

Comparison and analysis of seismic isolation, energy dissipation structure and traditional seismic structure

Shu-jiang JIANG¹, Shun-zhong YAO* and De-wen LIU²

¹College of Civil Engineering, Southwest Forestry University, Kunming 650000, Yunnan, China

Abstract. This paper uses SAP2000 finite element software to perform nonlinear time history analysis of nine structural systems, and compares the period, total floor displacement, base shear force, vertex displacement, and top acceleration of the structure under the action of an 8-degree rare earthquake. The research results show that seismic isolation and damping technology can effectively reduce the impact of earthquakes on structures.

1 Project introduction

This paper adopts two-story light steel-wood plastic structure [1], [2] building and selects and uses the following three seismic waves according to the location of the building: EL-Centro wave, Lanzhou wave, and Shanghai artificial wave [3].

2 Elastic-plastic analysis modeling

Traditional earthquake resistance mainly relies on the ductility and plasticity of the structure itself, and is based on "resistance" to dissipate the energy input caused by the earthquake. Judging from the current development, this kind of seismic resistance can no longer meet the seismic requirements of structures required by the current society. In recent years, scholars at home and abroad have proposed building seismic isolation and damping technology through a large number of studies [4], which controls the energy input to the building structure from earthquakes and reduces the seismic response of the

structure, which greatly increases the safety of the structure, which allows the structure to achieve The change from "resistance" to "control".

Through the SAP2000 finite element software, the Xishuangbanna Dai light steel-wood-plastic structure is established for seismic resistance, 5 types of base isolation and 3 types of damping structural systems [5], that is, a total of 9 finite element calculation models.

3 Analysis of results under rare earthquakes

3.1 Cycle comparison

This model uses the finite element analysis software SAP2000 for analysis, and carries out the modal analysis of the anti-seismic structure, the seismic isolation structure and the damping structure. The comparison of the natural vibration period of the light steel-wood-plastic structure under the three conditions is shown in figure 1、2 .

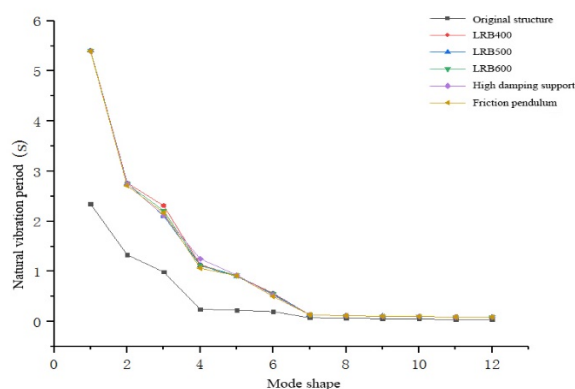


Fig. 1. Periodic comparison of original structure and isolated structure

* Corresponding author's e-mail: 1844095825@qq.com.

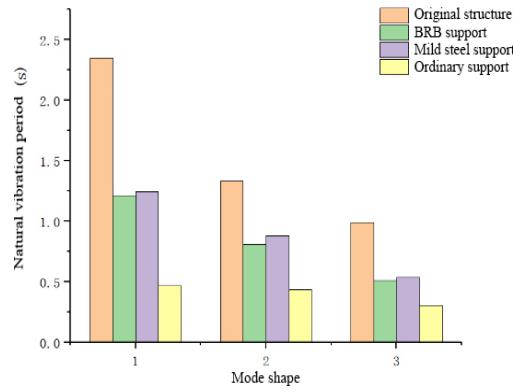


Fig.2. Comparison chart of natural vibration period of shock-absorbing structure

The above two figures show that the period of the seismic isolation structure is greatly extended, and the natural vibration period of the building is far from the characteristic period of the site, which greatly reduces the possibility of structure resonance. The overall rigidity of the shock-absorbing structure is increased after the

support is added, resulting in a decrease in the structural period and weakening of the torsional effect of the structure.

