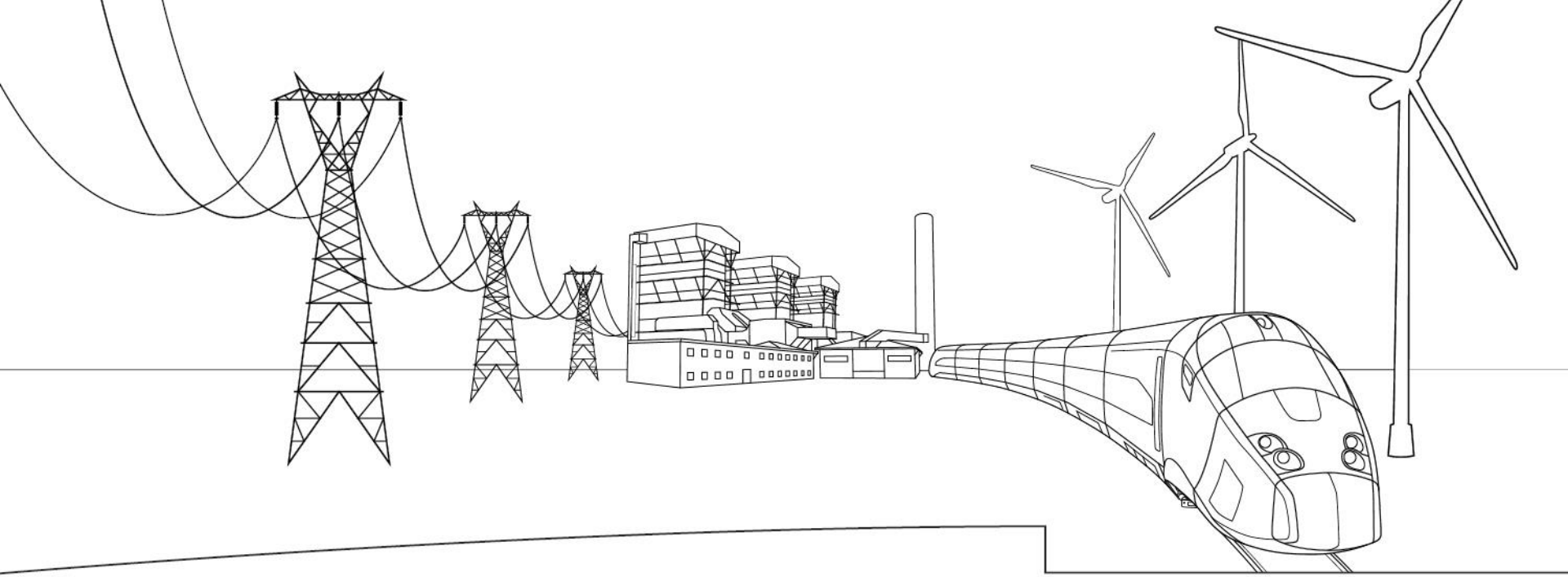


Bladed 4.7 & Bladed 4.6
Comparison with measurements

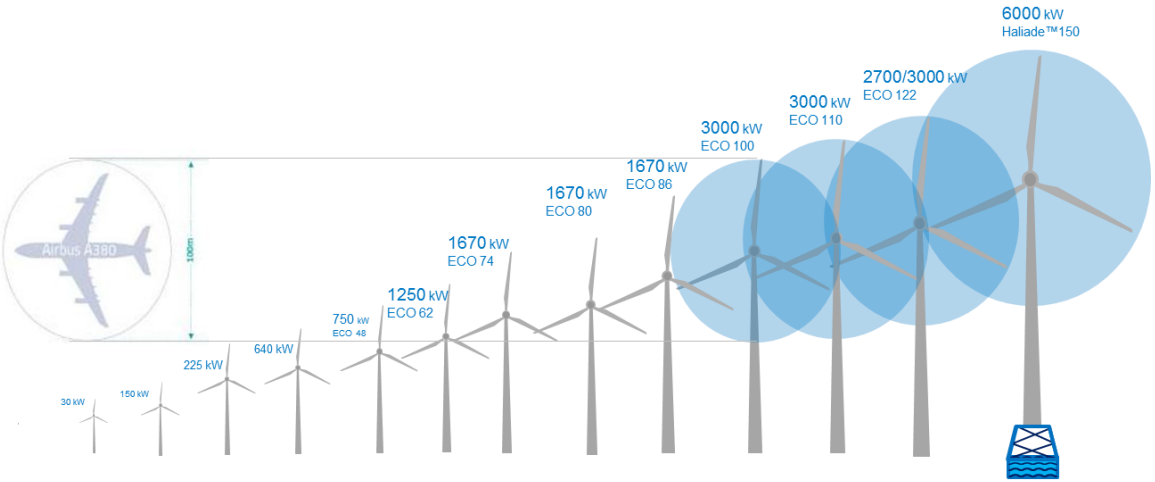
Loads & Aerodynamics
José María Milián Sanz

08/10/2015

ALSTOM
Shaping the future

Introduction - Motivation

Due to the increase in size in wind turbine rotors long and flexible blades present new aeroelastic modelling challenges. Accurate results of blade torsion is important with respect to loads, blade deflection and power estimation.



Wind turbine blades behavior has been tipically evaluated using linear models of blade deflection, with linear deflection mode shapes calculated. For short rotors, this approach has been proven to give good results within reasonable simulation time.

