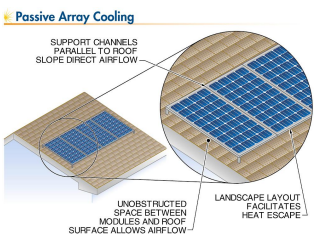
Mechanical Integration of PV Systems

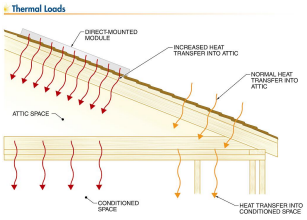
Ridha Hamidi, Ph.D.

- Aerial lifts are sometimes required to reach roofs or areas with poor accessibility.

- Several passive tech-niques can be used to keep arrays cool, which improves array performance.



- Modules mounted directly on the roof surface increase the heat transfer into a building.



- PV systems that match the shape, color, and/or alignment of the mounting surface produce aesthetically pleasing installations.

- Assembling PV subsystems such as panels before lifting them to the roof is called panelizing

SolarWorld Industries America

- Mounting systems may hold modules at a fixed tilt, or may allow adjustments to be made to the tilt for greater solar energy gain.

Module Mounting Systems

FIXED-TILT MOUNT

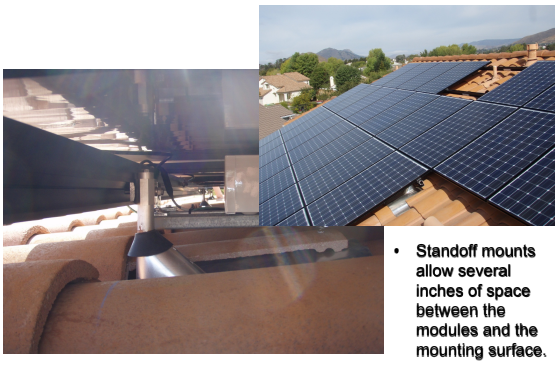
ADJUSTABLE-TILT MOUNT

- Direct mounts have little or no space between the modules and the mounting surface.

Direct Mounts

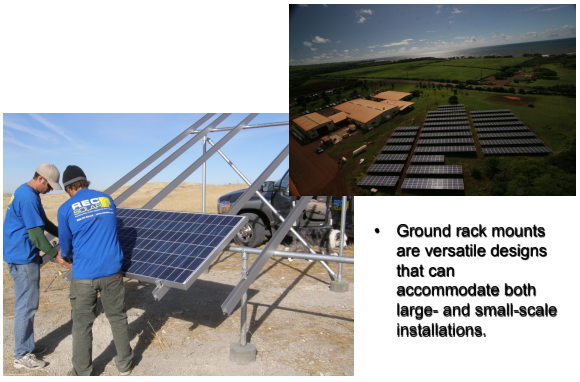
DOE/NREL, Jim Yost

- Roof rack mounts secure modules on a triangular trusslike structure that mounts to flat or low-tilt roofs.



- Standoff mounts allow several inches of space between the modules and the mounting surface.

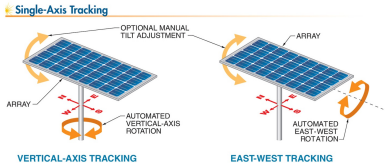
- PV modules can be integrated into building exteriors as roof shingles, windows, skylights, awnings, and many other structures.



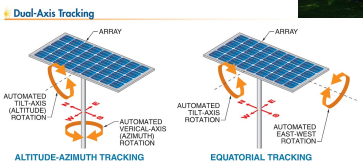
- Ground rack mounts are versatile designs that can accommodate both large- and small-scale installations.

- Pole-mounted arrays can be used in a variety of app-lications, such as lighting, communications, water pumping, and signage.

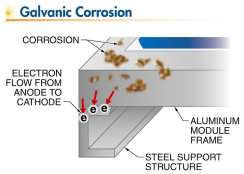
- Single-axis tracking mounts rotate one axis to ap-proximately follow the sun as it moves across the sky.



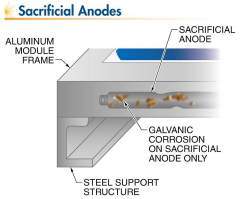
- Dual-axis tracking mounts rotate two axes to exactly follow the sun as it moves across the sky.



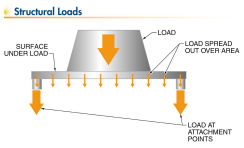
- Galvanic corrosion can occur when two dissimilar metals are in contact with each other.



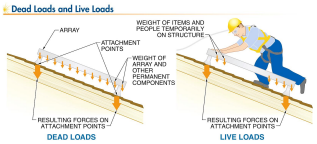
- Sacrificial anodes are more prone to galvanic corrosion than the metal they protect, so they corrode first.



