Lighting Fixtures

Recessed Lighting

- Lamp Types
  - Incandescent
  - Tungsten Halogen
  - Fluorescent
  - HID (metal halide)
  - Rare use of fiber-optics and LED

Parts of a fixture:
http://www.epl.com(fixture_movie.cfm?FixtureID=533)
Recessed Lighting

- Reflectors
  - Cutoff
  - Glare
  - Distribution
  - Wet or Dry

Recessed Lighting

- Reflectors
  - Trim

Housing Body

3.33' 86mm

1.88' 48mm

3.95' 100mm

3.75' 95mm
Recessed Lighting

- Performance
  - Downlight

Recessed Lighting

- Performance
  - Accent
Recessed Lighting

- Performance
- Accent

Recessed Lighting

- Performance
- Wallwash

Ceiling outlet: 0°±15°
Track

-Track heads vs. Track
  -Range of light sources, from incandescent, halogen, HID to fluorescent
  -Flexibility for temporary setups
  -Easily focused and accessorized
  -Different optics – eg: Wallwash, spot, gobos, etc…
Track

Mounting of track
- Suspended
- Surface mounted
- Recessed

Types of track
- Rigid track – 1 circuit, 2 circuit, 3 circuit
- Bendable track
- Cable mounted
- Monopoints

 Voltage
- Low voltage
- Line voltage
Linear Fluorescent – Recessed and Surface mounted

- Diffuse ambient light
- Cost effective and energy efficient
- Direct or direct/indirect

Linear Fluorescent - Pendants

- Indirect, direct, or indirect/direct
- Modular
- Choice of diffusion materials
Decorative

- Contemporary vs. historic
- Generally inefficient diffuse sources, which serve as accents in a space
- Look at choice of materials for diffuser and connection details at articulations. Also be aware of canopy or mounting plate conditions.
- Often companies will customize these types of fixtures.
Exterior Floodlights

- Distribution and beam shape is key.
- Be aware of ambient light conditions – contrast is critical.
- Look at gasketing – will this leak?
- How is this going to attach to your building?
- Does this fixture need a transformer or ballast? Is it line voltage or low voltage?
Exterior Ingrade

- Lighting the path vs. uplighting a building
  - Where is this located?
  - Slab
  - Gravel
  - Foliage
  - Driveover?

Misc Exterior

- Drive-overs
- Bollards
- Steplights
“Architectural”

-Certain fixtures are designed to be integrated into an architectural detail. As such, they either lack an optical control element or have little external casing/housing.

http://www.grandbrass.com/

CIE Luminaire Types / Distributions

Direct | Semi-Direct | General Diffuse

(IES) Direct-Indirect | Semi-Indirect | Indirect
Candlepower Distribution Curve

Candlepower distribution curves provide intuitive information on how a luminaire will perform. Candela values are used in calculations to predict light levels.

Asymmetrical Distribution Curve

- **Rectangular Tubular Fluorescent fixture**
  - 90° Perpendicular
  - 0° Parallel

Candlepower Distribution

- 30° 60° 90°
- 0° 30°
Photometry Reports

Plot of candlepower values
Summary of candlepower values in different planes
Fixture Efficiency
Lumen Summary
Luminance summary
Spacing criteria
Spacing/Mounting Height (S/MH) for uniformity
Coefficient of Utilization Table
Guides

Lighting Calculations

Point by point calculations
-Lumen method
-IES files and computer calculations
Point-by-Point

Foot-candle = \frac{\text{Candle Power}}{\text{Distance}^2}

FC = \frac{2651\text{ candelas}}{9\text{ ft}^2}
FC = \frac{2651}{81}
FC = 32.7 \text{ foot-candles}

Point-by-Point

Foot-candle = \frac{\text{Candle Power}}{\text{Distance}^2}

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Point-by-Point

Foot-candle = \frac{\text{Candle Power}}{\text{Distance}^2}

To solve for D, you can:
1. Scale the Drawing, or
2. Use Trigonometry

\[ X^2 + Y^2 = Z^2 \]
\[ 32 + 6^2 = D^2 \]
\[ 9 + 36 = D^2 \]
\[ D = (9 + 36) \]
\[ D = 6.7 \]

Point-by-Point

FC = 169 \text{ candelas} / 6.7\text{ft}^2
FC = 169 / 44.89
FC = 3.76 \text{ foot-candles}
Depreciation factors

