

CLASSROOM LIGHTING

TOPICS:

- The Value of Lighting Quality
- Lighting Controls
- Daylighting

- General Classroom Layouts
- Computer Classroom Layouts
- Corridor Layouts
- Lighting Fixture Specifications



CLASSROOM LIGHTING

knowhow

Good lighting promotes better learning. Today’s schools must provide a stimulating environment where children will learn best. High quality lighting improves

students’ moods, behavior, concentration, and therefore their learning.<sup>1</sup>

1 - Adapted from “Designing the Future,” AIA Center for Building Performance.

Lighting quality means visual comfort, good color, uniformity and balanced brightness. This can be achieved with light-colored materials, glare control,

avoided. (See the chart below for the importance of quality factors.)

This guide gives you the *knowhow* to provide “energy effective” lighting for classrooms – lighting systems that optimize energy use while creating a productive, comfortable, and adaptable learning environment. Energy effective lighting is the best use of financial and natural resources.



Classrooms with windows help keep children alert. See back page for more information on daylighting.



better yet

Lighting on the walls and ceiling improves lighting quality.

Numbers refer to quality issues in chart below.

ACHIEVING BETTER & BETTER YET RESULTS

Classrooms often are lighted by recessed parabolic fluorescent 2’ x 4’ or 2’ x 2’ fixtures, systems that may not provide the best quality of light for learning. This *knowhow* guide shows you energy effective solutions that will deliver Better quality with improved energy efficiency. The Better Yet solutions identify further improvements, providing even greater long-term value for schools.

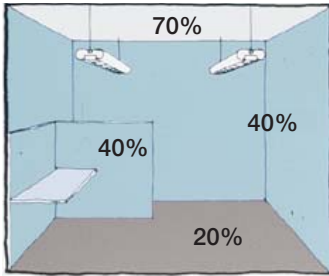
QUALITY ISSUES FOR SCHOOL LIGHTING

	General Classroom	Computer Classroom	School Corridor
Light on walls and ceilings 1 on photo above	●	●	◐
Control of direct and reflected glare 2	◐	●	○
Uniformity 3	◐	●	○
Daylight 4	●	○	◐
Color rendering and color temperature	◐	●	◐
Lighting controls	●	◐	○
Quantity of light (horizontal footcandles)	40-50 fc	20-40 fc	10 vert. fc

● Very Important ◐ Important ○ Somewhat Important \* Adapted from the Lighting Design Guide. IESNA Lighting Handbook, 9th Edition

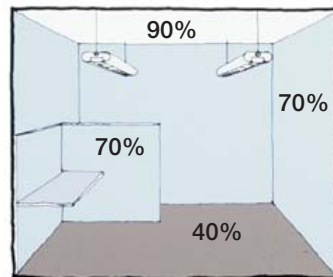
# how to achieve lighting quality

## USE HIGHER REFLECTANCES



A small increase in room reflectances (lighter-colored surfaces) greatly improves efficiency. The lighter-colored room (below) provides 55% more light on the work surface for the same energy or uses 70% less energy for equivalent brightness. The lighter-colored room also provides better daylight distribution, improves brightness ratios, and is more visually comfortable. These significant improvements are possible at little or no additional cost.

Light is both reflected and absorbed by surfaces. Lighter colors reflect more than darker colors. When more light is reflected, room surfaces become more uniform and visually comfortable. Reflectances are deceiving – surfaces absorb more light than you think! Don't guess: verify finish reflectances with manufacturers.



## CONTROL GLARE

Glare occurs when bright light sources and reflections interfere with the viewing of less bright objects. This high contrast may be uncomfortable or even disabling. Direct Glare is caused by fixtures located in front of students. Overhead Glare is caused by fixtures directly overhead. Reflected Glare is caused by bright reflections in surfaces such as glossy papers, shiny surfaces or computer screens. Glare control is especially important in flexible classrooms where desks and tables may face any direction, or in rooms with full time computer use.

### GLARE PREVENTION TIPS

- Distribute light to walls and ceilings. Bi-directional fixtures such as A, D, and E (see p. 7) work well.
- Use daylight to light walls and ceilings.
- Use adjustable blinds or shades that control window glare while retaining view.
- Choose higher reflectance room surfaces.
- Select only semi-specular or white painted louvers and reflectors. Avoid mirrored or specular (shiny) reflectors or louvers that can be seen from any angle.
- Shield the lamp from view with baffles, louvers, lenses or diffusing overlays.
- Use lamps of lower brightness. Use more fixtures if necessary.
- Only use T5, T5HO and T5 biaxial lamps in coves or indirect applications where the lamp is not visible by classroom users.
- Use no more than three (3) T8 lamps in 2' x 4' fixtures.

