Dynamic Design of Elastomeric Bearings for Vibration Isolation

Ulrich GERHAHER
Research and Development
mageba SA
Bülach, Switzerland
ugerhaher@mageba.ch

Hans-Jakob STREHLER
Head Building Products
mageba SA
Bülach, Switzerland
hstrehler@mageba.ch

Summary

Reinforced elastomeric bearings can be used as high quality vibration isolators for buildings, the separation of different sections of buildings or isolation of heavy machines. In contrast to the static behavior of elastomeric bearings the construction codes do not provide formulas to calculate their dynamic behavior. Extensive tests are required to specify the dynamic stiffness of bearings being essential for the optimization of the efficiency of isolation applications.

Thepresent paper describes the procedure of the calibration of a set of semi empiric formulas to describe the dynamic behavior of reinforced elastomeric bearings. The basis of this calibration is given by static and dynamic measurements on ten different bearing types.

Keywords: reinforced elastomeric bearings, dynamic stiffness, calibration

1. Introduction

The development of infrastructure in densely populated areas as well as the multiple use of infrastructure related buildings lead to a increasing demand of isolation of buildings or isolated separation of buildings sections. This request is enhanced by rising quality standards regarding the structural physics of high-priced inner city apartments and offices.

Not only a detailed knowledge of the vibration impact, but also of the dynamic behavior in vertical direction of the elastic elements and the structure itself is a prerequisite of an effective design of vibration isolation. In most cases the horizontal stiffness of the bearings is not relevant as it is much lower than in vertical direction. The calculation of the dynamic stiffness of a reinforced elastomeric bearing depends on the geometry, the material properties and the loading. It is based on the correlation of vertical force and displacement expressed by the nonlinear stiffness of the bearing. This leads to the tangential stiffness of the bearing at a certain load level. The effect of dynamic stiffening of the elastomer material is considered in the stiffening factor k which is defined as the ratio between dynamic and static stiffness.

The formulas given in the current design codes only give a rough approximation of the static stiffness. The dynamic behavior of reinforced elastomeric bearings is usually determined by expensive vibration tests. This paper presents the procedure of the parameter calibration of a set of semi-empirical design formulas usingstatic and dynamic measurements in an optimization process to achieve a precise design tool for elastomeric isolation bearings.

2. Measurements of the stiffness

The basis of the calibration process was given by the static and dynamic stiffness values measured on a series of different bearing types. To carry out tests it was essential to compromise between the geometric properties representing the most common isolators used in practise and the limitation if the bearing size related to the maximum load capacity of the testing machine.

https://doi.org/10.2749/222137912805112914