Resilient Integrated-Coupled FOW platform design methodology (ResIn)

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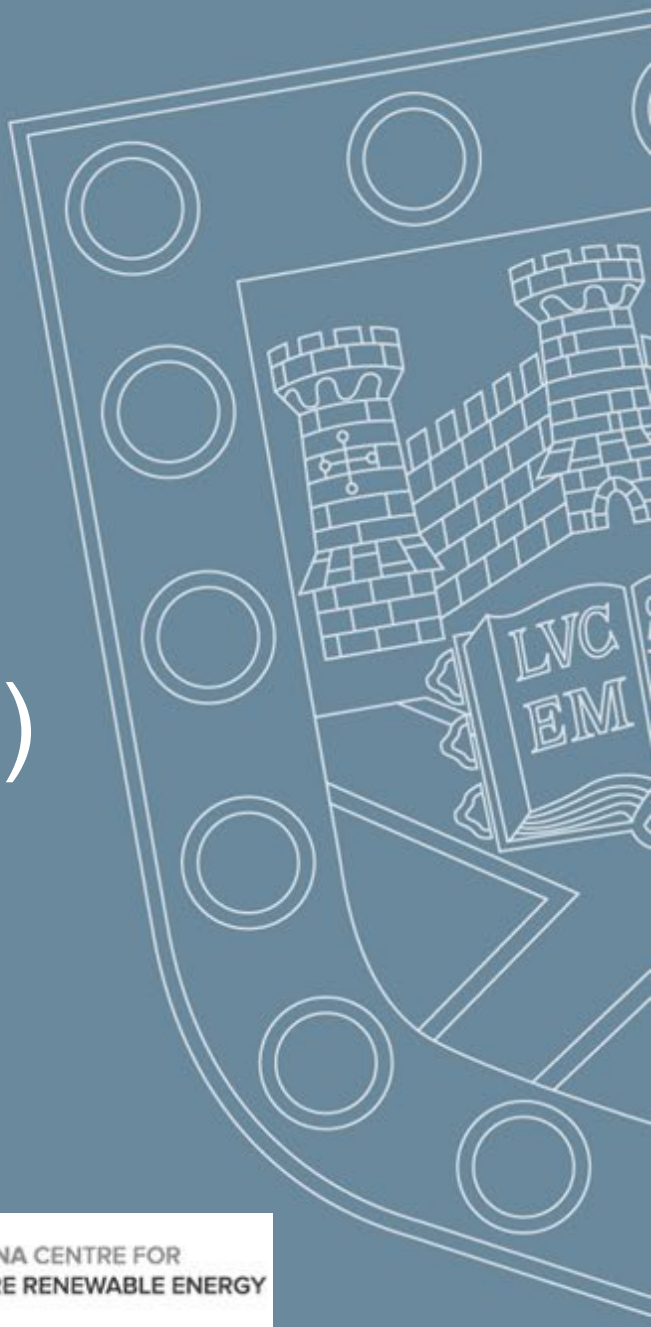
Supergen Annual Assembly, 6th Nov 2019, Glasgow