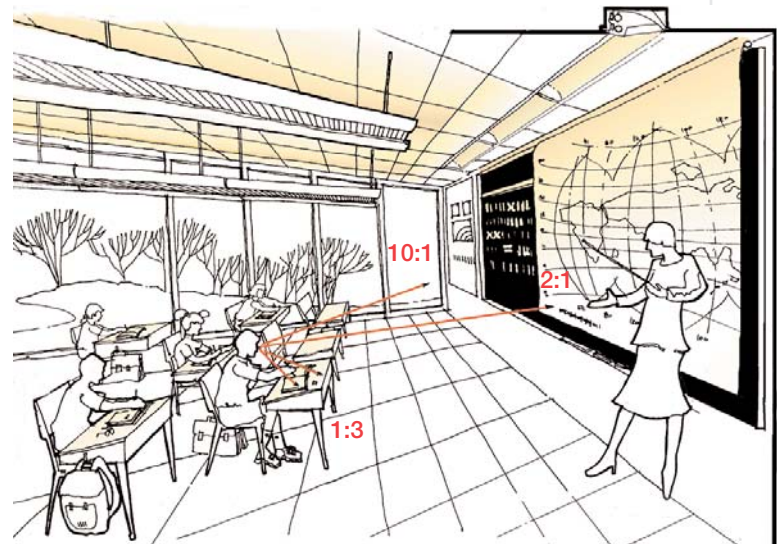
## COLORS & FINISH TIPS

- Acoustic ceiling tiles are often only 70% reflective. Specify 80% or higher. Ceiling tile and paint companies list these values in their product specifications.
- Choose wall colors that are light in color (pastels) and at least 65% reflective.
- Choose furniture that is light in color (60% or higher).
- Always use matte (not shiny or high gloss) surface finishes for walls, ceilings, and furniture.
- Limit the use of primary or saturated colors to accents or wainscots, since they absorb a lot of light.

## CREATE BALANCED BRIGHTNESS

Light levels throughout the classroom should not differ greatly from the light level on the desks. Large variations in brightness will cause distraction and fatigue.

- Use pendant light fixtures that direct at least 50% of the light upward.
- Avoid high contrast. The brightest and darkest room surfaces should be no greater than 3 times or 1/3 as bright as the task (preferred) or 10 times or 1/10 as bright as the task (maximum).
- For best student concentration, the brightest surfaces should be desk tops and focal walls.
- Use only semi-specular or white louvers to prevent harsh wall patterns.



## ACCENT FOCAL WALLS

The brightest surfaces should be the most important surfaces. Lighting the focal walls helps teachers catch and hold students' attention as well as to improve the visibility of information.

- For rooms where desks face one direction, provide focal lighting on the front wall or board.
- For multi-purpose spaces, provide focal lighting on two or three walls.
- Dedicate light fixtures (such as Type H, J, K) to accent these surfaces.
- Light levels on boards or focal walls should be at least equal to light levels on the desktop, or up to twice that level if the board is green or black. For uniformity, the edges of the board should not be less than 1/3 the brightness of the center.
- Locate fixtures 1 to 3 feet from the board or vertical surface so that light reflections do not obscure information on the board.

# lighting controls

Lighting controls give teachers the flexibility to set the lighting level to match the tasks being performed. Controls also turn off lights automatically in an empty room or dim the electric lights when there is enough daylight. For lighting controls to operate properly, they must be checked and set at the beginning of each school year. Calibration and maintenance of lighting controls are essential for energy conservation.



## MATCH CONTROLS TO ROOM TYPES

	General Classroom	Computer Classroom	School Corridor	Potential Energy Savings*
Ceiling Occupancy Sensor, Manual-On, Auto-Off	●	●	○	30%
Multi-Level Switching with Ceiling Occupancy Sensor	●	●	○	35%
Daylight Controls with Occupancy Sensor	●	◐	◐	45%
Multi-Level Switching	●	●	◐	15%
Building Time Controls	◐	◐	◐	10%

● Appropriate    ◐ Sometimes Appropriate    ○ Not Appropriate

\* As compared to standard manual switching for a 5,000 sq. ft. building with a 1.2 watts per sq. ft. connected load.

## OCCUPANCY SENSORS

- Require that lights turn off automatically when spaces are not occupied.
- Use manual-on automatic switches (AS) with ceiling or wall mounted sensors (OS) for all spaces with daylight or receiving spill light from other rooms. Manual-on prevents unnecessary activation when daylight is adequate or when doors are opened. The switches also allow the lights to be turned off for AV purposes. 
- Manual-off is recommended only as a temporary override. Sensor must stay in automatic-off mode at all times.
- Use ultrasonic sensors – they are more sensitive than infrared to subtle motion and less likely to turn lights off in an occupied room. Dual technology is not required when sensor is to be used with manual-on capability. 
- Set sensors for medium to high sensitivity and 10-minute delay.
- Locate sensors inside classrooms so they do not “see” corridor motion.

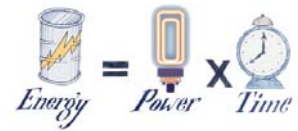
## OCCUPANCY SENSOR (OS) & PHOTOSENSOR (PS) TIPS

Optimum product locations, coverage areas and wiring requirements vary between products – work closely with manufacturers to verify appropriate coverage, installation and location. Redesign may be required if products are substituted during construction.

The row of lights closest to the window dims in response to daylight.



