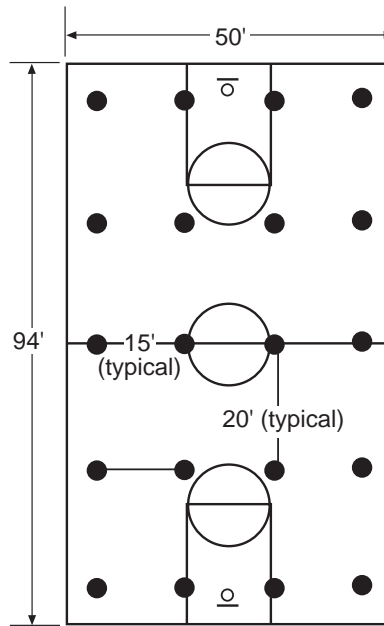
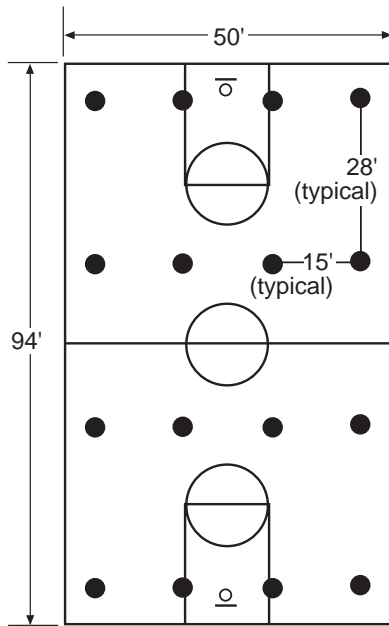


### BASKETBALL—25 FT. MOUNTING HEIGHT



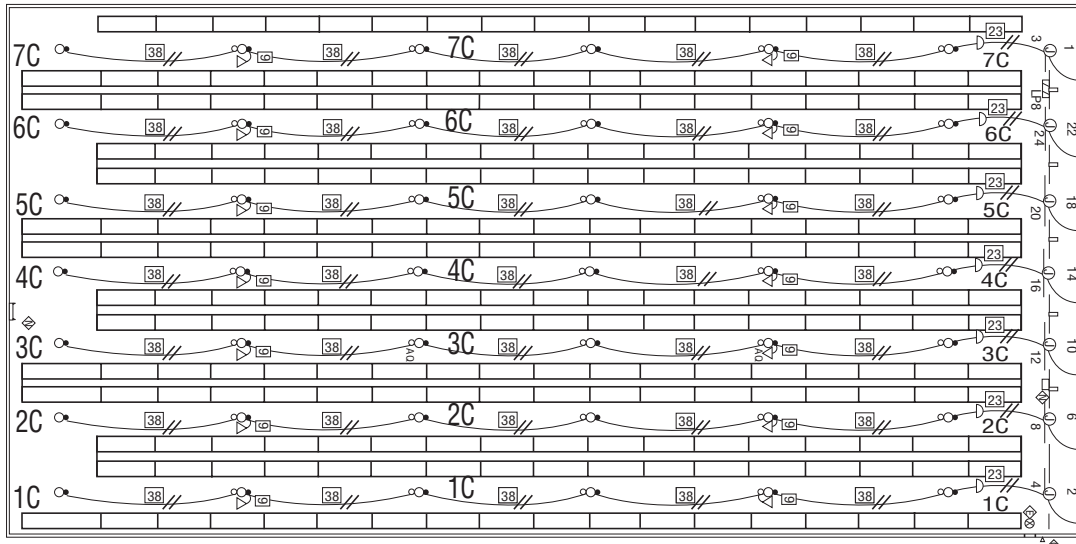
**BASKETBALL— INDOOR  
(16) LUMINAIRES**

Lamp	Average Maintained Footcandle Level	
	High Bay	Low Bay
MH 250	27 fc	24 fc
MH 400	51 fc	45 fc

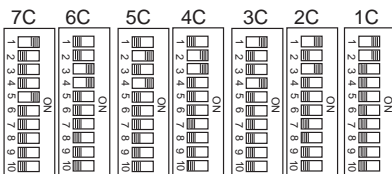
**BASKETBALL— INDOOR  
(20) LUMINAIRES**

Lamp	Average Maintained Footcandle Level	
	High Bay	Low Bay
MH 250	33 fc	28 fc
MH 400	65 fc	58 fc

### HI/LO ELECTRO-CONNECT WAREHOUSE LAYOUT



### HI/LO DIP SWITCHES



Note: Electrical contractor to verify all panel-board locations and circuit numbers (typical).

