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Retail Store Induction Lighting Case Study

By: L. Michael Roberts

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About the Author - L. Michael Roberts

L. Michael Roberts was born of Canadian parents in the Republic of South Africa. He moved back to Canada, via a year in Europe, in his late teens to correct the situation. His father was an electronics engineer and radio amateur (ham) and he influenced Michael's early interest in electronics and mechanical devices. In school Michael studied the regular subjects along with art, art history, classical and vocal music and was involved in his school theatre productions. He found he was more interested in the lighting, sound and production aspects of the shows. Thus began a life-long interest in the technical aspects of show production, especially lighting.

L. Michael Roberts is the Chief Technology Officer for InduLux Technologies Inc., an R&D and intellectual property company focusing on energy efficient technologies - www.InduLuxTech.com Michael is presently working on advanced, high efficiency, magnetic induction lamp light sources. An induction lamp Highbay fixture he designed won the 2006 "Innovative Product Award" from the Huron Manufacturers Association.

Michael travels to China frequently and regularly visits all of the major induction lighting factories. He has worked with a number of Chinese induction lamp manufacturers on improvements to the technology as well as fixture designs optimized for use with magnetic induction lamps.

Michael is an inventor with two granted patents in UV water treatment technology. He also invented the world's first UVC induction lamp. He presently has various patents pending on Magnetic induction lighting technology, and specialty induction lighting fixtures. He works as a consultant to manufacturers and distributors of magnetic induction lighting products worldwide, some of which are also licensees of his Intellectual Property. He is also an author whose works have been translated into a number of languages.

Retail Store Induction Lighting - Case Study

By: L. Michael Roberts

The retail store is located close to the central square in downtown Goderich, Ontario. The premises is a small custom embroidery and fabric item gifts store. Gift items are sewn and embroidered at 6 workstation areas in the retail store so that customers can have items personalised while they shop. The store also produces larger orders of custom embroidered items such as sports team shirts and jackets, caps, canvas tote bags, aprons and other embroidered items.

The premises consists of a 50.2 square meters (540 sq. ft) retail area with a large, west facing, floor-to-ceiling glass window at the front, flanked by a glass door. There are two smaller areas; one for storage (where the existing fluorescent lighting was not changed) and one of approximately 8.9 square meters (96 sq. ft.) with a wall-to-wall table for fabric cutting.

The type of work being done relies on fine vision for dealing with small stitching. Colour rendering is an important issue when matching the colours of embroidered corporate logos. The store had only been open for a few weeks and already the owner and staff of the store complained that the lighting was not bright enough over the embroidery machines and was also uneven - especially in the far corners of the store (see photo below).

BEFORE: THE RETAIL STORE LIT WITH 4-TUBE FLORESCENT TROFFER FIXTURES. NOTE THE UNEVEN LIGHT DISTRIBUTION, WITH THE FAR LEFT CORNER OF THE STORE, WHERE THREE SEWING MACHINES WERE LOCATED, BEING PARTICULARLY DIM.

Facility:

The main store area was originally lit by means of five 2 X 4 suspended ceiling "troffer" type fixtures each using four 40W fluorescent tubes with dual "coil and core" type ballasts. In addition, there was a suspended wire track-lighting system using eight 20W, MR16, halogen incandescent lamps for spotlighting merchandise on shelves and wall display boards.

