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Power poles

Pultruded products replace wood and concrete

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FIBERGLASS — Coming Soon to a Power Line Near You!

Up to 16 SE28 80' poles can be shipped on a single truck.

A light duty helicopter can set poles in difficult terrain.

SE28 poles are easy to field assemble using conventional tools.

The benefits of fiber reinforced polymer (FRP) composites have been known to the electric utility industry for years. Now those same benefits are available in a transmission or distribution pole!

Newmark International, Inc., in alliance with Strongwell, the world's leading manufacturer of fiber reinforced polymer (FRP) pultruded composites, offers the patented SE28 direct embedment FRP pole to complement its full line of tubular steel, spun cast concrete and spun cast FRP poles.

Manufactured using the pultrusion process, the SE28 pole is a fusion of expert engineering, top quality raw materials and a unique assembly and fabrication process. The resulting product is particularly ideal for use in difficult-to-access terrain, corrosive or wet soils and in fast track projects where quick delivery and installation are necessary.

Its lightweight characteristic makes the SE28 pole safer and much easier to handle and transport. The SE28 is also safer to install around energized powerlines because of its low conductivity properties.

Superior strength, reliability, safety and performance in even the most challenging environments — what more can you ask for in a transmission or distribution pole? Expect nothing less of the SE28 pole from Newmark.

Benefits of SE28 Poles:

- Strong
- Extremely Lightweight
- Class 1 Ground Line Moment Capacity
- Easy to Install
- Low in Maintenance
- Accepts Standard Pole Line Hardware
- Resistant to Insects and Birds
- Multiple Safety Benefits - Handling, Transporting,Installing, Low Conductivity Values
- Corrosion, UV and Water Resistant
- Non-toxic; Reusable
- Can be customized for sports lighting and other applications

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Pultruded poles carry power

Pultruded profiles have been used in electric distribution and lighting applications for over a decade. Their resistance to corrosion and decay, dielectric properties, and high strength-to-weight ratio make them ideal replacements for wood, steel and concrete poles. Recently, FRP poles as long as 24 m have emerged for transmission line applications, which require taller, stronger structures. Richard Stewart reports.

Composite poles do not lose strength as they age, like wood, and require very little maintenance. (Picture courtesy of Strongwell.)

The United States has an aging power distribution system consisting primarily of wood poles requiring replacement at a faster pace each year. Wood is susceptible to insects, woodpeckers, rot and fire. Concerns about toxic chemical preservatives used to treat them and the increasing cost of poles long enough for transmission applications contribute to a growing interest in alternative structural materials. Fibre reinforced plastics (FRP) have made some inroads as more and more utility companies try them and warm to their advantages.

About 21 million miles of electric utility lines carry power in the US, averaging 28.5 poles per mile.

About 21 million miles of electric utility lines carry power in the US, averaging 28.5 poles per mile. Investor-owned utilities own nearly 512 million poles, according to the Utility Data Institute. Another 83 million poles are owned by cooperatives. Poles for power transmission, distribution and lighting represent a billion dollar business in the USA.

Various processes are used in the manufacture of these poles, including pultrusion, filament winding and spin

casting. For the taller, stronger Class 1 and 2 poles required to support heavy transmission and sub-transmission lines, pultrusion offers the most economical FRP solution.

Going longer

Strongwell Corp of Bristol, Virginia, fabricates a Class 1-equivalent structure, typically in lengths of 20 m to 24.4 m, using pultruded panels and a patented method of assembling them. The company is hoping to develop a pole as long as 36.5 m. Designated as the Strongwell SE28, to indicate a tip load capacity of 1275 kg (2812 lbs), the pole was an offshoot of a lattice-frame tower constructed of pultruded components.

The tower, one-third the weight of an equivalent steel tower, was developed by Ebert Composites Company of Chula Vista, California. Strongwell-Ebert LLC, a joint venture formed to manufacture and market the products, was subsequently purchased by Strongwell. Three of the 25-m-tall towers, assembled without bolts, using 'snap-and-build' technology, have been undergoing testing by Southern California Edison (SCE) since 1996. They have resisted ultraviolet (UV) light radiation, weather and salt damage without the periodic washing required by steel towers, reports SCE, which expects them to last 80 years, twice as long as steel or wood towers.

