Other considerations in school lighting

- Controls
  - Schools operate on fixed time schedules.
  - Preprogrammed time-base control and daylight compensation applicable!!

Commercial interiors (Office buildings)

- Light sources: energy and color rendering
- Triphosphor lamps or equivalent CFL w/ electric ballasts recommended
- linear fluorescent lamps also popular
- High CRI HPS (MH/L): good for indirect lighting (w/ sufficient ceiling height)
- Incandescents: storage areas, closets, other short burning-period uses
- Incandescents or tungsten-halogen lamps (track lighting): display

Russell & Peachtree summit buildings (USA)

Commercial interiors (office buildings)

- The typical half-height partitions block 30% to 80% of the light from ceiling luminaires: partition finishes → light-colored
- Upper wall sections: light-color painted to match the ceiling → increasing ceiling cavity brightness

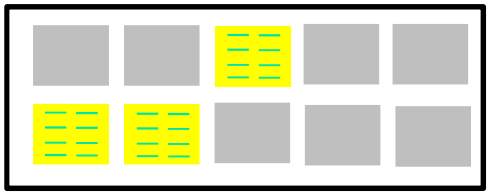
Peachtree summit building, USA

Office lighting guidelines (1)

- Private offices
  - Private office = office space for one person → visual task location is one.
  - (task + ambient) approach is frequent.
- General offices: two approaches
  - Approach I: general lighting
    - Uniform lighting in the entire area
    - most appropriate where the furniture layout is unknown.
    - However, wasteful of energy and increase of building energy budgets
    - no control of the lighting geometry allowed !! → direct and reflected glare.
  - Approach II: general + task lighting

Office lighting guidelines (2)

- Maintenance
  - In most offices, trouble call basis → replaced on burnout and then the fixture is cleaned
  - because of the long life of fluorescents, a cleaning cycle of 3-to 5 years.
  - An LLF of 0.65 is reasonable for air-conditioned spaces. A lower LLF for open-window offices.
- Control
  - Daylight control
  - Group control: operating small groups of lights while the remainder are off to permit off-hours work



  - Path lighting: permit traversing without turning on all lights
  - Scheduling with local override

Task-ambient office lighting

- Low level ceiling lighting for circulation + workstation-mounted task lighting
- Task lighting:
  - (1) furniture integrated (fixed)
  - (2) locally adjustable (stand-alone)

Task-ambient: Furniture integrated

- For ambient lighting: Indirect HID lamps are mounted on the top of furniture or can be free standing
- For task lighting: integral with office furniture
- Advantages
  - No problem with furniture layout or layout changes
  - Initial construction cost down
  - Energy reduction: short distances between light source and task & local on/off control
  - Easy maintenance (furniture is accessible from the floor)
  - Floor-to-floor height can be reduced.
- Disadvantages
  - Difficulty in dissipating heat from the lamps
  - Difficulty in evenly lighting large table or L-shaped desk areas
  - Not readily applicable to automatic switching and dimming schemes
  - The desk must be usable by left-handed and right handed people

Integrated and modular ceilings

- With a single in each module
- The higher cost for luminaires are usually offset by the absence of a hung-ceiling.
- Thus, lower cost, better appearance, more design-flexibility than a field assembly unit.
- can be integrated with lighting and HVAC units
- commercially available sizes: 60” square, 48” square, 30” square, 30” *60” module

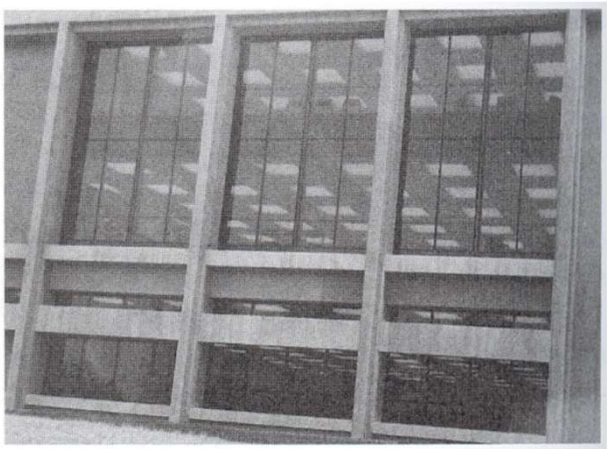


Fig. 21.41 *A square modular ceiling utilizing square lighting units demonstrates architectural symmetry, blending, and, incidentally, that lighting is easily visible from the outside, even during the day. (Photos by Stein.)*

← from 9th Ed.