EPSRC
Engineering and Physical Sciences Research Council

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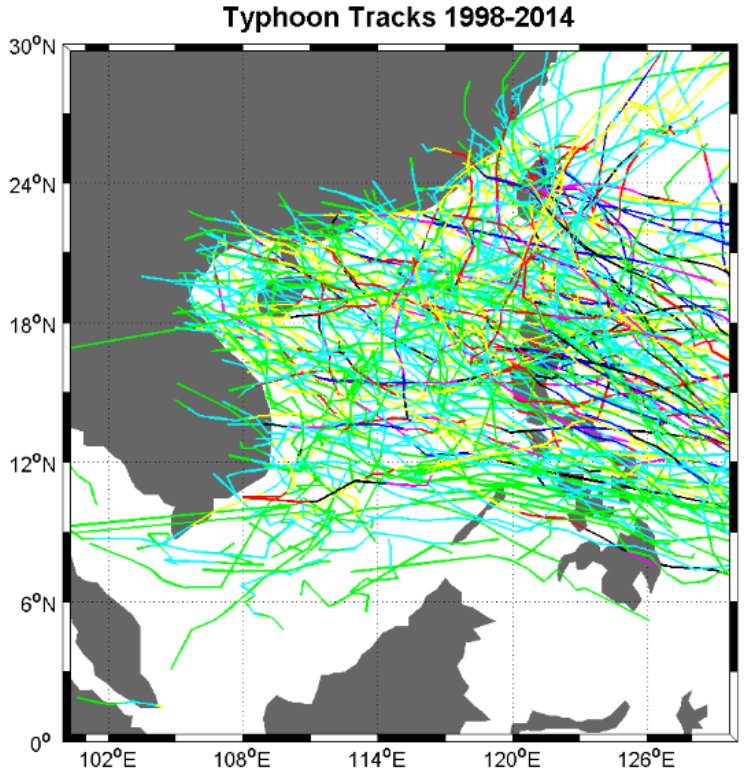
UK&CHN | CORE
UK & CHINA CENTRE FOR OFFSHORE RENEWABLE ENERGY

Project Aim

- Enhance the design and development of floating offshore wind as commercially viable electricity infrastructure
- Develop a risk based approach to build resilience against extreme events.



Academic Partners

University of Exeter
- Design innovations
- CFD modelling
- Structural reliability assessment

University of Edinburgh
- Environmental modelling
- Physical testing
- CFD coupling

University of Bath
- Particle-In-Cell (PIC) modelling method

Dalian University of Technology
- OWC damper
- Physical testing
- Hydrodynamic modelling
- Concrete materials

Zhejiang University
- Environmental conditions

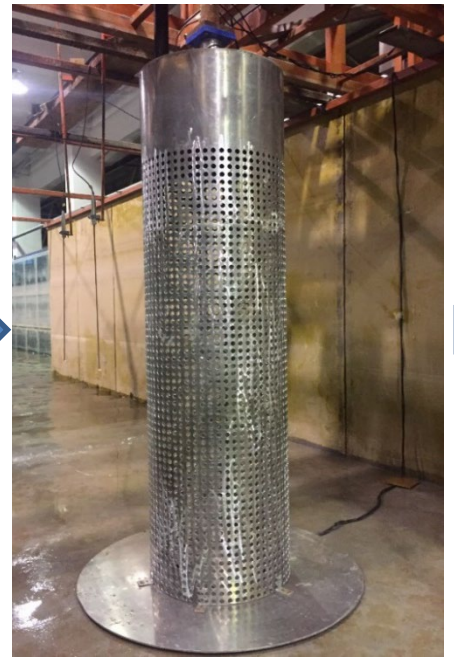
Porous structures in offshore engineering

- Used for energy dissipation and load reduction
- Applications:
  - Fixed & floating breakwaters
  - Tuned liquid dampers
- Can porous materials be beneficial for FOWTs?

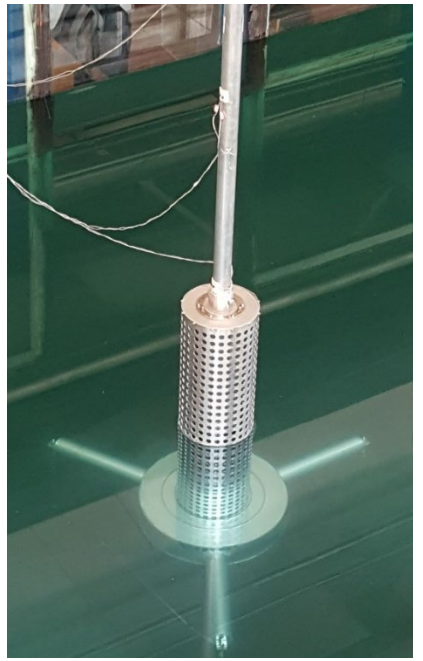
Approach:

