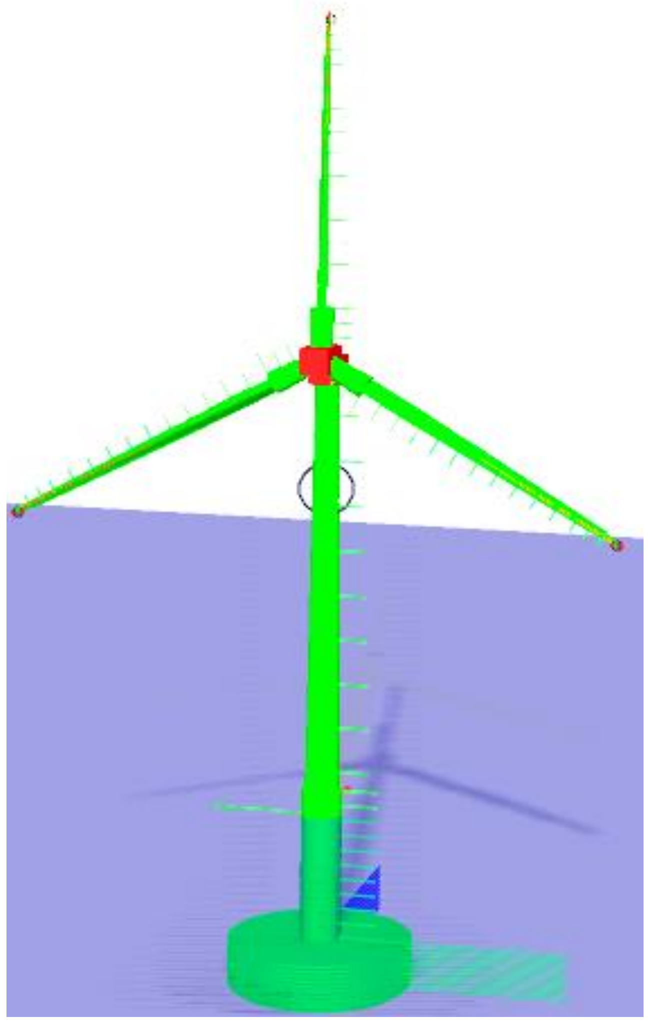
TIME DOMAIN SIMULATION PARAMETERS FOR FATIGUE ASSESSMENT OF AN OFFSHORE GRAVITY BASED WIND TURBINE

OBJECTIVE & SCOPE

The present thesis examines the sensitivity of fatigue damage estimation to simulation parameters, such as number of realizations. So, time domain simulations will be carried out to compute fatigue assessment for a 5 MW offshore gravity based wind turbine. By means of time and frequency domain simulations, decay as well as wind turbine performance tests the cumulative fatigue damage estimation has been obtained for several points along the structure.

INTRODUCTION

Offshore wind power has the potential to be popular since even though there is a low profit margin affecting this industry, a large number of OWTs are normally installed reducing marginal installation expenses. Additionally, new ways of reducing expenses are being considered as the new low-cost craneless installation prototype that has been developed (Elisa \& Elican Project) and is about to be installed close to the coast of Gran Canaria (Canary Islands, Spain). It is a pilot project to study if GBSs have the potential to become a cost effective solution in the OWT industry. Therefore, high future expectations have been placed in the offshore sector which will become more and more important in the years to come.



