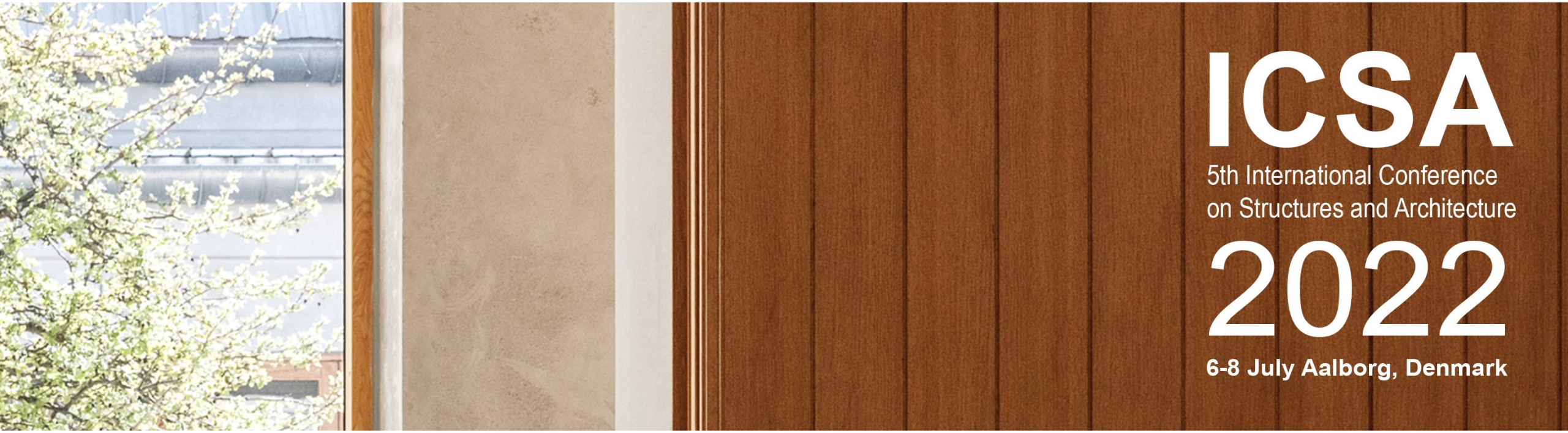
STRUCTURES & ARCHITECTURE
INTERNATIONAL ASSOCIATION EDUCATION • RESEARCH • COOPERATION



Blade Bridge - Design and Construction of a Pedestrian Bridge using Decommissioned Wind Turbine Blades

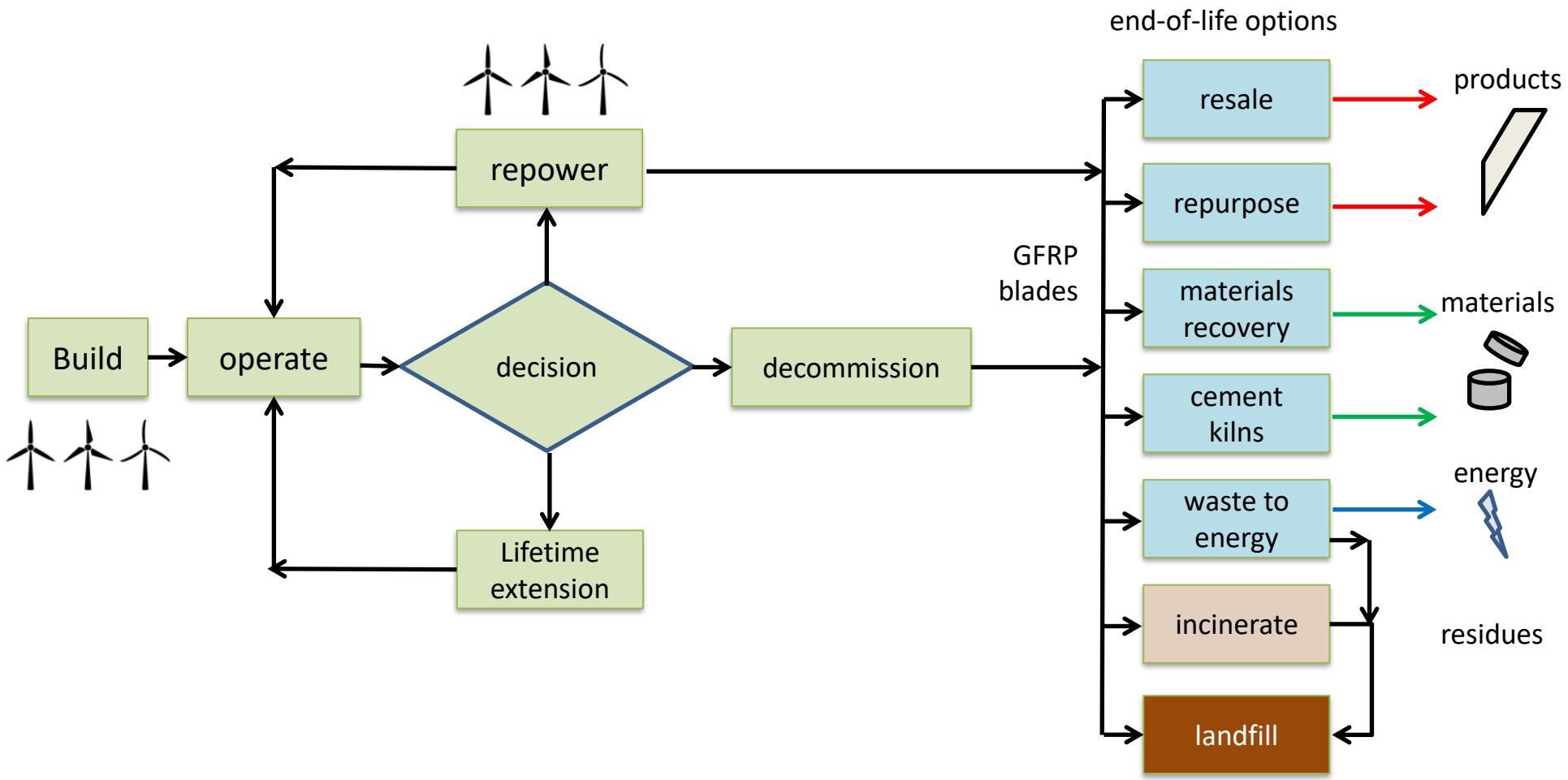
Z. Zhang, K. Ruane, A. Huynh, A. McDonald, P. Leahy, A. Alshannaq, T. R. Gentry, A. Nagle, L. C. Bank