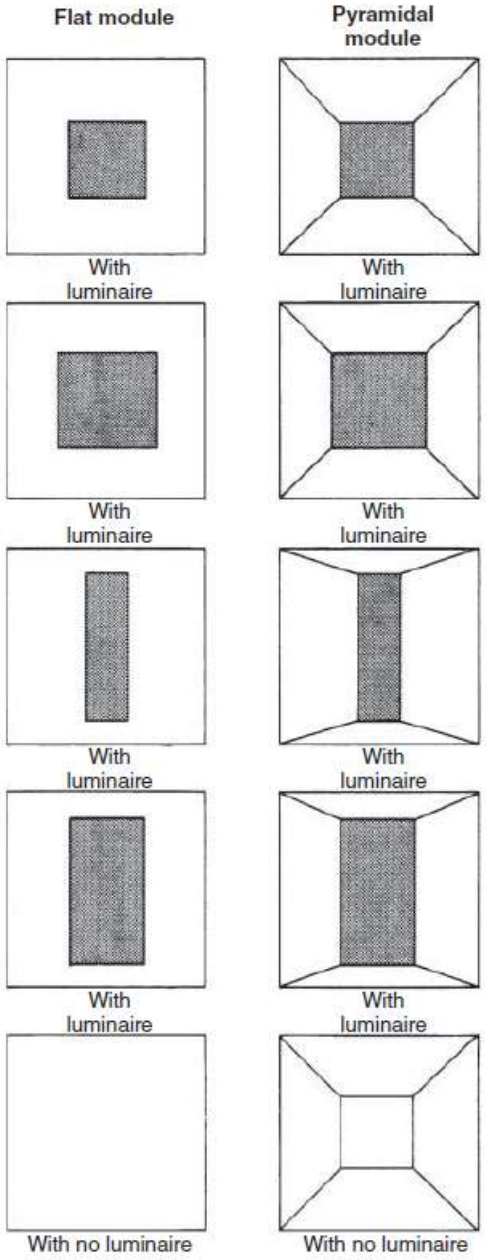
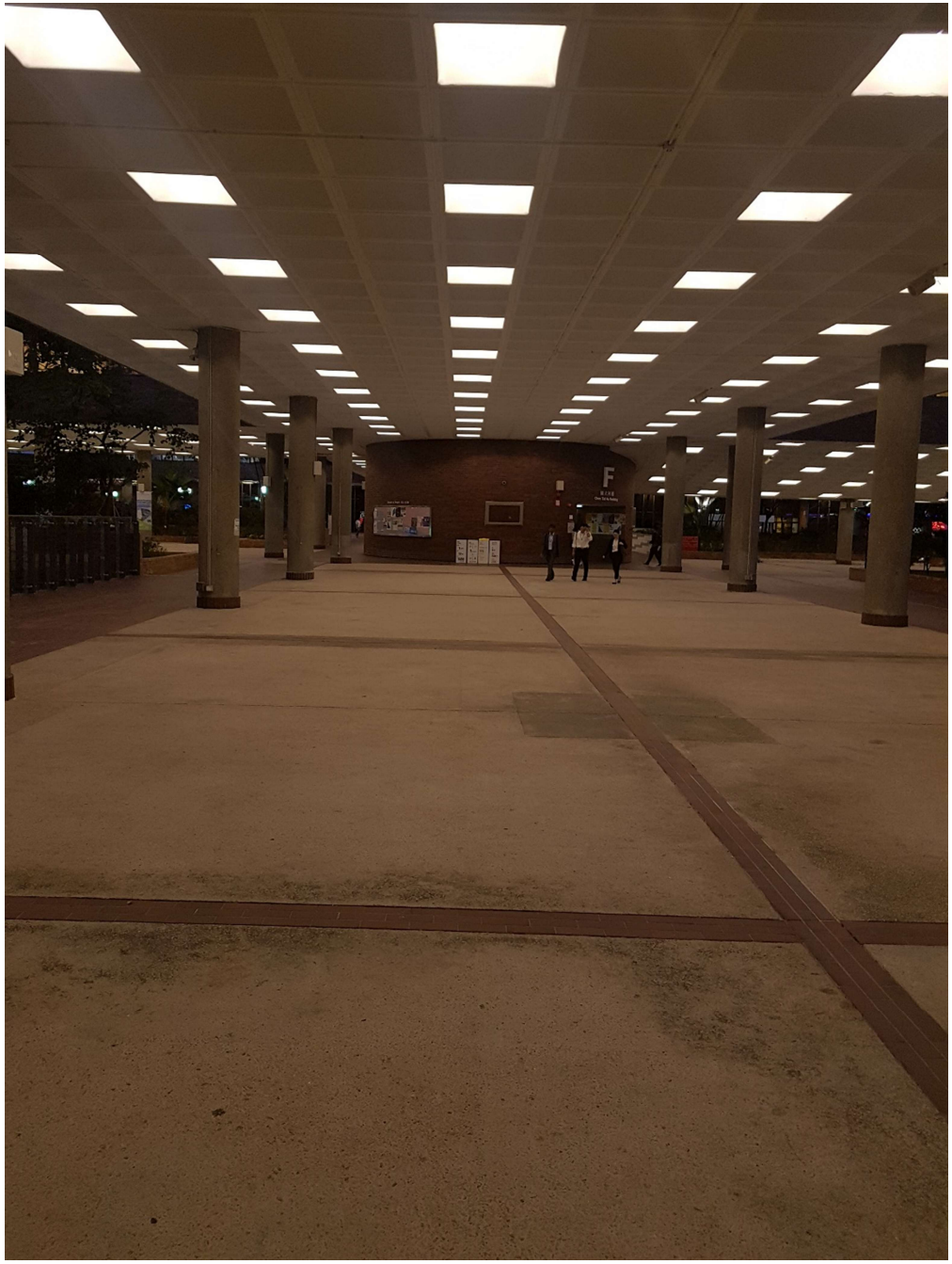
