

## **DAYLIGHT HARVESTING exercises**

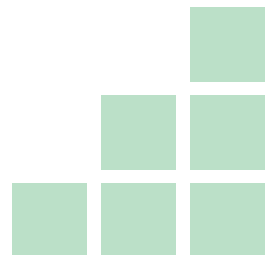
### **Put your knowledge to the test!**

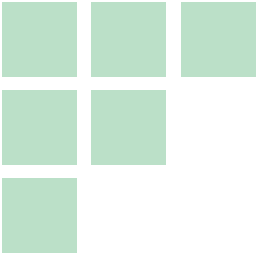
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and mail the completed exercises to:

**Lighting Control & Design  
905 Allen Avenue, Glendale, CA 91201  
Attn: Continuing Education Department**

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with DH06b in the subject line.

You may also download lessons (1 - 8) and the exercises from our website at  
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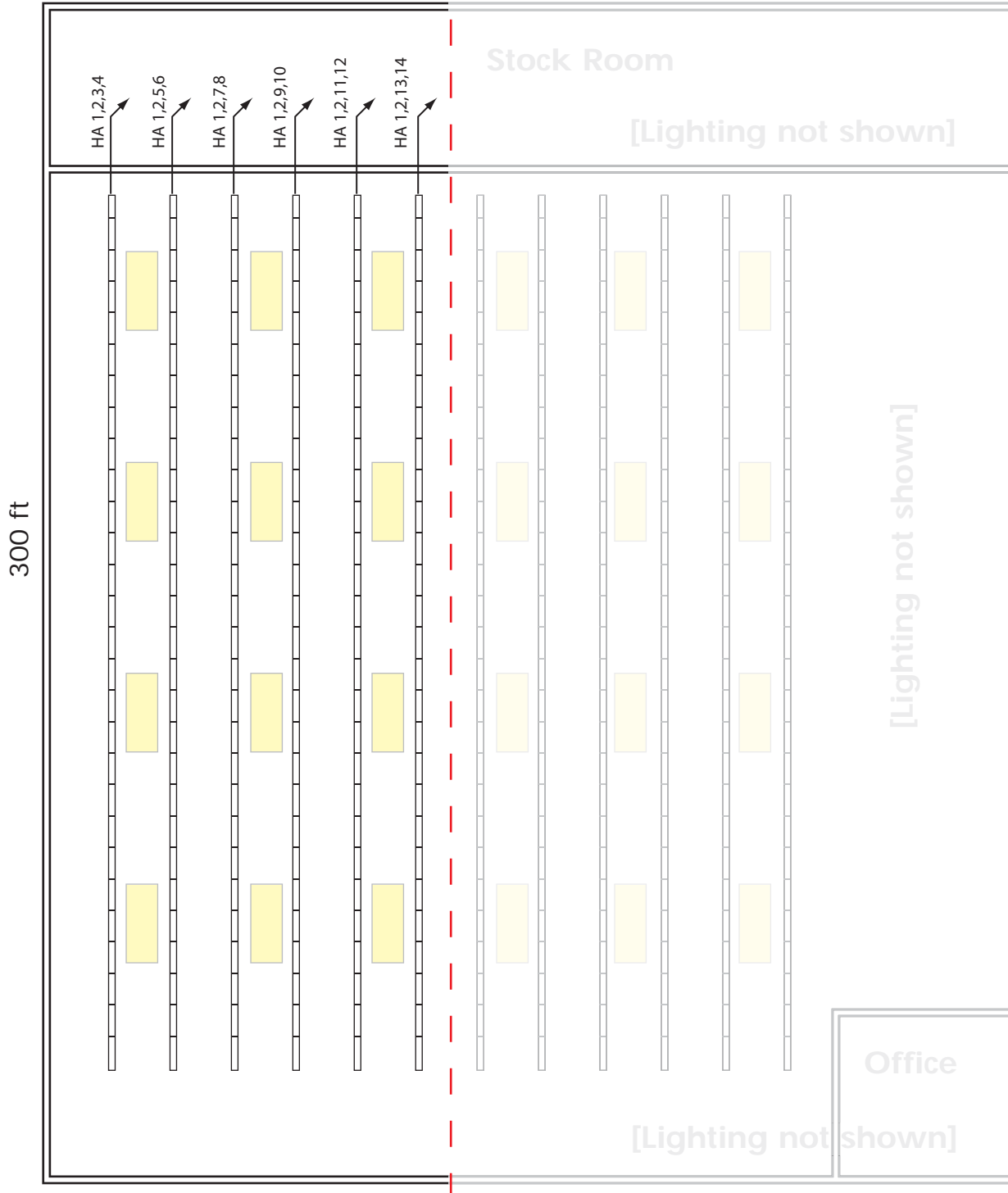


