Dear editors:

We gratefully thank for your constructive remarks and useful suggestions, which has significantly raised the quality of the manuscript and facilitated its improvement. Below the comments of the reviewers are responses point by point and the revisions are indicated.

Reviewer

1. General Comments:

Rewrite the abstract so that it reflects the context, methods, main findings and conclusions of the paper.

1. Reply

We gratefully appreciate for your valuable suggestion. A rewritten abstract is as follows:

Abstract: The pile-slab retaining wall, as an innovative rockfall protection structure, has been extensively utilized in the western mountainous regions of China. With its characteristics of a small footprint, high interception height, and ease of construction, this structure demonstrates promising potential for application in mountainous regions worldwide, such as the Himalayas, Andes, and Alps. However, its dynamic response upon impact and impact resistance energy remain ambiguous, due to the intricate composite nature of the structure. To elucidate this, an exhaustive dynamic analysis of a four-span pile-slab retaining wall with a cantilever section of 6 m under various impact scenarios was conducted utilizing the finite element numerical simulation method. The rationality of the selected material constitutive models and the numerical algorithm was validated by reproducing two physical model tests. The simulation results reveal the following: (1) The lateral displacement of the pile at the ground surface and the concrete damage under the pile as the impact center is greater than those under the slab as the impact center, implying that the impact location has a significant influence on the stability of the structure. (2) There is a positive correlation between the response indexes (impact force, interaction force, lateral deformation of pile and slab, concrete damage) and the impact velocities. (3) The rockfall peak

impact force, the ratio of peak impact force to peak interaction force, and lateral displacement of pile at the ground surface had strong linear relationships with rockfall energy. (4) Relative to the bending moment, shear force and damage degree, the lateral displacement of pile at the ground surface is the first to reach its limit value. Taking the lateral displacement of the pile at the ground surface as the controlling factor, the estimated maximum impact energy that the pile-slab retaining wall can withstand is 905 kJ in this study when the structure top is taken as the impact point. In cases where the impact energy of falling rocks exceeds 905 kJ, it is recommended to optimize the mechanical properties of the cushion layer, improve the elastic modulus of concrete, increase the reinforcement ratio of longitudinal tension bars, enlarge the section size of pile at ground level, or add anchoring measures to enhance the bending resistance of the retaining structure.

2. General Comments:

Highlight the novelty of the own studies. This can be done by highlighting the research questions, the research hypothesis, the assumptions and the limitations. The conclusions shall repeat the initial claim in the light of the conclusions which have been reached in the paper regarding the research hypothesis/the thesises. This way either the conclusion or the introduction will repeat the abstract.

2. Reply

Thanks for your comment. We made a serious We carefully reviewed the whole paper and rewrote the conclusion. A rewritten conclusion is shown below:

Compared to existing rockfall protection structures, the PSRW offers enhanced stability and requires a smaller footprint, making it adept at addressing a broad spectrum of rockfall impact scenarios commonly encountered in alpine canyon regions. In this paper, the dynamic response of the PSRW under different impact centers and velocities were compared and analyzed using the FEM simulation method. Additionally, the influencing factors such as peak impact force, peak interaction force, ratio of peak impact force to peak interaction force, concrete stress, reinforcement stress, maximum lateral displacement of the pile at the ground surface, and ratio of

damage failure units to overall structure units were quantified. Notably, the formula for calculating the peak impact force of the PSRW (Eqs. 1), the ratio of peak impact force to peak interaction force (Eqs. 2), maximum lateral displacement of the pile at the ground surface (Eqs. 3) based on the impact energy of rockfalls were proposed. The key findings of this study are as follows:

(1) The impact force, interaction force and lateral displacement exhibit a linear correlation with the impact velocity. however, the lateral displacement is more sensitive to velocity variations than the impact force and interaction force.

(2) Under different impact centers, the variations in impact force and interaction force are minimal. When the pile serves as the impact center, the lateral displacement of pile at the ground surface and the extent of concrete damage are significantly greater than when the slab center is the impact center. This indicates that impacts centered on the pile pose a more hazardous impact scenario.

(3) Concrete damage predominantly concentrates at the joints between piles and slabs, the impact center itself, and the section of piles at the ground surface. To minimize structural concrete damage, it is imperative to prioritize these critical sections in the structural design.

(4) The impact force, the ratio of peak impact force to peak interaction force, and the maximum lateral displacement of the pile at the ground surface have a significant correlation with the impact energy. These relationships are crucial for evaluating impact force, interaction force, and the lateral displacement of piles at ground surface during the design of PRSW structures. According to Chinese specifications for displacement requirements, the maximum lateral displacement of the pile at the ground surface should not exceed 10 mm. Consequently, the maximum impact energy that the PSRW can withstand is 905 kJ, when the crown is designated as the impact center.

3. General Comments

A more practical relationship between the concrete (site) study and the mathematical model shall be reached.

3. Reply

We gratefully appreciate for your valuable suggestion. A rewritten part about the practical relationship between the concrete (site) study and the mathematical model is shown below:

The design drawing of the PSRW (Fig. 3) is consistent with the actual project located in Zhangmu Town, China. Given the large scale of the actual engineering structure, numerical simulations have been focused solely on a representative four-span structure, incorporating appropriately simplified boundary conditions to facilitate the analysis. For a comprehensive understanding of the modeling specifics, kindly refer to Section 2.1.3.