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FASTBLADE

Structural Composites Research Facility

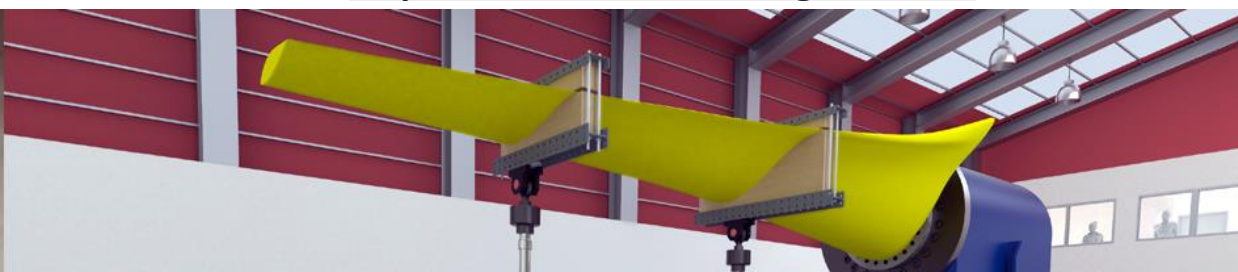
TIGER Supply Chain Webinar
SEA TECH WEEK 2020 - 13.10.2020



Prof. Conchúr Ó Brádaigh & Dr. Jeff Steynor

School of Engineering, University of Edinburgh

<http://www.fastblade.eng.ed.ac.uk>



Introductions



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Conchúr Ó Brádaigh



Prof Conchúr Ó Brádaigh
Head of School and
Chair of Materials Engineering

Jeff Steynor



Project Manager & Senior Experimental Officer
School of Engineering
The University of Edinburgh

FASTBLADE Project Partners



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babcockTM



Engineering and
Physical Sciences
Research Council



Scottish Enterprise



COUNCIL

ORBITAL
MARINE POWER



MACTAGGART SCOTT
Innovators since 1898



**SIMEC ATLANTIS
ENERGY**

SUZLON



Fife College



EDINBURGH
INNOVATIONS

MatchID
Metrology beyond colors



DNV-GL

cATAPULT
Offshore Renewable Energy

UNIVERSITY OF
Southampton



O'É Gaillimh
NUI Galway

CIT CORK
INSTITUTE OF
TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

FASTBLADE Animation



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What is FASTBLADE ?

An innovative structural composites test facility funded by the EPSRC for FULL scale hydraulic fatigue testing of:

- TIDAL BLADES
- Marine & Defence Structures
- Aircraft wing boxes
- Stiff and slender structures

15MNm

Static
Moment

3MN

Static
Load

8 x
FASTER

2021

5MNm

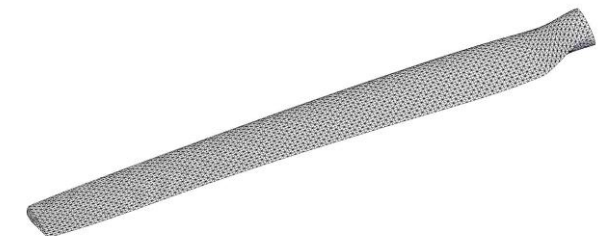
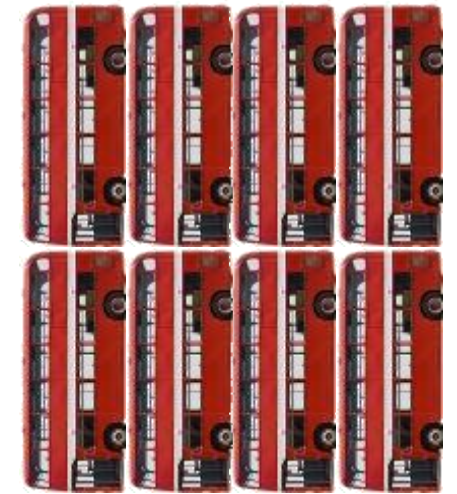
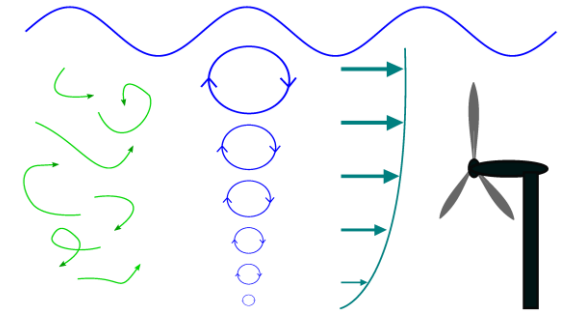
Fatigue
Moment

