Comments from reviewer

The manuscript attempts to model the transportation process of debris flow using flume tests and DEM simulations on dry particles. Qualitative comparisons were compared between the flume tests and DEM models. The study confirms the contribution of particle size on dynamic segregation during transportation and deposition process and effectiveness of energy consumption of jump gaps before barriers. The technical contents are generally sound and the formality meets the technical writing requirements. The two weak points are no particle-fluid interactions and few quantitative comparisons.

Specific comments are listed as followings.

1. The introduction section is too long. Because the trigger of debris flow is out of the scope of the manuscript, descriptions of triggering and cases should be shortened or removed.
2. Equations (1) & (2) should be removed because they are not related to the tests and simulations. Cited references should only cover important and relevant ones.
3. Figs. 4 and 5 can be removed or presented schematically. Fig. 6 is insignificant.
4. The procedure and details to determine frictional coefficients in Table 1 should be added for verifications. Only those tests related to current study should be included in this manuscript.
5. Descriptions of Lines 212-220 need quantitative evidence. For instance, the energy transformation, particle velocity patterns and deposition process need evidence to support the descriptions.
6. The determinations of parameters listed in Table 3 should be clearly described.
7. Velocity field or particle traces should be added in Fig. 10 to support the flow pattern descriptions.
8. The technique to construct Fig. 12 should be added to the content.
9. The large scale field tests should include both dry and wet tests to evaluate the significance of particle-fluid interactions and the confidence of implementing this study to real scenarios.

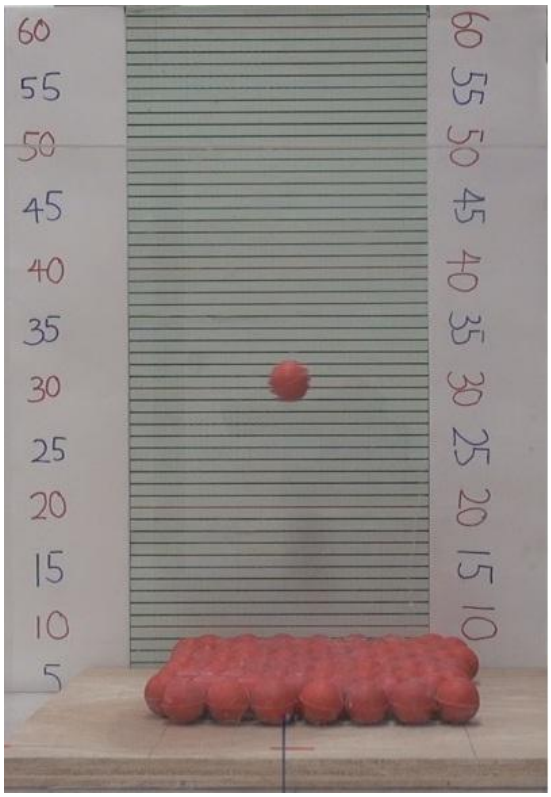
Reply

The authors would like to thank the reviewer for the constructive comments, based on which a revised manuscript has been prepared to address the comments. Some of the questions as raised are not precisely the aim of the present study, and practically outside the capability of the computational technique/numerical model that is available up to the present. As mentioned in the conclusion of the revised manuscript: “The authors have chosen flexible spherical rubber beads as well as rigid glass beads for the

laboratory. The segregation process as found from the laboratory test is actually similar to that in the field tests using non-spherical sand. Through such selection, it is clearly demonstrated that particle size distribution is a very critical factor in the segregation process, and it appears that it is more critical than particle shape or stiffness." The main work from the present study is more on qualitative than quantitative, though we also aim to produce useful quantitative results from DEM, but this is not the main theme of the work, as this is usually achieved by tuning the micro-parameters (previous papers by the authors as well as many research papers on DEM).

The authors would like to reply the comments as follows:

1. The introduction part has been shortened to include more relevant materials only.
2. Eqs.(1) and (2) are removed. Thanks to the comments.
3. The authors personally view that Fig.4 and 5 can be retained. Some readers may want to see the actual photos of the flume and the end process. In particular, other reviewers do not have such comment, hence the authors prefer to retain these figures, unless there is a strong comment on it. Similarly, the authors view that Fig.6 is actually useful, as the photo give a clear view about the nature and texture of the balls.
4. The frictional coefficients in Table 1 are provided by the manufacturers, while the parameters in Table 3 are determined by in-house testing procedures. The testing procedures are provided in the section just before Table 3.



rebound test

Deposition test

shear force applied to determine the frictional coefficients between balls.

5. Line 210-220 – as mentioned in many places in the revised manuscript, due to the limitations of DEM, it cannot provide a good quantitative description of the flow process, up to the present. It is also not the purpose of the present manuscript to address this issue. However, the authors are also working on this issue to improve the quantitative assessment by using DEM, while the general procedures are to fine-tune the parameters until the computed results match well with the measured results. Personally, the authors do not favour this approach, as we can tune everything to match with experiments, even if the theory is wrong.
6. The determination of the parameters are based on laboratory tests, as given in the revised manuscript. A sample test report for the deposition test is given below, while the values as given in Table 3 are the mean values.

Set	Balls	Angle (degree)	Fric
1	P(Black)	27	Average
2		20	0.365
3		20	Min
4		20	0.176
5		10	Max
6		20-30	0.577
7		18.5	
8	P(Red)	20	Average
9		20	0.429
10		20	
11		30	Min
12		23	0.365
13		20-25	
14		30	Max
15		20-23	0.577
16		25	
17		20	
18	P(White)	27	Average
19		30	0.547
20		28-30	

7. The photos at different stages are added in Fig.10. We do not add in the velocity vector, as DEM cannot reproduce the results well quantitatively. The overall phenomenon is however reasonable.
8. In PFC2D, we have developed the code to monitor the maximum velocity of the balls for comparison purpose. This is mentioned in the revised manuscript.
9. We know that the large scale field should include the wet tests. There is however two very major limitations in the study : time and money. We need to pay for the workshop and the field equipment as well as various personnel working on site (the test site is in China, and further expenses are required for our research personnel’s travelling and living allowances). Furthermore, we have only 1 month time in the test, from preparation to actual field tests. We are now trying to secure more fund for the next stage of works, for which the wet tests will be conducted.