The purpose of the present study is to show, at wind speeds at which the highest torsion occurs, a comparison between measurements and simulations for a very long rotor, done with a software considering non-linearities at the blade structure (Bladed 4.7) and one using linear models of blade deflection (Bladed 4.6).

The linear modelling is simulated tuning the geometrical stiffness based on results from simulations with the non-linear structural model.

Outline

- Loads Comparison (Statistics and Equivalent Loads)
  - TI 11%
  - TI 15%
- Performance Comparison
- Tower Clearance Comparison
- Conclusions and next steps

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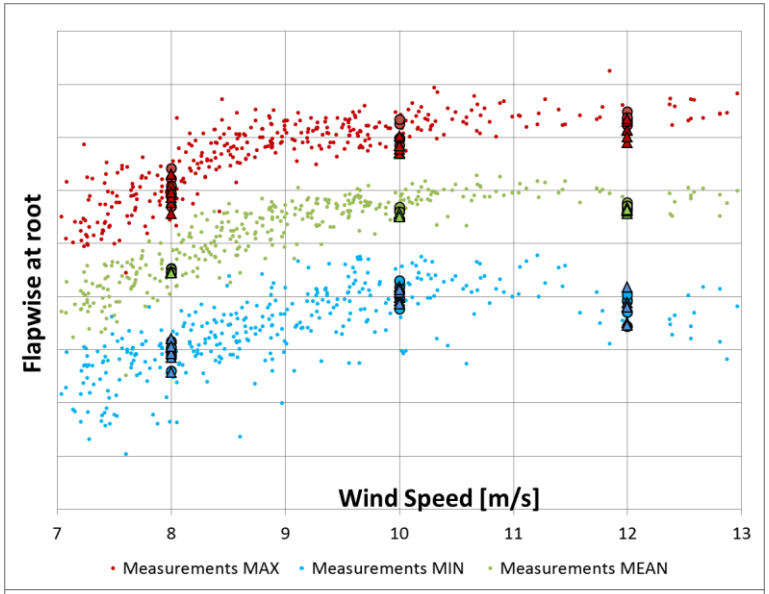
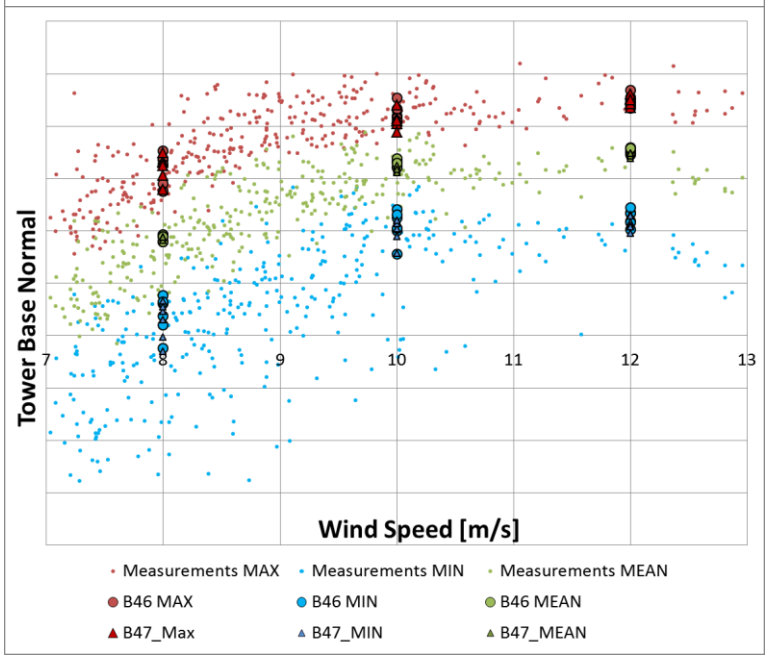
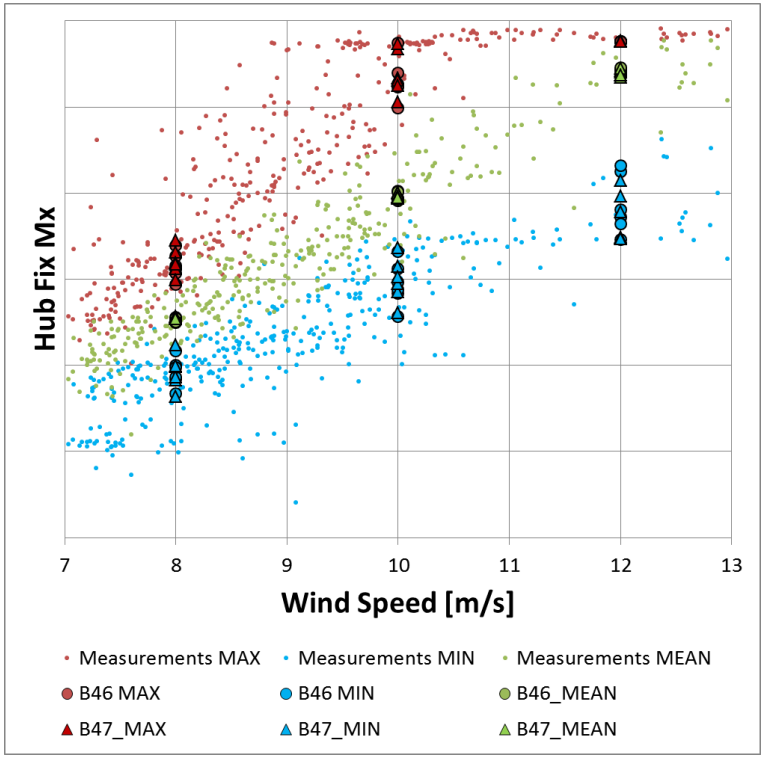
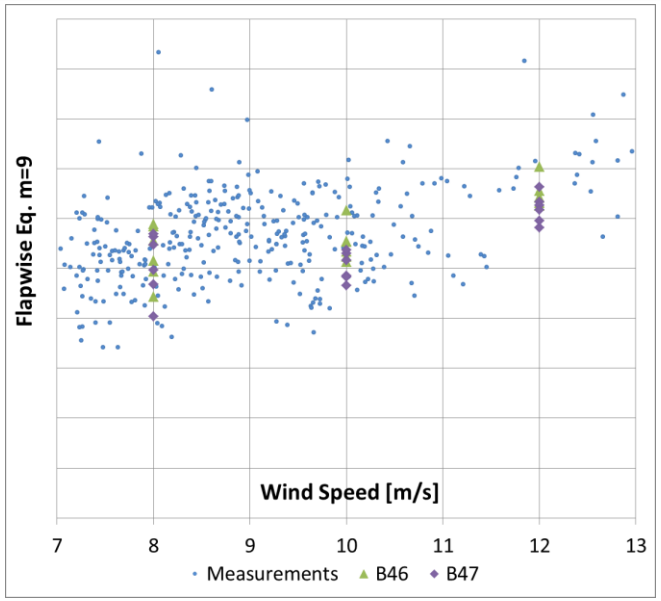
Loads Comparison – TI 11% - Statistics

