# 642. Impact of External excitations on the Dynamic properties of Negative-stiffness Vibration Isolation Table

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**Abstract.** This paper presents a study of the efficiency of a negative-stiffness vibration isolation table Minus K 500BM-1 in the frequency range of 2–110 Hz. An overview of other possible methods of vibration isolation is provided. Experimental testing of vibration transmissibility was conducted. Special vibration excitation equipment was tested, which enables the planned studies of the object in question to be carried out.

**Keywords:** negative stiffness, vibration isolation, low frequency, vibration isolator.

## Introduction

Vibration isolation is a procedure whereby the undesired impact of external vibration is reduced. This procedure normally involves the introduction of resilient dampers between the vibrating mass and the source of vibration, as a result of which, in the presence of specific conditions for excitation of the vibration, the dynamic reaction of the system is decreased [1]. Vibration isolation systems can be classified based on their characteristics. One of the classifications relies on the type of management systems—passive or active—used [2]. Only passive vibration isolation systems were used until approximately 1990.

**Active vibration isolation systems**. No active systems would be needed if it was possible to obtain a passive system with a very low natural frequency approaching zero. However, such low natural frequency systems require a stiffness, which is so low that it would be impossible for the system to maintain it. For this reason, we require active systems for vibration isolation in the vertical direction. It is easier to obtain low-frequency vibration isolation in the horizontal direction even with low horizontal stiffness [2].

Since most passive systems are effective and adequate for the isolation of high-frequency vibration, the need for active systems for the isolation of high-frequency vibration is smaller compared to their need in the case of isolation of low-frequency vibrations [2]. Furthermore, active vibration isolation systems require efficient vibration sensors, which is why they are also approximately ten times more expensive compared to passive vibration isolation systems [3].

Whenever the frequency of vibration impacting a machine or structure equals natural frequency of the system, the resonance phenomenon occurs, and this is associated with large amplitudes and failures.

**Passive vibration isolation systems**. The most common systems, which best protect against disturbances, are based on the principle of passive control of vibration/noise. These systems reduce vibrations and noise by simply dissipating the energy as heat [4]. These systems comprise a spring (an elastic part) and an energy damper. Elastomers, liquids, or negative stiffness parts can also be used. Springs resist the movement of vibration by straining the opposite forces which are in proportion to their displacement. Dampers comprise a piston moving through a viscous liquid or a conductor moving in the magnetic field, which dissipates kinetic energy in the form of heat. It should be mentioned though that springs have their natural