Development and Validation of Elastomeric Devices Supported Floating Slab Track Systems

J. Kim  
*Korea Railroad Research Institute, Uijeongbu, Korea*

**Abstract:** Floating slab tracks are widely used to control vibration from trains. There is no doubt that the best performances in terms of vibration reduction can be achieved by floating track systems, also called a MSS (mass-spring-system). These mass-spring-systems consist of floating slabs with the rail mounted on top. Together with the dead load of rails, sleepers and fastenings, they form dynamically active masses that are isolated from the sub-structure by elastic mounts that may be of rubber, elastomeric material or steel. The basic concept of a MSS is to prevent vibrations from penetrating into the slab by inserting isolators with a very low natural frequency, which should be as low as possible in order to let the reduction of vibrations start at the low end of the excitation frequency spectrum. In the case of a standard track, these frequencies might cause severe vibration problems in nearby buildings showing resonance frequencies just in that range. The rubber-spring type isolator developed by KRRI (Korea Railroad Research Institute) in this study can be relied on to provide a tuning frequency below 8 Hz according to experimental results.

The advantage of single bearings is that bearings show the same stiffness under static and dynamic loading. Therefore a MSS on bearings can be designed for very low natural frequencies (down to 7 ~ 10 Hz). Furthermore rubber-spring type isolators are much stiffer than elastomeric pad in horizontal directions. Since the tuning frequency depends on the static isolator deflection, it is obvious that the isolator stiffness is the most important issue. Although the actual correlations are much more complex, the tuning frequency can be used to evaluate the efficiency of a floating track system at a first view.

The KRS (Korea Rubber Spring) isolator, which was developed by KRRI, used in this study is combining isolator consisting of spring type isolators and elastomeric bearings. They are based on the enhanced damping properties of a compound of natural rubber with addition of steel plates. With these additional elements a requested shape factor can be reached. Beside the shore hardness this factor is a very important parameter for the stiffness of a bearing. Used rubber in the bearing is a high elastic material, which is very well suited for vibration isolations. KRS isolators developed and used in this study have a square cross-sectional shape with external in-plane dimensions equal to 400 x 400 x 300 mm as shown in Figure 1. The reinforcing steel plates have similarly a square planar geometry with external dimensions equal to 195 mm x 195 mm and with a thickness of 2 mm each.

![Figure 1. KRS isolator](image)

KRS isolators are inserted into recesses arranged laterally in the slabs or troughs requiring access space on both sides. In stations with elevated tracks the elements can be concentrated favorably on top of columns or above supporting beams. KRS isolator type is accessible for inspections at any time, either from above or from the side.
We investigate the vertical and lateral stiffness of isolators and find that stiffness of isolators satisfies the requirements. For vertical and lateral test, the specimen, 400 x 400 x 300 mm, is placed between two stiff steel plates designed to uniformly distribute the compression stress on the surface (Figure 2). The load is increased linearly up to a pre selected vertical load of 300kN.

Fatigue tests were conducted on KRS isolators to investigate the fatigue life represented for mechanical repetitive behavior. The number of repetitive load is up to 1,000 thousand cycles with 3mm amplitude.

The purpose of the analytical study is to take into account the particular structural properties of the Chonan-Asan station, to obtain results to evaluate the efficiency of KRS isolators. The frame is modeled using plates for the upper slab, and beam element for the infrastructure girders (Figure 3). From the analytical study, the effectiveness of KRS isolators has been verified for performances.

What’s new?
Rubber-spring type isolators for floating slab track are newly developed and they are based on the enhanced damping properties of a compound of natural rubber with addition of steel plates.

Author’s Biography
Jin-Ho Kim
Senior Researcher of Track Structure Research Team, Korea Railroad Research Institute
Received Ph.D. degree in Civil Engineering from University of California, Davis in 2003