A similar interlocking assembly is used to join panels of the multi-sided SE28 structure, explains David W. Johnson, chairman and chief executive officer of Ebert, whose company acquired the patent for the pole's design and construction. The SE28 is fabricated from three pultruded 0.5 m wide panels, which incorporate uniformly spaced reinforcing ribs on one side. In-line machining of the pultruded profiles is performed using five-axis computer numerical control (CNC) equipment as the parts exit the die.

Each panel is cut on a diagonal, producing two equal trapezoidal slats, which are turned end to end, ribs facing inward, and snapped together. An adhesive is applied to the joints prior to assembly for added strength. The struct-ure tapers uniformly from 0.56 m at the butt to 0.25 m at the tip. Once capped, urethane foam is injected into the hollow interior to help keep the pole from ovalizing or deforming under a high load.

Reinforcements

Strongwell uses a vinyl ester resin system with UV inhibitors and other additives to pultrude the SE28 panels. Reinforce-ments include continuous E-glass rovings, continuous strand mat, and stitched, multi-directional cloth for strength along both the longitudinal and transverse axis. A synthetic surfacing veil and a coating of UV-inhibiting polyurethane paint add further protection. Strongwell ships a complete pole manufactured to customer specifications.

Early composite crossarms and other FRP components used by some utility companies during the 1960s and '70s exhibited UV degradation and fibre blooming. The resin would erode, leaving fibres exposed on the surface. Technology advances have eliminated that problem.

FRP poles are easier to handle, using only a utility line truck rather than a heavy crane required to move and set concrete poles into place.

Designed to be a direct replacement for wood poles, the SE28 exhibits a higher strength-to-weight ratio than steel, wood or concrete transmission poles and weighs substantially less. The SE28, at about 600 kg, is a third the weight of an equivalent wood pole, which weighs about 1815 kg. Steel weighs 70% more than the SE28 at 1000 kg, while concrete, at 5900 kg weighs ten times

Lightweight SE28 poles are ideal for projects requiring helicopter installation. (Picture courtesy of Strongwell.)

The lightweight pultruded pole from Powertrusion facilitates installation in rough terrain. (Picture courtesy of Powertrusion International.)

FRP poles are easier to handle. (Picture courtesy of Strongwell.)

more. The Strongwell pole easily passed a cantilever strength test required for Class 1 structures, reports John D. 'Spike' Tickle II, head of Strongwell's SE28 programme.

Utility company linemen who have installed and worked on the poles like them because of their comparative lightness, he relates. The FRP poles are easier to handle, using only a utility line truck rather than a heavy crane required to move and set concrete poles into place. Linemen feel safer when working on the poles due to their low-conductive properties, allowing them to be safely erected near energized lines and existing structures, notes Tickle.

Linemen can hand carry composite poles into back lots, avoiding the need for heavy equipment in the installation. (Picture courtesy of Powertrusion International.)

Shakespeare offers pultruded square poles and filament wound round poles for utility applications. (Picture courtesy of Shakespeare Composites & Electronics.)

Good results

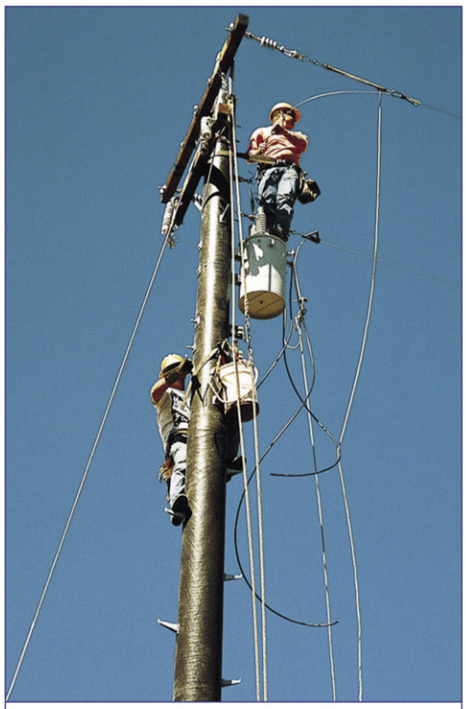
The Bristol Tennessee Electric System (BTES), serving 31 000 customers, installed 144 Strongwell SE28 poles on two transmission lines in 2000. Since then, 58 more have been added. BTES conducted its own tests on the poles for safety, durability and practicality. The Strongwell pole fares well in BTES's life-cycle-cost analysis, which is based on a service life of 50 years.

