
Case studies of repurposing FRP wind blades for second-life new infrastructure

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Wind Turbine Blade End-of-Life

- **Prevent:** Extend project or blade lifetime
- **Reuse:** Sell blades on secondhand market
- **Repurposing:** Remanufacturing for use in new products
- **Recycle Mechanically:** Shredding, grinding and milling for filler for FRP or concrete
- **Recover Materials:** Pyrolysis (~700 °C), thermolysis (~400 °C), solvolysis or hydrolysis (~100 °C) to recover composite material, fibers, or polymers.
- **Co-process in cement kilns:** chemical substitution at ~1500 °C
- **Incinerate** – with or without energy recovery, then landfill ash
- **Landfill**



<https://www.epa.gov/homeland-security-waste/waste-management-hierarchy-and-homeland-security-incidents>

Re-Wind Blade Repurposing Concepts



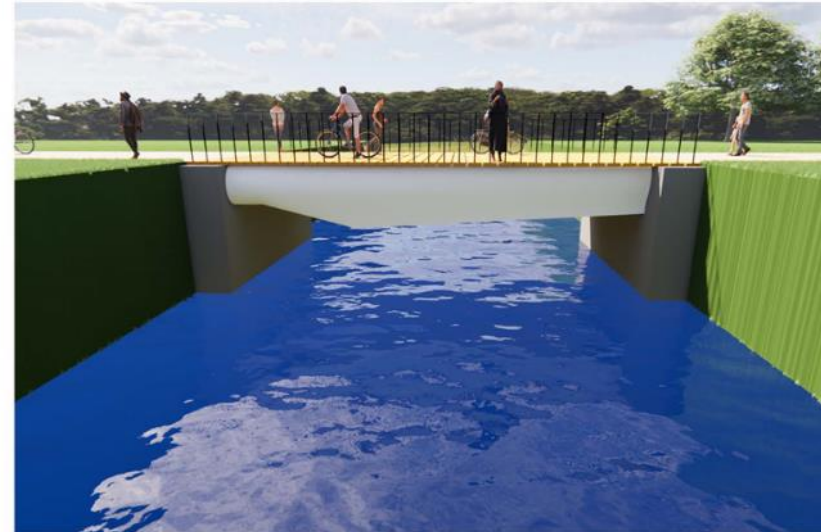
2021

Graphics: A. McDonald, S. Kakkad, C. Kiernicki, A. Poff, Georgia Tech

12m length - 6m width

Symmetric Girders - 21m V44 blade

Root ends - 3 girders below deck level at 3m spacing



Three wind blades of the same type are used in the above BladeBridge to support a 6m wide pedestrian deck. The girders are mostly hidden from view in this configuration which may be desirable in certain locations. With the girders placed below the deck the pedestrians have a more expansive view of their surroundings.

