Advanced Lighting II - Lighting Case Studies

Jason Robbins, 6506772
Nancy Maruca, advisor

01 Critical Seeing - Bethel Place

1.1 Design Considerations

Bethel Place is an Assisted Living Residence on Stafford. They recently completed a retrofit of their lighting fixtures and are moving towards replacing more in the leisure common area. They are concerned with efficiency as well as visual comfort.

Because older eyes adapt slower than younger eyes, it is important to consider transition areas when occupants move between areas of the residence. This adaptation takes longer when moving from bright areas to dark than from dark to bright. Transient adaptation is moving from stationary scenes to active scenes.

Older eyes are less able to adapt to lighting changes or focus on different tasks. Designs for the elderly should include equal spacing for similar situations – i.e. the distance of conversational seating, the TV and artwork, etc. Transitions need to be more gradual. If focus is required – more light is required. As well, aging eyes are more susceptible to glare.

Accommodation: the process of focusing on a task. Focusing is tiring; maintaining the same focus causes fatigue. Continually changing focus also causes fatigue.

When designing the lighting for a seniors' residence it is important to look at the multitude of activities. Is the lobby used for reading or greeting, or both? The lobby at Bethel Place is used for reading, visiting with neighbours, picking up your mail, waiting for rides, and checking in with reception for doctor, specialists, or hair appointments.

Blue-rich light can aid vision in low-light. While the compact fluorescent lamps of Bethel Place were chosen for efficiency over colour rendering, their blue-rich light does aid the vision of residents reading in the lobby.

The brightness of the transitions aids residences in their movement through the building. The foyer is brighter than the lobby, the elevators are again brighter, then the hallways are considerably dimmer. The result of this is to give a focus to travel routes where the end of the travelling is brighter.

Visiting and reading in the private resident's lobby.

Elevators.

1.2 Evaluate Conditions

Overall, the building is typical construction with 8-foot ceilings with walls made of drywall and paint or wallpaper.

The walls are creamy beige. The floors are dark carpeting with a lighter textured center in the hallways, elevator lobby and private residence lobby. The ceilings are white, and there is a dark wood railing running the length of the hallways. The results are a good contrast between surfaces where residents need them most.

The sconces on the wall in the hallways provide direct glare to people around 6' tall. It is reduced for residents who are bent over from age, or using walkers, but it should be addressed.

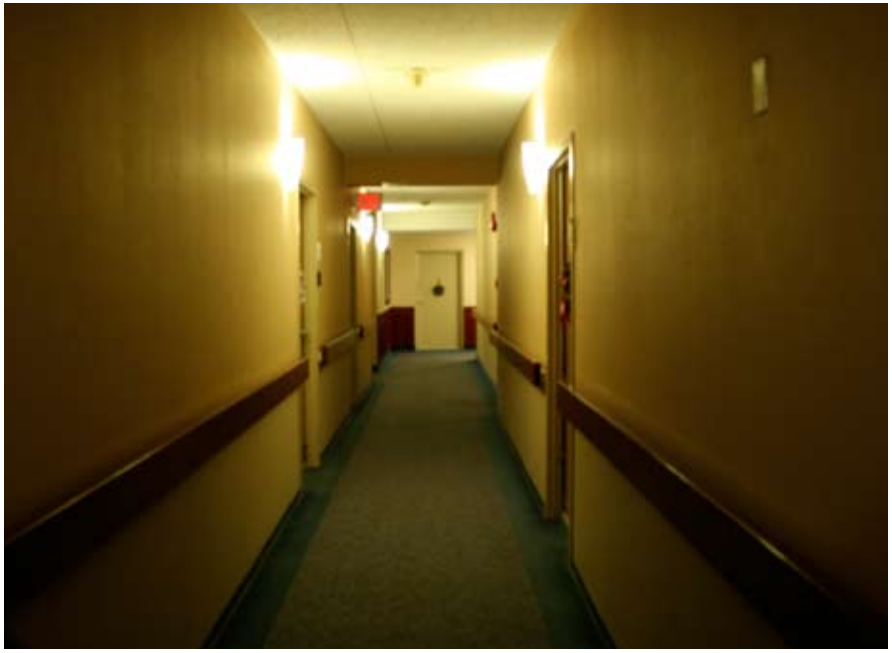
The furnishings throughout are high backed chairs upholstered with a fabric that contrasts the walls and floors. The tables for reading and activities are dark wood with a reflectance of <20%.

