after the spaces become unoccupied. In the Department of Labor offices, the lights in the large open spaces are typically on all day because of constant occupancy, while the lights in the smaller offices switch on and off with employee occupancy. Department of Labor conference spaces are used regularly but not for long periods of time, so the rooms are frequently unlighted, and energy is saved.



Ultrasonic occupancy sensor

start the lamp is approximately twice the voltage applied by rapid-start ballasts. Lamp life is significantly reduced when the lamp is repeatedly started with such a high voltage. DELTA recommends changing to rapid-start ballasts in these areas to extend lamp life. Both the sensitivity of the occupancy sensors and the length of the time delay required adjustment after installation. These adjustments were inconvenient because a ladder was required to reach the units. However, now that the adjustments have been completed, most interviewed employees expressed satisfaction with their performance.

A few of the occupancy sensors had failed, leaving lights in the “on” position. These failures are often difficult to detect



# Project Evaluation

## **Controls** (continued)

because, like the light in a refrigerator, you cannot be sure that the light really goes off when you close the door. Likewise with occupancy sensors, you cannot monitor the function of the occupancy sensor if your physical presence would trigger the sensor to keep lights switched on. (See Lessons Learned.) In two unoccupied spaces, a large Department of Labor office and the building's front stairwell, lights were observed through windows to be on at night. This could indicate that either the sensor had failed, or it was placed close to a window and was detecting vibration from motion on the street outside.

Some people in inner offices complained that lights switched off in adjacent, unoccupied outer offices while they were working or talking with people. To visitors who saw their exit path suddenly go dark, this was disconcerting. In these areas only, occupancy sensors could be relocated closer to the open door between offices so that their coverage area included a portion of the adjacent office. However, the control of these two offices would always be linked together, increasing energy use.

Department of Labor conference rooms demonstrate effective use of occupancy sensors. On a typical day, the conference room lights are switched off an average of 5.4 hours of the 10-hour workday because the rooms are unoccupied. This saves 5008 kWh of energy usage per year, which translates to a total annual savings of \$363 for these three conference rooms. At this rate, it takes only six months to pay back the cost of the occupancy sensors.

**Time Clocks** A programmable time clock controls the switching of lights on the building exterior, at the building entrance, and in the first floor elevator lobby. This time clock can be set to turn lights on and off from dusk to dawn

according to seasonal needs and special events.

**Control of Daylight** The windows along the two window walls are treated with roll-down solar shades to provide heat control and filter daylight. Designed to preserve the view outside, the shades are fitted with a cleanable, open-weave fabric (approximately 14% open) to admit some natural light while reducing glare and excessive brightness. Although they are left in the half-open position on both sides of the building most of the time, CAD workers lower the shades to reduce glare when the sun enters at low angles.

**Environmental and Economic Analyses** By using energy-saving electronic ballasts and T8 lamps as a building standard in the Department of Labor offices, compact fluorescent and long twin-tube compact fluorescent lamps for general lighting in the QP&K/JPS offices, and reducing lighting use with occupancy sensors, this office building was able to achieve significant energy savings and reduced costs. DELTA compared the annual energy cost based on observed day and night use with a hypothetical model. (This model is based on an ASHRAE whole building LPD of 1.65 W/ft<sup>2</sup> with the following assumptions:

- 100% of lights on in the Department of Labor for 10 hours/day;
- 25% of lights on in the Department of Labor for 5 hours in the evening;
- 100% of lights on in the design offices for 10 hours/day;
- 50% of lights on in the design offices for 5 hours in the evening.
- 33% of all lights in corridors in both areas on all night.)

The calculated annual energy cost savings is \$6120, \$3614 from lighting and \$2506 from reduced HVAC use.

The initial cost of the lighting system for the entire building, including luminaires, lamps, controls, and installation, was

\$287,000. This breaks down to \$126,250 for the Department of Labor; \$83,250 for QP&K and JPS; and \$77,500 for the building core and exterior. For a comparable building, an installed lighting system using magnetic ballasts and conventional lamps would have initially cost \$39,000 (13.6%) less; however, the cost was offset by a subsidy from the New York State Energy Office and a rebate from Niagara Mohawk Power Corporation, the local electric utility, for the installation of energy-efficient fluorescent lamps, ballasts, and occupancy sensors.

According to estimates of the United States Environmental Protection Agency (EPA), reduced energy from this building (when compared to a building at the ASHRAE LPD of 1.65 W/ft<sup>2</sup> [18 W/m<sup>2</sup>]) will result in lower power plant emissions of 63.3 fewer tons (57 metric tons) of CO<sub>2</sub>, 1100 fewer pounds (490 kg) of SO<sub>2</sub>, and 470 fewer pounds (210 kg) of NO<sub>x</sub> compounds. By reducing these emissions into the atmosphere, there is a smaller contribution to problems such as global warming, acid rain, and smog.