Re-Wind Blade Repurposing Concepts



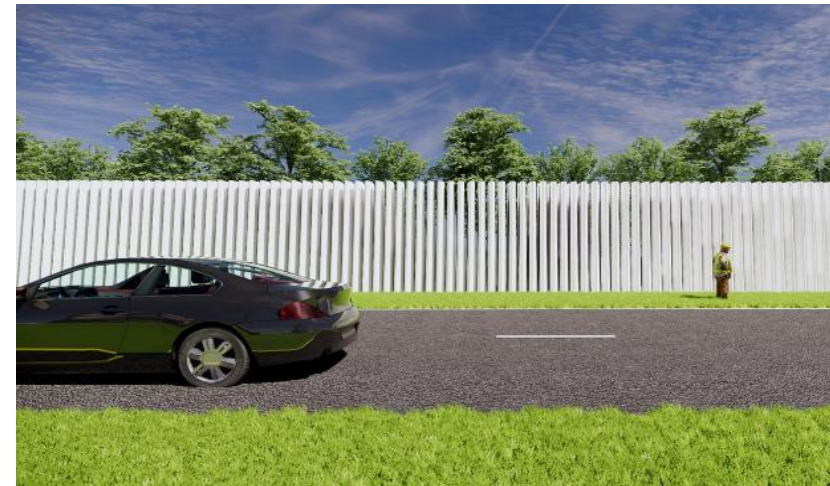
BladeHousing



BladeBridge

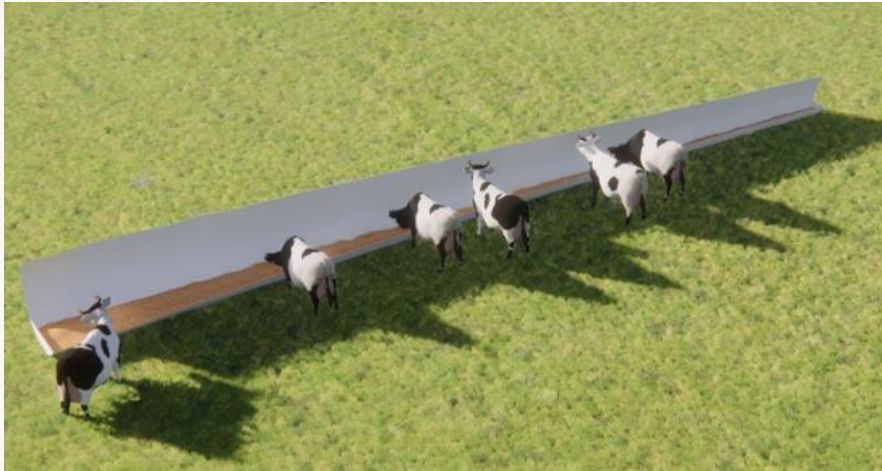


BladePole



BladeBarrier

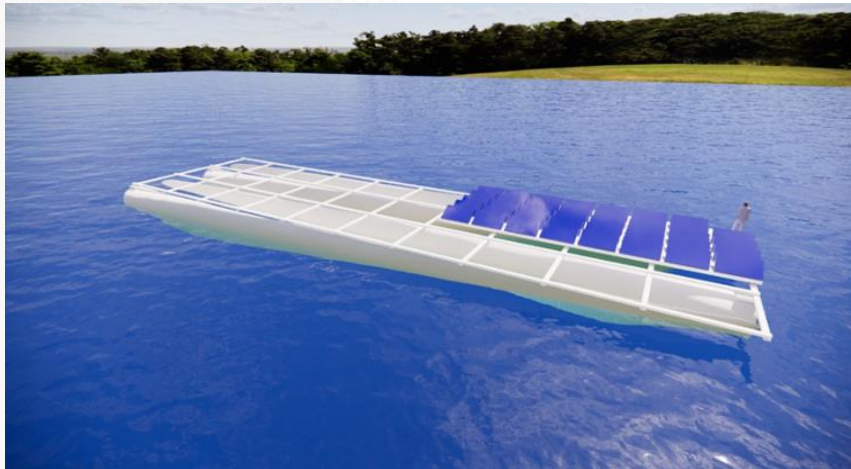
Re-Wind Blade Repurposing Concepts



