



Los Angeles Fire Department Requirement No. 96

SOLAR PHOTOVOLTAIC SYSTEM

The following is the Los Angeles Fire Department's **minimum** requirement for Solar Photovoltaic System Installations. The City of Los Angeles may create exceptions to this requirement due to new technology, methods, or other innovations to ensure firefighter and public safety.

Section:

1. Reference
2. Scope
3. Definitions
4. Plan Review
5. Markings, Labels, and Warning Signs
6. Access, Pathways and Smoke Ventilation
7. Direct Current (DC) Conductor Locations
8. Ground Mounted Photovoltaic Arrays
9. Overhead Arrays on Rooftops (e.g. trellis systems)
10. Inverter Locations
11. Concealed Conduit
12. Photovoltaic Array Diagrams

SECTION 1 - REFERENCE

- A. State Fire Marshal
 1. Solar Photovoltaic Installation Guidelines
- B. California Fire Code (CFC) - 2013
 1. 57.202 - Group U occupancy classification
 2. 57.605.11 - Solar photovoltaic power systems
 3. 57.1003.3.3 - Horizontal projections
 4. 57.1003.6 - Means of egress continuity
 5. 57.1014.3 - Common path of egress travel
- C. California Fire Code (CFC) - 2013 City of Los Angeles Fire Code Amendments
 1. 57.316.4 - Obstruction of exits and aisles
 2. 57.316.4.1 - Access aisles and operating clearances
 3. 57.316.4.3 - Storage on roofs
 4. 57.316.4.4 - Passageways on roofs
 5. 57.316.322 - Brush Clearance Requirements
 6. 57.316.503 - Access Road Requirements
- D. California Electrical Code (CEC) - 2013
 1. 690.1 - Solar Photovoltaic Systems



SECTION 2 - SCOPE

This requirement regulates the installation of solar photovoltaic systems and their ancillary devices. Included are requirements regulating access, fire protection, and other measures and general precautions relating to solar photovoltaic systems.

Exception: Detached, non-habitable Group U structures including, but not limited to, parking shade structures, private garages, carports, solar trellises and similar structures shall not be subject to these requirements. **However**, those structures located in the Very High Fire Hazard Severity Zone (VHFHSZ) shall comply with **Section 8** – Ground Mounted Photovoltaic Arrays of this requirement.

SECTION 3 - DEFINITIONS

The following words and phrases, whenever used in this requirement, shall be construed as defined in this Section.

Array - A mechanically integrated assembly of modules or panels with a support structure and foundation, tracker, and other components, as required, to form a DC power-producing unit.

Building Integrated Photovoltaics - Photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of that building.

DC Combiner - Combines the inputs from multiple strings of solar panels into one output circuit.

Grid - The electrical system that is on the service side of the meter.

Ground Mounted Photovoltaic Array - A mechanically integrated assembly of modules or panels with a support structure mounted directly to the foundation.
Examples include: parking shade structures, carports, solar trellises and similar structures.

Inverter - Equipment that is used to change voltage level or waveform, or both, of electrical energy. Commonly, an inverter also known as a power conditioning unit (PCU) or power conversion system (PCS) is a device that changes DC input to an AC output. Inverters may also function as battery chargers that use alternating current from another source and convert it into direct current for charging batteries.

Micro-Inverter - A device used to convert DC electricity from a single solar panel to AC electricity. The output from several micro-inverters is combined and often fed to the electrical grid. They are usually mounted adjacent to a solar panel.

Module - A complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of tracker, designed to generate DC power when exposed to sunlight.

Panel - A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit.



Required Access Pathway - A required walking pathway that is designed to provide emergency access, meeting the requirements in Sections 57.316.4 and 57.316.4.1.

Rack Mounted Photovoltaic System - Photovoltaic system on a rack with a space above the roof system. Typical area: 200 to 400 square feet.

Solar Photovoltaic System - The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to a utilization load.

String - Group of modules wired together in series.

Subarray - An electrical subset of a photovoltaic array.

Travel Distance - The walking distance between two points.

Venting Cutout - Section(s) in an array that is/are designed to accommodate emergency ventilation procedures.

Very High Fire Hazard Severity Zone (VHFHSZ) - Any geographical area within the City of Los Angeles that poses a significant threat of fire from adjoining natural brush hillside areas and which is determined by the following factors: topography, infrastructure, fire protection, population density, types of construction, weather, existing fire codes, ordinances, and fire history.

SECTION 4 - PLAN REVIEW

Photovoltaic (PV) installations shall be approved by the LAFD Development Services prior to installation.

EXCEPTION: Rooftop photovoltaic on one and two family dwellings and accessory structures provided the permit applicant agrees in writing or electronically to comply with this FPB Requirement. In this case the Los Angeles Department of Building and Safety shall ensure compliance with FPB Requirement No. 96.

At a **minimum**, the following information shall be presented for approval:

- A. Site plan (to scale) of the structure on which the photovoltaic array is to be installed showing the following:
1. Footprint of the building and north reference point
 2. Location of all structures on site
 3. Street address of building
 4. Access from street to building
 5. Location of arrays
 6. Location of disconnects
 7. Location of required signage
 8. Location of required access pathways



- B. Plan and elevation views of building clearly showing the following:
1. Array placement
 2. Roof ridgelines
 3. Eave lines
 4. Equipment on roof
 5. Other objects that may be present on the roof such as: vent lines, chimneys, skylights, and roof hatches
 6. Exterior wall openings at roof access points
- C. Location and verbiage of all markings, labels, and warning signs.
- D. Building photographs that may be useful in the evaluation of the array placement.