1. Develop numerical model for floating porous structures
2. Experimental validation cases
3. Design exploration and optimisation

Flat porous sheets



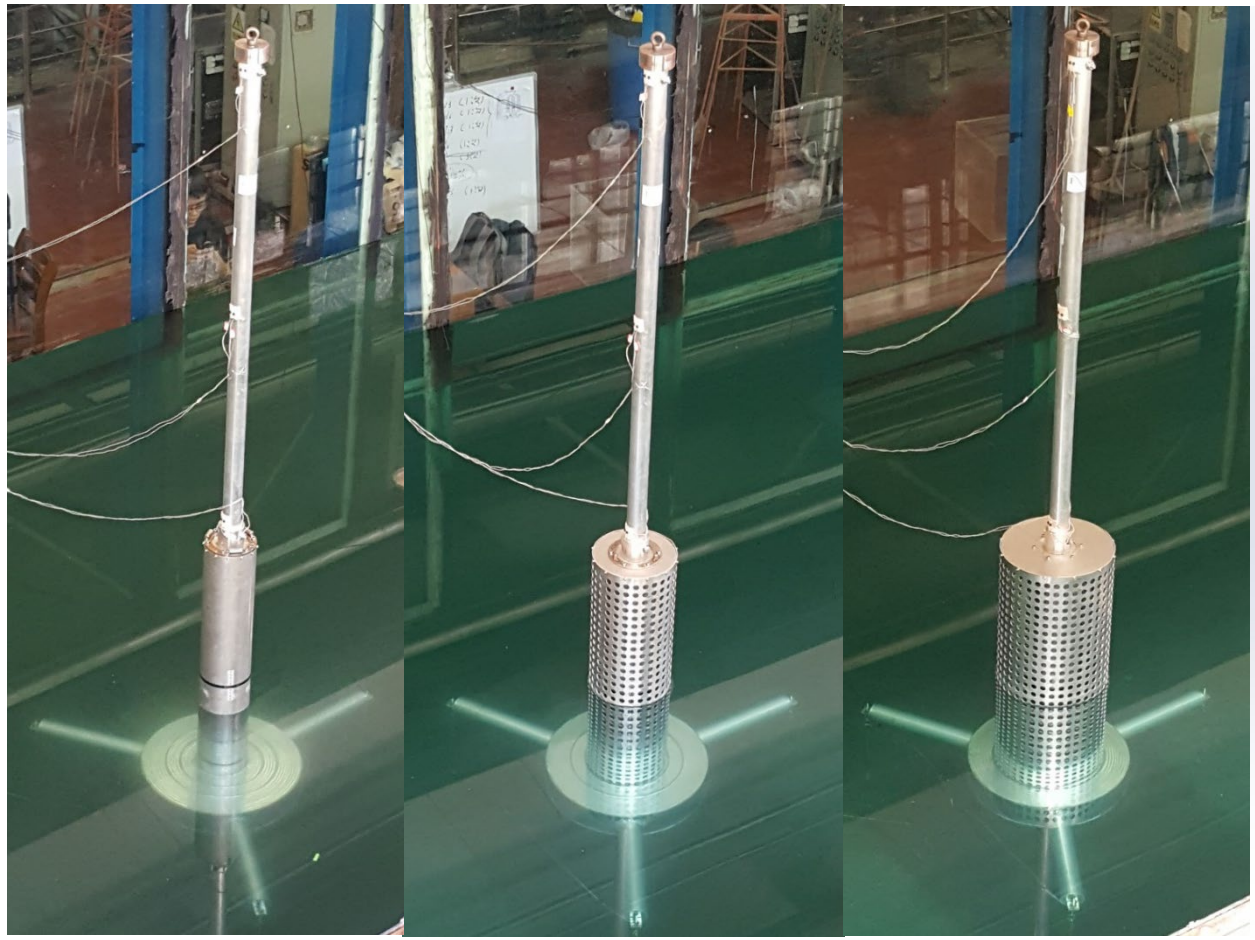
Fixed porous cylinders

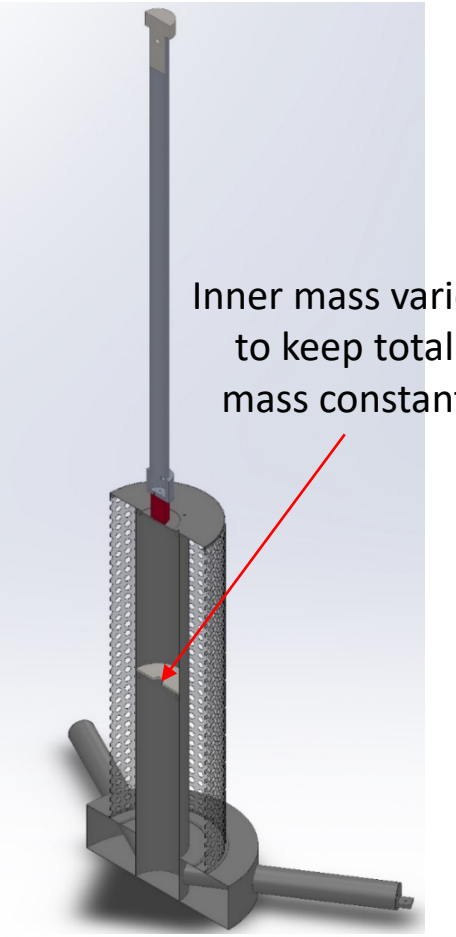