# Exercise 1 BIG BOX RETAILER

Square Feet: 100,000  
Ceiling Height: 18 ft

Skylights: 8 ft x 20 ft  
Luminaires: 3 lamp T8 indirect strips

Scale: 1" = 40'



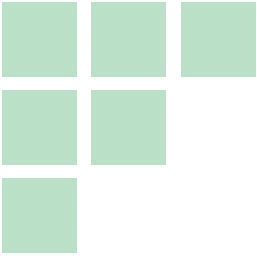
# Exercise 1 - BIG BOX RETAILER Questionnaire

1. On the plans draw primary daylight zone (refer to page 3)
2.  Open Loop  Closed Loop (refer to pages 4-7)
3. On the plans indicate a good photosensor placement location.
4. Light Reduction Strategy. (refer to page 8)
  - Multi-Level Switching     Inboard/Outboard     Alternate Rows
  - Alternate Lamps     Alternate Luminaires     Dimming
5. Other mandatory controls.
  - Time-based     Occupant-based     Both
6.  Centralized     Distributed (refer to pages 9-10)
7. Circuiting/Panels Schedules. Complete the LCP panel schedule.

Relay Panel Schedule							
<b>Job Name:</b> Big Box Retailer				<b>Comments:</b>			
<b>LCP Location:</b> Electric Room				Master Override switches in office.			
<b>Model #:</b> GR 1416/16-REMOTE				Entry Switch by alarm keypad			
<b>LCP Name:</b> LCP 1							
Relay	Line Feed	Voltage	Load Name	Relay	Line Feed	Voltage	Load Name
R1	HA 1	277V-N	Non-daylit Inboard	R2	HA 2	277V-N	Non-daylit Ouboard
R3	HA 3	277V-N	Inboard Row 1	R4	HA 4	277V-N	Outboard Row 1
R5	HA 5	277V-N	Inboard Row 2	R6	HA 6	277V-N	Outboard Row 2
R7	<input type="text"/>	277V-N	<input type="text"/>	R8	<input type="text"/>	277V-N	<input type="text"/>
R9	<input type="text"/>	277V-N	<input type="text"/>	R10	<input type="text"/>	277V-N	<input type="text"/>
R11	<input type="text"/>	277V-N	<input type="text"/>	R12	<input type="text"/>	277V-N	<input type="text"/>
R13	<input type="text"/>	277V-N	<input type="text"/>	R14	<input type="text"/>	277V-N	<input type="text"/>
R15	<input type="text"/>	277V-N	<input type="text"/>	R16	<input type="text"/>	277V-N	<input type="text"/>

## Manual Controls:

1. Consider placing a two button "staff entry" & "all off" switch near the alarm pad which allows the first employees to switch on enough lights to clean and stock the sales floor and to do paperwork.
2. Consider placing one switch in the office for individual manual control of each zone.