SECTION 5 - MARKINGS, LABELS, AND WARNING SIGNS

- A. Purpose: Provide emergency responders with appropriate warning and guidance with respect to isolating the solar electrical 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.
- B. Marking: Markings are required on interior and exterior DC conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes and disconnects. The markings should be readily visible from any direction of approach.
- C. Main Service Disconnect:
1. Residential Buildings – The marking may be placed within the main service disconnect. The marking shall be placed on the outside cover if the main service disconnect is operable with the service panel closed.
 2. Commercial Buildings – The marking shall be placed adjacent to the main service disconnect in a location clearly visible from the location where the disconnect is operated.
 3. Markings: Verbiage, Format, and Type of Material.
 - a. Verbiage: **“SOLAR DISCONNECT”**
 - b. Format:
 - i. White lettering on a red background
 - ii. Minimum 3/8 inches letter height
 - iii. All letters shall be capitalized
 - iv. Arial or similar font, non bold
 - c. Material: Reflective, weather resistant material suitable for the environment (use UL – 969 as standard for weather rating). Durable adhesive materials meet this requirement.



D. Marking Requirements on DC conduit, raceways, enclosures, cable assemblies, DC combiners and junction boxes:

1. Markings: Placement, Verbiages, Format, and Type of Material.
 - a. Placement: Markings shall be placed on interior and exterior DC conduit, raceways, enclosures and cable assemblies every 10-feet, within 1-foot of turns or bends and within 1-foot above and below penetrations of roof/ceiling assemblies, walls or barriers, all DC combiners, and junction boxes.
 - b. Verbiage: **“WARNING: PHOTOVOLTAIC POWER SOURCE”**

Note: The format and type of material shall adhere to Section 5-C (3b, c) of this requirement.

SECTION 6 – ACCESS, PATHWAYS, AND SMOKE VENTILATION

Roof Access Points:

1. Roof access points shall be located in areas that do not require the placement of ground ladders over openings such as windows or doors.
2. Located at load bearing walls where the access point does not conflict with overhead obstructions such as tree limbs, wires, or signs.

A. Residential Systems (Single Family Dwelling/Duplex)

1. Access:
 - a. Panels/modules shall be located in a manner that provides 3-foot-wide clear access pathways (3' clear width measured from the load bearing wall to the PV panel) to the ridge on all sides of each roof slope where panels/modules are located.
 - b. Access pathway clear width shall not include any eaves or overhangs.
 - c. Panels/modules shall be located no closer than 18-inches to a hip or valley if placed on both sides of the hip or valley.
 - d. Where panels/modules are located on only one side of a hip or valley that is of equal length, the panels may be placed directly adjacent to the hip or valley.
 - e. Roof slopes less than two units vertical in 12 units horizontal (2:12), panels/modules shall be located in a manner that provides a minimum 3-foot-wide clear access pathway (3' clear width measured from the load bearing wall to the PV panel) around the perimeter edges of the roof.



2. Dead Ends:

- a. Where there are two or more access pathways, the clear pathways shall be arranged so there are no dead ends greater than 25-feet in length.
- b. If any access pathway leading to a dead end is greater than 25-feet in distance, it shall continue on to the next access pathway.
- c. At no time shall any access pathway cause a person's travel distance to exceed 150-feet before arriving at another required access pathway.

Note: Same Guidelines Apply to Building Integrated Photovoltaic Systems

3. Smoke Ventilation:

- a. Panels/modules shall be located no higher than 3-feet below the ridge.
- b. The panels may be located no higher than 18-inches below the ridge if photovoltaic panels are installed only on one side of the ridge.
- c. Arrays shall be no greater than 150-feet by 150-feet in distance in either axis.

B. Commercial Buildings and Residential Housing (Comprised of three or more units):

EXCEPTION: The LAFD may determine that the roof configuration is similar to that of a one-or two-family dwelling residential building, as in the case of townhouses, condominiums, or single family attached buildings, the residential access and ventilation requirements in **Section 6-A (1a-d, 2a,b)** shall be permitted to be used.

1. Access: A minimum 6-foot-wide clear perimeter is required around the edges of the roof.

EXCEPTION: If either axis of the building is 250-feet or less, there shall be a minimum 4-foot-wide clear perimeter around the edges of the roof.

2. Pathways: Shall be established in the design of the solar installation and meet the following requirements:
 - a. Located over structurally supported members.
 - b. Center line axis pathways shall be provided in both axes of the roof. Centerline axis pathways shall run on structurally supported members or over the next closest structurally supported member nearest to the centerlines of the roof.
 - c. A minimum of 4-feet clear straight line pathway shall be provided from the access path to skylights and/or ventilation hatches.
 - d. A minimum of 4-feet clear straight line pathway shall be provided from the access path to roof standpipes.



- e. A minimum of 4-feet clearance around roof access hatches with at least one 4-foot clear straight line pathway to parapet or roof edge.

Note: Same Guidelines Apply to Building Integrated Photovoltaic Systems

3. Smoke Ventilation:

- a. Arrays shall be no greater than 150-feet by 150-feet in distance in either axis.
- b. Smoke ventilation options between array sections shall be one of the following:
 - (1) An access pathway 8-feet or greater in width.
 - (2) A 4-foot or greater in width access pathway and bordering roof skylights or smoke and heat ventilation hatches.
 - (3) A 4-foot or greater in width access pathway and bordering 4-foot by 8-foot “venting cutouts” every 20-feet on alternating sides of the pathway.

