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# THE USE OF RUBBER VIBRO-BASE ISOLATION TO DECREASE STRUCTURE DYNAMIC RESPONSE

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**Abstract:** *The use of rubber or another elastomer in the foundation structure is an efficient solution to reduce vibrations propagating into the building structure through the subsoil. The principle of vibro-base isolation consists in inserting an elastic layer between the dual foundation plates. The example of reinforced concrete structure of the building is used to show the efficiency of vibro-base isolation.*

**Keywords:** ***technical seismicity, vibro-base isolation, building, dynamic analysis, response.***

## 1. Introduction

The example of a residential building is used to illustrate the use of vibro-base isolation against the propagation of vibrations (Makovička & Makovička, 2009) from the subsoil to the protected building. The building has three underground storeys and graduated six (north side) up to ten (south side) storeys over the ground. The building is founded on a foundation plate on the level of the 3rd underground storey. 3D model was chosen for dynamic analysis (Fig. 1).

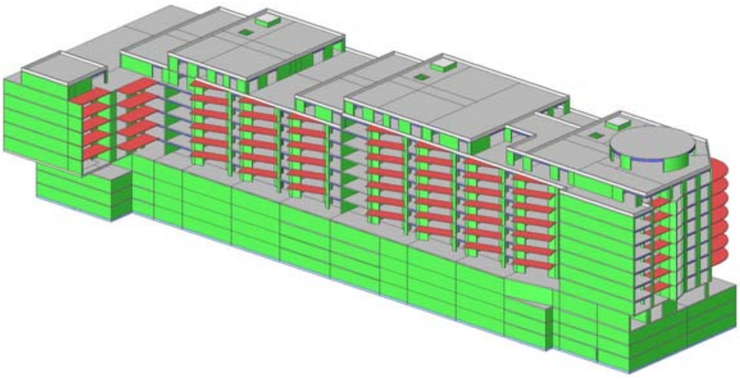

*Fig. 1: Calculation model ... South-West view*

## 2. Dynamic analysis

Dynamic excitation due to traffic was introduced to the model at selected points of the structure, in an approximately regular grid of points on the level of the foundation plate and at the same moment and with the same phase. Part of the measured acceleration record, incorporating the effect of B line metro passage in the duration of 1 s, was used for the calculation. The purpose of the analyses was to determine the relative response of individual building storeys compared to excitation on the foundation base level, at the place of rubber placement. For this reason, the response results were normalized.

The calculation of vibration transfer from the lower to the upper part of the foundation plate of the building was done for the model of the structure part laid on the elastic vibroisolation layer, lower foundation plate (base concrete), and subsoil layer (slate R3).

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The interaction at the rubber and reinforced concrete foundation structure interface has an effect on vibration transmission to the building structure itself. Characteristics of this interaction depend on (a) intensity and frequency composition of dynamic load, (b) properties of the foundation structure and subsoil under foundation level, (c) properties of the rubber used, and (d) the upper part of the modelled structure of the whole building. Vibrations of the lower foundation plate, due to passing through the rubber layer and thanks to interaction at the contact point between individual parts of the foundation structure, can be considered to become reduced approximately by 40 to 50% (Makovička & Makovička, 2011). Another positive consequence of using the rubber layer consists in changed intensities of individual dominant frequencies corresponding to natural frequencies of the system. The calculation results show that vibrations at frequencies of the order over 30 Hz become significantly filtered off.

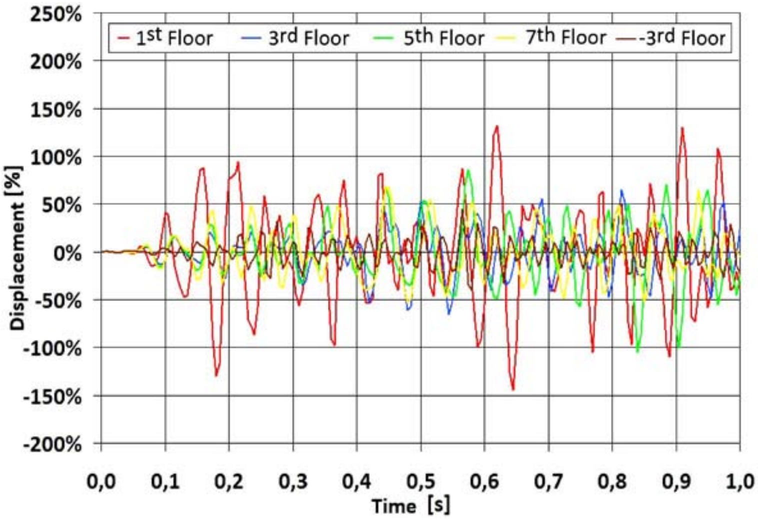


*Fig. 2: Time histories of vertical vibration for selected points of the whole building.*

Comparing the calculated response on the level of the foundation plate (at the place where the structure is laid on the rubber and at places where dynamic excitation is introduced) to the response on individual higher storeys, this ratio can be used to estimate the magnitude of vibration changes on individual storeys. Thanks to springing of the building structure by the inserted rubber layer, the frequency signal of the response would be redistributed in the area of low frequencies, approximately on the level between 1 Hz to 15 Hz, 20 Hz at the maximum (Fig. 2).

## 3. Conclusion

The aim of this paper is to assess the effect of building vibroisolation on the transfer of vibrations due to traffic from the subsoil environment. Maximum measured intensities of vibrations at the construction site were used as non-periodic load of the building by technical seismicity caused by traffic effects. Based on calculation of static and dynamic response of the building, optimum distribution of the rubber in the foundation structure was designed. Furthermore, the calculation was used to predict floor vibration on individual storeys, and time courses of vibration at selected points were determined.

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