1MN

Fatigue Load

75%
Efficient

£4.1M
CAPEX



FASTBLADE Test Layout

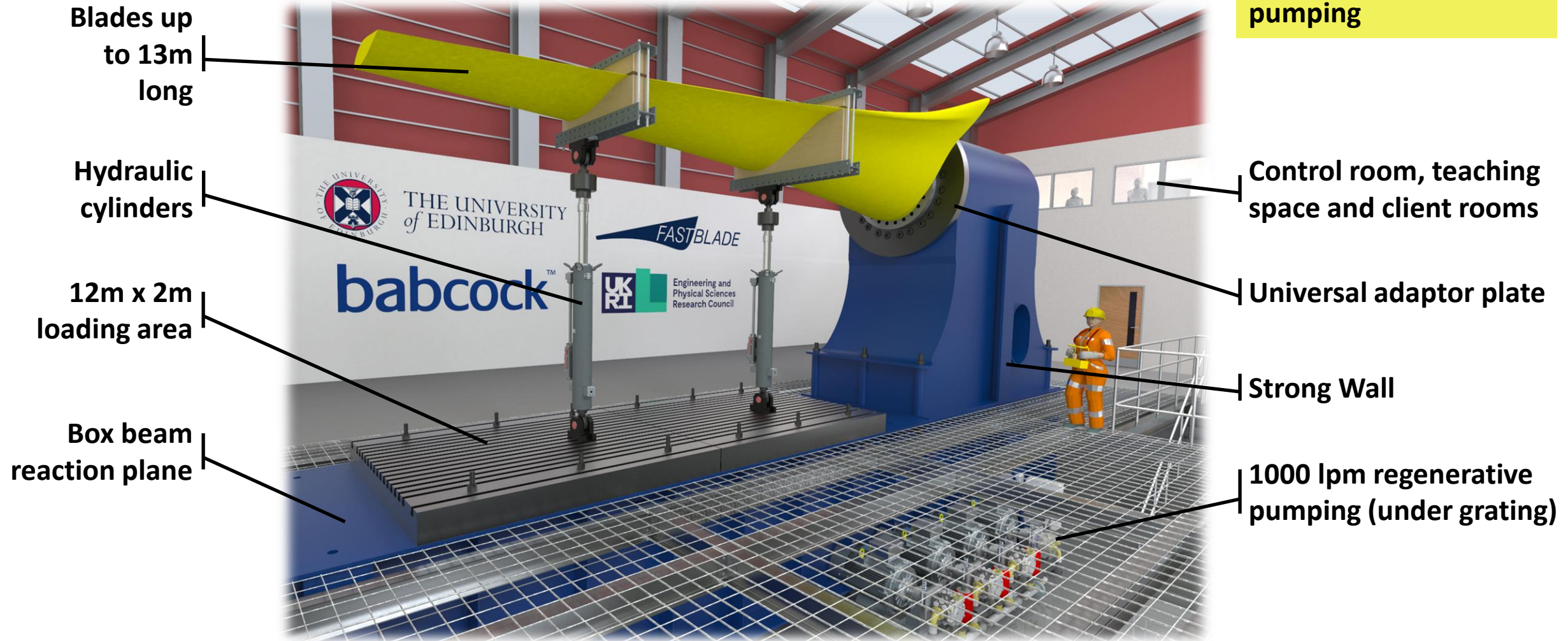
Estimated Commissioning Date: Mid 2021



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World's first structural
test facility with
regenerative hydraulic
pumping



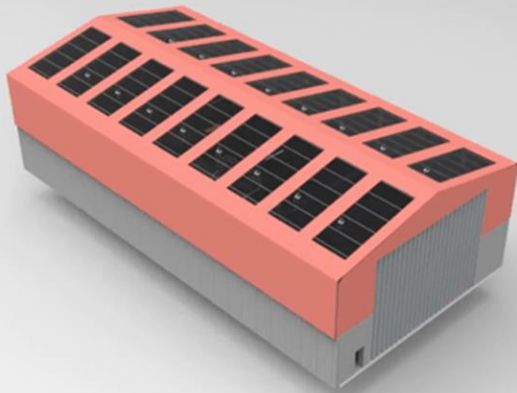
Where is FASTBLADE?



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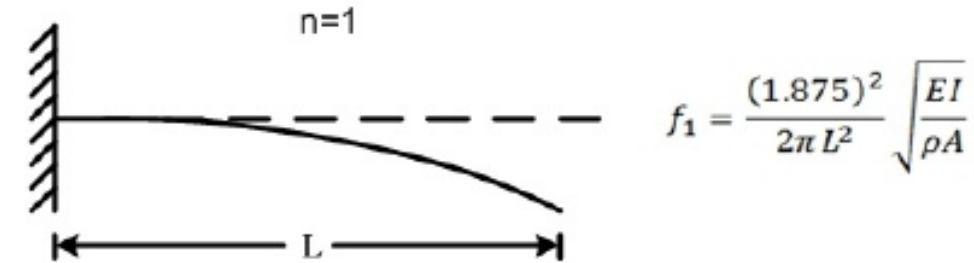


Rosyth Dockyard
Fife, UK



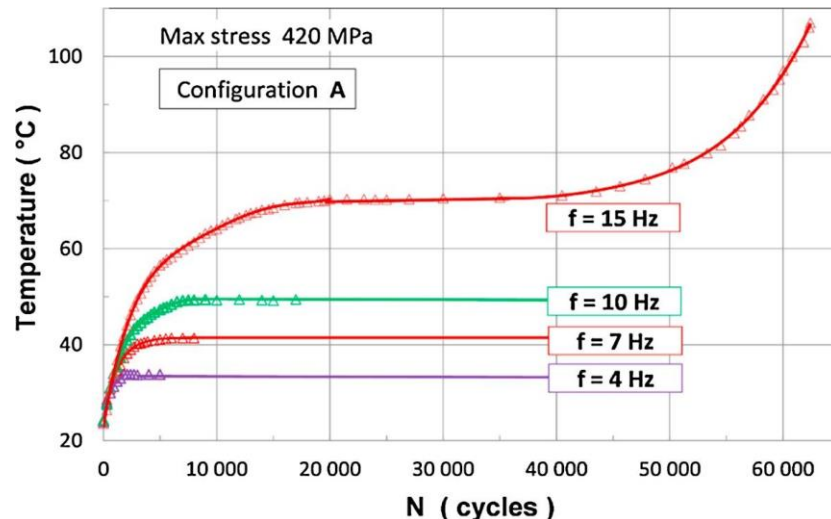
babcockTM

Why can't we fatigue test tidal blades resonantly?