Light Loss Factors to Consider
• Dirt
• Lamp Depreciation
• Environment
• Ambient Fixture Temperature
• Supply Voltage Variation (Low Voltage approx 4%)
• Ballast Factor (Fluorescent approx 90%)
• Lamp Burnouts (approx 80%)
• Lamp Lumen Depreciation (Fluorescent approx 70%)
• Fixture (Luminaire) Dirt Depreciation

Lighting Calculations – Lumen method

– Calculates the Average Illumination for a room.
– Takes into account the room surface reflectance’s – but assumes the surfaces are diffuse (not shiny!).
– Assumes an empty room (without furniture).
– Can also be used to determine the required Quantity of Fixtures needed for a target light level.
– Does not determine light fixture layout or location – you must following manufacturers’ spacing criteria.
Lighting Calculations – **Lumen method**

1. You need Room Dimensions and the Fixture Mounting Height.
2. You need to select a Light fixture
3. Determine the rooms Room Cavity Ratio (RCR).
4. Look-up the fixtures Coefficient of Utilization for the RCR.
5. Calculate

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**Room Reflectance**

Surfaces with less reflectance will bounce less light.
- Typical Reflectance Values:
  - 75%-90% White, Off White, Grey, Light tints of Blue or Brown
  - 30%-60% Medium Green, Yellow, Brown, or Grey
  - 10%-20% Dark Grey, Medium Blue
  - 5%-10% Dark Blue, Brown, Dark Green, and many wood finishes
Room Reflectance

Typical Commercial Values:
- 80% Ceiling
- 50% Wall
- 20% Floor

Typical Industrial Values:
- 50% Ceiling
- 30% Wall
- 20% Floor

Room Cavity Ratio

RCR = Room Area

Room Cavity Ratio (aka RCR) is the volume between the Fixture and Height of Calculation. Workplane height is typically 30-inches above the floor. A room's RCR will always be between 1 and 10.
Room Cavity Ratio

\[ \text{RCR} = 5x\text{MH}x(L+W) \]

Example:
Room Width: 12 ft
Room Length: 15 ft
Ceiling Height: 10 ft
RCR = 5(5.5)(12+15)
(12x15)
RCR = 742.5
180
RCR = 4.1

Coefficient of Utilization

\[ \text{RCR} = \text{Room Area} \]

Also known as \text{CU}

- Defines the percentage of light output that is expected from a fixture
- The value is determined by a CU table
- For our example of a RCR = 4.1...the CU is in this range
- For commercial Reflectance of 80/50/20, the actual CU value is this.
Lumen Method Formula

To Calculate Foot-candle level:
To Calculate number of Fixtures:
Lumen Method Formula

\[ FC = \text{Qty of Fixtures} \times \text{Number of Lamps per Fixture} \times \text{Lumens per Lamp} \times \text{CU} \]

Area of the Room

\[ FC = \frac{\text{Total Lumens in the Room} \times \text{CU}}{\text{Area of the Room}} \]

Qty of Fixtures = \[ FC \times \text{Area of the Room} \]

Number of Lamps per Fixture \times \text{Lumens per Lamp} \times \text{CU}

Qty of Fixtures = \[ FC \times \text{Area of the Room} \]

Total Lumens in the Room \times \text{CU}

Lumen Method Example

What is the resulting Foot-candle Level at table height from four downlights?
Lighting Calculations – Computer

Three main standards of fixture photometric data: IES, Eulumdat and Dialux ULD data
-IES is the most commonly available and used format in North America. Programs such as AGI and Lumen Micro and various free software applications from manufacturers use this format.
-Usually available in a file per fixture format or as one download for the entire fixture range available.


Lighting Calculations – Computer

Typical file format (may be opened as a text file, but needs the "ies" suffix to be used in calculation programs):

IESNA:LM-63-1995
[TEST] A7053BK
[TESTLAB] LOL FALL RIVER
[ISSUEDATE] 8-14-05
[MANUFAC] LIGHTOLIER
[LUMCAT] A7053BKW
[LUMINARIE] CALCULITE 4.5" INCANDESCENT RECESSED DOWNLIGHT
[MORE] BLACK FINISH TRIM
[LAMP] 75W A-19
[TILT]=NONE
1 110.0 1 11 1 1 1 -0.34 0 0
1 1 75
0 5 15 25 35 45 55 65 75 85 90
0
427.00 422.00 369.00 368.00 200.00 89.00 0.00 0.00 0.00 0.00 0.00
Lighting Calculations – **Computer**

Photometric grid  False colour rendering

Agi32 calculation software