Georgia Tech

Outline

- **Introduction**
- **Re-Wind Network**
- **BladeBridge**
  - Sourcing, Funding, Planning
  - Experimental Testing: Material and Section Properties
  - Design process
  - Fabrication and Installation
- **Conclusion**

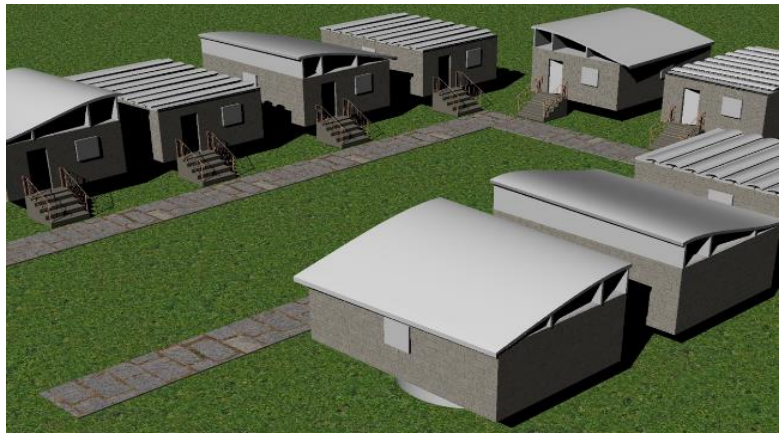
Wind farm life cycle



https://www.bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills

Blade repurposing concepts

RE-WIND NETWORK
BLADE REPURPOSING SOLUTIONS
WWW.RE-WIND.INFO



BladeShelters

BladeBridge

BladePole

BladeBarrier

BladeBridge – sourcing, funding, planning

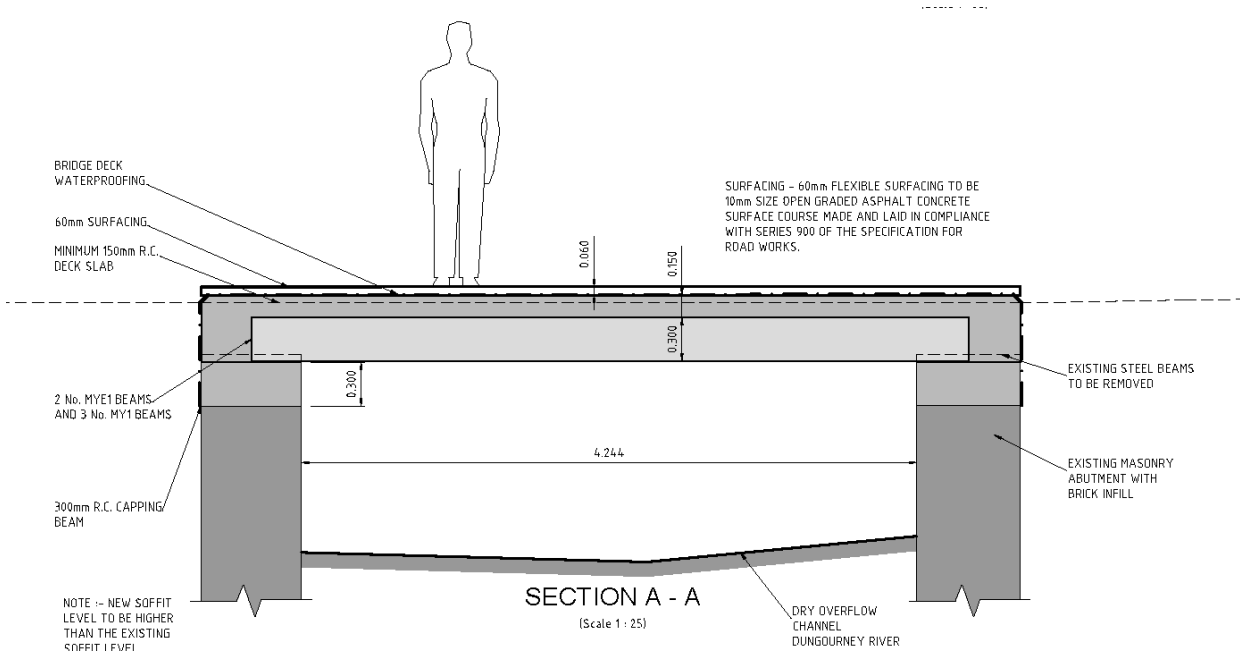
BladeBridge

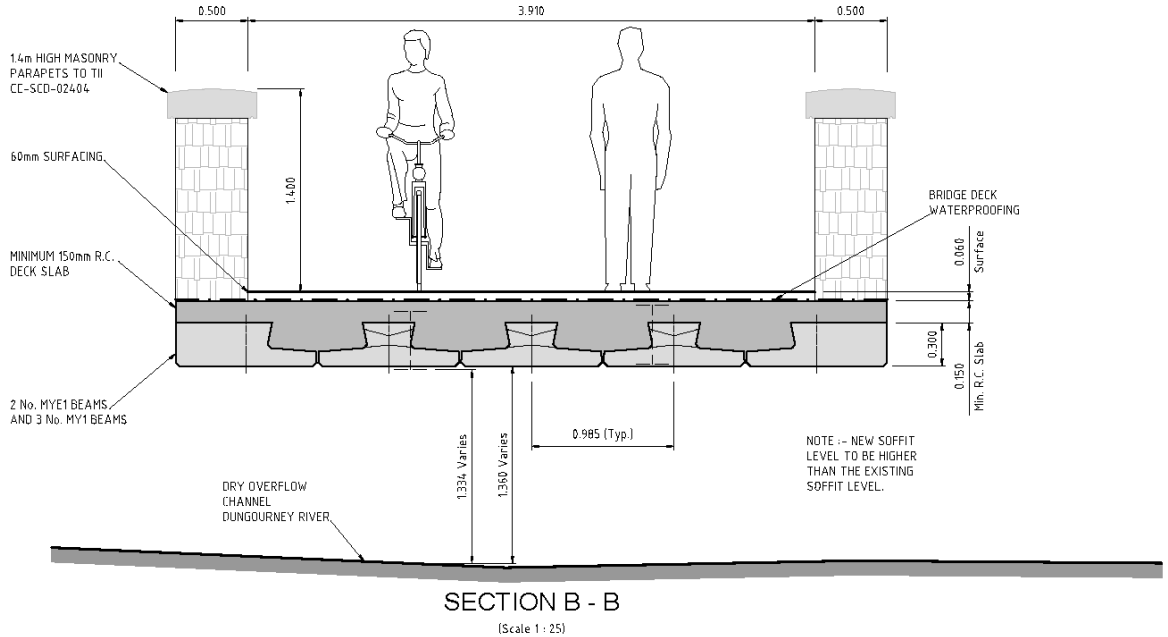
Funding & Management:	Blade Sourcing:	Preliminary Design & Testing:	Engineering Design:	LCA & Design Support:
Cork County Council	Everun Ltd.	Georgia Tech	Munster Technological University	University College Cork