The public foyer has a higher reflective ceramic floor with the same furnishings found in the residence lobby. It leads visitors to the public dining room, or to the multi-purpose room. Access to the residence is through a security swipe card door.

The public dining room is decorated with exposed brick and varnished wood giving it a darker more intimate feel. The perimeter ceiling is lowered giving the illusion of a raised ceiling in the center. The desire for a more cozy dining experience trumps efficiency in the dining room as the fixtures are all incandescent with the option of dimming. The tables have a reflectance of 15% and the floor 17% making for very little glare from the surfaces.

The multi-purpose room is used for movie screenings, church services, choir concerts or other informal gatherings. The coat rack in the MPR services the MPR as well as the dining room.

Hallways.



Hallways.

1.3 Illuminance Measurements

Residence Entrance

312 lux @ reception desk
1450 lux @ courtyard exit
230 lux @ reading table
130 lux @ hallway transitions
330 lux @ foyer
220 lux @ mailboxes
370 lux @ elevator

Hallway

40-70 lux @ handrail depending on proximity to wall sconces.

Public Foyer

930 lux @ entrance
130 lux @ floor inside foyer
130 lux @ each chair

Dining Room

245 lux @ place-setting
1010 lux @ table by window
90 lux @ exit/entrance door

MPR

100 lux @ coat rack
115 @ threshold between foyer & MPR
200 lux @ seats with pendant lights; 20 lux without lights on
650 lux @ fluorescent feature wall
150 lux @ incandescent feature wall
760 lux @ window; 147 lux 4' into room
92 lux with blinds drawn
97 lux @ piano with task light

Public foyer.

Public entrance.

1.4 Daylighting Conditions And Characteristics

Daylight availability

Bethel Place makes good use of its orientation and openings to provide adequate daylighting under most conditions. The public dining room faces a courtyard on two sides giving an even diffuse light even on sunny days. The west facing portion of the dining room is used the least and is the location for the kitchen ensuring most residents are not bothered by glare.

The private residence entrance also faces a courtyard providing a pleasant even light for the lobby. Any glare that may come from sunny days is diffused by the reception desk.

Dining room looking west.

Dining room looking east.

MPR with typical no-event lighting.

MPR with entrance lighting.

MPR with seating lighting.

MPR without perimeter lighting.

1.5 Assess (Or Identify) Lighting Systems

For the most part, the system at Bethel Place consists of modified ceiling mounted pendant lights that provide a diffuse upward indirect distribution. This provides a uniform light and reduces glare - especially unwanted with older eyes.

The hallways use a semi-indirect light that gives good contrast to the wall light without providing excess glare to residents.

The dining room uses direct diffuse downlights along the perimeter tables. This gives focus to those tables making them more suitable to recreational activities over the center tables below the diffuse indirect light.

The multi-purpose room uses a combination of lights to give the greatest flexibility in usage - from watching movies to church services or choir concerts.

The MPR does have a fun fluorescent fixture with a decorated diffusion panel to give it the appearance of a diffuse skylight.

Emergency lighting and exit signs

The emergency lighting is basic. Because it is an independent living facility, they don't feel the need for a more advanced exit lighting condition than the basic. The orientation and placement of exit signs should be given a little more consideration however as the exterior emergency exit sign in the MPR is partially blocked by renovated duct work.

Coat rack.

MPR piano.

