



The size of the turbine blades present unique challenges to the trucking companies hired to transport them to the construction sites. Careful planning is needed to ensure there are no conflicts with the topography or with fixtures along the route.

CASE STUDY



AutoTURN Helps Brazilian Firms Capture the Wind

Ensuring safe passage of massive wind farm equipment on Brazilian roads is job #1 for engineers

By Chris Johns, Transoft Solutions

There is far more happening in Brazil than volleyball games on Copacabana Beach in Rio de Janeiro. Head north for about 2,500 kilometers to the states of Rio Grande do Norte, Paraíba, Ceará and Bahia and one will find one of the true drivers of the most robust economy of the Southern Hemisphere. In these four northeastern states, there are over 600 wind turbines and with steady winds coming off the Atlantic Ocean, the Northern states of Brazil are in prime position to provide megawatts of power for years to come.

Hosting the 2016 Olympic Games and the World Cup of Soccer in the next few years, Brazil definitely has some wind in its sails. And what better to harness that wind than a forest of wind farms?

Located in Natal, Rio Grande do Norte, the consulting engineering firm of Próxima Engenharia has its offices on the doorstep of some of the most active wind turbine projects in the country. They are actively involved in constructing wind energy sites across Brazil and specialize in design work for highways, land developments and wind tower parks. They have also designed wind tower projects in Spain and Poland.

There are wind energy companies from all over the world who are trying to get a foothold in the rapidly expanding Brazilian power generation market. Próxima Engenharia leveraged its location close to the projects and its years of experience to become influential in the marketplace.

"We have designed several wind farms in Rio Grande do Norte, Paraíba, Ceará, Bahia and Rio de Janeiro," says Fernando Cesar de Oliveira Furtado, Chief Executive Officer of Próxima Engenharia. "We feel in the Northeastern states of Brazil have the greatest wind potential in the country. In the southern part of Brazil, we have the state of Rio Grande do Sul with great potential as well."

In the state of Rio Grande do Norte, Próxima Engenharia has participated in approximately 10 wind farm projects with the first one designed in 2008. They have also designed two farms in Paraíba State, two parks in Bahia, and one preliminary wind farm in Rio de Janeiro which is yet to be constructed. Two of their wind farms projects in Rio Grande do Norte include Santa Clara and Macacos 1, which are capable of producing 260 megawatts of electricity annually.

The construction of a wind turbine farm is an engineering challenge for any company involved. Sometimes the sites are easy to reach via a highway and sometimes the route can be challenging. Sites like Santa Clara have 35 kilometers of internal roads connecting all the turbines.

Variables like tight radii turns, elevation changes, narrow roads, low clearances on bridges are combined with special transport considerations, including the number of axles, the distance between the axles and wheelbase and the overall vehicle width. Fernando Cesar Furtado began researching suitable software solutions and discovered AutoTURN could handle all the variables.

"I learned about AutoTURN in 2010 by searching the Internet," says Mr. Furtado. "Soon after, we made contact to purchase it. It really helps us by facilitating the geometric design (of the roadway) in plan view and its profile, especially for large compositions.

AutoTURN allowed Próxima Engenharia's engineers to evaluate the swept path envelopes of both the vehicle body and the cargo on specific transportation routes, potentially preventing damage to the load or surrounding structures.

Within the vehicle libraries of AutoTURN are 6 specialized vehicle configurations allowing the creation and simulation of independent rear-

steering systems critical to the maneuvers required for these projects. These include a 19-axle heavy hauler trailer, a Wind tower trailer (or Schnabel trailer), a Wind blade trailer, a Beam transporter I and II and a Booster trailer.

There are decades of research behind standard vehicle swept paths and the proprietary algorithms built-into AutoTURN, so trucking companies who need to move beams, turbines and other wind energy equipment can trust its reliability. In speaking with representatives of the North American trucking industry, Transoft has learned the challenges they face and are building their requirements into the latest versions of the software. Transoft has also collaborated with Vestas and Tecsis, one of the world's leading builders of wind energy equipment.

In February 2012 a series of driving tests were performed in a Vestas works yard in Colorado. A driving course was built to replicate the critical roadway geometry of the planned access road for a complex terrain in a future project. GPS coordinates from key points on the tractor, trailer and loaded blade were recorded. Using AutoTURN and AutoCAD® software, the swept path of the simulated vehicle matched the swept path of the field test vehicle accurately, with variances consistently less than 30 centimeters.

