

Lighting Concepts: Education and Office Lighting

From Books to Computers

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Lighting the Office and Education environment.

Reference:
IESNA Handbook Chapter 11: Office Lighting
Recommended Practice RP-1

IESNA Handbook Chapter 12: Educational Facility
Recommended Practice RP-3

Why from books to computers?

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Lighting the Office and Education environment have common task.

- Reading and Writing
- Social Communication
 - Seeing and Talking to people up close
 - Seeing and Talking to people from afar
- Room used for learning
 - Classrooms
 - Lecture Rooms
- Library
 - Book Stacks
 - Storage
- Corridors and Circulation

The Purpose of Lighting

- Goals and Approach
- Quality and Quantity
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Educational Facilities

The overarching goal of educational facility lighting is to provide a visual environment for both students and instructors that is supportive of the learning processes.

This can be achieved only if the occupants can see their visual tasks accurately, quickly, and comfortably.

Uniform horizontal illuminance throughout an educational facility does not necessarily ensure high levels of visual performance because of the great variety of visual tasks, including visual display terminal (VDT) tasks, found in a school.

Lighting can make a school pleasant and attractive, reinforce feelings of spaciousness, delineate areas of different functions, stimulate learning, and improve behavior.

Office Environment

Offices are designed to house working people engaged in thought and in a number of forms of communication (written, visual, telephone, computer, and face to face). Office lighting should enable workers to perform these tasks effectively.

Since feelings of well-being, interest, and enthusiasm are affected by the environment, consideration should be given to the design of office interiors in an effort to achieve a stimulating work place.

Office lighting affects the appearance of the space and its occupants, and therefore their mood and productivity.

Naturally, lighting should provide good visibility for the visual tasks.

Lighting Concepts: Education and Office Lighting

The Basic Concepts

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

General Lighting
provides the basic light for any office space.

Task Lighting
is the most important office lighting system—often the primary light source for office activity.

Accent Lighting
brings offices to life—highlights pictures and other objects.

Perimeter Lighting
brightens the walls, making the space appear larger than it is.

Office Lighting Design Issues

- Goals and Approach
- Quality and Quantity
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OFFICE LIGHTING DESIGN ISSUES

Open Plan Office, Intensive VDT Use

- Flicker-free
- Illuminance uniformity
- Uniformity of Room Surface
- Impedance Drop
- Glare/Task/Use Correlation

Private Office

- Disrupting Integration and Control
- Flicker-free
- Uniformity of Room Surface
- Impedance Drop

Office Lighting Design Issues

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QUALITY ISSUES FOR OFFICE LIGHTING

	Private Offices	Open-plan Offices	Office Center
Control of direct and reflected glare	●	●	○
Light on walls and ceilings	●	●	○
Physical isolation of fixtures to users	●	●	○
Uniformity / Reduce shadows and flicker	○	○	○
Room surface characteristics	○	○	○
Color rendering and color temperature	○	○	○
Daylighting	○	○	○
Lighting controls	○	○	○
Quantity of light on task (task/landscap)	40-50 fc	40-50 fc	5-10 fc

● Very Important ○ Important ○ Somewhat Important

* Adapted from the Lighting Design Guide, ©2014 Lighting Handbook, 10th Edition

Lighting Concepts: Education and Office Lighting

Room Reflectance: Office

- Goals and Approach
- Quality and Quantity
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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 (pinks) and at least 60% reflective.
- Choose furniture that is light in color (60% or higher).
- Always use smooth (not fibrous or high-gloss) surface finishes for walls, ceilings, and furniture.
- Avoid the use of primary or saturated colors to accents or wainscots, since they absorb a lot of light.

Room Reflectance

- Goals and Approach
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A small increase in room reflectances produces a big improvement in efficiency. The lighter room provides 55% more light on the work surface for the same energy or uses 70% less energy to provide equivalent brightness. The lighter room also provides better brightness ratios, comfort and daylight distribution.

- Goals and Approach
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Luminous Ratios: Classroom

- Goals and Approach
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The brightnesses of the various surfaces in the normal field of view must be kept within accepted limits.