SECTION 7 - DIRECT CURRENT (DC) CONDUCTOR LOCATIONS

A. Conduit, Wiring Systems, and Raceways:

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

B. Conduit Runs Between Sub Arrays and DC Combiner Boxes shall:

- 1. Use design guidelines that minimizes the total amount of conduit used on the roof by taking the shortest path from the array to the DC combiner box.
- 2. The DC combiner boxes are to be located in such a manner that conduit runs are minimized in the pathways between arrays.

C. Direct Current (DC) Wiring:

- 1. DC wiring shall be run in metallic conduit or raceways when located within enclosed spaces in a building.
- 2. Conduit shall run along the bottom of load-bearing members.

SECTION 8 - GROUND MOUNTED PHOTOVOLTAIC ARRAYS

A. Setback Requirements:

- 1. Does not apply to ground mounted freestanding photovoltaic arrays.
- 2. Shall not obstruct Fire Department access.



B. Brush Clearance minimum requirements in the Very High Fire Hazard Severity Zone (VHFHSZ):

1. Residential Systems – One and two family dwelling units
 - a. Remove all weeds, dead material, and other vegetation within a minimum of 10-feet of photovoltaic arrays.
 - b. Maintain all weeds and other vegetation at a height of not more than 3-inches within 10-feet of photovoltaic arrays.
 - c. A minimum 20-foot access road may be required due to location/distances to photovoltaic arrays.
 - d. Maintain all weeds and other vegetation at a height of not more than 3-inches within 10-feet of an access road.
 - e. Maintain all weeds and other vegetation free from dead material within 10-feet of an access road.
 - f. Maintain trees that are 18-feet or more in height within 10-feet of that portion of an access road, so that no leafy foliage, twigs, or branches are within 6-feet of the ground. Trees and shrubs less than 18-feet shall be trimmed up 1/3 their height.
2. Commercial Buildings and Residential Systems Housing (three or more units):
 - a. Remove all weeds, dead material, and other vegetation within a minimum of 20-feet of photovoltaic arrays.
 - b. Maintain all weeds and other vegetation at a height of not more than 3-inches within a minimum of 20-feet of photovoltaic arrays.
 - c. Access road requirements in **Subdivision B-1(d-f)** from above shall be used.

SECTION 9 - OVERHEAD ARRAYS ON ROOFTOPS (e.g. trellis systems)

A. Minimum Requirements:

1. Overhead arrays shall comply with the same marking, labeling, and warning signs as required of roof-mounted systems.
2. There shall be an unobstructed clearance of 7-feet or more between the roof deck surface and the underside of the overhead array.
3. The regulations in 57.316.4.1 and 57.316.4.3 of the (CFC) Los Angeles Fire Code Amendments shall be complied with.



4. An uninterrupted section of solar photovoltaic panels shall not exceed 150-feet by 150-feet in dimension in either axis.
5. The overhead arrays or sub-arrays shall be spaced a minimum of 4-feet apart and extend from the edge of the arrays to the roof deck surface. This provides a clear 4-foot unobstructed pathway for emergency ventilation procedures.
6. The use of the area below arrays is prohibited.

SECTION 10 - INVERTER LOCATIONS

- A. Single Family Dwelling/Duplex – Inverter located within garage:
1. Must have DC disconnect on exterior of building.
 2. Must have AC disconnect on exterior of building.
 3. All disconnects shall be placed adjacent to the main panel.

SECTION 11 - CONCEALED CONDUIT

- A. Raceways running inside a concealed attic, floor and/or wall space must have a means of disconnect, prior to entering the structure.