Unlike wood poles, these composite poles will not start losing strength as they age.

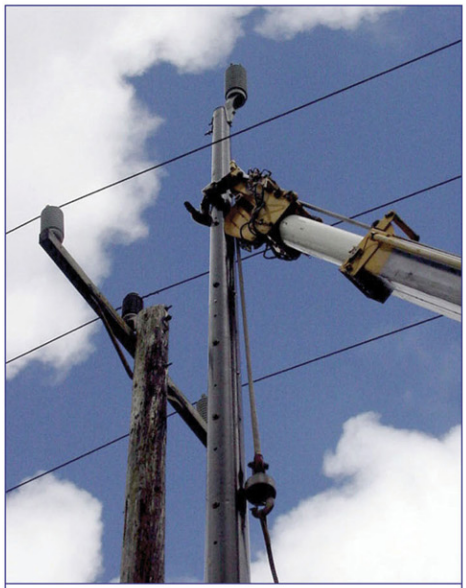
"Unlike wood poles, these composite poles will not start losing strength as they age, and maintenance on them will be almost nothing," says Dr R. Michael Browder, general manager of BTES and past chairman of the American Public Power Association.

He likes the increased insulation level of the composite poles, which provides protection against lightning strikes. With concrete poles, the utility has experienced lightning-induced flashover during storms, producing surges that can damage household appliances. Steel reinforcing bars (rebar) is used in the manufacture of concrete poles.

"In an vehicle accident or weather-related incident, we think less damage will occur to our lines because of the strength and flexibility of the fibreglass poles," comments Browder, noting that the poles are flexible enough to withstand heavy wind loading.



Linemen like the added level of safety provided by composite poles. (Picture courtesy of Shakespeare Composites & Electronics.)



Newmark produces this spun composite pole in lengths up to 15.2 m for distribution and street lighting. (Picture courtesy of Newmark International.)

"If one of the Strongwell poles were to snap off, the wires would likely hold it up until we can replace it. With a wood pole, that is not likely. And a concrete pole would definitely bring down other poles or break wires and insulators," he adds.

An SE28 pole damaged in a vehicle accident was repaired on site, making it stronger than before. The utility has not been able to repair other types of poles, relates Browder.

Strongwell and Newmark International Inc of Birmingham, Alabama, a leading manufacturer and marketer of steel, spun concrete and FRP poles to electric utilities, recently formed a strategic alliance around the SE28 pole. Newmark intends to demonstrate the benefits of composite materials as they apply to power transmission structures, says Wesley Oliphant, a Newmark vice president. "We're very positive that utilities like the characteristics of composite poles. Not only is the product non-corrosive, which is a problem for steel, but low conductive characteristics add safety and reliability from flashover related outages."

The Strongwell pole is slightly more expensive than equivalent poles of wood, steel or concrete, relates Oliphant, but Newmark feels that the price of FRP poles will drop as volumes increase. "Typically, it's more of an application issue than a pricing issue at this point," he says. "In many applications the weight of the poles is a major factor due to the terrain or remoteness of the location."

Tickle observes that the price differential between the SE28 poles and others shrinks when the total installed cost of poles is considered. "We get a real advantage when speed of delivery and construction of a transmission line is considered," he says. A flatbed truck can haul 16 24.4 m Strongwell poles to a site, which a crew can unload in an hour. Only two to four concrete poles can be carried on a truck, and a heavy crane is required to unload and set them. "That all works into the overall cost of installation and makes ours more cost competitive," adds Tickle.

The price differential between the SE28 composite poles and others shrinks when the total installed cost of the poles is considered. (Picture courtesy of Strongwell.)

Powertrusion poles

Powertrusion International Inc of Scottsdale, Arizona manufactures straight, hollow pultruded poles for the distribution market, offering products up to 13.7 m for Class 3, 4 and 5 applications. A 12.2 m Class 4 pole weighs 190 kg, compared with an equivalent wood pole at 454 kg. A 15.2 m pole is on the drawing boards, according to Chuck Stanford, Jr., treasurer and CFO. Patents cover the design and construction of the poles, which are octagonal in shape. The flat surfaces afford easy mounting of hardware, and the geometry permits high glass loading of the corners for added strength, he notes.

