Guideline D.04

FIRE SAFETY ELEMENTS OF SOLAR PHOTOVOLTAIC SYSTEMS

D.04.1 PURPOSE

The installation of solar photovoltaic (PV) systems presents additional areas of concern for firefighter safety and fire fighting operations including: energized equipment, trip hazards, restricting venting locations, limiting walking surfaces on roof structures, etc. 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.

D.04.2 SCOPE

This guideline applies to all solar photovoltaic systems regardless of size for residential and commercial purposes.

D.04.3 GENERAL REQUIREMENTS

1. 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 can 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 (UL listing of markings is not required).

   <u>Main Service Disconnect</u>

   For residential applications, the marking may be placed within the main service disconnect. If the main service disconnect is operable with the service panel closed, then the marking should 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 and Format

- Marking Content: CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED
- Red Background
- White Lettering
- Minimum 3/8" Letter Height
- All Capital Letters
- Arial or Similar Font, Non-bold
- Reflective weather resistant material suitable for the environment (durable adhesive materials must meet this requirement)

CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED

Marking DC Circuit

Marking is required on all interior and exterior DC conduit, raceways, enclosures, cable assemblies, and junction boxes to alert the fire service 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 and Format

- Marking Content: CAUTION: SOLAR CIRCUIT
- Red Background
- White Lettering
- Minimum 3/8" Letter Height
- All Capital Letters
- Arial or Similar Font, Non-bold
- Reflective weather resistant material suitable for the environment (durable adhesive materials must meet this requirement)

CAUTION: SOLAR 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.

2. Remote Disconnect

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.

Exceptions:

1) EXTERIOR- D.C array conductors that are routed and installed completely on the exterior of building. Shall be contained in galvanized rigid steel conduit from the point immediately adjacent to the PV array rooftop - "J" box, fusible combiner box, or fusible DC disconnect to the ground level DC disconnect and inverter (integral or separate component). These DC array conductors installed in galvanized rigid steel conduit which are run entirely on the exterior of the building need not be equipped with a means of remote disconnect other then the D.C. disconnects intrinsic to the system.

2) INTERIOR – D.C. array conductors that are routed through the building are required to be in galvanized rigid steel conduit or electrical metallic tubing [E.M.T.] from the required rooftop fusible combiner box or fusible disconnect switch through the attic space or other void space [required to be installed a minimum of 18 inches below the roof assembly when measured parallel to the surface of the roof] to the ground level D.C. disconnect and inverter [integral or separate component] Note : E.M.T. conduit not approved for exterior use

3) The system inverter may be used for remote disconnect when located immediately upstream of the roof penetration where the circuit enters the structure.

Signage shall be located immediately next to the remote disconnect control as follows:

- Marking Content: CAUTION: SOLAR CIRCUIT DISCONNECT
- Red Background
- White Lettering
- Minimum 3/8" Letter Height
- All Capital Letters
- Arial or Similar Font, Non-bold
- Reflective weather resistant material suitable for the environment (durable adhesive materials must meet this requirement)

CAUTION: SOLAR CIRCUIT

3. 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 area in question
- Other adequate ventilation opportunities when approved by the fire code official

- Adequate ventilation opportunities afforded by panel set back from other rooftop equipment (for example: shading or structural constraints may leave significant areas open for ventilation near HVAC equipment)
- 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 by tree limbs, wires, signs or other overhead obstructions.

RESIDENTIAL —Single and Two-Unit Residential Dwellings

Access

Residential Buildings with hip roof layouts:

Modules shall be located in a manner that provides one three-foot wide clear access pathway 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.

Residential Buildings with a single ridge:

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.

Hips and Valleys: Modules shall be located no closer than one and one half feet to a hip or a 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 and Residential Housing with Three or More Units

Note: If the fire code official determines that the roof configuration is similar to residential pitched roofs, such as in the case of townhouses, condominiums, or single family attached buildings, the fire code official may make a determination to apply the residential access and ventilation requirements.

Examples of these requirements appear at the end of these guidelines (Examples 5-8).

