

CHAPTER 3 INSTALLATION REQUIREMENTS

SECTION 301 GENERAL

301.1 Scope. The provisions of this chapter shall govern the installation of photovoltaic (PV) components including location, materials and structural support. Where the installation of PV systems is not covered by this code the installation shall be in compliance with the Oregon Structural Specialty Code.

SECTION 302 DEFINITIONS

(ICC proposal IBCS 22-09/10)

(1502.1) **302.1 General.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

CONVENTIONAL LIGHT-FRAME WOOD CONSTRUCTION. A type of construction whose primary structural elements are formed by a system of repetitive wood-framing members. ~~See in accordance with OSSC Section 2308 for conventional light frame wood construction provisions or the prescriptive framing provisions of the Oregon Residential Specialty Code.~~

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~~**PHOTOVOLTAIC MODULES/SHINGLES.** A roof covering composed of flat plate photovoltaic modules fabricated in sheets that resemble three-tab composite shingles.~~

RACKING. A system of structure that directly supports the PV ~~panels-modules~~ and transfers the applied loads to the building structure or ground-supported structure. *(This is a first stab at a def. and may need additional work.)*

SECTION 303 MINIMUM STANDARDS AND QUALITY

303.1 General. Photovoltaic (PV) components, racking, support structures and attachments shall be in accordance with the provisions of this chapter. PV systems shall be designed and installed in accordance with this code and the approved manufacturer's instructions. Where the installation of PV systems does not comply with the prescriptive provisions of this section the installation shall comply with the OSSC. *(sim to OSSC 1503 Roof coverings)*

(1509.6) **303.2 Roof mounted photovoltaic panels and modules.** Photovoltaic panels and modules ~~mounted-installed~~ on ~~top of~~ a roof shall be listed and labeled in accordance with UL 1703 and shall be installed in accordance with the manufacture's installation instructions. *(Add from S13- 09/10)*

(1507.17) **303.2.1 Photovoltaic modules/shingles.** The installation of photovoltaic modules/shingles shall comply with the provisions of this section.

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~~303.1.x For reference: (ICC proposal IBC S13-09/10) added portion to 303.2~~

~~**Photovoltaic systems Type of Construction.** Rooftop installed photovoltaic PV systems, including supporting structure, that are adhered or attached to the roof covering shall be labeled to identify their fire classification in accordance with the testing required in Section 1505.1 shall comply with the requirements of OSSC Chapter 6 for the buildings applicable type of construction.~~

~~(1507.17.1) 303.21.1 Material standards.~~ Photovoltaic modules/shingles shall be listed and labeled in accordance with UL1703.

303.2.1.2 Testing. Rooftop installed photovoltaic systems that are adhered or attached to the roof covering shall be labeled to identify their fire classification in accordance with the testing required in Section **1505.1**

~~(1507.17.3) 303.2.1.3 Wind resistance.~~ Photovoltaic modules/shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Photovoltaic modules/shingles shall comply with the classification requirements of Table **1507.2.7.1(2)** for the appropriate maximum basic wind speed. Photovoltaic modules/shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table **1507.2.7.1(2)**. (S28-09/10 1509.6.1) Rooftop mounted PV systems shall be designed for wind loads for component and cladding in accordance with OSSC Chapter 16 using an effective wind area based on the dimensions of a single unit frame.

~~**305.2.1 Weather protection.** Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration.~~

SECTION 304 LOCATION.

304.1 General. The location of Photovoltaic (PV) components, racking, support structures and attachments shall be in accordance with the provisions of this chapter.

304.2 Zoning requirements. The installation of PV systems shall comply with the requirements of the zoning requirements of the Authority Having Jurisdiction (AHJ).

304.3 Flood Hazard Areas. Installation of PV systems within flood hazard areas, as defined by the AHJ, shall comply with the following:

304.3.1 Protection of mechanical and electrical systems. Electrical systems, equipment and components shall be located above the design flood elevation. If replaced as part of a substantial improvement, electrical systems, equipment and components shall meet the requirements of this section. Systems, fixtures, and equipment and components shall not be mounted on a penetrate through walls intended to break away under flood loads.

Exception: Electrical systems, equipment and components are permitted to be located below the design flood elevation provided that t designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistant construction requirements of the OSSC. Electrical wiring systems are permitted to be located

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below the design flood elevation provided they conform to the provisions of the Oregon Electrical Specialty Code for wet locations.

