COMBINING
ENERGY EFFICIENCY
AND QUALITY DESIGN

Cathedral High School

A *knowhow*™ Case Study

demonstrating lighting

Today's schools require high quality, yet energy efficient lighting to meet student's educational needs. Forty years ago, when Cathedral High School was designed, schoolwork was done with pencils and ballpoint pens. Today, students are just as likely to be working at a computer screen as they are to be writing. The wide range of activities associated with modern education requires flexible, low-glare and efficient lighting design.

"When visiting classrooms I have noticed a decided difference in students' ability to see and to read the board, because of the even distribution and brightness of lights."

Sister Maureen Sheehan, SSJ

"With the grant from WMECO we were able to retrofit a forty-year old lighting system with the best technology available. Our teachers and students are now in a lighting environment that enhances their ability to learn."

Sister Denise Granger
Principal

Over several decades the lighting systems at this school had been modified and altered in a haphazard fashion, so that a wide mix of fixture styles and lamp types were found in the facility. Operating costs were very high, as much of the lighting was very inefficient. Hoping to improve lighting conditions, the school talked to Western Massachusetts Electric Company (WMECO). The utility offered to use the *Classroom Lighting knowhow*™ *Series* guide to develop a new and comprehensive lighting design for the school.

Now, in an excellent application of principals found in the *knowhow*™ *Series* guide published by the DesignLights™ Consortium, Cathedral High is ready for another generation of teaching. The installed solution uses indirect pendants with T-8 lamps and electronic ballasts to replace older, inefficient fixtures. The new system has much better color qualities and energy efficiency. The lighting re-design deals effectively with problems of glare, lighting uniformity, and provides control flexibility for the classrooms.

Problems Overcome

Cathedral High School was designed and built in the 1950's, using lighting system typical of commercial lighting designs of that era. WMECO found a mix of lighting technologies and styles throughout the building. Most of the classroom lighting fixtures were four-foot T-12 fluorescent lamps with standard magnetic ballasts. Some of these fixtures had been retrofitted with T-8 lamps and electronic ballasts over the years.

Lighting fixture styles include both pendant and surface mounted acrylic cube/grate fixtures, and recessed aluminum fixtures. Many fixtures showed their age with yellowed reflective and refractive surfaces. These fixtures were very likely delivering less than 50% of the light they were designed to provide.

Lighting Quality

Designing quality lighting for educational spaces means supplying good color, uniformity, and balanced brightness relationships—all factors that contribute to higher performance on visual tasks and enhance concentration. Adequate levels of illumination are equally as important. In this instance, appropriate light levels are attained for low energy operating cost because of the very high efficiency of the lighting equipment. In addition, the new design qualifies for a utility financial incentive.

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"In just a few months Cathedral High School has taken a quantum leap from the middle of last century to the twenty-first century. A feature of this project was a completely new lighting design, rather than a one-for-one replacement of the old fixtures. Lighting levels and lighting quality were significantly increased, and energy costs significantly decreased."

Bob Dvorchick, Western Massachusetts Electric Company Account Manager

"This project is successful because of the excellent teamwork. Manufacturer's representatives participated in commissioning, the school was able to organize local college students to help out with supporting activities, and the contractor went the extra mile to get the job done in time for the new school year. We didn't realize how bad the original lighting was until the project was complete."

Sean Cahillane, Vice Chair Board of Trustees

Quality Lighting Solution

The lighting solution was developed by Energy & Resource Solutions, who specified new lighting for most of the school, with the exception of the Gym, Cafeteria and Auditorium. The indirect/direct fixtures used in most classrooms and the lensed fixtures used in corridors are recommended by the *Classroom Lighting knowhow™ Series* guide.

The new design uses indirect/direct low glare pendant mounted fixtures, high-efficiency recessed parabolic fixtures, surface mounted fixtures, and LED exit signs. The pendant fixtures use highly reflective surfaces to provide widespread and even light distribution on the ceiling. A portion of the light filters directly through the perforated housing to boost overall lighting levels. High performance T-8 lamps with a CRI of 85 and a 3500K (white or neutral) color temperature are used throughout.

Certain classrooms had ceilings too low to allow pendant mounted fixtures. For these rooms, a recessed fixture with semi-specular parabolic louvers were used.

Fortunately most of the classrooms were originally designed with individual switching for each row of fixtures. The new lighting takes advantage of this wiring scheme, integrating it into the automatic lighting control circuits. Occupancy sensors control lighting in classrooms and offices. In classrooms with a significant daylight contribution, daylight-harvesting sensors provide additional on-off control of fixtures closest to the window.