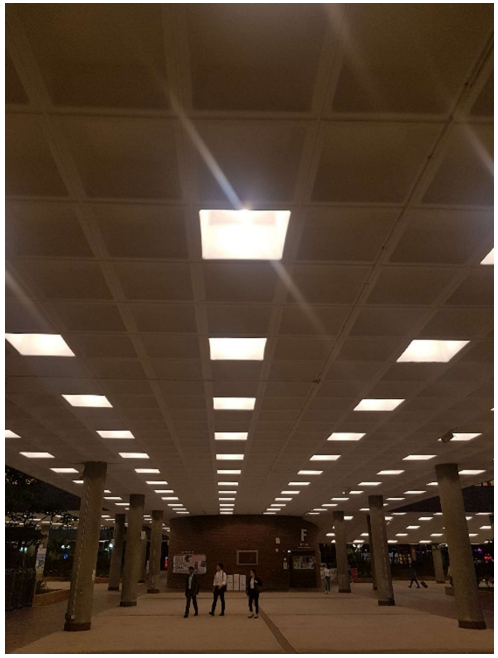
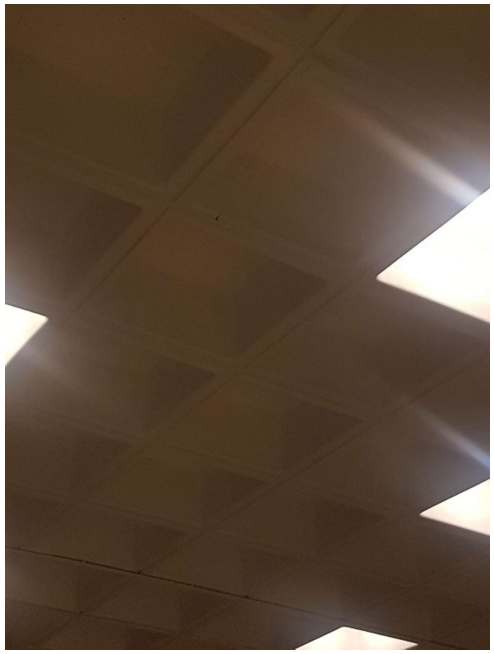


