A Comparative Assessment between Sequentially and Integrated Coupled Analysis Solutions for Offshore Wind Turbine Sub-Structures

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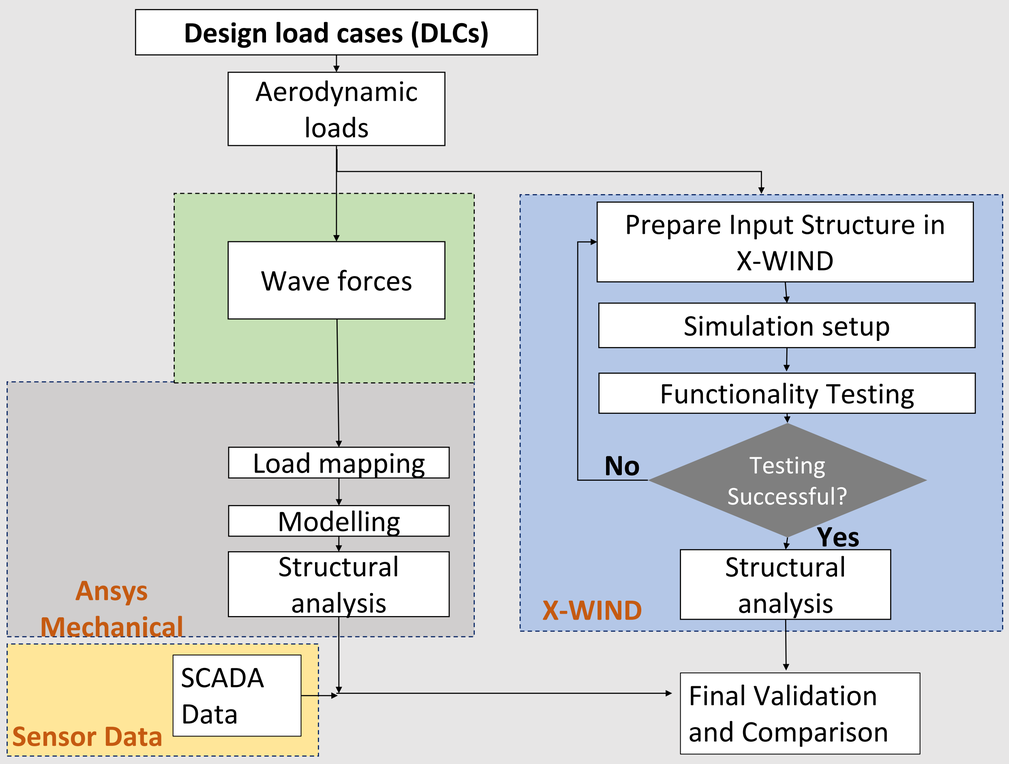
Introduction

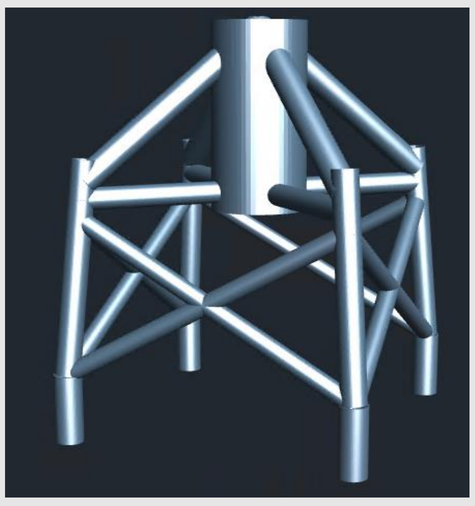
- Offshore wind energy has rapidly evolved as a critical component of the global renewable energy landscape
- With this increase in demand there is a need to improve simulation capabilities. This is particularly applicable with the sub-structure where the structural response can have a substantial impact on the rest of the turbine.
- This work looks to compare two separate methods and software tools (ANSYS, OpenFAST and X-WIND) by simulating a fixed (7MW Levenmouth Demonstration Turbine) and floating (IEA 15MW Umaine VolturnUS-S RWT) sub-structure