$$L_{wind} > L_{tidal}$$

$$f_{1_{wind}} \ll f_{1_{tidal}}$$



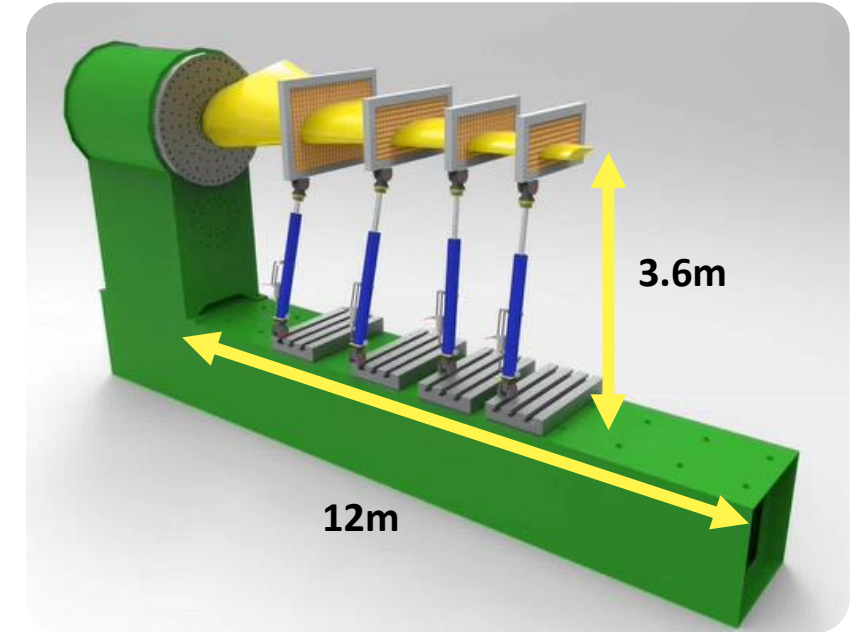
Due to their short length, tidal blades have a much higher first harmonic frequency than wind blades. If the load rate or frequency is too high, the composite cannot dissipate heat quickly enough and the polymer matrix fails as it approaches the glass transition temperature. This is complicated by thick sections in tidal blades. Hence, resonant frequency testing for tidal blades is not possible. **Hydraulic testing is needed, like for aircraft wings.**

<https://doi.org/10.1016/j.ijfatigue.2018.04.023>

Regenerative Hydraulics - the USP

8 x
FASTER

75%
Efficient

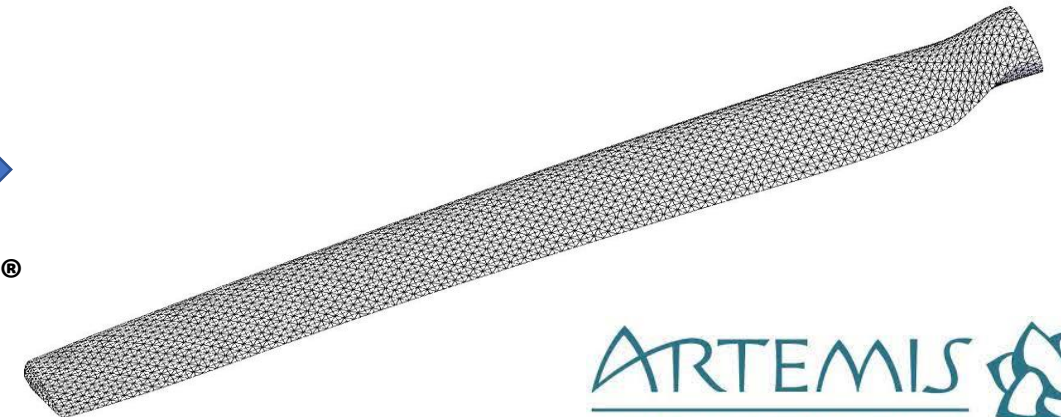
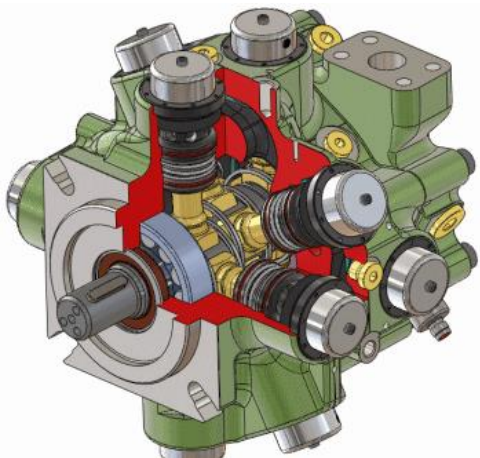


Schematic of 8.5m length tidal blade being tested on FASTBLADE reaction frame

Energy transfer from
kinetic to potential via
hydraulic circuit



Using Digital Displacement Technology®
from Artemis Intelligent Power Ltd.
<http://www.artemisip.com/>



How Do You Test a Blade?