George Leisley/Photographer, Pelows Falls, VT



## Conserve Energy by:

- **Reducing power.** Use energy efficient sources, ballasts and luminaires. The power limit\* for schools is 1.5 w/sf total connected load.
- **Reducing energy use.** Provide lighting controls to reduce the time of use (by switching) or level of power (by dimming).
- **Wise design.** Integrate daylight, room surfaces and layouts.
- **Proper maintenance.** Clean surfaces, group relamp, calibrate controls.

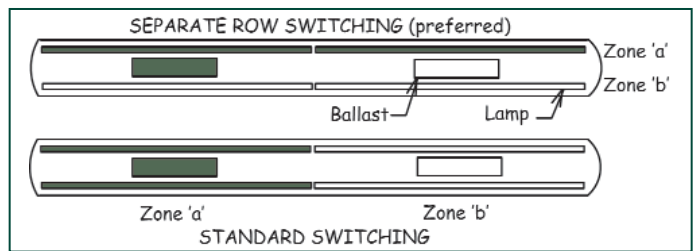
\* ANSI/ASHRAE/IESNA Std. 90.1 - 2001

## MULTI-LEVEL SWITCHING

- Avoid less-efficient one-lamp ballasts. Use master-slave wiring between adjacent fixtures and use multi-lamp ballasts. (See layouts 1, 6 & 7.)
- Use switchable two-level ballasts for three-lamp fixtures. Occupants can choose between two levels of light while maintaining uniform distribution.

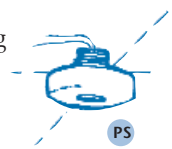
## SEPARATE ROW SWITCHING

- Provide multiple levels in a uniform pattern by factory-wiring each row of lamps separately (shown below) or dimming. Avoid distracting switching patterns.



## DAYLIGHTING CONTROLS AND PHOTOSENSORS

- Orient fixtures parallel to window wall. (See layouts 1 to 5.)
- Control each row of lamps separately.
- Continuous dimming is much better than switching – there are no distractions and greater energy savings. Electronic dimming ballasts typically dim to 10% of full output.
- Start dimming when combined light levels exceed 125% of designed light level.
- Specify photosensors of the “continuous response” type.
- Use “open loop” controls, i.e. photosensor is located to respond to daylight only, rather than located to sense daylight and the electric light source being controlled. (See [windows.lbl.gov/daylighting/designguide/designguide.htm](http://windows.lbl.gov/daylighting/designguide/designguide.htm) for reference.)
- Specify a 60 second time delay to allow for temporary cloud cover.



# classroom lighting

## general and multi-purpose classrooms

### What Makes Layout 1 'Acceptable'?

- Fixtures are oriented parallel to window; best for front focus, multipurpose uses, and daylighting.
- Fixtures use minimum 3" deep louver for greater comfort.
- Separate light on front board increases visibility and student attentiveness.
- Master-slave wiring saves energy by using multi-lamp ballasts.
- Occupancy sensors with manual-on switches save more energy in daylight spaces.

### What Makes Layout 2 'Better'?

- More visually comfortable than recessed or totally direct fixtures.
- Wider distribution puts more light on walls.
- White louvers and spill light on ceiling reduce fixture glare.
- Two-level switching of continuous rows more uniform.
- Best choice for ceiling lower than 8'-9'.

**Controls Upgrade:** Switch fixture adjacent to window separately, and connect to photosensor for automatic response to daylight. This is more reliable than leaving daylight control to the teachers.

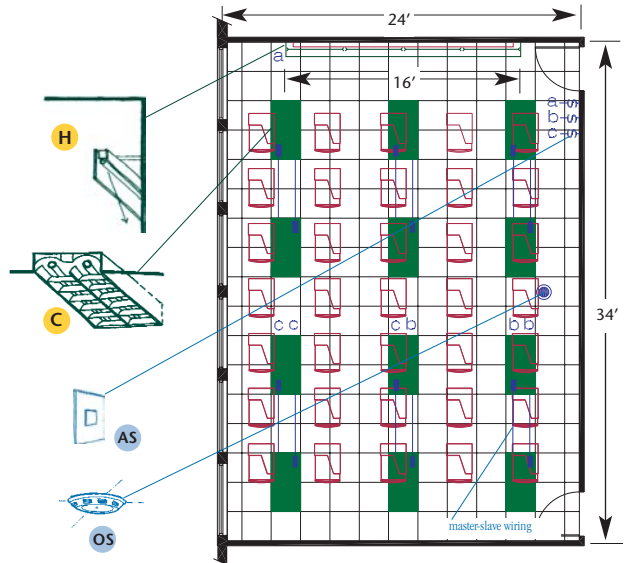
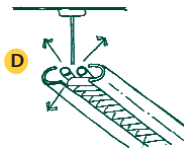
**Alternative 2A:** Add 3" stems and diffuser on top, to increase light on ceiling.