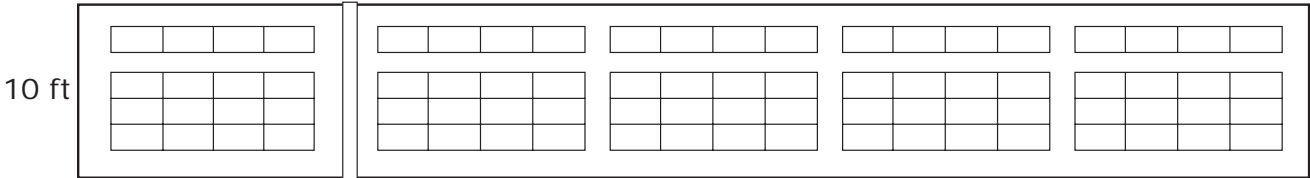
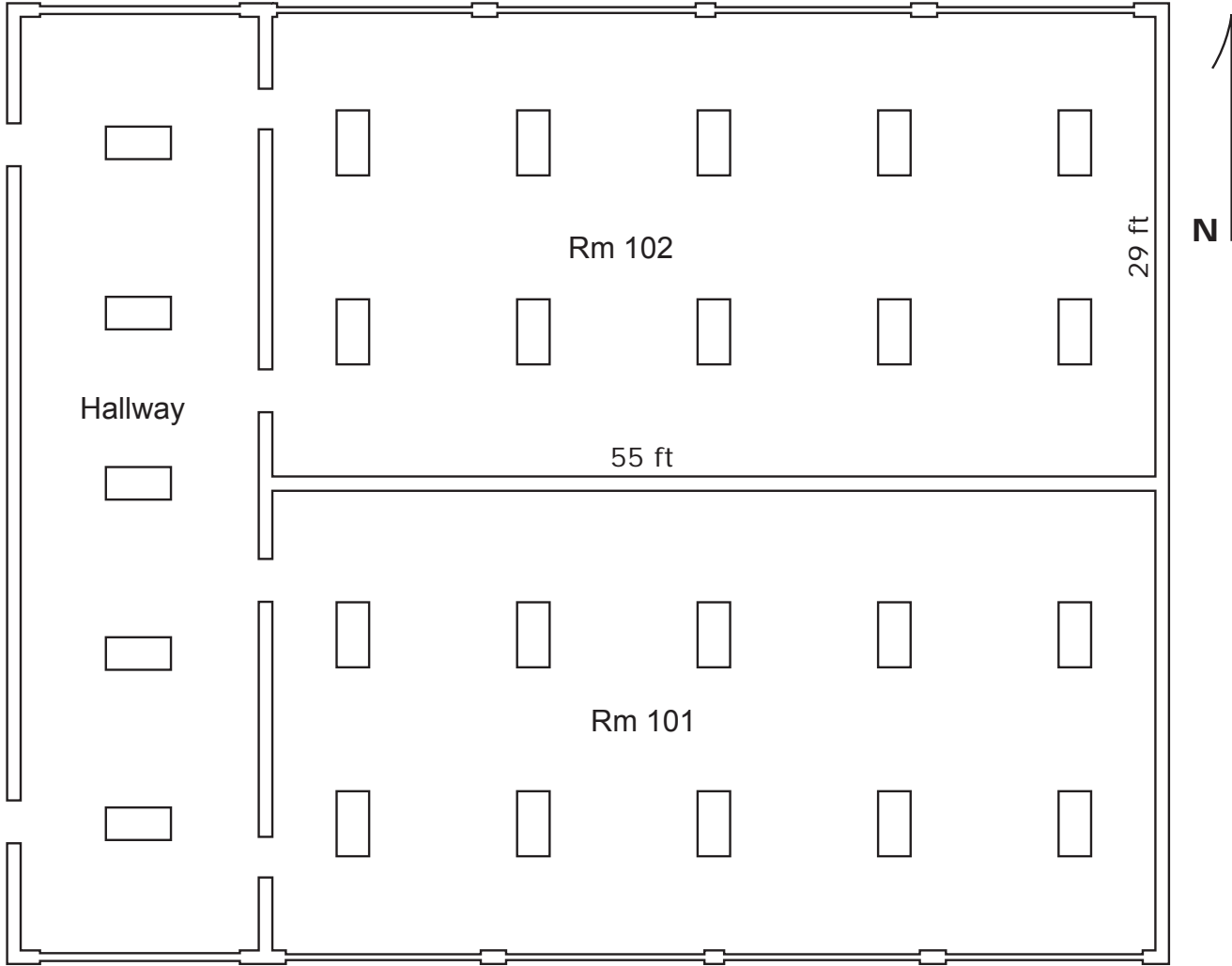


# Exercise 2 OPEN OFFICE & HALLWAYS

Overall:  
Square Feet: 4,020  
Ceiling Height: 10 ft

Individual Offices:  
Glazing: 288 ft<sup>2</sup>  
Exterior Walls: 550 ft<sup>2</sup>  
Luminaires: 2' x 4' parabolic

Scale: 1" = 10'



Elevation Drawing (north & south walls)

Note: Awning on south facing exposure eliminates direct sunlight (not shown on plans).