Wind Blades

- DNVGL-ST-0376
- IEC 61400-23

Tidal Blades

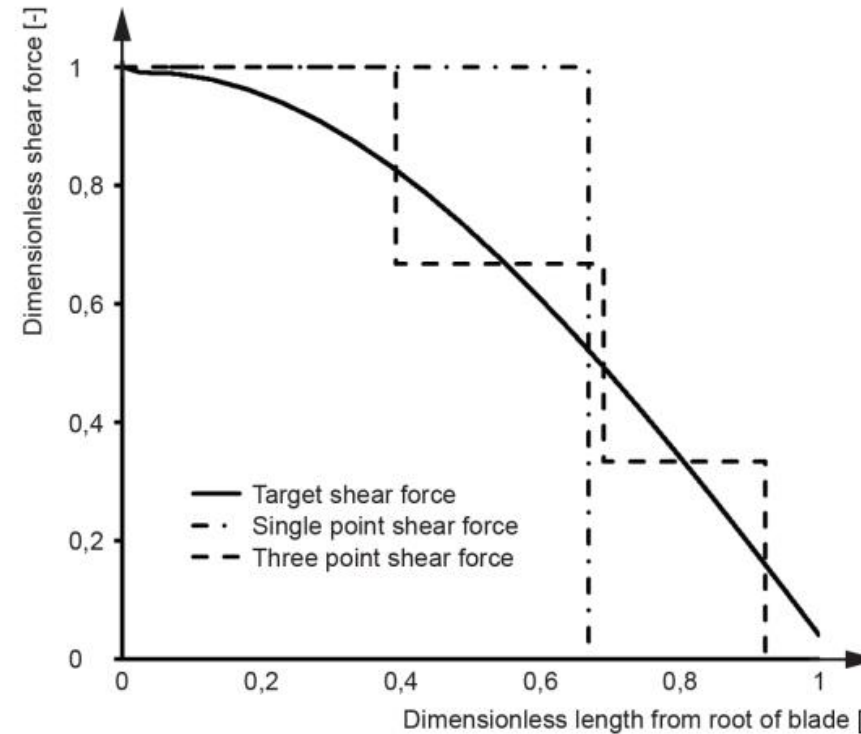
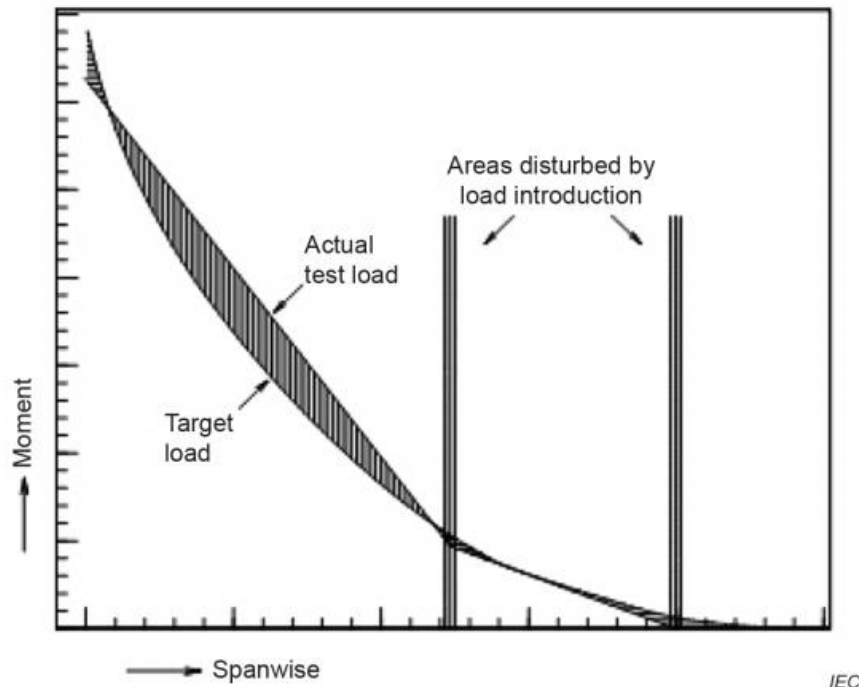
- DNVGL-ST-0164
- IEC 62600-3*



IEC TS 62600-3

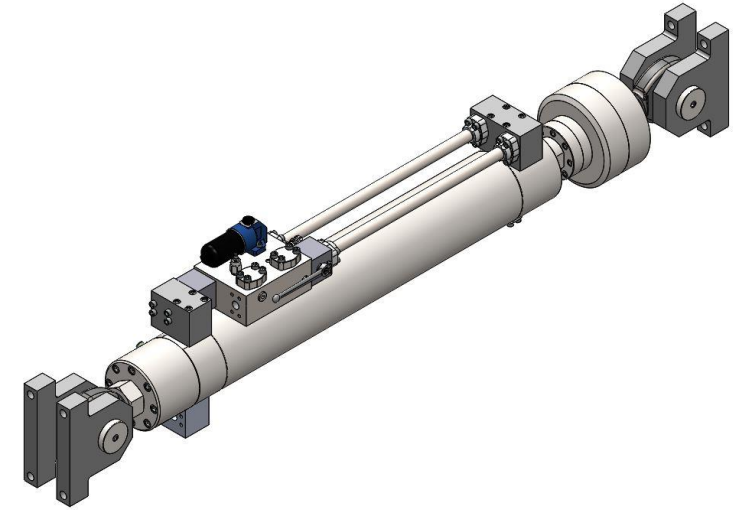
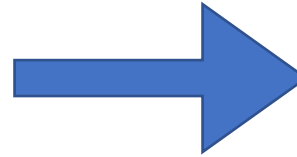
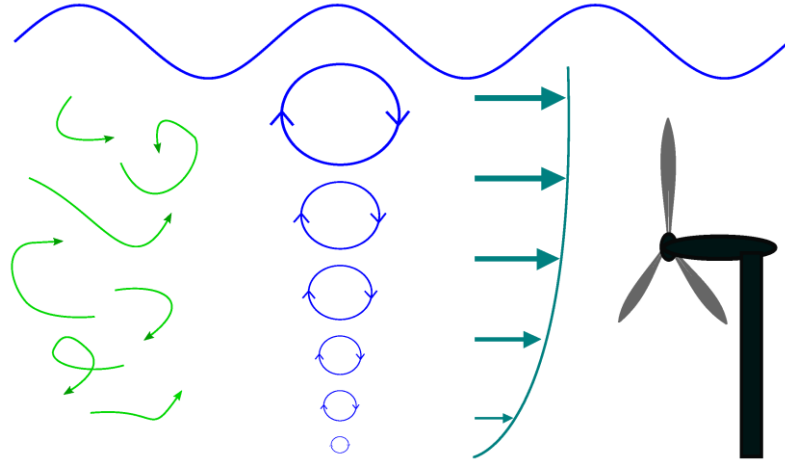
Edition 1.0 2020-05

