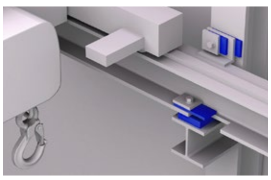
VIBRAX® – Elastomeric bearings

VIBRAX®CRANE

Vibration-damping bearing support of overhead bridge cranes



mageba
Switzerland
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Overhead bridge cranes cause noise

General

Overhead travelling cranes in production facilities adjacent to offices, and residential property above industrial space, are becoming ever more widespread. Depending on the circumstances, vibrations and noise from crane operations can cause disturbance throughout the building. The type and significance of the disturbance depend primarily on the crane itself. This can limit the extent to which offices and residential property can be used for such purposes, resulting in loss of rental income or other related costs.

Similar to disturbances from railway traffic, many of the vibrations that arise during crane movements originate at the rails along which the crane travels. The cause can be slight unevenness of the rails, or worn or dirty wheels. The range of possible excitation frequencies is therefore very wide; the frequency of relevant vibrations on various overhead bridge cranes has been measured by mageba to be as low as 20 Hz.

Damping by the building itself does not suffice

Whether or not the vibrations caused by an overhead bridge crane will be perceived as disturbing in adjacent areas depends on the building's construction. Depending on stiffness and material, certain frequencies will be better damped than others. It is not possible in practice to predict the transmission characteristics of a building. Unless a building is designed accordingly, its damping characteristics will not prevent disturbance from structurally transmitted noise and vibrations.

Noise-damping bearing support is required

Reliable prevention of disturbances can only be achieved in practice by elastically isolating the overhead bridge crane from the main structure. Because vibrations from such cranes are generally predominantly in the vertical direction, the vertical connection must be damped (see Figure 1) to reduce the transmission of vibrations to the building structure. It must be noted, however, that a vertical bearing which offers low dynamic stiffness is also characterised by low static stiffness and will thus experience higher static deformations. The right dimensioning thus depends on an optimal layout of the elastic bearings.

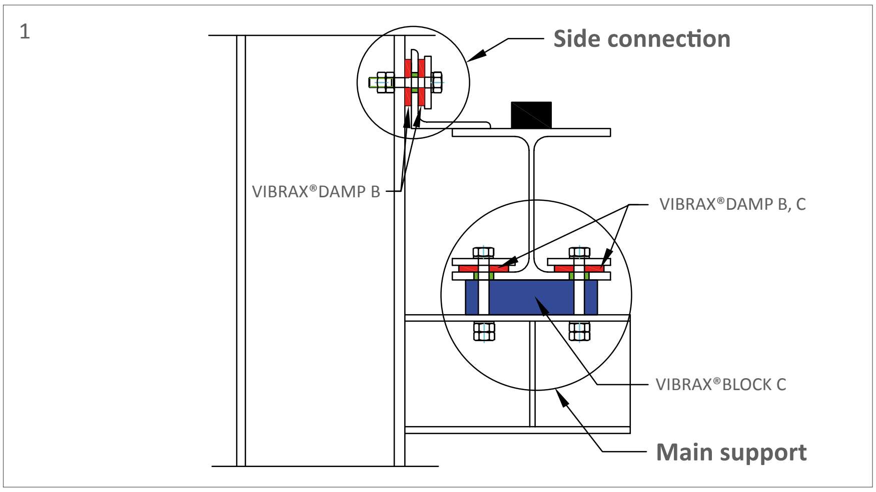
Solution

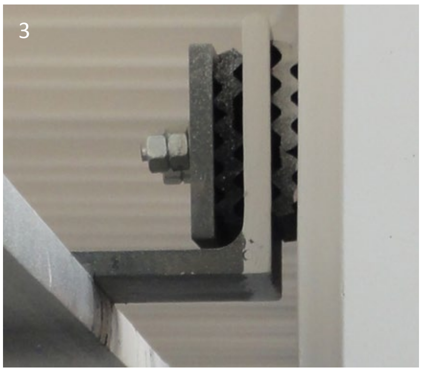
VIBRAX®CRANE is a specially developed system solution for the vibration isolation of overhead bridge cranes. It consists of a reinforced vibration-damping vertical bearing and an unreinforced vibration-damping horizontal bearing. The reinforced bearings are made of natural rubber (NR), which is known for its excellent damping properties and low compressibility even under high loads.

The VIBRAX®CRANE system enables improvements of 20 – 30 dB to be achieved, depending on frequency.

