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Interactive comment on "Beam-like models for the analyses of curved, twisted and tapered HAWT blades in large displacements" *by* Giovanni Migliaccio et al.

Anonymous Referee #3

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The proposed method in the manuscript is a novel model of beam-like structures with curved, twisted and tapered geometries. Since the wind turbine blade designs are curved, twisted and tapered beam-like structures and go through large displacements in their operational life, the proposed model is highly related to the wind turbine blade analysis. Today, beam models are generally preferred in load and aeroelastic stability analysis of the turbine blades due to their accuracy and computational speed compared to the 3D finite element models. Although, curved and twisted beam models already exist in the literature (Hodges, Dewey H. Nonlinear composite beam theory), counting the taper effects are the main novelty of the study.

Although the motivation of the study is very interesting and notable for state of the art blade analysis, there are essential things to be done before it is published. The manuscript is written in mathematical format, however the equations are hard to follow and re-derive because authors skip intermediate steps and give no reference in the derivation of the equations. I strongly recommend to write the intermediate steps explicitly or give relevant references for these steps instead of the statements such as 'well defined measures', 'proper manner' or 'when the 2D problem is solved'. Figures depicting the cross-sectional warping effects, loads and 'suitable coordinates' (coordinate curves) would be helpful to the readers. Another substantial point is the lack of reproducible results. The analytical example results given in the manuscript can't be reproduced by the explanations given in the manuscript, hence the solution needs to be explained clearly. If the authors come up with the analytical example by themselves, they should provide more information about it. If the analytical example is taken from another study, please give reference. They should also compare the their results with a higher fidelity analysis results such as 3D finite element results to show that the taper effects are captured correctly by their formulation. The authors mention that they already implemented the method in a MatLab code. However, there is no information about the implementation of the method. Example results of authors' code and comparison of them by higher fidelity models would increase the value of the study. A wind turbine blade example would also intensify the proposed methods' relevance to wind turbine applications.

Please below suggestions:

1- Section 2 : 'BeamDyn' is very relevant to the application of the geometrically exact beam models to wind turbine analysis. Consider citing it.

2- Section 3.1 : Instead of Figure-2 with wind turbine blade, a figure with cross-section warpings and coordinate curves would be elucidating.

3- Section 3.1 : Please explain 'y' clearly (in current position vector R).

4- Section 3.1 : Please explain deformation gradient explicitly or give reference for it.

5- Section 3.1 : Please explain 'some higher terms' after equation 14.

6- Section 3.1 : Please write intermediate steps between equation 13 - 15.

7- Section 3.2 : A figure with cross-section forces and moments would help the readers.

8- Section 3.4 : Please elaborate the section by providing the solution of the warping fields.

9- Section 4 : Please give more information about the example and how you obtain the final results. Please, compare them with higher fidelity solution to show your model captures the taper effects correctly. Comparison can also show the results of a model which ignores the taper effects.So, reader can see the effect of taper term in final results.

10- A section which explains the numerical implementation should be added.

11- A section with results of your numerical model and higher fidelity model should be added.

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