### What Makes Layout 3 'Better Yet'?

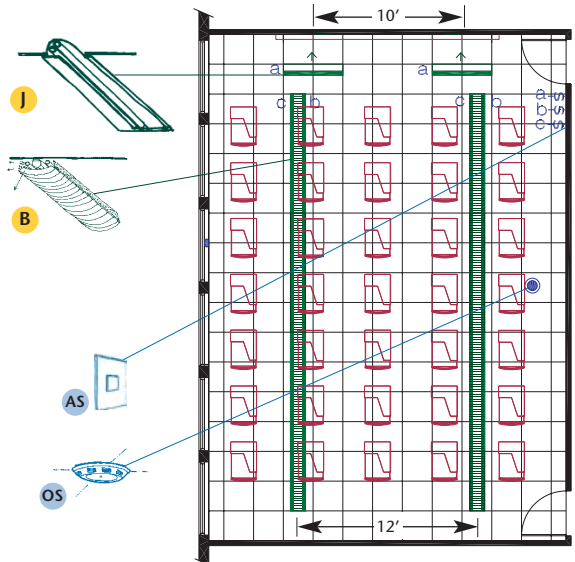
- Combination direct/indirect more comfortable than totally direct or surface systems. Works well for part-day computer use.
- Direct/indirect more energy efficient than totally indirect systems.
- Pendants faster to install than recessed fixtures, and easier to maintain.
- Most cost effective. Greatest long-term value for investment.
- Overhead glare not a problem, due to T8 lamp and lighted ceiling.
- Wide distribution and white louvers reduce contrast and increase uniformity.
- Separate light fixtures accentuate front board.

**Controls Upgrade:**<sup>3</sup> Provide dimming ballasts and photosensor for better control of light levels.

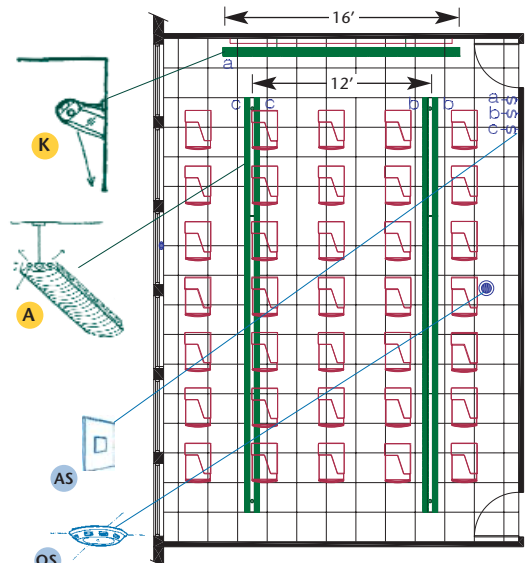
**Alternative 3A:** Use Type D T-8 fixtures with parabolic louvers, to provide more shielding for intensive computer use.



LAYOUT 1 - ACCEPTABLE



LAYOUT 2 - BETTER



LAYOUT 3 - BETTER YET

ACCEPTABLE

BETTER

BETTER YET

### LAYOUT TIPS FOR WIDER ROOMS

- For rooms 28 to 34 feet wide with continuous windows along the long wall, consider shifting both rows of fixtures 2 to 4 feet farther away from the windows.
- For rooms 34 to 38 feet wide, use three rows of fixtures.
- Perform lighting level calculations to verify expected light levels.

### COMPARISON CHART FOR GENERAL CLASSROOMS

For classrooms from 750 to 850 sf.

	Base Case <sup>1</sup>	Layout 1	Layout 2	Layout 3
Interest	★	★★	★★★★	★★★★
Uniformity	★★	★★	★★★	★★★★
Comfort & Quality	★	★★	★★★	★★★★
Power Density (w/sf)	1.32	1.01	1.16	1.16
Energy Savings (Potential %) <sup>2</sup>	Base	46%	40%	40%
First Cost (% Increase)	Base	40%	170%	115%
Maintained Footcandles (fc)	50-60	45-50	45-50	45-50

### OVERALL VALUE

ACCEPTABLE BETTER BETTER YET

Layouts shown will meet light level requirements and current energy codes if they are within the given size ranges, between 8'0" and 9'6" ceiling heights. 1 - Base case assumptions used for comparison are 12 fixtures, recessed 3-lamp 2'x4' parabolic 12-cell with T8 electronic ballasts and two-level switching. 2 - Includes savings due to controls shown. Control upgrades will yield greater energy savings. 3 - Go to [www.designlights.org/classroomwiring/](http://www.designlights.org/classroomwiring/) for schematic daylighting control diagrams.

# computer classrooms

## COMPARISON CHART FOR COMPUTER CLASSROOMS

For computer classrooms from 750 to 850 sf.