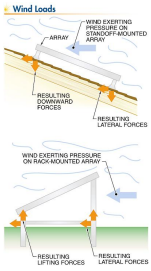
- Most structural loads are specified as a force per area. When the area attaches to other structures at certain points, the load is divided between the points.



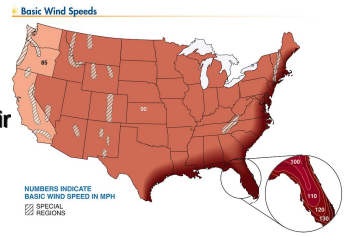
- Dead loads result from the weight of arrays and permanent components. Live loads are caused by the weight of people and/or items that are temporarily on the structure.



- The wind-load forces at attachment points can be downward, lifting, or lateral forces, depending on wind direction and the orientation of the array.

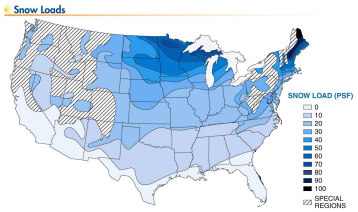


- Basic wind speeds are region-specific and are highest ir coastal areas prone to hurricanes.



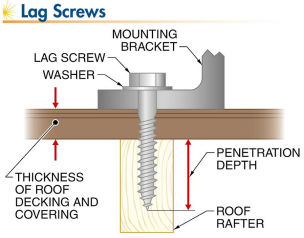
- Snow loads cause forces similar to dead loads, but the potential magnitude of a snow load varies greatly among geographic regions.

Snow Loads



- Lag screws are the most common type of fastener used to attach array mounting systems to wood structures, usually residential roofs.

Lag Screws



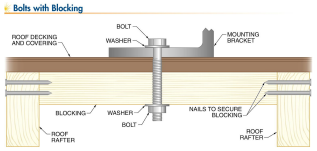
- Allowable withdrawal loads for lag screws are greater with larger screw diameter, deeper thread penetration, and higher-density lumber.

Allowable Withdrawal Loads*

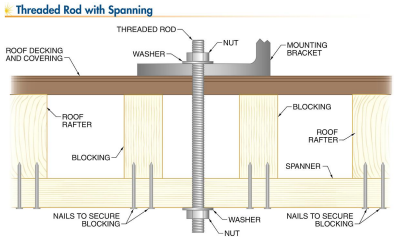
LAG SCREW DIAMETER†	WOOD TYPE		
	Southern Yellow Pine	White Spruce	Douglas Fir
¼	281	192	167
5⁄16	332	227	198
⅜	381	260	226
7⁄16	428	292	254
½	473	323	281

* in lb/in.
† in in.

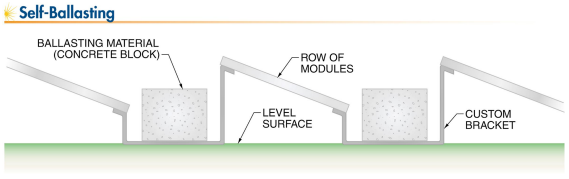
- Blocking can be used to provide a structural member between roof rafters. (VERY RARE)

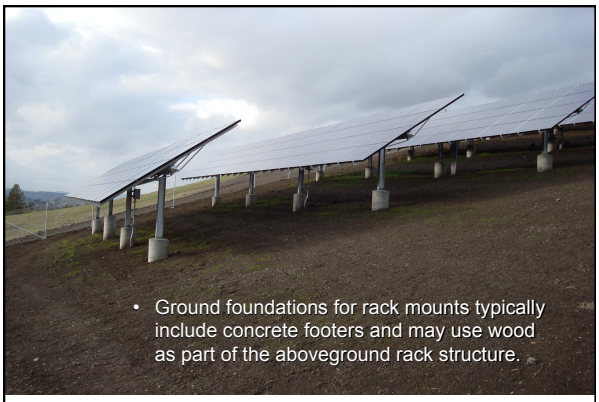


- Spanning is used to provide a structural member across roof rafters. Blocking boards are required to support the spanner. (VERY RARE)



- Self-ballasting systems rely on the weight of the array, support structure, and ballasting material to secure the array without making roof penetrations.

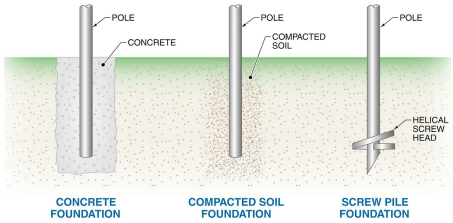




- Ground foundations for rack mounts typically include concrete footers and may use wood as part of the aboveground rack structure.

- Pole foundations may be encased in concrete or compacted soil, depending on local building requirements and the type of soil.

Pole Foundations



Weather Sealing with Caulking

To weather-seal roof penetrations, caulking material is applied between the bracket and the roof surface, around the fastener, and in the pilot hole.

- There's no reason for every roof penetration not to get a metal flashing

Flashings and rubber boots provide the highest-quality weather seal for attachment penetrations