Gran Canaria – Canary Islands

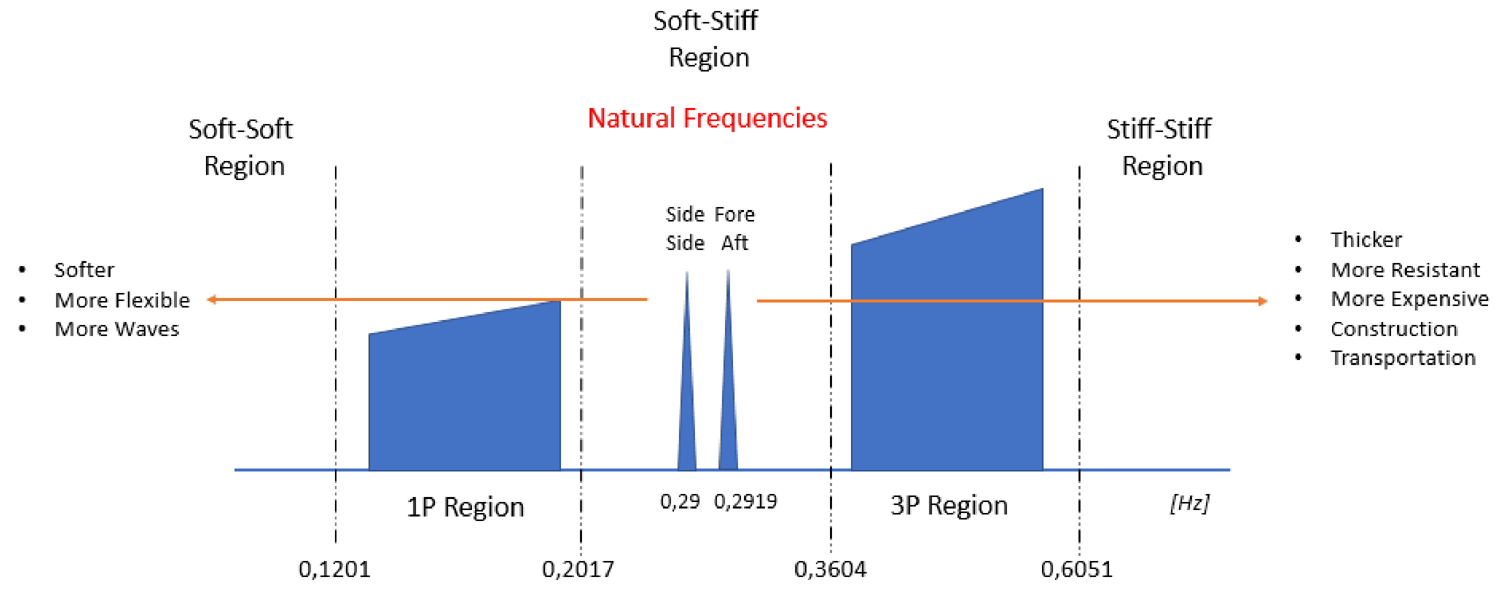
MODELLING

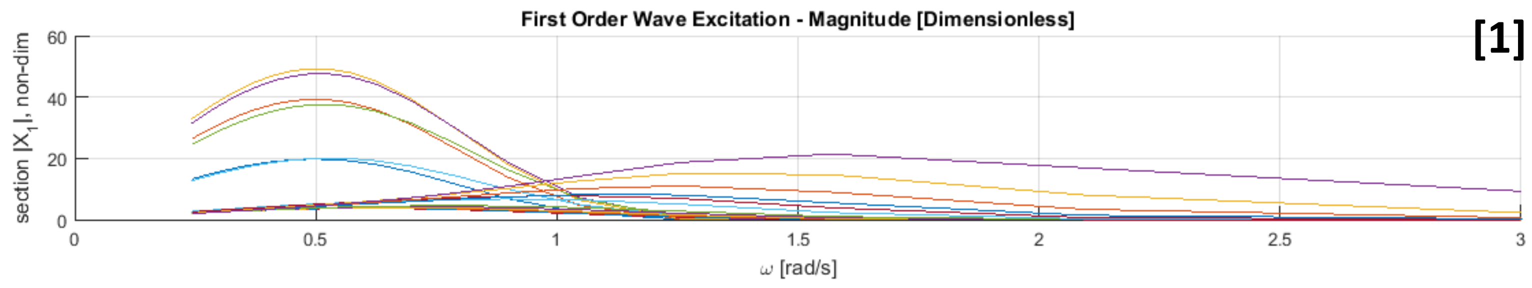
- SIMA: Morison – MacCamy&Fuchs – Potential Flow
- Finite Waters Assumption – Water Depth: 35 m
- Potential Flow: GenIE – HydroD – WAMIT
- North Atlantic MetOcean conditions
- SIMO – RIFLEX Coupled Model
- SN Curves: Concrete and Steel
- Soil-Structure Interaction
- Soil Bearing Capacity