Access

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

Exception: If either axis 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 axis pathways shall be provided in both axes of the roof. Center line axis 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 in a straight line not less than four feet clear width to skylights and/or 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 four feet in clear width to parapet or roof edge.

Ventilation

Arrays shall be no greater than 150 by 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 skylights or ventilation hatches
- Four feet or greater in width pathway and bordering 4' x 8' "venting cutouts" every 20 feet on alternating sides of the pathway

D.04.4 LOCATION OF DC CONDUCTORS

Conduit, wiring systems, and raceways for photovoltaic circuits shall be located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities.

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 raceways when located within enclosed spaces in a building and shall be run to the maximum extent possible along the bottom of load-bearing members.

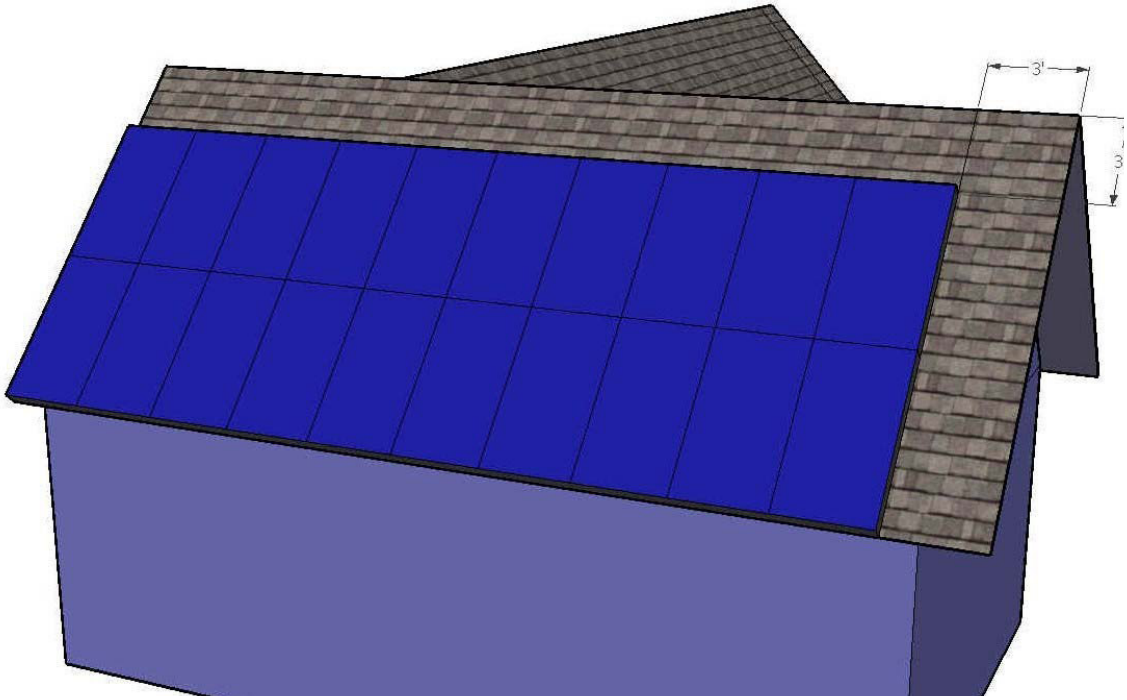
D.04.5 NON-HABITABLE BUILDINGS

These guidelines do not apply to non-habitable structures. Examples of non-habitable structures include, but are not limited to, parking shade structures, carports, solar trellises, etc.