**TECHNICAL
SPECIFICATION**

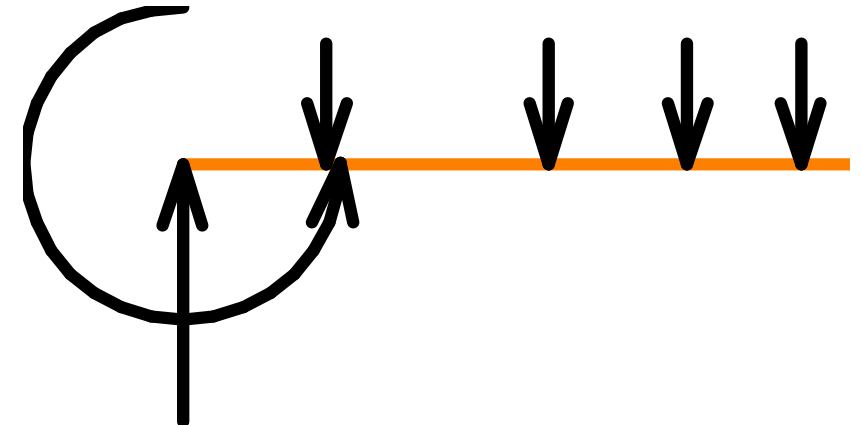
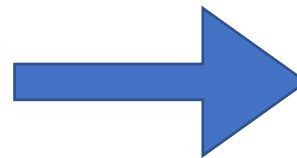
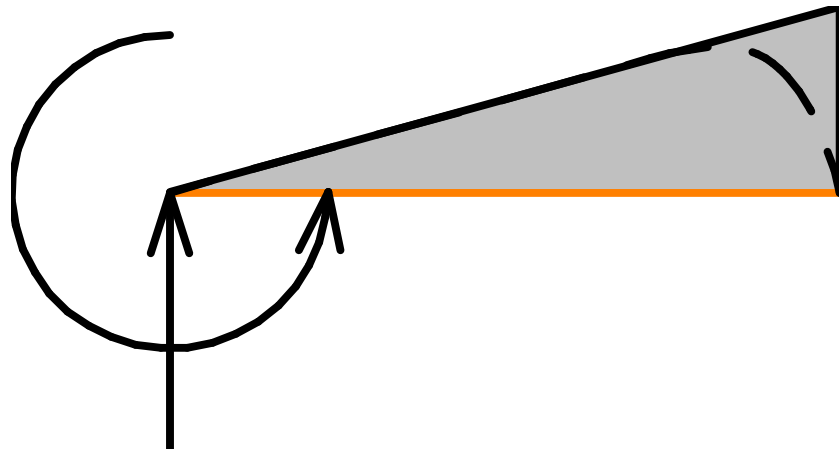


****Contribution from
Peter Nelson,
MEng Individual Project
Mechanical Engineering
University of Edinburgh
April 2020***

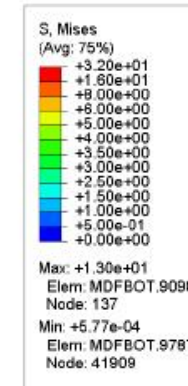
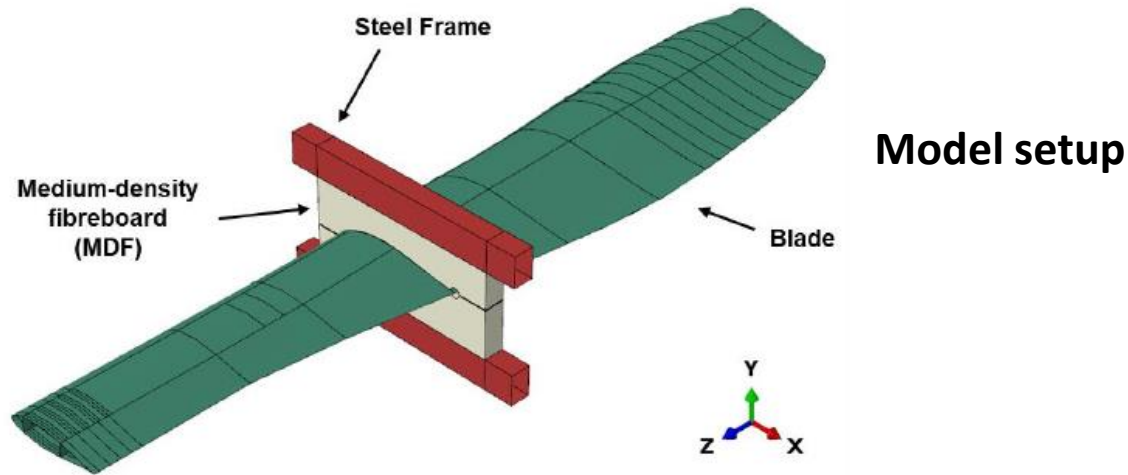
Load Simulation



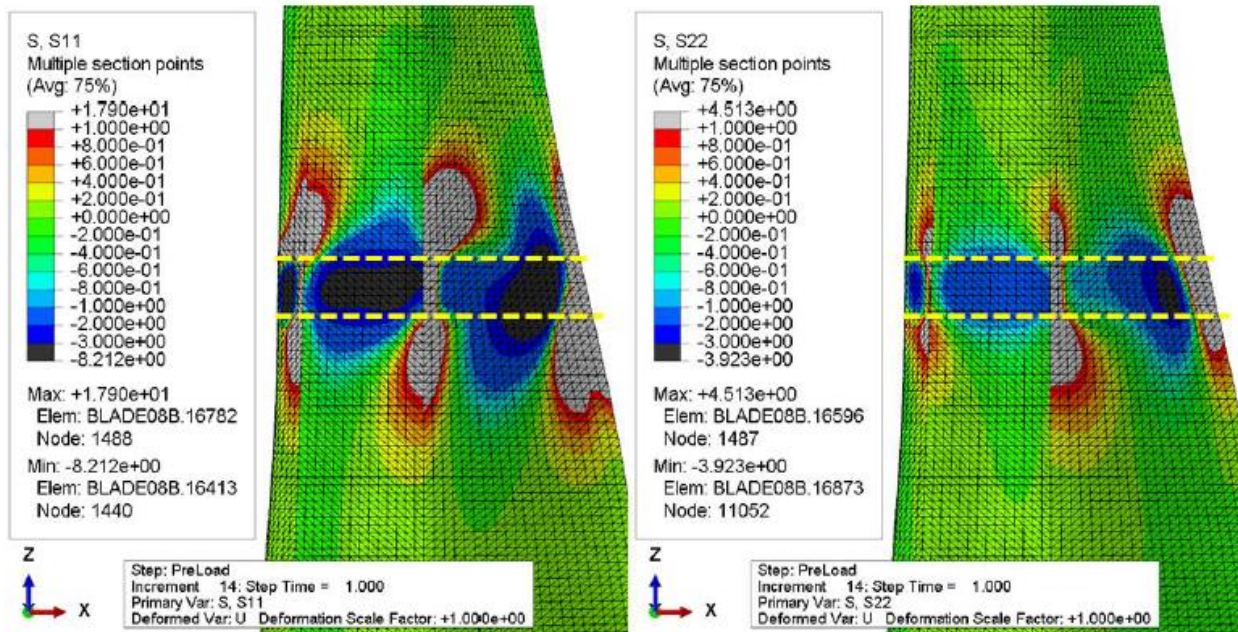
FOX-VPS LTD



Saddle Design and Local Loading*



Stresses on saddle



Stress concentrations in the fibre direction (left) and transverse directions (right) on the blade surface plies – dotted line shows the saddle contact area

