Implementation of Neural Networks for the Calibration of a Macroscopic Model of a Lead-Core Bearing Device

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Abstract

The increasing popularity of the lead-core bearing devices motivates the research efforts devoted to a more accurate behavior assessment. The contribution provides details of an accurate finite element model of the bearing device. The geometry is reproduced in great detail. Material models are defined for the rubber layers, steel elements, and lead core. The output of the finite element simulations provides an insight into the bearing response, for example, through the numerically obtained 'Restoring force- displacements' relationship. The definition of a less demanding model of the lead-core rubber bearing about an implementation into the finite element analysis of a base-isolated structure might be an attractive option. Some elements of the implementation of a neural network for the identification of the model parameters based on results obtained by finite element analysis are discussed.

Keywords: seismic isolation; lead-core rubber bearing device; finite element modelling; neural network.

1 Introduction

Lead-core Rubber Bearings (LRBs) are widely used hardware for seismic isolation of buildings and structures. Typically, elastomeric isolators consist of rubber layers separated by steel shims. The low horizontal stiffness of the bearing device, needed to lengthen the fundamental natural period of the base-isolated structure, is provided by the total thickness of the rubber layers. At the same time, the steel shims provide to LRBs with considerable vertical stiffness. Vertical stiffness assures the load-carrying capacity for vertical loads transferred from the superstructure. The lead, mounted in the center hole, yields relatively quickly under transverse Loads, which results in a well-pronounced hysteresis response of the LRB.

Due to their large energy dissipation capacity, they are often employed in the base isolation of important structures: nuclear power plants, hospitals, bridges, etc. A considerable research effort has been devoted to the study of the mechanical [1, 2] and the thermo-mechanical [3, 4, 5] behavior of the lead-core rubber bearings. Despite the recent advances in this field, some mechanisms involved in the complex response of

https://doi.org/10.2749/nanjing.2022.0880
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