Q&A Technical Questions & Answers

Best Practices for Using S-5! Clamps

What are the best design and installation practices when using S-5! clamps to structurally attach PV systems to standing seam metal roofs?

Standing seam metal roofing (SSMR) is the most convenient of any roof type for mounting PV modules, either crystalline or thin-film. The seams of SSMR are beam-like elements that not only add stiffness and flexural strength to the roof panels, but also provide expedient attachment points for a PV system. Joining PV modules to this roof type can be done with or without continuous mounting rails using aluminum S-5! seam clamps. These patented clamps anchor to the roof seam by pinching it within the clamp body with round point setscrews that are in no way invasive to the roof. The clamp body is machined with threaded holes to facilitate anchorage of PV modules or racking components to the clamp.

The SSMR industry has used this attachment technology for many years, and most SSMR manufacturers endorse and recommend this method when making attachments of various ancillaries to their roof systems. It is of prime concern to all parties—building owner, roof manufacturer, PV integrator and S-5! Attachment Solutions—that the integrity of the roof system is maintained and attendant warranties, if any are in place, are not jeopardized. The result is a PV-to-SSMR marriage that provides maintenance freedom for the expected service lives of both the PV system and the roof. When properly executed, these methods are not only dependable and expedient, but also cost effective—saving up to $1.00 per watt when compared to other roof types and mounting systems.

To achieve the perfect marriage between a PV system and the SSMR using S-5! clamps, follow the best practices described below.

Compatibility. Metallurgical compatibility is always important on a rooftop where materials will be in electrolytic contact. SSMR is most often steel, occasionally aluminum and very rarely copper, stainless or some other metal. Steel and aluminum may be prepainted (coil coated) or bare. The latter is something of a misnomer. Steel will always have a protective coating of pure zinc (galvanized) or an aluminum/zinc alloy (Galvalume or Zincalume) for corrosion protection.

Aluminum S-5! clamps are compatible with all these metals except copper. When roofing is copper, brass S-5! clamps should be used. Somewhere between the brass clamp and the aluminum PV frame an electrolytic switch must be made. This can be done with a passive metal like stainless steel or with rubber isolators or both.

Some installers might want to use the galvanic scale to identify dissimilar metals, but the graphical galvanic scale is not always a good way to determine whether one metal is compatible with another. The reason is that when metals oxidize, the oxide layer created is a new material that may or may not exhibit the electrochemical characteristics of the parent metal. Therefore, the scale does not always tell the whole truth.

Courtesy electronconnection.com

Aluminum seam clamps Using patented, non-invasive round point screws, S-5! clamps provide the structural interface between the PV racking system and the beam-like elements of the standing seam metal roofing.

Another compatibility issue has to do with the shape or profile of the SSMR seam itself and the S-5! clamp model selected. Many different seam geometries exist, along with a number of corresponding S-5! clamp profiles. Examining and verifying the dimensions of the seam in question prior to consulting the S-5! Web site (S-5.com) can determine the proper match for a mating clamp. The site shows various clamp profiles, nomenclatures and critical dimensions that should enable selection of the appropriate clamp to fit the SSMR.

Clamp holding strength. The holding strength of the S-5! clamp is tested in two different load directions: parallel to the seam direction and perpendicular, or

CONTINUED ON PAGE 18

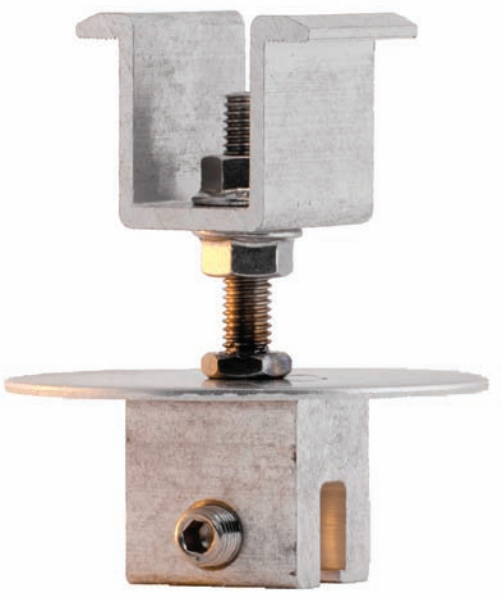
normal. These replicate drag loads such as sliding snow and uplift loads induced by wind effects. Ultimate and allowable loads (factor of safety = 2) are published on the S-5! Web site. Holding strengths are panel specific, varying with the seam material, gauge and profile of the SSMR. In order to determine the appropriate clamp and allowable load, these variables of the roof panel system must be identified. This is most easily done by matching the manufacturer name and the panel profile name to the listings on the Web site. When reviewing this data, keep in mind that most manufacturers make more than one profile.