Floating porous cylinders (1:50 TLP wind turbine)

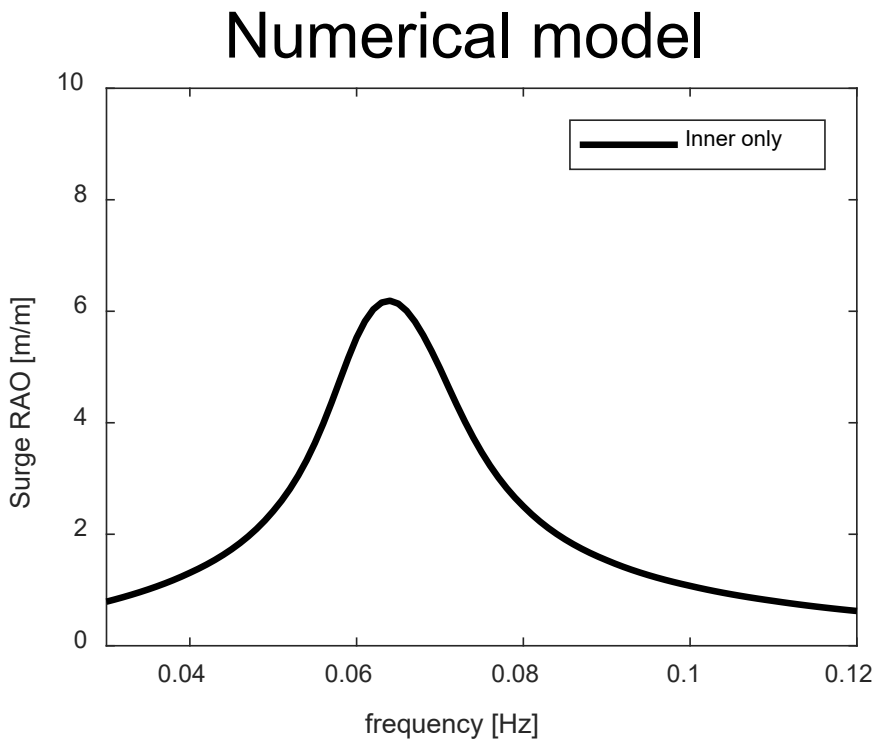
TLP model design

- Simplified 1:50 scale FOWT model
- Changeable porous outer cylinder
- Objective: numerical validation – not optimised design



