

PROCEEDINGS**Nonlinear Vibration Analysis of Horizontal Bi-Directional Restoring Force Characteristics for Seismic Isolated Laminated Rubber****Ayumi Takahashi^{1,*}, Kenya Kashiwagi², Tomoyuki Tsuchiya² and Kazuhito Misaji¹**¹College of Industrial Technology, Nihon University, 1-2-1 Izumi-cho, Narashino, Chiba, 275-8575, Japan²Graduate school of Industrial Technology, 1-2-1 Izumi-cho, Narashino, Chiba, 275-8575, Japan

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ABSTRACT

As a characteristic of seismic isolated laminated rubber, the rubber is torsional deformed when it was loaded in horizontal bi-direction, 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 Multiple Shear Springs (MSS) model which is a horizontal bi-directional model, and compared them with measured values to verify their validity [1]. The authors extended PFT-ELS method to MSS model which can analyze bi-direction [2]. The ELS method is a method in which the equivalent spring constant and the equivalent damping coefficient, which depend on the response displacement, are calculated each time the velocity sign changes, and the response is analyzed by substituting them into the equation of motion. However, this method causes discontinuities in the response due to sudden changes in these coefficients. Therefore, in order to remove these discontinuities, PFT-HYS (Hysteresis system using the restoring force model of power function type) method is proposed in which directly substitutes the restoring force model into the equation of motion and calculated the response. In this study, MSSPFT-HYS method are proposed, which enables horizontal bi-direction analysis. These analytical results are compared with results of the modified bilinear method and PFT-ELS which applies the MSS model, to verify the validity of the method.

KEYWORDS

Nonlinear vibration, seismic response analysis, seismic isolation laminated rubber

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