Existing Lighting and Utility Poles Are Not Fit for 5G, But Composite Poles Are

By David Kilmer

Introduction

This report compares the most common types of existing lighting and utility poles, considers their susceptibilities and examines what type of pole is best suited to support the rapidly growing need for 5G and IoT equipment, as well as other burgeoning industries such as lighting, solar, EV charging, transportation and security.

There are currently 1.6 billion poles in use globally, and just over 20 percent of those are street light and parking lot poles.[1] Of the 320 million street lighting poles across the globe, 25 percent are in Asia, 20 percent are in Europe and North America and 10 percent are in South America.[2] In North America, there are more than 200 million utility distribution poles, and 2-4 million are replaced annually.[3]

These poles are currently used primarily for the distribution of street lighting and electricity; however, the ongoing buildout of fifth-generation (5G) mobile communication infrastructure, platforms and devices will require massive numbers of transmitters and receivers throughout networks and platforms. This has begun to include new equipment installations on existing lighting and utility poles to distribute 5G service into businesses and homes.[4]

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[1] https://www.prnewswire.com/news-releases/global-street-lights--parking-poles-market-2017-2025-country-and-pole-type-steelaluminium-concrete-wood-composite-for-new-installations-and-replacements-300777697.html

[2] https://www.adlittle.com/cn-en/insights/report/evolution-street-lighting-market

[3] Distribution | American Galvanizers Association

[4] War on Woodpeckers: Utility Poles and the 1918 Migratory Bird Treaty Act

According to Ericsson, 5G is expected to reach a penetration of 90% in North America in 2027. Massive IoT technologies such as NB-IoT and Cat-M increased by almost 80% during 2021, reaching close to 330 million connections. The number of IoT devices connected by these technologies is expected to overtake 2G/3G in 2023.[5]

The most common three materials used to make existing utility and lighting poles are wood, concrete, and steel.[6] The issue, however, is that these poles are not necessarily designed or rated for extra equipment such as 5G antennas, and industry experts are concerned about the potential consequences.[7]

"The legal issue of pole attachments is being widely discussed in the industry, but the structural integrity of the poles is another issue that needs to be considered," said Pete Chase, CEO of EasyStreet Systems, which manufactures a composite pole to support small cells and other equipment.

"For stand alone structures like an individual small cell or IoT structure, the combined square feet of the objects and equipment mounted on the tower that can catch wind are the driving factor for structural integrity," says Kent Harrison, CTO for EasyStreet Systems, and former VP for AT&T Mobility. " On poles that have power, cable and fiber lines running from pole to pole, weight itself plays a larger role in the integrity of the pole."[8]

The rapid rise of 5G is causing consternation among electric cooperatives and other utilities, whose distribution poles will likely bear part of the burden of the expanded infrastructure, writes Derrill Holly, as published by the National Rural Electric Cooperative Association.[9]

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[5] 5G to reach a penetration of 90% in North America in 2027: Ericsson

[6] Types of Utility Poles- The Ultimate Guide

[7] Making Way for 5G - America's Electric Cooperatives

[8] https://easystreetsystems.com/the-team

[9] https://www.electric.coop/5g-broadband-is-coming

"Any foreign attachment that departs from the design and construction of the original overhead line may introduce significant engineering, safety, and reliability issues which must be considered," said Robert Harris, senior principal engineer for NRECA's Business and Technology Strategies department. "Co-ops and other utility providers are concerned about the added weight on the poles, and how that will affect their stability and integrity during wind and ice storms, or prolonged rain events," Harris added.

"The 5G attachment that will be placed in the communications space on a pole is being sold as pizza-box-sized equipment," said Tammy Embrey, an NRECA senior legislative adviser. "The reality is that when you factor in the total amount of equipment that will be added, this could add 300 to 400 pounds of weight to a pole."[10]

Additional equipment includes control units, auxiliary backup batteries and other support equipment housed in metal or composite refrigerator-sized boxes.

"This equipment is fundamentally different from any other type of attachment we've ever put on our poles," said Embrey. "There's more weight, wind and ice loading involved, there are reliability and worker safety issues, and most designs include a communications conduit running the length of the pole."

Servicing that communications equipment is also a major concern, said NRECA's Harris. "Some of that equipment could be near or above energized lines, so training, safety and potential service reliability issues need to be considered."

Analysis

The need for 5G support comes at a time when existing wood, metal and concrete poles are also showing degradation and destruction from aging, road and ocean salt, weather, wind, animals and other environmental impacts.

