

COMBINING  
ENERGY EFFICIENCY  
AND QUALITY DESIGN

## A knowhow™ CASE STUDY

# GODDARD SCHOOL

# demonstrating lighting



Natural light plays a big part in lighting the classrooms of the Goddard School, but on overcast days the School's new lighting system comes into it's own.

The Goddard School, located in Northborough, Massachusetts, is a nationwide franchise providing daycare and early childhood education to infants through pre-kindergarten ages. The school states its aim is to extend a warm, loving atmosphere to enhance the emotional, social, intellectual, and physical development of its children.

Helping meet this goal are state-of-the-art, custom designed buildings in which natural outdoor and premium indoor lighting play a key part.

Complementing natural outside light are low-glare, energy-saving recessed parabolic overheads and wall wash lights for the classrooms and other areas of the building. The lighting design closely follows lighting layouts in the DesignLights™ Consortium's *Classroom Lighting knowhow™* Series guide.

In the 8,000 square foot building, nine classrooms surround a central core of offices, staff lounge, kitchen, restrooms, and two 168 feet long hallways. The DesignLights™ Consortium's lighting solution, put together by member Massachusetts Electric, and with the help of Energy and Resource Solutions, Inc., replaced the Goddard School's original lighting layout, which failed to control glare and attain lighting uniformity and energy savings. The new lighting design encourages learning and promotes social skills among young children.



## PROBLEMS OVERCOME

The Goddard School's original lighting scheme called for 2 by 4 foot recessed ceiling troffers, each holding four T-8 lamps. But since the ceiling is at a height of 8-3/4 feet, it would have been difficult to incorporate these fixtures in an optimum lighting design. In order to stay within spacing/mounting height criteria, spaces would be over-lit. Otherwise, areas directly under the fixtures would be illuminated far in excess of requirements and areas distant from the fixtures would be under-illuminated.

The Goddard School's original design would have produced both direct and reflected glare. Using four T-8 lamps in the 2 by 4 foot open-celled troffers would have created direct overhead glare and added reflected glare with high light levels bouncing off work surfaces. Excessive glare and uneven lighting can produce fatigue among students and faculty because their eyes are constantly adjusting to changing light levels.



demonstrating classroom lighting knowhow™

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As in the classrooms, the lighting transforms hallways into display area for children to post their work.



### LIGHTING QUALITY

The DesignLights™ Consortium's *Classroom Lighting knowhow™ Series* guide outlines criteria that ensures quality for energy-effective classroom lighting. The solution also falls in line with the Illuminating Engineering Society's criteria for classroom lighting that stresses glare control, uniformity, and lighting on walls and ceilings.

Preventing direct glare can be achieved by using high-performance fixtures like the two-lamp 1 by 4 foot recessed troffers. These fixtures feature semi-specular parabolic louvers and an over/under lamp orientation that helps to shield occupants from a direct view of the lamps. The louvers control glare by reducing the exposure to direct lamplight and by directing the light to surrounding surfaces. Wall washing

light is achieved through the use of one-lamp asymmetrical fixtures. These reduce glare by targeting the majority of their light to the upper portion of the wall surface. The result is high visual comfort and an atmosphere that is conducive to classroom activities.

The selection of 3500K T-8 lamps with a high color rendering index of 85 compared to the 75 CRI of the standard T-8 lamps in the original lighting scheme ensures that colors are viewed accurately.

### QUALITY LIGHTING SOLUTION

Overhead and indirect wall wash lighting from three rows of four 1 by 4 recessed parabolic troffers illuminate the typical classroom. Variations on this layout illuminate other classrooms. The two center rows are comprised of deep recessed 1 by 4, 8-cell fixtures holding two T-8 lamps.

Wall wash lighting is provided with two outer rows of recessed 1 by 4 parabolic one lamp troffers that have an asymmetrical light distribution. Classroom walls double as working surfaces where children prepare and display their works.

The ceiling and wall wash lights are controlled separately, so staff can turn one or the other off or on according to classroom rest periods or brightness of outside light. An energy savings result.

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)		✓	



During sleep activities, only the wall washers remain on.

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Three crib/infant rooms also feature two lighting levels to save energy. During rest periods, recessed 1 by 4 ceiling fixtures covered with acrylic lenses (so infants do not look up at bare lights) remain off, while four 18W recessed compact wall wash fluorescents supply low level light. For waking activities, all lights remain on; for sleeping, only the wall washers stay on.

