STEP 6 (SIMPLIFIED): STRUCTURAL PV ARRAY MOUNTING REQUIREMENTS

The structural requirements for mounting a PV array on a residential rooftop that are presented in this section are consistent with the approach taken by SolarAPP+. For jurisdictions that require a more detailed approach to the structural PV array mounting requirements, please consult the Detailed Structural PV Array Mounting Requirements in a separate document available on the www.solsmart.org/permitting website. These detailed requirements are intended to meet all the requirements of the residential code without the need for a structural engineer's certification in most cases.

The items below from the SolarAPP+ process represent a sufficient characterization of the residential code requirements for systems that meet these criteria.

1. The weight of the PV system 4 lbs/sq ft. or less

Practical weight limits need to be set for solar systems. The 4 psf average self-weight limit of a PV array, including its support components, is easily met by virtually all PV systems. Even glass-on-glass modules, including bifacial modules, fit within this distributed weight limit. This limit is similar to the weight of roof overlays, which were usually allowed automatically in 1990s and earlier Building Codes.

2. The attachment points of the mounting system are staggered (no check requires low snow and wind load location)

The Detailed Structural Commentary has a 20-page explanation as to why staggering of attachments in adjacent rows provides for fully distributed loading of a residential roof structure (section D.6). By staying within the 4 psf distributed weight for the array, the point-loading of roof framing members is negligible. As the detailed commentary discusses, when the design snow load is 10 psf or less, staggering of attachments is not necessary since the combined load of the snow and the array is still within the point loading limits of the roof members.

3. The maximum spacing in inches between adjacent attachment points of the mounting system 48" or less (no check means that the spacing is no larger than 72" and requires no snow and low wind load location)

Again, section D.6 of the Detailed Structural Commentary explains why 48" is the standard distance between attachment points for most locations in the United States. This allows for snow loads up to 60 psf and wind loads as high as 150 mph. For low snow load (10 psf or less) and low wind load (120 mph or less) areas, an attachment distance of 72" is permitted without causing excessive loading of roof framing members. Also, these rules are contingent on the distributed weight of the array being no greater than 4 psf.

4. The array is on a single roof face (if no check, how many roof surfaces at different slopes and/or orientations will be used for installation? _____(fill in)

Many simple PV systems are installed on a single roof face. When multiple roof faces are involved, their may be unique roof slopes on some of the roof faces. This item simply documents whether the array is only a single face or if additional roofs must be taken into account. The site diagram is a requirement of the simplified residential

PV+ESS permit guidelines whereas the SolarAPP+ does not require the site diagram but uses this information to determine the eligibility of the project for submittal under SolarAPP+.

5. The PV array is flush mounted (parallel to roof)

Roof installations of PV arrays that are not parallel (or nearly parallel) to the roof structure present unique wind and snow loading issues that may need further review by a design professional. Parallel installations are well-understood and can be addressed with standard products and standard guidelines.

6. If "5." not checked is the maximum distance off the roof no greater than 10" (if no check, this process cannot be used)

The combination of items 5 and 6 determine that the installation is typical and does not need special engineering to evaluate compliance. Most residential rooftop PV arrays are mounted between 4" and 6" off the surface of the roof and are parallel, or nearly parallel to the roof surface. A system on a flat roof will be mounted at a slight angle in most cases to prevent pooling of water on the surface of the solar panels. For parallel-to-roof arrays, the distance between the roof surface and underside of module needs to be limited to 10 inches to control wind uplift pressures and take advantage of the "Kopp factor." Wind tunnel research (Stenabaugh et al, 2014) shows that this reduction factor is 0.80 or less for arrays up to 10 inches off the roof. See the discussion under E.3 in the detailed structural commentary for further explanation.

7. The solar module and mounting system rated by the manufacturer to withstand the upward force of the local wind speed and evenly distribute load into the supporting structure at the proposed maximum spacing, and confirmed in UL 1703 or 61730, and 2703 listings (validated through the UL 1703 or 61730 module rating for mechanical load rating, and UL 2703 mounting system mechanical load rating)

This item is to check that the mechanical loading of the structural rails and attachments are being applied consistently with the manufacturer's instructions and any listing requirements. The PV modules are listed to UL1703 or UL61730 and the manufacturer's instructions dictate how the module is to be supported and held in place for various mounting methods. The mounting system may or may not be listed to UL2703 for mechanical load rating. If the UL2703 mechanical load rating is required by the manufacturer, then the installation must comply with any limitation that this load rating requires.

8. The individual roof structure appears to be structurally sound, without signs of alterations or significant structural deterioration or sagging.

The contractor or site auditor should verify the following:

1. No visually apparent disallowed rafter holes, notches and truss modifications as shown above.
2. No visually apparent structural decay or un-repaired fire damage.
3. Roof sag, measured in inches, is not more than the rafter or ridge beam length in feet divided by 20.

Rafters that fail the above criteria should not be used to support solar arrays unless they are first strengthened. Excessive roof sag can indicate an originally under-designed roof, or subsequent deterioration of a correctly designed roof. Roof sag, measured in inches, is not to exceed span, measured in feet, divided by 20. This corresponds to a dead load deflection of span L/240. Per IBC, dead plus live load deflections are not to exceed L/180, and if dead load is 10 psf and live load is in the range of 12 to 20 psf, the expected original dead load

design deflection is of the order of one third to one half of L/180, that is, L/360 to L/540. Hence a larger dead load deflection of L/240 could indicate problems, warranting further investigation.

9. What is the roof covering material?_____(fill in blank)

This item simply documents the type of roof covering material which may be relevant for roof sealing methods for attachments. Wood shake roofs are specifically not allowed under this method. Metal roofs are limited to a design snow load of no greater than 15 psf.

10. What is the slope of the roof surface? _____(fill in blank))

This item simply documents the slope of the roof surface. Where multiple roof faces are used that have differing slopes (item 4), each slope should be recorded here. Also, if the roof covering material is standing seam metal or similar sheet metal roofing types, then the design snow load can be no greater than 15 psf.