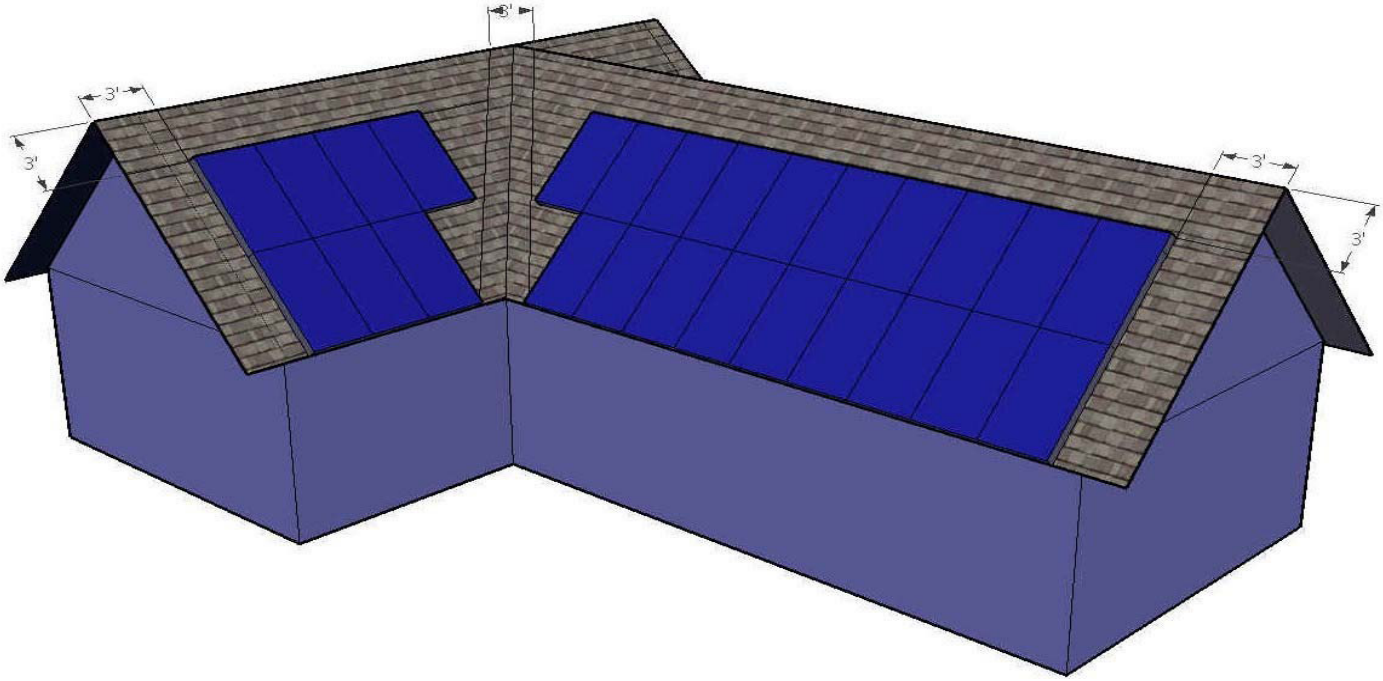
D.04.6 GROUND MOUNTED PHOTOVOLTIAC ARRAYS

