

## 9. Solar Ready

### §110.10

This chapter of the nonresidential compliance manual addresses nonresidential solar ready buildings requirements, which are new requirements are a new for the 2013 Standards (§110.10 and §141.0). The requirements are mandatory for newly constructed hotels/motels, high-rise multi-family buildings, and low-rise nonresidential buildings.

Surveys of the existing building stock indicate that fewer than 30 percent of existing nonresidential buildings have suitable locations to install solar photovoltaic (PV) or solar water heating (SWH) systems. The intent of the solar ready building requirements is to integrate design considerations that impact the feasibility of installing solar energy systems into the original building design. The Standards require buildings to have an allocated solar zone that is free of obstructions and is not shaded. The solar zone would be a suitable location to install PV or SWH collection panels. In addition, the Standards require that the construction documents depict a plan for connecting a PV and SWH system to the building's electrical or plumbing system.

There are no infrastructure related requirements in the Standards. Equipment such as solar modules, inverters, and metering equipment do not need to be installed, nor does conduit, piping, or pre-installed mounting hardware. The building structural design does not need to be modified to accommodate the additional loads from solar equipment that might be installed at a future date.

---

### 9.1. Overview

The requirements for solar ready buildings are all mandatory. There are no prescriptive and performance compliance paths for solar ready buildings. Since the provisions are mandatory, there are no tradeoffs allowed, and applicants must demonstrate compliance with each measure. Exceptions to the mandatory measures are described in the sections below.

This chapter is organized as follows:

- 9.1 Overview
- 9.2 Covered Occupancies
- 9.3 Solar Zone
  - 9.3.1 Minimum Area
  - 9.3.2 Orientation
  - 9.3.3 Shading
- 9.4 Construction Documents
  - 9.4.1 Structural Design Loads
  - 9.4.2 Interconnection Pathways

## 9.4.3 Documentation

## 9.5 Additions

---

**9.2. Covered Occupancies****§110.10(a)**

The nonresidential solar ready requirements apply to:

- Hotel/motel occupancies with ten stories or fewer,
- High-rise multi-family buildings with ten stories or fewer; and
- All other nonresidential buildings with three stories or fewer.

---

**9.3. Solar Zone****§110.10(b)**

The solar zone is an allocated space that is unshaded and free of obstructions. It serves as a suitable place that solar panels can be installed at a future date.

The solar zone can be located at any of the following locations:

- Roof of building
- Overhang of the building
- Roof of another structure located within 250 feet (75 meters) of the primary building
- Overhang of another structure within 250 feet (75 meters) of the primary building
- Covered parking installed with the building project.

Other structures include, but are not limited to, trellises, arbors, patio covers, carports, gazebos, and similar accessory structures.

The solar zone design must comply with the access, pathway, smoke ventilation, and spacing requirements as specified in Title 24, Part 9 or in any requirements adopted by a local jurisdiction. . These additional requirements are located in other Parts of Title 24 including Parts 2, 2.5, and 9 that are adopted by the California Building Standards Commission as part of the California Building Standards Code.

**9.3.1. Minimum Area****§110.10(b)1**

The solar zone must have a total area that is no less than 15 percent of the total roof area after subtracting any area of the roof that is covered by a skylight.

The total area of the solar zone may be composed of multiple sub-areas. No dimension of a sub-area can be less than five feet. If the total roof area is equal to or less than 10,000 square feet (1,000 square meters), each sub-area area must be at least 80 square feet (24 meters). If the total roof area is greater than 10,000 square feet (1,000 square meters), each sub-area must be at least 160 square feet (48 meters).

## Example 8-1

**Question**

A portion of nonresidential building will have 6 floors and a portion of the building will have 2 floors. Is the new building subject to the solar zone requirements?