**Work of Miguel Angel Valdivia, MSc Thesis, University of Edinburgh, August 2020*

Instrumentation Suite

National Instruments
DAQ and Control



Load Cell



Accelerometer



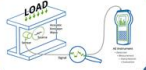
Laser Position



Strain



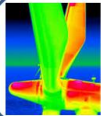
Acoustic Emission



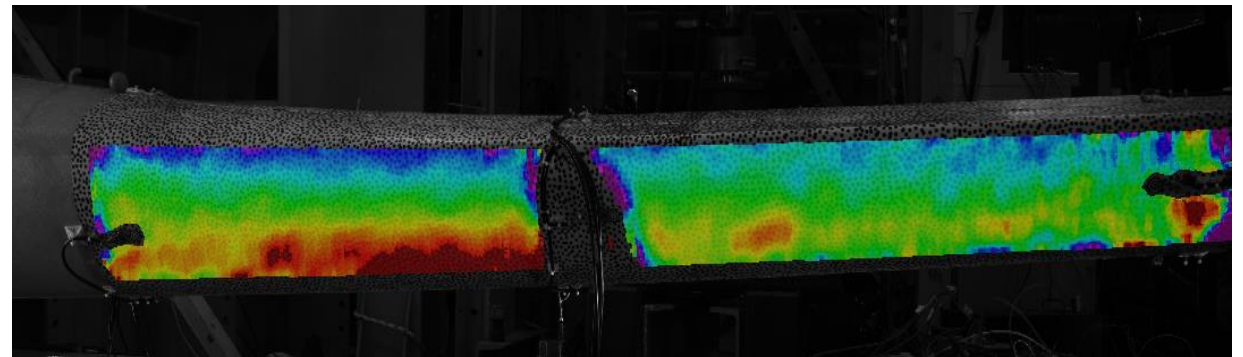
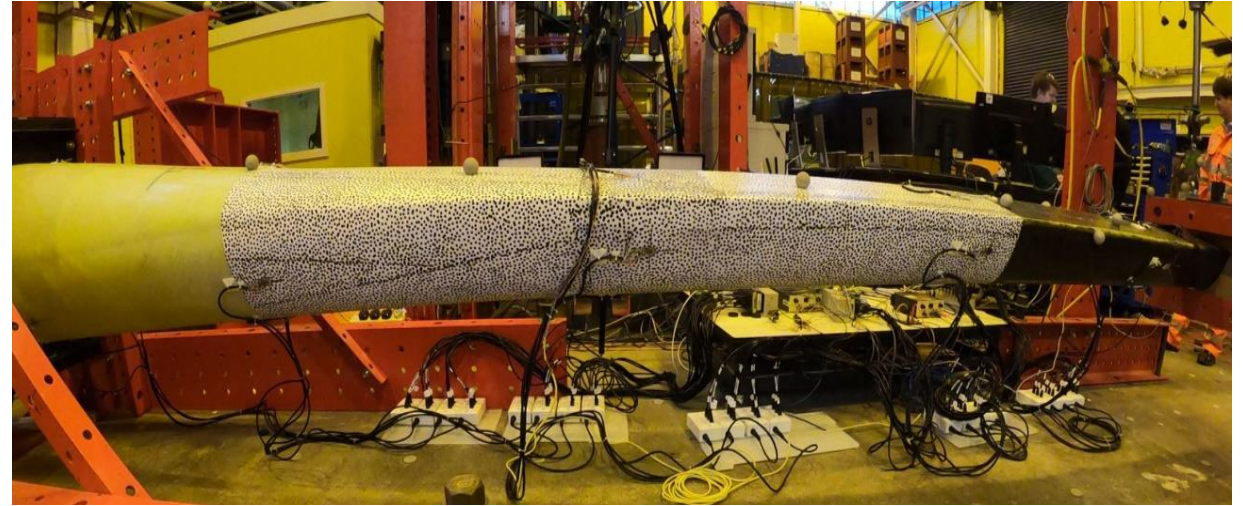
3D Digital Image
Correlation (DIC)



Thermographic Stress
Analysis (TSA)