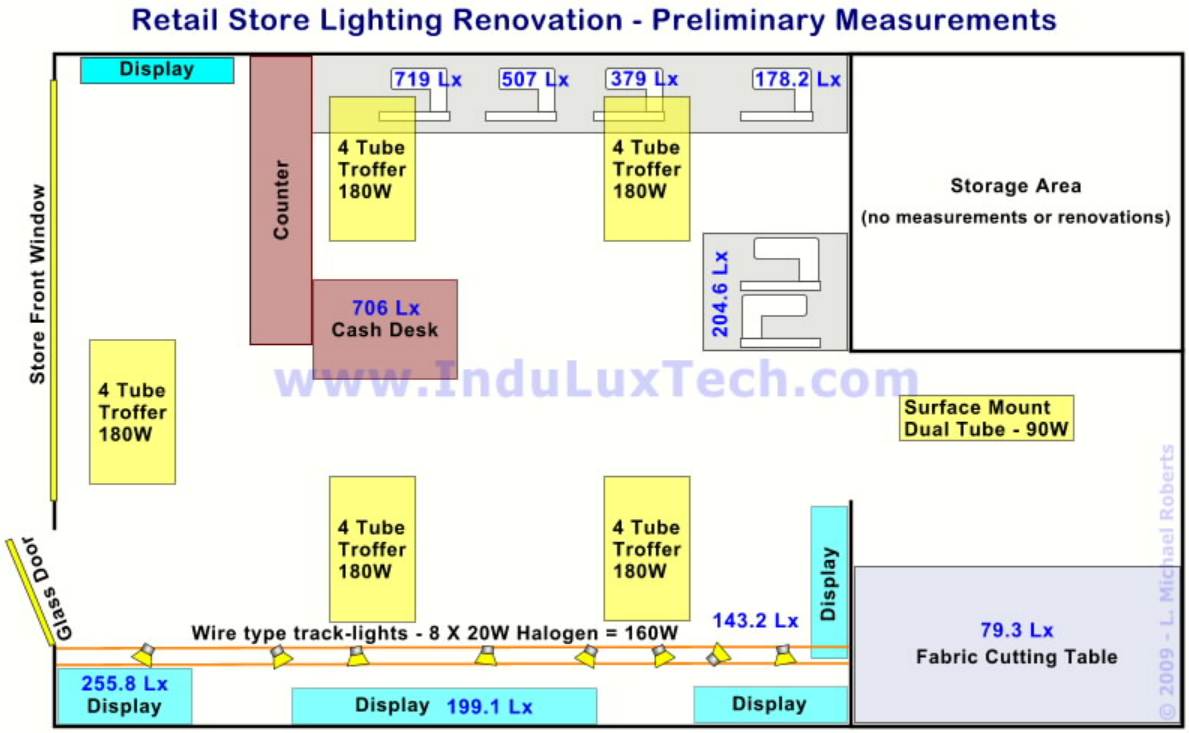
The lighting load in the retail store area was 800 watts for the 5 fluorescent troffers and 160 watts for the track lights. When the ballast overhead is included, the total lighting load in the retail area was 1,060 watts (1.06 kWh).

The fabric cutting area at the back was lit with a poorly placed, ceiling mounted, dual tube florescent fixture with a "core and coil" type ballast nominally consuming 80 watts. The actual power consumption was 90 watts of power with the ballast overhead included.

The total electrical load of the fluorescent and track lighting in the retail area and the fabric cutting area was 1,150 Watts (1.15 kWh).

Initial Measurements:

Detailed light level measurements (see diagram below) at each workstation and in the merchandise display area of the store were taken before the lighting renovations began (the measurements are shown in blue) using a "Cooke Cal-Light 400 calibrated precision lightmeter"[1] and were taken in Lux (Lx). The readings were taken at night so as to eliminate the effects of daylight entering through the glass storefront and glass entry door.



Before the lighting renovations, the light levels varied from a low of 199.1 Lux to a high of 706 Lux - with an average lighting value of 365.8 Lux in the retail store area. The average was computed by adding the readings from all areas and then dividing by 9 [(719 + 507 + 379 + 178.2 + 204.6 + 143.2 + 199.1 + 255.8 + 706 = 3291.9)/9 = 365.8 Lux] As can be noted from the readings in the diagram above, the work areas varied widely in light levels.

The light level in the fabric cutting area was 79.3 Lux as measured in the center of the wall-to-wall cutting table (this figure was not included in the average calculation).

Retail Lighting Renovation Design Objectives:

The objective was to raise light levels at all the sewing machines and generally in the whole store. The Illumination Engineering Society (IES) recommends levels of 200 to 500 Lux for "Performance of visual tasks with high contrast or large size" - with higher levels recommended for working with small objects or critical assembly work. Some of the computerised embroidery machines in use have display screens and thus the Ontario Ministry of Labour regulations also had to be observed[2]. Since the staff working in the store were older, and the tasks involved working with fine stitches, the objective was to raise the light levels to a minimum of 500 Lux at the sewing machines. A secondary objective was to reduce overall electrical power consumption for lighting in the store.

The existing troffer fixtures in the store were to be left in place and the new fixtures would be wired into their circuits to reduce the costs of the lighting upgrade/renovations.