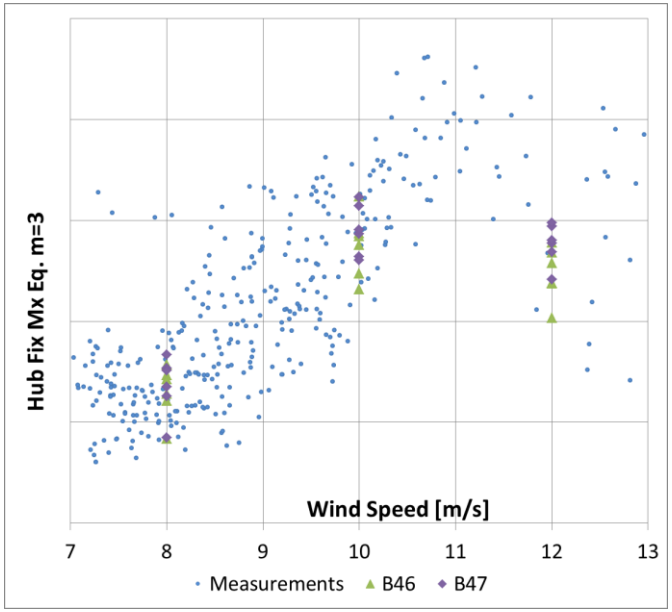


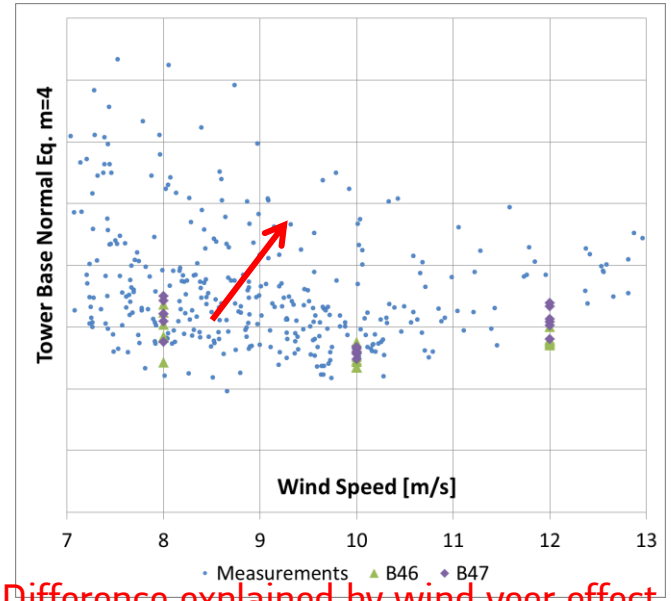


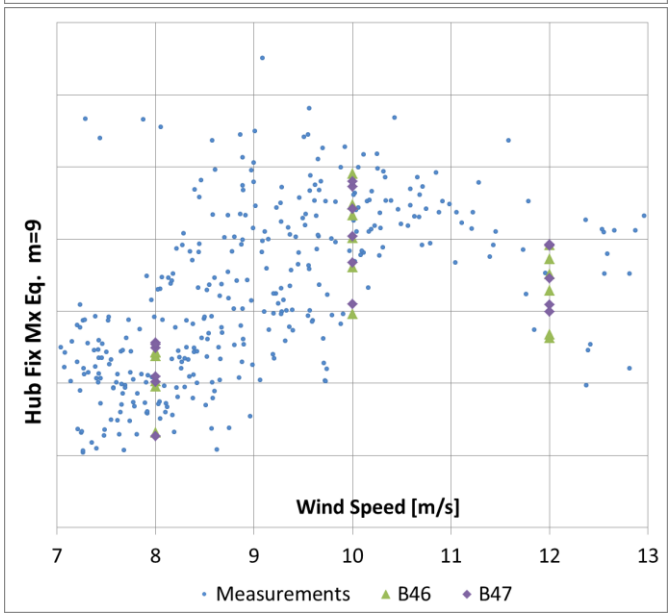


Loads Comparison – TI 11% - Equivalent



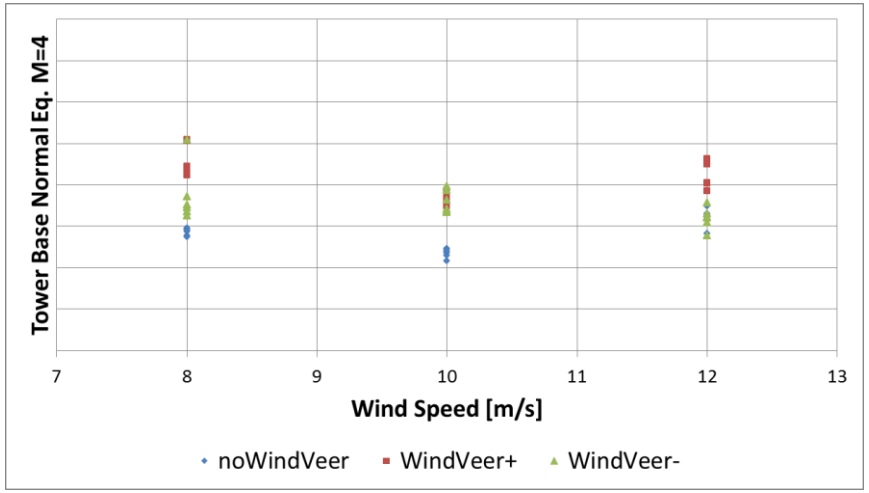






Difference explained by wind veer effect

Loads Comparison