Quality Indicators

	Rating		
	Acceptable	Good	Excellent
Control of Direct and Reflected Glare			✓
Light on Walls and Ceilings			✓
Fixture Location Related to People			✓
Light Patterns and Uniformity			✓
Daylighting Integration		✓	
Color Rendering and Color Temperature			✓
Lighting Controls and Flexibility		✓	
Quantity of Light on Horizontal Surfaces (fc)		✓	

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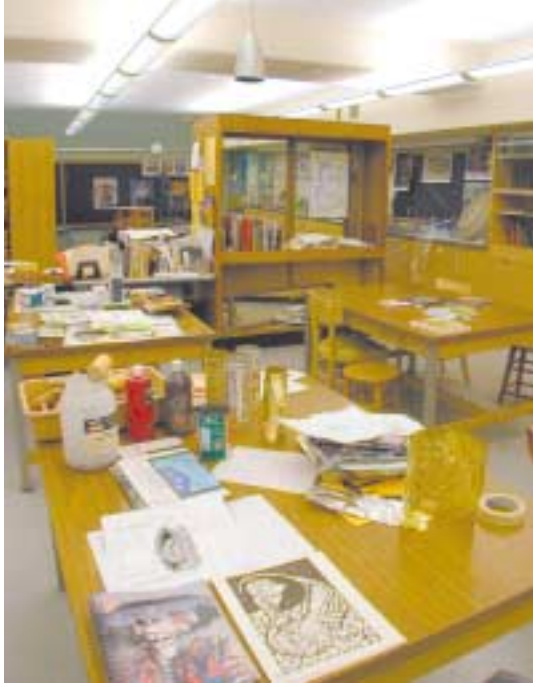

Prior to the re-design, existing fixtures showed their age and delivered less than half the light they were designed for.

Impressions

The general classroom lighting was designed to a target lighting level of 40 footcandles. In science lab classrooms, the designers increased the average illumination to 50 footcandle. In most classrooms the achieved lighting levels are 45-55 footcandles. The school's administrators believe the higher light levels and even light distance improves the students ability to see and read.

And Now the Numbers

Existing lighting exceeded code requirements at almost 1.8 watts per square foot. The new lighting system provides proper illumination at 1 watt per square foot. The new design reduced power demand by almost 58 KW. Quality lighting is achieved for 58 percent of the original connected load, with greater uniformity and no glare. The inherent efficiency of the electronically ballasted T8 lamps, and the 83% efficiency of the indirect fixtures, compared to an estimated 50% efficiency for the original fixtures, made this possible.

The low power density does not include any credit for lighting controls. Automatic lighting controls increase the savings expected from this energy efficient lighting design. WMECO expects additional demand savings from the occupancy sensors and daylight-harvesting controls.

Because classes are not actively conducted in all rooms simultaneously, and with the long delay between the time of the last class and the janitorial cleaning period, the utility expects occupancy sensors to cut lighting use in the classrooms by 33%. The daylight sensor works together with the occupancy sensor. The occupancy sensor has priority in keeping the lights off when the room is empty, regardless of the amount of daylight. When the room is occupied and the lights are turned on, the daylight sensor provides additional control. The utility estimates that the daylight-harvesting controls will keep the outside row of fixtures off about 36% of the occupied time.

Costs	
Total fixtures and lamps	$191,018
Total installation labor	$28,958
Installed system cost	$219,976
Materials per square foot	$2.48
Installation labor per square foot	$0.37
Total cost per square foot	$2.85
Savings	
Demand reduction	58 KW
Watts saved per square foot	.75 W/SF
Annual energy savings	376,300 KWH
Annual utility cost savings[1]	$31,609

[1]Based on 4,160 hours per year usage and local utility rate of $0.084 per kilowatt-hour. Demand and annual energy savings reflect estimates for added savings from controls (both occupancy and daylight on/off).

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Project Summary

Utility:	Western Massachusetts Electric Company
Utility Representative:	Bob Dvorchick
Customer:	Cathedral High School
Facility:	Cathedral High School
Location:	Springfield, Massachusetts
Space:	Classrooms and Corridors
Area:	77,000 square feet
Ceiling Height:	10 feet typically
Fixtures Used:	Corelite 'Class A Full-Perf' direct-indirect pendant with three 2950 lumen T8 lamps, the Watt Stopper LightSaver LS-100 daylighting controls and DT-200 Dual Technology occupancy sensors
Mounting:	Suspended 18 inches from ceiling on 10-foot centers
Light Levels Achieved:	45 footcandles average
Lighting Power Density:	1 Watt per square foot
Lighting Specifier:	Energy & Resource Solutions
Installing Contractor:	Enercon

"I'm highly satisfied with the quality of the new lighting. The controls and energy-efficient features are examples of good decision-making I point out to students as we study examples of sustainability in my environmental course segment."

Robert Broduer, Science Teacher

The Lighting *knowhow*™ Series

The DesignLights™ Consortium publishes the ***knowhow*™ *Series*** for office, small retail and classroom lighting. This ***demonstrating lighting knowhow*™ *Case Study*** highlights a specific installation of lighting that showcases quality, comfort and efficient use of energy. With members located throughout the Northeast, the DesignLights™ Consortium is "a regional collaboration seeking to influence naturally occurring lighting events towards quality, comfort and efficiency." The DLC includes among its members many New England electric utilities as active participants, as well as several other interested stakeholders. The DLC created these case studies with the intention of helping contractors and lighting specialists sell and deliver the benefits of high quality, energy efficient lighting to their customers in the commercial building market.

National Grid

- Massachusetts Electric
- Narragansett Electric
- Granite State Electric
- Nantucket Electric

Northeast Energy Efficiency Partnerships, Inc.

New York State Energy Research and Development Authority

Northeast Utilities

- The Connecticut Light and Power Company
- Western Massachusetts Electric Company

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- Boston Edison Company
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United Illuminating

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- Fitchburg Gas and Electric Light Company

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