

# COUPLED STRUCTURAL ANALYSIS OF A FLOATING OFFSHORE WIND TURBINE



Author: Ignacio Fabregas Claramunt

Tutor: Pau Trubat Casal

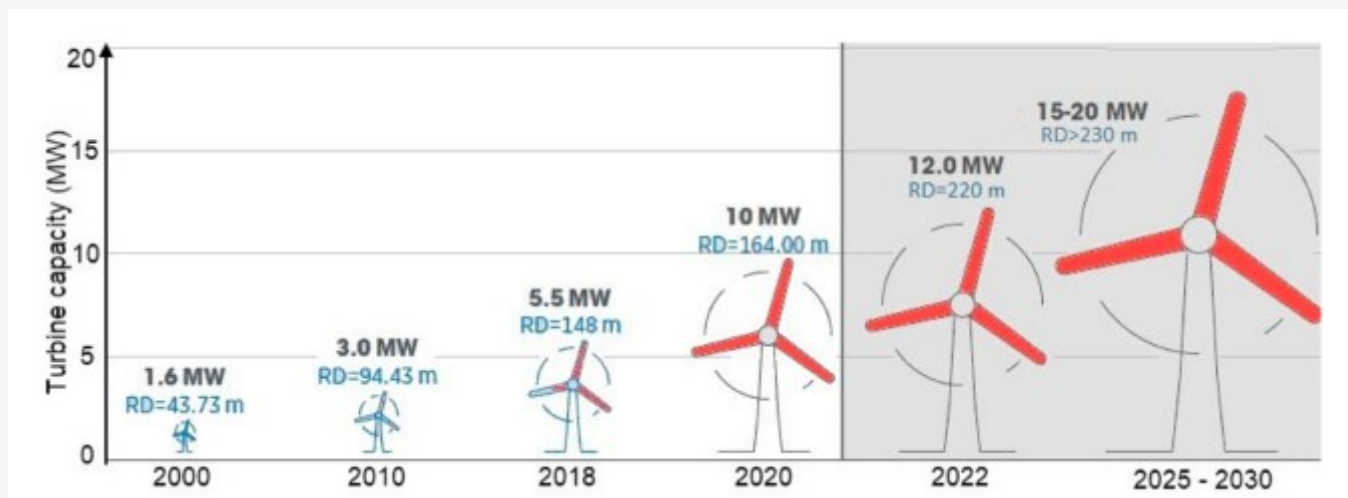
Master's degree in Naval Architecture and Ocean Engineering

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## Introduction

- Trends in FOWTS → larger rotor sizes:
- ↑ Structural elasticity.
  - ↑ Fatigue damage.
  - ↑ Simulation complexity.