When the eye fixates on a task, an adaptation level is established. As the eye shifts from one luminance, such as for a book, to another luminance, such as for the chalkboard, it must adapt to the new level. If there is much difference between the two levels, a period of time is required for the eye to adjust itself to the new situation, which can slow visual performance. Further, if the difference is great, discomfort and fatigue can be experienced.

Lighting Concepts: Education and Office Lighting

Glare

- Goals and Approach
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Angle from Vertical (deg.)	Average Luminance (cd/m ²)	
	Preferred	Maximum
55	850	—
65	350	850
75	175	350
>85	175	175

* Luminance is measured along the lengthwise, crosswise, and 45° horizontal planes.

Energy Codes

- Goals and Approach
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POWER LIMITS From ASHRAE 90.1 Standard 90.1-2005

	Watts / sf		Watts/ft ²
Private Offices	1.5	School / University	1.5
Open Plan Offices	1.3	Library	1.5
Office Corridor	0.7	Cafeteria	1.8
Reception/Lobby	1.8		
Conference/Meeting	1.5		
Active Stairs	0.9		
Active Storage	1.1		

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

* Incorporate manual control switching for a 10% savings in buildings with a 1.2-watt/ft² or less connected load.

Lamp Control


- Goals and Approach
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The Problem with Standard Lighting





- Goals and Approach
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Avoid staggered layouts and locating fixtures too close to walls.

The Office Troffer


- Goals and Approach
- Quality and Quantity
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<p>A. 2' x 4' THREE-LAMP PARABOLIC TROFFER</p> <p>LAMPS: (3) 32W T8, 855 color</p> <p>DESCRIPTION: Recessed fluorescent troffer 2' by 4' with white baked enamel interior, semi-specular low-irradiance parabolic lenses with 18 cells, minimum 2.54" deep. Use white painted lenses in private office. Three-lamp electronic instant-start ballast, nominal 91 input watt, 71% minimum fixture efficiency. Note: 3-lamp or 2-lamp ballasts with inboard-on-board switching and tandem wiring.</p> 	<p>A. 2' x 4' THREE-LAMP PARABOLIC TROFFER</p> <p>LAMPS: (3) 32W T8, 855 color</p> <p>DESCRIPTION: Recessed fluorescent troffer 2' by 4' with white baked enamel interior, semi-specular low-irradiance parabolic lenses with 18 cells, minimum 2.54" deep. Use white painted lenses in private office. Three-lamp electronic instant-start ballast, nominal 91 input watt, 71% minimum fixture efficiency. Note: 3-lamp or 2-lamp ballasts with inboard-on-board switching and tandem wiring.</p> 
<p>B. 2' x 4' TWO-LAMP PARABOLIC TROFFER</p> <p>LAMPS: (2) 32W T8, 855 color</p> <p>DESCRIPTION: Recessed fluorescent troffer 2' by 4' with white baked enamel interior, semi-specular low-irradiance parabolic lenses with 12 cells, minimum 2.54" deep. Use white painted lenses in private office. Two-lamp electronic instant-start ballast, nominal 61 input watt, 73% minimum fixture efficiency.</p> 	<p>B. 2' x 4' TWO-LAMP PARABOLIC TROFFER</p> <p>LAMPS: (2) 32W T8, 855 color</p> <p>DESCRIPTION: Recessed fluorescent troffer 2' by 4' with white baked enamel interior, semi-specular low-irradiance parabolic lenses with 12 cells, minimum 2.54" deep. Use white painted lenses in private office. Two-lamp electronic instant-start ballast, nominal 61 input watt, 73% minimum fixture efficiency.</p> 

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Better


- Goals and Approach
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better yet

Better


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better yet

Direct versus Indirect

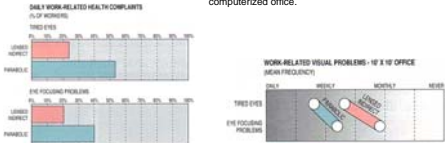
- Goals and Approach
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In the last decade, during which personal computers have proliferated in the office, researchers have paid increased attention to lighting. Several studies have investigated the relationship of modern office lighting to the visual health, satisfaction and productivity of office workers.