Midleton–Youghal Greenway

Original site

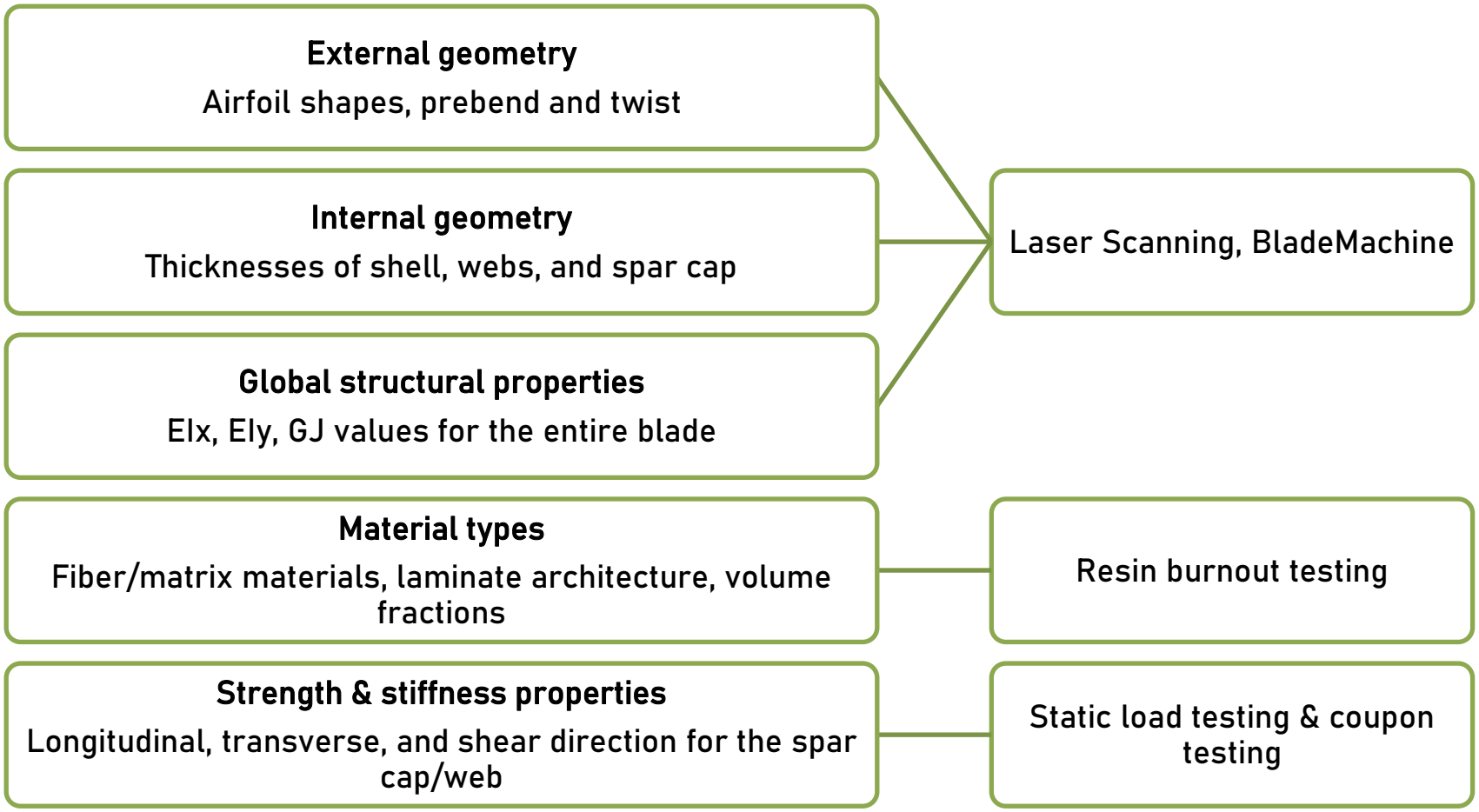
Greenway bridge – original plan