3.2 Comparison of total floor displacement

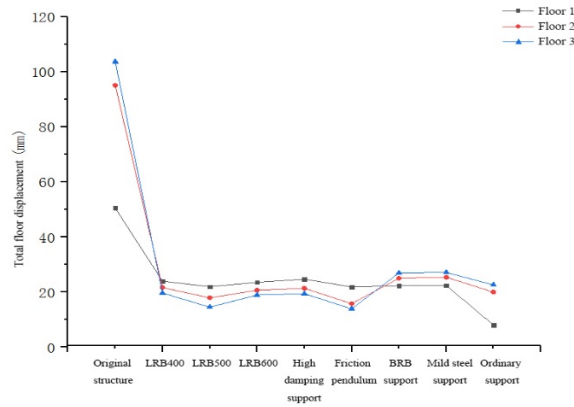


Fig.3. Comparison EL-Centro Wave

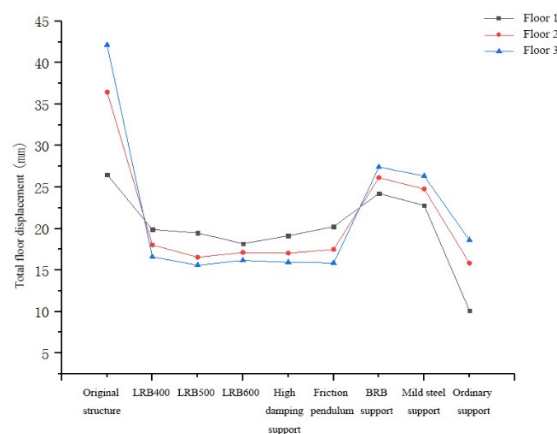


Fig.4. Comparison of Lanzhou Wave

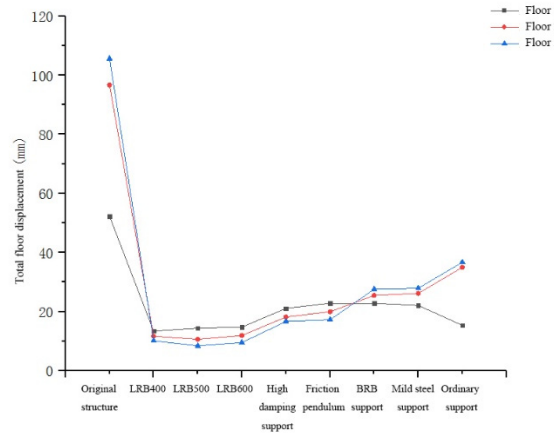


Fig.5 Comparison of Shanghai Artificial Wave

It can be seen from the above chart that the total floor displacement value generated by the original structure is the largest under the EL-Centro wave, Lanzhou wave and Shanghai artificial wave. Under the action of an earthquake, the total floor displacement value of the upper structure of the seismic isolation system is greatly reduced compared with the total floor displacement of the original structure. And under the action of three kinds of seismic waves, the displacement values of the five structures of the seismic isolation system are all smaller than those of the BRB support and mild steel support structure of the seismic damping system.

steel support and the ordinary support structure Compared with the original structure, the base shear force is not very obvious. This is because the natural vibration period of the structure is shortened under seismic waves and the base shear force will increase due to the addition of a displacement energy dissipator.

(3) Comparing the base shear force data of five types of seismic isolation system and three types of seismic damping system, the values of the five types of seismic isolation structure are all smaller than the value of the specific damping system.

3.3 Comparison of base shear force

Tab1. Comparison table of base shear forces of various structure types under three wave earthquakes (unit:KN)

