

Dear Editors and Reviewers,

We are very grateful to your help and the comments for the manuscript entitled “Mechanical State of Gravel Soil in Mobilization of Rainfall-Induced Landslide in Wenchuan seismic area, Sichuan province, China”. Your valuable comments can effectively help our paper improve. We have revised the manuscript in accordance with your detailed comments. Besides, we have carefully proof-read the manuscript to remove mistakes about language and grammar.

Please find the following responses to the comments of reviewer.

Best wishes.

Liping Liao and behalf of all co-authors

Reviewer 1

General comments This paper presented a study about the mechanical state of gravel soil in the landslide initiation using artificial flume model tests and triaxial tests. This topic is very interesting and significant for the landslide early identification and prediction, and it is within the scope of ESURF. The experiment and testing are designed reasonably and its results are reliable. but I think the innovation of this paper is slightly weak. The Introduction and Conclusion did not prepare well. In addition, the language of this paper should be improved. I think this paper needs a round of major revision before publication.

Authors' response: Thank you for your kind suggestions. The introduction and conclusion has been rewritten. The language of the manuscript has been improved. The revised details can be found in Line 31~77, Line 382-397.

Specific comments

1. I think the introduction was not prepared well. too many previous studies were presented, only important studies related to you study should be presented; the purpose and motivation of this paper should be clearer.

Authors' response: Thanks a lot for your comment. Your comment provides the valuable guidance for improving the manuscript. According to your suggestion, the introduction has been rewritten and improved. The revised details can be found in Line31-77.

2. The initial dry density is important for the analysis and conclusions, I suggest the authors add some explanation that why or how these four initial dry densities (1.54g/cm^3 , 1.63g/cm^3 , 1.72g/cm^3 , 1.81g/cm^3) were selected?

Authors' response: Thanks you for your comment. The designed initial dry density is 1.50g/cm^3 , 1.60g/cm^3 , 1.70g/cm^3 and 1.80g/cm^3 . In order to achieve a predetermined density, the soils of the models are divided into four layers, and each layer is compacted respectively. Therefore, some experiment errors exist; the actual density is 1.54g/cm^3 , 1.63g/cm^3 , 1.72g/cm^3 and 1.81g/cm^3 . The revised details can be found in Line103~109.

3. In the Section of 3.1, the authors stated that 'throughout the rainfall, the volume moisture content of soil depth of 40cm exhibits a slow-growth trend or remains the stable'; however, as shown in Fig. 6, the volume moisture content of soil depth of 40cm increased sharply, please provide a brief explanation for this phenomenon.

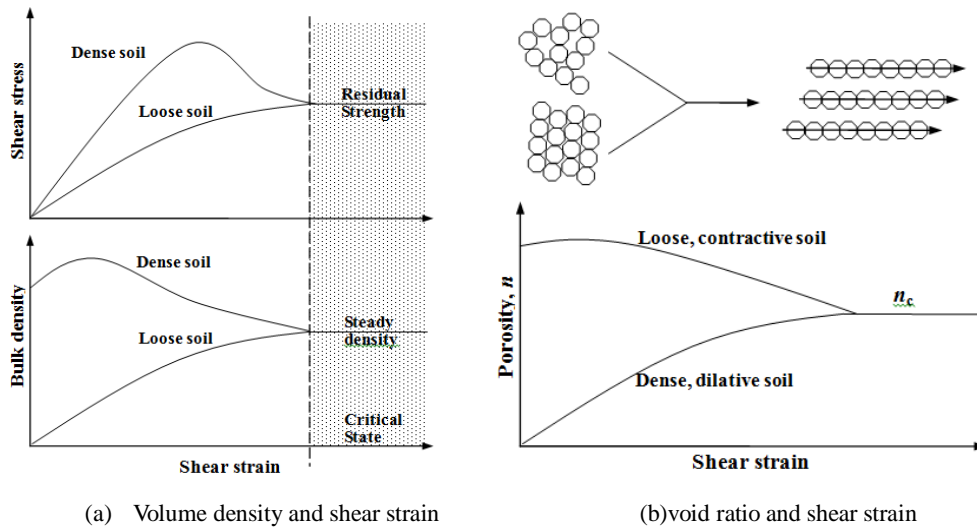
Authors' response: Thanks a lot for your comment. The reason of the phenomenon "the volume moisture content of soil depth of 40cm increased sharply" is its x-label is shorter than x-label of other figures. Therefore, all panels have been plotted for the same x- and y-labels for better comparison. The description about volume moisture content and pore water pressure has been modified accordingly. The revised details can be found in Section 3.2.

4. The authors design the experiment to explore the relationship between the initial dry density and landslide initiation. With the results, it was proved that they have a very close relationship. But, it is still not clear that what the relationship is. For example, why the initiating time of the landslide with the initial dry density of 1.72g/cm³ (18 minutes) is shorter than the landslide with the initial dry density of 1.54-1.63g/cm³ (30 40 minutes). A deep analysis is needed.

Authors' response: Thank you for your kind suggestion. A deep analysis on the relationship between initial dry density and landslide initiation has been added. The revised details can be found in Section 3.1. The revised details can be found in Line 165-187.