Motion Capture



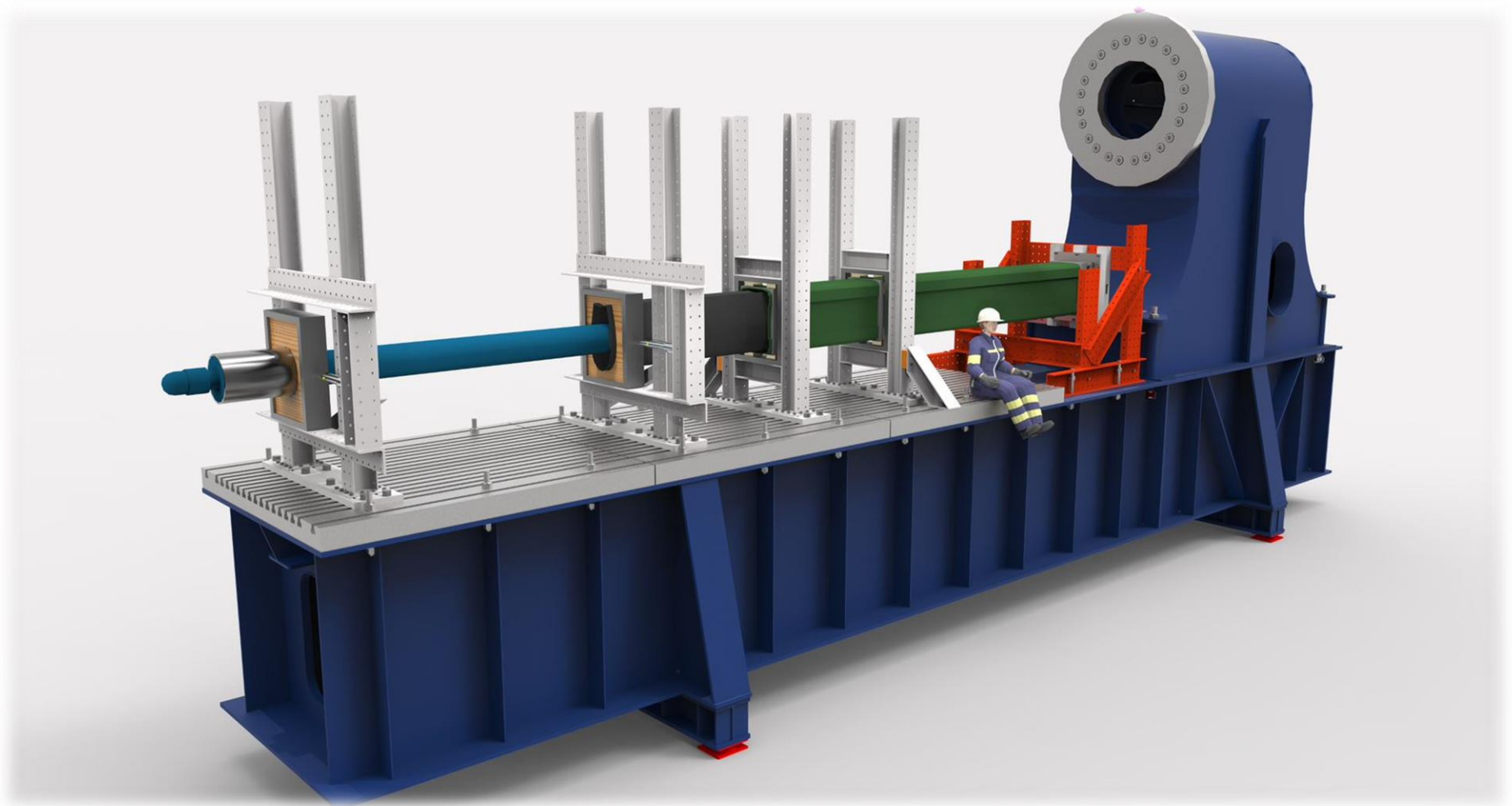
MatchID

Metrology beyond colors



APPLIED
MEASUREMENTS
LIMITED

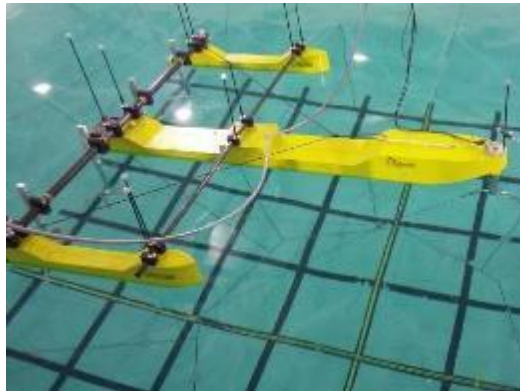
Other equipment



From scale models to prototype....



SCALE MODEL TESTING



Engineering and
Physical Sciences
Research Council



FULL SCALE DEPLOYMENT



The School of Engineering has experience with numerous developers. Above are two examples of scale model experiments at FloWave that have eventually led to full scale tidal energy prototypes being deployed.

Data from the ocean to the laboratory and back



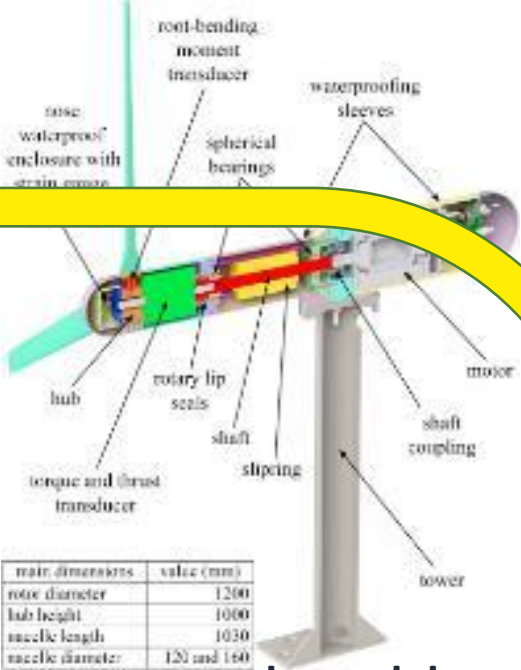
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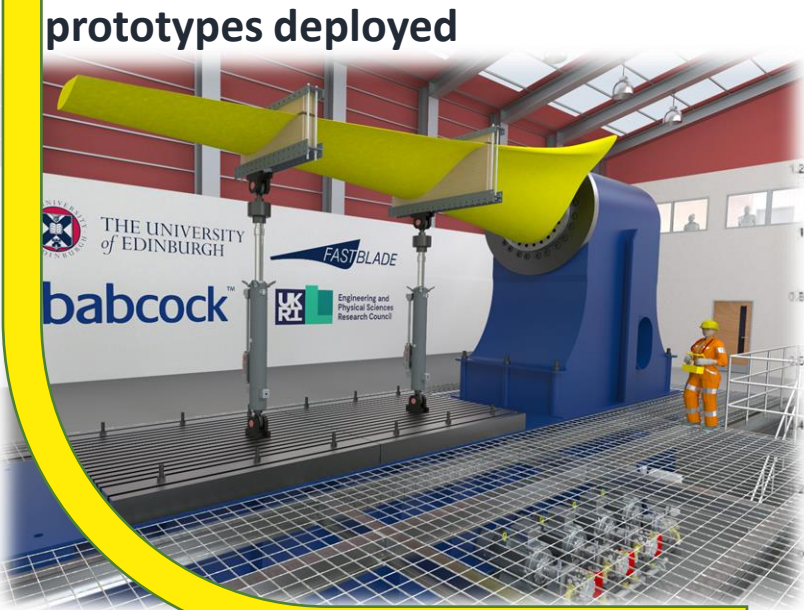
advanced ocean measurements



