QQ Engineering & Consulting

Smart Soil = Smart Foundations

QQEC- Civil Engineering Department

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How Soil Influences Module Mounting Structure Foundation Design in Solar PV Projects

In utility-scale solar PV projects, the success of the foundation system depends largely on the soil conditions beneath the surface. While modules, inverters, and trackers often capture most of the attention, it is the soil properties that significantly dictate the foundation's type, dimensions, and overall cost. A deep understanding of soil behavior enables smarter and more efficient foundation solutions tailored specifically to each site's unique conditions.

This presentation examines how varying soil types inform foundation decisions and highlights the importance of early collaboration between geotechnical and structural engineers to ensure project success.

Sandy Soils and Deserts

Loose sand conditions reduce both uplift and lateral resistance, necessitating careful evaluation to prevent potential foundation risks.

Driven Piles

Driven steel piles are the most efficient and widely adopted solution for PV module mounting structures in sandy and desert environments.

- Rapid installation.
- Minimal reliance on concrete.
- Cost-effective deployment over large utility-scale sites.
- High adaptability to varied sand densities and site-specific conditions.

Thorough soil density and groundwater assessments are essential to ensure driven piles achieve the necessary stability and longevity for solar arrays.

Rocky or Shallow Bedrock Zones

Rocky terrains and shallow bedrock complicate foundation installation due to hard strata that resist traditional piling techniques.

Drilling through this substratum is time-consuming and increases costs but is critical for anchoring foundations deeply and securely.

Micro Piles

Micro-piles and grouted anchors offer adaptable solutions by achieving anchorage in hard soils with minimal excavation.
This technology ensures stability while mitigating disruptions and construction delays common in rocky sites.

Ballast Foundation

Ballast foundation to resist uplift through self weight is adopted when excavation is not viable and ramming/ drilling is costly or infeasible.

Soft Clay and Expansive Soils

Soft clays and expansive soils are prone to differential settlement and soil heave, posing structural risks over time.
Expansive soils like black cotton soil has swelling and shrinkage property and it exerts uplift forces on the foundation.

Concrete Pile

Cast-in-situ Piles, precast driven piles are used in clay soil to minimize settlement and deep cast-in-situ piles, Micro-piles are used in expansive soil to bypass active swell zones.

Ballast / Raft Foundation

When pile installation isn't feasible, ballast or raft foundations help spread loads over a larger area, reducing soil pressure. Their performance improves with ground treatments like topsoil replacement, lime/cement stabilization, and geotextile or drainage layer installation.

Civil Structure & Infrastructure Services

QQEC specializes in providing comprehensive Civil Engineering Services tailored for Solar PV Plant, Wind Farm, EHV Substation and Transmission Line Projects and more.

Feasibility Studies

Conducting thorough feasibility studies to assess the viability of projects and ensure optimal planning and execution.

Hydrology Studies

Performing hydrology studies to understand flood depth and its impact on project design and site selection.

Soil Investigation Studies

Conducting soil investigation and developing detailed geotechnical reports to evaluate the site soil condition and recommend suitable foundation type.

Infrastructure Services

Delivering robust and sustainable infrastructure solutions for long term performance which includes the design and planning of access roads, stormwater drainage system, culverts and structural bridges.

Structure Design Services

Expertise in designing structures latest design tools and deign software by focusing on material optimization and efficient design that can stand the test of time while respecting our environmental conditions.

Foundation Design Services

Offering all types of complex foundation design to meet the specific need of the different structures in PV Solar plant, Substation, BESS projects.

Reach Us…

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Thank You!!!

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