5. In the Section of Critical state of gravel soil, the gravel soil with an initial dry density of 1.94g/cm³ and 2.00g/cm³ were used, why not the soil sample used before (1.54-1.81g/cm³)?

Authors' response: Thank you for your kind suggestion. The one reason is that according to the research (Gabet and Mudd 2006; Iverson et al., 2000), the soil with the same granular composition can obtain the approximate critical void ratio in the uniform stress condition (Figure 1). The other reason is that the authors tried to make the soil sample with 1.54-1.72g/cm³, but the soil sample could not maintain stable when it suffers from the gravity of axial loading system. Based on the above reasons, the density of the soil sample for triaxial test is 1.94g/cm³ and 2.00g/cm³.



(a) Volume density and shear strain (b) void ratio and shear strain
Figure 1 Volume density and shear strain (Gabet and Mudd 2006; Iverson et al., 2000)

6. In my opinion, the conclusion section was not written well. the 5th conclusion is not clear; I suggest the conclusions about the Critical state of gravel soil can be synthesized. Technical corrections Line 36-41: please cite only the important references, it is unnecessary to list all the related literature; Line 91: I suggest the authors provide a location map with Niujuan Valley and Duwen highway. Line 93: please check the unit of '32.7' Line 116: what does 'CAS' mean, please provide its definition. Line 120: what does 'DL2e' mean; Line 166-167: please correct the sentence; Line 240-241: please check the language; Tab 2: please check the value of initial dry density, 1.62 or 1.63? it is not clear the meaning of h(cm), soil depth? Tab 3: it is not clear the meaning of $U_{sP0.0075}$, U_{sP5} , U_{sP2} and h. Tab 4: please provide the definition of σ_3 ; Fig.7-9: please add captions for each subfigure.

(1) In my opinion, the conclusion section was not written well. the 5th conclusion is not clear; I suggest the conclusions about the Critical state of gravel soil can be synthesized.

Authors' response: Thanks a lot for your kind suggestion. The conclusion has been rewritten. The revised details can be found in Line 382-397.

(2) Line 36-41: please cite only the important references, it is unnecessary to list all the related literature.

Authors' response: Thanks a lot for your kind suggestion. The unimportant references have been removed. The revised details can be found in Line 37.

(3) Line 91: I suggest the authors provide a location map with Niujuan Valley and Duwen highway.

Authors' response: Thanks a lot for your kind suggestion. The location map of the study area was provided. The revised details can be found in Line 89.

(4) Line 93: please check the unit of '32.7

Authors' response: Thanks a lot for your kind suggestion. The unit of '32.7 has been checked. 32.7% is the gradient of valley bed, which is equal to the ratio of the height and the length of the valley. So this value is dimensionless.

(5) Line 116: what does 'CAS' mean, please provide its definition.

Authors' response: Thank you for your comment. CAS is the abbreviation of Chinese Academy Science. Its definition has been added to Line 110, Line 123.

(6) Line 120: what does 'DL2e' mean;

Authors' response: Thank you for your comment. DL2e is the model of the data acquisition system. The revised details can be found in Line 117-119.

(7) Line 166-167: please correct the sentence;

Authors' response: Thank you for your comment. The sentence has been corrected. The revised details can be found in Line 252~267.

(8) Line 240-241: please check the language;

Authors' response: Thank you for your comment. The language of Line 240-241 has been modified. The revised details can be found in Line 305~308.

(9) Tab 2: please check the value of initial dry density, 1.62 or 1.63? it is not clear the meaning of h (cm), soil depth?

Authors' response: Thank you for your comment. 1.63 is the correct value. The value of initial dry density in Tab 2 has been modified. h is the soil depth and its meaning has been added to Tab.2 and Fig.2(a)

(10)Tab 3: it is not clear the meaning of $U_{sP0.0075}$, U_{sP5} , U_{sP2} and h .

Authors' response: Thanks a lot for your kind suggestion. The cumulative content of coarse (particle diameter > 5mm) is represented by P_5 , the cumulative content of gravel (particle diameter < 2mm) is represented by P_2 , and the cumulative content of silt and clay (particle diameter < 0.075mm) is represented by $P_{0.075}$. The meanings of P_5 , P_2 and $P_{0.075}$ have been given in section 2.2.3. The revised details can be found in Line 139~141.

(11)Tab 4: please provide the definition of σ_3 ;

Authors' response: Thanks a lot for your kind suggestion. The definition of σ_3 has been added to Tab.4.

(12)Fig.7-9: please add captions for each subfigure;

Authors' response: Thanks a lot for your kind suggestion. Due to the adjustment of the structure of Section 3, the figure numbers have been changed. For example, Fig.7-9 is changed to Fig.4~7. The captions of each sub-figures of Fig.4~Fig.7 have been added to the manuscript. The revised details can be found in Line 207~223.

References

- Gabet, E. J. and Mudd, S. M.: The mobilization of debris flows from shallow landslides. *Geomorphology*, 74, 207-218, doi: 10.1016/j.geomorph.2005.08.013, 2006.
- Iverson, R. M., Reid, M. E., Iverson, N. R., LaHusen, R. G. and Logan, M.: Acute sensitivity of landslide rates to initial soil porosity. *Science*, 290, 513-516, doi: 10.1126/science.290.5491.513, 2000.