SECTION 12 – PHOTOVOLTAIC ARRAY DIAGRAMS

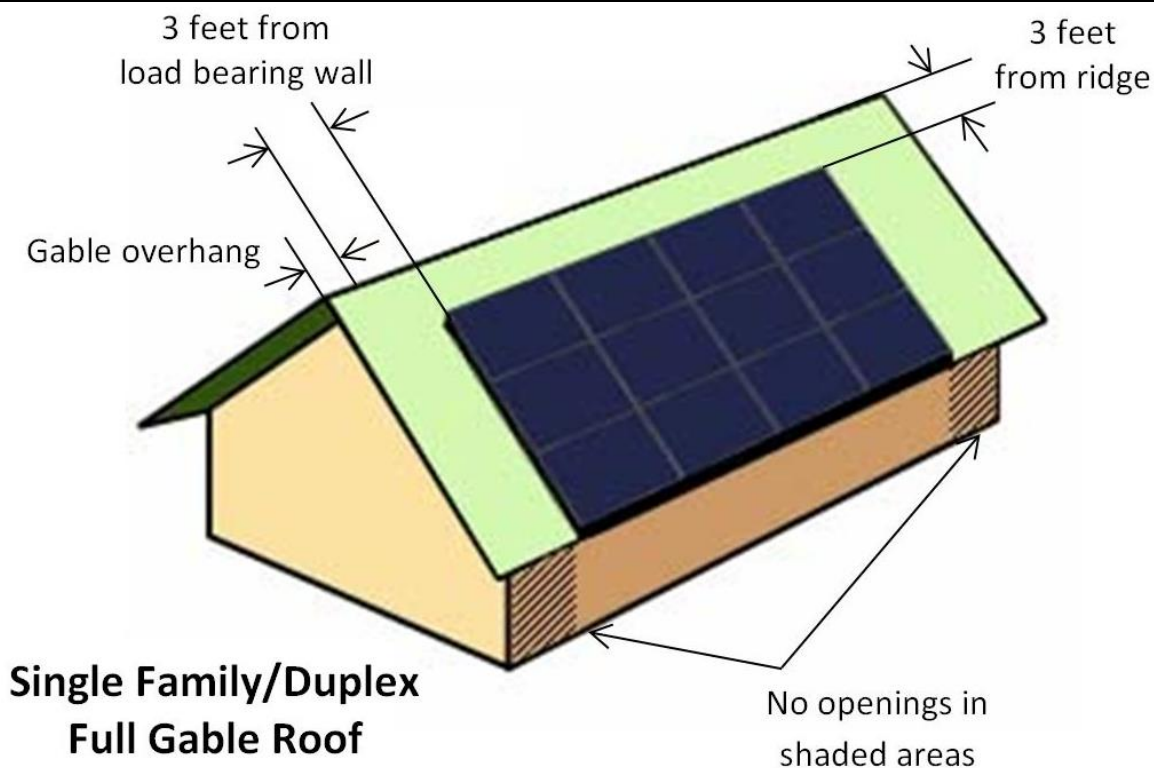


Diagram 1

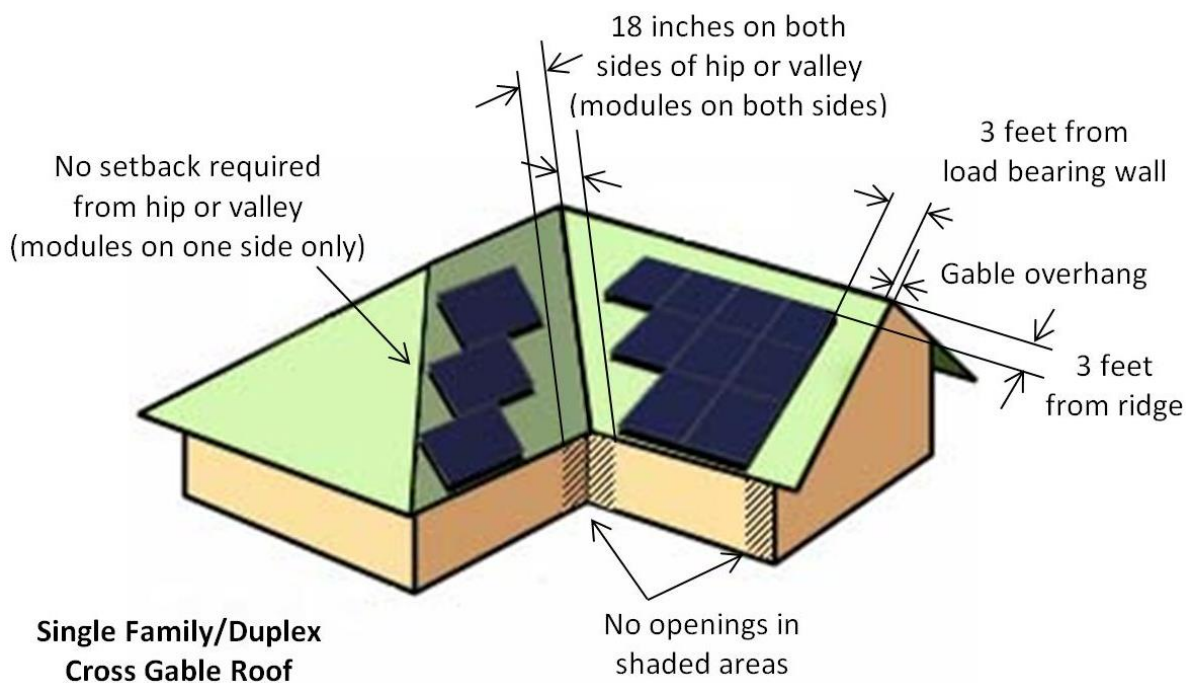


Diagram 2