1.6 Conclusion

While taking measurements in the private residence lobby, I was asked, "So, is it bright enough?" I asked if she could read her paper OK, and when she responded, "yes" I told her it was bright enough, and that it didn't matter what the lux measurement was as long as she could read without strain.

There is a concern about economy and energy use when running a large facility such as this. They have nearly completed a re-fit into compact fluorescent lighting and discovered their hydro bill dropped by a third.

The new CFLs are very bright and some of their output needed to be reduced in the lobby areas to give a more pleasant feeling.

Architecturally, the dining room & foyers could have higher ceilings to allow for more efficient use of available sunlight. Overall, the lighting at Bethel Place is pleasing and comfortable. The glare is minimal and the contrast is high enough where it is required.

MPR exit.

"Skylight."

02 Residential - M House 900 Grosvenor

2.1 Design Considerations

M House is the private residence of Neil Minuk, principal of DIN Projects. Located at 900 Grosvenor Avenue it nestles into the existing neighbourhood. Neil designed this house with the intention of taking ordinary materials and techniques and make them aesthetically beautiful.

A residence can serve many purposes including eating, sleeping, work and play. Because of this, areas within the home may serve a variety of functions at the same time. Lighting can help delineate and separate task areas & public/private spaces, or it can unite them.

Design considerations for residential lighting include task lighting surfaces, overall ambient lighting, daylighting, security lighting, and controlling the lighting zones.

Identify and evaluate human factors

Living Room: reading, watching TV, visiting
How much time is spent in this room each day?

Dining Room: entertaining guests, laptop computer, eating
How much time is spent in this room each day?

Kitchen: cooking elaborate dinners, eating, transition between private & public space
How much time is spent in this room each day?

Front Entrance: main entrance for guests
How much time is spent in this room each day?

Living room.

Dining room.

2.2 Evaluate Conditions

M House is 4 rectilinear volumes with 3 making up the main floor and a 4th stacked on top for the second floor. It has an open floor plan built around available joist spans, i.e. each room is 16' wide - the longest readily available Tru-Joist. The ceilings are flat with occasional openings between the joists for recessed lighting & electrical boxes as well as hidden drapery track. The connections to the floor and ceiling are intended to be seamless with no visible baseboard or trim.

The furnishing of M House are low and modern. Legs for tables and chairs are open and as light as possible to give the appearance of heavy pieces held up effortlessly.

The primary construction of M House is 2x4 stick framing with a painted drywall finish. The results are thin walls with a diffuse reflectance of about 75% The walls are white. The floors are light hardwood finished with oil instead of varnish. This is less durable, but more pleasant to the eye and touch.

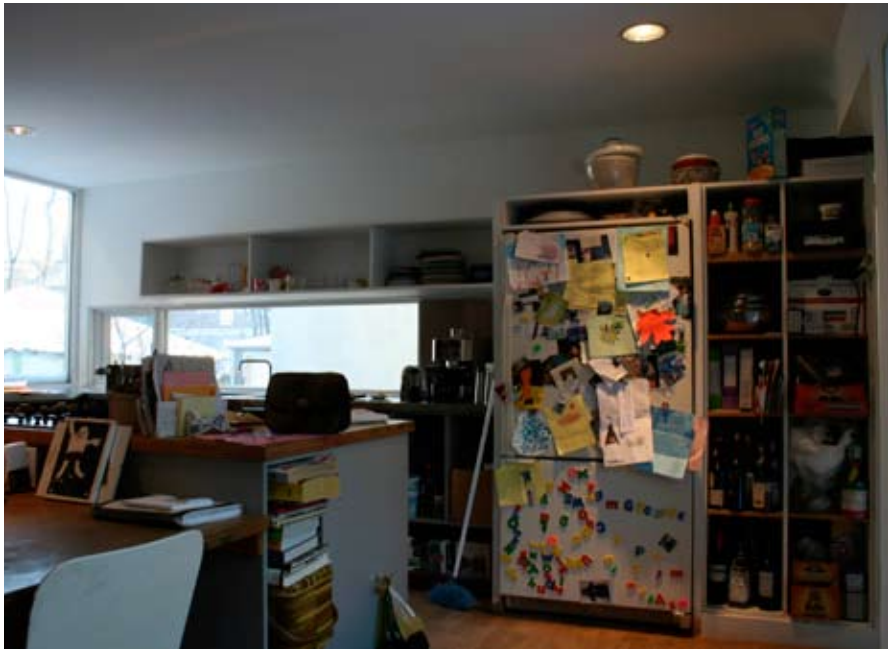
Kitchen.