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

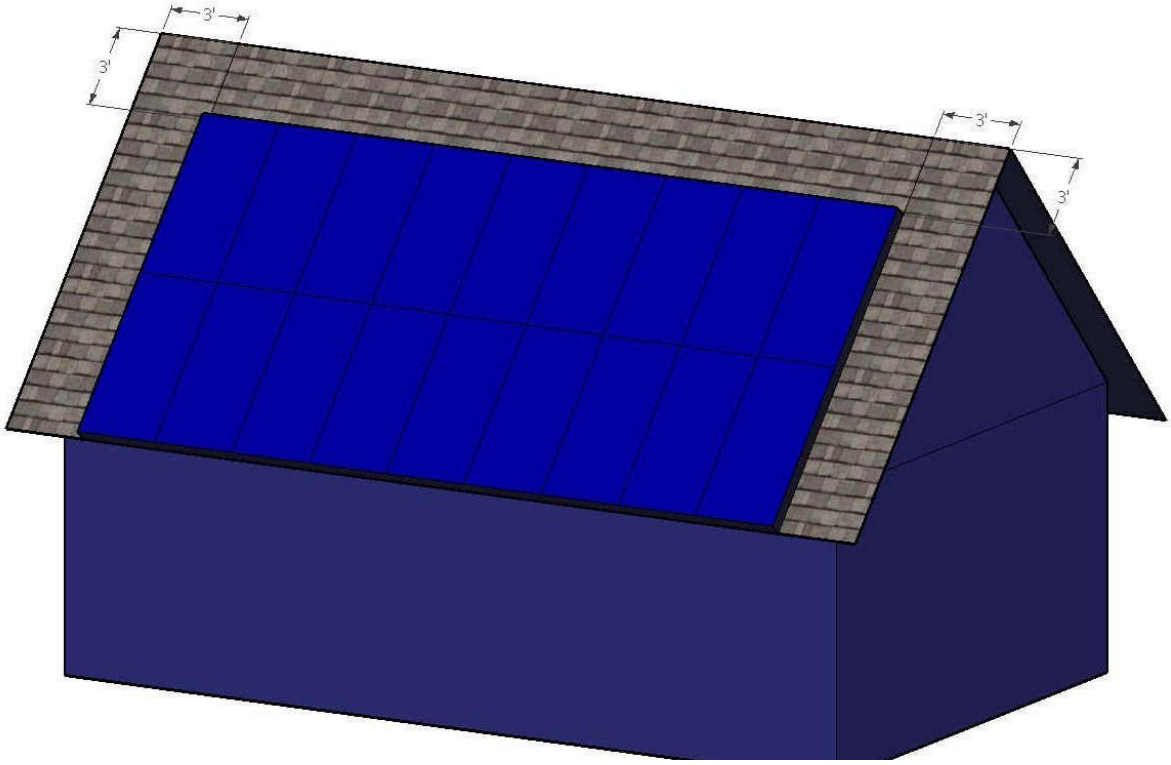
