Review by editor:

On reliability design and code calibration of wind turbine blade bearings under extreme wind conditions

21 April 2025

The combination of two highly specialized topics (structural reliability and bearing design) in the present manuscript makes it challenging to find reviewers with such profile – or at least challenging to find reviewers that can cover both topics simultaneously. I therefore see it necessary to supplement the other reviews with a "review by editor", where I am mostly focusing on topics related to the structural reliability and load calculations.

General comments

1) Grammar: the use of the definite article "the" is not correct in a number of places in the paper, there are both examples of unnecessary "the" and examples of missing "the" or "a". An example with the abstract – the first few sentences should read: "This study presents a reliability analysis of a blade bearing against ultimate limit state failure. The National Renewable Energy Laboratory 5 MW Reference Wind Turbine is selected for the study, and a Monte Carlo simulation (or "the Monte Carlo simulation method") is used for reliability analysis and estimation of the probability of failure….". Please correct the entire manuscript for grammar.
2) Blade bearing or blade pitch bearing? In my view, it is better to mention it is a pitch bearing.
3) Section 1: The authors list references that deal with fatigue of rolling bearings. However, I am missing the discussion about the fundamentally different loading pattern that blade bearings are subject to – they work as so-called "oscillating bearings" which is the main reason for specific failure modes (such as static failure) being more relevant. I suggest the authors discuss the specific loading pattern of oscillating bearings, add any necessary literature, and link the loading pattern with the choice of failure mode.
4) Figure 2: I am not sure the uncertainties on the loads side are so clear. I believe they should be split more clearly between aleatory uncertainties (like the short-term wind conditions), and epistemic uncertainties – which could be further subdivided into 1) model uncertainties in the climate model, the dynamic loads calculation model and the bearing model, 2) measurement uncertainties, and 3) statistical uncertainties due to finite sampling periods. It is also fine if some of these uncertainties are considered irrelevant or small enough to be omitted, but the current description does not make it clear what is the source of each uncertainty is and why it should be included or not.
5) Page 10, line 183: the authors use the maximum likelihood estimator (MLE) for fitting extreme probability distributions. While the MLE is the standard way of fitting parametric probability distributions to data, it is often insufficient when the aim is proper representation of the tails of the data. Further, the current format of Figure 3 is not clearly showing the quality of the fit in the tails. I hereby remind my earlier comment which the authors suggested will be addressed in a revised

version: “When considering reliability analysis with respect to ultimate limit state with small probabilities, the failures normally occur under rare conditions which fall within the tails of the underlying distributions. Therefore, when evaluating the quality of fit of distributions, normally the most useful way of graphical evaluation is plotting the exceedance probabilities (1 minus the CDF) on a logarithmic y-axis. Sometimes also the max likelihood method may not be the most applicable fitting method as it will ensure the best fit to the main body of the distribution but not necessarily the tails. I suggest you replace Figure 3 by an exceedance probability plot, and based on that re-evaluate which may be the best fitting distribution, and whether you may need other fitting method than the MLE or other quantitative criteria than the CE indicator. For the exceedance probabilities of the actual data, you can use the empirical CDF formulas based on data ranking.”

6) Could changes in the bearing geometry affect the maximum ball force?
7) Page 14, line 241: Ball diameter: in my view the changes “fine to coarse machining” will not affect the nominal ball diameter, but rather the tolerances which will be larger for coarse machining, correct? If that’s the case, then the probability distribution of the ball diameter for “coarse machining” will correspond to a worse-case scenario. Further, we may assume that the diameters for balls within the same bearing will vary, and we will have a population of ball diameters in a single bearing. So, a ball diameter distribution can be taken into account by defining what could be worst-case ball dimension (the ball with highest deviation from the nominal diameter within the bearing) and base the reliability calculation on this worst-case ball dimension. Could the authors discuss how this can affect their assumptions?
8) Failure probabilities always are with respect to a certain reference period. What is the reference period here, I believe it is annual failure probability (as in Fig.7)? Please specify, and define P_f as annual probability of failure the first time you mention it in the text.
9) Figure 8, load index: this is a discussion/observation rather than anything that is used further in the paper, right? Maybe extend the discussion on how this information can be used (for example for tuning safety factors).

Specific comments

10) Abstract: please include a description of the bearing configuration (e.g., a double-row, four-point contact ball bearing).
11) Page 1, lines 14-15, “changing the broken blade bearing is costly” – I agree, but please support with a reference and/or an indicative number.
12) Page 6, equations 2,3,7: I suggest to denote the trigonometric functions with regular text rather than italic, e.g., $\sin\alpha$ rather than $sin\alpha$.
13) Figure 5 d): there is a typo (cotact instead of contact).
14) Page 17, line 273: “class IA has a reliability of 0.999979”. I suggest changing to “class IA has annual probability of failure of 2.1e-5”. In the same sentence, you both define reliability numbers and probability of failure numbers, which is confusing. I suggest to stick with failure probabilities in scientific format.
15) Pf: I suggest changing the notation to a formula-like format, such as “P_f”.
16) Conclusions: when you summarize the paper in the first paragraph, please add description of the bearing configuration.