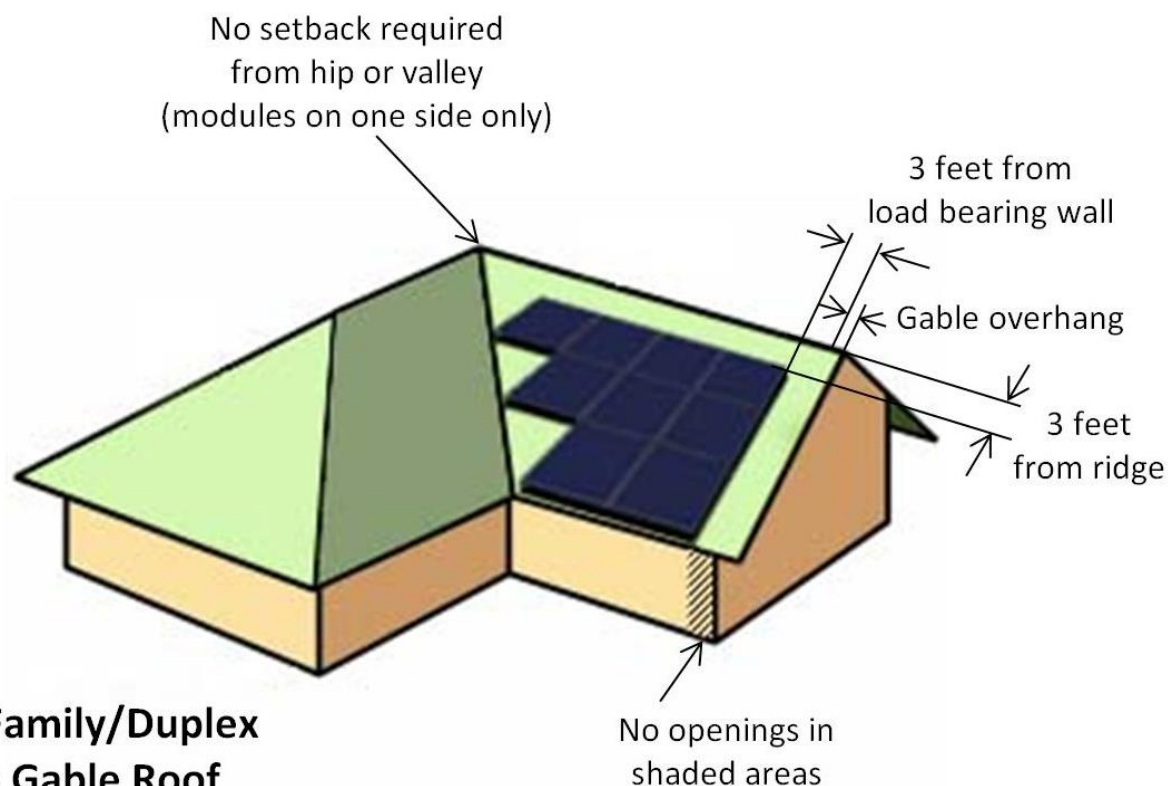


Diagram 3

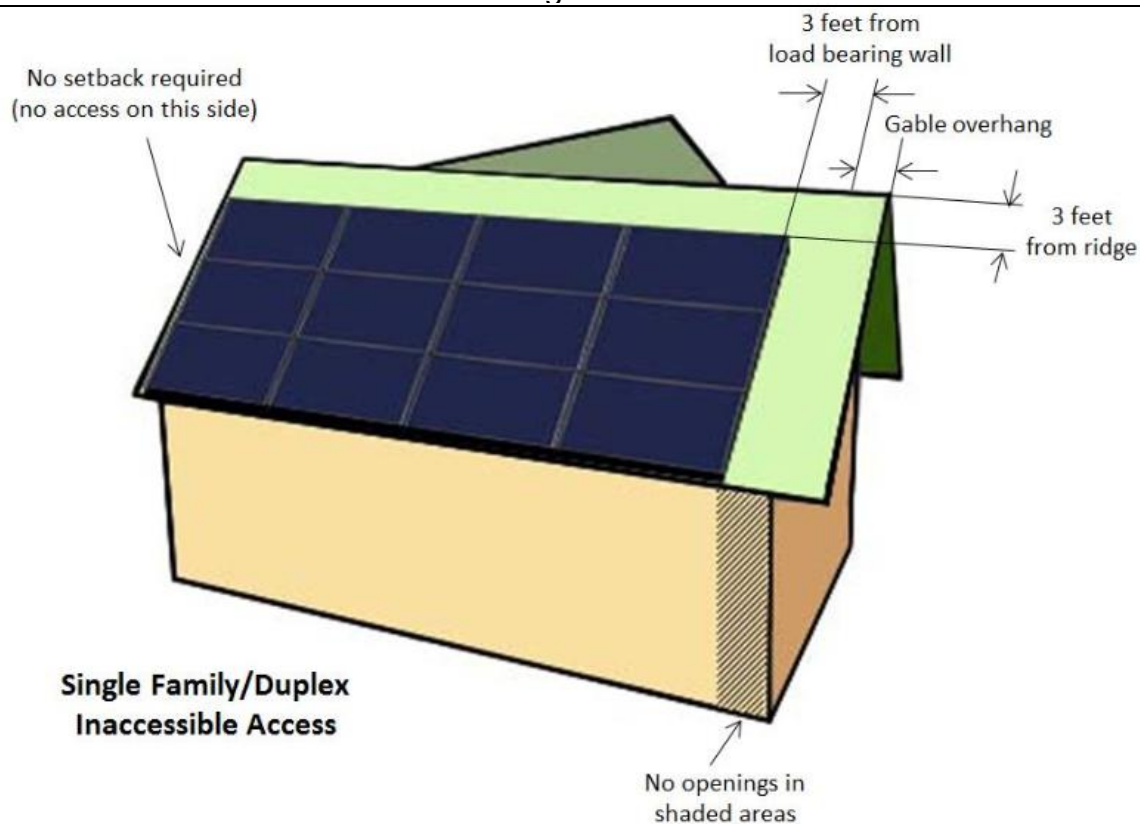


Diagram 4



Diagram: 5 Solar Arrays for Large Commercial (8 Foot Walkways)