[10] https://www.electric.coop/5g-broadband-is-coming

“The transition to underground, composite, or hybrid cannot happen fast enough. It is a fool's errand to build a 21st century network on a 19th century foundation,” says Jim McKenna, CEO of Redzone Wireless.[11]

Some of the most publicized failures of metal poles have been in the city of Chicago. Maya Kirk, 47, suffered serious injuries after a light pole fell over and struck her as she was walking in downtown Chicago on Nov. 21, 2019.

“Ms. Kirk was fortunate she wasn’t killed when the pole toppled over. Corroding light poles hidden under decorative bases in the city of Chicago are hidden timebombs and the city is aware this problem exists,” said Attorney Michael K. Demetrio.[12]

Kirk was walking with co-workers at 1:30 p.m. on LaSalle St., just south of Lake St., when the pole toppled, striking her and shattering her leg and hip in three places. In addition, she suffered a concussion. The lawsuit, filed in Cook Co. Circuit Court by Corboy & Demetrio, alleges the city was negligent by failing to adequately inspect and maintain the light pole, allowing the support structure to deteriorate. The suit specifically alleges that the city allowed excessive and unsafe levels of water and/or debris to accumulate at the base of the light pole, resulting in a dangerous and defective lack of support.

Of the 330,000 light poles in the city, more than 33,000 poles, or 10 percent, were graded as having some sort of serious issue across all four of the major categories, a CBS data analysis found.

"That's a scary number," said Dr. Sammy Tin, formerly a professor at the Illinois Institute of Technology. "Aging infrastructure, deferred maintenance are tremendous issues – not just in Chicago, but across the country."[13]

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[11] https://www.linkedin.com/in/jim-mckenna-879bb5140/

[12] https://www.corboydemetrio.com/newsroom-news-lawsuit-chicago-falling-city-light-pole

[13] https://www.cbsnews.com/chicago/news/city-was-warned-about-thousands-of-corroding-light-poles-but-failed-to-fix-many-cbs-2-investigation-finds/

Tin, a metallurgist, now heads up the University of Arizona Materials Science and Engineering Department. He's spent years visually examining Chicago's light poles.

He said rust is often a key indicator of a deeper problem with the integrity of the pole. More than 22,000 poles were rated as having a concerning amount of rust, the data shows.

Metal pole failures represent a significant risk to business, according to the inspection experts at Exo Inc., both from a financial standpoint but also the potential liability if personal injury or property damage occurs. Along with the concrete pier foundation, the welded connection where the pole shaft meets the base flange is the most important structural element of the asset. It is also the most susceptible to corrosion and deterioration. Oftentimes, this process happens from the inside out and goes undetected until it is too late.[14]

Spun-cast concrete poles have been used in coastal areas, due to sea air, harsh winds, and boggy ground.[15] Some of the disadvantages of concrete poles are that they cannot be easily modified, are heavy and awkward and can pose a safety risk if they weaken.

There are some 160 to 180 million wood utility poles in service in the US. They are currently the backbone of overhead line construction.[16] On a yearly basis, about 2.5 million wood poles are being replaced because of age, damage and decay.[17]

“Wood utility poles are surprisingly complex structures, and consequences of their collapse or failure are grave,” says structural engineer, Anthony Volonnino, P.E., writing for Robson Forensic.[18]

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[14] https://exoinc.com/blog/what-we-see-steel-light-pole-corrosion

[15] Types of Utility Poles- The Ultimate Guide

[16] Wood Utility Poles and Preservative Choices | Utility Products

[17] https://www.tencom.com/blog/composite-poles-outlast-wood

[18] https://www.robsonforensic.com/articles/utility-pole-failure-expert

Decay in wood poles typically occurs at the ground line and below, resulting in an unseen but common and foreseeable hazard.

Jim McKenna, CEO of Redzone Wireless, has demonstrated the hazards of wood poles breaking near his home in Maine in late fall of 2022. “The damage at the intersection was initiated by a truck that backed into a pole outside of the local convenience store,” McKenna says. “When the pole cracked, it caused the lines to sag, and a separate tractor trailer struck the catenary. The truck driver broke all power and communications lines, including fiber, and it pulled down two other wood poles on the far side of route 131.”

The consequences of a pole failure can be catastrophic, says Robson Forensic. Significant damage and/or injuries can occur when wood poles, weighing upwards of 1,000 pounds, crash to the ground. Electrical shock hazards are created when energized lines and equipment contact the ground or other structures. There are many reasons why utility poles can fail, including: Neglect/oversight/abandonment, decay, natural events (such as a tree falling on a wire), vehicle impact, overload, improper use, alteration or removal of guy wires or their anchors, improper pole setting or erosion,or a combination of the above.