	Base Case <sup>1</sup>	Layout 4	Alt. 4A	Layout 5
Interest	★	★★	★★	★★★
Uniformity	★★	★★★★	★★★★	★★★★★
Comfort & Quality	★	★★★★	★★★★	★★★★★
Power Density (w/sf)	1.32	1.01	1.01	1.01
Energy Savings (Potential %) <sup>2</sup>	Base	46%	46%	46%
First Cost (% Increase)	Base	12%	30%	30%
Maintained Footcandles (fc)	40-50	35-40	30-35	35-40
<b>OVERALL VALUE</b>		<b>BETTER</b>	<b>BETTER</b>	<b>BETTER YET</b>

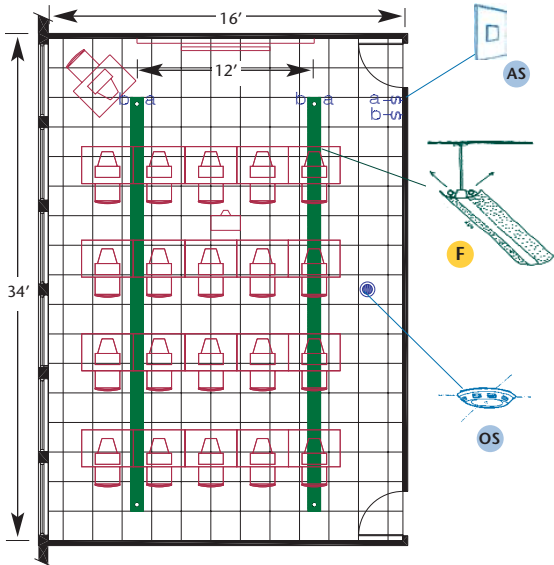
Layouts shown will meet light level requirements and current energy codes if they are within the given size ranges, between 8'6" and 9'6" ceiling heights. 1 - Base case used for comparison is 12 fixtures, recessed 3-lamp 2' x 4' deep-cell VDT parabolic, 27-cells, with T8 electronic ballasts and two-level switching. 2 - Includes savings due to controls shown. Control upgrades will yield greater energy savings.

Photo by Whitney Cox. Courtesy of Norman Rosenfield Architect.



"Pendant fixtures can save installation time and cost, since they only require one power feed at the end of each row."

*Electrical Contractor, Braza Electric*



LAYOUT 4 - **BETTER**

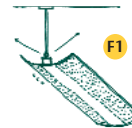
### What Makes Layout 4 'Better'?

- Indirect lighting more comfortable than totally direct systems.
- No overhead glare.
- Greater uniformity of light on ceilings and walls.
- Two levels of control provide flexibility and energy savings.
- Glowing sides reduce contrast, increase comfort.
- Pendant fixtures faster to install and easier to maintain.

Controls Upgrade: Provide a third switch to control lamps nearest the front of the room for better contrast on video screen.

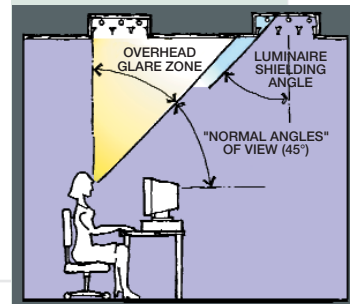
Alternative 4A: Same layout. Use fixture Type F1 with T5H0 lamps. (See T5 box on page 6.)

- High lumen output of the T5H0 lamp requires half the amount of lamps.
- Illuminance decreased. Appropriate for computer use only.



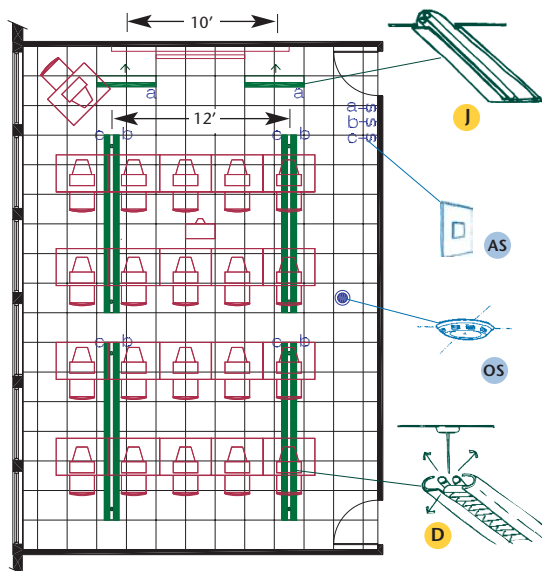
### Use A Different Approach for Computer Rooms

- Avoid totally direct lighting systems.
- Recessed fixtures leave ceilings dark. Contrast between bright lamps or lens and dark ceiling is too great for computer rooms.
- Specular (shiny) louvers or reflectors create overhead glare (see diagram) and harsh patterns.



- Small-cell louvers are very inefficient and create cave-like rooms.
- Always provide some light on ceiling and walls. Distribute light as uniformly as possible.

knowhow classroom lighting



LAYOUT 5 - **BETTER YET**

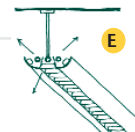
### What Makes Layout 5 'Better Yet'?

- Combination direct/indirect more comfortable than totally direct.
- Direct/indirect more energy efficient than totally indirect.
- More cost effective. Greatest value for investment.
- T8 lamp and lighted ceiling prevent overhead glare.
- Higher light levels and 2-level switching more flexible for computer rooms with paper tasks.
- Separate fixtures used for front board when video screen not in use.