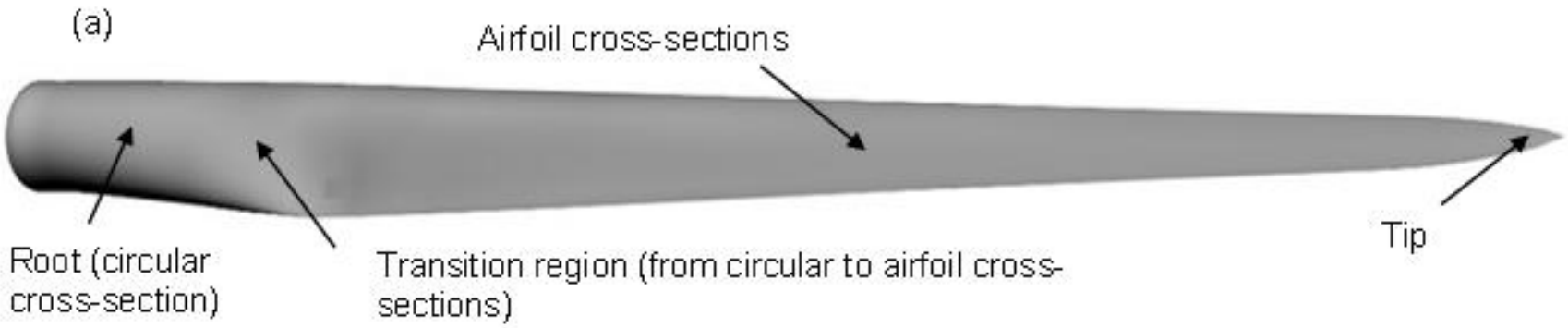


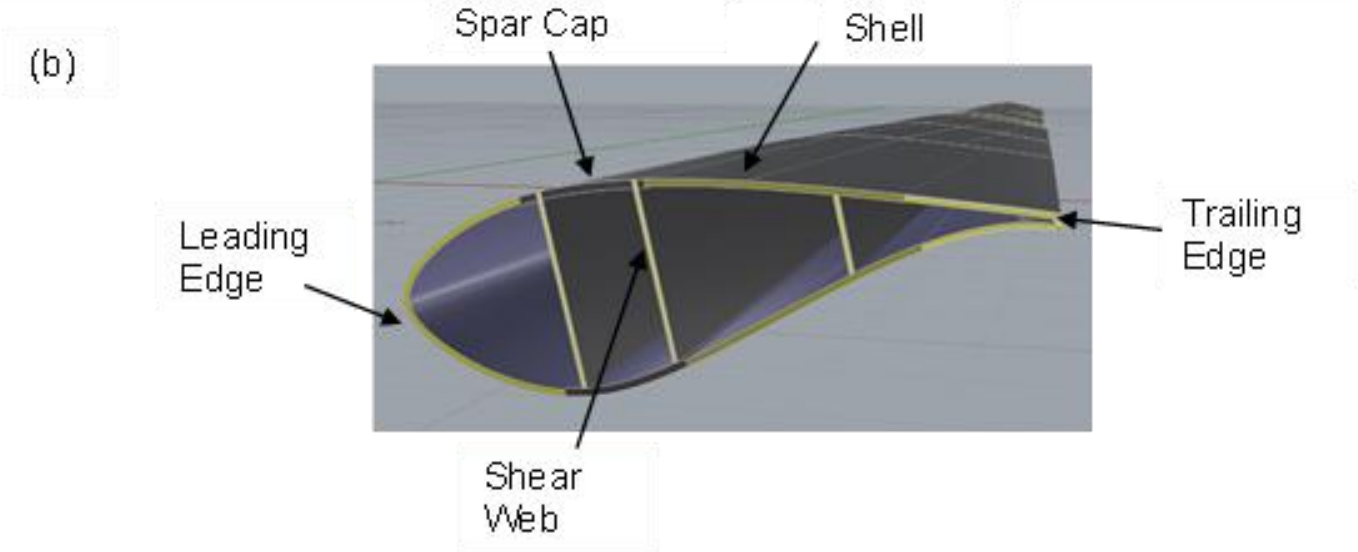
Nordex N29 windblades – sourced from Everun Ltd.