2.3 Illuminance Measurements

240 lux @ Dining Room Table (day); 210 lux w/ light; 20k lux at source
300 @ front entrance (day); 330 @ w/ light
140 lux @ kitchen table (day); 600 lux w/ light
1060 lux @ kitchen counter (day); 2700 lux w/ light
20000 lux @ Dining room wall (w/ lights)
330 lux @ living room north window; 1000 lux @ w/ light
300 lux @ coffee table

Surface reflectance

Walls: 73%
Floors: 32%
Kitchen counter: 33%
Floor: 30%



Kitchen & pantry.

2.4 Daylighting Conditions And Characteristics

Daylight availability

The fenestration allows direct transmission. There are purposefully no window coverings to take advantage of as much available daylight as possible.

Fenestration type/placement

The low long windows generally extend to a change in surface plane, either a corner, floor or ceiling. This seems to draw light into the room along the perpendicular surface. It may not make the room physically brighter, but it makes the room feel brighter and it makes the structure seem lighter.

Illuminance measurements

Beside window: 1500 lux
6' Inside room: 250 lux

Built in kitchen table.

Transition from kitchen to dining room.

2.5 Assess (Or Identify) Lighting Systems

All of the lighting in M House is direct down lighting giving the various surfaces strong pools of light. This creates areas of shadow and contrast between the beams. The task surfaces, i.e. the dining table and the kitchen table have pendant lights that give a dramatic light to the surface they are illuminating.

The overall effect of this direct lighting is in contrast to the diffuse light of day.

The lamps are PARs giving a good degree of beam control.

There is an intention to add fluorescent tubes to kitchen cabinets and over millwork, but this has yet to be realized.

2.6 Conclusion

This is a home with careful attention to surface and edge details and window openings. The result is a home that changes daily and seasonally with the conditions outside. At times the glass is highly reflective, then other times it seems to disappear. The rooms change from highly diffuse light to strong directional light and everywhere in between.

The task lighting could be better, but it's hard to be critical when everything else is so great. In an effort to be flexible, the lighting for the tables doesn't work very well.

Entrance with diffuse glass.

Lighting in dining room.