Wind Veer Effect at Fatigue Fore-Aft



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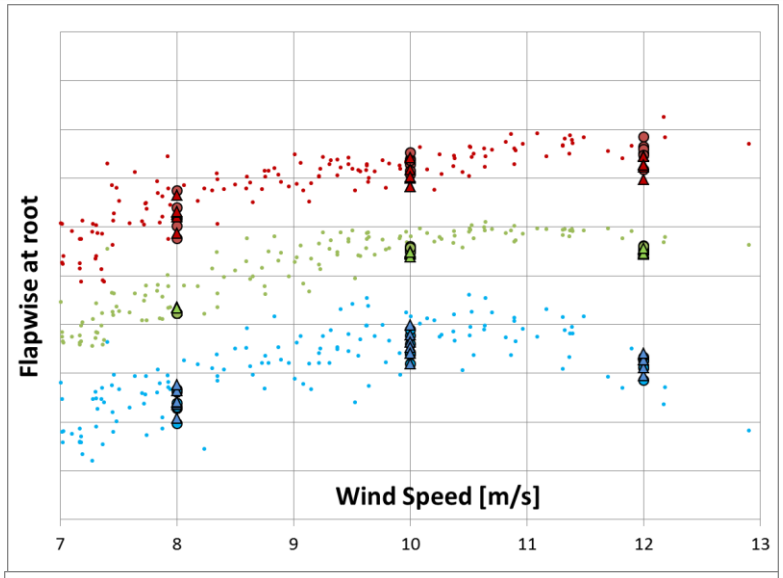
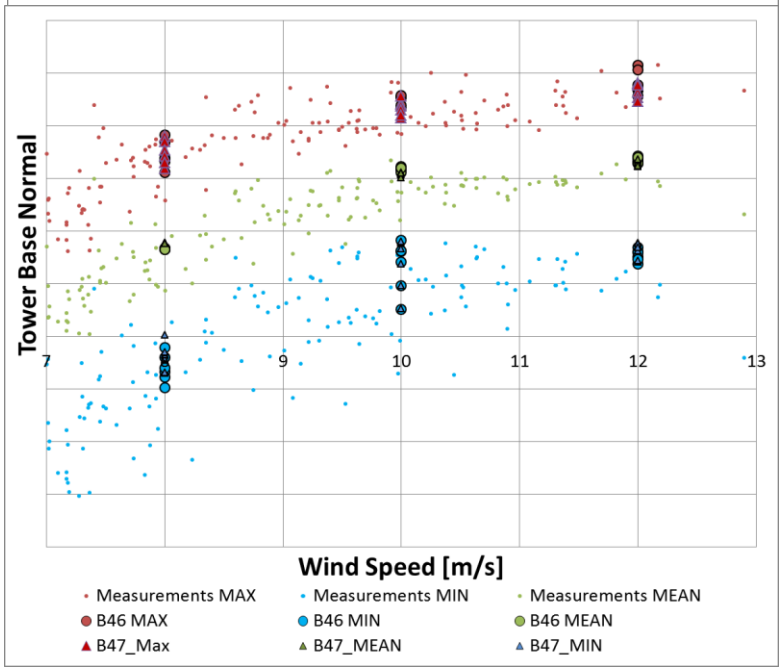
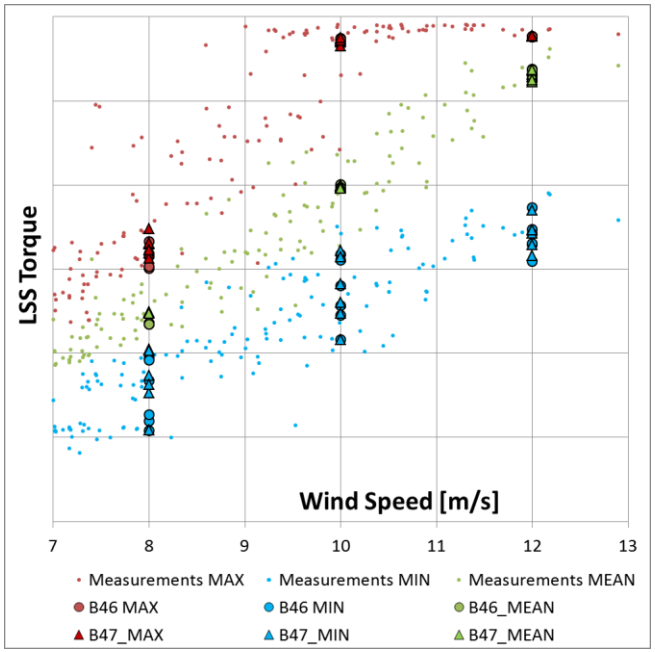
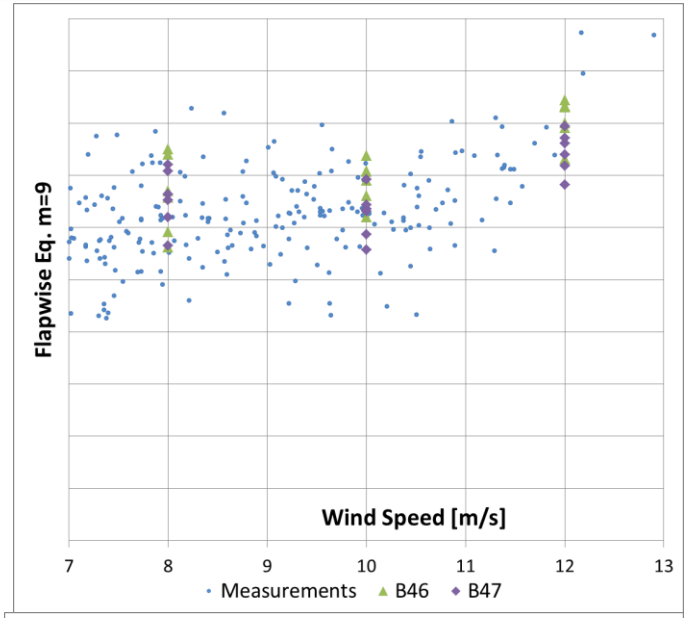
Loads Comparison – TI 15% - Statistics