BladeBridge – experimental testing

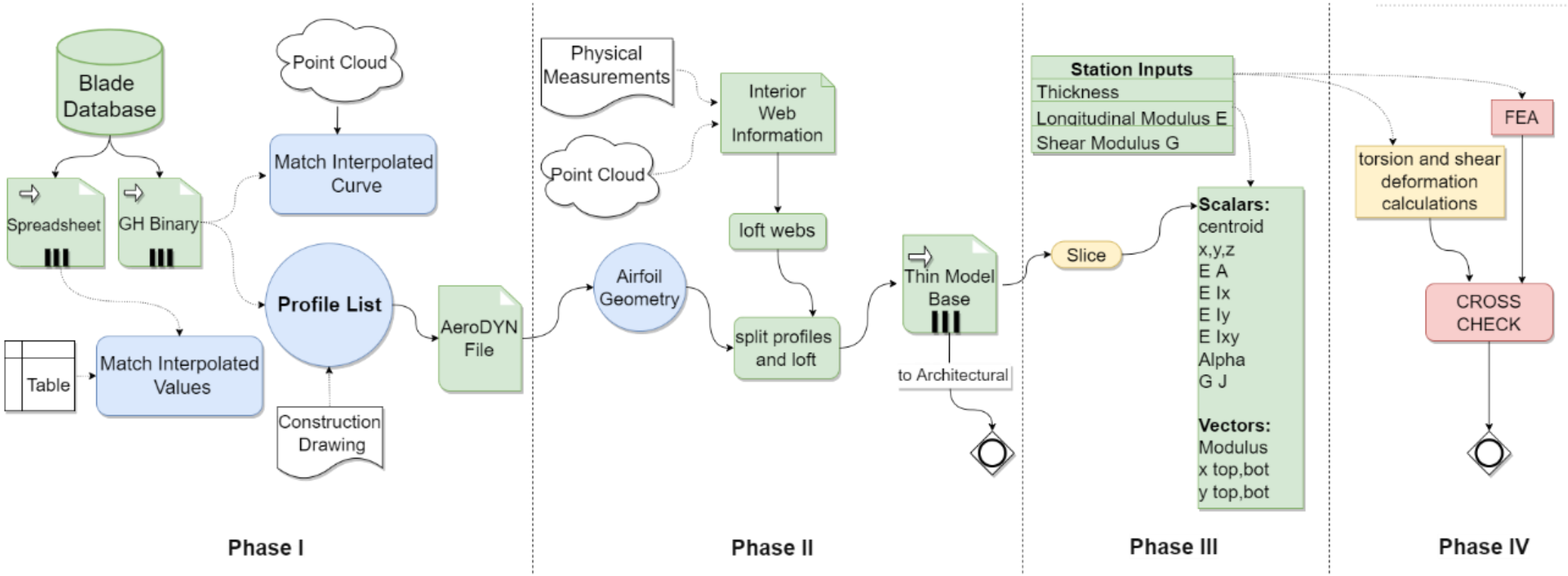


Airfoil terminology



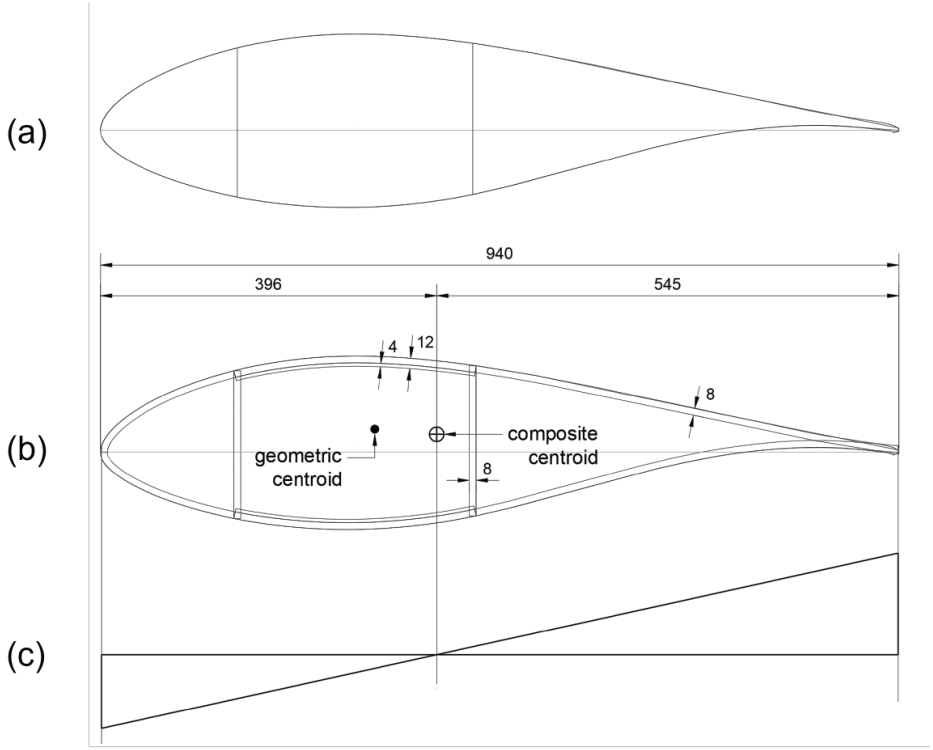


BladeMachine – digital reprocessing

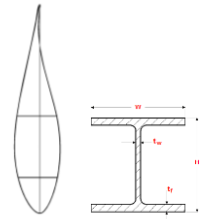


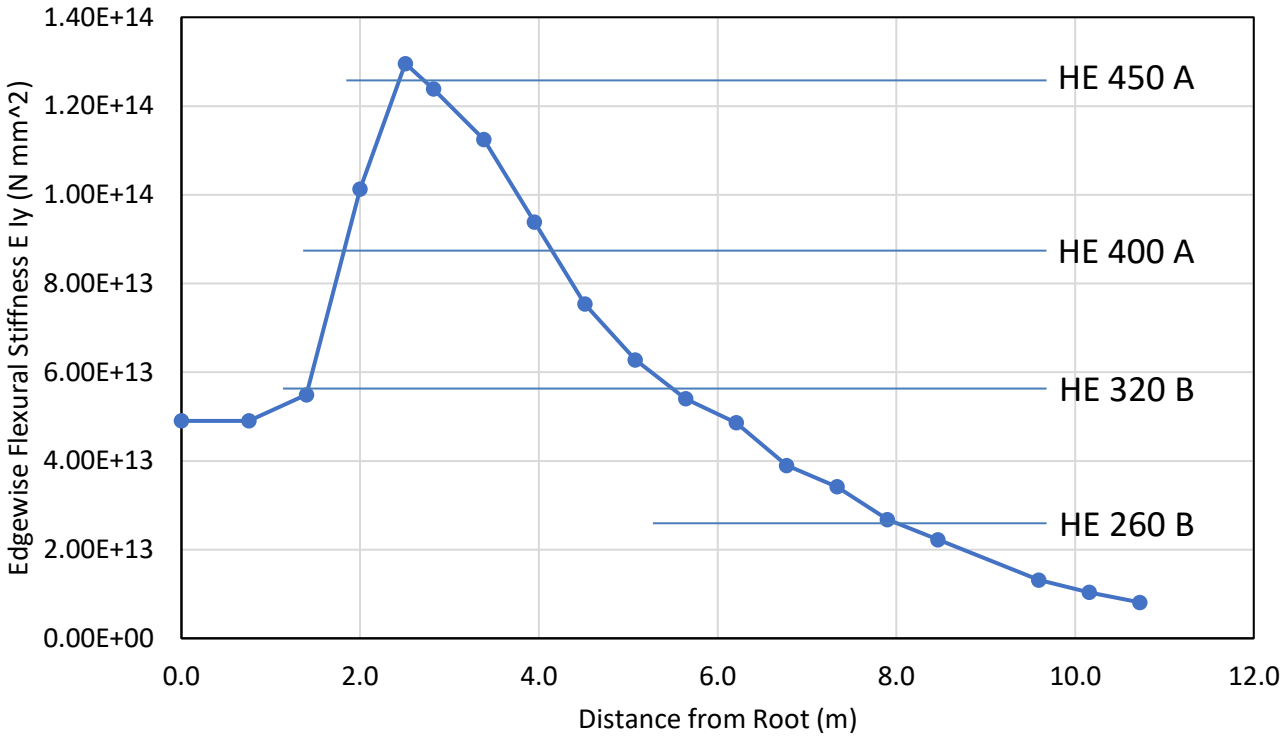
Kiernicki, C., Kakkad, S.D., Bermek, M.S., and Gentry, T. R. (2022). "A Digital Process for Reconstructing Wind Turbine Blade Geometry from Point Cloud Data." In Proc., 5th Annual International Conference on Structures and Architecture, Aalborg, Denmark.

BladeMachine Phase IV – global structural properties



(d) Weight = 22.6 kg/m E Ix = 2.57e+12 N-mm^2
E A = 5.45e+08 N E Iy = 3.71e+13 N-mm^2



