Cyclone/High Wind resistant solar MMS solutions

Before you size and design a system, understand the risk. Most DRE rooftop solar installations skip this step entirely. Panels, inverters, batteries, and cabling receive all the attention — yet the Module Mounting Structure (MMS) is treated as lowest priority or missed entirely. Then a cyclone arrives and the MMS is the first thing to fail, taking everything with it. A holistic approach integrating both electrical and civil engineering is essential.

The guidance in this document draws on learnings from over 10,000 rooftop solar installations across diverse climate contexts in India — part of SELCO Foundation's larger Energy for Health (E4H) programme that aims to ensure reliable, decentralized renewable energy reaches 25,000 public health facilities. These installations span cyclone-prone coastal zones, high-altitude north-eastern regions, and rain-intensive inland areas, forming the empirical basis for every recommendation here.

STEP 01: UNDERSTAND THE RISK BEFORE ANYTHING ELSE

The first question must not only be 'How many panels?' — how to mount the array safely is equally critical. Beyond the structural analysis of the roof, it is essential to map the natural hazards the site is exposed to. In India, risk varies categorically across the subcontinent.

High-Risk Zone	Examples & Exposure
Cyclone-prone zones (Wind Zone III–V)	Odisha, Andhra Pradesh, Telangana, Tamil Nadu, Puducherry, Gujarat — cyclonic winds, storm surges, heavy rainfall.
High-altitude zones	North-Eastern states — mountain ridge effects, Nor'westers, altitude-driven wind exposure, seismic activity, floods.

> *If your site falls in any of these zones, every MMS design decision that follows — elevation, tilt angle, orientation, clamping, wind deflectors, materials, anchoring, and concrete block sizing — must be derived from that risk. Not estimated. Not average. Derived.*

Wind zone data exists. Cyclone track records exist. Historical disaster data exists. What is missing is the discipline to let that data drive design - One that allows safety, performance, longevity, and aesthetics to be properly prioritized throughout.

STEP 02: ROOF ANALYSIS

Evaluate the roof type and condition before any MMS decisions are made:

- **RCC Flat Roof:** Age, slab thickness, and waterproofing conditions are critical. Also assess available unshaded area, maintenance walkways, and safe access points.
- **Inclined Sheet Roof:** Purlin-rafter material, size, profile, spacing, load-bearing capacity, sheet profile, thickness, corrosion, and waterproofing are all evaluated.

STEP 03: MMS DESIGN

The MMS is the structural backbone of the solar plant — designed for 30+ years, optimal tilt, easy maintenance, and minimal soiling losses.

RCC Flat Roofs

- **Low Elevations:** Mounting-surface-hugging approach minimises wind uplift. Higher elevations increase load and risk.
- **Landscape Orientation:** Reduces panel height and adds stability. Align toward the equator for maximum harvest.
- **Tilt Angle:** 12°–15° is optimal for high-risk zones — balancing safety, yield, and moisture management. Do not match slope to latitude.
- **Clamping Points:** 6 symmetrical clamping points per panel for maximum grip and wind resistance.
- **Wind Deflectors:** Fit open rear and sides with anodised aluminium deflectors to prevent wind from entering beneath panels and generating uplift.
- **Triangular MMS:** Delivers superior stability against dynamic loads. Factor of safety: 1.5–1.75× wind loads. No legged or pole-type structures.
- **Ventilation & Drainage:** Maximum 4-inch ground clearance on all sides for airflow and rainwater drainage.
- **Material:** Anodised aluminium — superior strength-to-weight ratio, anti-corrosive against coastal salt mist, reduces dead load.
- **Anchoring:** Minimum 6 anchors per triangle at ~60% slab depth penetration. For weak/soft roofs, use portable ballast blocks only.
- **Ballast Blocks:** High-density plain cement concrete blocks along resting members. Quantity per panel based on block design, MMS design, and roof strength.

Inclined Sheet Roofs

Panels must remain parallel to the roof — no tilt or orientation of corrections. Use anodised aluminium rails or mini-rails with 6 inches of elevation. Stainless steel self-drilling screws for mini-rails; anodised aluminium klip-lock clamps for long rails. Apply EPDM tape and silicone gel at all mounting points for waterproofing.

All three steps must be applied collectively — their protective effect is cumulative. The gap is not technical. It is the discipline to begin with the risk, ensuring safety and performance remain the foundation of every decision.

Understand the risk first. Let the design follow. Everything else is just hardware.

Sample pictures taken from the SELCO Foundation's installation sites – Odisha

Figure 1: Examples of climate-resilient RCC rooftop solar MMS installations demonstrating low-elevation landscape mounting, optimal tilt, multi-point clamping, wind deflectors, triangular support structures, ventilation and drainage clearance, anodised aluminium members, secure anchoring, and ballast block reinforcement for high-wind and cyclone-prone regions.