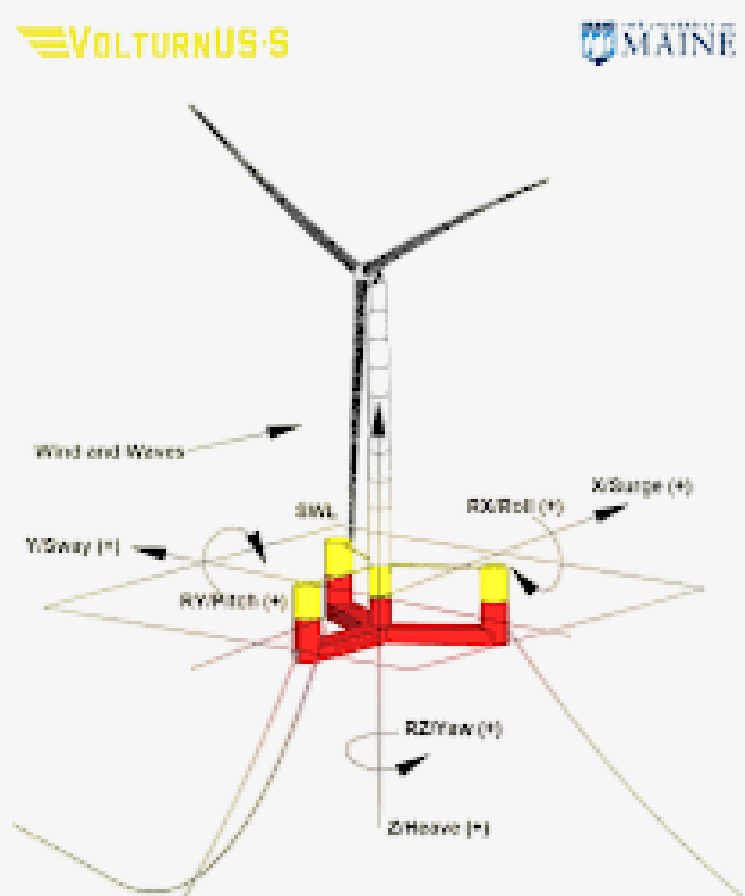


Simulation needs:

- Coupled aero-hydro-servo-elastic simulations.
- Integrated load analysis.

## Case study

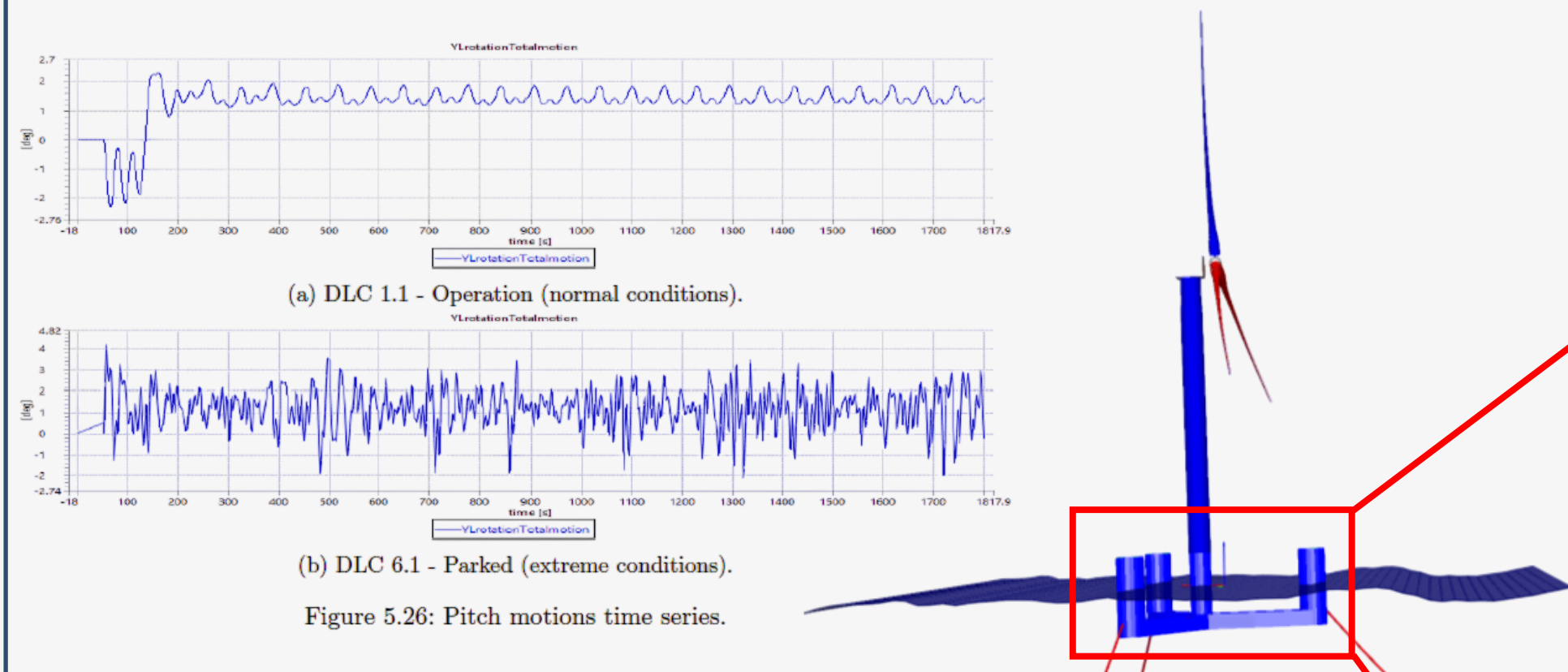
The VoltturnUS semi-submersible platform, paired with the IEA 15 MW wind turbine, is used as the case study.



