

Infrastructure Application of Decommissioned Wind Turbine Blades as Energy Transmission Pole

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Figure 1: BladePole as a series of straight run Tangent Poles in a double circuit 230 KV transmission line

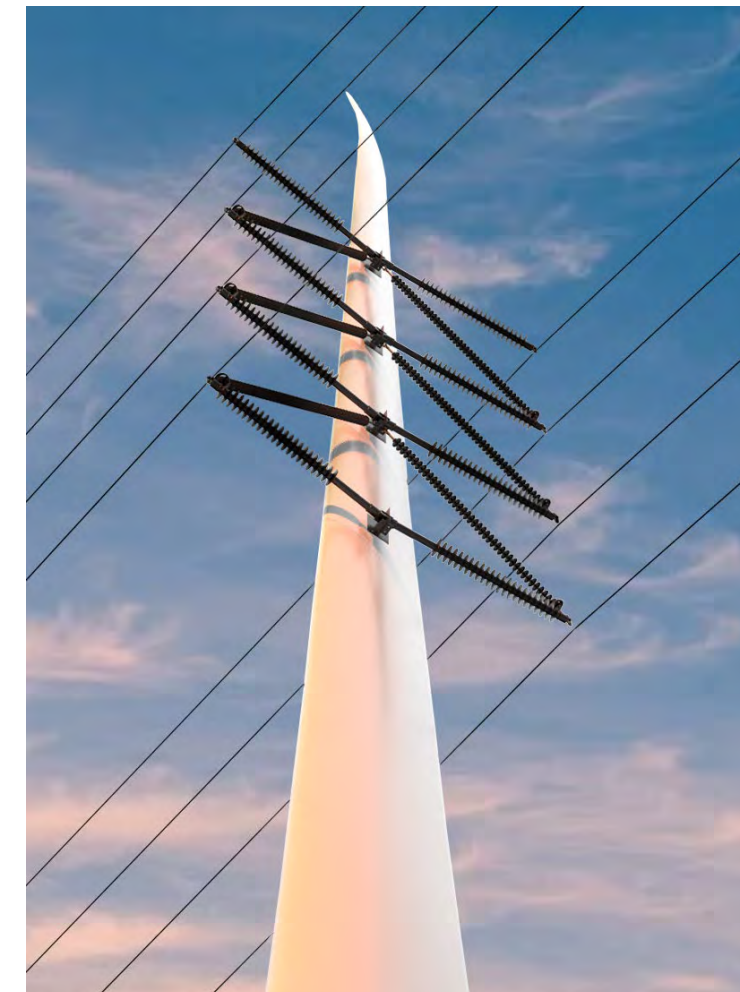


Figure 2: BladePole, Hardware detail

Abstract

Wind energy is one of the cleanest systems in energy production. However, most of high wind speed areas for efficient energy production are typically not located near high density populations. Therefore, the need to expand and strengthen the current energy transmission grid is paramount. Moreover, decommissioned wind turbine blades are starting to be accumulated by the thousands in wind farms across the world. Re-Wind aims to fix both the energy grid and the blade waste problem by repurposing wind blades as energy transmission poles. Our team has designed, tested, and built the first prototype of our patented solution, the BladePole.

Objectives

The objective of the BladePole is reduce blade waste and provide infrastructure for electricity grids. Re-Winds aims at providing the BladePole as a solution by presenting the design and construction with its respective advantages and challenges of implementing a second life for this used material.