Methodology - Fixed



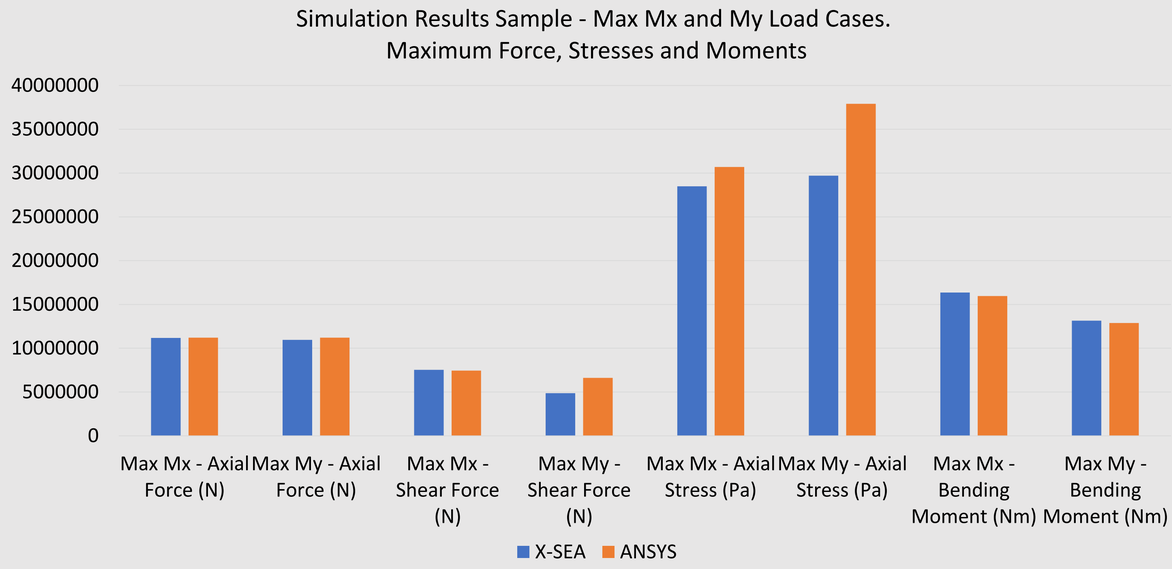
- Bladed is used to run a full suite of DLCs to identify key aerodynamic loads
- Wave forces were determined via Morisons's Equation due to lower water depths
- These loads are fed into ANSYS and X-SEA for structural analysis
- Results are also compared with strain gauge data for validation