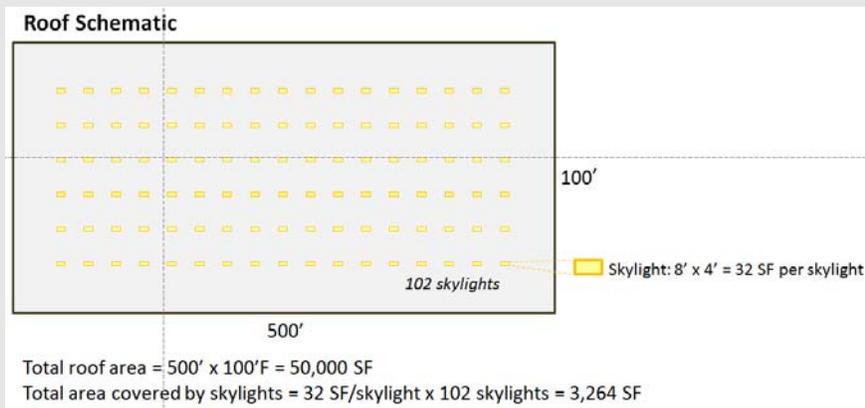
**Answer**

**TBD**

## Example 8-2

**Question**

A new warehouse has a total roof area of 50,000 square feet (SF). Skylights cover 3,264 SF of the total roof area. What is the minimum solar zone area?

**Answer**

The minimum solar zone area would be 7,010 SF

$$\text{Minimum Solar Zone Area} = 15\% \times (\text{Total Roof Area} - \text{Area Covered by Skylights})$$

$$7,010 \text{ SF} = 15\% \times (50,000 \text{ SF} - 3,264 \text{ SF})$$

## Example 8-3

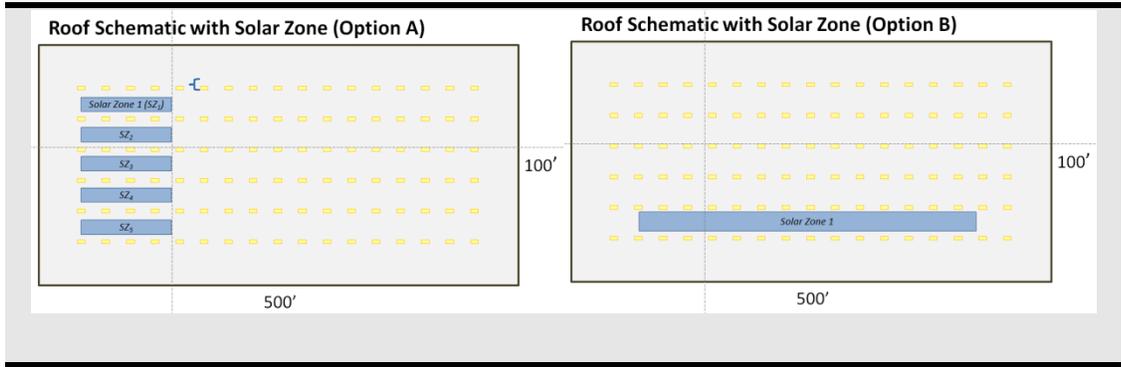
**Question**

Does the solar zone have to be one contiguous area?

**Answer**

No. The solar zone does not have to be one contiguous area. The total solar zone can be composed of multiple smaller areas. A sub-area cannot be narrower than 5 feet in any dimension. If the total roof area is 10,000 SF or less, each sub-area must be at least 80 SF. If the total roof area is greater than 10,000 SF, each sub-area must be at least 160 SF.

Option A below illustrates a solar zone layout that is composed of five smaller areas. The sum of all the smaller areas must equal the minimum total solar zone area. Option B illustrates an example of the entire solar zone in one contiguous area.



**Exceptions:**

There are three exceptions to the minimum solar zone area requirements that apply to low-rise nonresidential buildings and hotel/motel occupancies. Each exception is described below.