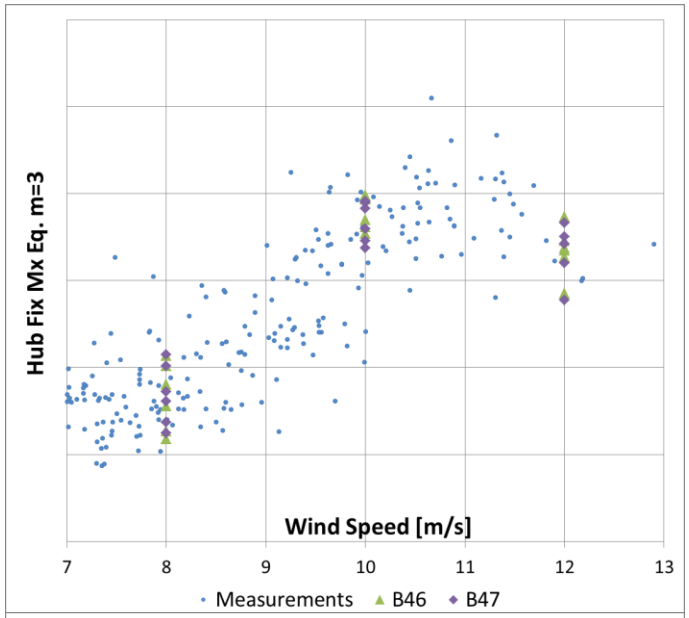


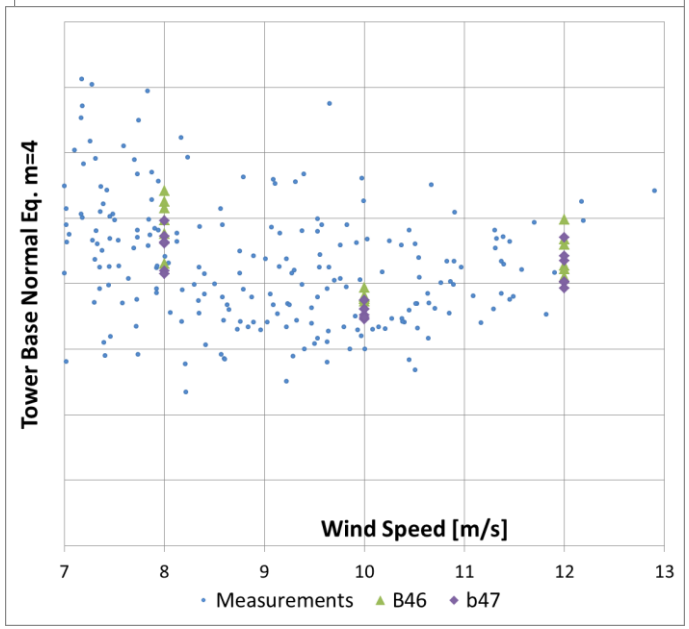


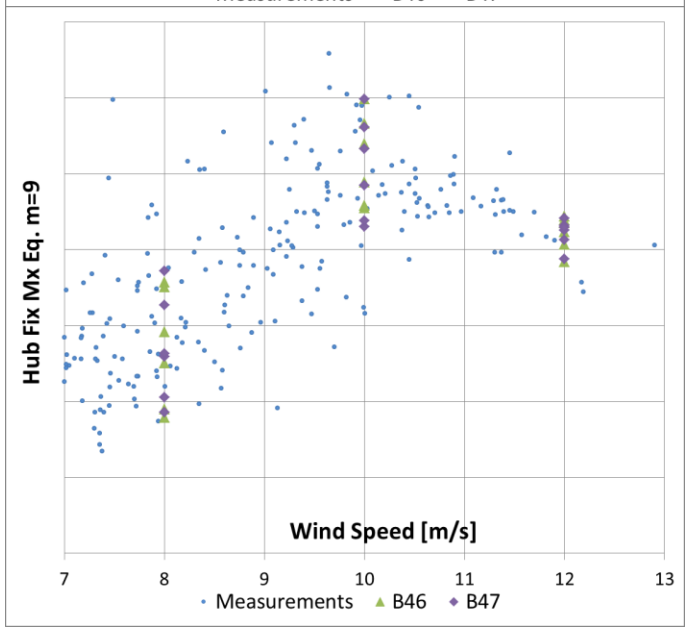


Loads Comparison – TI 15% - Equivalent