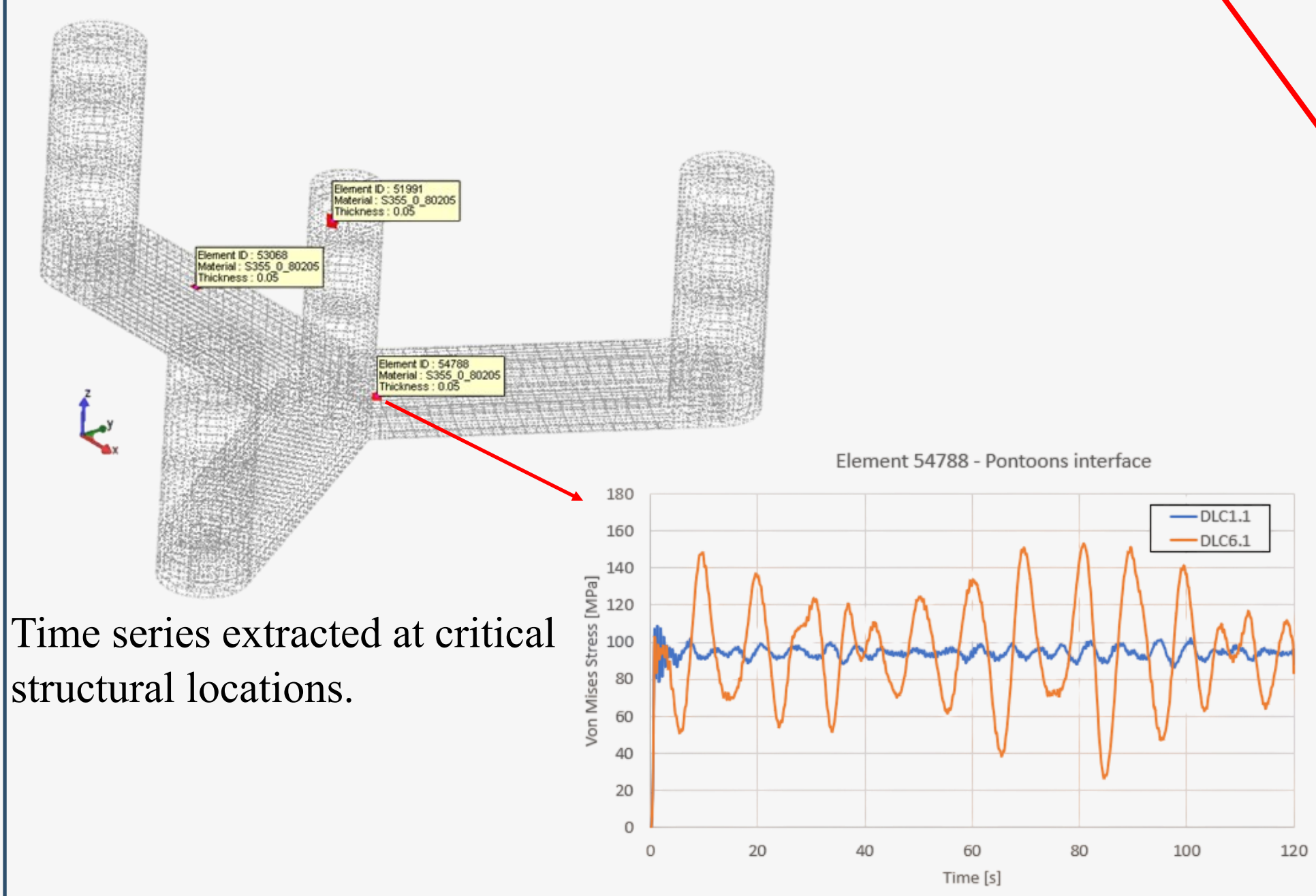
Turbine rating	15	MW
Draft	20	m
Total mass	20,093	t
Platform mass	17,893	t
Tower mass	1,263	t
RNA mass	991	t
Water Depth	200	m
Mooring	3 line chain catenary	

## Coupled analysis in SIMA

Time-domain analysis is performed under two different design load cases.



