

**Author:** Cezary Kraśkiewicz  
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The doctoral thesis focuses on selected aspects of the application of vibro-acoustic isolators, which are used in the rail track systems to reduce negative effects of the railway traffic, such as vibration and noise, on the surroundings of the railway track. At the beginning of the thesis a state of the art on vibro-acoustic isolators and mechanical models of rail track systems is presented. It is used as a basis for the development of the original mechanical model of a rail track system with four degrees of freedom, which ensures more accurate results of the analyses than the commonly used model with one degree of freedom. Further, certain parameters of selected vibro-acoustic isolators: under sleeper pads (USP) and under ballast mats (UBM), most significant from the point of view of their function, were determined and described. The values of these parameters were identified basing on the analysis of the valid standards – mainly German and European ones. The rules used for identification and selection of the material properties of vibro-acoustic isolators used in Polish and foreign rail track systems were compared and evaluated.

Using the constructed test stand, aimed at the identification of static and dynamic elastic characteristics of the vibro-acoustic isolators, laboratory tests of the selected parameters (e.g. static and dynamic bedding modulus, fatigue strength, resistance to severe environmental conditions and ageing) characterizing USP and/or UBM were performed. The tests were carried out on prototype products based on polyurethane, rubber and mineral rock wool, which were developed within the BRIK InRaViS project. The results obtained from the laboratory identification of the static and dynamic elastic characteristics of selected vibro-isolators were applied to simulate the analysis of a ballasted rail track system using its discrete model. Basing on the results obtained from the performed analyses, such as the values of insertion loss and static track deflections, and the results of the laboratory tests of material characteristics of selected prototype vibro-isolators, recommendations with regard to the basic requirements for the application of USP (partially also UBM) were developed, for the products used in the railway system administered by PKP PLK S.A.

In the summary of the thesis the conclusions were presented, which include a proposed methodology for identification and selection of the material properties characterized by certain parameters, recommended ranges of their values, adequate testing procedures and further research suggestions.

Cezary  
Kraśkiewicz

PRZEWODNICZĄCY  
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dr hab. inż. Konrad Lewczuk, prof. uczelni