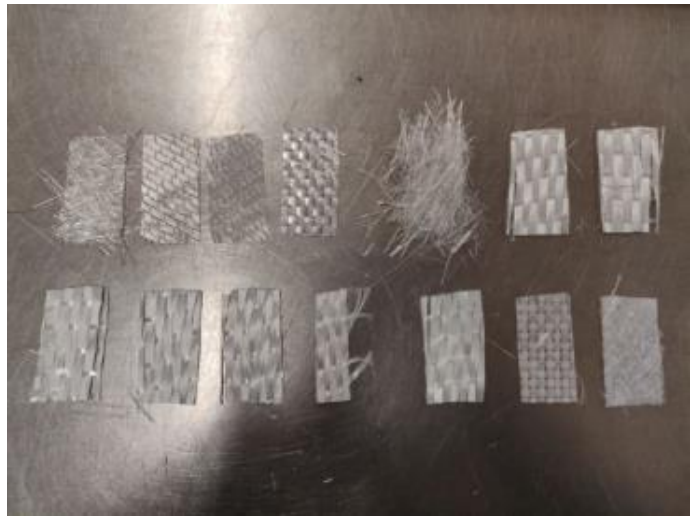


Laboratory testing

Static loads

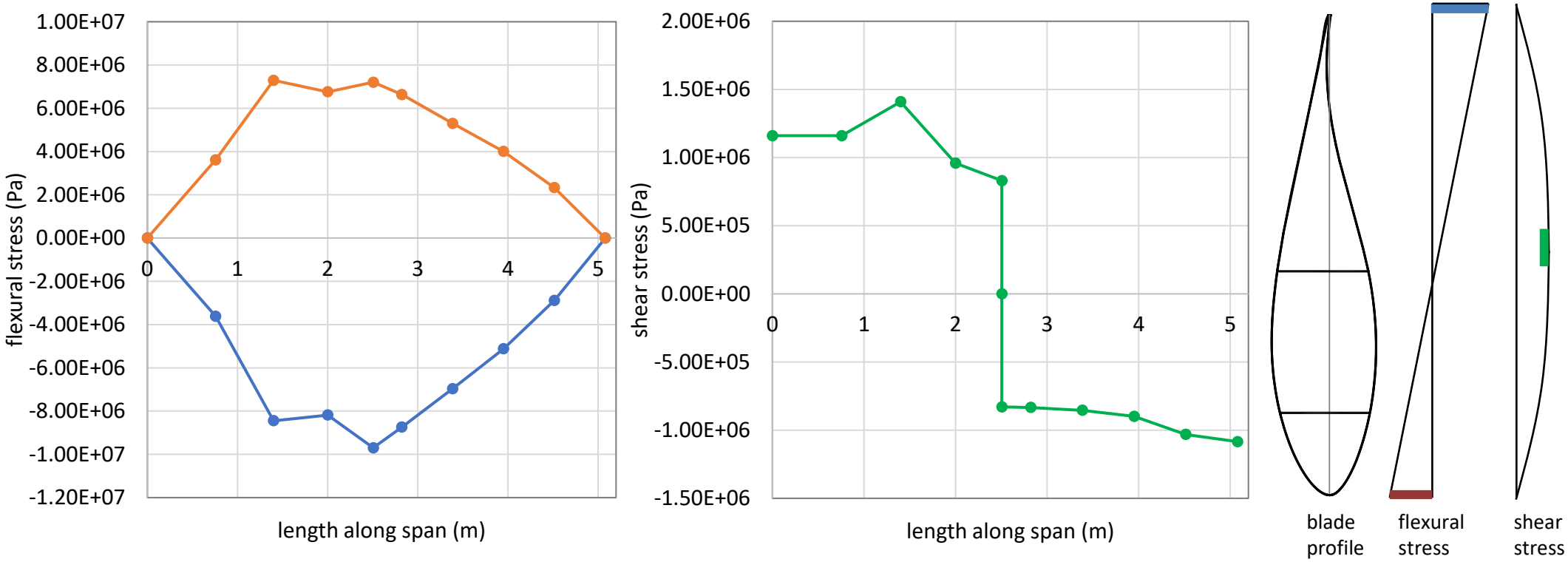
Coupon testing

Resin burnout



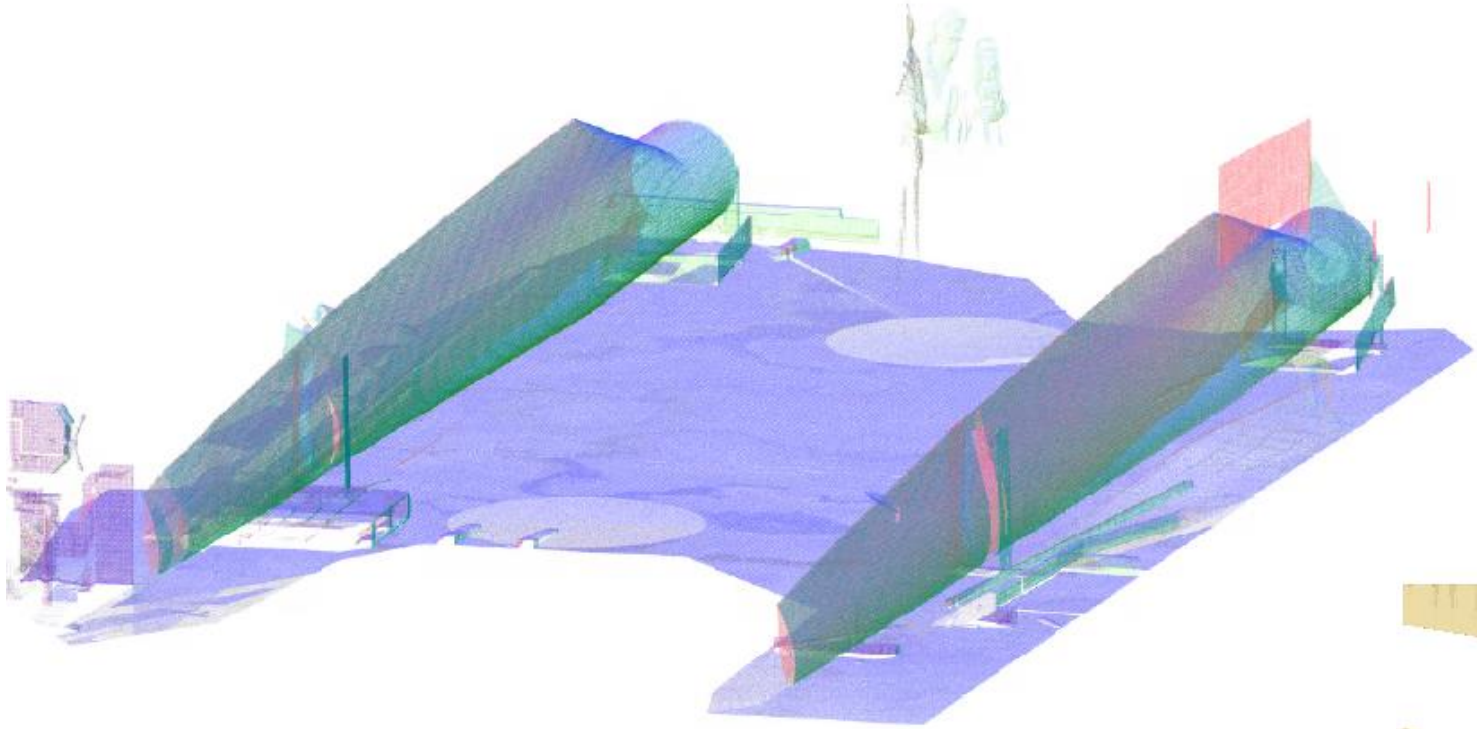
Ruane, K., Zhang, Z., Nagle, A., et al. (2022). Material and Structural Characterization of a Wind Turbine Blade for Use as a Bridge Girder. Transportation Research Record. https://doi.org/10.1177/03611981221083619