EXAMPLE 1 Cross Gable Roof



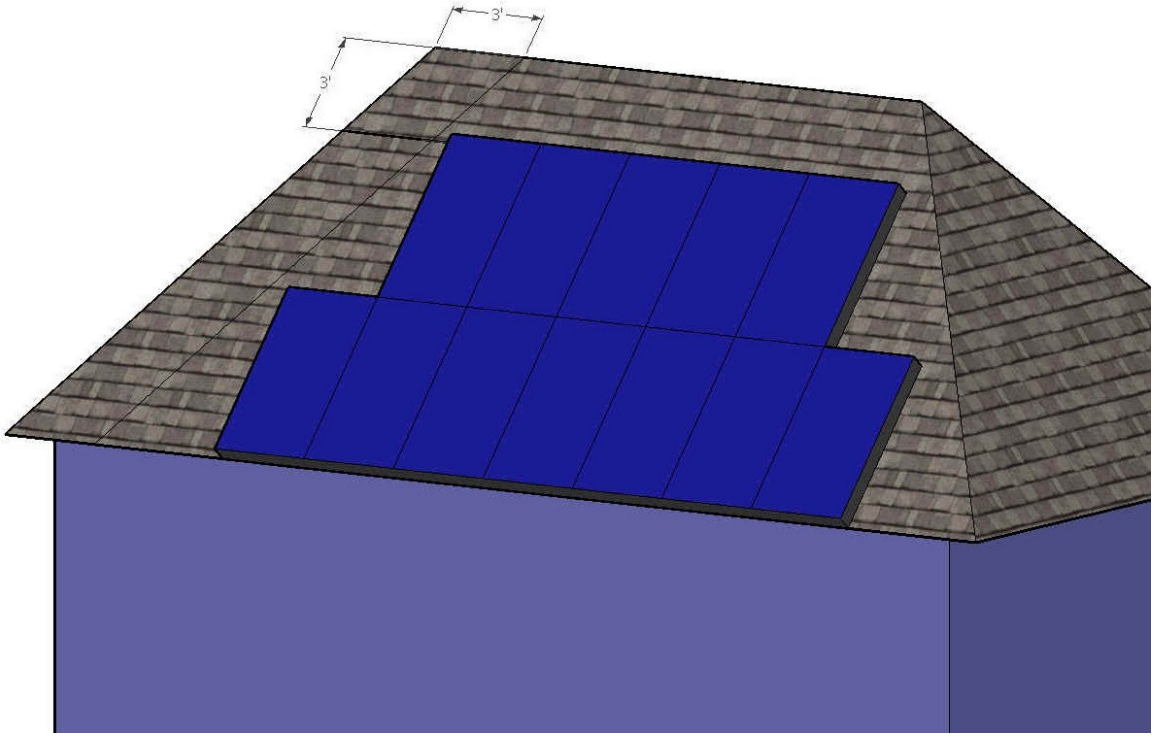
EXAMPLE 2 Cross Gable with Valley



