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Nonlinear Vibration Analysis of Seismic-isolation Laminated Rubber Considering Bi-directional Restoring Force Model

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Abstract: The seismic-isolation laminated rubber is used as a means of suppressing damage to the structures caused by an earthquake. To design the seismically isolated structure, it is important to calculate the dynamic response reflecting the rubbers characteristics accurately. The authors have applied the nonlinear vibration analysis method using the restoring force model of the power function type to the seismic response analysis of seismic isolation rubber in horizontal unidirectional [1-3]. However, when seismic isolation laminated rubber is loaded in horizontal bi-direction, the seismic isolation laminated rubber is torsional deformed and breaks with less force than when loaded in unidirectional. It is necessary to extend the model which has been used for unidirectional analysis to the model which can be analyzed in bi-direction. As a previous study, Igarashi applied the MSS (Multiple Shear Springs) model, which is a physical model capable of horizontal bi-direction analysis, to the bilinear model and Park-Wen model, which are nonlinear vibration analysis methods [4]. The validity of the method was verified by comparing the calculated values of the vibration response analysis in the bi-direction with the measured values. In this study, we applied the MSS model to the restoring force model of power function type which can accurately express the restoring force characteristics of seismic isolation laminated rubber. The proposed model was discussed in comparison with the calculated value of the modified bilinear method using the MSS model.

Keywords: Nonlinear vibration, seismic response analysis, seismic isolation laminated rubber

References

1. Kazuhito, M. etc. (1994). *Vibration Characteristics of Rubber Vibration Isolators of Vehicle: Analysis of Nonlinear Vibration Response*. Transactions of the Japan Society of Mechanical Engineers Series C. Vol. 60. No. 578 P 3274-3280.
2. Ayumi, T. etc. (2017). *Optimization of Nonlinear Vibration Characteristics for Seismic Isolation Rubber*. Computer Modeling in Engineering & Sciences. 113(1). 1-15.
3. AYUMI T. etc. (2019). *Seismic Response Analysis of a High-rise-building with Seismic Isolation Rubber*. International Conference on Computational & Experimental Engineering and Science.
4. Akira, I. etc. (2013). *LOADING TESTS AND INVESTIGATION OF ANALYTICAL MODELS FOR BI-DIRECTIONAL RESTORING FORCE RESPONSE OF ELASTOMERIC BEARINGS*. Journal of Earthquake Engineering. Volume 69 Issue 4 Pages I_311-I_325.

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