### ADDRESS TABLE

Aisle No.	Settings	
	On	Off
1C	1, 2	3, 4, 5, 6, 7, 8, 9, 10
2C	1, 3	2, 4, 5, 6, 7, 8, 9, 10
3C	1, 4	2, 3, 5, 6, 7, 8, 9, 10
4C	2, 3	1, 4, 5, 6, 7, 8, 9, 10
5C	2, 4	1, 3, 5, 6, 7, 8, 9, 10
6C	3, 4	1, 2, 5, 6, 7, 8, 9, 10
7C	1, 5	2, 3, 4, 6, 7, 8, 9, 10

### BILL OF MATERIAL

Item	Desc.	Qty.	Cat. No.	Symbol
Distribution Cable	Two Cir.	7	LD-27-2E-23	
Lighting Cable	Two Cir.	35	LC-27-2E-38	
Dust Cover	—	—	7-70173-001	

Fixtures Requiring Electro-Connect				
Item	Symbol	Qty.	Cat. No.	Wiring Inst.
HLA	n/a	42	HLA-27-CA-03	Factory Inst.
Adapter		14	LA-27-CA-09	Field Inst.
HB0400M27-HL-A16		42		

## LAYOUT—MOUNTING HEIGHT PRINCIPLES AND EXAMPLES BEFORE MAKING LAYOUT ON GRAPH PAPER

### LAYOUT TIPS

- For equal spacing of fixtures in both direction, take the square root of the square feet/fixture value.

$$\sqrt{\text{Area/Fixture Value}}$$

For fixture locations where the spacing is greater than the square root in one direction, the product should approximately equal the square feet/fixture value. For example, a 6'x8' spacing would give approximately the same illuminance as a 7'x7' spacing.

- Make Adjustments to:
  - Avoid columns, sprinklers, or outlets, etc. that would interfere with the location of fixtures.
  - Take advantage of structural elements that can be economically utilized to support the new fixtures.
  - Obtain a layout that is harmonious with room dimensions and the architectural elements of the space.
  - If good footcandle uniformity is desired because of the proximity of work stations, the orientation of machinery, etc., then make adjustments to stay within the maximum fixture spacing-to-mounting-height ratios.

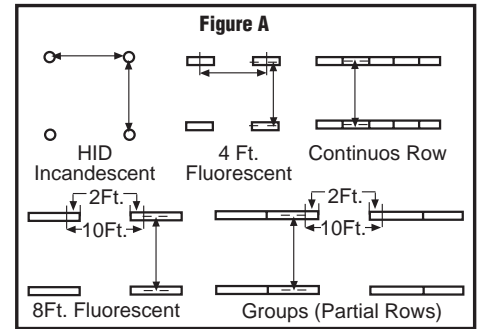
- For Recessed Fixtures:
 

If exposed grid "T" ceiling, draw heavy line for "T"s. Lay out for uniform distance from walls. If task located near perimeter of space, start first fixture 2' from side wall and 2' from end wall. If "T"s are located on 2' centers in one direction and 4' centers in the other direction, remember that 2'x4' fixtures must be spaced some multiple of 2' in one direction, and a multiple of 4' in the other direction. The "T"s are normally centered within the room with the 4' direction parallel to the room length in rectangular rooms.

- For Surface and Suspended Commercial Fixtures:
 

End wall to first fixture: 1' to 4' maximum  
Side wall to first fixture: 1' to 2' preferable

- For Fluorescent Industrial Fixtures: (see Fig. A)
  - Clean areas with difficult seeing tasks, use same type layout as in (2) for commercial fixtures.
  - General industrial area, side walls and end walls are of less importance...use one half of spacing of rows at walls.
  - Spacing of fixtures in continuous rows:
 
$$\frac{\text{Area per Fixture}}{\text{Length of Fixture}} = \text{ft. (center line to center line)}$$



- For H.I.D. Industrial Fixtures: (see Fig. A)
  - Often a layout can be developed for a single bay which can be repeated through the entire area.
  - Determine the location of floor or roof joists, which are useful structural elements for supporting the HID Industrial fixtures, and wiring. For example, when lighting a plant with 40'x40' bays and joists on 5' center, you could use 400W HPS fixtures on 20' centers, and the joists will provide support for all fixtures.

