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Groundbreaking Foundation Deployed on Va. Lookout Tower

By Bruce Buckley

The Nautilus Observation Tower in Virginia Beach, Va., is an 80-ft-wide steel structure modeled after similar designs in Europe that is the first of its kind built in the U.S.
Photo courtesy Outdoor Venture Group

A novel foundation system has taken root on a tower project in Virginia Beach. The system, created by Austrian-firm Spinnanker, mimics the roots of trees to create a stable foundation with relatively low-impact on the site compared with conventional concrete foundations. The Spinnanker system is being installed for the first time in the U.S. on the Nautilus Lookout Tower at the Owl Creek Landing project.

Foundation work began in January, and the tower is scheduled to open in time for Memorial Day weekend.

The observation tower project was conceived by Outdoor Venture Group, an owner, operator and constructor of adventure parks with features such as ropes courses, climbing areas and platforms in trees. Outdoor Venture Group, which owns and operates the Adventure Park at Virginia Aquarium, had long envisioned creating a new attraction on an adjacent 38-acre site. Initially, the company considered building a tower that could be used for ziplines, but the company decided to go a different direction, says Bahman Azarm, founder and chief executive of Outdoor Venture Group.

“People like the idea of jump towers [for ziplines], but a lot of people are just too scared,” he says. “I did quite a few tours around Europe to determine what kind of a product would work well, and I found that in Europe they started building what they call observation towers about a decade ago. People were essentially going to these outdoor centers where they had these towers with incredible views. It was an experience that anyone could enjoy.”

Set on a heavily wooded site on the shores of Virginia Beach’s Owl Creek, the natural site presented significant challenges. The team needed an ecologically responsible solution that caused minimal disruption to an environmentally sensitive area. Additionally, site access was restricted to a single pedestrian bridge with a 1-ton capacity, so heavy equipment and large pieces of materials could not be used. The team determined early on that traditional concrete foundations would not be a viable option, which led the team to consider the Spinnanker system, Azarm says.

A Spinnanker crew did onsite tests, threading steel rods into a circular base, similar to ones used in the lookout tower’s foundation.

Rooted With Rods

The basis of the foundation system uses a circular steel base plate with 12 threaded holes. Threaded double-galvanized steel rods—up to 12 meters long with a diameter of ¾ in.—are screwed through the bases and into the ground. The threaded holes in each base are designed at various angles, so when the rods are screwed into the ground, they spread out in a crisscross pattern like the roots of a tree.

Peter Okonek, CEO of Spinnanker, says the system can be used in a wide variety of soil conditions. The rods have some flexibility, so if they encounter rocks during installation, they may shift direction, just as a tree root would.

“Based on our calculations, with each slight bend in the rod, we increase the load-bearing capacity,” he says.

He says the rods can also pierce softer rock types and, under certain conditions, could act like a rock nail.

The Spinnanker system has been used in Europe for more than a decade, primarily for applications such as guy wires on utility towers. However, Okonek says the company has recently expanded its capabilities to include larger structures. For the Nautilus Lookout Tower, the foundations would need to support a 115-ft-tall, 80-ft-wide steel structure. The tower design features a 7-ft-wide spiral pathway, constructed with open steel deck, that ascends the tower in a circular pattern at a slope of up to 5 degrees. The tower also features steel staircases and railings.

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> **— Peter Okonek, CEO, Spinnanker**

The Spinnanker anchor system was designed with the capacity to withstand 150 tons of force across 12 anchor points. At each anchor point, the team used a series of precast concrete modules that each held four Spinnanker anchors. As a modular solution, crews install as many concrete sections as needed at each anchor points. For the Nautilus Lookout Tower, three modules were used at each interior point and two at the exterior points.

Soil testing and analysis showed that each rod should be driven roughly 25 ft deep to meet capacity requirements. Given that the site is located one mile from the Atlantic Ocean, the structure also needed to be able to withstand hurricane force winds of up to 170 miles per hour. Ahead of construction, Spinnanker sent a team to install an anchor and conduct a pull test.

Okonek says Spinnanker also designs its anchors to account for potential soil erosion or other issues over time. "We can always lose up to 10% of the installed rod (capacity) and meet safety," he says. "If we have twelve 6-meter rods, that makes 72 meters of installed rod. So, we can lose seven meters in total and still the anchor gives you the same results."

Although the system has never been used in the U.S., its track record in Europe impressed Danny Speight, president of Speight, Marshall and Francis of Virginia Beach, which served as the structural engineer. He says the concept makes sense in situations where traditional concrete footings can't be placed.

"When you think about it, these act as precast footings that are tied together," Speight says. "It's very out-of-the-box thinking, but that's what was required for this project."

A 7-ft-wide spiral pathway leads to an open deck, elevating visitors to a bird's-eye view of the natural setting.
Image courtesy Outdoor Venture Group

Rapid Installation

To install each anchor point, topsoil was excavated several inches deep at each point, then filled with gravel. The modules were then placed using a skid steer, leveled and tied together. A U.S.-based crew trained in the system installed the rods using modified high-power handheld drills. A total of roughly 1,900 rods were installed over a two-week period in January.

Okonek claims that one of the main advantages of the system is that it is "immediately" load bearing. "We have a lot of construction [projects] where we do the foundations in the morning and in the afternoon, [a construction crew] comes back with a crane to set [structure] on it."

While the Spinnanker system helped address many of the project's challenges, site access remained an issue throughout the project. Given the limited 1-ton capacity of the pedestrian bridge, which was the only access to the site, all materials had to be limited in size and weight. The entire tower and foundation system had to be prefabricated with no cutting on site. Structural elements were limited to 12 ft in length and spliced together as needed. The project laydown area was in a parking lot nearly a half mile away.

"It's very out-of-the-box thinking, but that's what was required for this project."
—Danny Speight, Speight, Marshall and Francis

"It took a week of just sorting everything out," Azarm says, "like all the nuts and bolts and pipe and where they go and where everything fit and so on."

He says that, at first, the team thought it would need to use a skid steer to transport all materials. Ultimately, the team was able to use carts to pull most of the materials onto the site.

Once the foundations were in place and materials were sorted, crews of up to eight people were able to construct the tower in four weeks. With the structure now complete, the team is putting the finishing touches on the tower and tying it into the existing

Adventure Park. When it opens on Memorial Day weekend, visitors will have the option to walk from the tower across rope bridges that pass through the tree canopy and connect to other areas of the park.

The precast foundation technology deployed is modular, so multiple elements can be tied together to create anchor points.
Image courtesy Outdoor Venture Group

Future Applications

With work wrapping up, Azarm says he was impressed with the speed and simplicity of the Spinnanker system. “It was so easy for these people to design this for us, which was a surprise to me,” he says. “Now that this structure is up, it really gives confidence in what kinds of structures are possible.”

Okonek says the company is about to release a more robust system that uses a machine capable of higher torque that can drill rods that are up to 1 ½ in. in diameter, twice the diameter of the current rods. He claims that the more robust system would be able to handle significantly higher loads and open up opportunities.

“For example, we get dozens of requests for temporary bridges after a disaster,” he says. “With this new device, we can build much bigger foundations.”

Okonek says that about 25% of Spinnanker’s business is temporary structures. In addition to being able to quickly install the system with no need to cure concrete foundations, the system also can be removed with minimal impact, he says.

“The rods are simply drilled out and nothing remains,” he says.

For now, Okonek is cautiously optimistic that Spinnanker could be widely accepted in the U.S., recognizing that it could take time for clients to pilot its system and prove its concept to the domestic market. “The Nautilus Tower is very important for us,” he says.