03 Classroom - Helen Glass Centre

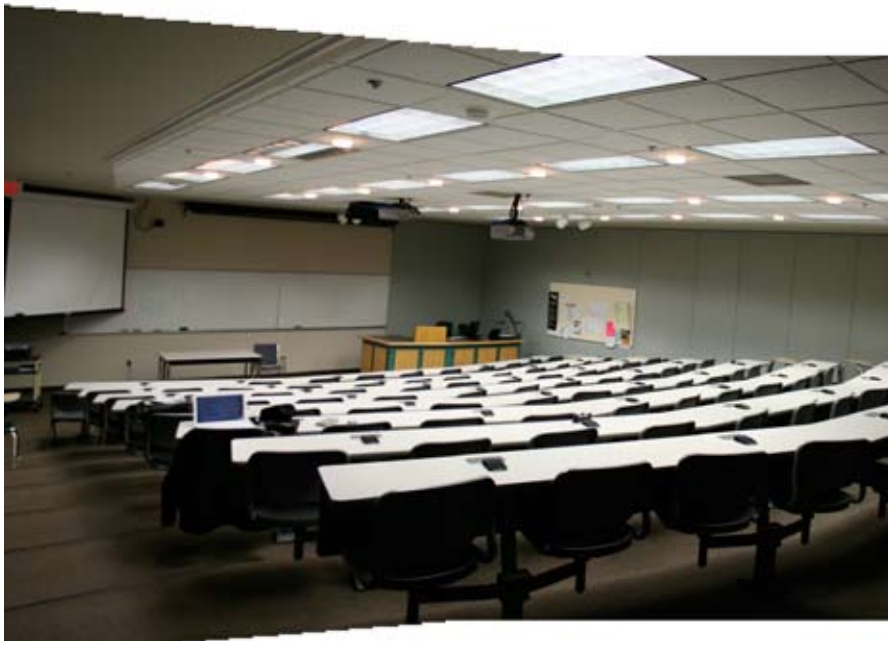
3.1 Design Considerations

From the PCL web site: "This state-of-the-art building serves as an education facility for nurses, faculty and the University of Manitoba Students' Union office space. The building hosts the most advanced lecture theatre at the University of Manitoba for 100 students, nursing training labs (hospital alike), computer laboratories and interactive rooms."

A classroom has many functions and learning outcomes to accomplish, so a variety of tasks need to be considered. The combinations of close work (desks) and remote work (blackboard) are examples.

A pitfall to be aware of is the direct glare zone (45˚ to 90˚). Direct glare from luminaires should be avoided at all times. Luminaires should be placed so the smallest luminous area is presented to the line of sight.

Avoid high contrast between chalkboards and adjacent walls.



Classroom in Helen Glass Centre for Nursing

Classroom in Helen Glass Centre for Nursing

3.2 Evaluate Conditions

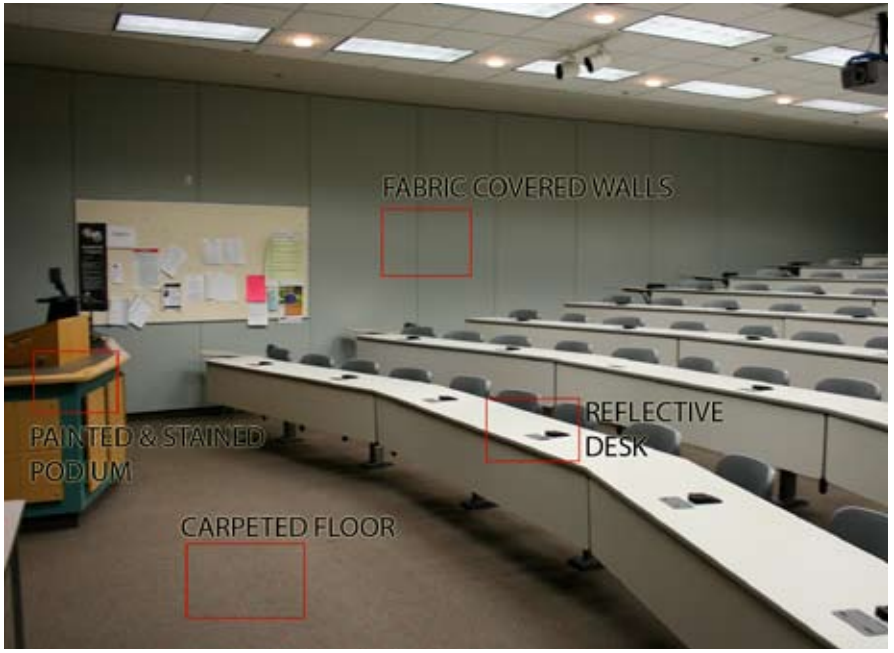
The lecture hall is a wedge shape in plan with tiered fixed seating and fixed desks. The ceiling is acoustic tile, the walls are fabric covered and the floor is carpeted. The colours are less than pleasing, but perhaps that's a strategy to give the nurses a taste of the clinical environments they'll be working in.