Refer to zoning, solar access, flood hazard areas, height, etc. Also, the flood hazard area requirements should probably just be references to like to the ORSC section R324.1.5 and/or OESC sections. For example;

304.4 Egress. PV systems shall not be installed in locations that would restrict, or otherwise prevent the use of, the required means of egress. The means of egress shall comply with Chapter 10 of the OSSC.

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304.5 Light and Ventilation. PV systems shall not be installed in locations that would restrict the required light and ventilation. Light and ventilation shall comply with Chapter 12 of the OSSC.

304.6 Flood-Resistant Installation. PV systems and support structures constructed in whole or in part in flood hazard areas (including A or V Zones) as identified by the local jurisdiction shall be designed and constructed in accordance with the provisions contained in this section.

Exception: PV systems and support structures located in whole or in part in identified floodways as established by the local jurisdiction shall be designed and constructed as stipulated in the OSSC or equivalent design methods based on nationally recognized standards.

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304.6.1 Structural systems. All PV systems and structural support systems shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement resulting from hydrodynamic and hydrostatic loads and stresses including the effects of buoyancy.

304.6.2 Protection of PV systems from flood. PV systems and support structures shall be located above the design flood elevation. Systems shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: PV systems are permitted to be located below the design flood elevation provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistant construction requirements of the OSSC. Electrical wiring systems are permitted to be located below the design flood elevation provided they conform to the provisions of the OESC for wet locations.

R304.6.3 Flood-resistant materials. Materials used below the elevation required in Section R322.2 (flood hazard areas including A Zones) or R322.3 (coastal high-hazard areas including V Zones) shall comply with the following:

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1. All wood, including floor sheathing, shall be pressure-preservative-treated in accordance with AWPA U1 for the species, product, preservative and end use or be the decay-resistant heartwood of redwood, black locust or cedars. Preservatives shall be listed in Section 4 of AWPA U1.

2. Materials and installation methods used for flooring and interior and exterior walls and wall coverings shall conform to the provisions of FEMA/FIA-TB-2.

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(How much should be included from the Residential Code? If we don't incorporate some then the other option will be to just refer everything to the OSSC)

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304.7 Fire Fighter Access PV systems installed on roofs shall be located in accordance with this section.

For reference from the ORSC

R324.1.5 Protection of mechanical and electrical systems. Electrical systems, equipment and components, and heating, ventilating, air conditioning and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall be located above the design flood elevation. If replaced as part of a substantial improvement, electrical systems, equipment and components, and heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall meet the requirements of this section. Systems, fixtures, and

equipment and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: Electrical systems, equipment and components, and heating, ventilating, air conditioning and plumbing appliances, plumbing fixtures, duct systems, and other service equipment are permitted to be located below the design flood elevation provided that they are ~~designed and installed to prevent water from entering or~~ accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistant construction requirements of the *Building Code*. Electrical wiring systems are permitted to be located below the design flood elevation provided they conform to the provisions of the *Electrical Code* for wet locations.

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**SECTION 305
STRUCTURAL**

305.1 General. Photovoltaic (PV) components, racking, support structures and attachments shall be in accordance with the provisions of this ~~chapter~~section.

305.2 Module Attachment. Photovoltaic modules shall be attached in accordance with the manufacturer's installation instructions or shall be designed in accordance the OSSC..

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305.3 Racking. ~~(should probably do a def for "racking")~~ Racking shall comply with this section ~~a~~.....

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305.3.1 Materials. Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration.

~~**305.2.1 Weather protection ?.** (From BCD draft) Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration.~~

305.2.2 Structural Support. Racking and racking supports shall be mounted to structural components and shall not be attached to wall or roof coverings, trim or structural sheathing as a means of structural support ~~members in accordance with section xxxx.~~ *(Not sure I like the wording yet)*.

305.2.3 Connection to structural members. Racking and racking supports shall be attached to the structural components through the use of screws, bolts, j-bolts, or other approved means in accordance with manufacturer's specifications or be designed in accordance ~~with accepted engineering practice~~in accordance with the OSSC.

(BCD Draft language) Racking Installations; General: Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration. Racking and racking supports shall be mounted to structural components and will be attached to the structural components through the use of screws, bolts, j bolts, or other approved means in accordance with manufacturer's or engineer's instructions. Screws smaller than No. 10 or bolts smaller than 1/4" shall not be allowed, in addition, the use of plywood, particle board or chipboard as the sole supporting means for racking shall not be allowed.