## Exercise 2 - OPEN OFFICE & HALLWAYS Questionnaire

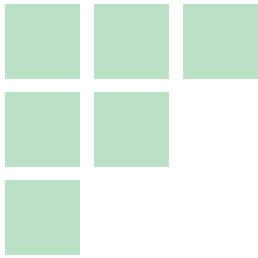
2. On the plans draw the primary daylit zones (refer to page 3). Don't zone the hallway - not viable.
3.  Open Loop  Closed Loop (refer to pages 4-7)
4. On the plans indicate a good photosensor placement location.
5. Light Reduction Strategy. (refer to page 8)
  - A. Offices:
    - Dimming
    - Alternate Lamps
    - Alternate Luminaires
    - Inboard/Outboard
  - B. Hallway:
    - Dimming
    - Alternate Lamps
    - Alternate Luminaires
    - Inboard/Outboard
6. Other mandatory controls.
  - Offices:  Time-based  Occupant-based  Both
  - Hallway:  Time-based  Occupant-based  Both
7.  Centralized  Distributed (refer to pages 9-10)
8. Circuiting. Complete the LCP schedule, or indicate circuiting on the plans.
9. Locate and detail manual switches/dimmers, using switch schedule.

Relay Panel Schedule							
Job Name: Office & Hallways				Comments:			
LCP Location: Room 102							
LCP Name: LCP 31							
Relay/ Dimmer	Line Feed	Voltage	Load Name	Relay/ Dimmer	Line Feed	Voltage	Load Name
1	HA-16	277V-N		2	HA-16	277V-N	
3	HA-16	277V-N		4	HA-16	277V-N	
5	HA-16	277V-N		6	HA-16	277V-N	
7	HA-16	277V-N		8	HA-16	277V-N	
9	HA-16	277V-N		10	HA-16	277V-N	

### Considerations for Manual Controls:

1. Should manual controls (dim or switch) be allowed to exceed the maximum amount of electric lighting as allowed by the photosensor? If yes, what re-sets this? Time? Next Day? Re-occupancy?
2. If using occupant sensors, consider disabling the "automatic on". Instead use switch to turn lights on.
3. Consider a single push button that enables the Photosensor and create completely automatic lighting controls. Will this give the room occupant enough control?
3. Should the primary and secondary daylit zones be separately controlled?
4. If switching, should the multi-level switches be set as "high, low, off" or just one switch for the "a" circuit and one for the "b" circuit?

Switch Schedule											
Switch Location: Rm 101 & Rm 102											
Button/ Slider #	Function*	Dimmers or Relays Controlled									
1											
2											
3											
4											
5											
<p>* Possible Functions</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-right: 20px;">On</td> <td>Raise</td> <td>High</td> </tr> <tr> <td>Off</td> <td>Lower</td> <td>Low</td> </tr> <tr> <td>Toggle</td> <td>Scene</td> <td>Off</td> </tr> </table>			On	Raise	High	Off	Lower	Low	Toggle	Scene	Off
On	Raise	High									
Off	Lower	Low									
Toggle	Scene	Off									