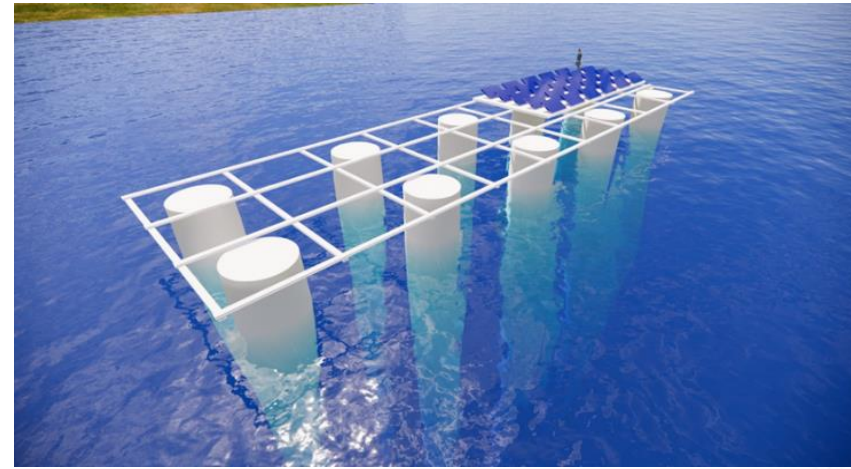
BladeFarm



BladeJetty



BladeSolar



BladePlatform

BladeBridge

Cork, Ireland, January 2022

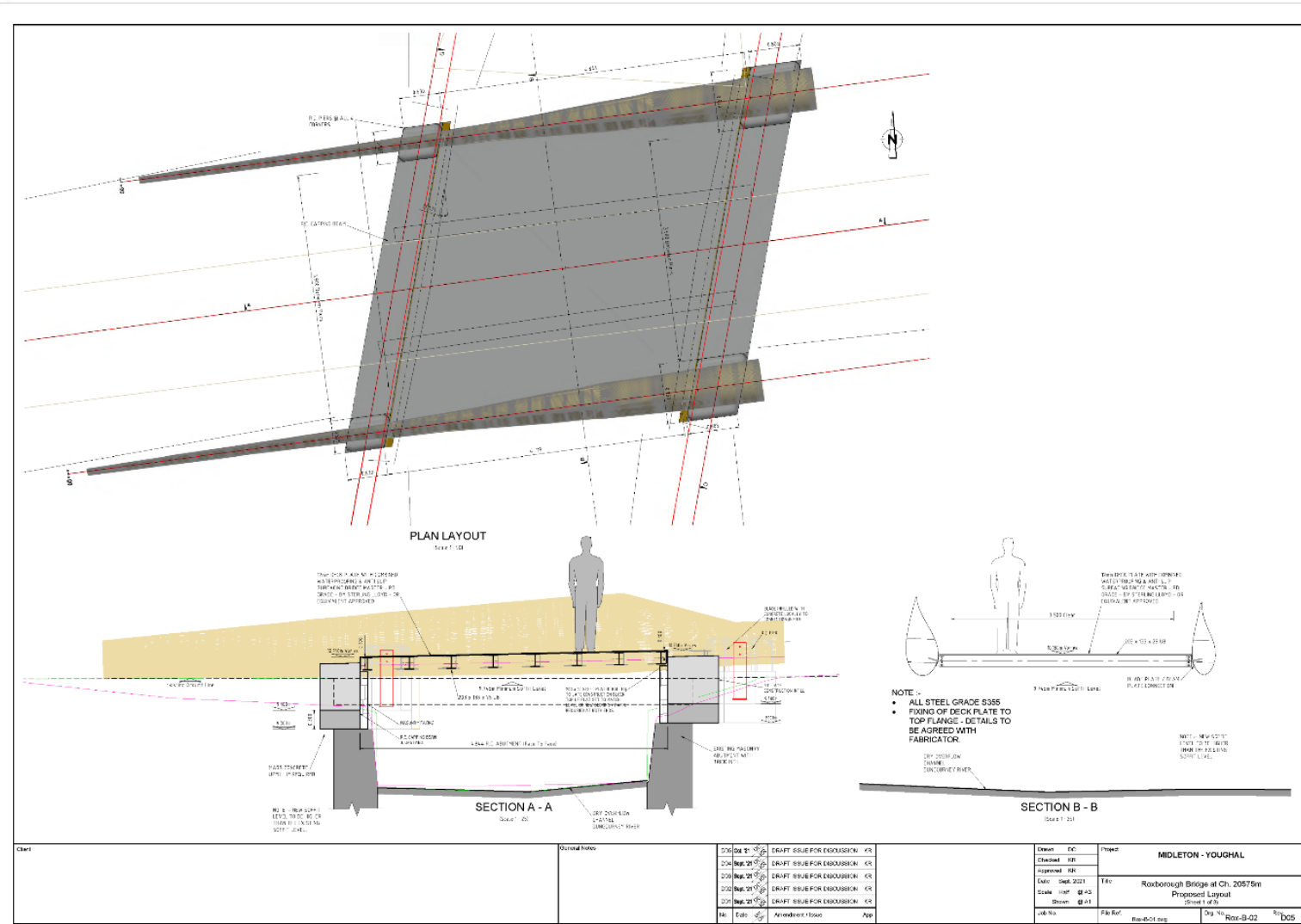


BladeBridge Testing



Testing conducted at Munster Technological University, Cork, Ireland by Kieran Ruane, Zoe Zhang and staff