Fig. 17.20 *Various configurations of reflected ceiling plan modules.*





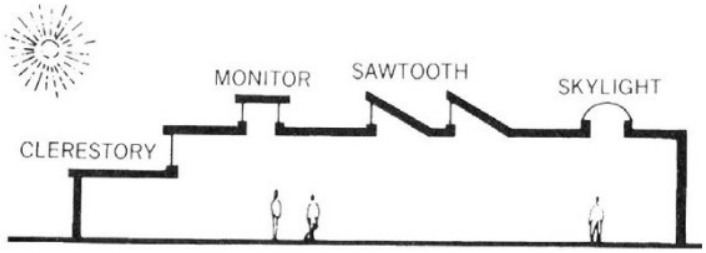


Lighting and HVAC

- Lighting heat partially contributes to heating.
- Fixture efficiency is directly affected by its temperature: fluorescent units operate at an optimum temperature of 77°F (25°F). Temperatures above and below this decrease output and fixture efficiency.
- The most effective method of fixture heat removal is duct connection to the fixture unit. But, expensive and immobilizing the fixture.
- Practically, the plenum is exhausted with air passing over the fixtures, picking up excess heat.

Industrial lighting: general

- Productivity, product failures, accidents
- Illuminance level: IESNA handbook Ch.30 (refer to the next slide)
  - Levels higher than 50-75 fc: general + task
- Industrial facilities → one-story facilities: monitors, skylights, clerestories for daylight autonomy.



- Heavy soot and dirt: frequent cleaning & maintenance required
- LLF must be kept at reasonable levels.
- Light sources: high efficacy, good lumen maintenance, and long life. → HID, florescent lamps
  - HID lamps easier to maintain store, clean, and relamp than fluorescent lamps and have equal or better efficacy.
  - Disadvantages of HID: delay and lower output on restrike.

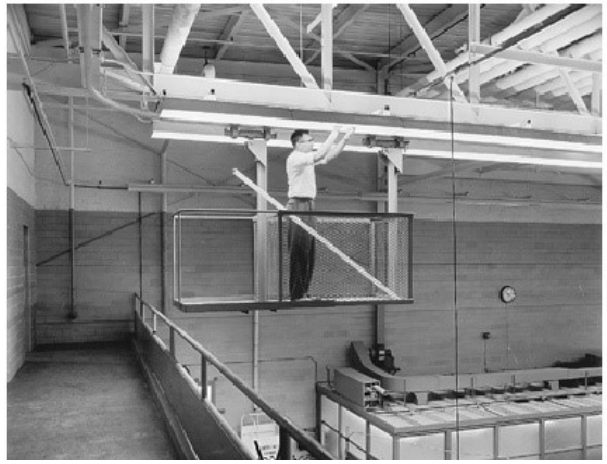
Table 30.2 | Industrial Illuminance Recommendations continued from previous page