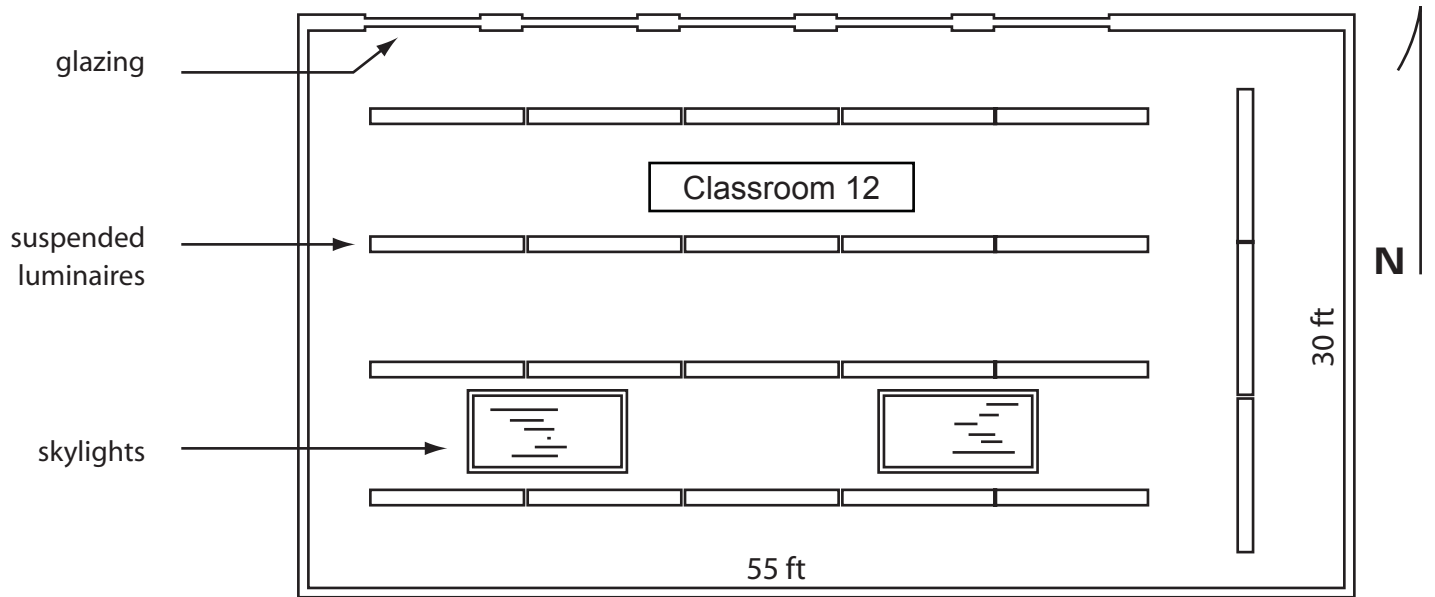


### Exercise 3 TOP-LIT/SIDE-LIT CLASSROOM

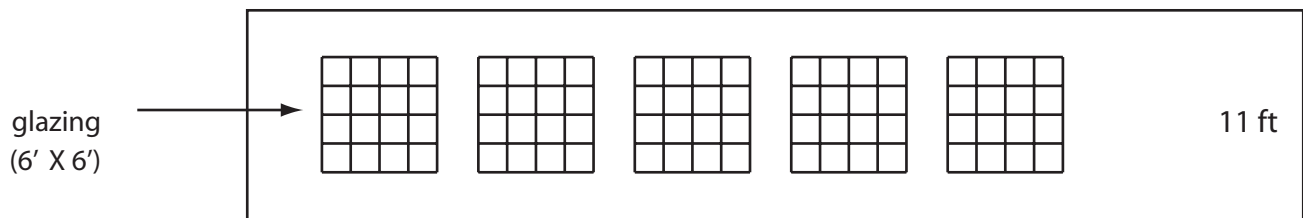
Overall:  
Square Feet: 1650 ft sq  
Ceiling Height: 11 ft  
Skylights: 4' x 8'

Luminaires: 8' T5 HO  
Direct/Indirect Luminaires  
Suspended 8' 6" AFF

Scale 1" = 10'



REFLECTED CEILING



ELEVATION

## Exercise 3 - TOP-LIT/SIDE-LIT CLASSROOM Questionnaire

2. On the plans draw the primary daylight zones (refer to page 3). Zone each exposure separately
3.  Open Loop  Closed Loop (refer to pages 4-7)
4. On the plans indicate a good photosensor placement location. *How can you avoid direct exposure to electric light?*
5. Light Reduction Strategy. (refer to page 8)
  - Dimming
  - Alternate Luminaires
  - Alternate Lamps
  - Inboard/Outboard
  - Alternate Rows
6. Other mandatory controls.
  - Time-based
  - Occupant-based
  - Both
7.  Centralized  Distributed (refer to )
8. Circuiting. Complete the LCP schedule, or indicate circuiting on the plans.
9. Locate and detail manual switch/dimmer, using the switch schedule.