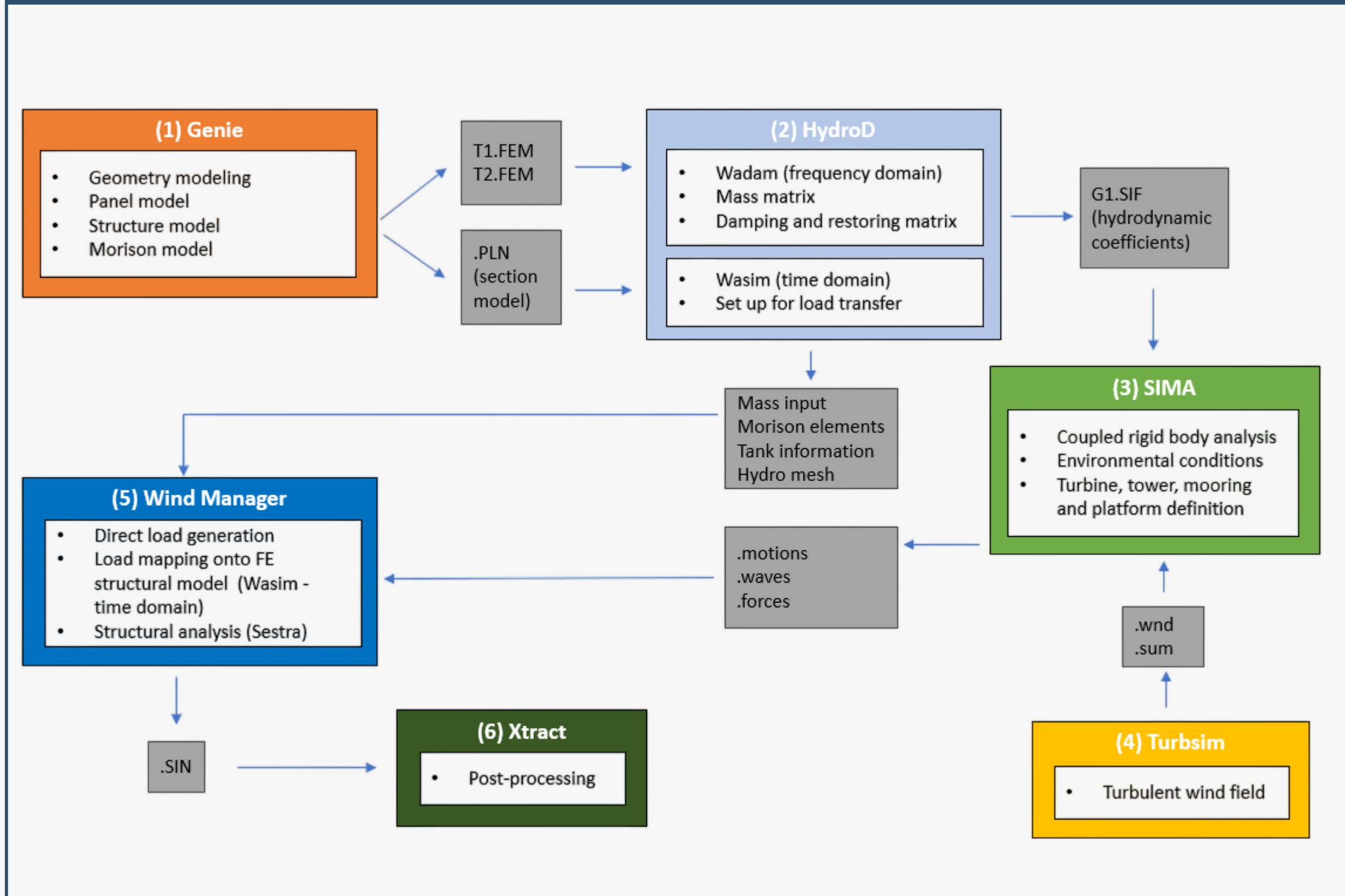
## Hotspots time series tracking



## Objectives

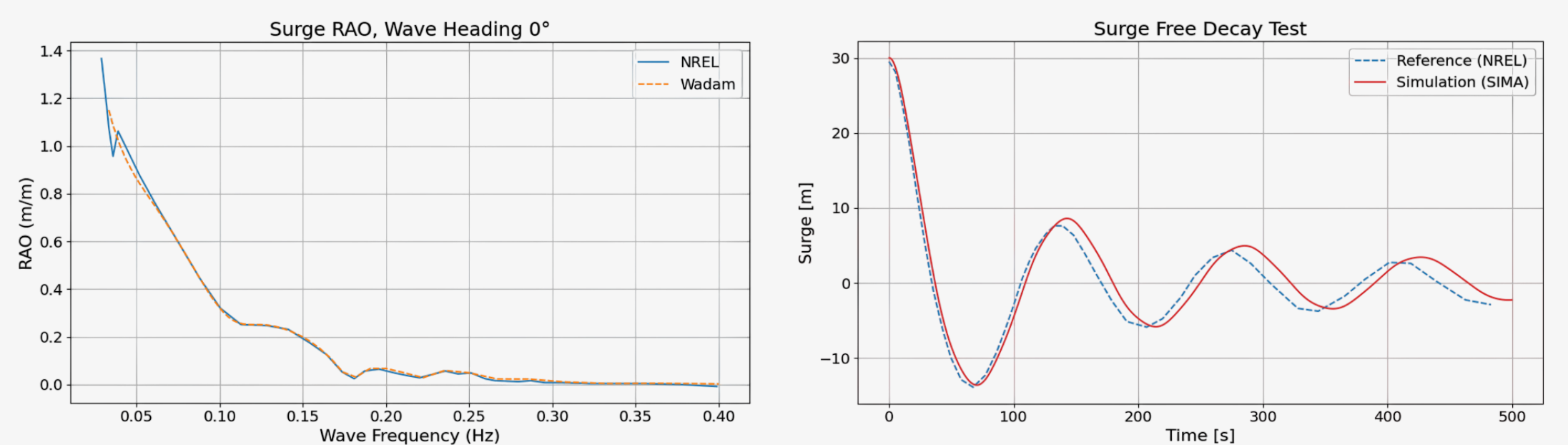
- Implement a fully coupled structural analysis for a reference FOWT using DNV's Sima software suite with the "Direct Load Generation" workflow.
- Define site conditions and realistic design load cases (DLCs).
- Design an internal structural layout that can withstand the applied DLCs.
- Evaluate the efficiency of the coupled analysis workflow in Sesam.

