Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2017-35-AC3, 2017

WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Benefits of sub-component over full-scale blade testing elaborated on a trailing edge bond line design validation" *by* Malo Rosemeier et al.

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Received and published: 8 December 2017

Thank you very much for taking the time to review our manuscript and giving us your feedback. In the following, please, find our responses (R) to your comments (C):

C "1/15 In the introduction section, the subcomponent testing is somehow presented as a substitute for full-scale testing which is not realistic. Coupon testing of the materials and the final full-scale test are both required for certification of utility-scale blades. However, subcomponent testing can bridge the gap between the coupon and full-scale tests and increase the assurance of the blade manu-

facturer/designer for use of new materials or designs in a blade before a full-scale test. Subcomponent testing may not replace the need for a final full-scale test but it has the potentials to be considered as a standard intermediate test for utility-scale blades. Subcomponent test can also expedite and facilitate the introduction of new materials into wind turbine blade manufacturing industry."

R The intention of this paper is not to give arguments that full-scale blade testing should be replaced by sub-component testing. The idea is to have a further intermediate level experimental method at hand to validate models under more realistic loading conditions. To eliminate misunderstandings, we have added a sentence to the introduction and some application case scenarios to the conclusions.

C "4/7 Reference should be added to give the readers examples of the use of DIC technique and full-field measurements in subcomponent testing. See the papers below:

Zarouchas, D. S., Makris, A. A., Sayer, F., Van Hemelrijck, D., Van Wingerde, A. M. (2012). Investigations on the mechanical behavior of a wind rotor blade subcomponent. Composites Part B: Engineering, 43(2), 647-654.

Asl, M. E., C. Niezrecki, J. Sherwood, and P. Avitabile. "Experimental and theoretical similitude analysis for flexural bending of scaled-down laminated I-beams." Composite Structures (2017).

Asl, M. E., C. Niezrecki, J. Sherwood, and P. Avitabile. Similitude analysis of the strain field for loaded composite I-beams emulating wind turbine blades. In Proceedings of the American Society for Composites: Thirty-First Technical Conference 2016 Sep."

C "Authors should expand the literature review and provide the readers with a broad perspective of the different approaches and techniques that have been developed so far for subcomponent testing of wind turbine blades. In the literature review, authors should also comment on the limitations of the developed subcomponent techniques to give the readers a realistic assessment of the state-of-art techniques that have been developed to date for structural performance assessments of utility-scale wind turbine blades. This should include the experimental techniques using DIC, analytical tools such as similitude analysis and scaled subcomponents or computational models for fracture in the adhesive joints. See the papers below:

Ji, Y.M. and Han, K.S., 2014. Fracture mechanics approach for failure of adhesive joints in wind turbine blades. Renewable Energy, 65, pp.23-28.

Laustsen, S., Lund, E., Kühlmeier, L. and Thomsen, O.T., 2014. Development of a High fidelity Experimental Substructure Test Rig for Grid scored Sandwich Panels in Wind Turbine Blades. Strain, 50(2), pp.111-131.

Eydani Asl, Mohamad, et al. "Similitude analysis of thin-walled composite I-beams for subcomponent testing of wind turbine blades." Wind Engineering (2017): 0309524X17709924.

Fernandez, Garbiñe, Hodei Usabiaga, and Dirk Vandepitte. "Subcomponent develop- ment for sandwich composite wind turbine blade bonded joints analysis." Composite Structures 180 (2017): 41-62.

Asl, M. E., Niezrecki, C., Sherwood, J., Avitabile, P. (2014). Application of structural similitude theory in subcomponent testing of wind turbine blades. In Proceedings of the American Society for Composites (pp. 8-10)."

R The proposed references deal with blade elments and details. According to DNVGL guideline 2015 we consider a rotor blade substructure as a blade subcomponent. Therefore, we have added a reference to DIC w.r.t. full-scale blade testing. Furthermore, we have taken out the reference dealing with element/detail testing by Sayer et al. (2012).

C "5/10 It might not be not clear for readers where the 10from. Either a figure should be added to address that or authors can explicitly mention that it's measured from the root section of the blade."

R The definition was added.

C "Section 3, The paper is supposed to discuss and compare the full-scale test to sub- component test. Although the authors' comments on full-scale testing have been fairly supported by simulation data, there are no significant data or quantitative measures to support their comments on subcomponent testing side. Authors should either include simulation data to justify their comments on subcomponent testing or cite the references which include such data or elaborate on their reasoning to support their insights on subcomponent testing. For instance, page 8 line 11 reads "while in an SCT setup any of the loading scenarios for the different wind speed bins which are shown can theoretically be replicated..". It's not clear how this scenario could possibly be implemented in reality. There are no diagrams, figures, references or at least a detailed explanation. Same thing on page 11 lines 1 through 7."

R Rosemeier et al. (2016) is referenced wherein the SCT principle is described and shown that FST conditions can be reached. Additionally, we give the advice that it is possible to replicate arbitrary loading conditions with the described method through shifting the ball joint positions within the cross-section. We think that the references and explanations given are sufficient to follow our conclusions.

Please also note the supplement to this comment:
https://www.wind-energ-sci-discuss.net/wes-2017-35/wes-2017-35-AC3-supplement.pdf

Interactive comment on Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2017-35, 2017.