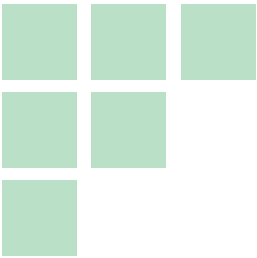
Relay Panel Schedule				
Job Name: PS 100		Comments: <input style="width: 100%;" type="text"/>		
LCP Location: Classroom 12				
LCP Name: LCP 39				
Relay/Dimmer	Line Feed	Voltage	Dimmer Type*	Load Name
1	HA-24	277V-N	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
2	HA-24	277V-N	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
3	HA-24	277V-N	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
4	EHA-3	277V-E	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>

\*Dimmer Types:  
0-10v  
Phase Dimmer

### Considerations for Manual Controls:

1. Should manual controls (dim or switch) be allowed to exceed the maximum amount of electric lighting as allowed by the photosensor? If yes, what re-sets this? Time? Next Day? Re-occupancy?
2. If using occupant sensors, consider disabling the "automatic on". Switch lights on manually instead.
3. When dimming lights for a presentation, ensure that all automatic controls are disabled during the presentation to prevent nuisance tripping.
4. Some state energy codes require the daylight zone near the glazing and the daylight zone near the skylight may need to be separately and manually controlled.
5. Emergency loads must be brought to full bright in the event of a normal power failure automatically. Ensure the system you specify is UL Listed for emergency lighting (UL 924).

Switch Schedule		
Switch Location: Classroom 12		
Button/Slider #	Function*	Dimmers or Relays Controlled
1	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
2	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
3	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
4	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
5	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
* Possible Functions		
On	Raise	High
Off	Lower	Low
Toggle	Scene	Off
		<b>Presentation Mode</b>