A comparison study by Polesaver shows these weaknesses: In concrete poles, the typical failure mode is corrosion of the reinforcing bars. For steel poles, ground line corrosion is common over time and for wood, ground-line decay and termite attack are the common failure modes.[19] With decay, deterioration is often hidden from sight. Decay typically occurs at the ground line and below, resulting in an unseen but common and foreseeable hazard.[20]

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[19] https://polesaver.com/blog/utility-pole-materials-review-which-is-best/

[20] https://www.robsonforensic.com/articles/utility-pole-failure-expert

“For those of us who make a living in this industry we know this to be true,” McKenna says. “We deal with it every week, week after week. The majority of outages are caused by fiber damage on wood poles. Squirrels are the worst culprits, but also vehicle accidents, storm /wind damage, and construction. Network equipment failures do happen, but they are a distant second. To drive home the point, one night in the fall of 2022, my wife and I awoke to the sound of a splintering wood pole right out in front of our house. There was no car accident, no wind, no ice storm. Just a wood pole that was under too much stress. Thankfully we use wireless internet, and we have a backup generator.” [21]

Conclusion

Weather events are increasingly testing infrastructure, showing providers the need for hardening the system. In 2011, Southern California saw strong winds which swept across counties and knocked over power lines causing major power outages and started a fire in another. In 2012, Hurricane Sandy unleashed devastating floods and winds, knocking down power and transmission lines across the East Coast of the United States leaving more than 8 million customers without power. Since that time, State Public Utilities Commissions (PUCs) have been trying to find alternatives to the wooden pole.[22]

Composite poles are one of those alternatives. They are lightweight, strong and have low conductivity properties. They also resist corrosion, rot, UV rays, water absorption, insects and woodpeckers. Composite poles do not lose strength as they age, so maintenance is minimal. Engineers also appreciate the electrical properties of composite poles and their ability to withstand heavy wind loads and impacts.[23]

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[21] https://www.linkedin.com/feed/update/urn:li:activity:7001513520282402816/

[22] https://www.tencom.com/blog/composite-poles-outlast-wood

[23] Composite Transmission and Distribution Poles: A New Trend | Energy Central

An important attribute of composite poles, as Kent Harrison points out, is the fact that all cabling can be run inside the structure, as opposed to wood or concrete. This is particularly true of EasyStreet's design, Harrison said.[24]

"Yet another advantage of composite poles is the ability to readily adapt mounting locations," Harrison added. "Not everything runs perfectly in the field. Sometimes small changes have to be made and it's simple to drill or cut composite material using regular tools."

Harrison said the most compelling aspect for many customers is the savings in installation costs.

"The biggest savings come from fewer people spending less time per pole, and that translates to a 30-50 percent cost savings," he says. "When you use light duty equipment, those installation costs are further reduced by as much as 70 percent."

Composites have transformed other industries around the globe, and it would appear they are poised to do the same in lighting, utilities and telecommunications.

For the future of above-ground assets, including small cell, 5G and the Internet of Things, composite poles appear to offer the most resilient support structure with the fewest potential weaknesses.

David Kilmer is a researcher and editor for EasyStreet Systems, which provides ultra-lightweight composite poles for 5G/IoT applications. More at easystreetsystems.com

Examples of damage to wood and metal poles shown below

[24] https://easystreetsystems.com/tower-specifications

Serious wood pole damage and failure in Maine in the fall of 2022, which was initiated by a truck that backed into a pole outside of the local convenience store. When the pole cracked, it caused the lines to sag, and a separate tractor trailer struck the catenary. The incident broke all power and communications lines, including fiber, and it pulled down two other wood poles on the other side of the highway.

In a separate incident in the fall of 2022, located outside a residence in Maine, this wood pole failed not from ice, wind, snow or storm, but in clear weather from no apparent cause other than age and overloading stress.

A CBS News investigation discovered that at least 10 percent of the metal light poles in Chicago were dangerously corroded, and failures to this infrastructure have caused severe injuries.

Field technicians from EasyStreet Systems install a composite pole which is non-corroding, ultra-lightweight and strong. Composite poles have low conductivity properties; and resist corrosion, rot, UV rays, water absorption, insects and woodpeckers. In addition, composite poles do not lose strength as they age.

Ultra-lightweight composite poles, seen carried here by a single technician, support these uses and more: 5G and Internet of Things, wind power, solar power, EV charging, lighting, transportation and security.