**Staff response** The DELTA team interviewed employees working in the offices of the Department of Labor, QP&K, and JPS to learn about their impressions and experiences with the lighting. DELTA wanted to find out which lighting features worked well and which, if any, could be improved. DELTA specifically asked about visual comfort, task visibility, reactions to controls, window glare, and any changes in the lighting the employees would suggest. In addition, 47 employees of the Department of Labor and 37 employees of the design offices were asked to complete survey forms on lighting.

Overall, the interviewed employees were very satisfied with the appearance of the lighting and considered it comfortable. Some employees at the Department of Labor reported seeing annoying reflections

of the parabolic luminaires on their computer screens, but most did not find this to be a serious problem. Although a few thought that the lighting in the Department of Labor offices was too bright, and some disliked the bare lamps visible in the parabolic luminaires, most were satisfied that the lighting was sufficient for reading and writing without task lights. A reading test on the survey forms confirmed that 83% of the Department of Labor employees were able to read 6 point type or higher. This is a moderate level of performance compared to normative data.

In the design offices, interviewed employees considered the lighting both attractive and comfortable, and 94% of those completing surveys were able to read 4 point type. This is an excellent level of performance. The reasons for the differences in satisfaction with the lighting may be due to different employee populations and their attitudes toward their work environments, as well as differences in lighting equipment.

Employees in both types of offices reported that occupancy sensors functioned well, once sensitivity and time delay adjustments had been made. Most people commented that they liked the convenience of not having to find light switches; however, DELTA received some negative comments too. While some people reported feeling more secure at night with lights turning on automatically to illuminate their path and to indicate the presence of others, some commented that a space looked dark and unsafe if the occupancy sensors had shut the lights off. Some people would prefer to keep hallway lights on all the time because they do not like entering a dark corridor, even though the occupancy sensors would turn lights on within a second of their entering.

The only problems reported were that occasionally occupancy sensors would switch lights off while a person working alone at night sat quietly for a long period of time, and that people conversing in an inner office were sometimes distracted by the lights switching off in an empty outer office.

**Employee Comments**

*“Very comfortable - no eyestrain at all, I don’t miss having a window office.”*  
*–QP&K employee*

*“The lighting is better, brighter, more pleasant than the last office I worked in.”*  
*–Supervisor of Work Force Training Department of Labor*

*“I like the convenience of not having to grope for light switches. The occupancy sensors alert you to visitors.”*  
*–Architect, QP&K*

**Maintenance and Product Performance** The overall response to product performance and maintenance issues was positive. Manufacturers were responsive to problems identified after installation. Most of the occupancy sensors required some initial adjustment, but are now working well. There has been a greater-than-expected number of lamp failures in specific areas of the building, probably due to the frequent starts with instant-start ballasts. This problem could be mitigated by using rapid-start ballasts rather than instant-start ballasts in locations where frequent switching is anticipated. There were some failures of ballasts and occupancy sensors; however, all failed ballasts and occupancy sensors were promptly replaced by manufacturers. Maintenance was reported to be easy because lamps can be replaced quickly by one person with a short ladder.

Several long twin-tube compact fluorescent lamps (FT40) have failed, leaving the plastic base on the lamp appearing charred and partially melted. There was some concern that this was a fire hazard. DELTA checked with the lamp manufacturer who reassured us that this occurrence is caused by high voltage from the instant-start ballasts at end-of-life, but is not a hazard. However, the manufacturer recommends operating this FT40 lamp on

**LIGHTING SURVEY—Percentages of People Who Agree:**

	<b>QP&amp;K/JPS</b>	<b>Dept. of Labor</b>	<b>Norm*</b>
1. The lighting is comfortable.	92%	85%	69%
2. The lighting is uncomfortably bright for tasks performed.	3%	17%	16%
3. The lighting is uncomfortably dim for tasks performed.	0%	13%	14%
4. The lighting is poorly distributed.	0%	15%	25%
5. The lighting causes deep shadows.	0%	6%	15%
6. Reflections from the light fixtures hinder work.	3%	21%	19%
7. The light fixtures are too bright.	0%	9%	14%
8. Skin has an unnatural tone under the lighting.	3%	17%	9%
9. The lights flicker throughout the day.	0%	9%	4%
10. The lighting is worse than similar workplaces in other buildings.	3%	4%	19%
11. The lighting is about the same as similar workplaces in other buildings.	35%	64%	60%
12. The lighting is better than similar workplaces in other buildings.	57%	32%	22%

*\*Normative data for this survey based on over 1200 responses from employees in several offices throughout the northeast United States.*



### Product Performance (continued)

a magnetic rapid-start ballast until an electronic rapid-start ballast is available with a circuit that senses the end of lamp life.