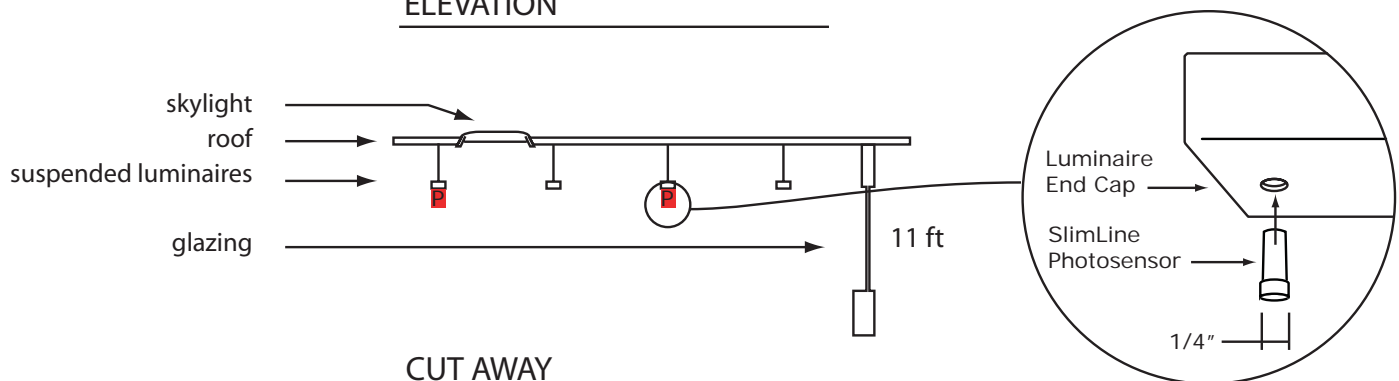
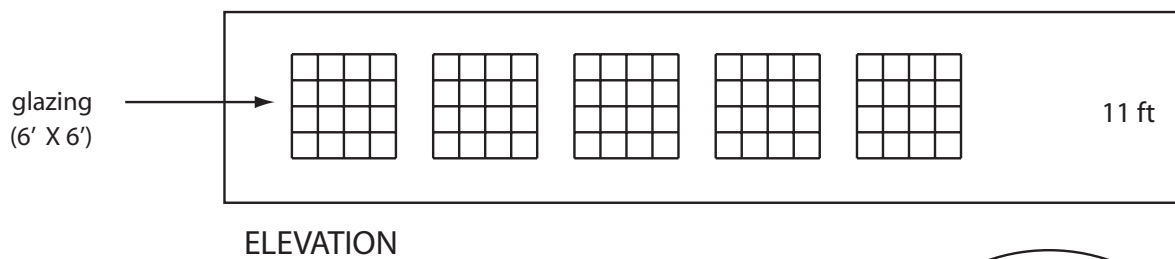
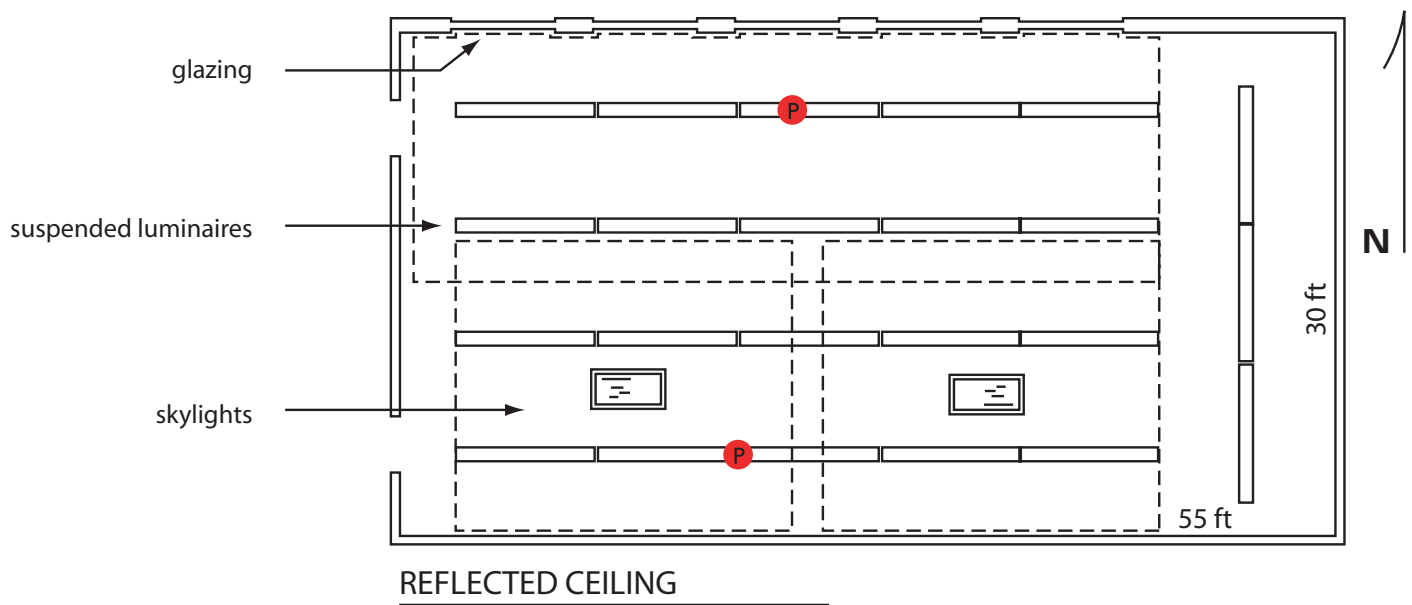
## Exercise 3 - addendum TOP-LIT/SIDE-LIT CLASSROOM

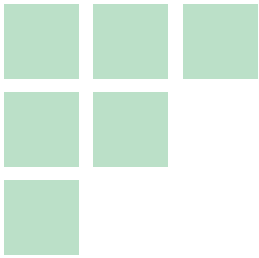
### Suspended Indirect Luminaires Can Cause Problems

Suspended luminaires which throw light at the ceiling can inadvertently prevent photosensors from operating properly.