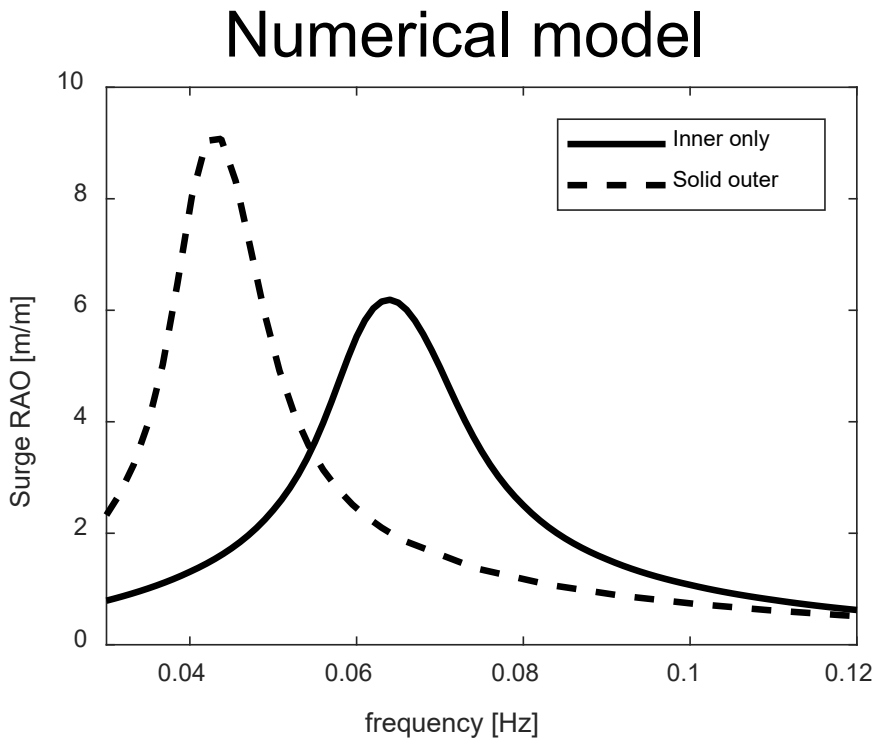


Regular wave RAO



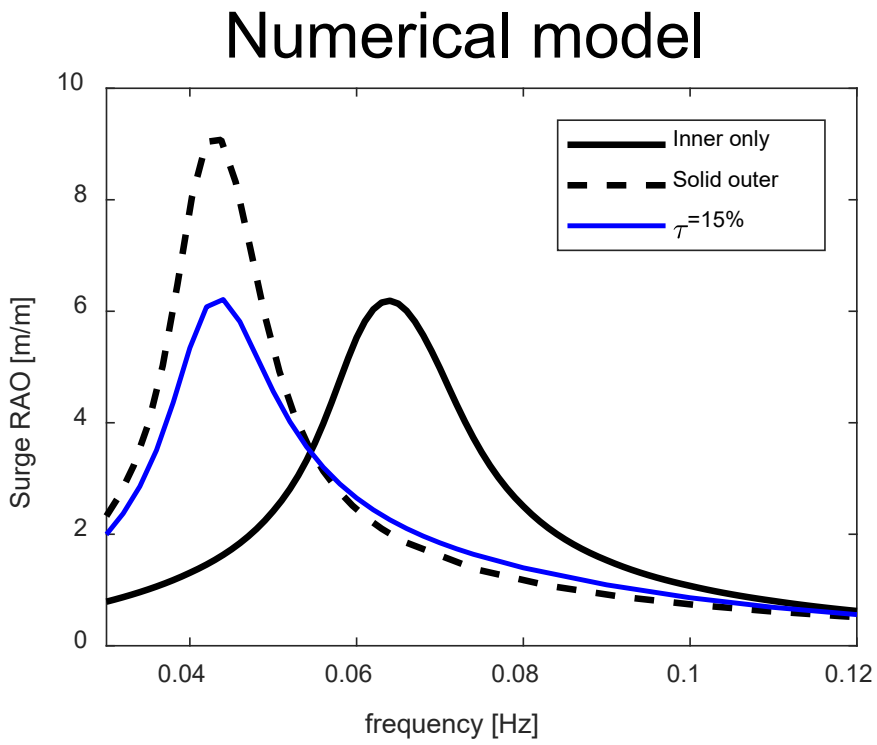
Regular wave RAO

- Solid outer moves resonant peak to lower frequency



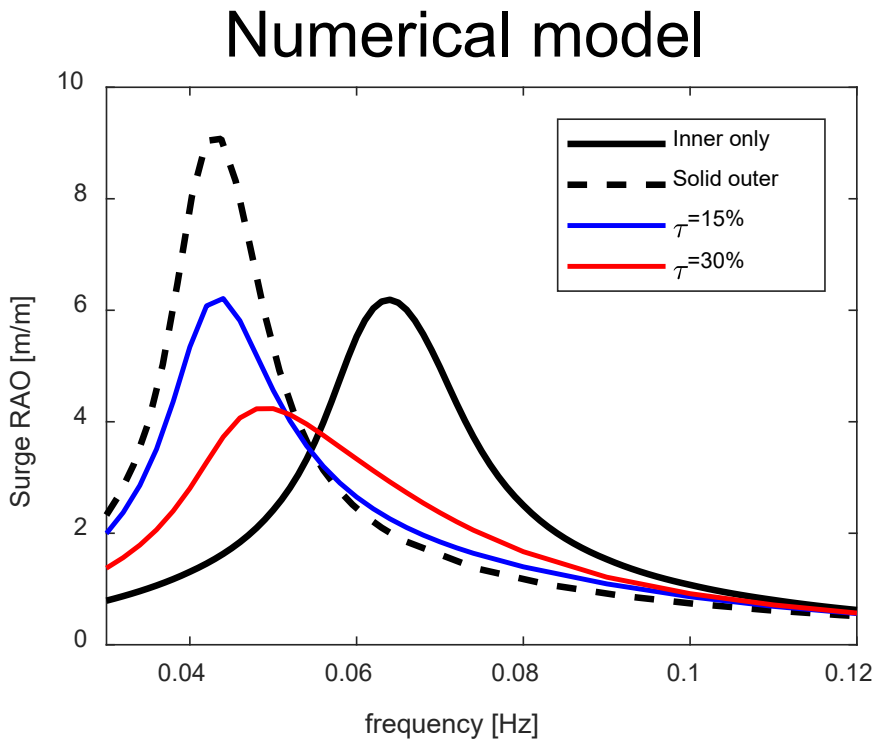
Regular wave RAO

- Solid outer moves resonant peak to lower frequency
- Response for lower porosity close to solid outer



Regular wave RAO

- Solid outer moves resonant peak to lower frequency
- Response for lower porosity close to solid outer
- Higher porosity in between, but with lower peak