Lighting Renovations:

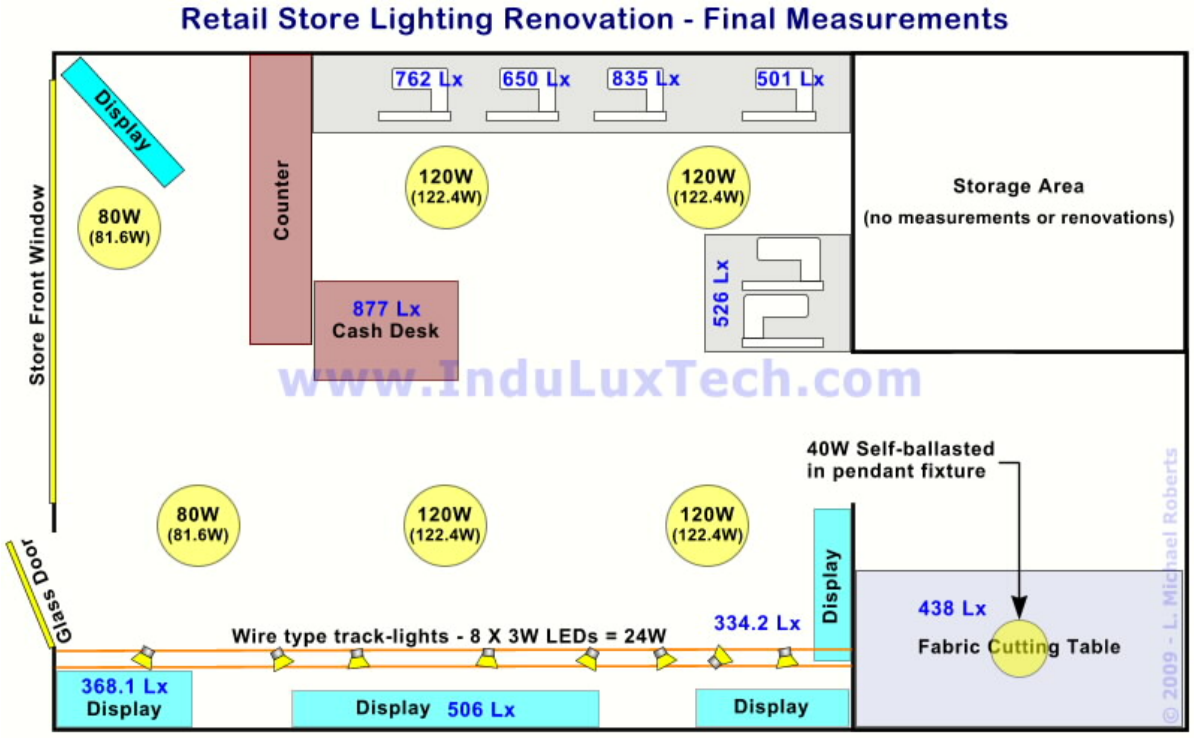
Six, low profile, Lowbay type induction lamp fixtures[3] with prismatic diffusers were chosen to light the main store area. The prismatic diffusers allow for some light to project onto the ceiling to eliminate the "cave effect" caused by a dark ceiling. The low profile Lowbay fixtures were chosen not only for their aesthetic appeal, but because the ceiling height was just over 3 meters (9.84 feet) and larger fixtures would have hung down further changing the apparent ceiling height.

The existing fluorescent troffer fixtures were disconnected but were left in place in the suspended ceiling to save the cost and mess involved in removing them. Four of the induction lamp fixtures were equipped with 120W lamps. The two fixtures at the front of the store, where there was an abundance of natural light entering through the window and door (even on cloudy days), were equipped with 80W lamps - all the induction lamps were 4100K type. 4100K lamps were chosen as some people find the 5000K and 6500K to be "cold" while the 4100K appears bright and provides a high S/P ratio with good colour rendering.

The placement of the fixtures was generally symmetrical with the exception of one of the fixtures at the front of the store (see "final measurements" diagram on next page for layout). This was placed closer to the storefront window as the store has a hinged display wall which is moved to an approximately 45 degree angle when the store is closed. The placement of this fixture, and wiring it to a separate circuit, allows it to remain on at night to light the merchandise displayed in the storefront window. The replacement fixtures were 120 watt models for the store interior and 80 watt models at the front as less lighting was needed there due to the daylight from the windows.

The eight, 20W, MR16 halogen lamps in the track lighting were removed and replaced with 3W, LED, MR16 lamps to light the display areas. No changes to the track lighting were required to accommodate these lamps as they are a direct plug-in replacement.

The dual 40W fluorescent tube surface-mounted fixture in the fabric cutting area, was removed and replaced with a 40W, self-ballasted, 5000K induction lamp in a pendant fixture mounted over the center of the wall-to-wall table at a height of 1 metre above the work surface. A 5,000K lamp was chosen to provide colour rendering closer to daylight when cutting and assembling fabrics for production where colour matching is an important factor.