3.3 Illuminance Measurements

1000 lux @ desk
380 lux @ podium

Particular attention should be paid to surface finishes and reflectance. According to the Philips Lighting Handbook they should be:

Ceilings: 70-90% (actual: 76%)
Walls: 40-70% (actual: 37%)
Floors: 30-50% (actual: 7%)
Furniture: 20-40% (actual: 16%)
Desks: 25-45% (actual: 35%)
Chalkboards: <20% (actual: 75%)



Finishes (specularity)

Lighting controls.

3.4 Assess (Or Identify) Lighting Systems

The basic lighting for the lecture hall is overhead diffuse lighting with a high intensity. The four-bank fluorescent fixtures provide a high light output with a high degree of efficiency.

The basic lighting is supported by incandescent semi-diffuse down lighting. They are dimmable and provide flexibility when viewing work on screens or listening to lectures.

The third element of lighting in the lecture hall is flexible track lighting for the lecture podium. They provide a direct beam of light to properly light the lecturer. They are also on a dimmer to provide comfort to the speaker or adjust visual contrast between the speaker and the background for the students.

Emergency lighting and exit signs are oriented towards the viewer making them more effective than if they were simply mounted against the wall.

Control is an important element for creating a well-lit classroom and allowing the flexibility required by varying tasks. Each bank of lights is individually controllable from the podium.

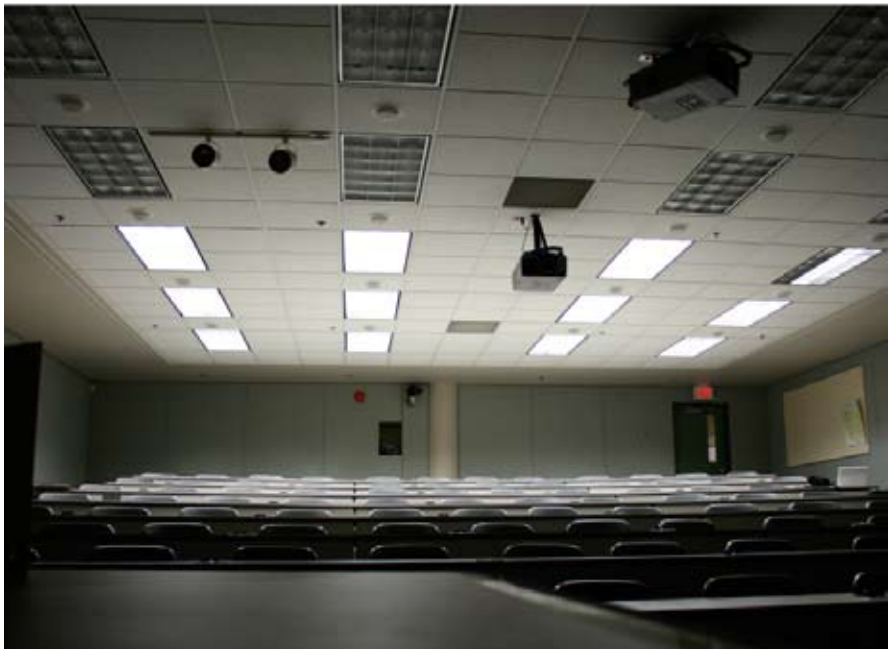
An occupancy sensor would allow for more cost savings and energy efficiency.

Exit Signs.

Diffuse direct down lighting.

3.5 Conclusion

The quality of lighting and control are adequate for classroom use. But, they are by no means exemplary. Certainly more effort was put into the technology of the room - the various projectors, hearing impaired ports and data and AC outlets at each seat.



Controllable banks of fluorescent fixtures.

Controllable banks of fluorescent fixtures.

04 Retail - EQ3

4.1 Design Considerations

The EQ3 store at 1545B Portage Avenue was designed with a nod to the modern. It has an expanse of glass and wide open spaces for universal functionality. Today it is a store, tomorrow it could be a bank.