**PV System is Permanently Installed:** A solar zone is not required if a solar PV system with a nameplate direct current (DC) power rating of no less than 1 watt per square foot of roof area is permanently installed at the time of construction. The nameplate rating must be measured under Standard Test Conditions. The permanently installed solar PV system can be installed anywhere on the building site.

**Example 8-4**

**Question**

An office building has a total roof area of 5,000 SF. The total roof area covered by skylights is 200 SF. A solar PV system with a DC power rating (measured under Standard Test Conditions) of 4 kW will be installed. The collection panels for the 4 kW system will cover 400 SF. Does the building have to include a solar zone in addition to the installed solar PV system?

**Answer**

Yes. To be exempt from the solar zone requirement, the solar PV system must have a power rating equal to 1 watt for every square foot of roof area, or in this case 5kW (see equation below).

$$\text{Minimum Power Rating PV System} = \text{Total Roof Area} \times 1 \text{ Watt per SF}$$

$$5,000W = 5000 \text{ SF} - 1W/SF$$

The minimum solar zone for this building is 720 SF (see calculation below). The 400 SF on which the solar PV system is installed does count towards the minimum solar zone area, so an additional 320 SF would need to be allocated to complete the minimum solar zone requirement.

$$\text{Minimum Solar Zone Area} = 15\% \times (\text{Total Roof Area} - \text{Area Covered by Skylights})$$

$$720 \text{ SF} = 15\% \times (5,000 \text{ SF} - 200 \text{ SF})$$

- **SWH System is Permanently Installed:** A solar zone is not required if a domestic SWH system is permanently installed at the time of

construction. The SWH system must comply with Section 150.1(c)8Ciii, the prescriptive solar water heating system requirements when installing a water-heating system serving multiple dwelling units. The permanently installed domestic SWH collectors can be installed anywhere on the building site.

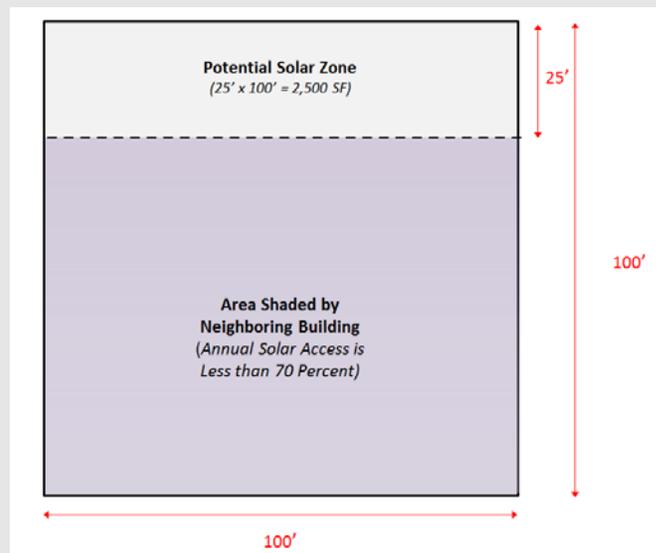
- **Limited Annual Solar Access:** The minimum required solar zone area may be reduced if the building site is shaded by objects that are not part of the building itself and there is no unshaded area that could accommodate the full solar zone.

For the purpose of the Standards, the potential solar zone is defined as the total area on an eligible space (that is, roof, overhang, roof or overhang of a structure within 250 feet (75 meters) of the building, or on a covered parking structure installed with the building) that has annual solar access is 70 percent or greater. If the potential solar zone is smaller than the minimum solar zone area specified in §110.10(b)1 (15 percent of the roof area net of the area covered by skylights), then the solar zone can be reduced to half the area of the potential solar zone.

#### Example 8-5

##### Question

The roof with no skylights has an area of 10,000 SF. A neighboring building shades the roof, so 7,500 SF of the roof has less than 70 percent annual solar access. How big does the solar zone have to be?



##### Answer

If the entire roof had an annual solar access of 70 percent or greater, the minimum solar zone would be 1,500 SF. However, since the potential solar zone is 2,500 SF, the minimum solar zone can be reduced to half the area of the potential solar zone, or 1,250 SF.