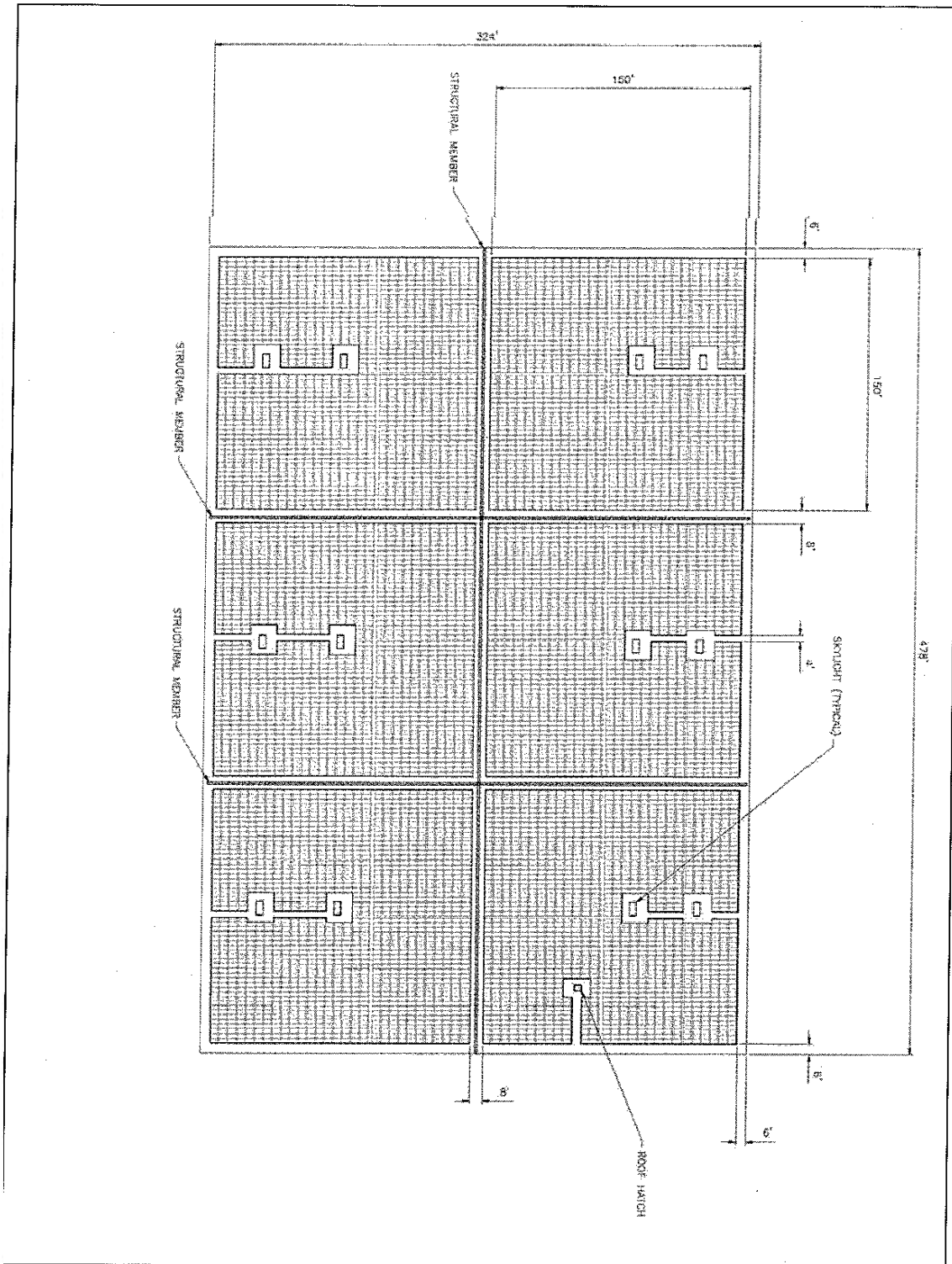




Diagram 6: Solar Arrays for Large Commercial (4 Foot Walkways with 8' x 4' Ver Opportunities every 20')