The VIBRAX®CRANE system is available for all types of overhead bridge crane, and its supply includes:

- Project-specific design
- Detailed drawings
- Installation instructions





1 Schematic representation of the mageba VIBRAX®CRANE bearing system, with isolated connection bolts in vertical and horizontal directions

2 Main support bearing for isolation of vibrations in the vertical direction

3 Side connection to stabilise the overhead bridge crane horizontally

VIBRAX®CRANE provides effective damping of noise and vibrations

Design

In designing elastic vibration isolation bearing systems, the single mass oscillator model is generally used. In using this model, e.g. to design the isolation of a building from vibrations from an adjacent railway line, it can typically be assumed that the building acts as a rigid mass. This mass, M, is supported by isolating elements with stiffness C_{dyn}, see equation (1). From the ratio β of the excitation frequencies to the first natural frequency of the supported structure ($\beta = f/f_0$), a transmission factor V_3 can be determined for every frequency level; the greater the mass and the lower the stiffness, the lower will be the natural frequency and thus also the vibration transmission V_3.

$$f_0 = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{C_{dyn}}{M}}$$

Equation (1) relating to natural frequency with M = dynamically active mass and C_{dyn} = dynamic stiffness

$$V_3 = \left| \frac{1}{1 - \beta^2} \right|$$

Equation (2) relating to amplification capacity, with damping neglected

Designing vibration isolation for overhead bridge cranes is considerably more complex, because the masses needed to calculate the natural frequency of the structure are not clearly defined. The individual masses of the supported structure are not, in contrast to many buildings, rigidly connected, but rather are connected by elastic elements such as the cables between load and trolley, the platform between trolley and runway girder, and the runway girder itself.

Measurements on supported overhead bridge crane

With well-designed elastic isolation of an overhead bridge crane using VIBRAX®CRANE, excellent damping values of **20 - 30 dB** can be achieved, depending on frequency. This has been well proven by measurements such as those shown in Figure 2.

Vibrations were measured directly at the runway girder (green lines) and on the support bracket of the precast concrete columns (blue lines on steel built-in part; red lines on concrete). The damping performance of the support can be determined from the difference between vibration strengths. The following situations were measured and are illustrated in Figure 2:

a) Background noise without crane activity
b) Passing of crane with 10 t weight in upper load position
c) Passing of crane with 10 t weight in lower load position
d) Passing of crane without any load (often identical to b)

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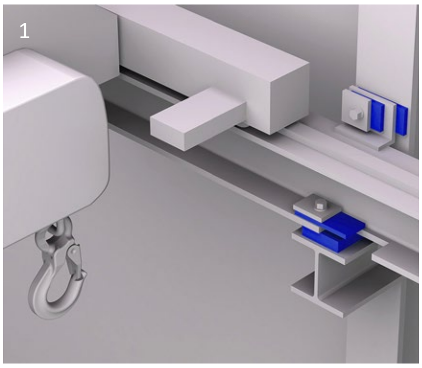

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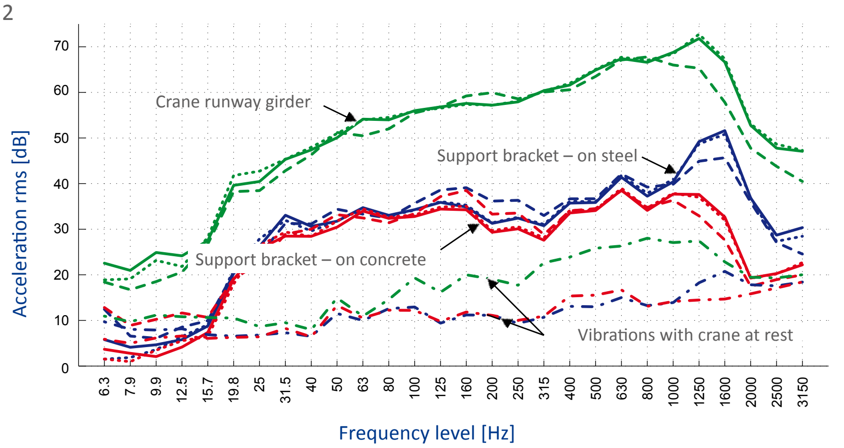

1 mageba VIBRAX®CRANE

2 Strength of vibrations during passing of crane, measured at the steel girder (above the bearing) and on the support bracket (beneath the bearing); lower lines: vibrations from ambient excitations, with no crane activity

Vibration damping

Tender texts

Text for requests for quotations

VIBRAX®CRANE vibration protection system for overhead bridge cranes, for isolation of runway girders.

Main support for isolation in the vertical direction.

Consisting of VIBRAX®BLOCK bearings (.... mm x ....mm x ....mm) and isolation elements for connectors, including technical design, installation instructions and recommendations for connectors.

The scope does not include additional steel elements such as load distribution plates, connection brackets and connectors.

Units = number.

Side connection for stabilisation in the horizontal direction.

Consisting of damping elements of natural rubber (NR) and isolation elements for connectors, including technical design, installation instructions and recommendations for connectors.

The scope does not include additional steel elements such as load distribution plates, connection brackets and connectors.

Units = number.

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Project references

Meyer Burger, CH

Holzspecht AG, CH

Meyer Rottal Druck, CH

Factory building, Dusseldorf, DE

Product groups (building construction)

Bearings

Vibration isolation

Expansion joints

Special products

engineering connections®