For more details see: "Material and Structural Characterization of a Wind Turbine Blade for Use as a Bridge Girder," <https://doi.org/10.1177%2F03611981221083619>

BladeBridge Detailed Design



Design: Kieran Ruane, Munster Technological University



BladeBridge

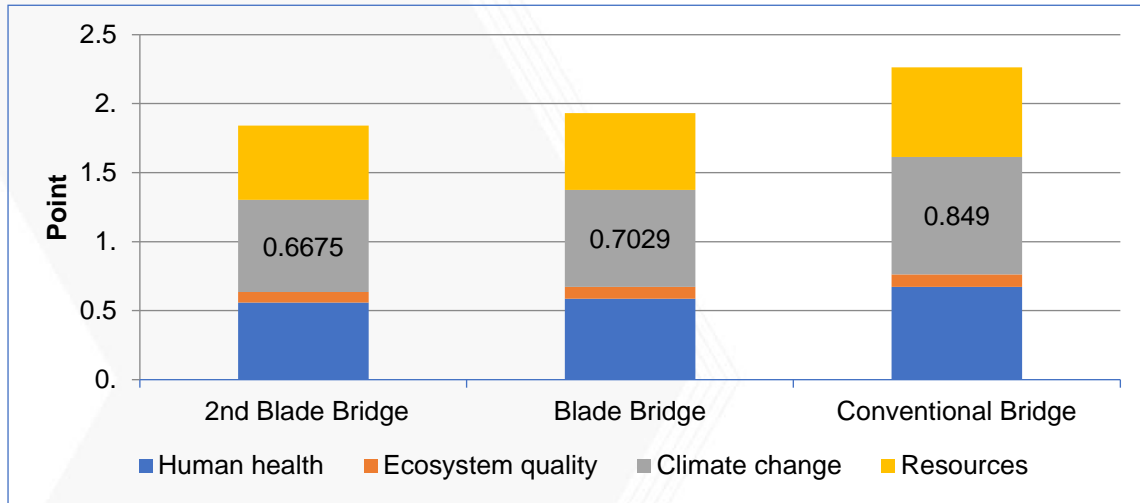
Dunnamore, Northern Ireland, May 2022



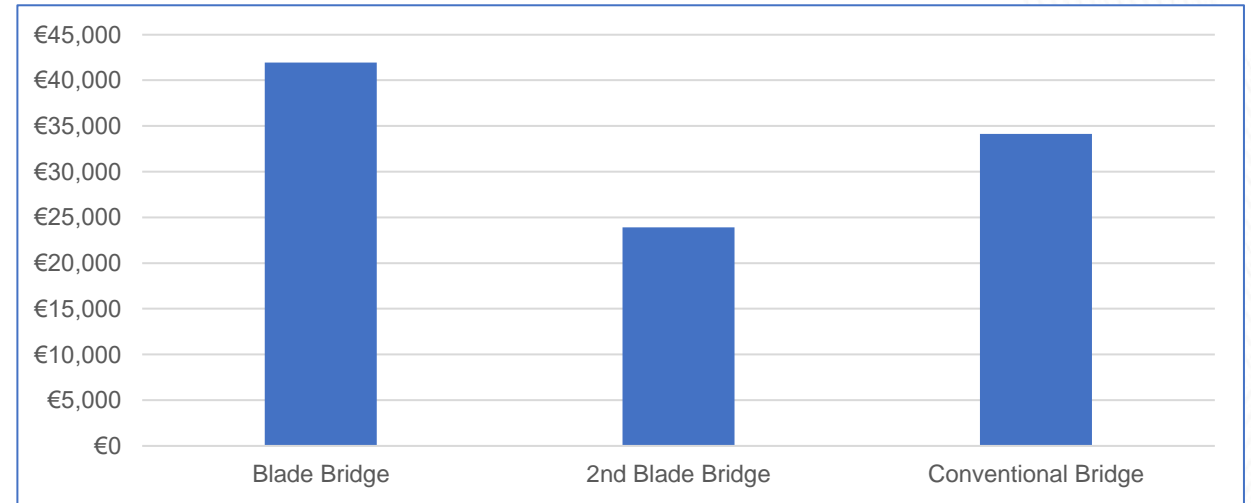
Design: An Huynh, Marios Soutsos; Construction: Kenny McDonald and QUB lab staff,
Queens University Belfast, Northern Ireland



