Numerical Modelling – Directionality & FSI

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WS1: Numerical & Physical Convergence

Introduction

This poster describes the investigation of the effect of support structure proximity to the rotating plane of a TST. Also the effect of geometry deformation on TST performance.

ANSYS Transient CFD

Figure 1 shows C_P vales for 3 rotations of the turbine. For flood flow the avg. C_P reduced by around 9% for each separation distance. In ebb flow the avg. C_P are very similar but there is significantly greater fluctuation.

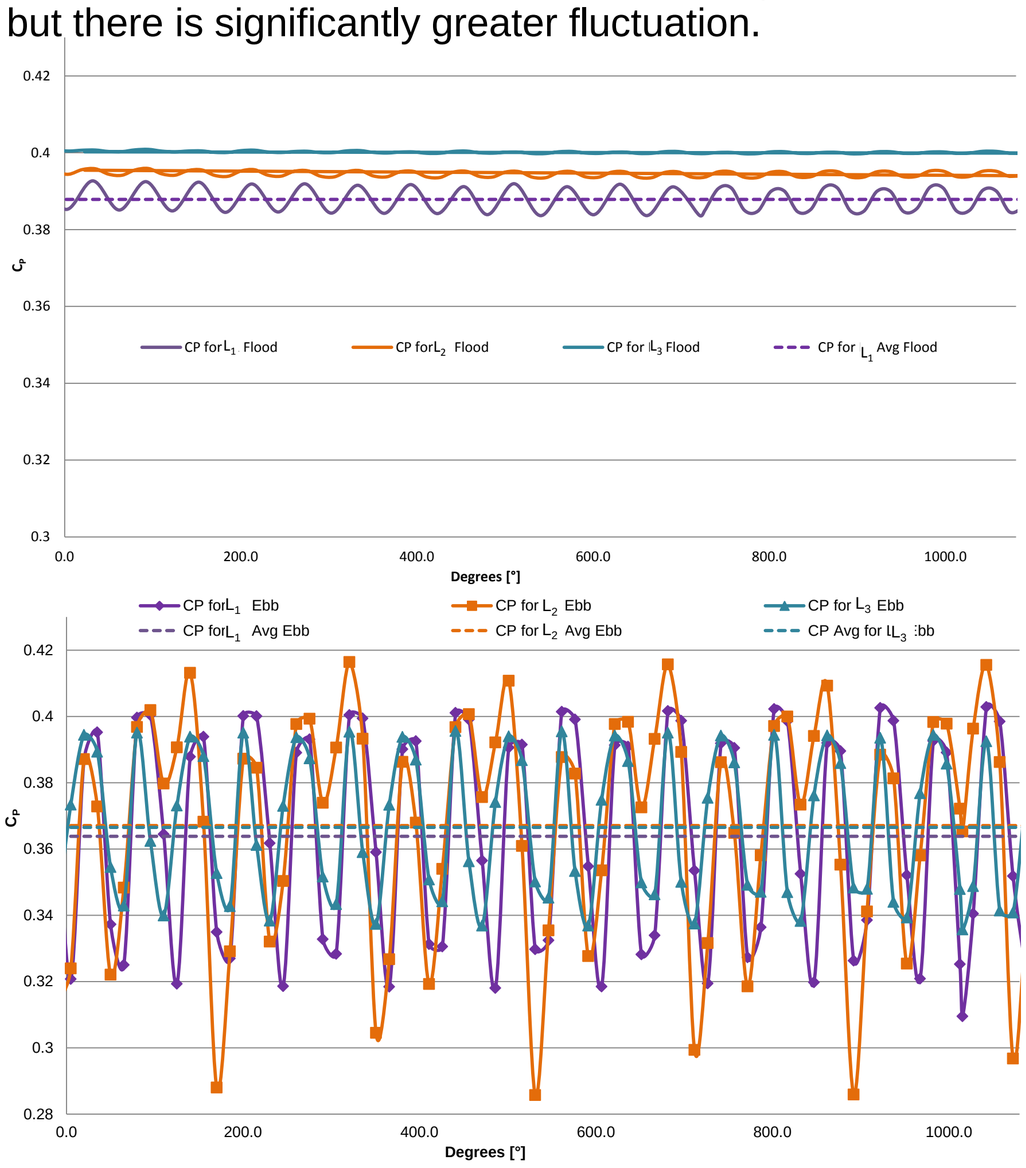

Figure 1 C_P over 3 complete rotational cycles over a rotational cycle for a) Flood and b) Ebb flows

Figure 2 looks at the fluctuations of C_P for Ebb conditions over a third of a rotation. What is clear is that the curves are not symmetrical as the blade passes through the shadow of the stanchion.