- The American Society of Interior Designers found that 68% of employees complain about the light in their offices.
- A Silicon Valley study pointed out that 79% of VDT users want better lighting.
- A 1989 Louis Harris survey, the Steelcase Office Environment index, revealed that workers think of eyestrain as the number one health hazard in the office—ahead of radiation, asbestos, even exposure to AIDS.

This degree of dissatisfaction is difficult to ignore. It confirms the need to identify the best methods of lighting the computerized office.



COMPLAINT	LUMINOUS	PARALLEL
Tired Eyes	~40%	~20%
Eye Focusing Problems	~30%	~15%

PROBLEM	DIRECT	INDIRECT
Tired Eyes	~40%	~20%
Eye Focusing Problems	~30%	~15%

Lighting Concepts: Education and Office Lighting

Direct Distribution: Troffer

- Goals and Approach
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Before After

Direct Distribution: Troffer

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The sharp cut-off provides good glare control, but creates dark walls and ceilings, leading to darker cave-like environments.

People and objects have a direct view of the lamp.

Glare Zone

Direct Distribution: Alternate Troffers

- Goals and Approach
- Quality and Quantity
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A small amount of controlled brightness is introduced to the walls and ceiling, creating a brighter, more pleasant environment without causing unwarmed glare.

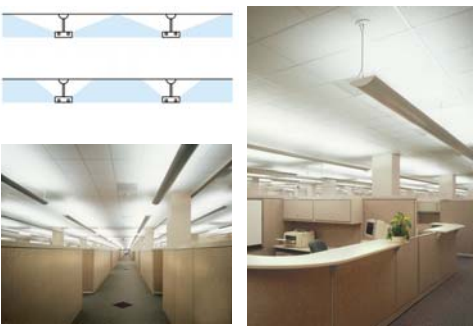
Blowing lighting distribution creates less brightness directly below the fixture, minimizing ceiling reflections, causing unwarmed glare.

Glare Zone

Lighting Concepts: Education and Office Lighting

Indirect Distribution: Pendant


- Goals and Approach
- Quality and Quantity
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The image block contains two diagrams at the top showing light rays from pendant fixtures reflecting off the ceiling. Below the diagrams are two photographs: one of a long hallway with recessed ceiling lights and another of a modern office reception area with a long wooden counter and a pendant light fixture.

Direct Distribution: Pendants

- Goals and Approach
- Quality and Quantity
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The image block contains two side-by-side photographs of a meeting room with a yellow wall. Each photo shows a round table with chairs and a long fluorescent light fixture hanging directly above the table.

Combination Distribution

- Goals and Approach
- Quality and Quantity
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The image block contains a single photograph of a modern office workstation. It features a wooden desk with a computer monitor, a blue office chair, and a combination of recessed ceiling lights and a desk lamp.

Lighting Concepts: Education and Office Lighting

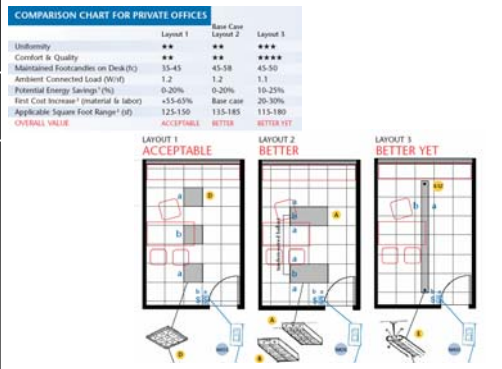
Combination Distribution

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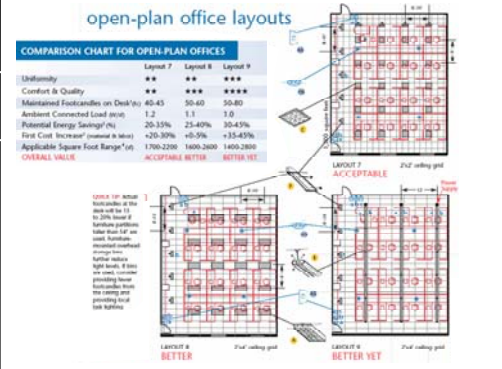
Private Office