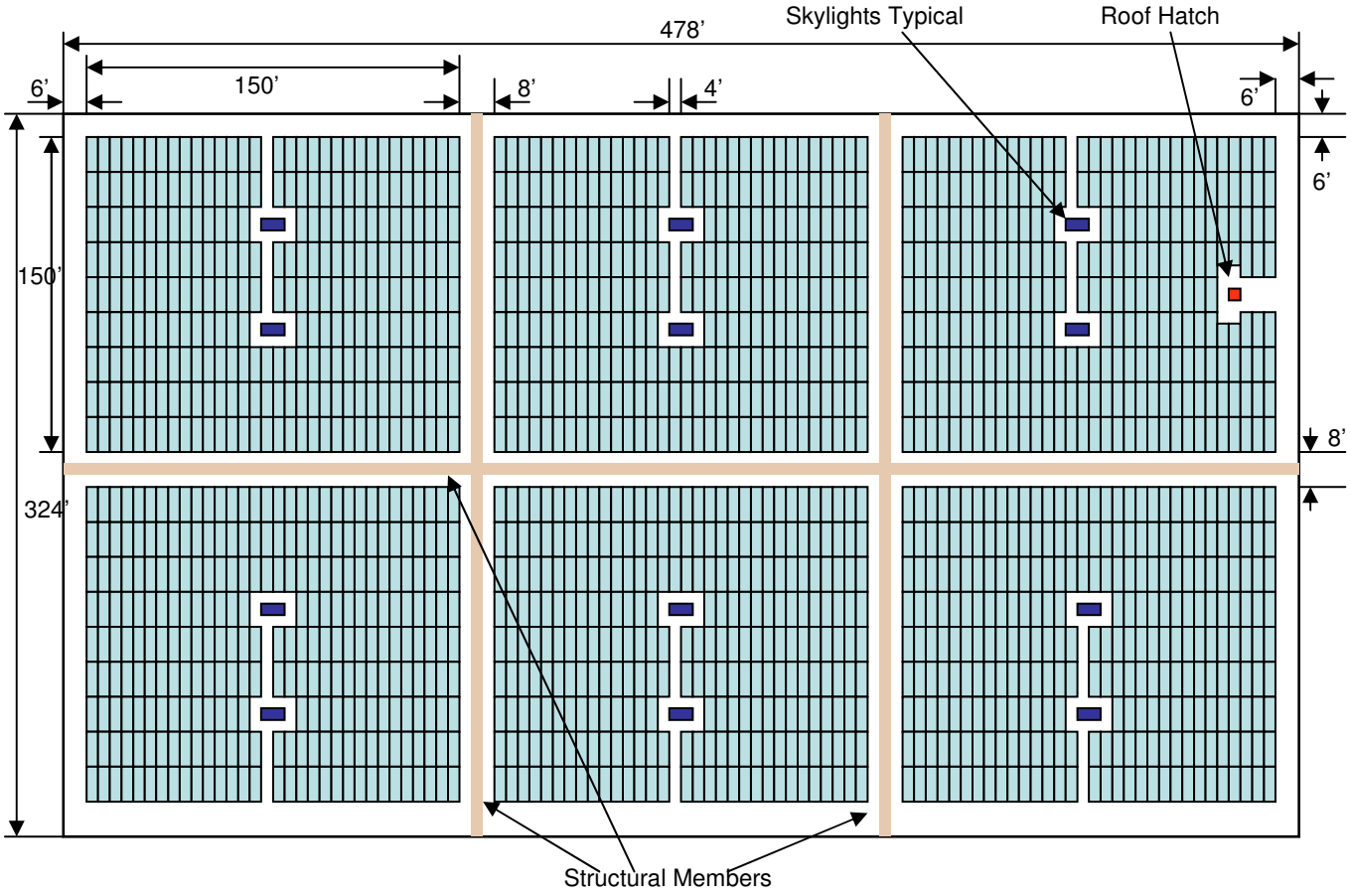
EXAMPLE 3: Full Gable



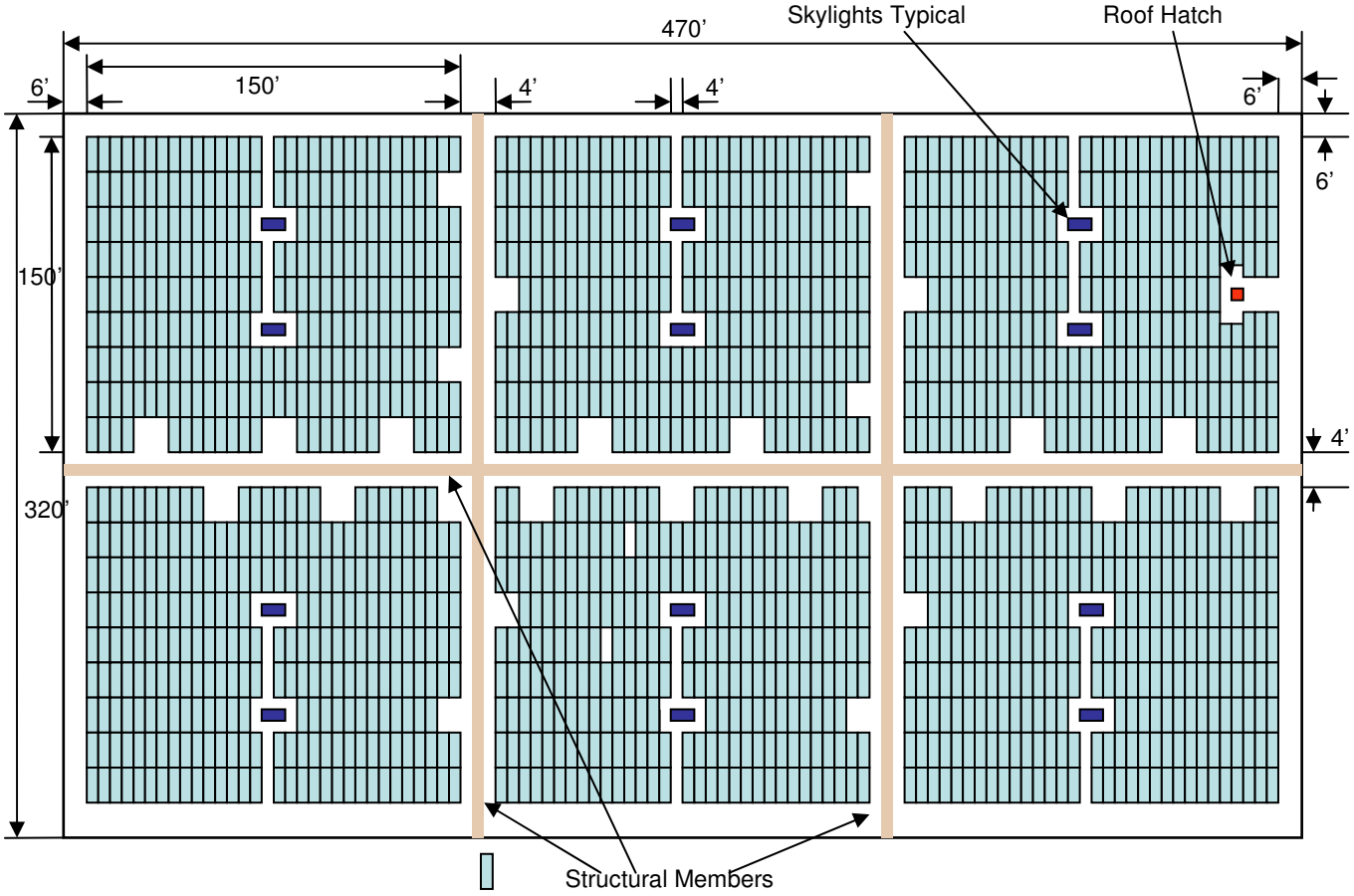