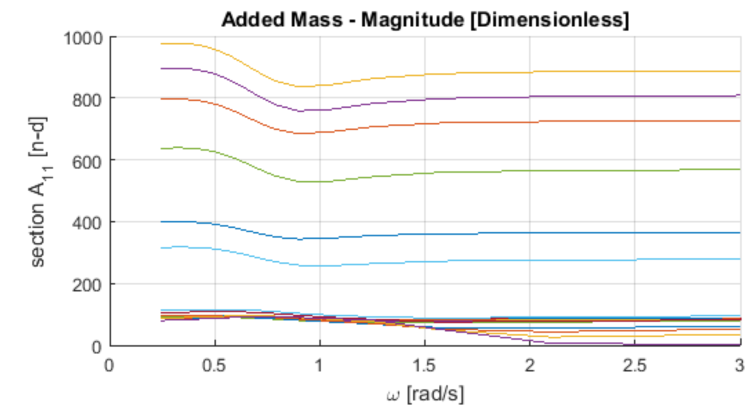
Hub Height	Caisson Height	Shaft Height	Base Diameter	Shaft Diameter
90 m	10 m	30 m	31 m	7 m

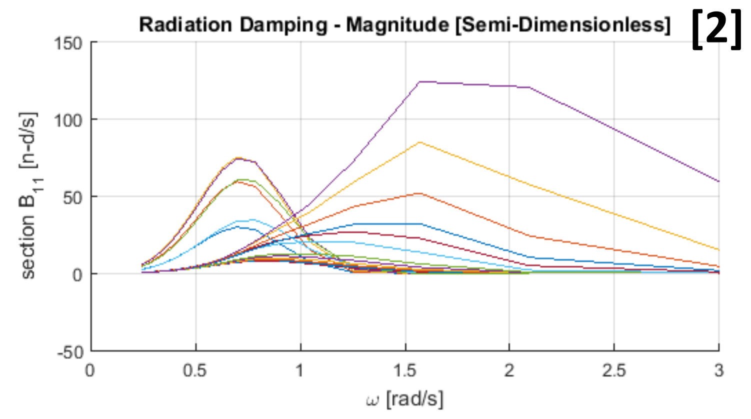
Caisson Thickness	Shaft Thickness	GBS Volume	GBS Weight	Turbine Weight
1 m	0,5 m	7312 m^3	3000 tons	640 tons