- Goals and Approach
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Open Plan


- Goals and Approach
- Quality and Quantity
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Lighting Concepts: Education and Office Lighting

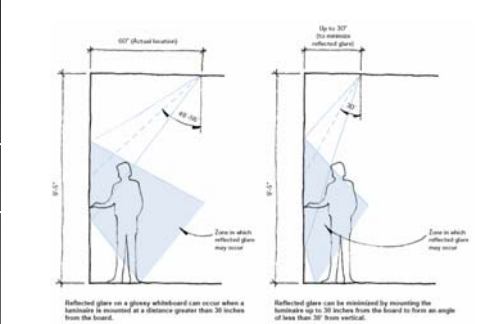
Lighting Whiteboards or Vertical Display

- Goals and Approach
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Lighting Whiteboards or Vertical Display

- Goals and Approach
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Reflected glare on a glossy whiteboard can occur when a luminaire is mounted at a distance greater than 30 inches from the board.

Reflected glare can be minimized by mounting the luminaire up to 30 inches from the board to form an angle of less than 30° from vertical.

Asymmetric Distribution: Pendant

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Lighting Concepts: Education and Office Lighting

Asymmetric Distribution: Recessed

- Goals and Approach
- Quality and Quantity
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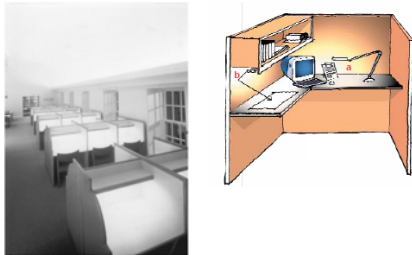
Asymmetric Distribution: Surface (above)

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Task Lighting

- Goals and Approach
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Lighting Concepts: Education and Office Lighting

Task Lighting

- Goals and Approach
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Book Stacks

- Goals and Approach
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- Bookstacks must be lit adequately so patrons can find books and also so staff can spend long hours shelving books without visual discomfort.
- Evenness of illumination across the stack face is more important than achieving a high lighting level at any single point. More specifically, the lighting level should be no more than a 6-to-1 maximum-to-minimum ratio across the entire stack face.
 - Reading Stacks – 30fc horizontal (30in above the floor)
 - Active Stacks – 30fc vertical (30in above the floor)
 - In Active Stacks – 5fc vertical (30in above the floor)

Approaches to Stack Lighting

Parallel scheme, where rows of linear fixtures are located directly above the stack aisles

Perpendicular scheme, where rows of fixtures run perpendicular to the stacks and stack aisles

Indirect scheme, where lighting is aimed upward rather than downward, and is bounced off the ceiling. The resulting light is diffuse and non-directional. Therefore, the light fixtures can be arranged in almost any uniform geometry above the stacks.


Book Stacks

- Goals and Approach
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Lighting Concepts: Education and Office Lighting

Online Resource:
<http://www.librisdesign.org/docs/lighting1.html>

- Goals and Approach
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The screenshot shows a webpage titled 'Libris DESIGN' with a navigation menu on the left and a main content area. The main content area is titled 'general Requirements' and 'Lighting for Libraries'. The table of contents includes:

Section	Sub-sections
1. THE PROFESSIONALS	
2. LIGHTING BASICS	2.1 Glossary 2.2 Basic Concepts
3. LIGHT SOURCES	3.1 Introduction to Light Sources 3.2 Fluorescent Lamps 3.3 Incandescent Lamps 3.4 High Intensity Discharge (HID) Lamps
4. LIGHTING FOR BOOKSTACKS	4.1 Overview 4.2 Approaches to Stack Lighting
5. LIGHTING IN GENERAL READING AND STAFF AREAS	5.1 Approaches 5.2 Tables, Appliances, Bookshelves and Cases 5.3 Lighting for Service Desks 5.4 Lighting for Community Rooms
6. DAYLIGHTING	
7. EXTERIOR LIGHTING	
8. LIGHTING CONTROLS	8.1 Occupancy Sensors 8.2 Natural Lighting
9. ACCESSIBILITY ISSUES	