305.2.3.1 Roof mounted ~~arrays~~racking Roof-mounted supporting structures, and all parts thereof, shall be designed in accordance with accepted engineering practice, constructed and installed to safely support all loads, including dead loads, snow loads, wind loads and seismic loads as prescribed by the OSSC.

305.3.3.1.1 Roof installation on conventional light-frame construction. Installations that comply with this section shall qualify as a prescriptive installation and shall not require if all of the following criteria are met:

1. Roof structure: The supporting roof framing shall be *conventional light framed wood construction* with pre-engineered trusses or roof framing members that comply with the applicable allowable span charts of OSSC Section 2308.10 for the specific loads including snow.

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Exception: Roof framing in compliance with the provisions of Section 802 or 804 of the Oregon Residential Specialty Code shall satisfy the requirements of this section when the PV system is installed on:

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1.1 Detached one and two family dwellings and townhouses classified as Group R-3, and Group U Occupancies; and

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1.2 Residences used for family daycare or foster care in accordance with ORS Chapters 418, 443 and 657A; and

1.3 Detached Congregate residences (each accommodating 10 persons or less) and detached lodging houses containing not more than five guest rooms.

2. Roof materials. Roofing material shall be standing seam metal, single layer wood shingle or shake, or not more than two layers of composition shingle.

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3. Loading: Collectors are either directly attached to the roof framing or are mounted to continuous rails that are attached directly to the roof framing. These attachments must be anchored to roof framing at a spacing no greater than 48 inches (1219 mm) on center maximum and not exceed 45 pounds (20.4 kg) of combined dead plus live or snow load at each support. The combined weight of the PV modules and racking shall not exceed 4.5 pounds per square foot (xxx kPa). See Figure 305.3.3.1.1(1).

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(Do we want to include the figures or similar ones or have the text speak for itself?)

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4. Height: Maximum panel height above roof shall be 18" from top of panel to roof surface and in accordance with Figure 305.3.3.1.1(1). For installations where the panels will not be mounted flush with the roof, a building elevation showing the height of the installation will be required. The elevation must be to scale and show the height of the building and the height of the solar installation but need not show other building details, unless a Design Review will be required.

5. Submittal Requirement. *(Include a fill-in-the-blank form to be submitted stating rafter size/spacing/span, panel weight (psf), etc.*

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305.2.3.1.1 Attachment. Photovoltaic modules/shingles shall be attached in accordance with the manufacturer's installation instructions or shall be designed in accordance the OSSC.

305.2.3.2.2 Ground mounted arrays/racking. *(From the ORSC section R301.1) Buildings and Ground-mounted supporting structures-structures, and all parts thereof, shall be designed, constructed and installed to safely support all loads, including dead loads, live loads, roof loads, flood loads, snow loads, wind loads and seismic loads as prescribed by the OSSC this code.*

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The bottom of panels installed at ground level shall be at least six-? (6?) inches (452? mm) above the clear from ground level.

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(From BCD Draft for reference — probably don't need. See 305.2.3.2 and chapter 1)

Arrays: Pole or other structure mounted systems: Arrays mounted to pole or structures other than a roof shall be anchored in a manner to resist wind, snow, vibration, or seismic loading. Engineered drawings detailing

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soil conditions, depth of concrete base, concrete base rebar makeup may be required to approval of permit. Any pole mounted solar installation shall have the concrete or supporting base no less in depth than the frost line as required in the Oregon Structural Specialty Code. Alternate attachment and support methods may be approved by the authority having jurisdiction.

Arrays: Ground Mounted

In addition to being anchored in a manner to resist wind, snow, vibration, or seismic loading, panels installed at ground level shall be at least six (6) inches (152 mm) above the ground level. *(Moved this to 305.2.3.2)*

305.2.3.2.1 (1507.17.2) Attachment. Photovoltaic modules/shingles shall be attached in accordance with the manufacturer's installation instructions or shall be designed in accordance the OSSC.

(The blue portion are portions of the SOC ICC provision)

305.3 Roof installation on conventional light frame construction. Installations that comply with this section shall qualify as a prescriptive installations if all of the following criteria are met:

305.3.1 Roof structure: The supporting roof framing shall be *conventional light framed wood construction* with a maximum spacing of 24 inches [mm] on center and installed in accordance with Figure xxxx

305.3.2 Roof materials. Roofing material shall be standing seam metal, single layer wood shingle or shake, or not more than two layers of composition shingle.