There is only one motivation to consider when designing lighting for a retail store - sell merchandise. If the store doesn't sell - it doesn't exist.

Retail lighting should give the customer a comfortable feeling and make the shopping experience enjoyable. The lighting scheme should emphasize specific merchandise using a combination of general and specific lighting, as well as direct and indirect lighting.

Showcases, counter tops, wall displays and cases need to be emphasized for content as well as vision. A combination of diffuse light to eliminate shadows and direct light to enhance features make the customer look better, making him more likely to buy more.

The interior colour of the walls is also important. Green is complementary to most complexions.

Storefront/display windows should be lit like a theatre set to draw people into the store from the street. Reflection and glare should be avoided at all times. Care also needs to be taken with UV rays fading the merchandise.

Finally, a store needs to be concerned with security lighting. They need enough light to keep burglars out, and keep electricity costs at a minimum. And, while we're at it, it should still look appealing to after hours window shoppers.

Entrance.

Reception.

4.2 Evaluate Conditions

The basic form of the EQ3 store is box construction with exposed open web joists. The vast expanse of glass at the front of the store provides a diffuse wash of light into the store. However, because the windows are tinted they give the merchandise in the windows a dull grey appearance.

The store's line of modern furniture is mostly sleek and low, and like the furniture in Neil Minuk's M House it is clear of the floor supported by slender legs. The floor is polished concrete. There are low partitions separating the furniture displays.

The lighting designer's grand move was to create heavy lighted columns at the center of the store.

Cash area.

Front display area.

4.3 Illuminance Measurements

60-100 lux in pathways between furniture displays
150-200 lux around furniture displays
900-1000 lux @ reception entrance
800 lux @ checkout

Surface reflectance

Walls: 13%
Floors: 19%

4.4 Daylighting Conditions And Characteristics

The curtain wall of glass is oriented to the east catching morning sun, which is mostly past by the time the store opens at 10 am. The wrap-around glass also faces north. There are two display windows on the west side that project out towards the sidewalk.

The glass façade is an integral part of the architectural design, but it isn't integrated into the store's daylighting strategy. The glass itself is too reflective to be an effective display window, which is a real lost opportunity.

Illuminance measurements

Beside window: 4500 lux
Inside room: 1500 lux

This store would be well served with some skylights.

Display cases/shelving. The plate must be on special.

Lighted columns.

4.5 Assess (Or Identify) Lighting Systems

The majority of the lighting is provided by fluorescent diffuse semi-direct downlights with reflectors and baffles. They provide an even shadowless base for the store. This store is under lit without its general lighting, but the colour rendering of the fluorescent fixtures is undesirable when they're on, so they are always turned off.

Flexible direct incandescent track lights are intended to provide focus to displays at the front of the store, as well as the display shelving on the south side. The par lamps used in these fixtures are too far away, or too wide of a beam spread to be effective.

The center of the store holds the furniture displays that are changed less frequently, so they were able to build a bulkhead and install direct downlights. They also installed the downlights in the rear window displays. There are two problems with these lights. First, they appear to have been installed for their looks only as their on-center spacing is too great to provide coverage. Secondly, the downlights at the center of the store are perceptually over powered by the lighted columns.

Semi-direct diffuse pendants are installed at the checkout counter to aid the customer in signing his or her bill.

The lighted columns are made with fluorescent tubes inside a light box frame. Upon first glance they are a nice piece, but while shopping in the store they become a distraction and source of glare.

Exterior display windows.

Interior display windows.

4.10 Conclusion

According to an employee of EQ3, they were wined and dined by the lighting designer and promised them a great design. When installation was in progress, he complained he couldn't get lamps with the proper colour temperature. That's not all that's missing...

Now, the current manager leaves the fluorescent lighting off during the day because of their colour rendering, and also because a third stopped working. To add to this they are discontinued.