## Example 8-6

**Question**

The total roof area is less than 10,000 SF, but the potential solar zone is less than the minimum size requirements for any sub-area (less than 80 SF or narrower than 5 feet in the smallest dimension). Does the building still need to comply with the solar ready requirements?

**Answer**

No. Probably need an explanation for no answer)

For purposes of the solar ready requirements, solar access is the ratio of solar insolation including shade to the solar insolation without shade.

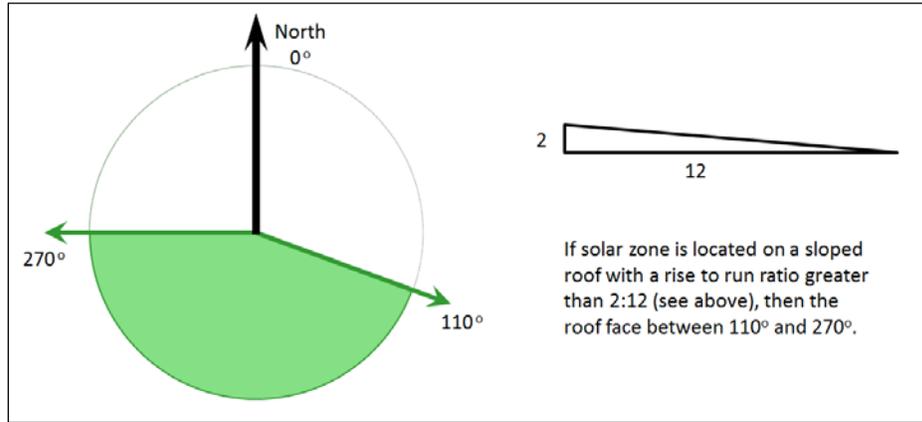
$$\text{Solar Access} = \frac{\text{Solar Insolation Including Shade}}{\text{Solar Insolation Without Shade}}$$

Annual solar access is most easily determined using an instrument that is equipped with a camera with a fisheye lens and specialized imagery processing software. The instruments can calculate the annual solar access of any point on a proposed site based on the location of the building and information that is captured in the digital photograph. Since this type of instrument relies on photographs, their most appropriate use is to determine solar access on existing buildings. The instruments are not as useful in the design phase for newly constructed buildings when capturing a digital photograph from the proposed solar zone location is not feasible.

During the design phase for newly constructed buildings, annual solar access can be quantitatively determined using several computer-aided design (CAD) software packages which can import a CAD file of the building and perform a shading analysis or several online solar quoting tools which make use of both overhead and orthogonal aerial imagery. Annual solar access can be qualitatively determined using several three-dimensional modeling programs.

**9.3.2. Orientation****§110.10(b)2**

If the solar zone is located on a steep-sloped roof (that is, the roof has a ratio of rise to run of greater than 2:12), then the roof must be oriented between 110 degrees and 270 degrees of true north (not magnetic north). The orientation is important because it ensures a reasonable solar exposure if a solar energy system is installed in the future.



**Figure 8.1: Orientation of roof if solar zone is located on steep-sloped roof.**

If a solar zone is located on a low-sloped roof (that is, the roof has a ratio of rise to run less than 2:12), the orientation requirements do not apply.