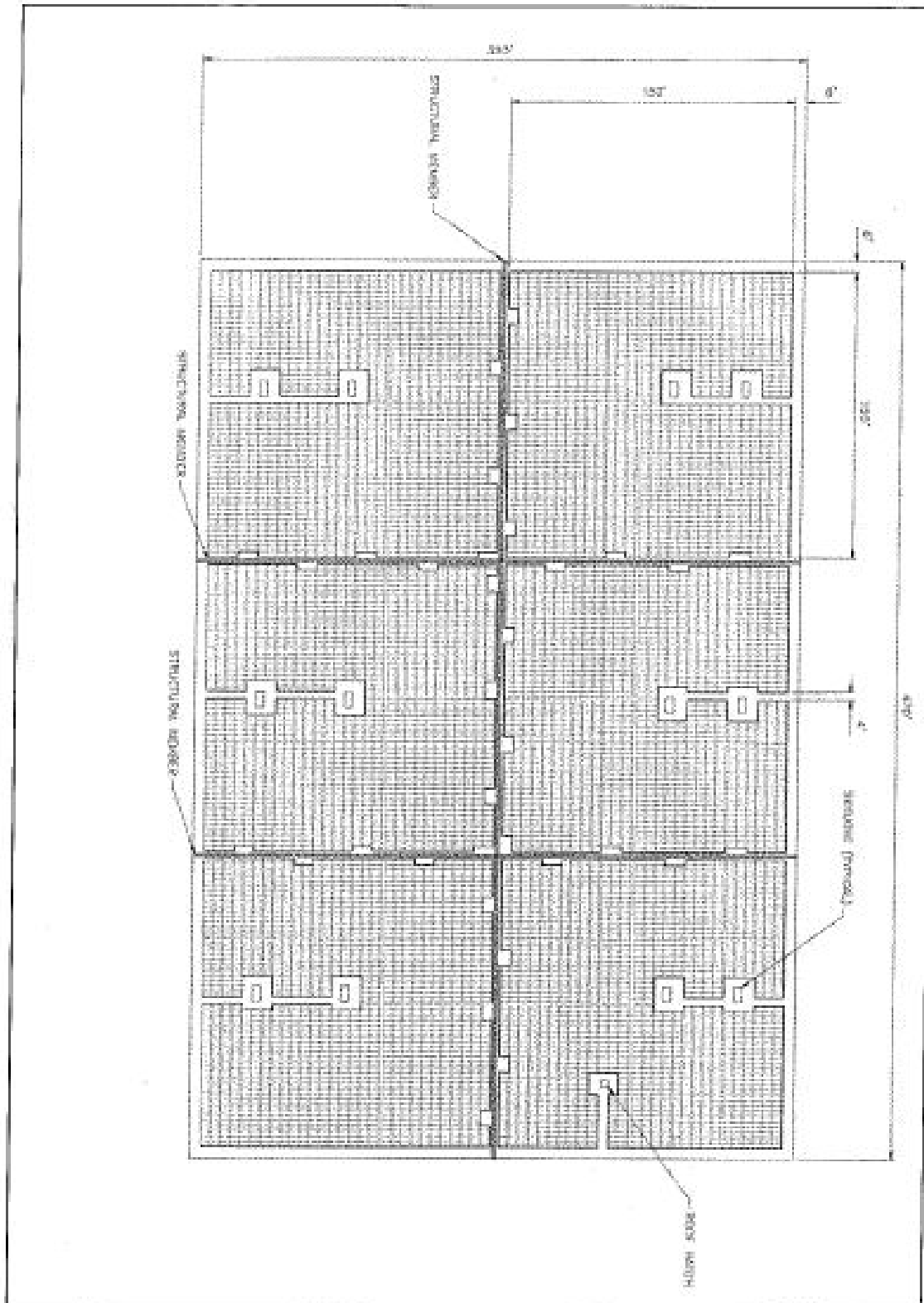




Diagram 7: Solar Arrays for Small Commercial (4' Walkways with 8' x 4' Venting Opportunities every 20' along Walkways)

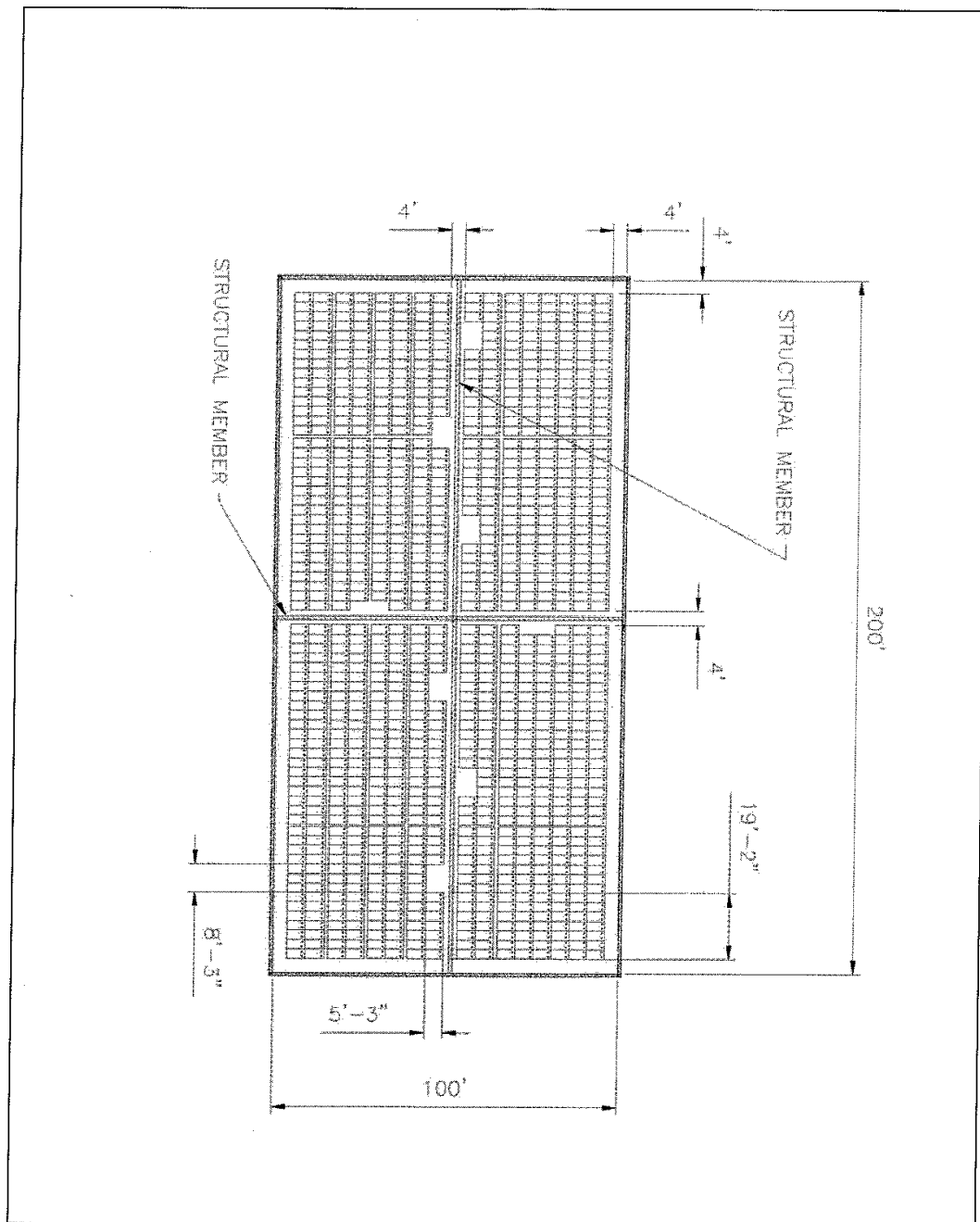




Diagram 8: Solar Arrays for Small Commercial (8' Walkways)