Applications and Tasks[a]	Notes	Recommended Maintained Illuminance Targets (lux)[b, c, d]									
		Horizontal (E_h) Targets					Vertical (E_v) Targets				
		Visual Ages of Observers (years) where at least half are					Visual Ages of Observers (years) where at least half are				
		<25	25-65	>65			<25	25-65	>65		
		Category			Gauge		Category			Gauge	
MACHINING											
• Fine bench or machine work		W	1500	3000	6000	Avg	W	1500	3000	6000	Avg
• Fine grinding		W	1500	3000	6000	Avg	W	1500	3000	6000	Avg
• Medium bench or machine work		R	250	500	1000	Avg	R	250	500	1000	Avg
• Rough bensh or machine work		P	150	300	600	Avg	P	150	300	600	Avg
MAINTENANCE		R	250	500	1000	Avg	N	75	150	300	Avg
MANUAL CRAFTING	Engraving, carving, painting, stitching, cutting, pressing, knitting, polishing, or woodworking										
• Coarse		P	150	300	600	Avg	P	150	300	600	Avg
• Exacting		W	1500	3000	6000	Avg	W	1500	3000	6000	Avg
• Fine		T	500	1000	2000	Avg	T	500	1000	2000	Avg
• Medium		R	250	500	1000	Avg	R	250	500	1000	Avg
MATERIALS HANDLING											
• Loading	Inside truck and freight cars	M	50	100	200	Avg	I	15	30	60	Avg
• Picking stock, classifying		M	50	100	200	Avg	K	25	50	100	Avg
• Wrapping, packing, and labeling		P	150	300	600	Avg	N	75	150	300	Avg
MOTOR AND EQUIPMENT OBSERVATION		P	150	300	600	Avg	P	150	300	600	Avg
RAW MATERIAL PROCESSING	Cleaning, cutting, crushing, sorting, or grading										
• Coarse		M	50	100	200	Avg	M	50	100	200	Avg
• Medium		P	150	300	600	Avg	P	150	300	600	Avg
• Fine		R	250	500	1000	Avg	R	250	500	1000	Avg
• Very fine		T	500	1000	2000	Avg	T	500	1000	2000	Avg
SERVICE SPACES											
• Elevators, freight and passenger	See 22 | LIGHTING FOR COMMON APPLICATIONS										
• Stairways, corridors	See 22 | LIGHTING FOR COMMON APPLICATIONS										
• Toilets and wash rooms	See 22 | LIGHTING FOR COMMON APPLICATIONS										
SHIPPING AND RECEIVING	See 22 | LIGHTING FOR COMMON APPLICATIONS										
WAREHOUSING AND STORAGE											
• Inactive		K	25	50	100	Avg	H	10	20	40	Avg
• Active: bulky items; large labels		M	50	100	200	Avg	K	25	50	100	Avg
• Active: small items; small labels		P	150	300	600	Avg	N	75	150	300	Avg

Table 30.2 | Industrial Illuminance Recommendations continued next page

Industrial lighting equipment

- The cost of replacing a ballast can be greater than the cost of the ballast.
- Long life high quality lamps & ballasts recommended where luminaires are not easily accessible.
- Catwalk or platform relamping must be avoided, e.g. relamping from the floor.