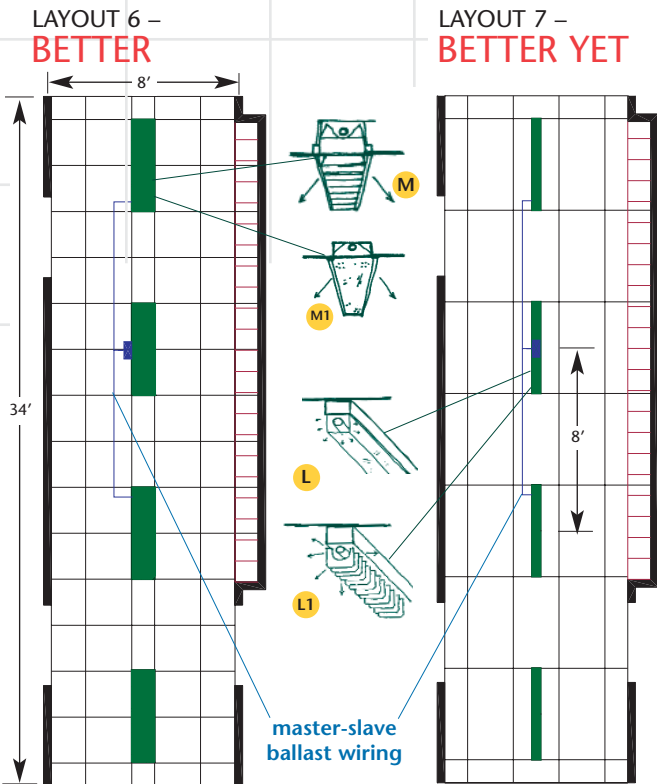
Controls Upgrade: Provide dimming ballasts and wall box dimmer for better light level control.

Alternative 5A: Same layout. Use Type E three-lamp T-8 fixtures.

- Direct and indirect components can be controlled separately.
- Greatest flexibility for rooms used for both computers and paper tasks.



# school corridors



## What Makes Layout 6 'Better'?

- One-lamp fixtures, oriented parallel to corridor, provide uniform distribution on lockers and walls.
- Master-slave ballast wiring saves energy by using multi-lamp ballasts.

## What Makes Layout 7 'Better Yet'?

- Surface mounted fixture allows for greater ceiling height.
- Works well with any tile system and access panels.
- Wide distribution and white louvers provide most uniformity.

### COMPARISON CHART FOR SCHOOL CORRIDORS

For corridors up to 9 feet wide.

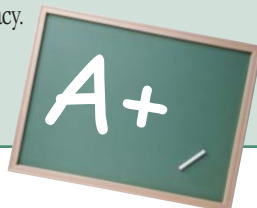
	Base Case <sup>1</sup>	Layout 6	Layout 7
Interest	★	★★	★★★★
Uniformity	★	★★★★	★★★★★
Comfort & Quality	★	★★	★★★★
Power Density (w/sf)	0.61	0.49	0.49
Energy Savings (Potential %) <sup>2</sup>	Base	20%	20%
First Cost (% Increase)	Base	60%	23%
Maintained Footcandles (fc) <sup>3</sup> on walls	5-15	8-12	8-12
<b>OVERALL VALUE</b>	<b>ACCEPTABLE</b>	<b>BETTER</b>	<b>BETTER YET</b>

<sup>1</sup>Base case assumptions used for comparison are 2'x4' lensed fixtures, with two T8 lamps and electronic ballasts, spaced 12' on center, oriented perpendicular to the corridor, and on time clock control.  
<sup>2</sup>Includes savings due to controls shown. Layout tips for wider corridors: Layout 7 works for 10' corridor. Layout 6 limited to 9' corridor.

### SCHOOL CODE TIP

If your state code requires minimum light levels, consider:

- Computer calculations for greater accuracy.
- Precise definition of task area.
- High output ballasts.
- Higher room reflectances.



## lamp and ballast specifications

### T5 LAMPS

T5 lamps are not a replacement for T8 lamps. They are different lengths, use different sockets and ballasts, and have different pros and cons.

#### Advantages:

- Smaller size allows for greater reflector control.
- Smaller lamps and ballasts allow for smaller fixtures.
- Higher lumen output (T5HO) reduces the number of lamps and ballasts to maintain.
- Costs for T5 fixtures are competitive with T8 fixtures.
- Efficiency of T5 and T8 systems are comparable.

#### Disadvantages:

- Excessive brightness of T5 and T5HO limits their use to primarily indirect fixtures.
- Current replacement cost of components (lamps and ballasts) higher than T8, but will reduce over time.
- Using one T5HO lamp instead of two T8 lamps eliminates two-level switching options.
- Adds an additional lamp type to a project, complicating ordering, maintenance and repair.

The following specifications apply to all of the fixture types shown on page 7 for both T8 and T5 linear fluorescent systems.

#### Lamp Criteria:

- Minimum Color Rendering Index (CRI) of 80.
- Color temperature of 3500 Kelvin or 4100 Kelvin. Provide mockup for other colors. Note: Generic color code "835" means CRI of 80 and color temperature of 3500.
- Mean lamp lumens (at 40% of rated life) at least 94% of initial lumens.