The building manager noticed a color difference in fluorescent lamps from different manufacturers; some appeared to have a green tint, some a pink tint. The recommendation of the DELTA team is to use, if possible, lamps from the same manufacturer in the same space.

### Lessons Learned

**• Occupancy sensors DO save energy by turning lights off when spaces are unoccupied.** Private offices, conference rooms, and stairwells are frequently unoccupied for long periods of time during the day, and most spaces are unoccupied for most of the night. When specifying occupancy sensors, the type of sensor and the coverage pattern should be carefully matched to each area. Factors to consider include traffic patterns, height of partitions, and the perception of insecurity that dark corridors create. An occupancy sensor should be located so that it will detect all occupants within the intended coverage area. In general, employees like the benefits of automatic switching. Refer to the National Lighting Product Information Program publication, *Specifier Reports: Occupancy Sensors* (1992) for further information.

**• Occupancy sensors will need sensitivity and time delay adjustment after initial installation.** They may require adjustment more than once to fine tune the detectors for different situations. Sometimes unforeseen traffic patterns in the coverage area can trigger the sensor to keep the lights on when a space is unoccupied, or switch lights off when someone is at the edge of the coverage area.

**• Occupancy sensor failures may be hard to spot.** If you suspect a failure, DELTA suggests setting a minimum time delay on the sensor and standing still, as far away from the sensor as possible. Make sure that you are the only occupant in the space. After a few seconds, the occupancy sensor should shut off the lights. If it does not, it is probably malfunctioning.

**• Fluorescent lamps frequently switched by occupancy sensors should be operated on rapid-start ballasts rather than on instant-start ballasts in order to maintain lamp life.** Otherwise, the high starting voltage delivered by instant-start ballasts can substantially shorten lamp life.

**• The combination of ambient light and task lighting provides great flexibility for paper tasks, drafting, and VDT use in the design offices.** The ambient light from the cove uplighting provides a pleasant, reduced-glare environment for VDT use, while the flexibility of adjustable task lighting enables employees to control the illuminance in their own workspaces as needed.

**• The roll-down solar shades reduce window glare while maintaining a view to the outdoors.** The ability to filter daylight without blocking views is appreciated by the employees of the design offices.

#### DELTA MEMBERS

Bonneville Power Administration  
Consolidated Edison Company of New York, Inc.  
New York State Energy Research and Development Authority  
Niagara Mohawk Power Corporation  
Northeast Utilities System  
Ontario Hydro  
Lighting Research Center

#### DELTA STEERING COMMITTEE

James Barron, Craig Ciranny, Patricia Glasow,  
Michael Henville, Roger Knott, Mitchell Kohn,  
Peter Morante, Frank Napoli, John Scala,  
Jerry White

### DELTA Portfolio Lighting Case Studies

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**Program Director:** Naomi Miller

**Reviewers:** Russell P. Leslie and Mark S. Rea

**Evaluation Team Leader:** Peter Boyce

**Publication Manager:** Judith Block

**Evaluation Team:** Robert Strobel, Charles Lloyd

**Technical Assistance:** Linda Sanford, Rita Koltai, Xin Wang, Maarten Mulder

#### CREDITS

#### NYSERDA Contact:

James Barron, Senior Project Manager

#### NMPC Contact:

John Scala, Divisional Marketing Coordinator

#### Architects:

Quinlivan Pierik & Krause- Architects/Engineers

Alfred Krause: Partner-in-charge

William Mowat: Project architect

Robert Haley, A.I.A.: Architectural and lighting design

Diana Cesta, ASID

Steve Jennings: Building Manager

#### Electrical and Lighting Engineer:

William Clifford, Fraser & Fassler, M.E.

#### Building Owner:

450 South Salina Street Partnership

#### Luminaire Manufacturers:

Type A, Columbia; Type B, Alcco;  
Type C, Keystone; Types D, D1, D2,  
E, Prescolite; Types D3, D4, D5, D6,  
Halo; Type F, Visa; Type G, Vista;  
Type H, Luxo Lamp; Type I,  
Litecontrol; Type K, Alcco.

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For publications ordering information write or fax:

Lighting Research Center, Rensselaer Polytechnic Institute, Troy, New York 12180-3590 • FAX (518) 276-2999