The Cryosphere Discussions

The Cryosphere Discuss., author comment AC1
https://doi.org/10.5194/tc-2022-155-AC1, 2022

Reply on RC1

Shibing Huang et al.

Author comment on "The temperature-dependent shear strength of ice-filled joints in rock mass considering the effect of joint roughness, opening and shear rates" by Shibing Huang et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-155-AC1, 2022

Nov 20, 2022

Dear referees

Thanks for your comments and suggestions. Based on these comments and suggestions, we have made careful modifications on this manuscript. Appended to this letter is our point-to-point response to the comments. These comments were reproduced and our response were given directly afterward in a different color (blue).

We hope that the manuscript can be accepted for publication in **The Cryosphere**. If you have any question, please contact us immediately. We are grateful for your attention to our manuscript. Once again, thanks very much for your arduous work and instructive suggestions to our manuscript processing.

Sincerely,

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Response to the comments

Response to referee:

- Abstract part should be compressed and polished. Line 24~25 should be deleted, because it is not the main conclusion of this study.

Response: Thank you for your good suggestion. We have deleted L24-25 and compressed the abstract. In addition, more important results have been added in Lines 15 to 22, mainly including the effect of joint roughness, freezing temperature, joint opening and normal stress. (Details can be found in the abstract in our revised paper, which are marked in red.)

- Red sandstone blocks with dimensions of 100×100×50 mm were used to engrave roughness curve. However, a certain amount of specimen thickness is consumed during engraving. The ice-filled joint masses may not be a standard 100×100×100 mm cube. This point should be claimed and whether the height of ice-filling samples has any effect on the shear strength should be explained.

Response: Thank you for your suggestion, the standard red sandstone block after engraving roughness curve will have different heights, so we added a steel gasket to ensure the ice-filled joint blocks have a unified height during the shear experiment. We ensured the block’s height error was within 0.5 %, which makes the same joint opening under the same experimental condition. The location of the steel sheet is shown in the following figure. This point has been clarified in our revised paper (Details can be found on Line 136~137 and in Fig. 4 in our revised paper, which are marked in red.)

- Line 69. “normal stress” should be deleted, because the previous literature has considered the effect of normal stress

Response: Thank you for your good suggestion. We rechecked the previous literature and found that it had considered the effect of normal pressures, so we deleted “normal stress” in Line 68. (Details can be found in Lines 68 to 69, which are marked in red.)

- In Fig. 2, it can be seen that when studying the influence of different shear rates and joint openings on the shear strength of ice-filled joint, the experimental temperature is -5 ☐. Why -15 ☐ is used as the experimental temperature under different normal stress. This may be not conducive for comparison. Can you explain it?

Response: In the normal stress group, we want to investigate the influence of the normal stress on the shear strength of the ice-filling joints. The freezing temperature, shear rate and joint opening are the same. Therefore, this group is not related with the freezing temperature. In addition, the difference of the shear strength between -15 ☐ and -5 ☐ is small. The change rule of the shear strength against the normal stress are similar no matter which freezing temperature is adopted. Therefore, the freezing temperature has no effect on the change rule of shear strength caused by normal stress.

- In Fig. 7, why the error bars are not added, because three parallel experiments were conducted?

Response: We do not give the uncertainty, because we only continuously capture the shear rupture picture for one group. Although only one set of data is monitored, the experiment data are reliable and the experiment phenomenon is remarkable. In order to make the experimental results more convincing, we will pay attention to these details in the future studies.

- Line 193~195. The turning point of brittle and ductile failure of pure ice at different temperatures is not clear. It is suggested to compare the present results with other studies and describe the macroscopic or microscopic failure phenomena more clearly.

Response: Thank you for your good suggestion. Lou et al. (2022) claimed that plain ice has strong brittleness at the temperature from -20 ☐ to -5 ☐. The brittle-ductile transition interval of pure ice is not clear according to the previous literature, so we take the characteristics of the failure plane as the basis for judging ductile failure and brittle failure. Rupture ice (macroscopic failure phenomena) will be produced under brittle failure condition. In the ice-filled joint, these parts of the rupture ice cannot squeeze out the joint and will form an aggregation of rupture ice area along the noticeable bulges. The increasing aggregation area of the rupture ice in Fig. 6 further proves that the brittleness of ice increases with decreasing the freezing temperature. The maximum shear displacement before failure is smaller at -15 ☐. The above comparisons are added in our revised paper. Thank you for your instructive comments. (Details can be found in Lines 214 to 219, which are marked in red.)

- Figure 16 - This figure show the effect of normal stress on the peak shear strength of ice-filled joints, the experimental condition should be corrected as T = -15 ☐, v = 0.2 mm/min and d = 2 mm.

Response: Thank you for your good suggestion. We have replaced "σ_n = 0.5 MPa" as "d = 2mm" in Fig. 17. (Details can be found in Lines 381 to 382, which are marked in red.)

- It is interesting to propose the noticeable bulges to explain the change of shear strength of ice-filling joints against the joint roughness. However, how to determine the noticeable bulges and what is the characteristic of these noticeable bulges need more evidence.

Response: Thank you for your good suggestion. The "noticeable bulges" are pointed out in Fig. 7. The bulges causing the reduction of joint width and aggregation of ice are called noticeable bulges. The noticeable bulges have larger inclination angles and they are far away from the joint edges. The definition of the noticeable bulge is added in our revised paper. (Details can be found on Line 206~208 in our revised paper, which are marked in red.)

- The conclusions should be compressed and improved, for example the sentence "Above all, this study … normal stress" may be shorten or deleted.

Response: Thank you for your good suggestion. We have deleted the sentence "Above all, this study … normal stress" and polished the conclusions. (Details can be found in conclusion in our revised paper, which are marked in red.)

- Line 329 to 333 – Where should be replaced by "where".

Response: Thank you for your good suggestion. We have replaced "Where" as "where". (Details can be found in Line 363, which are marked in red.)

- Line 12. "was" should be replaced by "were". It is suggested to polish the English carefully.

Response: Thank you for your good suggestion. We have replaced "was" with "were" and done a double check about the English and fixed grammatical errors. (Details can be found in Line 12, which are marked in red.)

- It is suggested that the authors search for the literature related to "ice-filled rock joints" or "ice-filled rock flaw" and cite it appropriately in the introduction.

Response: Thank you for your good suggestion. We have added the literature related to "ice-filled rock joints" or "ice-filled rock flaw" in our revised paper. (Details can be found on Line 36~40, which are marked in red.)