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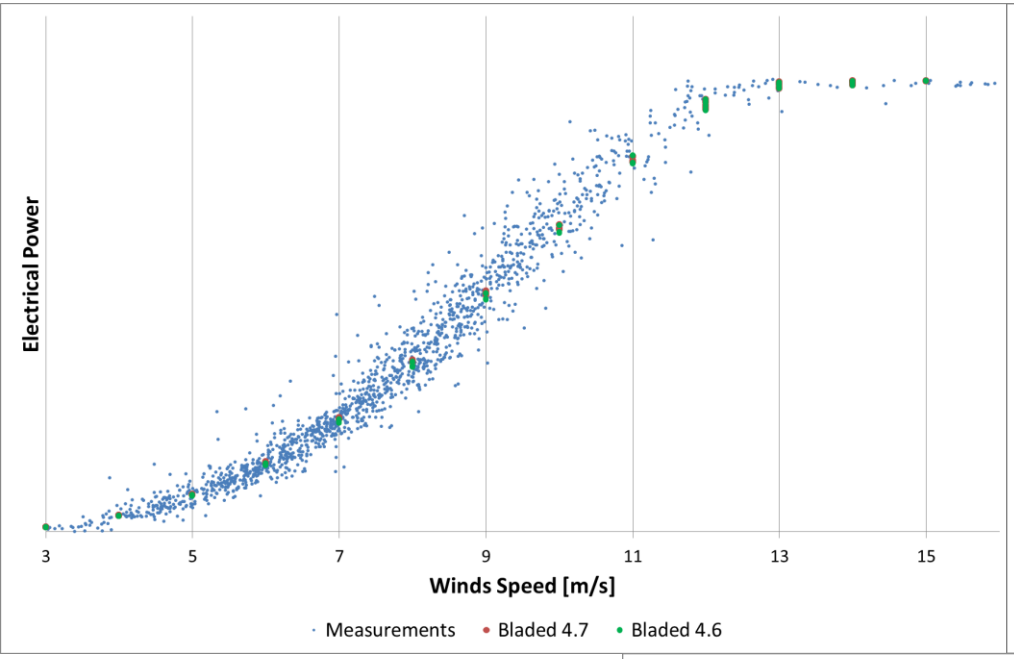
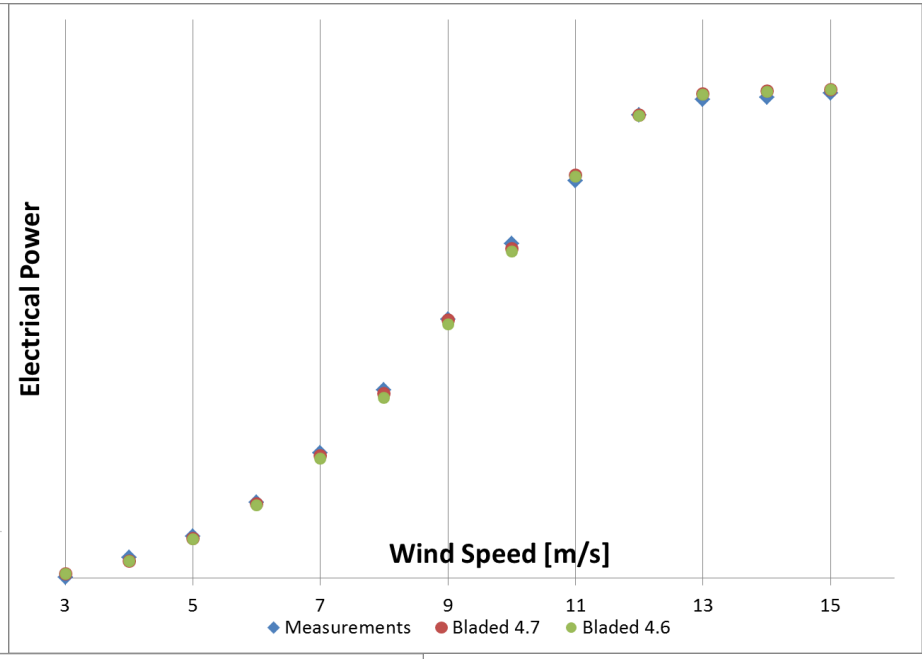
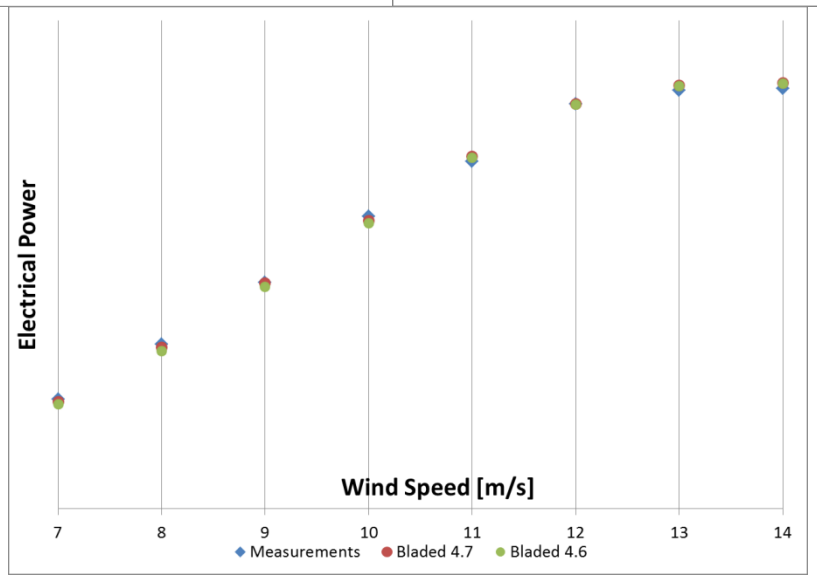
Performance Comparison – Electrical Power







