

Case Study - Geotechnical

House O'Hill Wind Cluster

Client: Catto Family



Green Cat Renewables



Green Cat Renewables managed all aspects of this three E48 Enercon turbine project, with particular input for the geotechnical aspects.

As with all developments, the design of an adequate foundation is essential for wind turbines. While other elements of the turbine, such as rotor blades, hub, generator, tower construction and foundation base, are all designed and manufactured to controlled and measurable standards, the foundation materials below the turbine are naturally-occurring and therefore subject to natural variations. A great many critical unknowns exist. A site investigation is essential to evaluate these unknowns and allow an effective geotechnical design. Nonetheless, the investigation must be designed to provide sufficient technical information, but still be economic.

The initial desk study suggested bedrock to be relatively shallow. A single rotary (rock) borehole was put down at the location of each turbine. In two cases rock was encountered at about 3.0m depth and the approach was successful. An appropriate foundation could be designed. However, at one turbine location rock was found to be at 7.0m. Clearly, excavating to this depth was not acceptable. Instead, consideration was given to removing some of the soil and replacing it with well-compacted granular fill. A layer of relatively compressible soil would still be present below the foundation and the acceptable thickness of this layer had to be determined, whilst keeping the amount of granular fill to a minimum for an economic solution.

A cable percussion (soil) borehole was sunk to sample and test the soils. This additional information allowed the soil strength, stiffness and settlement characteristics to be determined, and consequently a technically adequate and cost-effective foundation was designed. The thickness of soil replacement was reduced to 2.0m and settlements were maintained within tolerable limits.

The Green Cat Renewables geotechnical team were then employed directly by the contractor constructing the project, as independent checkers of the foundation formations and compaction of the soil replacement. During this process, examination of the exposed formations revealed thin layers of sand and slight water seepages which were associated with some weakening of the formation soils. As a result, some additional soil had to be removed to achieve an adequate bearing medium.

To assess the quality of the soil replacement, plate load tests were carried out in accordance with DIN 18134 for every 0.5m thickness, as the material was placed. This method was used in preference to dynamic probing which could have been employed as a check after the full thickness of soil replacement was laid. Dynamic probing would have allowed placing of the fill to proceed to completion uninterrupted, which was the contractor's preference. However, with only a single check after the full thickness of fill had been placed, a failure would result in all the need for all the material to be removed and then re-laid. The contractor agreed that this risk was not acceptable. Indeed, the adoption of plate load tests was justified when the bottom layer of soil replacement for one of the turbines failed the compaction criteria and required additional rolling.

In summary, the close involvement of the Green Cat Renewables geotechnical team throughout the project ensured the most cost-effective foundation solution was achieved. A lack of quality information on the bearing materials could, in the worst case, lead to failure (collapse) of the tower, or simply result in deformation of the structure making it unserviceable. Even encountering unforeseen ground conditions during construction can cause additional cost due to delays or design changes. Obviously, it is better to be fully aware and have an appropriate and well-considered design.

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