

Responses to comments by reviewers of manuscript tc-2020-301-RC1 “The flexural strength of bonded ice”

We sincerely thank anonymous referee for valuable comments/suggestions on our work. The comments are constructive and insightful. We have modified our manuscript according to them. Please, see all the responses in red.

Comments:

I find this paper to give an very useful review of the strength of the freeze-bond formed between two contacting ice surfaces. Also, and of great importance, the authors present important new data and observations regarding the freeze-bod strength of bonded ice.

The paper is easily read and its main conclusions clearly understood. I enjoyed reading the paper.

I recommend that this paper be accepted for publication after several minor adjustments (evident to me) are made. The following adjustments struck me:

Line 14: I had expected a section (in Results and Observations) on temperature increase effects. Though temperature is mentioned, I did not see a discussion of how temperature affects freeze-bond flexural strength. Perhaps, in line with the Abstract, such a section should be added.

Re: Thank you for this comment. We organized the structure of Results & Observations for bonded ice in such a way that we divide it only for two parts, i.e. Freshwater bond subsection and Saline bond subsection. Within each subsection we present results on the effect of temperature, salinity, time, etc. We do not think that it is reasonable to divided each subsection into a few more and to devote each of them to temperature, salinity and time observations separately. We do, however, present the temperature effect on both the freshwater and saline bond strength in Results and observation (for example, lines 172-181). We also provide tables and plots with data that provide explicitly the temperature dependence. The temperature effect on the flexural strength is mentioned in the Discussion in lines 280-286 and we also provide Appendix C where we derive an analytical equation for the strength vs temperature dependency. Therefore, we think that we covered the effect of temperature on the freeze-bond.

Lines 31-40. The cohesion when using the Mohr-Coulomb model to describe bonding between ice blocks is often referred to as a "pseudo-cohesion", which to me indicates that the term "cohesion" is used as a convenience, with the actual nature of the "pseudo-convenience" left to be determined. "Cohesion" is a term understood in civil engineering and thus has its uses. I fully agree with the authors that "pseudo-cohesion" has been needed to be investigated, something that the authors have now largely accomplished. I do wonder, though whether the authors should mention "pseudocohesion" and the vagueness inherent in this term.

Re: Thank you for this suggestion. The term “cohesion” is also commonly used the ice engineering literature related to freeze-bonds and partly consolidated ice rubble. Therefore, we decided to keep the term “cohesion” in order to be consistent with the literature.

Line 56: How thick were the pucks?

Re: We added to the sentence that the thickness of the ice puck is ~25 cm.

Lines 210-211: Shouldn't semi-colons be used when listing? I.e., . . . : (1) . . . : (2) . . . ; and, (3)

Re: Thank you for this comment. We have corrected this.

Line 265: The authors sometimes use the second-person voice "one may..." when the remainder of the paper is in the third-person voice. I wonder is some consistency is needed.

Re: We have replaced “As one may have expected” with “As expected” in line 280.

Line 271: A space exists in front of the period (.).

Re: Thank you for pointing this out. We deleted the period.

Line 297, Conclusions: Should the authors relate back to the objective of the paper (and the paper's Abstract) and be more definitive about bond-strength variation with temperature?

Re: Thank you for this comment. Conclusion 3 actually states how the bond strength changes with temperature: "An increase in bond salinity and **in freezing temperature** leads to a **decrease in bond strength**". We tried to keep conclusion concise, although such that includes all main observations. Therefore, given the structure of the conclusions we used, we do not want to include more information on bond-strength variation with temperature.

Again a very interesting and useful paper.