Design

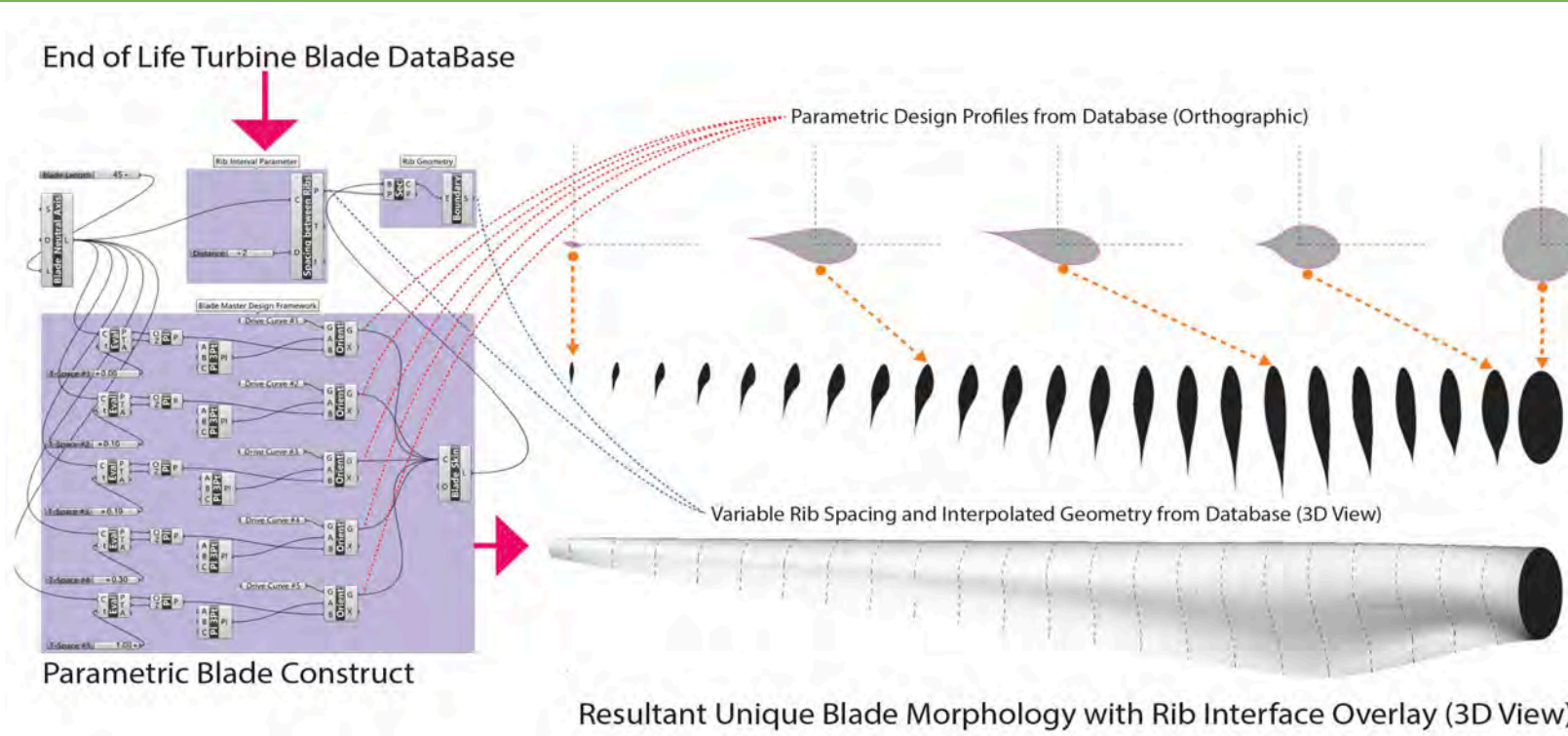


Figure 2: Blade Machine constructing a new model of the blade's Digital Twin as a NURBS surface

