



Wind and Seismic Design for Ballasted Photovoltaic Panel Systems

Direction for engineers regarding the seismic and wind design requirements for ballasted photovoltaic panel systems.

CODE REFERENCE

2016 California Building Code (CBC) Section 1510.7, 1613.6, and ASCE 7-10 Section 13.4

BACKGROUND

PV panels in a ballasted system are typically not attached to the roof and rely on their weight and friction to counter the effect of wind and seismic forces. In some cases, ballasted systems are provided with attachment points to increase the friction forces.

According to the California Building Code, the seismic design for ballasted non-penetrating systems need to be designed to accommodate seismic displacement determined by nonlinear response-history analysis or shake-table testing using input motions consistent with ASCE 7 lateral and vertical seismic forces for nonstructural components on roofs. However, there is no detailed guidance provided. Furthermore, Section 13.4 of ASCE 7-10 requires that nonstructural components and their supports be attached (or anchored) to the structure. The wind design for unattached (ballasted) PV systems is not addressed in Building Code either.

The following white paper documents were developed by the Structural Engineering Association of California (SEAOC) in the effort of addressing the lack of clarity and specific requirements in applying the structural building code provisions to solar photovoltaic systems:

1. Seismic structural requirements and commentary for rooftop solar photovoltaic arrays (Report SEAOC PV1-2012).
2. Wind Design for low-profile solar photovoltaic arrays on flat roofs (Report SEAOC PV2-2012).

FINDINGS

A ballasted solar array system can be used on flat roofs without a positive connection when the following requirements are met:

1. The seismic design of ballasted PV arrays shall fully comply with Report PV1-2012 mentioned above. The displacement can be determined by one of the following procedures:
 - Prescriptive design seismic displacement per Sections 6, 7, and 8 of PV1-2012 if applicable; or
 - Nonlinear response history analysis per Sections 6, 8 and 9 of PV1-2012 (CBC 1613.6); or
 - Shake table testing per Sections 6, 8 and 9 of PV1-2012 (CBC 1613.6).
2. The wind design of ballasted PV arrays shall fully comply with Report PV2-2012 mentioned above. The wind design load can be determined by one of the following procedures:
 - Prescriptive pressure coefficient G_{Crn} per Section 3 of PV2-2012; or
 - Wind tunnel tests per Section 5 of PV2-2012.

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3. Post a placard: Permanently affix a durable weather and fade resistant placard on or near the photovoltaic system, visible from all sides of roof location. This may require placards in multiple locations. The placard shall state in letters with a minimum letter height of 5/8 inch the following:

WARNING
THIS IS A BALLASTED PHOTOVOLTAIC PANEL SYSTEM.
DO NOT REMOVE / RELOCATE ANY ARRAYS AND/OR
BALLASTS (specify ballast type). ANY CHANGES TO THE PV SYSTEM,
ROOFING MATERIAL, ROOF STRUCTURE AND OTHER ALTERATIONS
SHALL BE MADE WITH ALL REQUIRED BUILDING AND ELECTRICAL PERMITS.
DO NOT REMOVE THIS PLACARD

For questions or comments about any of the above items please contact your Plan Review Engineer.