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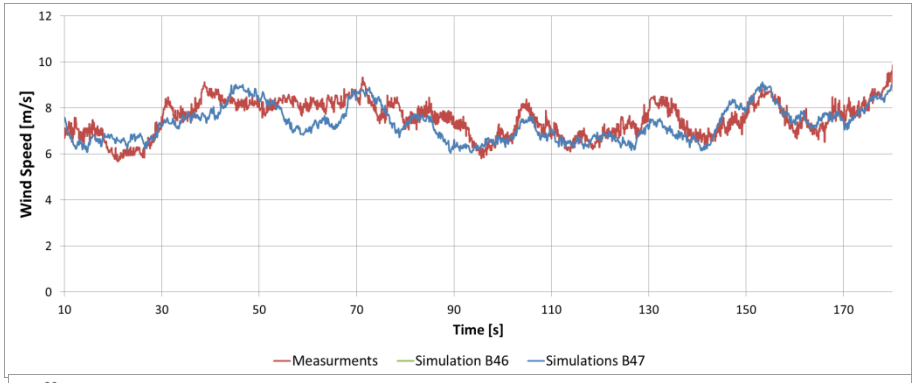
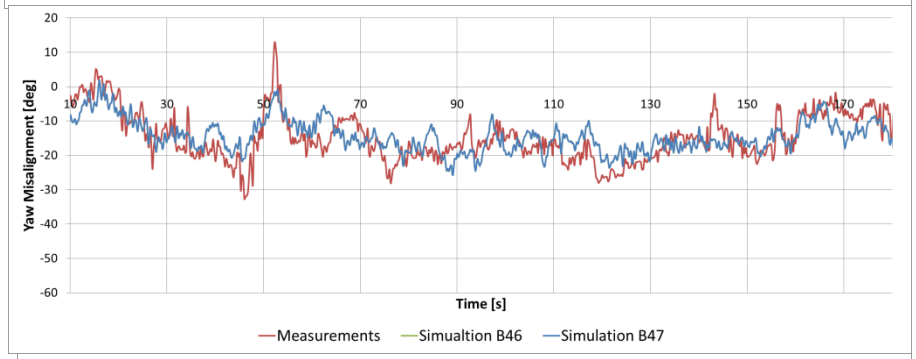
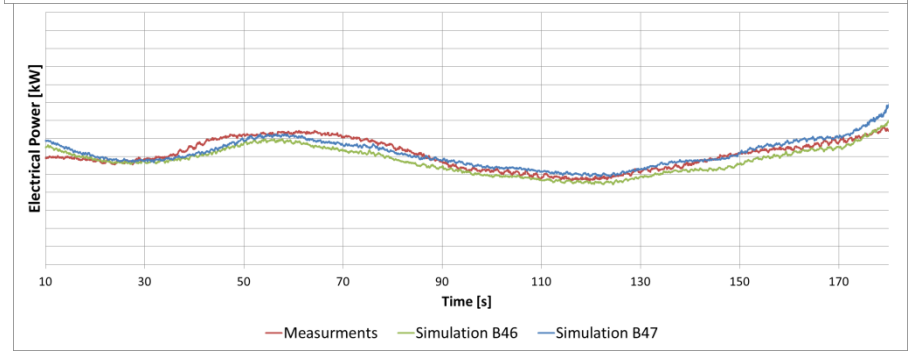
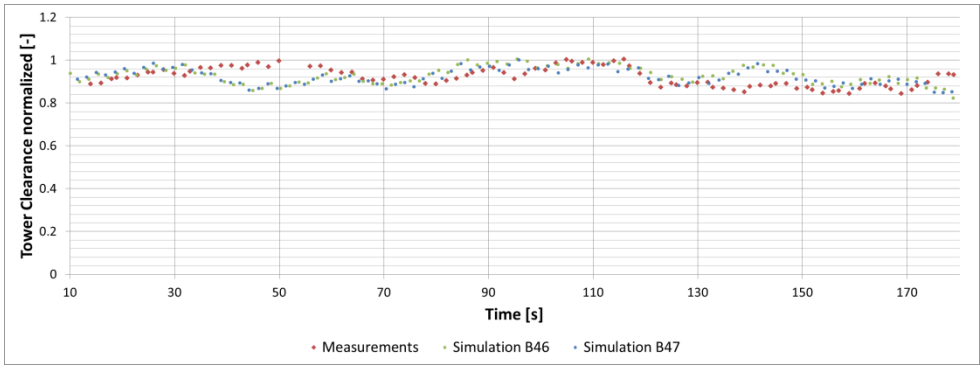
Tower Clearance Comparison