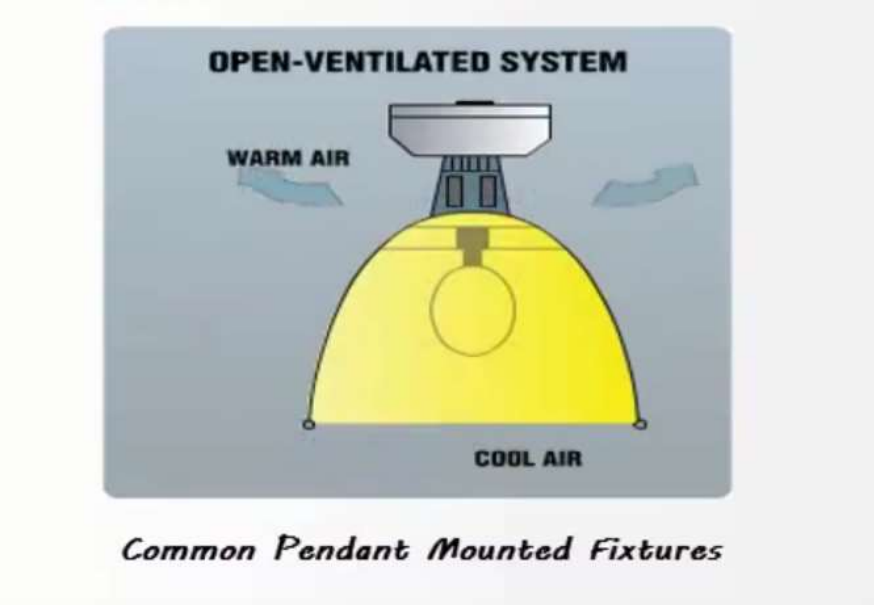
cage

platform

relamping from the floor

Industrial lighting equipment

- Ventilated luminaires tend to be self-cleaning by convection (Fig. 17.21).



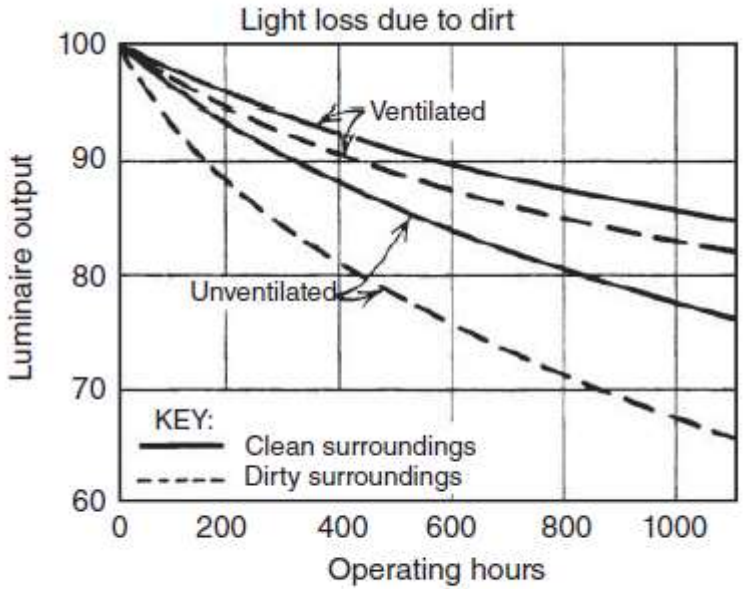


Fig. 17.21 *Graph demonstrating the advantage of ventilated fixtures.*

Image source: https://www.youtube.com/watch?v=kHPMjYxxQ5E

Maintenance

- dirt, vibration, wear-and-tear, rough service → proper maintenance protocol
- Maintenance includes cleaning, relamping, inspection, preventive maintenance
- burnout-based relamping is extremely uneconomical due to disruption of production → group relamping
- Cleaning should be on a planned group basis

A fluxometer developed to measure a luminaire's available light in order to determine the benefits of periodic cleaning.

Emergency lighting

- general power failure, failure of the building's electrical system
- Minimum average illumination levels along the egress path: 10 lux