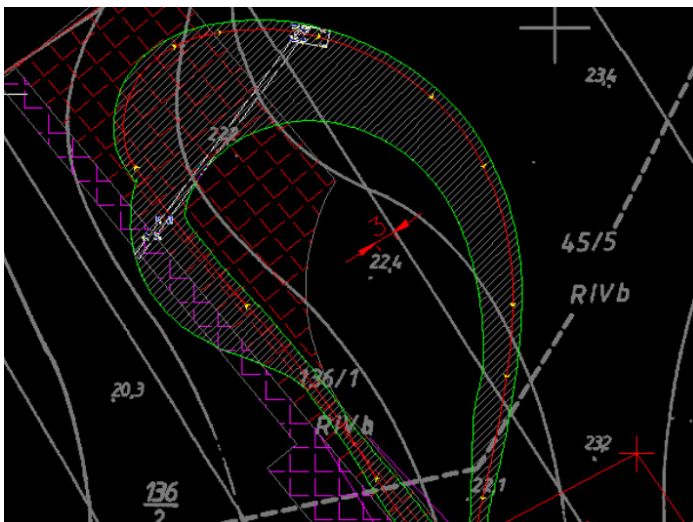
"AutoTURN was born from the Master's thesis of our CEO, Milton Carrasco," says Steven Chan, Transoft Solutions' Senior Product Engineer. "From the very beginning, our focus has been on ensuring that our tool accurately simulates vehicle paths. The result from the Wind Transport field test gives us confidence to stand by our product."

Three hundred and sixty degree turns and figure-eight maneuvers were also performed during the field test to determine the mechanical limitations of the vehicle. These properties were entered into the AutoTURN vehicle model to ensure that simulations were realistic and would not exceed the mechanical limits of the vehicle.

Especially in the wind energy sector, with large and expensive parts over 100 feet in length moving along the highway, it pays to know in advance how they're going to get to their destination. In North America, there is a movement towards standardizing some of the industry's policies and procedures about transporting OSOW (over size, over weight) equipment. There is also a strong belief that technology can go a long way towards making special transportation vehicles safer and making the trips more economical for all interested parties.

In March 2013, a Wind Energy Transportation workshop was held in Portland, OR, where trucking companies and engineering staff from Transoft Solutions met to discuss the use of vehicle swept path software like AutoTURN to plan transport routes when large equipment was involved. When truck drivers can see exactly how their truck and trailer will behave during turning maneuvers, they have greater confidence the route can be traversed safely.

In Brazil, some of the wind farm locations are quite remote and the roads



Once the variables were entered into AutoTURN, engineers from Próxima Engenharia evaluated the vehicle swept path and the in-swing/outswing of the turbines and blades on the route to wind farm sites.

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Fernando Cesar de Oliveira Furtado,
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aren't always perfect ribbons of smooth asphalt. In Northeast Brazil, many of the roads are made of sand dune soil and the majority of wind farms are in the coastal regions. Some of the bridges the special transport trucks have to traverse are only rated for loads up to 36 tons and specialized equipment like the nacelles weigh much more. The truck drivers also have to deal with oncoming traffic and navigating narrow roads.

"In the coastal region, the wind farms are near federal or state highways," says Mr. Furtado. "In the mountains, there is a greater shortage of major roads, so there are situations where we need to build access roads of 10 to 15 kilometers in length." Alegria 1, located on the sand dunes of Guamaré was easy to get to while the Santa Clara wind farm, near the town of Parazinho was just over 11 kilometers off a main road.

He continued, "Our roads do not have enough lane width, and our highway interchanges often aren't designed for such large combinations as the truck and trailer. These combinations need special permission to travel and also need leader cars to facilitate efficient movement throughout the trajectory of the turns. In the beginning, most of the difficulties encountered were in designing internal accesses inside the farms, especially areas of maneuvers. But in these cases we relied on AutoTURN heavily in order to facilitate these projects," said Mr. Furtado.

Companies like Vestas and Tecsis are responding to the global demand for wind energy equipment by building larger nacelles and turbines. Towers that started out at 75 meters in height and featured 0.9 megawatt potency turbines are now considerably bigger. "Everything depends on the type, height, and power of the turbines," said Mr. Furtado. "Today, we work with towers up to 120-meter tall, and turbines with 3 megawatt potency,"

Demonstrating the company's global reach, Próxima Engenharia was called in to help plan the route to a difficult wind farm site in Poland.

"In the specific case of the project in Poland, there was a question regarding the viability of the wind farm project by the Spanish construction company, because (the site) was located on top of a mountain," said Mr. Furtado. "So we made an (AutoTURN) simulation for them with a composition that had the steerable rear wheels. We proved that it was possible for the trucks to reach the site and have room to maneuver around for returning."

Successful field tests and public consultations are just part of the commitment Transoft Solutions has made to being a thought leader in the special transport sector. Information gathered through all channels is added to the development stream for future versions of AutoTURN.

"Through our discussions with consultants like Próxima Engenharia, DOTs and trucking companies, we've seen the complexity involved in many of these special transport projects," said Transoft's Steven Chan. "Modeling the vehicle swept path accurately is important to ensure designers can plan safe and efficient routes for the super loads. It's no fluke AutoTURN performs brilliantly. Our on-going investment in research and development to support the industry puts Transoft on solid footing now and for the future." ■