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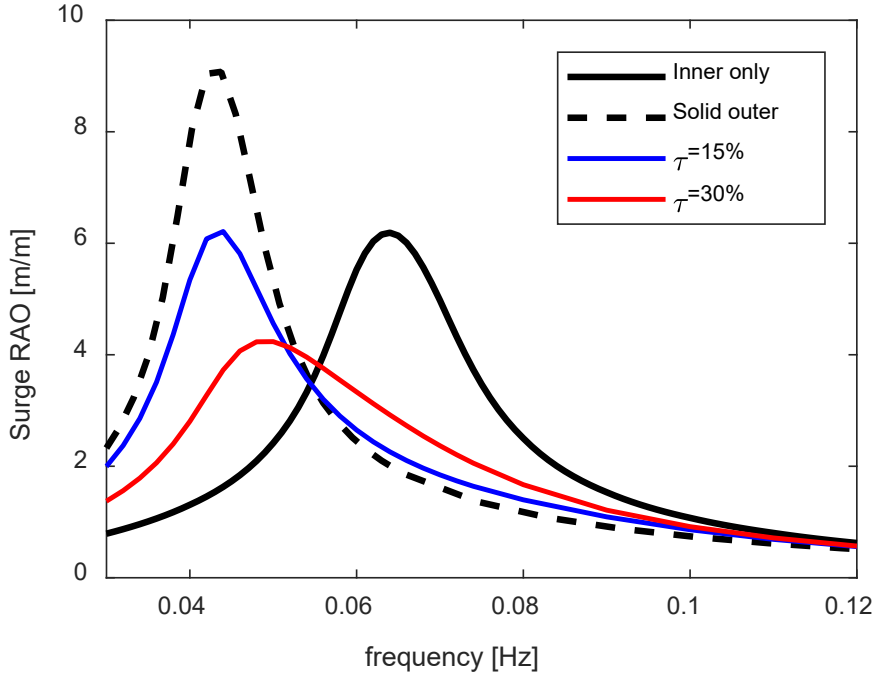
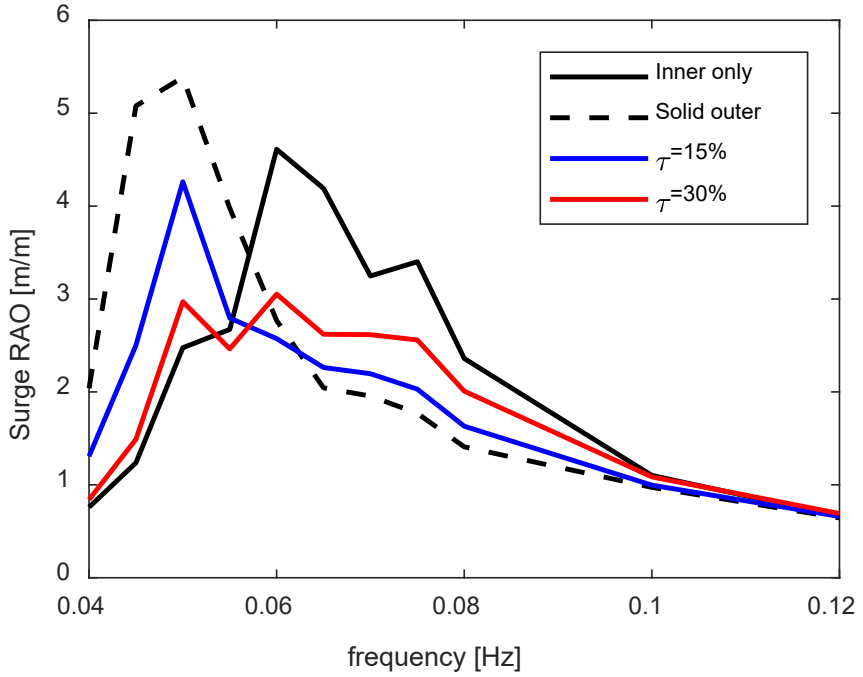
Numerical model