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Conclusions and next steps

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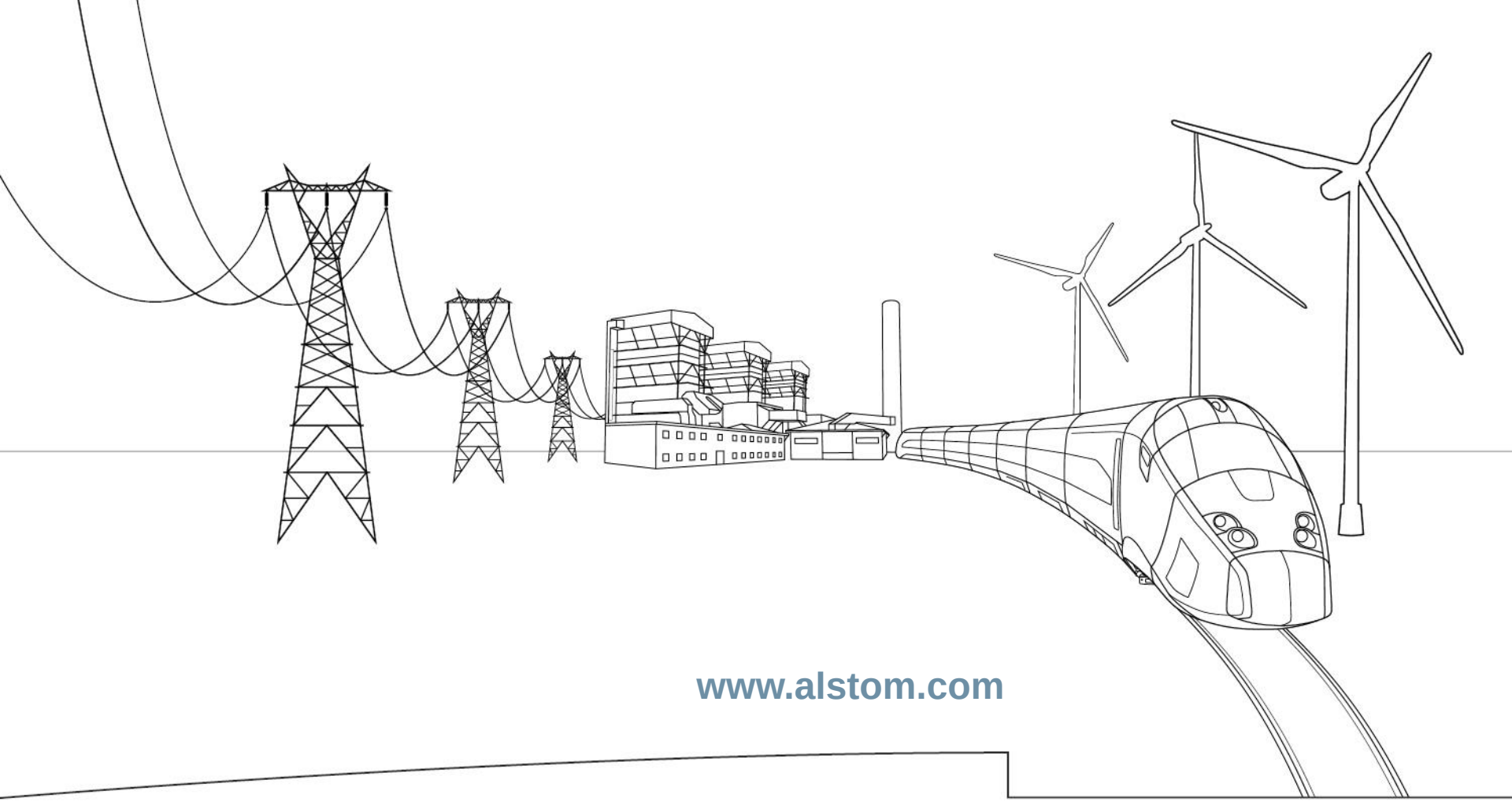
Conclusions

- Good agreement is seen between both linear and non-linear modelling and measurements.
- The software using the linear modelling tuned gives very similar results compared to the ones obtained with the non-linear blade structural model in terms of loads and performance.
- The torsional aeroelastic modelling is well estimated at both approaches.

Next Steps

- Measure blade deflection for more time series to be able to better conclude on the reliability of results from both softwares and measurements.
- Simulate with both approaches extreme events for which there are measurements available.



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