Renaico Wind Farm
Working with the Wind Energy Industry & Developing Integrated Construction Solutions

APPLICATION: In the Araucanía Region of Chile, forty-four 100 meter wind turbines were constructed to establish a new wind farm spreading over 2,965 acres in Renaico, located at about 8.08 miles (13 km) from the city of Angol. Access roads, internal roads, and working platforms were necessary for the construction of the wind farm, and foundation improvement was needed for the wind turbines.

THE CHALLENGE: All work was performed on a composite of soft clay and silty soils, in a limited time frame and with ground deformation restrictions. According to the European wind farm equipment suppliers, a subgrade with a shear strength of $C_u > 28.45$ psi (2.0 Kg / cm²) is required to support the wind farm turbines and equipment, but the natural subgrade had a $C_u = 3.56$ psi (0.25 Kg / cm²). In addition, temporary platforms to support the crane during the installation of the wind turbines required a $C_u > 35.56$ psi (2.5Kg / cm²).

TENSAR® TRIAX® SOLUTION: More than 17 km (10.56 miles) of internal roads were built between the turbines that make up the wind farm. In addition, 44 temporary working platforms were built to support the crane during the installation of the wind turbines. Tensar TriAx geogrids stabilized both the roads and crane pads, resulting in significant savings in costly imported granular fill.

GEOPIER® SOLUTION: Geopier Rammed Aggregate Pier® (RAP) elements were installed to increase the rotational stiffness and substantially decrease the differential settlement at the base of the foundations. The project management team evaluated an alternative solution based on concrete piles, which proved to be more expensive. The Geopier solution consisted of 79 RAP elements for each wind turbine, with effective lengths of 13.12-26.25 ft (4m to 8m) each, in order to reinforce the soft soil stratum underlying the foundations.

NORTH AMERICAN GREEN® SOLUTION: Approximately 10,000 yd² of North American Green® Eronet® C125 was used on the slopes of the turbine platforms and on the access road slopes. Eronet C125 provided protection of the soil, reducing soil loss and enhancing the vegetation growth, which ensured that the native grasses and vegetation could take root.
Tensar® Engineers perform DCP testing on behalf of the contractor.

HAUL ROADS
Tensar® TriAx® Geogrids are most commonly used to reduce the required aggregate thickness for the unpaved roads constructed to provide access to individual turbine locations. When geogrid is placed at the bottom of an aggregate layer, the aggregate particles partially penetrate through the apertures of the geogrid. This causes confinement of the aggregate and stiffening of the road structure.

By incorporating Tensar TriAx Geogrids, a mechanically stabilized layer is created for the haul/access roads and unpaved working areas. Construction cost savings of up to 50% can be realized in the amount of aggregate required. This results in less excavated material to be taken away from the site, and less aggregate to be imported, placed and compacted.

CRANE PADS
In addition to road structures, geogrids can also be used to reduce the required aggregate thickness at crane platform locations. The locations where turbine components are unloaded and lifted into position often present the greatest challenge to avoiding subgrade failure. In these areas, multiple layers of Tensar TriAx Geogrids can be used to strengthen the aggregate section.

The stiffened aggregate results in an enhanced load distribution beneath the large static and dynamic loads imposed by the lifting equipment. This increases the factor of safety against a bearing capacity failure in the subgrade.

TENSAR PROJECT SUPPORT
Tensar’s team of professional engineers is available to provide free-of-charge support on wind farm projects. The ways that Tensar can bring value include the following:

- Initial assessment of soil conditions at the bidding stage of a project. If a geotechnical report is available, a review of this information can be made prior to submitting a bid. If information on soil quality is limited, Tensar engineers can arrange to visit the site and undertake dynamic cone penetrometer (DCP) or other testing in order to determine the quality of the sub-soil conditions. The goal is to provide our clients with the most accurate estimate of the aggregate thickness required for construction of the access roads and crane platforms.

- During the construction phase of a project, the soil conditions encountered are often significantly different than previously understood — perhaps due to a period of prolonged wet weather. When this occurs, Tensar engineers are available to visit the site and provide an accurate assessment of the requirements for the construction of the access roads and/or crane platforms.

For more information: 800-TENSAR-1
www.TensarCorp.com
UNIQUE FOUNDATION CHALLENGES
Wind turbine structures present unique design challenges, including high applied foundation bearing pressures resulting from significant overturning moments, minimum rotational/dynamic stiffness requirements, and total/differential settlement design tolerances. Geopier® ground improvement provides site-specific solutions to address these challenges.

IMPROVED BEARING PRESSURE
Geopier ground improvement systems provide high internal friction angles and soil improvement to allow significantly improved design bearing pressures of 5 to 10 ksf, depending on soil conditions. The improved bearing pressure provides support for the large foundation edge pressures and may also reduce footing sizes, saving time and money on your project.

SUPERIOR SETTLEMENT CONTROL
Geopier systems are engineered to provide you with a cost-effective approach that meets your specific project requirements. Geopier design-build engineers are experienced in providing superior settlement control for thousands of projects. In addition, site specific modulus testing provides an unmatched level of support and reliability.

FOUNDATION STIFFNESS IMPROVEMENTS
The vertical energy imparted during construction results in piers with exceptional stiffness, delivering documented, proven settlement performance. The stiff Geopier elements improve the composite shear modulus beneath the tower foundation, increasing the rotational and dynamic stiffness to the reinforced soil for reliable foundation support. The Geopier design is specifically tailored to deliver the required rotational/dynamic stiffness values specified by tower designers.

SOLUTIONS FOR ALL SOIL CONDITIONS
Subgrade conditions for wind turbine structures are usually the biggest variable in tower foundation design and construction. Whether your site is challenged by soft clays, loose sandy deposits, or even organic soils, Geopier design engineers have numerous Geopier ground improvement options to choose from to help satisfy your project’s performance needs.

For more information:
800-371-7470
www.Geopier.com
EROSION CHALLENGES
Major construction can leave a project site vulnerable to the effects of wind and rain erosion. On wind farm sites, the winds generated can further erode and strip the land of vegetation, which in turn can lead to sediment deposits and even more soil erosion. North American Green erosion and sediment control solutions can be tailored to your site, eliminating both long and short-term concerns.

TEMPORARY AND PERMANENT EROSION CONTROL
Every site has unique challenges created by soil characteristics, topography, climate and other environmental conditions. North American Green covers them all with our full line of RollMax™ System Rolled Erosion Control Products (RECPs). Whether temporary or permanent protection, short-term or long-term durability, our RECPs deliver a wide variety of features, advantages, and benefits.

• Protect topsoil from wind and water erosion
• Support quick, healthy vegetation growth
• Quickly conform to landscape features for easy installation
• Work on a wide range of applications from mild expanses to slopes and channelized flows

For additional soil adhesion consider HydraMax™ Hydraulic Erosion Control Products (HECPs). All of our HECPs contain a patented blend of straw, reclaimed cotton plant material and tackifiers to ease application, enhance adhesion, retain moisture, and stabilize soil. They also prevent erosion and aid in vegetation establishment on mild to steep slopes by applying seed, soil amendments, and mulch all in one step. HydraMax systems offer a low-cost, low-labor solution that comply with environmental effluent guidelines without treating water with flocculants or advanced water treatment systems.

WE’VE GOT YOU COVERED
North American Green is the industry leader in providing comprehensive erosion control solutions and absolute customer satisfaction. Our products are backed by the most thorough quality assurance practices, and we provide comprehensive design assistance for every system.

For more information:
800-772-2040
www.NAGreen.com