Solar Photovoltaic Foundation Design

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Abstract : Solar Photovoltaic (PV) development is reliant on the sunlight hours available in a particular region to generate electricity. A potential area is assessed through its inherent solar radiation intensity measured in watts per square meter. Solar energy development involves the feasibility, design, construction, operation and maintenance of the relevant infrastructure, but this paper will focus on the design and construction aspects. Africa and Australasia have the longest sunlight hours per day and the highest solar radiation per square meter, 7 sunlight hours/day and 5 kWh/day respectively. Solar PV support configurations consist of fixed-tilt support and tracker system structures, the differentiation being that the latter was introduced to improve the power generation efficiency of the former due to the sun tracking movement capabilities. The installation of Solar PV foundations involves rammed piles, drilling/grout piles and shallow raft reinforced concrete structures. This paper presents a case study of 2 solar PV projects in Africa and Australia, discussing the foundation design consideration and associated construction cost implications of the selected foundations systems. Solar PV foundations represent up to one fifth of the civil works costs in a project. Therefore, the selection of the most structurally sound and feasible foundation for the prevailing ground conditions is critical towards solar PV development. The design wind speed measured by anemometers govern the pile embedment depth for rammed and drill/grout foundation systems. The lateral pile deflection and vertical pull out resistance of piles increase proportionally with the embedment depth for uniform pile geometry and geology. The pile driving rate may also be used to anticipate the lateral resistance and skin friction restraining the pile. Rammed pile foundations are the most structurally suitable due to the pile skin friction and ease of installation in various geological conditions. The competitiveness of solar PV projects within the renewable energy mix is governed by lowering capital expenditure, improving power generation efficiency and power storage technological advances. The power generation reliability and efficiency are areas for further research within the renewable energy niche.

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