### RECOMMENDED MOUNTING HEIGHTS FOR INDOOR INDUSTRIAL LIGHTING FIXTURES

Mounting Height	Industrial Fluorescent	HPS	MH	HID Fixture
9-15 Ft.	F40T12-F96T12/HO	50w 70w 100w	— 70w 100w	LLB LLB LLB
11-18 Ft.	F96T12-F96T12/HO	150w — —	150w 175w —	LLB, HB LLB, HB LB, HB
15-20 Ft.	F96T12-F96T12/HO	200w —	— 250w	LLB, LB, HB LLB, LB
15-25 Ft.	F96T12-F96T12/VHO	250w —	250w 400w	LB, HB LB, HB
18-25 Ft.		310w	400w	LB, HB
18-30 Ft.		400w	400w	LB, HB
30-50 Ft.		1000w	1000w	HB

LLB=Little Low Bay

LB=Low Bay

HB=High Bay

**I.E.S.N.A. Illuminance (footcandle) Recommendations**

INTERIOR CATEGORIES AND FOOT CANDLE RANGES†				
Type of Activity	Illumination Category	Ranges of Illuminances		Reference Work Plane
		Lux	Footcandles	
Public spaces with dark surroundings	A	30	3	General lighting throughout spaces
Simple orientation for short temporary visits	B	50	5	
Working spaces where visual tasks are only occasionally performed	C	100	10	
Performance of visual tasks of high contrast or large size	D	300	30	Illuminance on task
Performance of visual tasks of med. contrast or small size	E	500	50	
Performance of visual tasks of low contrast or very small size	F	1,000	100	
Performance of visual tasks of low contrast and very small size over a prolonged period	G	3,000-10,000	300-1,000	

FOR ILLUMINANCE CATEGORIES A THROUGH C			
Room and Occupant Characteristics	Weighting Factor		
	-1	0	+1
Occupant's Ages	Under 40	40-55	Over 55
Room Surface Reflectances*	Greater Than 70%	30%-70%	Less Than 30%

FOR ILLUMINANCE CATEGORIES D THROUGH G			
Task and Worker Characteristics	Weighting Factor		
	-1	0	+1
Worker's Ages	Under 40	40-55	Over 55
Speed and/or Accuracy**	Not Important	Important	Critical
Reflectance of Task Background***	Greater Than 70%	30%-70%	Less Than 30%

Determine the weighting factors which apply for each Room-and-Occupant or each Task-and-Worker characteristic and add them algebraically. If the sum is -2 or -3, use the lowest of the three footcandle values; if +2 or +3, use the highest value. Otherwise the middle footcandle value.

†I.E.S.N.A. Lighting Handbook 2000. Reprinted by permission.

\*Average weighted surface reflectances, including wall, floor and ceiling reflectances, if they encompass a large portion of the task area or visual surround. For instance, in an elevator lobby, where the ceiling height is 7.6 meters (25 feet), neither the task nor the visual surround encompass the ceiling, so only the floor and wall reflectances would be considered.

\*\*In determining whether speed and/or accuracy is not important, important or critical, the following questions need to be answered: What are the time limitations? How important is it to perform the task rapidly? Will errors produce an unsafe condition or product? Will errors reduce productivity and be costly? For example, in reading for leisure there are no time limitations and it is not important to read rapidly. Errors will not be costly and will not be related to safety. Thus, speed and/or accuracy is not important. If however, a worker is involved in exacting work, accuracy is critical because of the close tolerances, and time is important because of production demands.

\*\*\*The task background is that portion of the task upon which the meaningful visual display is exhibited. For example, on this page the meaningful visual display includes each letter which combines with other letters to form words and phrases. The display medium, or task background, is the paper, which has reflectance of approximately 85%.