As can be noted from the diagram (above) and seen in the "after" photo (top of next page), the work areas are now more uniformly lit and all of the work stations are at, or above, the recommended 500 Lux for fine work.

Final Measurements:

Detailed measurements were taken after the new induction lighting fixtures were installed - again at night so as to eliminate the effects of daylight from the glass storefront.

After the lighting upgrade (see diagram above - readings in Lux [Lx] shown in blue), the light levels varied from a low of 334.2 Lux to 877 Lux - with an average lighting value of 595.5 Lux - an increase of over 55%. The average was computed by adding the readings from all areas (except fabric cutting) and then dividing by 9 [(762 + 650 + 835 + 501 + 526 + 334.2 + 506 + 368.1+ 877 = 5359.3)/9 = 595.5 Lux].

The VEL (Visually Effective Lux/Lumens[4]) for the store was not calculated since the fluorescent lighting which was replaced, had an S/P Ratio of 1.54, while the induction lamps have an S/P Ratio of 1.62 - a difference of about 5% which is not noticeable.

The light level in the fabric cutting area was measured at 438 Lux in the center of the wall-to-wall cutting table. This is just slightly below the recommended levels, but the 5000K induction lamp which was installed has an S/P ratio of 1.96 yielding an adjusted reading of 858.4 VEL with much improved colour rendering.

The higher colour temperature of the replacement LED lamps in the track lighting (S/P Ratio of 1.9) improved the colour rendering of the merchandise displayed on the wall racks.

AFTER THE UPGRADE: A VIEW OF THE STORE WHERE 5 OF THE INDUCTION LOW-BAY FIXTURES ARE VISIBLE. NOTE THAT THE LIGHT DISTRIBUTION IS NOW MORE EVEN AND THE SPACE IS MUCH BRIGHTER.

Comparison of Electrical Power Consumption:

The total electrical load of the old fluorescent lighting in the retail area and the fabric cutting area (with ballast overhead included) was 990 watts. The halogen track lights contributed an additional 160 watts for a total of 1,150 watts (1.15 kWh).

The total electrical load of the new magnetic induction and LED lighting installed in the premises (including the ballast overhead) is 717 Watts (.717 kWh) - an energy reduction of 433 Watts (.433 kWh).

Summary:

The new **magnetic induction fixtures and LED lamps** provide much **smoother, glare free lighting**, at **higher light levels**, with **improved colour rendering** and **significant energy savings**. Improved placement of the induction lamp fixtures eliminated operator shadows at the sewing machines. Staff and management were delighted with the improvement in lighting levels.

- Electrical load was reduced from 1,150 W to 717 W - **more than a 37% energy savings!**
- Average light levels were improved from 365.8 to 595.5 Lux - **more than 55% brighter!**

References:

1. http://www.cookecorp.com/cooke/php/products/lightmeasuringsys_1-en__01031301.html
2. http://www.labour.gov.on.ca/english/hs/pubs/comp_erg/gl_comp_erg_3.php
3. For those unfamiliar with Magnetic Induction Lamps, see the **"How Magnetic Induction Lamps Work"** available at http://www.induluxtech.com/Library.html or a shorter on-line version available form Google Knol at http://knol.google.com/k/how-induction-lamps-work#
4. For more detail on S/P Ratios and VEL (Visually Effective Lumens/Lux) see pages 11~17 in the publication "The Science behind Induction Lighting" at http://www.induluxtech.com/Library.html

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InduLux Technologies Inc., brings years of experience working with, and innovating, Magnetic Induction Lighting technologies to our world-wide clients. Magnetic Induction lighting, also called Induction Lamps or Induction Lights, is currently the most energy efficient lighting on the planet!

We provide consulting, product design, R&D, and Intellectual Property services primarily to manufacturers and distributors of induction lighting systems and equipment around the world.

SERVICES

We provide consulting on Induction Lighting technology, marketing, business issues, product design services, contract R&D, technical support, interface with Chinese suppliers (including English/Chinese/English translation), literature and web site design, CAD drawings and 3D computer modeling services to manufacturers and distributors of induction lights.

PUBLICATIONS

We have a number of Induction Lighting publications available on-line at http://www.induluxtech.com/Library.html These include "The Science Behind Induction Lighting" which gives a clear and concise explanation of the scientific advantages of Induction Lighting, "Environmental Aspects of Magnetic Induction Light" which demonstrates how Induction Lighting is one of the most environmentally friendly lighting technologies available today, and many more.

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