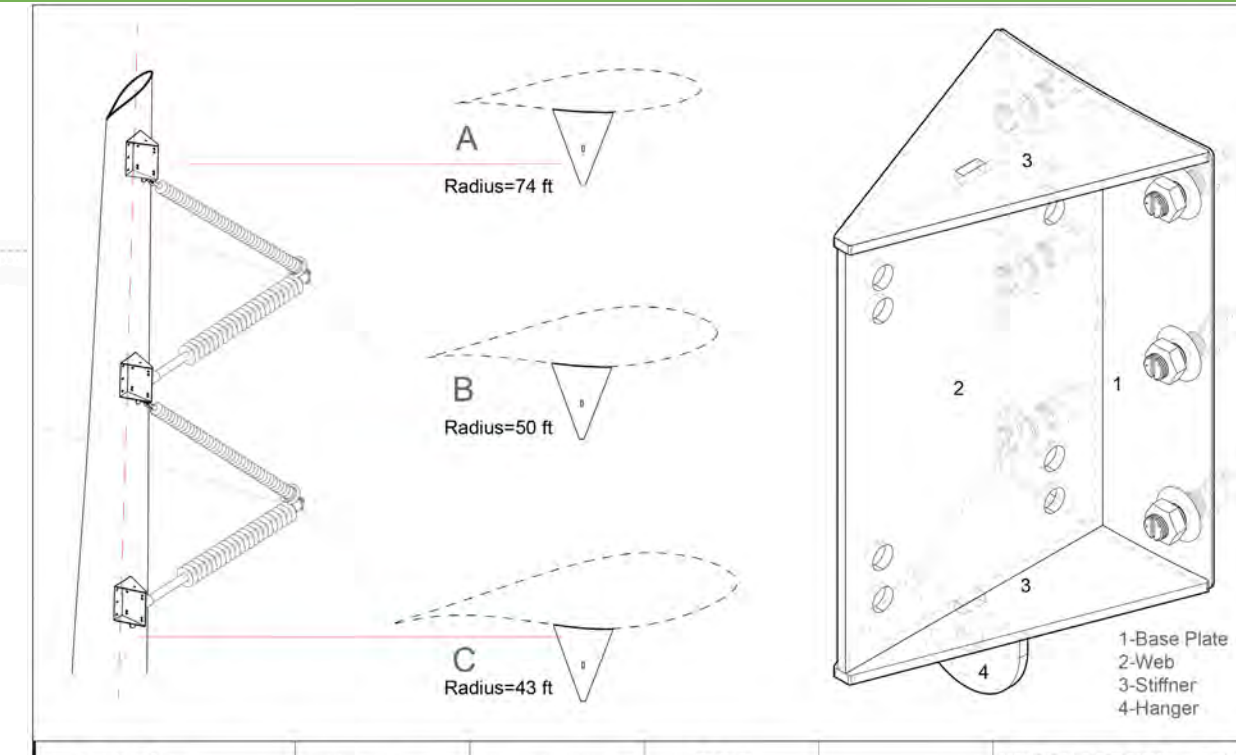


Figure 3: The Universal Connector (UC) is a steel fixture that allows attachment points to the FRP spar cap for various structural functions and automatically adjusts to the blade's local curvature in the Blade Machine model

Our experience provided insight in that hardware is a key aspect of transmission power poles and the importance of using as much conventional hardware as possible. However, due to the asymmetrical cross section of the blade, a special connection is required to adhere to the surface of the material. Re-Wind has developed the Universal Connector (UC) and a method of installation which allows for the attachment and structural transfer of forces into the spar cap of the blade through a custom steel fixture