	X-SEA	ANSYS
Number of Nodes	106	413
Number of Elements	156	213

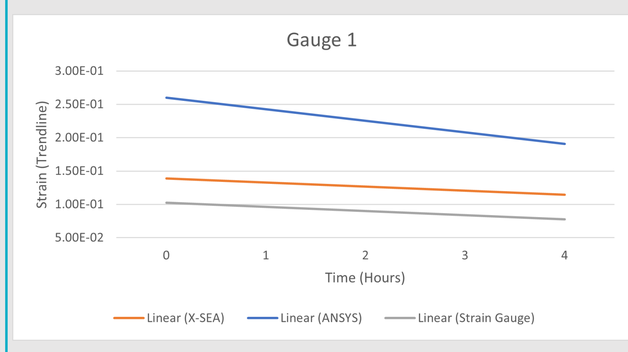


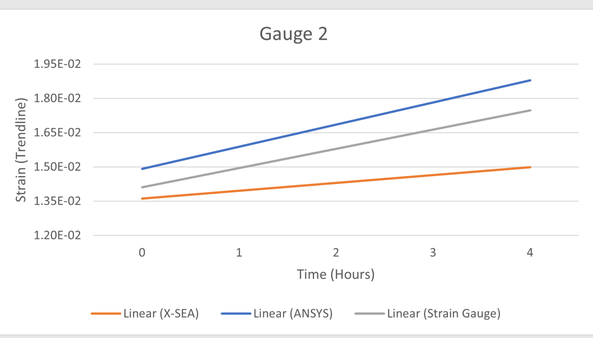
Render of Jacket Sub-Structure in X-SEA

Results - Fixed



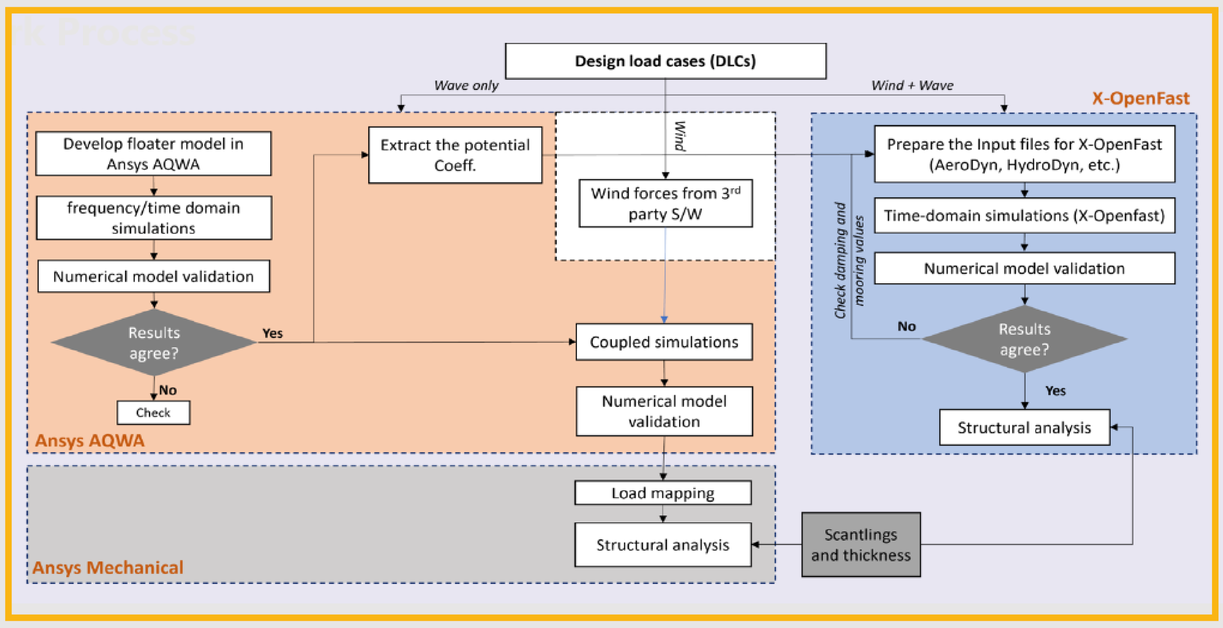
Sample of results when both ANSYS and X-WIND models are run under maximum Mx and My conditions





Comparison with strain gauges - completed by taking data over a 4-hour period and trending accordingly

Methodology - Floating/ Future Work



Conclusion

- Fixed sub-structure structural analysis results appear closely correlated albeit with noticeable load differences in certain areas
- Strain gauge results were positive and showed that the simulated results followed similar trends with real-life strain data. These results could be bettered with more detailed modelling,
- Because of differences with meshing tools, getting identical modelling setups was very difficult and is the primary cause of these discrepancies.
- Completely integrated floating structural analysis is now underway

References

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3. ORE Catapult. (2022). 7MW Levenmouth Demonstration Turbine. https://ore.catapult.org.uk/what-we-do/testing-validation/levenmouth/
4. Allen, C., Viscelli, A., Dagher, H., Goupee, A., Gaertner, E., Abbas, N., Hall, M., & Barter, G. (2020). Definition of the UMaine VolturnUS-S reference platform developed for the IEA wind 15-Megawatt offshore reference wind turbine. https://doi.org/10.2172/1660012

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