### Typical Illuminance Categories<sup>†</sup>

<b>Assembly</b>	
Simple .....	D
Difficult .....	F
Exacting .....	G
<b>Banks</b>	
Lobby	
General .....	C
Writing Area .....	D
Teller's Stations .....	E <sup>a</sup>
<b>Conference Rooms</b> .....	D
<b>Drafting</b>	
CAD Stations Only .....	C
Mixed CAD and Paper Task .....	D
Mylar	
High Contrast media; India ink plastic leads, soft graphite leads .....	E <sup>a</sup>
Low Contrast media; hard graphic leads .....	F <sup>a</sup>
Vellum	
High Contrast .....	E <sup>a</sup>
Low Contrast .....	F <sup>a</sup>
Tracing Paper	
High Contrast .....	E <sup>a</sup>
Low Contrast .....	F <sup>a</sup>
Overlays Light Table .....	C
Prints .....	E
<b>Educational Facilities</b>	
Classrooms	
General (see reading) .....	E
Science Laboratories .....	E
Lecture Rooms	
Audience (see reading) .....	F
Demonstration .....	F
Music Rooms (see reading) .....	F
Sight Saving Rooms .....	F
Study Halls (see reading) .....	F
Typing (see reading) .....	F
<b>Food Service Facilities</b>	
Dining Areas	
Cashier .....	D
Cleaning .....	C
Dining .....	C
Kitchen .....	E
<b>Inspection</b>	
Simple .....	D
Difficult .....	F
Exacting .....	G

<b>Libraries</b>	
Book Stacks (vert. 30" above floor)	
Active Stacks .....	D(V*)
Inactive Stacks .....	B(V*)
Card Files .....	D
Circulation Desks .....	D
<b>Machine Shops</b>	
Rough bench or machine work .....	D
Med. bench or machine work ordinary automatic machines, rough grinding, med. buffing and polishing .....	E
Fine bench or machine work, fine automatic machines, medium grinding, medium buffing and polishing ...	G
Extra-fine bench or machine work, grinding, fine work .....	G
<b>Materials Handling</b>	
Wrapping, packing, labeling .....	D
Picking stock, classifying .....	D
Loading, inside truck bodies and freight cars .....	C
<b>Merchandising Spaces</b>	
Alteration Room .....	F
Fitting Room	
Dressing Areas .....	D
Fitting Areas .....	F
Locker Rooms .....	C
Stock Rooms .....	D
Sales Transaction Area .....	D
<b>Offices</b>	
Accounting (see reading) .....	D
Conference Areas .....	D
General/Private Offices (see reading) Lobbies, Lounges and reception Areas .....	C
Mail Sorting .....	E
Off-Set Printing and Duplicating Areas .....	C
<b>Reading</b>	
Copied Tasks	
Micro-Fiche Reader .....	A <sup>a</sup>
Photographs, moderate detail ...	E <sup>a</sup>
Thermal Copy, or Poor Copy .....	F <sup>a</sup>
Xerograph .....	D
Xerograph, 3rd generation and greater .....	E

<b>Electronic Data Processing Tasks</b>	
CRT Screens .....	A <sup>de</sup>
Good Ribbon .....	D
Poor Ribbon .....	E
2nd Carbon & Greater .....	E
Inkjet Printer .....	D
Keyboard Reading .....	D
Machine Rooms	
Active Operations .....	D
Tape Storage .....	D
Machine Area .....	C
Equipment Service .....	E <sup>c</sup>
Thermal Print .....	E
<b>Handwritten Tasks</b>	
#2 Pencil/Softer Leads .....	D <sup>a</sup>
#3 Pencil/Harder Leads .....	E <sup>a</sup>
Ball-Point Pen .....	D <sup>a</sup>
Felt-Tip Pen .....	D
Handwritten Carbon Copies .....	E
Chalkboards .....	E <sup>a</sup>
White Boards .....	B
<b>Printed Tasks</b>	
6 Point Type .....	E <sup>a</sup>
8 & 10 Point Type .....	D <sup>a</sup>
Glossy Magazines .....	D <sup>e</sup>
Maps .....	E
Newsprint .....	D
Typed Originals .....	D
Telephone Books .....	E
<b>Service Spaces</b>	
Stairway, Corridors .....	B
Elevators, Freight/Passenger .....	B
Toilets & Washrooms .....	B
<b>Sheet Metal Works</b>	
Misc. Machines, Ordinary Bench Work .....	E
Presses, Shears, Stamps, Spinning Medium Bench Work .....	E
<b>Testing</b>	
General .....	D
Exacting Tests, Extra-Fine Instruments, Scales, Etc. ....	F

<sup>a</sup>Task subject to veiling reflections.

<sup>b</sup>Provide higher level over food service or selection areas.

<sup>c</sup>Only when actual equipment service is in process. May be achieved by a general lighting system or by localized or portable equipment.

<sup>d</sup>Veiling reflections may be produced on glass surfaces. It may be necessary to treat plus weighting factors as minus in order to obtain proper illuminance.

<sup>e</sup>Especially subject to veiling reflections. It may be necessary to shield the task or to reorient it.

<sup>f</sup>Degradation factors: Overlays—add 1 weighting factor for each overlay; used material—estimate additional factors.