Fitting

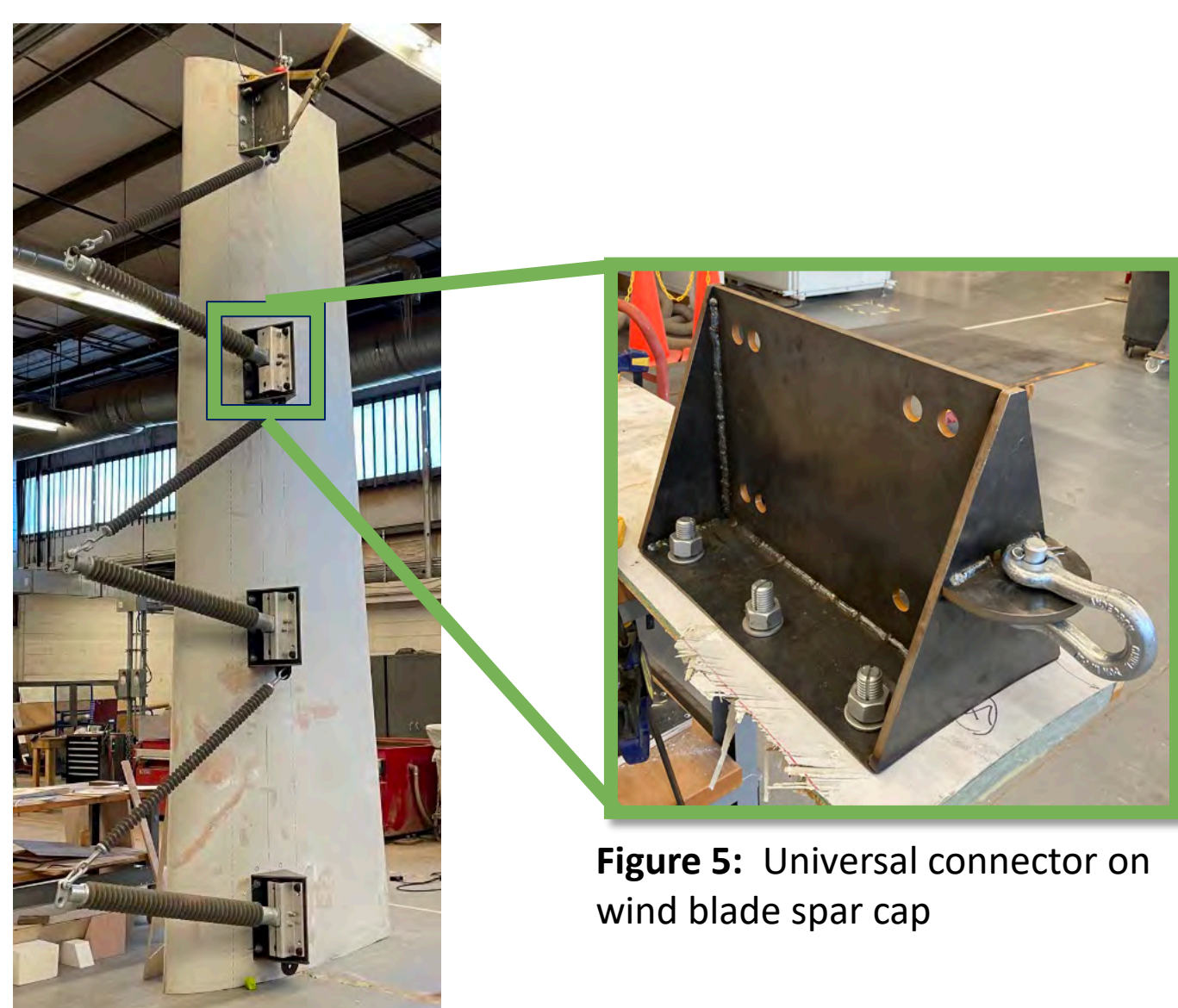


Figure 5: Universal connector on wind blade spar cap

Testing

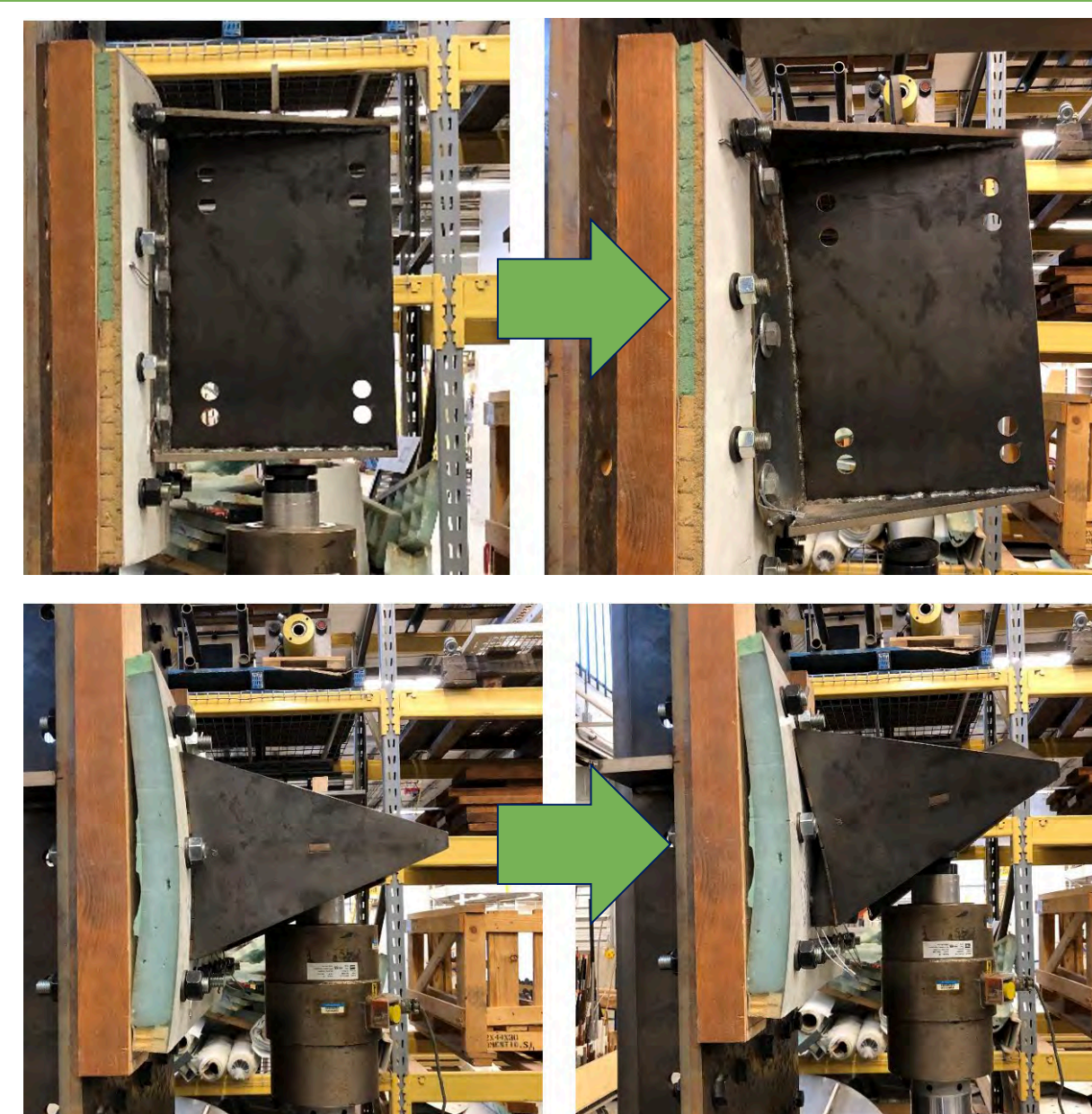


Figure 6: Major (top) and minor (bottom) axis connection testing. Wind blade is stronger than the steel in the universal connector

Construction

Re-Wind compare sustainable end-of-life repurposing strategies for wind blades using Data Driven Structural Modelling in a Geographic Information Science hardware configuration on a section of an actual wind turbine blade. platform coupled with environmental, economic, and social Lifecycle Sustainability Assessments.