BladeBridge LCA and LCC



Single Score Comparison between blade-bridge and a conventional bridge



Lifetime cost comparison between BladeBridge, a second BladeBridge and a conventional bridge

“Sustainability Assessment of the Repurposing of Wind Turbine Blades,” Angela Nagle, Thesis submitted for the degree of Doctor of Philosophy, School of Engineering & Architecture, Environmental Research Institute University, College Cork.

BladePole



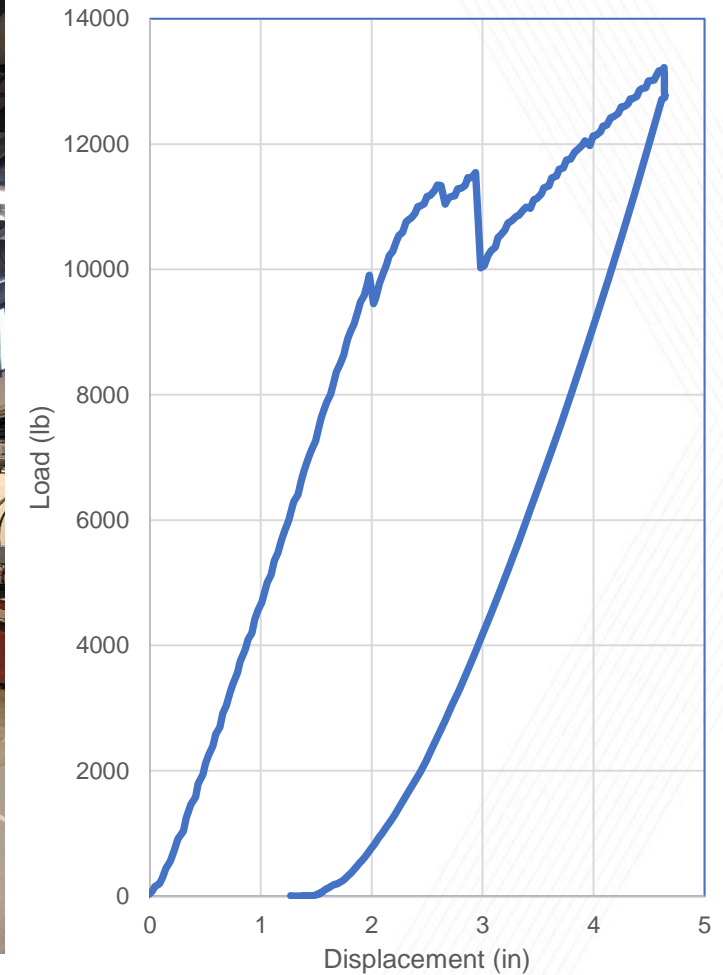
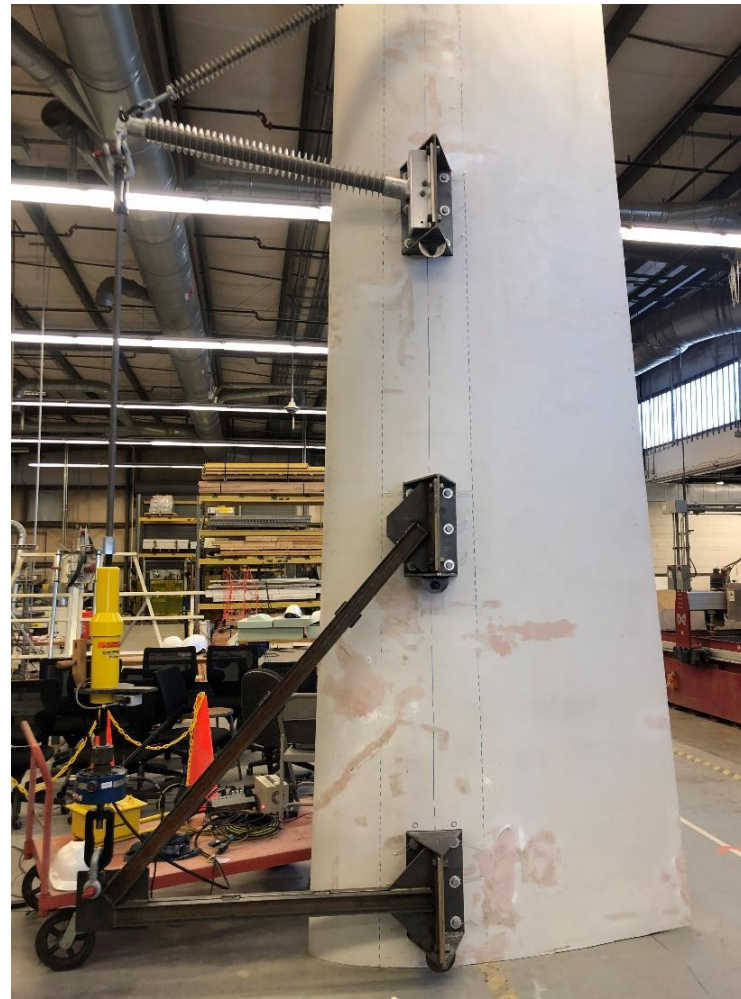
Graphics: T. Al-Haddad, M. Bermek, S. Li, A. Poff, J. Respert, C. Woodham, Georgia Tech