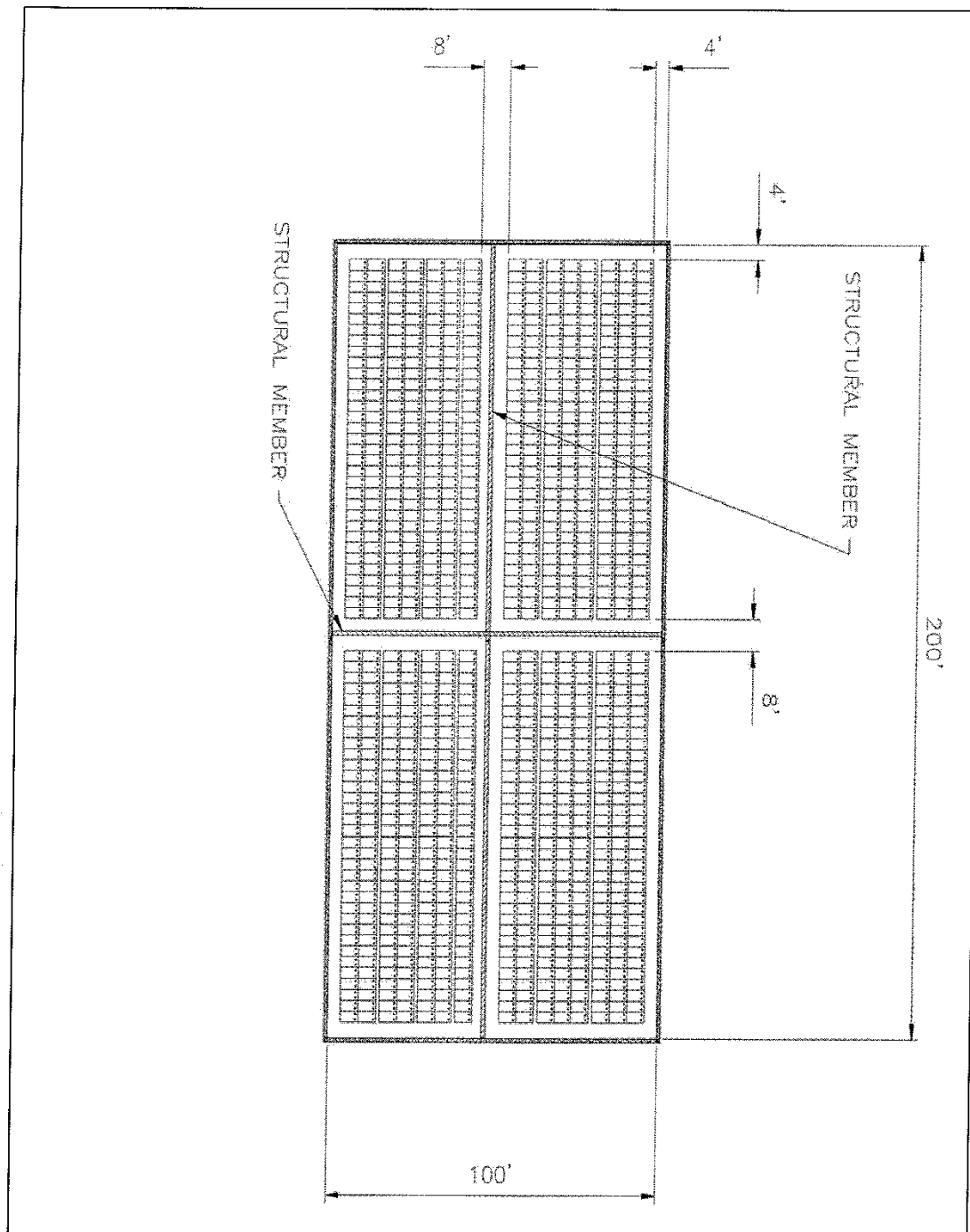




Diagram 9: Travel distance for access pathway leading to a dead end shall not exceed 25 feet.

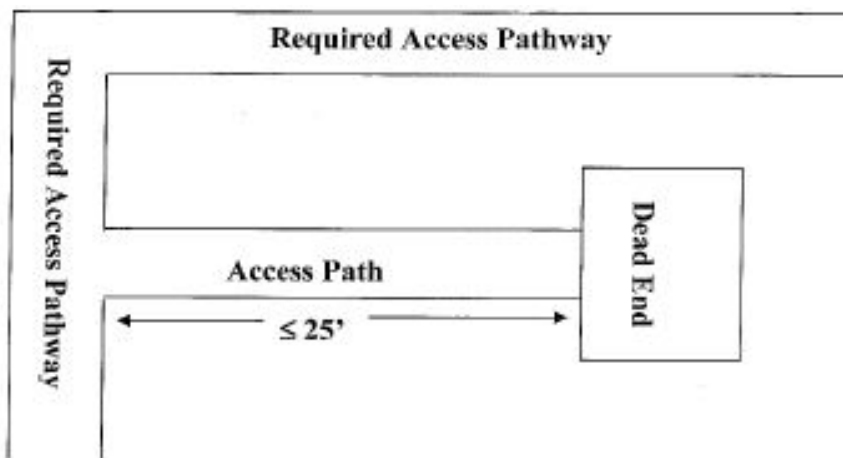


Diagram 10: Travel distance for access pathway exceeding 25 feet shall require a second access pathway. Access pathways shall have a maximum 150 feet travel distance.