The full-scale prototype of the hardware assembly presents the potential configuration that can be applied directly in the field with a reduced labor time requirement. Our team has worked on assembling a full-scale representation of the BladePole located at the Georgia Institute of Technology, USA. This prototype presents a conventional energy transmission

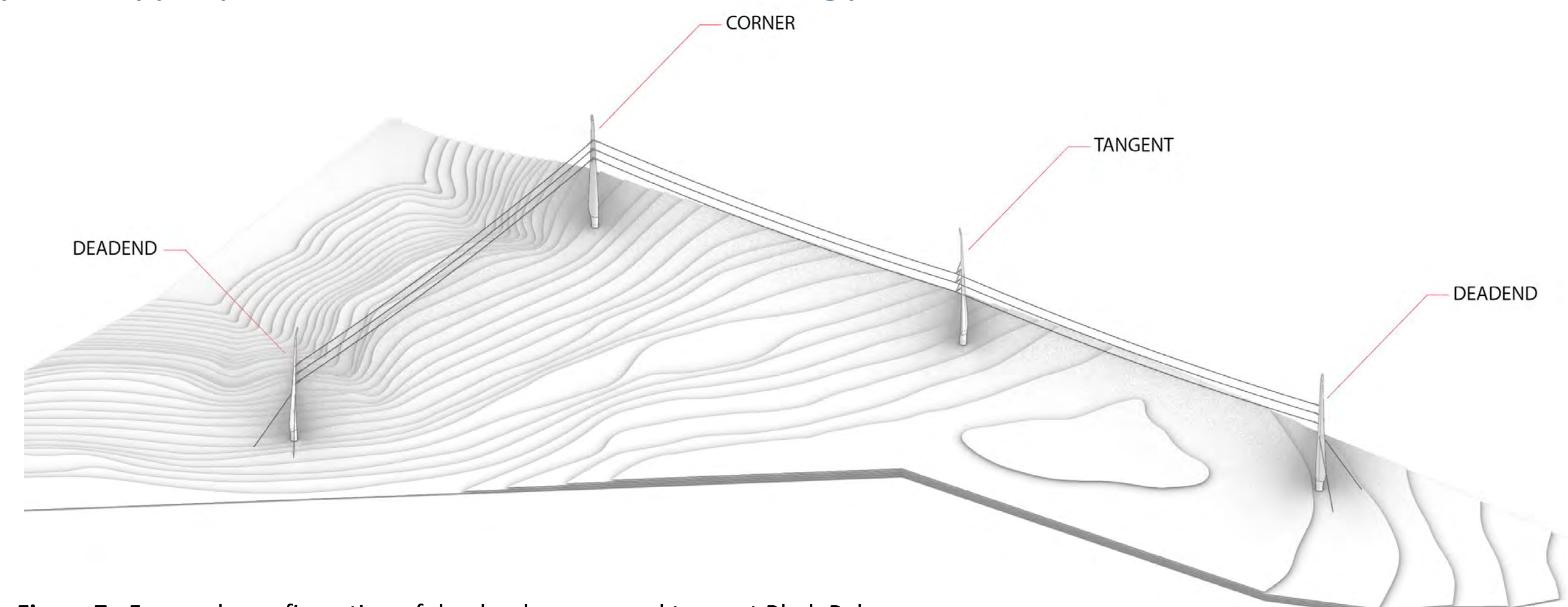


Figure 7: Four-pole configuration of deadend, corner and tangent BladePoles

BladePole can be installed with the same equipment and labor as conventional poles. The installation can be streamlined by an easy and straightforward hardware attachment to the BladePole.

