

**City of Vista Fire Department**  
Development Services Section  
200 Civic Center Drive, Vista CA 92084

**Guideline:**

***Photovoltaic Systems – Fire Safety Elements***



**Guideline G-17**

Date: January 2009

# Photovoltaic (PV) Systems – Fire Safety Elements

## PURPOSE

The installation of solar photovoltaic (PV) systems presents areas of concern for firefighter safety and fire fighting operations. This guideline establishes the minimum standard for the layout design, marking, and installation of solar photovoltaic systems and is intended to mitigate the fire safety issues.

## SCOPE

This guideline applies to all solar photovoltaic systems regardless of size for residential and commercial purposes. It is based upon the *Final Draft Photovoltaic Installation Guideline* developed by the California State Fire Marshal (SFM). The technical content of this document is consistent with that document except for the provisions pertaining to the requirement for a remote disconnect.

## 1. GENERAL REQUIREMENTS

### MARKING

PV Systems shall be marked. Marking is needed to provide emergency responders with appropriate warning and guidance with respect to isolating the solar electric system. This will facilitate identifying energized electrical lines that connect the solar panels to the inverter, as these should not be cut when venting for smoke removal.

Materials used for marking shall be weather resistant. UL 969 shall be used as a standard for weather rating.

#### Main Service Disconnect

**Marking Location.** For residential applications the marking may be placed within the main service disconnect. If the main service disconnect is operable with the service panel close, then the marking shall be placed on the outside cover.

For commercial application the marking shall be placed adjacent to the main service disconnect in a location clearly visible from the location where the lever is operated.

**Marking Content:** CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED, red background, white lettering minimum 3/8" letter height, all capitals in Arial or similar font on reflective weather resistant material suitable for the environment.

**CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED**

### DC Circuit

**Marking Location.** Marking is required on all interior and exterior DC conduit, raceways, enclosures, cable assemblies, and junction boxes to alert emergency responders to avoid cutting them. Marking shall be placed every 10 feet, at turns and above and/or below penetrations, and at all DC combiner and junction boxes.

**Marking Content:** CAUTION: SOLAR ELECTRIC CIRCUIT, red background, white lettering minimum 3/8" letter height, all capitals in Arial or similar font on reflective weather resistant material suitable for the environment.

**CAUTION: SOLAR ELECTRIC CIRCUIT**

### **Inverters**

The inverter is a device used to convert DC electricity from the solar system to AC electricity for use in the building's electrical system or the grid.

No markings are required for the inverter.

### **Remote Disconnect**

DC circuits shall be equipped with a means for remote disconnect located downstream from the photovoltaic array at the point where the circuit enters the structure. Control of the remote disconnect shall be located within five feet of the building's main electrical panel. The remote disconnect shall be listed and meet the requirements of the California Electrical Code.

Exceptions:

1. DC circuits contained in rigid or electrical metallic tubing running between the array combiner box and the main electrical panel which are entirely exterior to the building need not be equipped with a means of remote disconnect other than the disconnects intrinsic to the system.
2. DC circuits contained in rigid or electrical metallic tubing running between the array combiner box and the main electrical panel that run through the interior of the building when installed a minimum of 18" below the roof assembly when measure parallel to the surface of the roof.
3. The system inverter may be used for remote disconnect when located immediately upstream of the roof penetration where the circuit enters the structure.

**Marking Location.** Signage shall be located immediately next to the remote disconnect control.

**Marking Content:** CAUTION: SOLAR CIRCUIT DISCONNECT, red background, white lettering minimum 3/8” letter height, all capitals in Arial or similar font on reflective weather resistant material suitable for the environment.

**CAUTION: SOLAR CIRCUIT DISCONNECT**

**Marking Location.** Signage shall be located immediately next to, or on the array disconnect.

**Marking Content:** CAUTION: SOLAR ARRAY DISCONNECT, red background, white lettering minimum 3/8” letter height, all capitals in Arial or similar font on reflective weather resistant material suitable for the environment.