305.3.3 Loading: Collectors are either directly attached to the roof framing or are mounted to continuous rails that are attached directly to the roof framing. These attachments must be anchored to roof framing at a spacing no greater than 4 ft. on center maximum or per manufacturer's instructions. Collector and mounting hardware (rails, frame, etc) weight shall not exceed 4.5 pounds per square foot (psf). Solar thermal collector weight shall include the weight of the working fluid inside the collector. See attached diagram #1A.

305.3.4 Height: Maximum panel height above roof shall be 18" from top of panel to roof surface and in accordance with Figure xxxxx

(Move this stuff to chapter 1 ??)

Permit Submittal Requirements

The following information shall be submitted for each permit application for a PV installation.

1. Structural Plans

a. Prescriptive system. If the system meets all of the prescriptive requirements of the structural section of this program guide, no structural plans and calculations will be required. Data showing that the solar installation meets the prescriptive requirements must be included with the site plan.

b. Designed elements.

If any of the prescriptive requirements for roof structure, roof materials, loading or height are not met, then structural calculations by an Oregon engineer showing complete details for the rails, support struts and roof attachments must be provided. In addition, stamped calculations verifying adequacy of the roof construction are required.

In the case where the support struts raise the panel height greater than 18" above the roof but all other prescriptive requirements of this program guide are met, then structural calculations by an Oregon engineer

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and details only for the support struts and its connections are required. In some cases, manufacturer's information and installation details may be substituted for the required engineering.

2. Elevation Drawings

For installations where the panels will not be mounted flush with the roof, a simple building elevation will be required to measure the height of the installation. The elevation must show the height of the building, and the height of the solar installation, but does not need to show other building details, unless a Design Review will be required.

(Add standard)

UL 1703-02

~~1703-02~~ Flat-Plate Photovoltaic Modules and Panels – with revisions through April 2008

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End of Chapter 3

(BCD draft – moved to 305.2.3)

Racking Installations; General: Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration. Racking and racking supports shall be mounted to structural components and will be attached to the structural components through the use of screws, bolts, j bolts, or other approved means in accordance with manufacturer's or engineer's instructions. Screws smaller than No. 10 or bolts smaller than 1/4" shall not be allowed; in addition, the use of plywood, particle board or chipboard as the sole supporting means for racking shall not be allowed.

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Arrays: Roof Mounted Array panels shall be anchored to roof structural components in a manner to resist wind, snow, vibration or seismic loading in compliance with the applicable Oregon Building Codes. Anchors secured to and through roofing material shall be made in a manner to maintain the water integrity of the roof covering. Roof drainage shall not be impaired by the installation of panels or racking. Panels which are not an integral part of the roofing system shall be installed in a manner so as to preserve the integrity of the roof surface; inspection of the attachment method shall occur prior to setting of panels.

Arrays: Pole or other structure mounted systems: Arrays mounted to pole or structures other than a roof shall be anchored in a manner to resist wind, snow, vibration, or seismic loading. Engineered drawings detailing soil conditions, depth of concrete base, concrete base rebar makeup may be required to approval of permit. Any pole mounted solar installation shall have the concrete or supporting base no less in depth than the frost line as required in the Oregon Structural Specialty Code. Alternate attachment and support methods may be approved by the authority having jurisdiction.

Arrays: Ground Mounted

In addition to being anchored in a manner to resist wind, snow, vibration, or seismic loading, panels installed at ground level shall be at least six (6) inches (152 mm) above the ground level.

Equipment Location: Components shall not be so located as to interfere with the normal operation and use of windows, doors, or other required facilities or obstruct access to equipment such as: inverters, batteries, electrical disconnects, meters, valves. Array Panels constructed of combustible materials shall not be located on or adjacent to construction required to be of non-combustible materials or in special fire areas unless approved by the Authority Having Jurisdiction.

Controls: Required electrical, mechanical, safety, and operating controls shall be of such design and construction as to be suitable for installation in the environment in which they are located.

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Protection: Any portion of the solar system installed where it may be subjected to mechanical damage shall be guarded against such damage by being installed behind barriers such as bollards, fences, or other approve means or when located within a garage be elevated a minimum of 48” above finished garage floor or located out of the normal path of a vehicle.