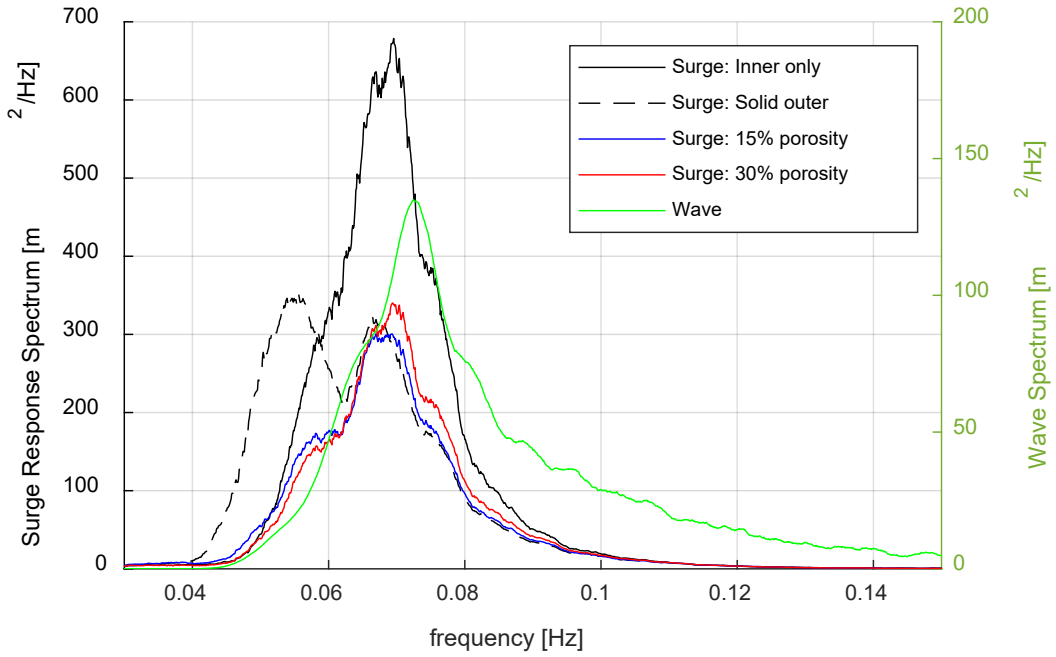


Tank test

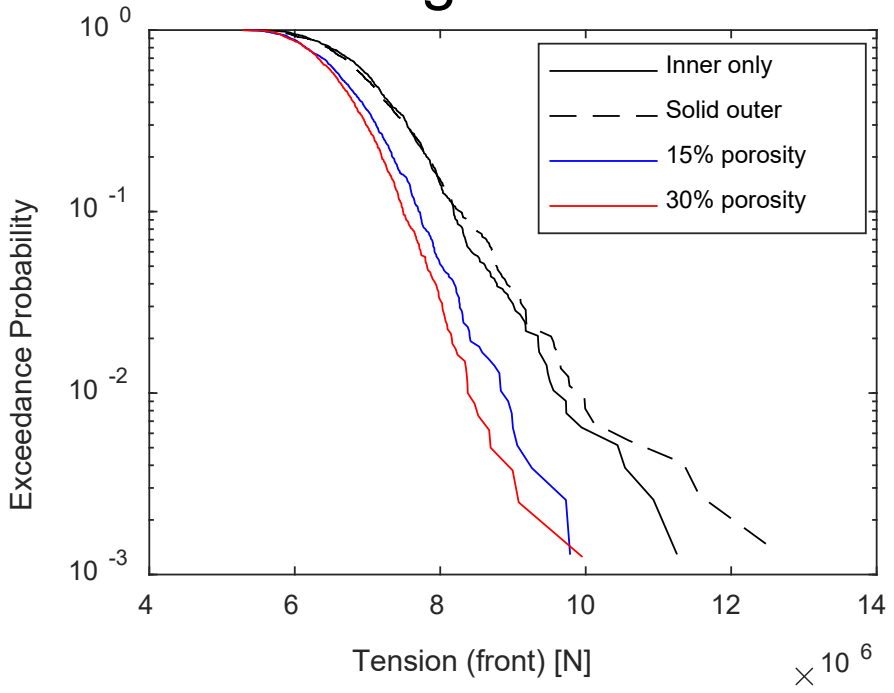


Irregular wave response

Motion response



Mooring line tension



Irregular directionally spread waves Hs=8m, Tp=14s

Conclusions

- Numerical predictions and tank test results indicate that porous structures may be able to reduce platform motions and loads on turbine and mooring
- Potential for cost reduction for structure and mooring
- Potential for improved energy capture

Next steps

- Studies with other platform types (spars + semi-subs)
- Design optimisation & detailed engineering analysis

Thanks for your attention

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