**CAUTION: SOLAR ARRAY DISCONNECT**

## **ACCESS, PATHWAYS, AND SMOKE VENTILATION**

Access and spacing requirements shall be observed in order to:

1. Ensure access to the roof
2. Provide pathways to specific areas of the roof
3. Provide for smoke ventilation opportunity areas
4. Provide emergency egress from the roof

Exceptions to this requirement may be requested where access, pathway or ventilation requirements are reduced due to:

- Unique site specific limitations
- Alternative access opportunities (as from adjoining roofs)
- Ground level access to the roof in question
- Other adequate ventilation opportunities when approved by the fire code official
- Automatic ventilation device
- New technology, methods, or other innovations that ensure adequate fire department access, pathways and ventilation opportunities

Designation of ridge, hip, and valley does not apply to roofs with 2-in-12 or less pitch. All roof dimensions are measured to centerlines.

A roof access point shall be defined as an area that does not require ladders to be placed over openings (i.e., windows, vents, or doors), that are located at strong points of building construction and in locations where ladders will not be obstructed overhead by tree limbs, wires, signs, or the like.

### **Residential – Single and Two-Unit Residential Dwellings**

Plan review is required if a system is to be installed that will occupy more than 50% of the roof area of a residential building.

Examples of these requirements appear at the end of this guideline.

**Access.** For **hip roof layout** residential building modules shall be located in a manner that provides one three-foot wide clear access pathway along at least one side of the array from the eave to the ridge on each roof slope where panels are located. The access pathway shall be located at a structurally strong location on the building such as a bearing wall.

For **single ridge roof** residential buildings modules shall be located in a manner that provides two, three-foot wide access pathways from the eave to the ridge on each roof slope where panels are located.

For **hips and valleys roof** residential buildings modules shall be located no closer than one and one-half feet to a hip or valley if panels are to be placed on both sides of a hip or valley. If the panels are to be located on only one side of a hip or valley that is of equal length then the panels may be placed directly adjacent to the hip or valley.

**Ventilation.** Modules shall be located no higher than three feet below the ridge.

### **Commercial Buildings and Residential Housing with three or more units**

Plan review is required if a system is to be installed that will occupy more than 50% of the roof area of a commercial building.

Exception: If the Fire Marshal determines that the roof configuration is similar to residential (such as in the case of townhouses, condominiums, or single family attached buildings), he may make a determination to apply the residential access and ventilation requirements.

Examples of these requirements appear at the end of this guideline.

**Access.** There shall be a minimum six foot wide clear perimeter around the edges of the roof.

Exception: If either the length or width of the building is 250 feet or less, there shall be a minimum four feet wide clear perimeter around the edges of the roof.

**Pathways.** Pathways shall be established in the design of the solar installation. Pathways shall meet the following requirements:

1. Shall be over structural members.
2. Center line pathways shall be provided from both the width and length of the building. Center line pathways shall run on structural members or over the next closest structural member nearest to the center lines of the roof.
3. It shall be a straight line not less than four feet clear width to skylights and ventilation hatches.
4. It shall be in a straight line not less than four feet clear width to roof fire protection standpipe outlets.
5. It shall provide not less than four feet clear width around roof access hatch with at least one pathway not less than 4 feet in clear width to parapet or roof edge.

**Ventilation.** Arrays shall be no greater than 150 feet in distance in either axis.

Ventilation options between array sections shall be either:

- A pathway eight feet or greater in width
- Four feet or greater in width pathway and bordering on existing roof skylight or ventilation hatches
- Four feet or greater in width pathway and bordering 4' X 8' "venting cutouts" every 20 feet on alternating side of the pathway

## **2. LOCATION OF DC CONDUCTORS**

Conduit runs between sub arrays and to DC combiner boxes shall use the design that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes are to be located such that conduit runs are minimized in the pathways between arrays.

To limit the hazard of cutting live conduit in venting operations, DC wiring shall be run in metallic conduit or raceway when located within enclosed spaces in a building and shall be run, to the maximum extent possible, along the bottom of load-bearing members.