As a customer, I find the store to be way too dark and difficult to negotiate. I find I like the furniture in their catalogue, but don't like it in the store.

A proper lighting scheme and careful attention to paint colour would make this store much more inviting.

Track lights with open-web joists.

Fluorescent diffuse downlights.

Down lighting in bulkhead.

05 Exterior Architecture - Riel Esplanade

5.1 Design Considerations

Riel Esplanade was completed in the fall of 2003 and opened to the public on New Year's Eve. It is strictly a non-vehicular bridge for pedestrians and recreational cyclists.

Exterior lighting of an architectural object gives the designer an opportunity to play with form and colour to create a light sculpture, where that is not always the case with interior lighting designs that are more concerned with the task at hand.

There are two areas of emphasis with a sculptural exterior lighting design to consider, however. The first is the object you're lighting, and the second is the pedestrian or traffic that will be using the area or in close proximity.

While minimal illumination is required for a path at night, security and safety is paramount.

A concern with outdoor pedestrian lighting is the adaptation that occurs between over lit parking lots and under lit landscaping. Unsavory characters can hide in the dark bushes beyond. In nature, the even light of moonlight allows us to distinguish objects and movement.

As well, the pathway needs to be illuminated enough to avoid tripping, or being hit by vehicular traffic that may cross the path - additional illumination is required for crosswalks.

Another concern is reflectance and glare. The cable stays on the Riel Esplanade are individually lit, but they must be lit in such a way as to not produce direct glare for pedestrians or drivers.

Bridge at night from the west.

Bridge pathway.

5.2 Evaluate Conditions

The Riel Esplanade Pedestrian Bridge is a cable stayed bridge where the cables all rise to meet at a mast in the middle. The walkway, which is only wide enough for pedestrian traffic, has a railing. There is a restaurant in the middle of the span. There are also transition areas at either end of the bridge with benches and paths that connect to either the street or pedestrian walkways.

There are benches at either end of the span. Plus, there are plaques to read with historical information. These are not specifically lit for night-time visitors.

The bridge is cast-in-place concrete. The mast and cable stays are made of painted steel. Except for the restaurant, it is open to the air.

Cable stays and mast lighting.

5.3 Illuminance Measurements

52 lux @ sidewalk lamp standard
10 lux between standards
230 lux @ railing post mount
4 lux @ centre of bridge pathway

According to the Philips Lighting Handbook: 5 lux is the recommended illumination for a walkway.

Perceived Brightness/Contrast

The pathway and transition areas leading up to the bridge are physically brighter than the bridge span, but perceptually the span appears brighter. Blue-rich light can aid vision in low-light, making the pathway perceptually brighter, ergo safer.

Post mounted railing lights.

Yard lights for bottom third of mast.

5.4 Assess (Or Identify) Lighting Systems

The sidewalk and transition areas use direct diffuse downlights. This gives a fairly even spread of light with minimal shadows. They are lamped with low pressure sodium lamps.

The bridge span pathway is lit with post mount lights at the height of the handrail with a semi-direct semi-diffuse beam. They are very bright and at the bluish end of the spectrum projecting their beams downward onto the path creating distinct beams and shadows.

The cable stays are lit with what appear to be exterior theatre lights - Par 56s with tungsten-halogen lamps. They are direct narrow beams that are focused specifically on each cable stay.

The mast is lit ambiently by the cable stay lights. It is also enhanced with halogen yard lights to catch the bottom third. They are a direct semi-diffuse light with a relatively uncontrollable beam spread.

The bridge is lit only at night, presumably controlled with photocells.

5.5 Conclusion

This is a beautiful iconic bridge, and it is lit well. The efficiency of the LPS lamps often get in the way of proper exterior lighting. Their colour rendering is poor and they don't seem to light much.

Stepping onto the bridge pathway with its blue-rich white light is a treat.

It seems to me that the white bridge gives an opportunity for some play with colour, but maybe that's just too much too soon.

Par 56 cable stay lighting.

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