The two hallways are lit by 1 by 4, 8-cell parabolic troffers, each holding one T-8 lamp and washing light symmetrically on both walls.

Ceiling mounted occupancy sensors were installed in the classrooms to maximize the savings already achieved with the efficient lighting system. The users of the classrooms can manually override these sensors when in use.

## IMPRESSIONS

People at Goddard School are convinced that the lighting scheme promotes learning. Dipak Biswas, the Northborough franchise's owner, notes that lights are brighter and his electric bill is lower as compared to other Goddard Schools built to the standard lighting design. Although the use of natural light from the large exterior windows is advantageous; the bright lighting system in classrooms compensates for gloomy outside light on dark days.

The lighting helps accomplish Goddard School's goal of providing "the best possible environment for education and development of the child." The scheme at the Northborough school has proven so effective that new Goddard Schools built in Massachusetts will incorporate DesignLights™ Consortium's high quality lighting design rather than their standard layout.

## AND NOW THE NUMBERS

The lighting specifier, Energy Resources and Solutions, Inc., estimated the new lighting design would yield an average of 40 footcandles in classrooms. In actuality, light levels, combined with light entering from windows, rise as high as 70-80 footcandles. In corridors, light levels vary from 20 footcandles between fixtures to 30 footcandles beneath fixtures.

Lighting power density falls to 0.97 watts per square foot. The current Massachusetts energy code calls for lighting power density no greater than 1.5 watts per square foot for educational facilities. The lighting layout, even with 60 more fixtures, reduces connected lighting load by 2.67 kW, or 26 percent, and operating costs by one-third when compared to the original design. Bi-level lighting controls and occupancy sensors, permitting classrooms to go unlit 25% of the time, also save energy.



### COSTS

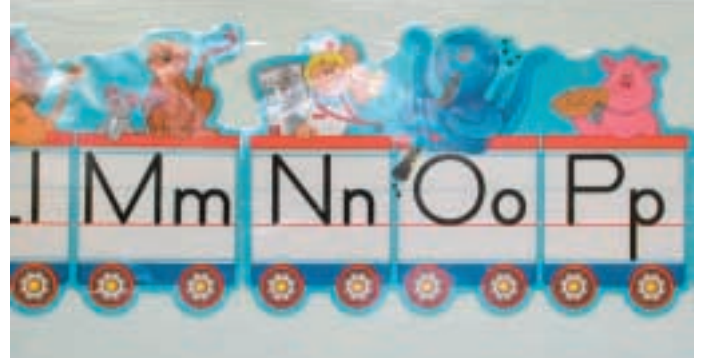
Total fixtures and lamps	\$18,780
Total installation labor	\$7,670
Installed system cost	\$26,450
Materials per square foot	\$2.35
Installation labor per square foot	\$0.96
Total cost per square foot	\$3.31

### SAVINGS

Demand reduction	2.76 KW
Watts saved per square foot	.33 W/SF
Annual utility cost savings <sup>1</sup>	\$1,400

<sup>1</sup>Based on 4,160 hours per year usage and local utility rate of \$0.085 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

<b>Utility:</b>	Massachusetts Electric
<b>Utility Representative:</b>	Donald Robinson
<b>Customer:</b>	Goddard School
<b>Location:</b>	Northborough, Massachusetts
<b>Space:</b>	Classrooms
<b>Area:</b>	8,000 square feet
<b>Ceiling Height:</b>	8 ¾ feet
<b>Fixtures Used:</b>	Metalux™ EP3GAX series troffers with Sylvania Optron F032/835 ECO Series T-8 lamps
<b>Light Levels Achieved:</b>	40 footcandles average
<b>Lighting Power Density:</b>	0.97 watts per square foot
<b>Lighting Specifier:</b>	Energy & Resource Solutions, Haverhill, MA
<b>Installing Contractor:</b>	Land Investments & Development, Northborough, MA

## THE LIGHTING KNOWHOW™ SERIES

The DesignLights™ Consortium publishes the *knowhow™ Series* for office, small retail, classroom and industrial/warehouse 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 and the Mid-Atlantic, 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 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.

### Efficiency Vermont

#### Long Island Power Authority

#### National Grid

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

#### Northeast Energy Efficiency Partnerships, Inc.

### Northeast Utilities

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

#### New York State Energy Research and Development Authority

#### NStar Electric

#### United Illuminating Company

#### Unitil

- Fitchburg Gas and Electric Light Company



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