\*Vertical Illuminance.

<sup>†</sup>For a complete list of area/activities, illuminance categories and specified illuminance values, see the I.E.S.N.A. Lighting Handbook, 9th Edition (2000), Chapter 10.

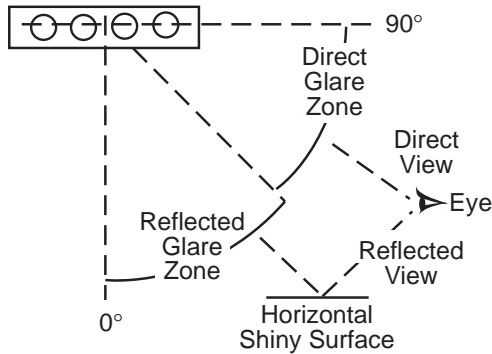
### VISUAL COMFORT—WHAT IS IT?

An important quality factor, achieved by minimizing fixture luminances (brightness) within the visual field that are generally above eye level. Fixture brightness can be distracting, cause visual discomfort, and in extremes cases result in loss of visibility.

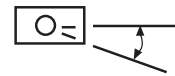
VCP values express the percentage of people who would rate a particular fixture as comfortable in a particular sized room. IES recommends that VCP's be 80 or higher in offices and other spaces containing video display terminals. Many school systems require VCP's of 70 or higher for classrooms.

### WHAT TO DO ABOUT IT:

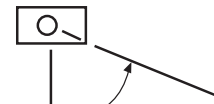
Select fixtures which have lower brightness in the direct-glare zone, to avoid excessive direct glare. Problem is prevalent in open areas involving critical, prolonged seeing, and considerable horizontal direction of view—such as working with computer screens, word processors and other visual display units.



**Note:** The direct and reflected glare zones are generally defined as shown by the diagram. It should be noted that there is no sharp line of demarcation between these zones at 45°.



**Shielding Angle:** (luminaire) The angle between a horizontal line through the light center and the line of sight at which the bare source first becomes visible.



**Cutoff Angle:** (luminaire) The right angle, measured up from nadir, between the vertical axis and the first line of sight at which the bare source is not visible.

Smaller, enclosed spaces, such as private offices are less likely to be a problem. Fewer fixtures are in the field of view, and they can be positioned to minimize both direct glare and veiling reflections. The latter reduce task contrast and reduce performance without causing visual discomfort.

Complete Visual Comfort Probability (VCP) tables are available from our Applications Engineering Department.

Recessed fluorescent fixtures with aluminum parabolic louvers or parabolic plastic molded louvers are frequently selected for such interiors. The following table gives VCP values for 100 footcandle installations of several Day-Brite fixtures, in rooms with 80% reflectance ceilings, 50% walls and 20% floors, and 8.5' and 10' ceiling heights.

### VISUAL COMFORT PROBABILITY TABLE

Troffer & Enclosure Paralouver	30'x30' Room				60'x60' Room			
	Lengthwise		Crosswise		Lengthwise		Crosswise	
	8.5'	10'	8.5'	10'	8.5'	10'	8.5'	10'
<b>VDT Ultra Parabolic</b> 2'x4', 3-T8 Lamps, 27 Cell Specular Aluminum Louver	99	99	100	100	100	100	100	100
<b>P4 4" Parabolic</b> 2'x4', 3-T8 Lamps, 18 Cell Semi-Specular Aluminum Louver	90	86	93	88	95	92	97	95
<b>P3 3" Parabolic</b> 2'x4', 3-T8 Lamps, 18 Cell Semi-Specular Aluminum Louver	86	81	89	84	93	90	95	92
<b>LP3 3" Parabolic</b> 2'x4', 3-T8 Lamps, 18 Cell Softcell Aluminum Louver	82	77	84	79	91	86	91	87
<b>Designer VDT CF33, 1-1/2" Parabolic</b> 2'x4', 3-T8 Lamps, 105 Cell Specular Aluminum Louver	93	88	91	85	97	95	96	93
<b>Designer VDT CF15, 3/4" Parabolic</b> 2'x4', 3-T8 Lamps, 377 Cell Specular Aluminum Louver	94	89	92	87	97	95	97	94
<b>TG-PL3 VDT Vacuum Metalized Plastic</b> 2'x4', 3-T8 Lamps Specular Aluminum Louver	92	87	91	86	96	94	95	93
<b>Designer Lensed Unit</b> 2'x4', 3-T8 Lamps Pattern 12 Prismatic Acrylic	56	61	54	59	48	51	46	49

## TERMINOLOGY

**Coefficient of Utilization (CU)**—Portion of lamp lumens which reach the work plane. Affected by fixture design, room proportions and room-surface reflectances.