## Methodology in Sesam



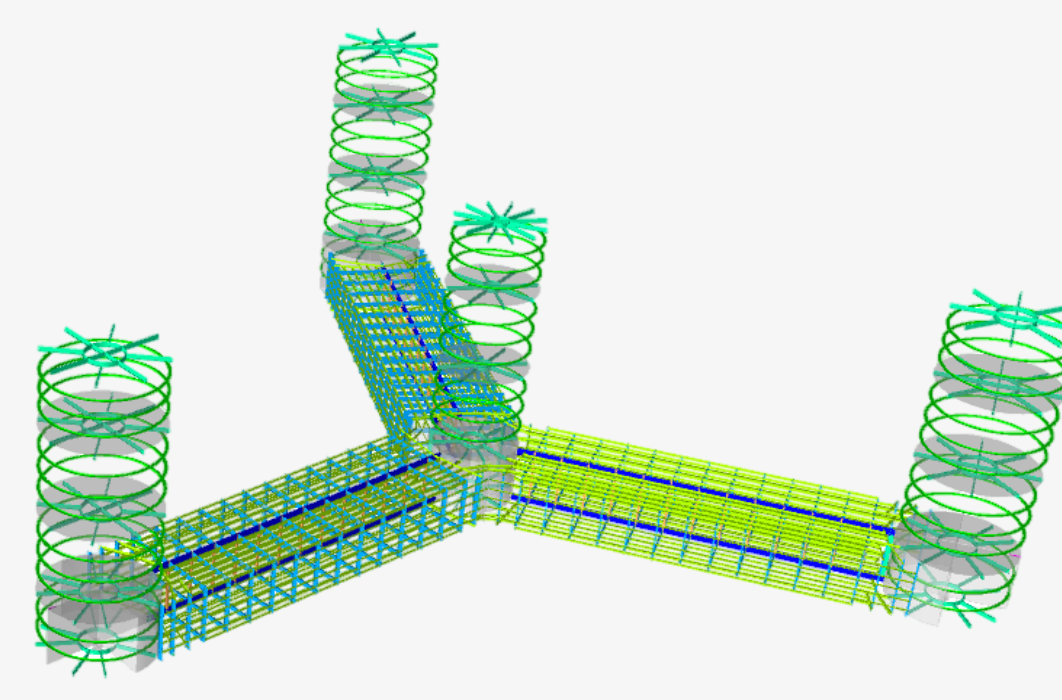
## Model verification

The structural design is verified against benchmark RAOs and free decay tests.

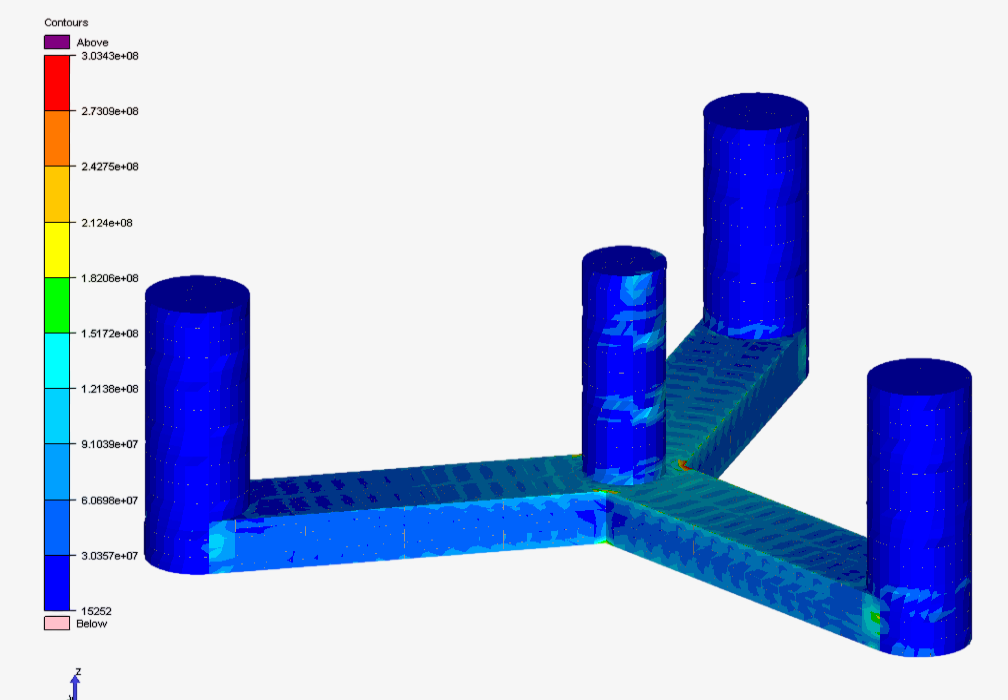


## Structural analysis

Proposed structural layout.



Load transfer. Von Mises stresses shown.



## Conclusions

The tested fully coupled workflow has a series of strengths and limitations:

Advantages	Disadvantages
Goes beyond structural beam theory.	Computationally expensive.
Enables detailed structural analysis and accuracy.	Not practical to test all DLCs required for
Avoids partitioned strategies, reducing uncertainties and improving the design reliability.	Less suitable during early design stages when testing numerous configurations.

- The proposed structural layout has shown to withstand the applied DLCs.
- Although computationally demanding, this workflow provides valuable insights to the structural response of FOWTs.