BladePole Material Testing



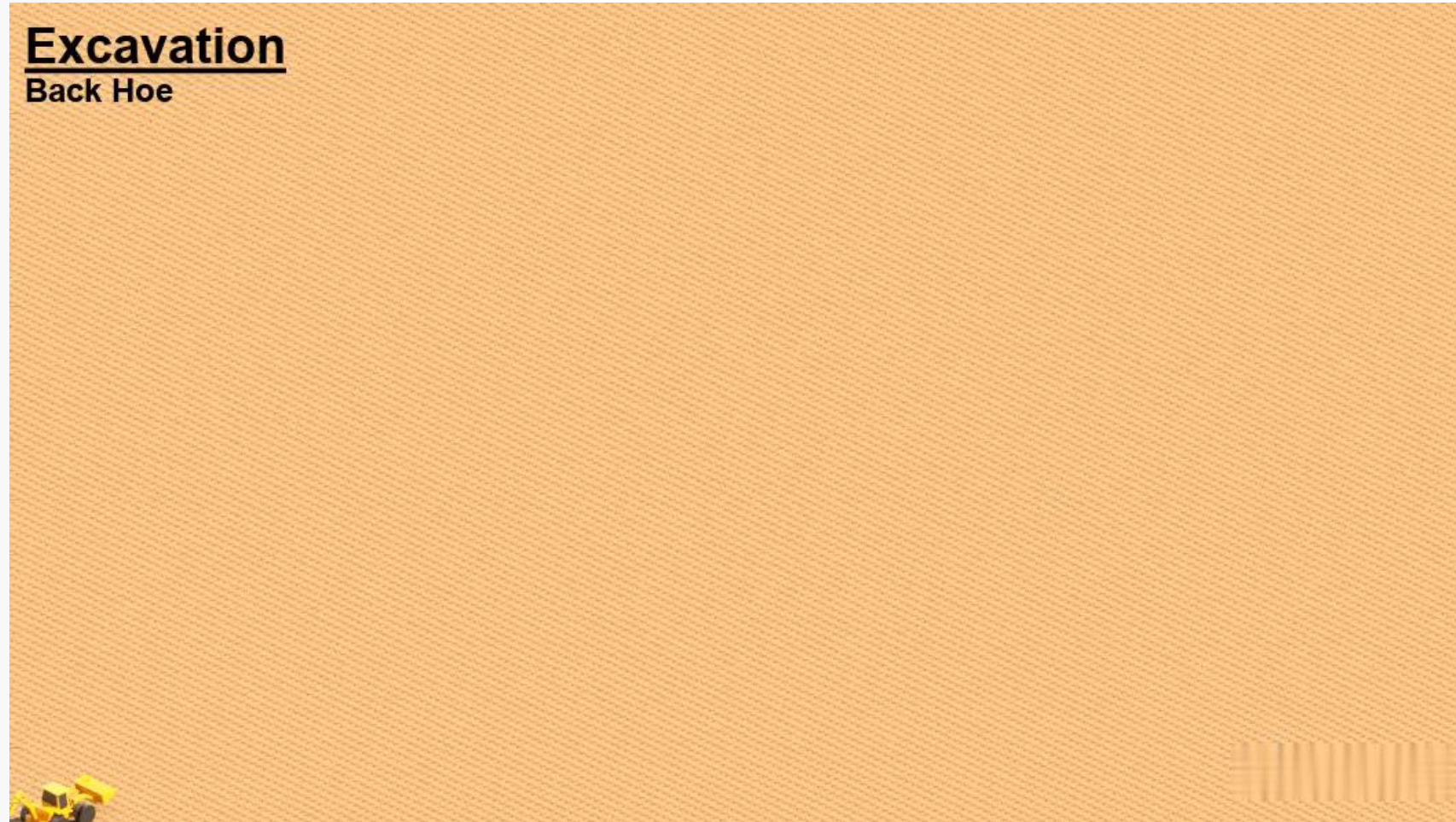
See details in the paper/presentation in this proceedings: “Properties of a 37 m long FRP wind turbine blade after 11 years in service” by A. Alshannaq et al.

BladePole Connection Testing



Testing conducted at Georgia Tech by R. Gentry, A. Alshannaq, J. Respert and Y. Henao-Barragan

Construction Simulation



Simulation by Yulizza Henao-Barragan and Sean Li, Georgia Tech

Re-Wind Partners, Projects, Funding

Network University Members:

- Georgia Tech
- City University of New York
- University College Cork
- Queens University Belfast
- Munster Technological University

Affiliate Members:

- University of Bristol, UK

Funding (~\$2m 2014-current)

- NSF (CBET, PFI, I-CORPS), NYSERDA
- SFI, DfE, ENEL Green Power

Current Project Partners:

- Logisticus Group
- ENEL Green Power
- Siemens-Gamesa RE
- Vestas
- Cork County Council
- NYC Dept of Design and Construction (DDC)
- NREL Wind Manufacturing

Conclusions

- We have demonstrated that structures can be analyzed, designed and constructed with decommissioned wind turbine blades
- Since many blades of every type are available in-depth testing of only the first prototype structure is needed
- Transportation and construction logistics are very important and must be considered up-front
- Significant environmental benefits are obtained by using large sections of decommissioned blades
- BladeBridges have been shown to be cost competitive with other pedestrian bridges
- We encourage all wind farm owners to consider repurposing as a viable alternative to waste processing
- For more information and publications visit www.re-wind.info