**Light Loss Factor (LLF)**—Depreciation of initial lighting level due to Lamp Lumen Depreciation (LLD), and accumulation of dirt on the lamp and luminaire surface (Luminaire Dirt Depreciation—LDD). Affected by fixture design, lamp choice, number of burning hours and type of interior environment.

**Ballast Factor (BF)**—The commercial ballast performance relative to reference ballast.  $LLF = LLD \times LDD \times BF$

## STANDARD FORMULAS

$$\text{Number of Luminaires} = \frac{(\text{Maintained Illuminance [FC] Desired} \times (\text{Area in Square Feet}))}{(\text{Lamp Lumens/Luminaire}) \times (\text{CU}) \times (\text{LLD}) \times (\text{LDD}) \times (\text{BF})}$$

$$\text{Maintained Illuminance} = \frac{(\text{Number of Luminaires}) \times (\text{Lamp Lumens/Luminaire}) \times (\text{CU}) \times (\text{LLD}) \times (\text{LDD}) \times (\text{BF})}{(\text{Area in Square Feet})}$$

## INDOOR LIGHTING CALCULATIONS

How to calculate number of fixtures using "Maintained Illumination Tables" in Day-Brite Catalog sheets.

MAINTAINED ILLUMINATION TABLE SQUARE FEET/FIXTURE					
<ul style="list-style-type: none"> <li>• 80-50-20 reflectances (ceiling-wall-floor)</li> <li>• LLF=0.77 2900 lumens/lamp—very clean</li> <li>• Room width divided by room height =5 or more, 2 or 1</li> </ul>					
Fixture Size & No. of Lamps	Room Width Room Height	Approx. Area (sq. ft.) Per Fixture			
		30 ft-c	50 ft-c	70 ft-c	100 ft-c
2'x4' (3LP)	5	—	109	78	54
T-8 Electronic .01 Lens	2	130	78	56	40
	1	94	57	40	—

### EXAMPLE

30'x30'x9' Classroom with 2'x4' grid tees. Approximately 70FC maintained is specified.

Selected: Day-Brite 2TG332-01-1/3EB. 2'x4', 3-Lamp Static Recessed 3-Lamp Troffer.

#### STEP 1:

Determine approximate footcandle level from the I.E.S.N.A. Illuminance (footcandle) recommendations on page 00 and 00 or by using the I.E.S.N.A. Lighting Handbook, 8th Edition, pages 460-475 for illuminance categories of other areas and activities.

**70FC**

#### STEP 2:

Divide room width (narrowest dimension) by room height and select closest ratio (5, 2 or 1) in the "Maintained Illuminance Table" of the catalog sheet for the Day-Brite fixture involved.

$$\frac{W}{H} = \text{Ratio}$$

$$30 \div 9 = 3.33$$

#### NOTE:

In Day-Brite Catalog Sheets, the square feet/fixture values are calculated as follows:

Room Width/Room Height  
ratio of 5 = RCR of 1

Room Width/Room Height  
ratio of 2 = RCR of 4

Room Width/Room Height  
ratio of 1 = RCR of 7

#### STEP 3:

Select from the table the square feet/fixture value for the width/height ratio for the maintained footcandle level. Divide the square feet/fixture value into logical spacing dimensions.

Ratio	Area Per Fixture (Sq. Ft.)
5	78
2	56
3	<Difference between 2 & 5> 22

$$[3.33 \text{ is between } 2 \text{ \& } 5. \ 3.33 - 2 = 1.33$$

$$1.33 \div 3(5-2) = .44]$$

$$3.33 \ 22 \times .44 = 9.2 + 56 = 65$$

#### STEP 4:

Total number of fixtures per room is calculated by dividing the room area by the square feet per fixture.

$$\text{No. Fixtures} = \frac{\text{Area}}{\text{Sq. ft./Fixture}}$$

$$900 \div 65 = 13.9$$

**Fixtures**

For typical tile ceiling conditions use 2' increment in one direction and either 2' or 4' (depending on fixture) in the other direction. If continuous rows be careful not to have the rows exceed the maximum spacing of the fixture.

**USE 12 FIXTURES. (3 rows of 4 on 8' x 10' centers)**