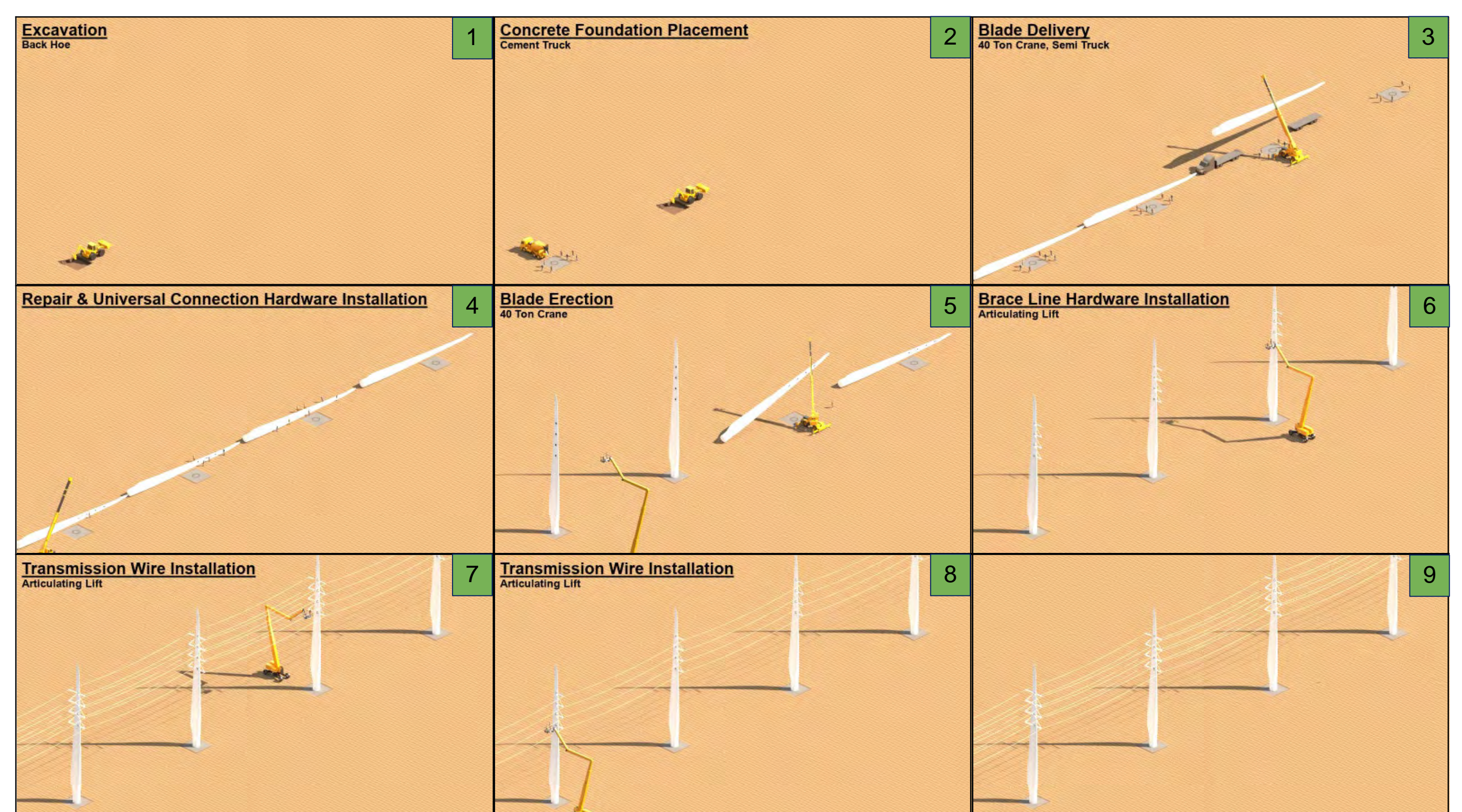


Figure 8: BladePole construction sequence in the field: 1) Excavation of site, 2) Concrete foundations are placed, 3) Blades are delivered, 4) Blade repairs are made and UC's are installed, 5) Blade erection with small crane, 6) Braced Line Post Hardware is installed, 7) Transmission wires are installed on first side, 8) Transmission wires are installed opposite side, 9) Final Installation of tangent BladePoles

Conclusions and Future Work

The use of wind turbine blades as energy transmission poles can introduce a waste reduction stream and add to the expansion and improvement of the energy transmission grid. BladePole has a positive socio-economic impact by providing more resilient and durable infrastructure thanks to the great material composition of wind blades. Our research presents an innovative solution that can solve current and future grid infrastructure problems and implement true blade circularity from wind farms to second life applications.

References

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