Durability Assessment of Adhesive Mounting of Solar Modules for Residential Rooftops

Honeker, C.1; Watts, A.1; Lloyd, A.1; Schmid, C.1; Booth, D.2
1 Fraunhofer Center for Sustainable Energy Systems CSE, 5 Channel Center Street, Boston, MA 02210, USA, Phone +1 617-575-7263, choneker@cse.fraunhofer.org
2 H.B. Fuller, 4401 Page Avenue, Michigan Center, MI 49254, USA

HISTORY of Adhesive Mounting in Photovoltaics (PV)

Adhesive Mounting is not new to PV

Uni-Solar (2007)
Beamreach (2016)
Lumeta (2010)
Lightweight Module
Plug and Play Project (2015)

Traditional (Rail-less) Approach
Adhesive Mounting Approach

Elements of traditional rail-based mounting

Comparison of installation steps of the two approaches

RESULTS

Adhesive Mounting: Loadpath Geometry

Mounting structure is designed to distribute load so that stress level < critical stress for any loadpath element

Adhesive/Shingle Strength - Thermal Cycling

Adhesion increase with high temperature exposure is thought to be due to wetting of shingle

NEXT STEPS: APPROACH TO EVALUATING DURABILITY

Component Tests

<table>
<thead>
<tr>
<th>Material</th>
<th>Type of Test</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesive</td>
<td>Bond strength under accelerated testing (heat/humidity)</td>
<td>Adhesive Supplier</td>
</tr>
<tr>
<td>Sealant Strip</td>
<td>Peel and pluck strength under accelerated testing (heat/humidity)</td>
<td>Shingle Supplier</td>
</tr>
<tr>
<td>Shingle</td>
<td>Nail pull-through load under accelerated testing (heat/humidity)</td>
<td>Shingle Supplier</td>
</tr>
</tbody>
</table>

System Tests

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Scale</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Tests</td>
<td>Full-sized modules on test decks</td>
<td>More realistic More expensive Less quantitative</td>
</tr>
</tbody>
</table>

OPEN QUESTIONS

- Identifying field failure modes Needed to develop the appropriate accelerated test protocols
- Discrepancy between PV and Shingle aging conditions
  - Typical shingle tests:
    - Dark Oven (70C) (ASTM D5147, D5869)
    - Xenon Arc (0.35 W/m2*nm & spray cycle) (ASTM D4798)
    - Freeze-thaw (ASTM D4798)
  - Typical PV tests:
    - IEC 61215, UL 1703 (DM, TF, HF)
  - It is possible that shingles will not survive the PV standards
- How should PV mounting standards (e.g. UL 2703) be modified to accommodate adhesive mounting.
  Will there be an IEC standard for PV mounting systems?