Direct exposure to sunlight or electric light will prevent the success of daylight harvesting.

The solution is to specify a photosensor which can be mounted directly onto the downward facing side of the luminaire to prevent direct exposure to electric light.

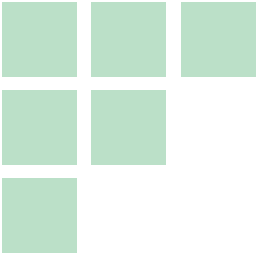




# RECOMMENDED SPEC

## Daylight Harvesting System

1. Photosensors shall be diode-based or shall have a demonstrable linear reaction to daylight. The photosensor shall see light in the same manner as the human eye. Photosensors which do not block out light in the infra-red shall not be acceptable.
2. Photosensors shall be capable of operating both as open loop or closed loop or at least shall be available in either style.
3. Closed loop photosensors must be capable of operating with suspended indirect luminaires either as mounting directly onto the luminaire or with some capability to block out direct light.
4. Light levels for each photosensor shall be displayed from a handheld programmer and via pc (Ethernet/internet or dial-up). Photosensors shall be locally and remotely programmable as to trigger-points (switching) or maintained light levels (dimming) from the handheld device or pc. Photosensors which require climbing a ladder to adjust set-screws on photosensor shall not be allowed, as they present difficulties in after-market support.
5. Other adjustment which shall be remotely and locally programmable include:
  - a. high trim/low trim for dimming ballasts
  - b. must turn-on
  - c. dimming curve
  - d. baseline
  - e. fade rate up/fade rate down
  - f. time delay on/time delay off
6. Photosensor may not control lights directly but shall control lighting through a smart control panel. This is to allow them to operate successful with manual switches, occupant sensors and building automation as required. Control panels shall be available as either centralized or distributed. Manufacturer must be able to link centralized and distributed controls into a single network.
7. Photosensors, switches, and occupant sensors must be capable of being enabled or disabled through the network and enabling of disabling each other as required. Enable and disable settings shall all be programmable.
8. Photosensor placement: The consulting specifying engineer shall be responsible for general photosensor placement during the planning phase. This is recommended placement only. Final placement is the responsibility and must be submitted by electrical contractor or photosensor manufacturer.
9. Photosensor commissioning and client demonstration: commissioning shall be the responsibility of the electrical contractor and lighting control manufacturer. System shall be demonstrated as operational to the satisfaction of the client.
10. After-market support shall be offered by the lighting control manufacturer or electrical contractor at no additional cost for a period of not less than two years, including remote adjustment of any settings needed to create a daylight harvesting system that is satisfactory to the client.
11. Manual bypass options which shall be available through programming include:
  - a. temporary override above levels allowed by photosensor
  - b. temporary override up to levels allowed by photosensor
  - c. temporary override off for presentation
  - d. permanent adjustment of baseline
  - e. enable and on
  - f. disable and on
  - g. disable and off
  - h. disable and scenes
12. Photosensors and smart controllers shall be part of a building-wide lighting control package.



## Put your knowledge to the test!

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**905 Allen Avenue, Glendale, CA 91201**  
**Attn: Continuing Education Department**

You may also download lessons (1 - 8) and the exercises online from our website at  
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With a passing grade of 80% you will be awarded up to two Professional Development Hours (or Learning Units) for completing the tutorial and exercises. This offer applies to all 50 states.

Remember to include your email address to receive a certificate. Submissions without start/finish times indicated shall receive one PHD (or LU).

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Name: \_\_\_\_\_

AIA Member? Y/N If so, please provide member number: \_\_\_\_\_

Company: \_\_\_\_\_

Title: \_\_\_\_\_

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Mailing Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Phone: (    ) \_\_\_\_\_ Fax: (    ) \_\_\_\_\_

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