Example 4: Full Hip Roof



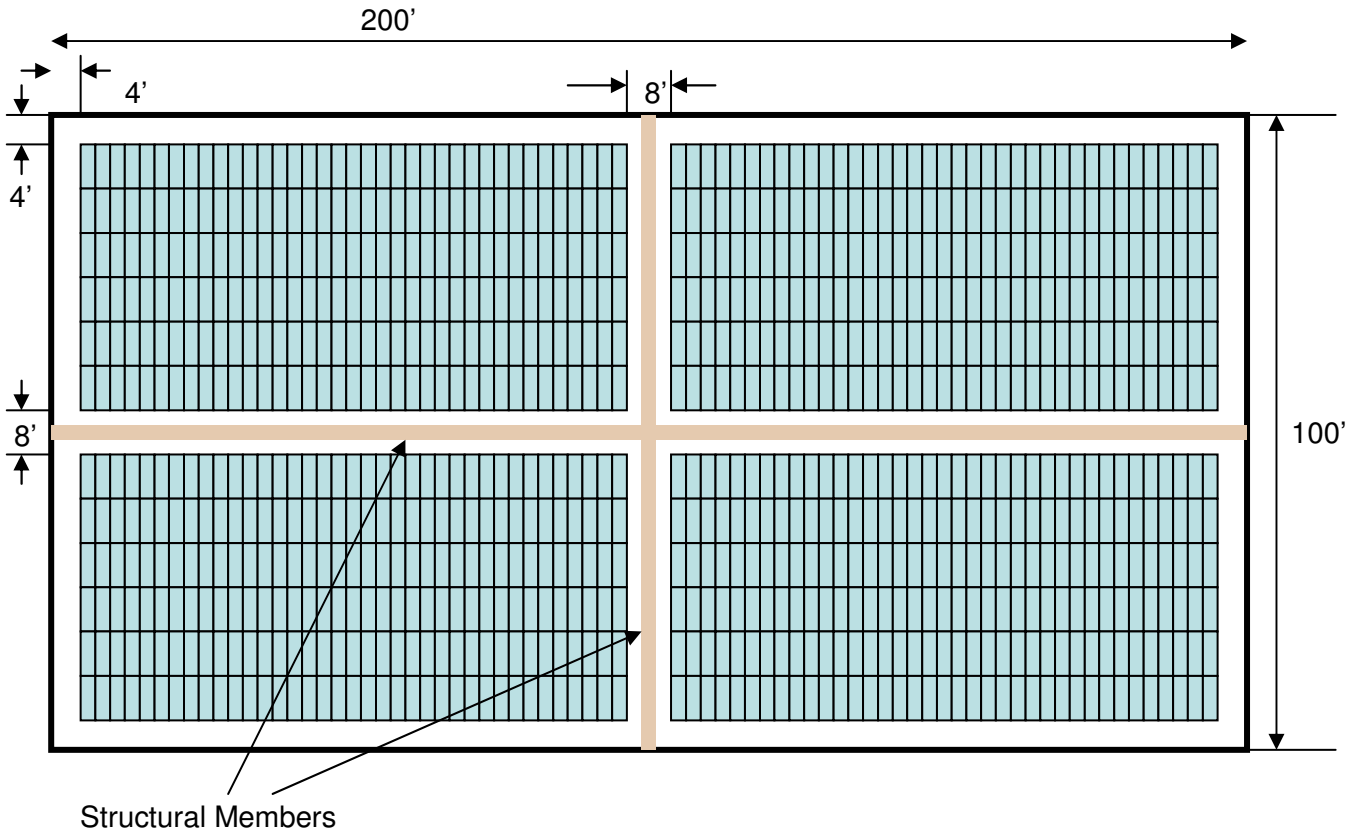
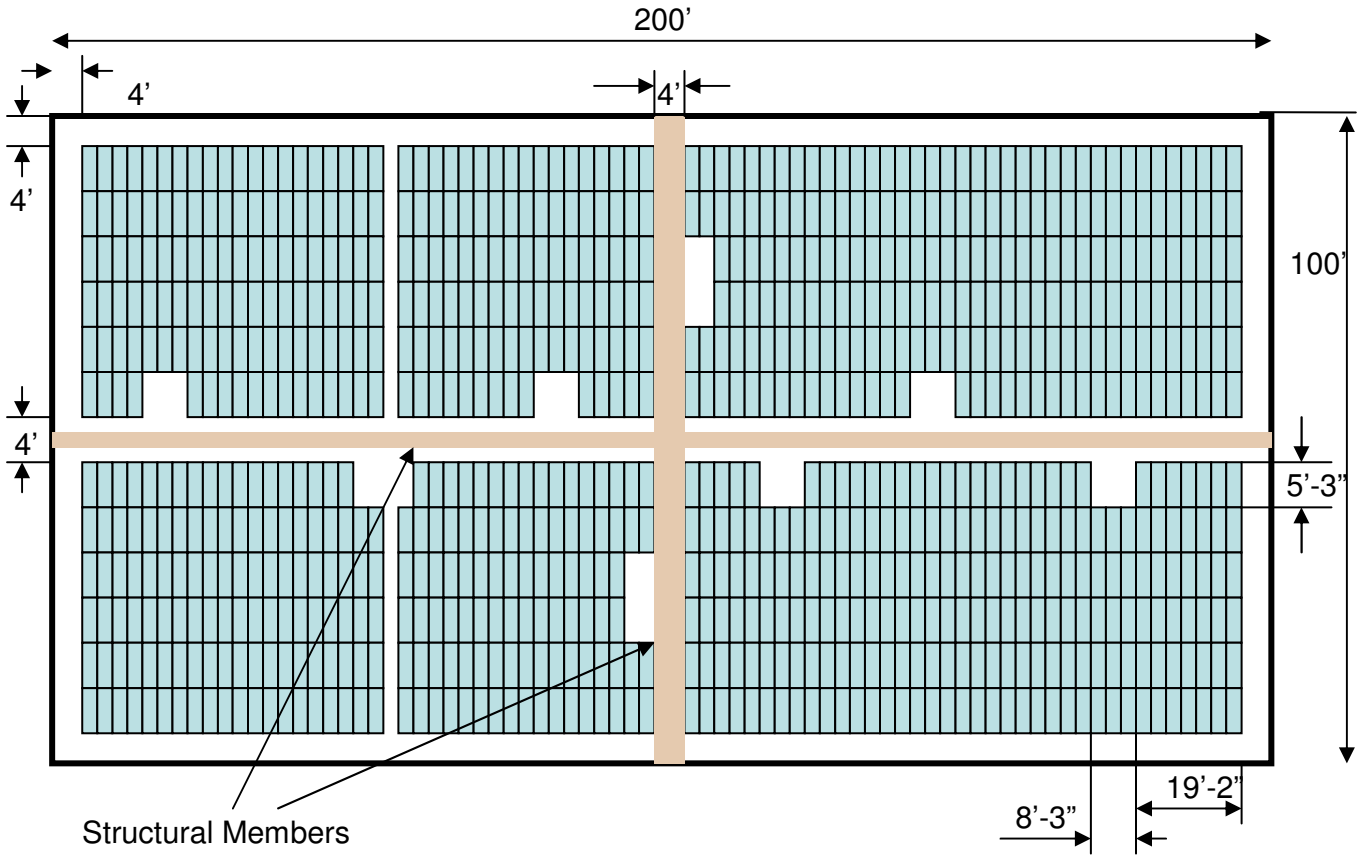
EXAMPLE 5 – Large Commercial (Axis > 250')
8' Walkways



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