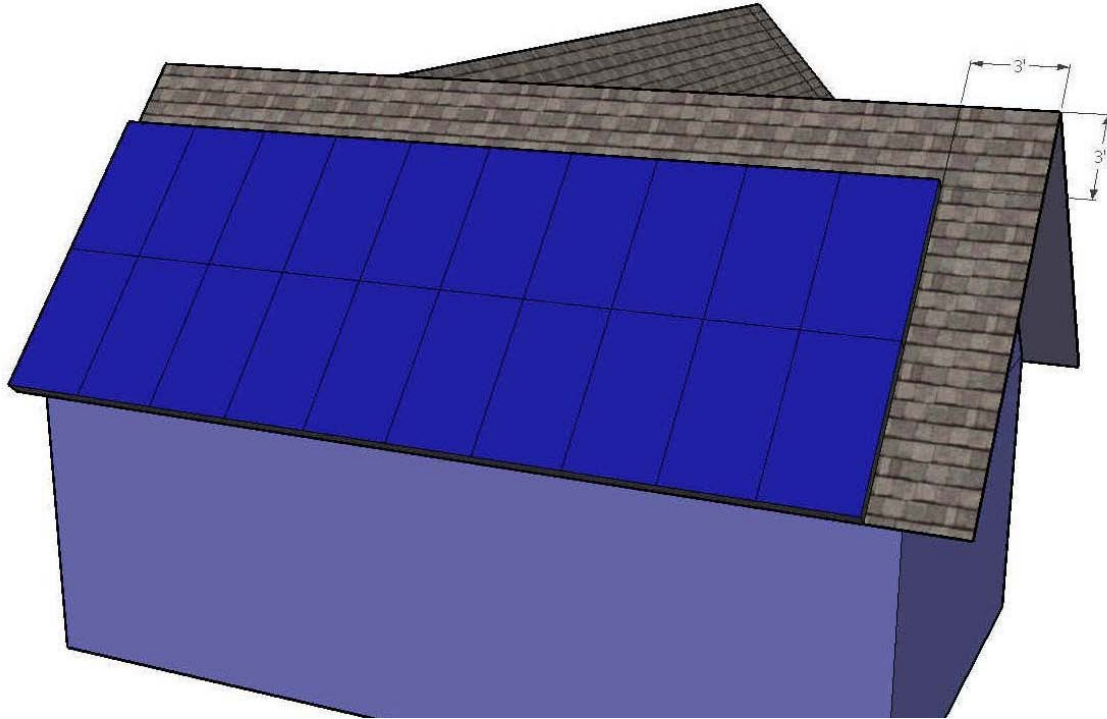
### **3. NON-HABITABLE BUILDINGS**

This guideline does not apply to non-habitable structures. Examples of non-habitable structures include, but are not limited to, parking shade structures, carports, solar trellises, etc.

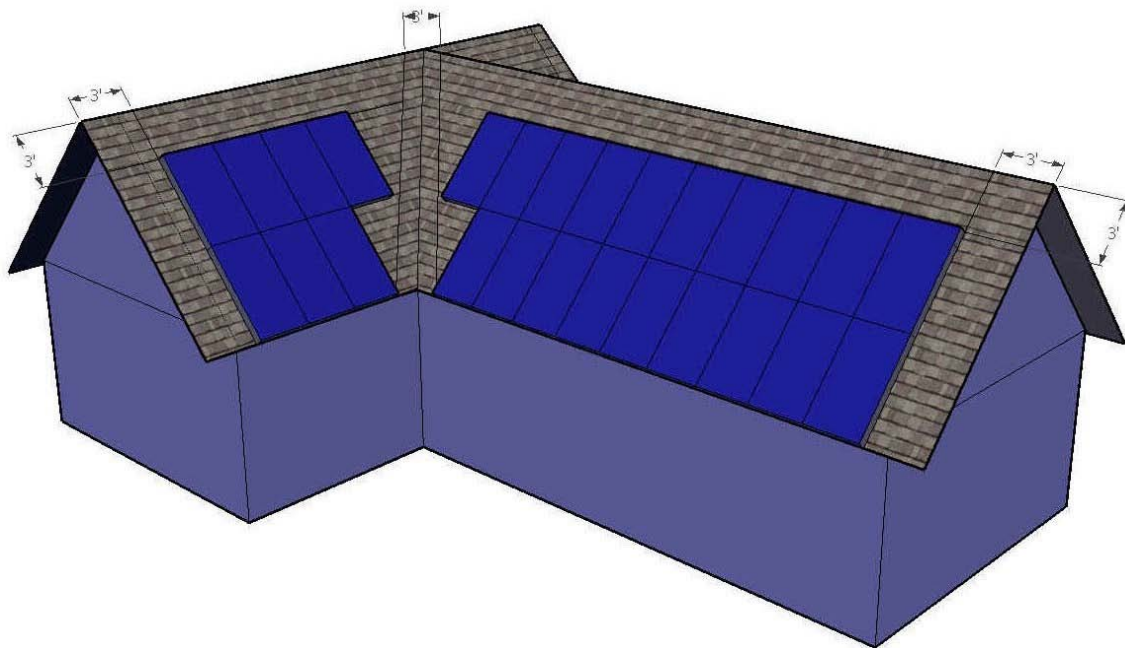
### **4. GROUND MOUNTED PHOTOVOLTAIC ARRAYS**

Setback requirements do not apply to ground-mounted, free standing photovoltaic arrays. A clear brush area of 10' is required for ground mounted PV arrays.