Powertrusion is a subsidiary of Unisource, which also owns Tucson Electric Power Company (TEPC), Arizona's second largest electric utility company. TEPC spent two years evaluating various poles before selecting Powertrusion products for much of its new line construction and pole replacement, reports Stanford. The study evaluated safety factors, cost versus benefits, environmental impact and ease of use. Line crews like the non-conductive nature of the composite material as well as the ability to hand carry the FRP poles into back-lot installations, he continues.

The current and long-term value of using composite poles is a major selling point.

"The current and long-term value of using composite poles is a major selling

point," observes Stanford. "The cost savings to utilities from the avoidance of future environmental liabilities arising from the use of wood poles and the related toxic chemicals could greatly multiply the savings."

Powertrusion recently expanded its sales force in response to increasing demand for its products from utilities and communications companies across the US, particularly in the east, notes Stanford.

Other processes

Newmark makes FRP poles up to 15.2 m for street lighting and electrical utility distribution applications using the centrifugal casting process. Glass cloth is rolled onto a mandrel, which spins inside a mould, causing the sheets of material to fly off and form a tapered, hollow tube. Resin is injected inside the mould, and centrifugal force causes the resin to saturate the cloth. It produces a very dense, compacted composite laminate with excellent resin penetration, explains Oliphant. It also builds up a resin layer on the outside for a smooth surface and good UV and mechanical protection to the underlying fibres. The length of the pole is limited to the length of the mould and mandrel. Special American Association of State Highway and Transportation Officials (AASHTO) approved break-away designs are available for roadway lighting applications.

Shakespeare Composites and Electronics Division, based in Newberry, South Carolina, manufactures poles for utility applications and lighting poles under the Tuff-Pole™ brand. Both tapered round and square FRP poles are offered, including Class 1-equivalent poles of up to 19.8 m long. The round poles, up to 21.3 m long, are filament wound, while square poles are straight, single-piece pultrusions up to 9.1 m long.

Shakespeare also manufactures Lewtex® crossarms, transformer supports, insulators and other utility components using the pultrusion process. One customer, Montana Power Company, has installed the composite poles in steep, mountainous areas, where their light weight enabled the utility to install them using a smaller, less-expensive helicopter than needed for heavier poles.

Shakespeare also produces Breakaway Poles, featuring a patented joining technique, designed to break off and fly over top of a vehicle that strikes them for improved safety.

In promoting FRP poles to utility companies and other potential customers, manufacturers emphasize the total life cycle costs of their products, which include low cost of delivery and installation, long life, low maintenance, and safety advantages over competing products. The cost differential between the initial price of composite poles and other materials is gradually shrinking, giving the composite poles an even greater advantage. ■

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Strongwell Corp; tel: +1-276-645-8000; fax: +1-276-645-8132; website: www.strongwell.com.

Strongwell pole beats sledgehammer

Strongwell recently invited representatives of two large utilities, American Electric Power (AEP) and Tennessee Valley Authority (TVA), to tour its pultrusion plant and witness a demonstration of the strength and durability of the composite transmission pole. A standard cantilever pole test was conducted on the SE28 as well as on an equivalent 24.4 m Class 1 wood pole supplied by AEP for comparison. The SE28 was also subjected to multiple sledge hammer blows by the visitors, who were curious about how much abuse it could take at their hands.

The tour and tests were part of the utilities' evaluation program of the composite pole. At the start of the demonstration, the wood pole was placed in the test crib and force was applied. "The pole should have gone to 4500 lbs, which is a safety factory of four," recalls Spike Tickle, head of Strongwell's SE28 programme. "But it exploded into three pieces at about 3700 lbs." Next, the Strongwell pole was manoeuvred into the crib for the same test. "Everybody wanted to see it break, but we couldn't break it," Tickle says, noting that the test cable snapped at 4700 lbs.

Everybody wanted to see it break, but we couldn't break it.

Archie Pugh, an AEP transmission line engineer, and several others in the group decided they would have some fun by seeing how much damage they could inflict on the pole. Taking turns wielding a heavy sledge hammer, the men pounded away at it. "The material was quite resistant to the blows. The hammer would bounce off the pole without damaging it," he says.

The activity soon turned into a competition among the determined crew. "It took a lot of banging away at the pole before it showed some signs of slight indentation. In the end, the pole probably won," quips Pugh. "I think everyone was pleased with its performance in the tests. We gained a lot of insight with fibre reinforced products."