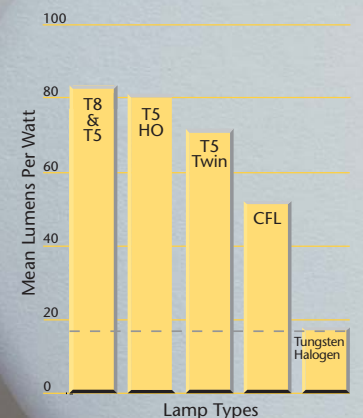
#### Ballasts and Lamp-Ballast System Criteria:

- High-frequency electronic using instant start or program rapid start circuitry.
- Harmonic distortion shall not exceed 20%.
- Ballast factor minimum 0.88 for T8 and 1.0 for T5.
- Consider "low" or "high" ballast factor ballasts to optimize lamp count, input watts, and power density. Limit any ballast type to only one type of fixture.
- Mean system efficacy (mean lamp lumens times # of lamps divided by ballast input power): Minimum 83 lumens/watt for 4' long T8 at 25°C and minimum 80 lumens/watt for 4' long T5HO at 35°C.

### USE ENERGY EFFICIENT SOURCES

Fluorescent lighting today is not only more energy efficient, but rivals incandescent in quality, comfort and aesthetics. Lamps are available in a variety of superior colors providing a natural appearance for people and room colors. Electronic high frequency ballasts eliminate the flicker and noise of older model ballasts. The graph compares efficacies (mean lumens per watt) of common fluorescent lamp/ ballast combinations with the efficacy of a tungsten halogen (incandescent) lamp.

### Lamp / Ballast Efficacies



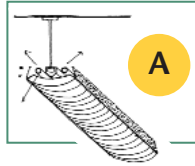
# lighting fixture schedule

These specifications are for cost-effective fixtures that ensure a balance of performance, energy savings, comfort, lighting quality and ease of maintenance. Many standard products meet these generic specifications. Even small variations from these specifications may result in undesirable effects. For example, specular louvers or reflectors may increase light levels and reduce reflected glare, but will also increase overhead glare and decrease desirable room surface brightness.

## AMBIENT LIGHTING

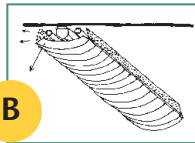
### A. Pendant Direct/Indirect Baffled

LAMPS: (2) 32W T8 fluorescent, 835 color  
DESCRIPTION: Pendant mounted. White cross-baffles. Minimum 35° lengthwise shielding. Wire for separate row switching. Multi-lamp ballasts. 80% min. fixture efficiency. Nominal 59 watts per (2) lamps.



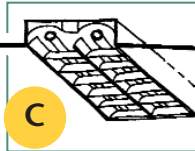
### B. Surface Mounted Baffled, Wide Distribution

LAMPS: (2) 32W T8 fluorescent, 835 color  
DESCRIPTION: Same as Type 'A' except surface mounted. Luminous sides for wide distribution. 60% min. fixture efficiency.



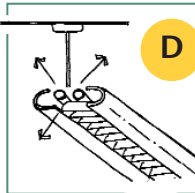
### C. Two-Lamp Recessed Parabolic 2' x 4'

LAMP: (2) 32W T8 fluorescent, 835 color  
DESCRIPTION: Recessed. White baked enamel reflector (minimum 90% reflectance) and minimum 3" deep parabolic louvers. 12 cells. Wire for separate row switching. Multi-lamp ballasts. 76% min. fixture efficiency. Nominal 59 watts per (2) lamps.



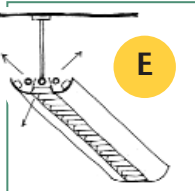
### D. Pendant Direct/Indirect Parabolic

LAMPS: (2) 32W T8 fluorescent, 835 color  
DESCRIPTION: Pendant mounted. Semi-specular low-iridescent parabolic cross-baffles minimum 1-3/4" deep, 3" on center. Wire for separate row switching. Multi-lamp ballasts. 80% min. fixture efficiency. Nominal 59 watts per (2) lamps.



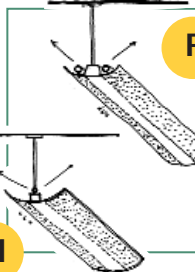
### E. Pendant Direct/Indirect Three-Lamp

LAMPS: (3) 32W T8 fluorescent, 835 color  
DESCRIPTION: Pendant mounted. 2 lamps up and 1 lamp down. Semi-specular low-iridescent parabolic cross-baffles, minimum 1-3/4" deep and 3" on center. Optional lamp shield for center lamp. Wire for separate row switching. Multi-lamp ballasts. 71% min. fixture efficiency. Nominal 89 watts per (3) lamps.



### F and F1. Pendant Indirect – Perforated Sides

LAMPS: (2) 32W T8 fluorescent, 835 color  
DESCRIPTION: Pendant mounted. 85% indirect component with perforated sides. Wire for separate row switching. Multi-lamp ballasts. 78% min. fixture efficiency. Nominal 59 watts per (2) lamps. Alternative F1: (1) 54W T5HO lamp, 95% indirect component. 88% min. fixture efficiency. Nominal 117 watts per (2) T5HO lamps.