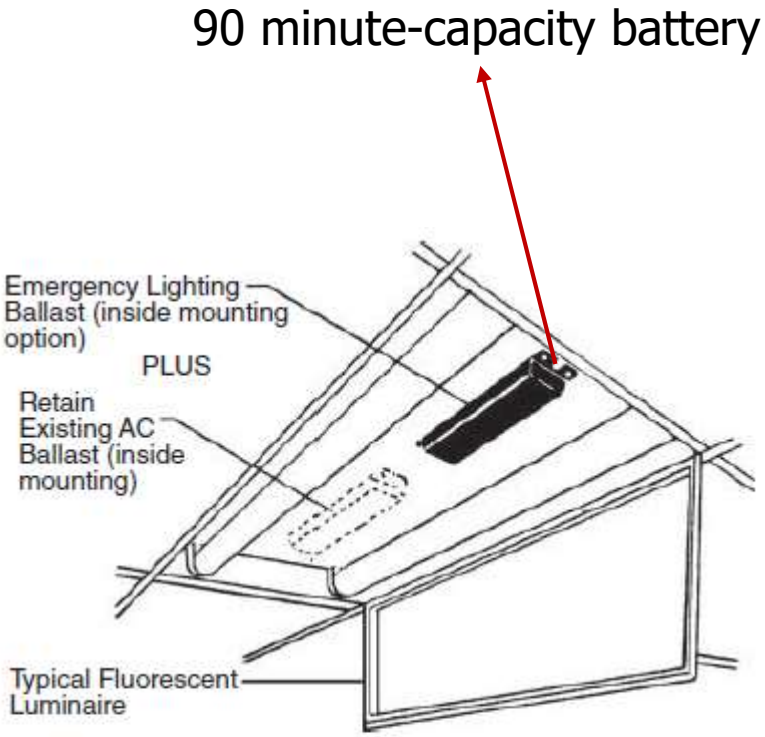


Fig. 17.24 *The emergency lighting ballast package contains a 90-minute-capacity high-temperature battery, inverter, sensing and switching equipment, and electronic ballast circuitry to operate the lamp(s) at full or reduced output. The emergency ballast is energized on loss of normal power. The entire package measures 9½ in. × 2⅜ in. × 1½ in. (241 mm × 60 mm × 38 mm). (Courtesy of Big Beam Emergency System, Inc.)*

Emergency lighting units

It is general to furnish the required emergency illumination from ceiling or wall-mounted fixtures.
It is advisable to install emergency lighting fixtures near floor level. (baseboard covering wall and floor joint) → to prevent disabling glare and distorting shadows.

Fig. 17.25 *Commercial emergency lighting units. (a) This decorative unit contains a sealed, maintenance-free lead–acid battery, an automatic charger, and an automatic low-battery-voltage disconnect. The battery is designed to supply a minimum of 90 minutes of operation of two fully adjustable 5.4-W sealed beam lamps. The unit measures 16.5 in. × 5 in. × 5 in. (419 mm × 127 mm × 127 mm). (b) Conventional design emergency unit contains a lead-acid or lead-calcium battery, which is housed with its required electronic control and safety equipment in a polycarbonate housing. The lamps are rated 7.2 W each. The entire unit measures approximately 15.75 in. × 11.5 in. × 4 in. (400 mm × 292 mm × 102 mm); exact dimensions vary with battery type, voltage, and capacity. (Courtesy of Dual-Lite, a division of Hubbell Lighting, Inc.)*

Flood lighting

- An artificial light across a wide area, both interior and exterior
- parking lots, shopping centers, building under construction and excavation, building gates and surrounds, roadways,…

(a) (b)

Fig. 17.28 *(a) Floodlighted section of a wall surrounding the Old City of Jerusalem, Israel, adjacent to the Jaffa Gate. Light sources are 400-W HPS units giving an average illuminance level of 50 lux. A sodium source was chosen to enhance the yellow-red color of the stone. (b) Church of All Nations, Mount of Olives, Jerusalem, Israel. Floodlight sources are 250- and 400-W mercury and metal–halide units, giving an average illuminance of 70 lux. Sources were selected to complement the colors in the mosaic at the top of the façade. (Photos courtesy of City of Jerusalem and J. Stroumsa, Chief Engineer.)*

San Francisco city hall (2008 Oct 19

Glasgow, Scotland (Jul, 2009)

Glasgow, Scotland (Jul, 2009)

Glasgow, Scotland (Jul, 2009)