**9.3.3. Shading.**

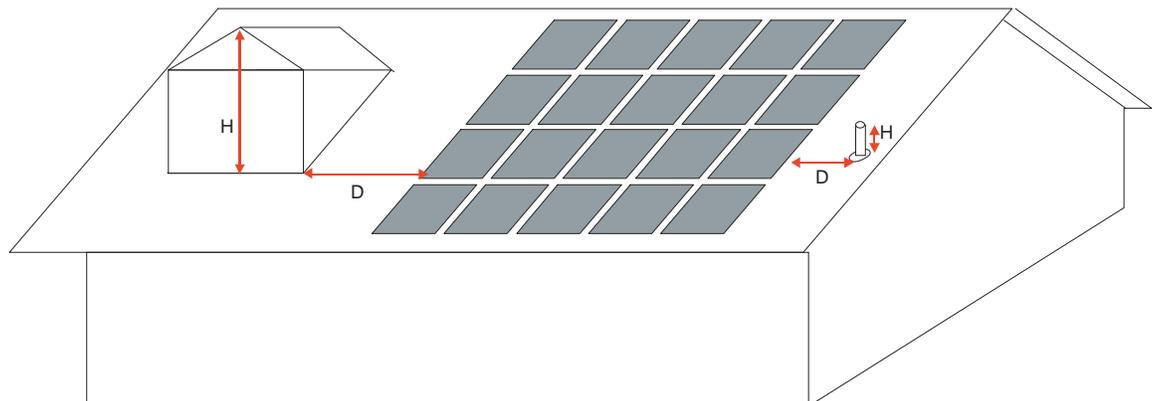
**§110.10(b)3**

Obstructions such as vents, chimneys, architectural features, or roof mounted equipment cannot be located in the solar zone. This requirement is in place so the solar zone remains clear and open for the future installation of a solar energy system.

Any obstruction located on the roof or any other part of the building that projects above the solar zone must be located at a sufficient horizontal distance away from the solar zone such that the obstruction will not shade the solar zone. Equation 8.1 and Figure 8.1 describe the allowable distance between any obstruction and the solar zone. For each obstruction, the horizontal distance (“D”) from the obstruction to the solar zone has to be at least two times the height difference (“H”) between the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone.

$$D \geq 2H$$

(Equation 8.1)



**Figure 8.2: Schematic of Allowable Setback from Rooftop Obstructions**

Source: California Energy Commission

Obstructions located north of all points of the solar zone are not subject to the horizontal distance requirements. Obstructions that are not located on the roof or another part of the building, such as landscaping or a neighboring building, are not subject to the horizontal distance requirements.

---

**9.4. Construction Documents**

Construction documents must include information about the as-designed structural loads and plans for interconnecting a PV and SWH system to the building's electrical or plumbing systems.

**9.4.1. Structural Design Loads.****§110.10(b)4**

The structural design load requirements apply if any portion of the solar zone is located on the roof of the building. For the areas of the roof designated as the solar zone, the structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents. This is required so that the structural loads are known if a solar energy system is installed in the future.

The Standards do not require the roof on which the solar zone is located to be designed taking the loads of the solar equipment into consideration. In other words, there are no requirements for the inclusion of any collateral loads for future solar energy systems.

**9.4.2. Interconnection Pathways.****§110.10(c)**

All buildings that must include a solar zone must also include a plan for connecting a PV and SWH system to the building's electrical or plumbing system. The construction documents must indicate:

1. A location for inverters and metering equipment for future solar electric systems. The allocated space should be appropriately sized for a PV system that would cover the entire solar zone.
2. A pathway for routing conduit from the solar zone to the point of interconnection with the electrical service. There is no requirement to install conduit. Rather, the design drawings must show where the conduit would be installed if a system were installed at a future date.
3. A pathway for routing of plumbing from the solar zone to the water-heating system. There is no requirement to install piping.

**9.4.3. Documentation.****§110.10(d)**

A copy of the construction documents that show the solar zone, the structural design loads, and the interconnection pathways must be provided to the building occupant. The building occupant must also receive a copy of compliance form number *{insert compliance form number}*. Providing information to the building occupant is required so that the solar ready information is available if the occupant decides to install a solar energy system in the future.

---

## 9.5. Additions

### §141.0(a)

The solar ready requirements for additions is covered by the Standards in Section §141.0(a). Additions do not need to comply with the solar ready requirements unless the addition increases the roof area by more than 2,000 square feet (200 square meters).