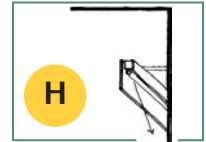
George Leisey/Photographer, Bellows Falls, VT

Valances (Type H) are an inexpensive way to light focal walls, but don't provide the best uniformity.

## WALL ACCENT OPTIONS

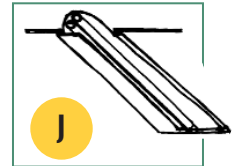
### H. Fluorescent Channel with Valance

LAMP: (1) 32W T8 fluorescent, 835 color  
DESCRIPTION: Surface mounted standard channel concealed by architectural valance. Multi-lamp ballasts. Nominal 30 watts per fixture.



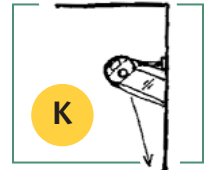
### J. Recessed 1' x 4' Linear Wall Wash

LAMPS: (2) 32W T8 fluorescent, 835 color  
DESCRIPTION: Recessed wallwasher with semi-specular aluminum reflector. Locate 2' to 3' away from wall. Nominal 59 input watts per (2) lamps, 67% minimum fixture efficiency.



### K. Bracket Mounted Asymmetric Board Light

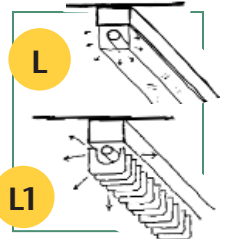
LAMP: (1) 32W T8 fluorescent, 835 color  
DESCRIPTION: Wall mounted. Asymmetric reflector. Cantilever 6" to 12" from board. Multi-lamp ballasts. 71% min. fixture efficiency. Nominal 59 watts per (2) lamps.



## CORRIDOR OPTIONS

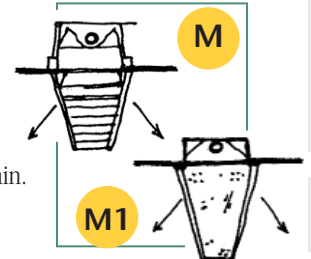
### L and L1. Surface Mounted Corridor Wall Lighter

LAMP: (1) 32W T8 fluorescent, 835 color  
DESCRIPTION: Surface mounted. White baked enamel housing and prismatic lens. Multi-lamp ballasts. 78% min. fixture efficiency. Nominal 59 watts per (2) lamps. (Available as pendant version if ceiling height is greater than 9'0".) Alternative: White cross baffles. 68% min. fixture efficiency.



### M and M1. Recessed Fluorescent 1' x 4'

LAMPS: (1) 32W T8 fluorescent, 835 color  
DESCRIPTION: Recessed. White upper reflector and white parabolic louvers 6" on center. Multi-lamp ballasts. Nominal 59 input watts per (2) lamps. 73% min. fixture efficiency. Alternative: Prismatic lens. 65% min. fixture efficiency.



# daylighting

Daylighting is a key to lighting quality. Students with daylight in their classrooms (from windows and skylights) perform 20 to 25% better on reading and math tests than students without access to daylight.<sup>2</sup> The same study shows that students in classrooms with larger window areas progress up to 20% faster than their counterparts in rooms with smaller window areas. Go to <http://www.h-m-g.com> to read the study that presents these data.

## DAYLIGHTING HINTS

Daylight only saves energy if the electric lights are dimmed or switched off. Dimming lights in response to daylight is less distracting than switching, but requires dimming ballasts and a commitment to maintenance. Avoid direct solar penetration – it creates glare and overheating. Use neutral-colored window glass and exterior overhangs to control window glare and solar heat gain. Balance the light by providing daylight from more than one direction. See page 3 and classroom layouts for daylight controls.

2 - The Heschong-Mahone Group (published 1999)



George Ilesky/Photographer, Bellows Falls, VT

Students and teachers benefit from a connection to the outdoors – windows not only provide daylight but also a sense of time, weather, and distant focal points – all of which prevent fatigue and contribute to greater alertness in class.

# better lighting = better learning

Research has shown that information presented visually is absorbed faster and retained more reliably than information presented orally.<sup>1</sup> To promote learning, provide an environment where teachers and students can perform their visual tasks comfortably, quickly and accurately. Lighting impacts the psychological and emotional needs of students: it makes a room attractive and pleasant, stimulates learning and improves behavior. High quality, energy effective lighting is a wise investment for our schools!

1 - Adapted from Good Lighting for Schools by Fodergemeinschaft GutesLicht.



“Visual richness in classrooms stimulates creative thinking. Quality lighting and flexible lighting controls are major contributors to a positive learning environment.”

Professor, Texas Christian University

## high quality checklist

- ✓ Use fixtures that provide comfort by distributing some light on ceilings and walls, such as direct/indirect or semi-indirect fixtures.
- ✓ Use light-colored finishes on room surfaces to maximize reflected light.
- ✓ Include windows or skylights in every classroom.
- ✓ Design electric lighting to maximize benefits from natural lighting.
- ✓ Use interior blinds to control window glare.
- ✓ Use lighting controls to increase flexibility and decrease energy use for each room.
- ✓ Provide additional light for front wall or board, and other important room features.

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