Figure 2 Detail of the fluctuation in a) CP and b) CT as the blade rotates

Fluid-Solid Interaction

By closely coupling CFD and FEA codes into one model the interaction of the fluid domain on the deformation of the solid domain and its resulting change in hydrodynamics can be assessed.

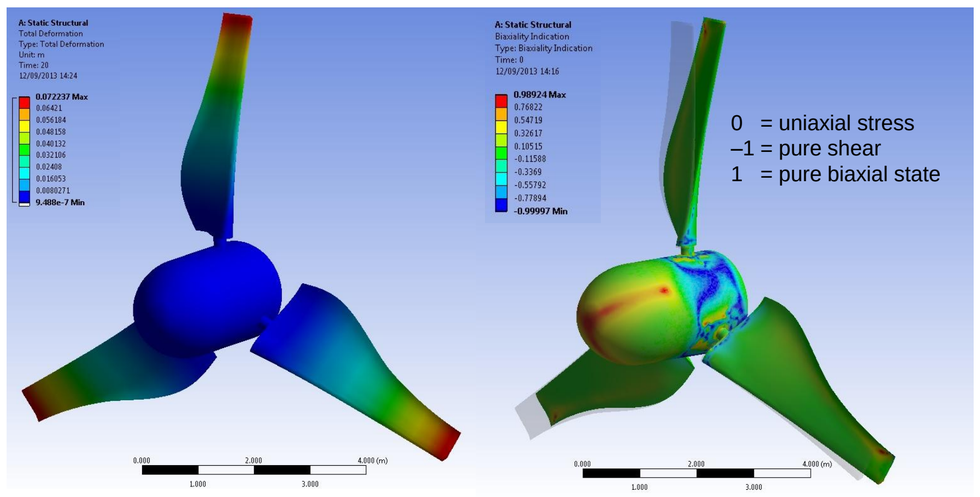

Figure 3 a) Blade Displacement b) Life Prediction

Figure 3 shows the displacement of the blades due to the hydrodynamic forces. Along with the Bi-axial stress states of the Turbine

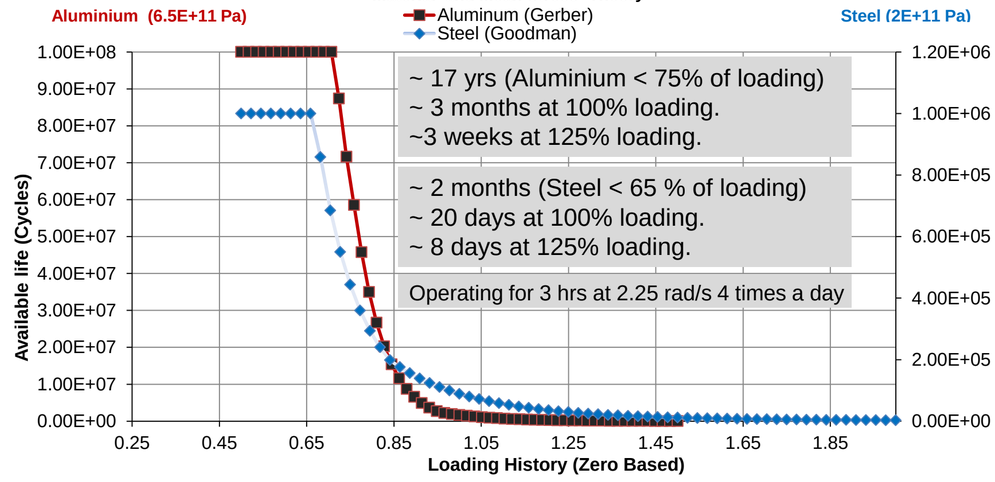

Figure 4 Available Life Cycles

Figure 4 shows the potential for life prediction analysis which has been done for various load conditions.

Conclusion

i. Proximity effects on the turbine in flood conditions become negligible after L_3.

ii. In ebb conditions turbulence generated from the stanchion results in lower average C_P and the detail reveals the non-linearity of the stanchions effect.

iii. The FSI study has shown the feasibility of life prediction study and a range of predictions based on hydrodynamic loads.

Acknowledgements

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References

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