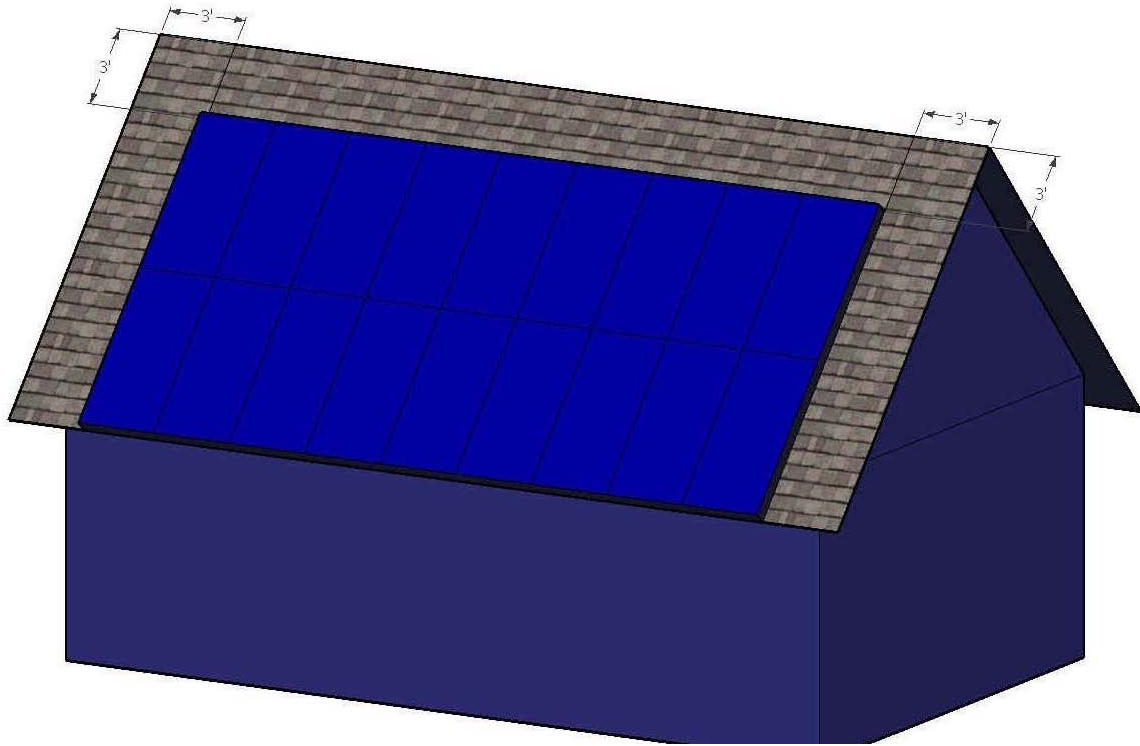
### EXAMPLE 1: Cross Gable Roof



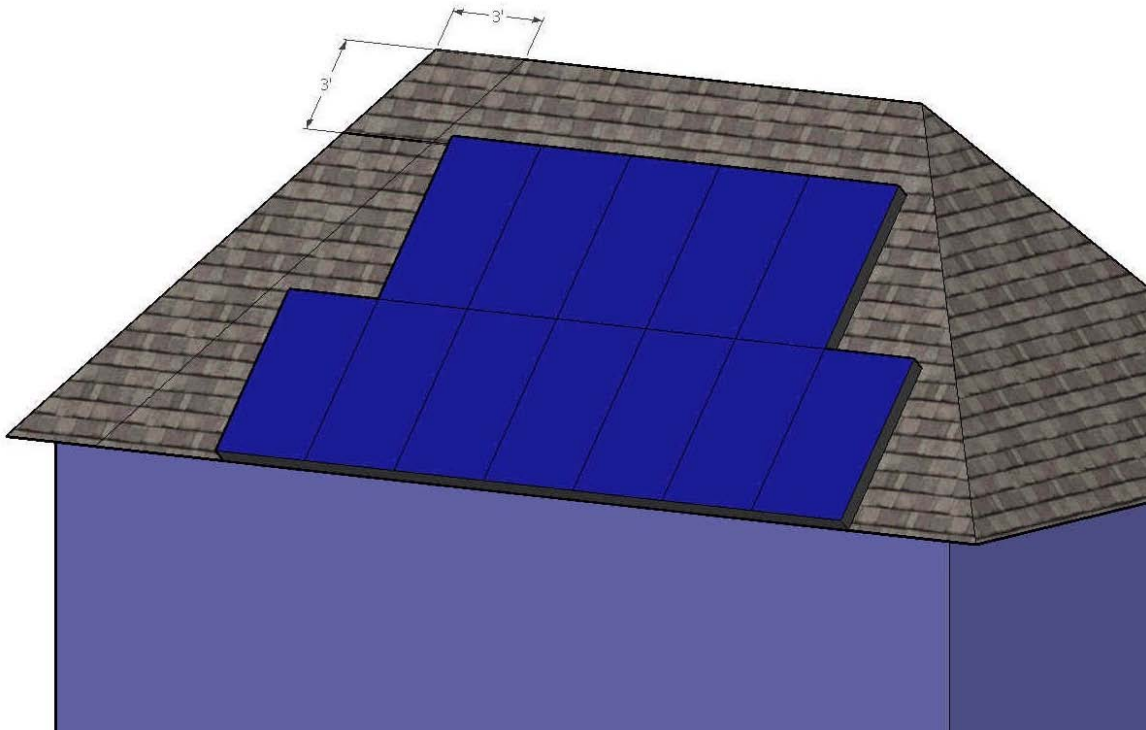
### EXAMPLE 2: Cross Gable with Valley



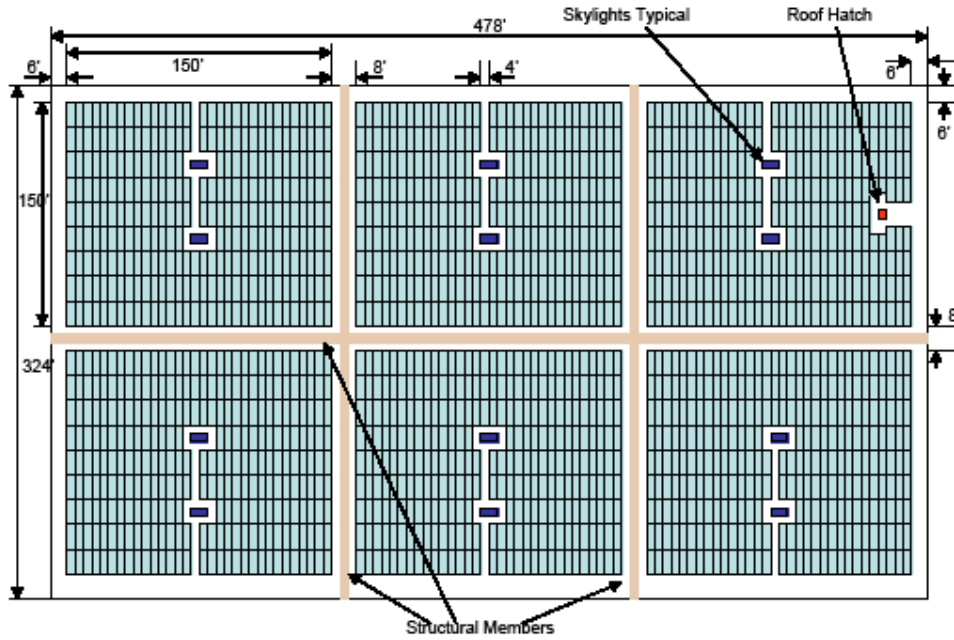