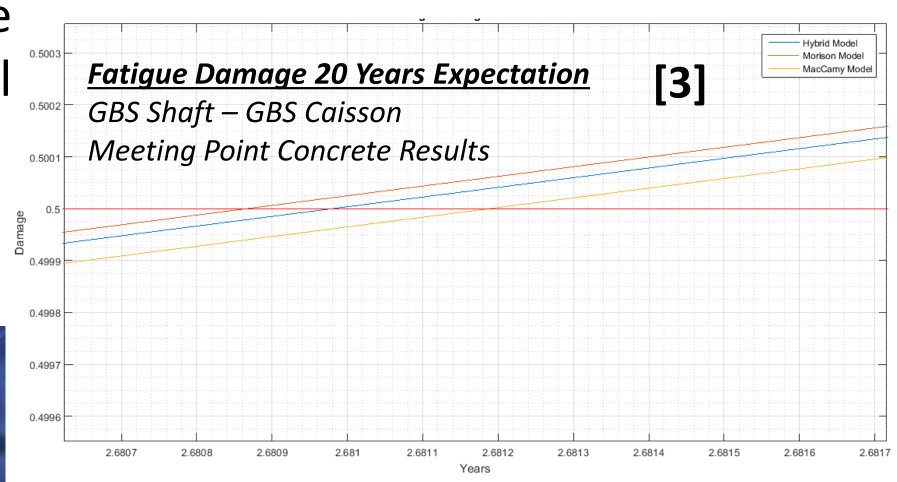
SIMULATIONS & RESULTS

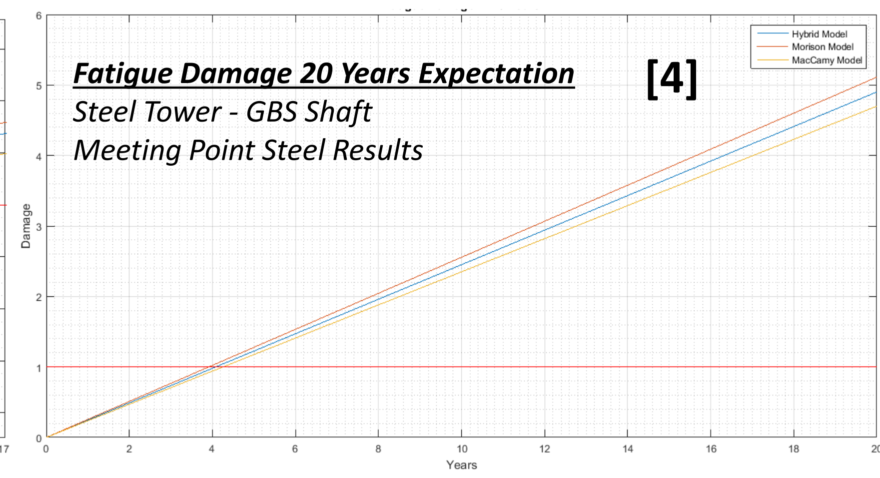


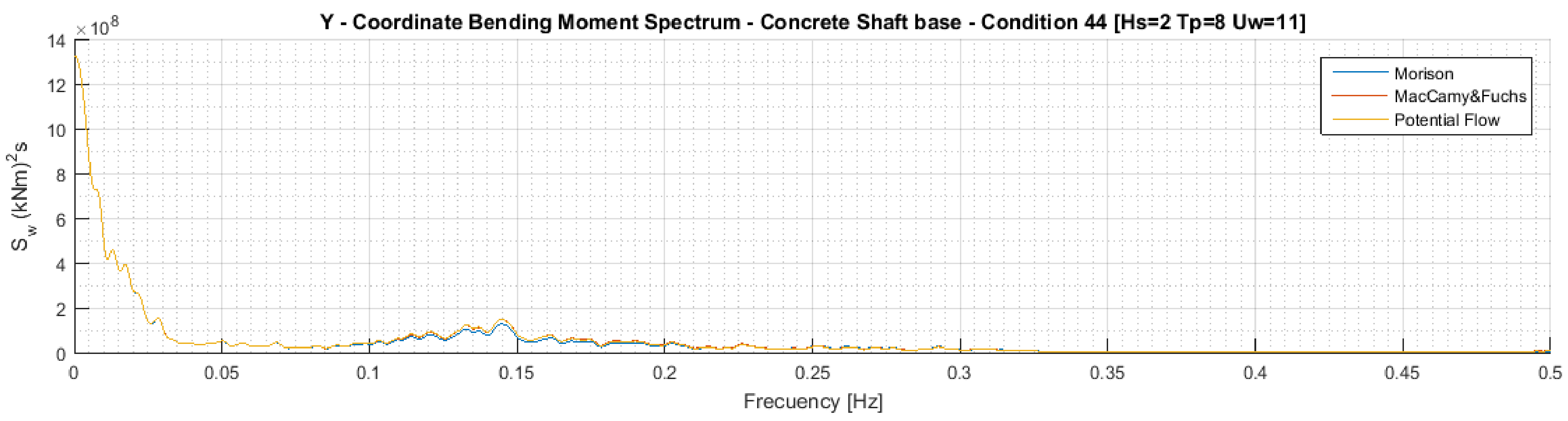












CONCLUSIONS

- First order wave excitation forces and linear damping values going to zero in low and high frequency zones. Noticeable change in diameter size 31 to 7 [m] reflected in the amplitude of both parameters, see pictures **[1]** and **[2]**
- Morison always giving highest damage than MacCamy&Fuchs and potential flow resulting in less fatigue life. This means overestimation of loads when wave diffraction occurs. Both in steel and concrete.
- MacCamy&Fuchs and potential flow giving similar axial stresses values, so potential flow was rejected in the full fatigue analysis since requires much more work and similar results are obtained.
- Steep SN concrete curve, meaning that stresses are quite sensible to the number of cycles. pretty sensible to wind speed and probability of occurrence.
- Short fatigue life: 2,68 years for the concrete structure and 4 for the steel tower base, where the tower meet the concrete shaft, see pictures **[3]** and **[4]**
- According to frequency spectrums and structural displacement analysis of the whole structure, it resulted that the GBS was so stiff that the bending moments occurring due to large stiffness forces were not actually being transferred to the OWT's tower. This means that inertia is not considered at all when taking up the external loads affecting the GBS.

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