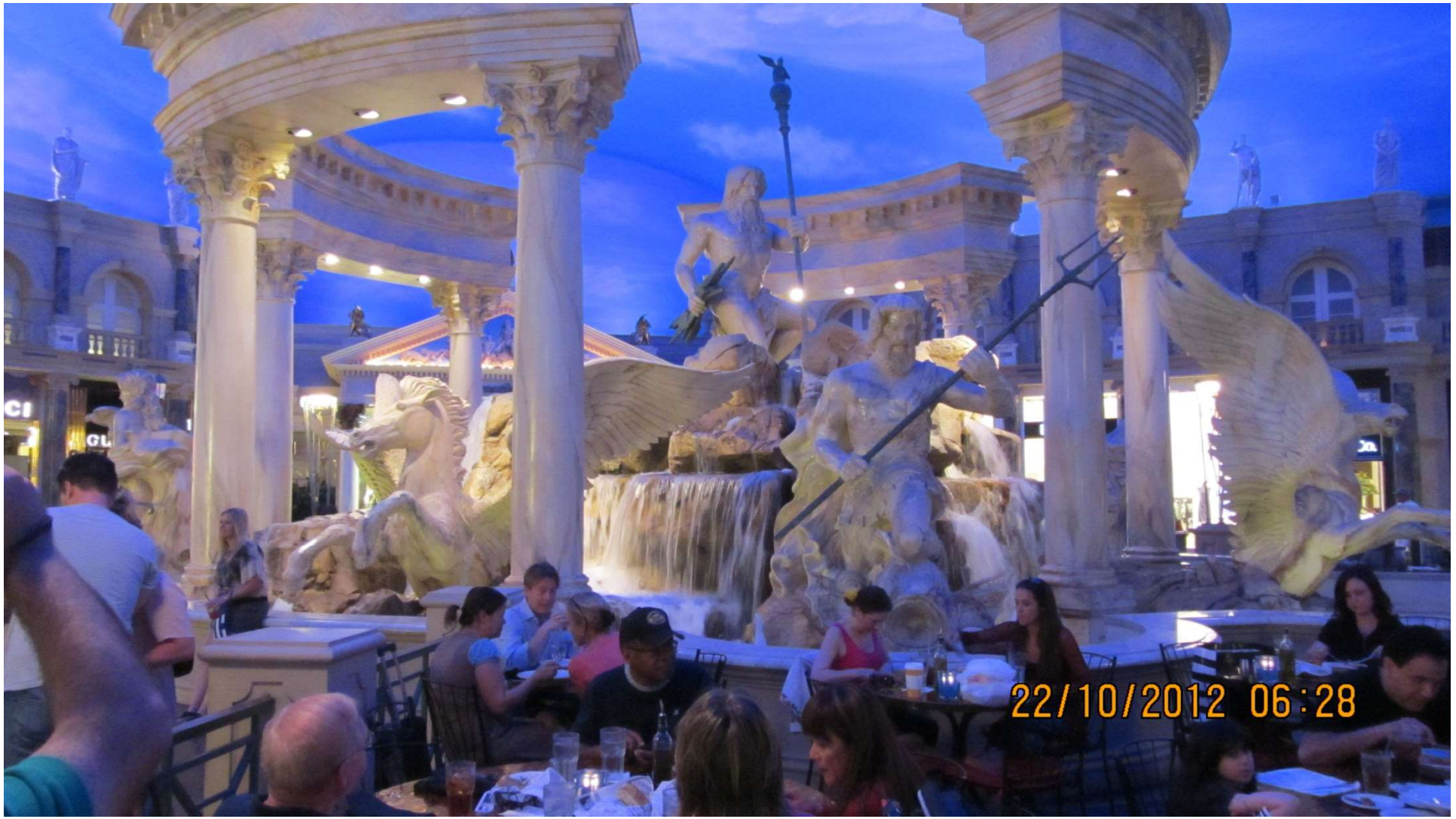
Glasgow, Scotland (Jul, 2009)

Colosseo, Rome, Italy (Aug, 2009)

Rome, Italy (Aug, 2009)

Fontana Trevi, Rome, Italy (Sep. 2019)

Fontana Trevi, Rome, Italy (Sep. 2019)



The forum shops, Las Vegas, NV (Oct. 2012)

The forum shops, Las Vegas, NV (Oct. 2012)