### EXAMPLE 3: Full Gable



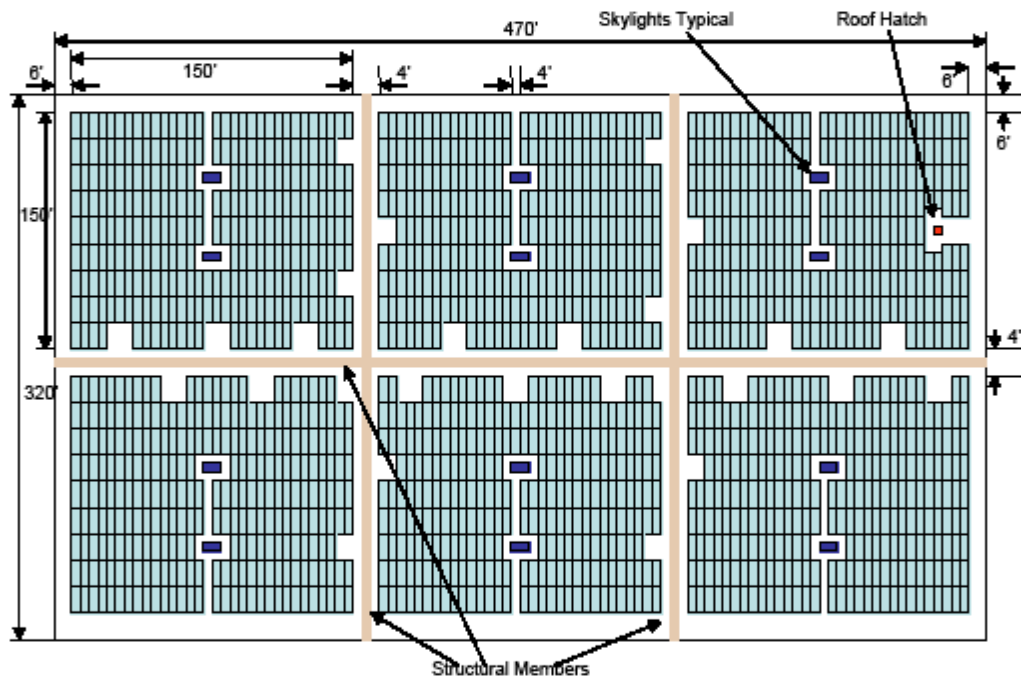
### EXAMPLE 4: Full Hip Roof



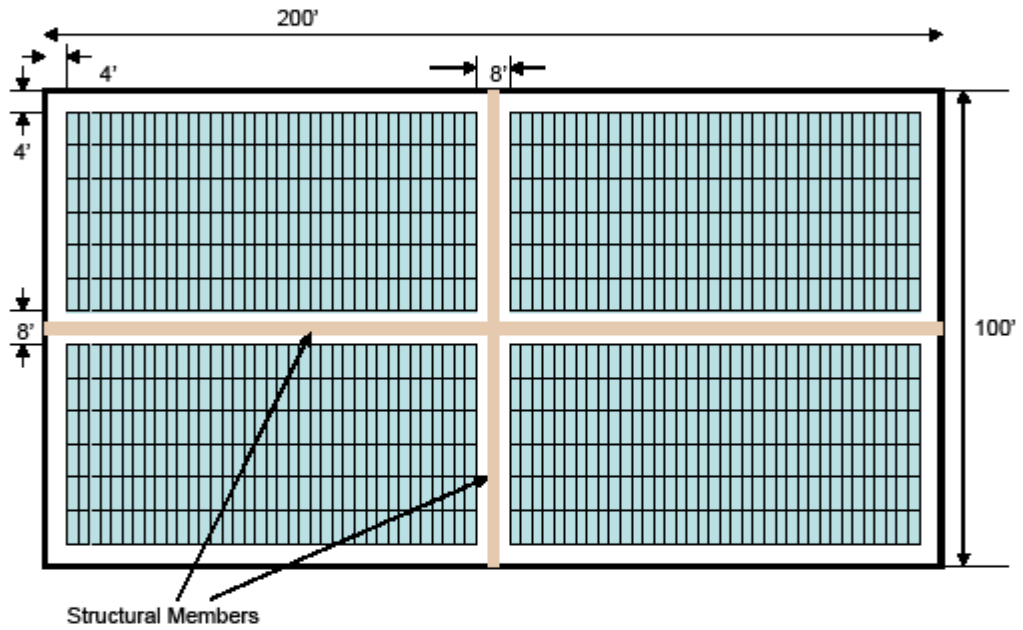
### EXAMPLE 5 – Large Commercial (Axis > 250') 8' Walkways



**EXAMPLE 6 –Large Commercial (Axis > 250') 4' Walkways  
With 8' x 4' Venting Opportunities Every 20'**



### Example 7 Small Commercial (Axis < 250') 8' Walkways



**Example 8 Small Commercial (Axis < 250') – 4' Walkways**  
**Venting Opportunities Every 20' Along Walkway**

