
Subject Grootvlei PV Facility Mounting Structure Construction Methodologies

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Job No/Ref

GV-Construct-Method

1 Introduction

There are three foundation techniques which are being considered for the Grootvlei PV facility, namely:

1. Screwed or rammed piles;
2. Pre-drilled holes with backfilling or concrete; and
3. Ballast foundations

2 Screwed or Rammed Piles

2.1 Geotechnical Criteria

Screwed or rammed piles are the cheapest and preferred founding methodology for PV mounting structures and are therefore always considered first when investigating the founding conditions of a site. The following criteria are investigated in order to determine if the conditions are adequate for a screwed or rammed pile foundation type:

1. If bedrock is present too close to the surface this option becomes impractical as the piles generally can't penetrate the bedrock and a sufficient founding depth will not be reached.
2. Consideration needs to be given to the layer of topsoil (if any) to determine if it can take any static loads coming from the posts. Generally speaking, the soil close to the posts that is loosened up by the ramming or screwing process, consolidates and the force transfer is improved. However for calculation purposes and safety factor this is not considered.
3. The founding rocks or soil must be capable of tolerating all loads coming from the posts.
4. Generally, the depth to which the posts should be founded is determined by the horizontal forces (wind) at the upper end of the post, which are to be transferred into the ground.

2.2 Construction Methodology

2.2.1 Screwed Piles or Erath Screws

Earth screws are embedded in the soil the same way that wood screws are embedded in wood and provide resistance to loads in much the same way. Maximum allowable uplift forces for a given earth screw size are determined primarily by the soil's shear resistance and the depth to which the earth screw is sunk. Figure 1 and Figure 2 show a typical earth screw and the machine used to screw it into the earth.



Figure 1: Typical ground screw pile



Figure 2: Typical machine used to screw the piles into the ground

2.2.2 Rammed Piles

The anchoring of the pile driven profiles in the soil is carried out using special terrain-friendly hydraulic pile drivers. This pile-driving technique is especially suitable for very big plants. Depending on the terrain, a pile-driving performance of 250 piles/day can be achieved. Pile-driving on difficult terrain (stones, etc.) is also possible. In case of rocky subsoils, the machine can be additionally equipped with a drilling unit. Figure 3 and Figure 4 show a typical machine used to drive the piles into the ground and the finished product rammed piles.



Figure 3: Typical machine used to drive or ram the piles into the ground



Figure 4: Rammed piles

3 Pre-drilled holes with backfilling or concrete

3.1 Geotechnical Criteria

Geotechnical conditions may result in the need for foundation holes to be pre-drilled prior to ramming the piles and backfilling with concrete or some other aggregate. These conditions are as follows:

1. The presence of bedrock close to the surface; and
2. Inadequate sheer strength of the founding soil.

3.2 Construction methodology

3.2.1 Pre-drilled holes with backfilling

A hole is drilled not more than 5cm wider than the breadth of the steel profile and the cuttings that result from the drilling process remain in the hole. If a small amount is missing from the drilled hole, it is replaced by a suitable material such as concrete recyclate or chalky gravel. The filling is not compacted before ramming the pile. The steel profiles are then to be rammed into the holes to the necessary depth, and during this process the filling is compacted and the transfer of forces from the post to the wall of the drill hole is improved.

3.2.2 Pre-drilled holes with concrete

If ramming or screw posts are not able to penetrate the bedrock, pre-drilling and filling the boreholes will have to be done. This is done using the same approach as above, however the cuttings are removed and the voids are grouted up with the post rammed in place. Figure 5 shows a typical concrete filled foundation.



Figure 5: Typical concrete filled foundation

4 Ballast foundations

4.1 Geotechnical Criteria

Ballast foundations are the most expensive and least preferred founding methodology for PV mounting structures. The only geotechnical consideration is the bearing capacity of the soil which is the maximum pressure that the soil can bear without compacting so much that the structural integrity or functionality of the structure being supported is compromised.

4.2 Construction Methodology

The primary purpose of the concrete foundation is to provide sufficient weight to counteract any lift forces generated by the wind loading on the modules. Concrete slabs are cast either above ground or in shallow excavations. The Mounting structures are then mounted to the concrete slabs by using fixings cast into the slab or base plates bolted onto the slab. Figure 6 shows typical ballast foundations for a ground mounted pV facility.



Figure 6: Typical ballast foundations