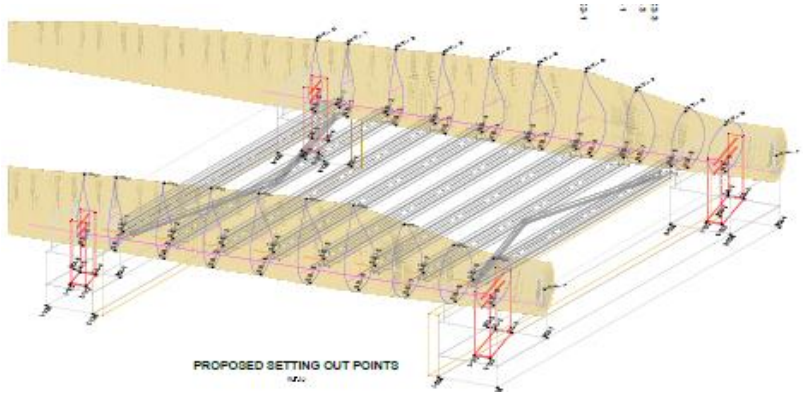
Strength & stiffness comparison – 50kN midspan load



BladeBridge – design & fabrication

BladeBridge fabrication – AR Brownlow Lt. Carrigaline





Windblade alignment cradles

BladeBridge fabrication – custom steel connections

January 2022

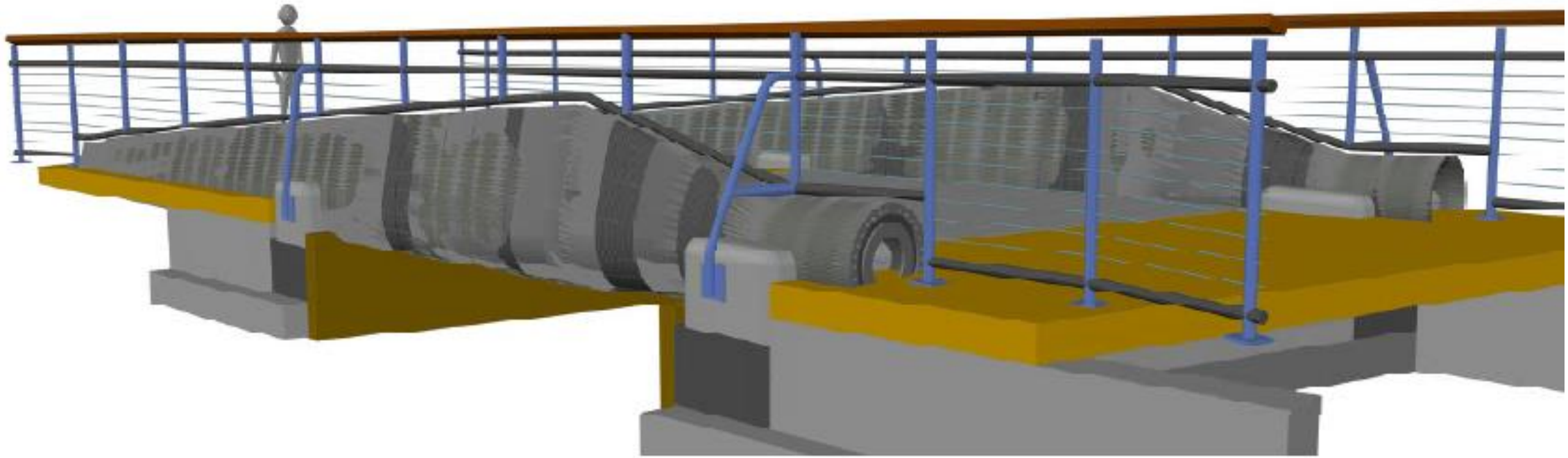
January 26, 2022 – site installation

April 2022 – groundwork & abutments completed

April 2022 – groundwork & abutments completed

June 2022 – bauxite surfacing

Summer 2022 – guardrail design & fabrication



Conclusions

- Windblades are a strong, durable and versatile building material
  - Strength properties remain even as EOL products
- Potential for expansion – Ireland, US, and beyond

RE-WIND NETWORK

BLADE REPURPOSING SOLUTIONS

WWW.RE-WIND.INFO

Re-Wind Network partners, collaborators, & funding

Network University Members:

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

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
- Cork County Council
- NYC Dept of Design and Construction (DDC)
- NREL Wind Manufacturing