~~Fire Safety Requirements/Fire Fighter Access:~~

~~Solar arrays which function as building components shall comply with the Building Code, and shall not reduce the required fire resistance or fire classification of the structure. Examples include but are not limited to: curtain walls, membrane roofing, sky lights and solar windows. On residential structures, solar arrays shall maintain a minimum clearance of 36” from all edges, peaks, valleys, roof access points, skylights. In addition, a minimum 36” wide pathway shall be maintained to access skylights, roof hatches, HVAC equipment or other equipment requiring maintenance. On commereial structures a 48” wide pathway shall be maintained from all edges, peaks, valleys, roof access points, skylights. In addition, a minimum 48” wide pathway shall be maintained to access skylights, roof hatches, HVAC equipment or other equipment requiring maintenance, this pathway shall be directly over roof structural members. (See attached examples for best design practices):~~

~~Installation of conductors, conduits, combiner boxes, disconnects shall be made in such a manner as to not create a tripping hazard or impede fire fighter access nor cross through the required pathway.~~

~~Each solar array string shall be installed with a visible D/C disconnect. This disconnect shall be marked “Array # ___ D/C disconnect”. Letters shall be a minimum of 1” in height, suitable for the environment and red in color.~~

~~This space reserved for examples of “best practice” installations relating to fire fighter access.~~

~~Identification of Solar Photovoltaic System Components in Common System Configurations:~~

(From SOC-ICC)

Structural

The following provisions apply when the solar collectors and underlying substructure (mounts, rails, etc.) are designed to meet the loading requirements of the Oregon Residential Specialty Code or the Oregon Structural Specialty Code. The prescriptive requirements as described in this section are assumed to meet the residential code requirements and therefore will not require the system be design by a registered Oregon engineer. An engineer registered in Oregon must complete the design and details of all other systems not meeting the prescriptive requirements provided in this guide.

A project will qualify as a prescriptive installation with an acceptable supporting roof structure if all of the following criteria are met:

Roof structure: The supporting roof framing shall be of typical residential construction with multiple parallel wood roof rafters or trusses. Minimum rafter or truss chord size is 2x4 and maximum spacing is 2 ft. on center. See attached diagram. #1A

Roof materials: Roofing material must be either standing seam metal, single layer wood shingle or shake, or not more than two layers of composition shingle. Concrete or tile roofs will require structural review.

Loading: Collectors are either directly attached to the roof framing or are mounted to continuous rails that are attached directly to the roof framing. These attachments must be anchored to roof framing at a spacing

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no greater than 4 ft. on center maximum or per manufacturer's instructions. Collector and mounting hardware (rails, frame, etc) weight shall not exceed 4.5 pounds per square foot (psf). Solar thermal collector weight shall include the weight of the working fluid inside the collector. See attached diagram #1A.

Height: Maximum panel height above roof shall be 18" from top of panel to roof surface. See attached diagram #1B.

For additional information regarding the structural requirements for solar panel installations, please contact the AHJ local building department at (insert your jurisdiction here).

Permit Submittal Requirements

The following information shall be submitted for each permit application for a PV installation.

1. Structural Plans

a. Prescriptive system. If the system meets all of the prescriptive requirements of the structural section of this program guide, no structural plans and calculations will be required. Data showing that the solar installation meets the prescriptive requirements must be included with the site plan.

b. Designed elements.

If any of the prescriptive requirements for roof structure, roof materials, loading or height are not met, then structural calculations by an Oregon engineer showing complete details for the rails, support struts and roof attachments must be provided. In addition, stamped calculations verifying adequacy of the roof construction are required.

In the case where the support struts raise the panel height greater than 18" above the roof but all other prescriptive requirements of this program guide are met, then structural calculations by an Oregon engineer and details only for the support struts and its connections are required. In some cases, manufacturer's information and installation details may be substituted for the required engineering.

2. Elevation Drawings

For installations where the panels will not be mounted flush with the roof, a simple building elevation will be required to measure the height of the installation. The elevation must show the height of the building, and the height of the solar installation, but does not need to show other building details, unless a Design Review will be required.

t as AHJ or Building Dept.

RWR: See section 107.2 above where there are exemptions from plan review

Reference material

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For reference:

305.1 GENERAL

305.2 MODULE ATTACHMENT

305.3 RACKING

305.3.1 MATERIALS

305.3.2 STRUCTURAL SUPPORT

305.3.3 CONNECTION TO STRUCTURAL MEMBERS

305.3.3.1 ROOF MOUNTED RACKING

305.3.3.1.1 ROOF INSTALLATION ON CONVENTIONAL LIGHT FRAME CONSTRUCTION

1. Roof structure
2. Roof materials
3. Loading
4. Height
5. Submittal Requirements

305.3.3.2 GROUND MOUNTED