It is also important to recognize, when relying upon these tested holding strengths, that S-5! Attachment Solutions can test the strength of the clamp-to-seam only and not other elements of the roof assembly, because these vary with every job. The S-5! connection in most instances exceeds the strength of other elements in a completed PV-to-SSMR assembly. Think of a PV system mounted on a rooftop as a chain of components. The S-5! clamp's attachment to the seam is usually the strongest link. The weaker links in the chain may include the SSMR attachment to the structure, the flexural strength of the SSMR seam or even the buckling strength of the structure. This is why it is important not to rely solely on the strength of the clamp as the determining factor when populating attachment frequency.

Clamp placement and population. The frequency of attachment of the PV system to the roof is critical but oftentimes misunderstood. There are no standards per se that spell out these requirements. A competent professional must design and specify the clamp population. PV modules, for example, are subject to UL 1703, which states that they should resist 30 pounds per square foot plus a 50% factor of safety. SSMR in general is subjected to some of the most exacting wind tests in the construction industry, including ASTM E1592, UL 580 and FM4471. SSMR is a structural element and is engineered to meet design wind speeds and resultant negative pressures on its surface.

The preengineered metal building industry has standardized roof attachment around a 5-foot structural spacing and 2-foot roof panel width, resulting in clips anchoring roof panels to structure every 10 square feet, on a 2 x 5 foot grid. Other roof panels used may be 16-inch, 18-inch and in rare cases 30-inch widths. Occasionally, structural purlin spacing will also vary from the 5-foot standard. The objective when attaching a PV array to the SSMR is to distribute the loads from the PV array—primarily uplift—evenly into and through the SSMR to the building structure. Attachment to the building structure is accomplished with clips hidden within the seams. The conservative and recommended way to distribute the load is to determine the frequency of the roof's attachment to the structure, and then duplicate or exceed it with the attachment of the PV components to the roof. This is detailed in S-5! Document SSPV07, which is available on the Web site. By following this approach, you are assured that loads are distributed uniformly into the roof system and its attachment to the building structure. Attachment should be less frequent only when a qualified engineer has proven adequacy.

Thermal movement also affects clamp placement. SSMR is designed to respond thermally with dimensional change along the length of the panels. This is accomplished at the panel-to-attachment clip interface. Most preengineered metal buildings utilize dual component clips. The top portion moves thermally with the panel, while the base portion, which is attached to structure, is stationary. When attaching to this type of SSMR, the S-5! clamp can be attached at a clip location or between clips. Some other SSMR types—normally installed over wood decks—rely on differential movement between roof clips and roof panels to accommodate thermal cycling. When installing a PV system on this type of SSMR, the clamp locations should avoid the panel's attachment clips.



Courtesy S-5.com

Direct attachment Using the S-5! PV Kit eliminates the need for racking. This low-profile attachment method can save money and more evenly distribute uplift loads.

The above guidelines are valid whether using mounting rails or using direct attachment with the S-5! PV Kit. One advantage of rails is slightly better space utilization. Advantages of direct mounting are economic: the total MSRP hardware costs, including S-5! clamps and all interface hardware, are around $0.12/Wp on small systems and more like $0.06/Wp on very large ones.

—Rob Haddock /
S-5! Attachment Solutions /
Colorado Springs, CO / S-5.com