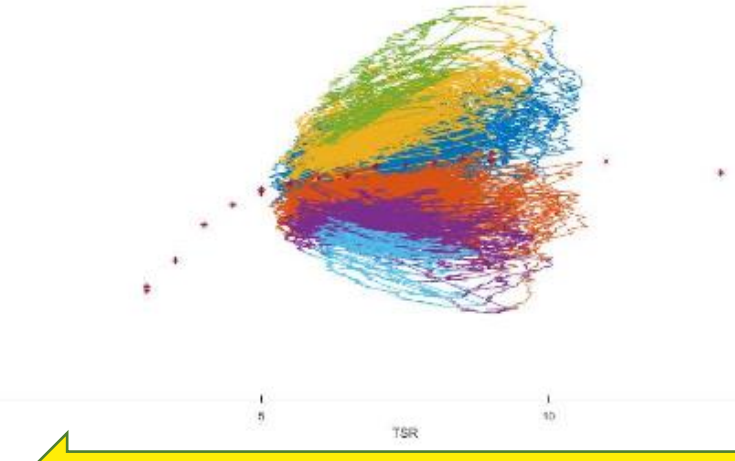
recreated and verified at scale



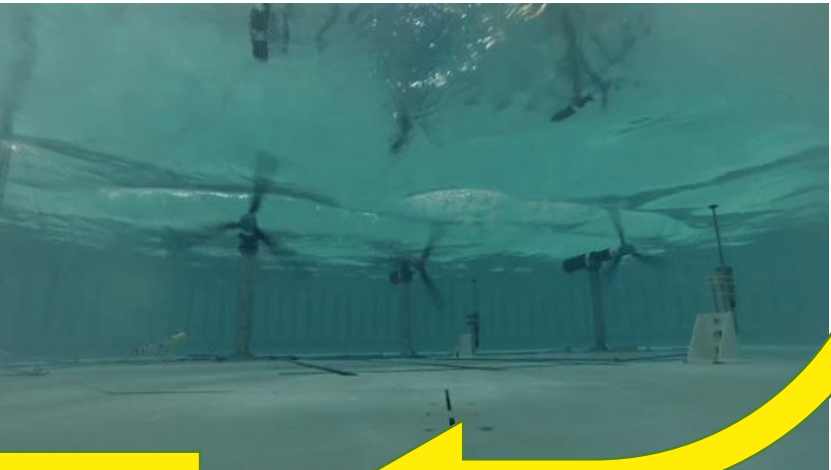
scale models



components tested for endurance



data collected, wrangled & analysed



tested in the simulated environment

FASTBLADE Digital Skills



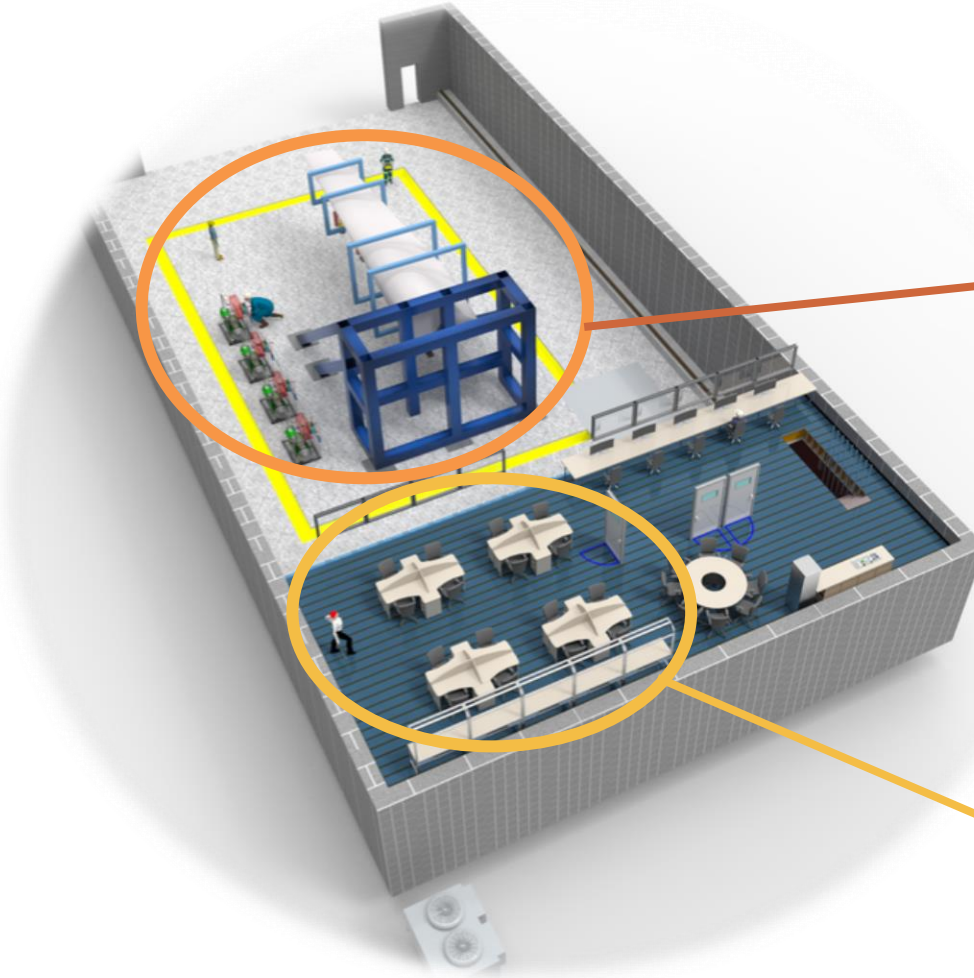
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INDUSTRIAL
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IN CONTEXT**



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IDCORE

<https://www.idcore.ac.uk/>



Contact & Questions



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Thank you, are there any questions?

Email: jeff.steynor@ed.ac.uk

Website: www.fastblade.eng.ed.ac.uk



Prof Conchúr Ó Brádaigh
Head of School and
Chair of Materials Engineering



Senior Experimental Officer
School of Engineering
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