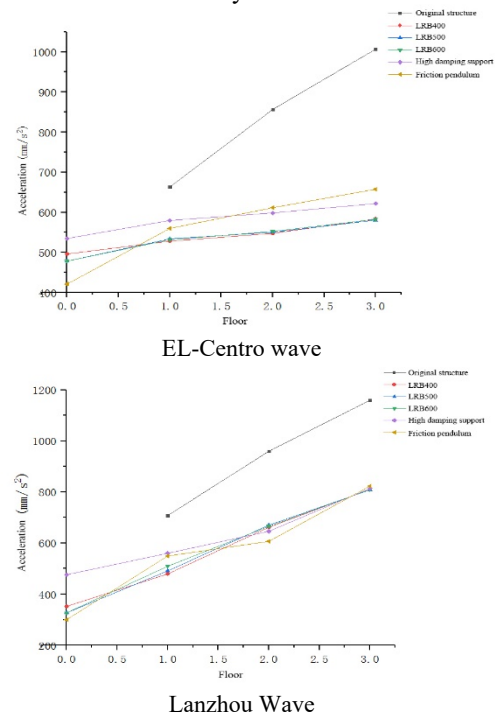
	Seismic wave		
	EL-Centro wave	Lanzhou Wave	Shanghai Artificial Wave
Original structure	130.12	152.62	208.6
High damping support	84.52	54.02	63.72
Friction pendulum	96.3	77.78	54.64
LRB400	109.38	92.54	110.54
LRB500	109.78	93.98	112
LRB600	109	93.42	110.02
BRB support	118.16	143.42	190.26
Mild steel support	123.34	144.7	197.2
Ordinary support	127.3	149.32	203.06

(1) There is a certain difference in the base shear value of the structure under the action of different seismic waves. The shear value of the original structure is the largest under the action of the three kinds of seismic waves.

(2) Under the effects of rare earthquake EL-Centro waves, Lanzhou waves and Shanghai artificial waves, the base shear forces of the five types of seismic isolation structures are greatly reduced; the buckling restraint support of the shock absorption system, the metal mild

3.4 Structural acceleration response

Analyzing the response of the structure under seismic waves, the acceleration of the structure is one of the important parameters, and three types of seismic waves are input to nine structural systems.



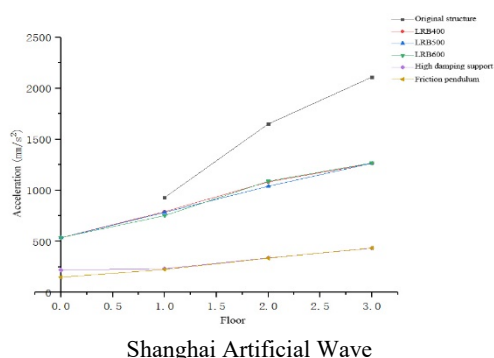


Fig.6. Comparison of floor acceleration response between original structure and isolated structure under seismic wave

From figure 6, it can be seen that the acceleration of the upper floors of the different seismic isolation structures under different seismic waves is smaller than that of the original structure, and does not change much with the increase of floors, while the peak acceleration of the original seismic structure increases as the number of floors increases obviously. Therefore, under the action of seismic waves, the seismic isolation structure mainly relies on the deformation of the seismic isolation layer to consume the energy input from the earthquake. It can also be seen that the seismic isolation effect is more significant.

4 Conclusion

(1) The period of the seismic isolation structure is compared with the original structure. The period of the five basic isolation structures is 2 to 3 times that of the original structure. The natural vibration period of the structure is greatly improved, effectively avoiding the excellent period of the site, and reducing the seismic response of the seismic wave input to the superstructure. After seismic isolation, the acceleration amplitude of the top layer of the structure and the acceleration amplitude of each layer are significantly reduced. The deformation of the seismic isolation structure is mainly concentrated in the isolation layer, and the upper structure moves in translation, which greatly improves the seismic performance of the structure;

(2) The shock-absorbing dampers mainly provide lateral stiffness to consume the energy input from the earthquake. The natural vibration period of the three kinds of shock-absorbing structures is smaller than that of the original structure. The greater the stiffness, the smaller the period. The hysteresis curve of the damping structure shows that both the BRB support structure and the mild steel support structure play a good energy consumption situation;

(3) From the acceleration diagram, base shear force and total displacement diagram, it is shown that the seismic isolation support can better change the dynamic characteristics of the structure in the structure studied in this paper, and its seismic effect is better than that of the damping system.

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