

DUAL-CONTROL BEARING FOR SEISMIC AND VIBRATION ISOLATION

Comprehensive Vibration and Seismic Protection for Urban Structures

OVERVIEW

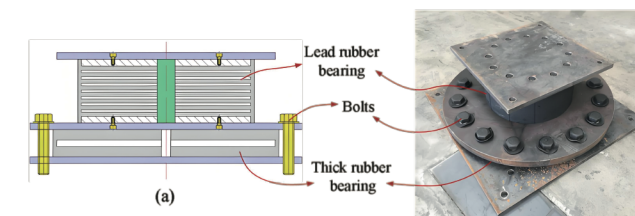
As urban development accelerates, especially in major cities, there is a growing need to address both seismic isolation and vibration control, particularly for structures located above or near underground metro systems. The continuous operation of rail systems generates vibrations that can affect building functionality and safety. At the same time, many of these structures are located in seismically active zones, necessitating robust earthquake protection.

The Dual-Control Bearing offers a comprehensive solution by combining seismic isolation and vibration control in one device. It isolates seismic energy while simultaneously mitigating vibrations caused by rail systems, making it ideal for buildings and infrastructure that must meet high-performance standards for both earthquake resistance and vibration reduction.

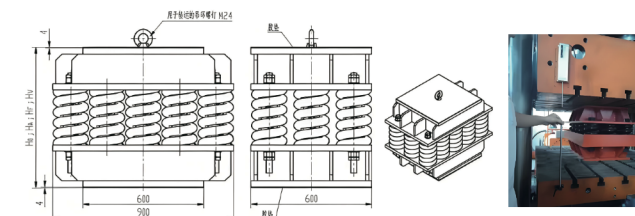
TYPES OF DUAL-CONTROL BEARINGS

The dual-control bearings typically fall into two main categories:

• **Thick-Rubber Three-Dimensional Bearings:** Designed with a thicker elastomeric layer to absorb both horizontal seismic movements and vertical vibrations.



• **Steel-Spring Three-Dimensional Bearings:** Incorporates steel springs that effectively dampen vertical vibrations, ensuring both seismic isolation and vibration control in all three dimensions.



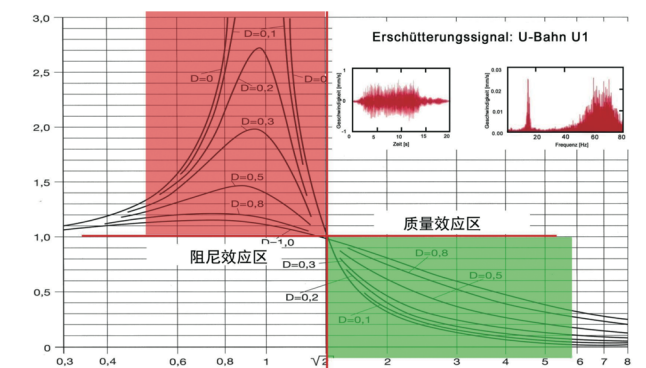
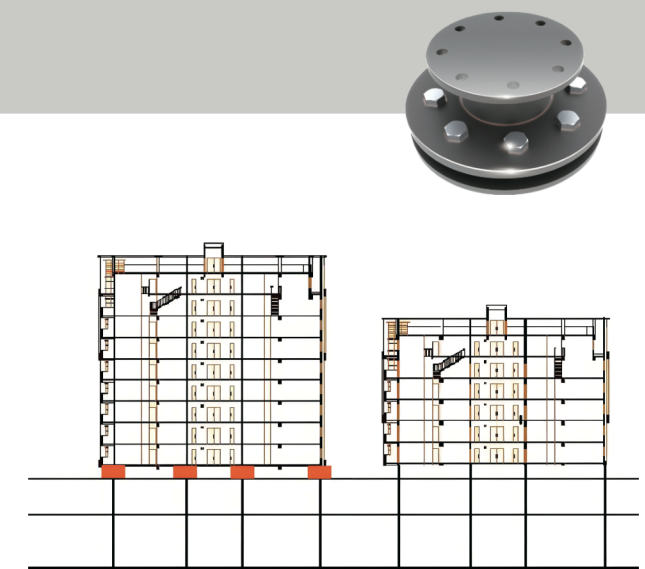
WORKING PRINCIPLE

The operating frequency of metro-induced vibrations generally exceeds 50 Hz, while isolation frequencies are lowered to 5-10 Hz for effective control. In addition, the horizontal isolation period ranges from 2-3 seconds. The dual-control bearing system uses a combination of thick-rubber layers and springs to address both vertical and horizontal movements.

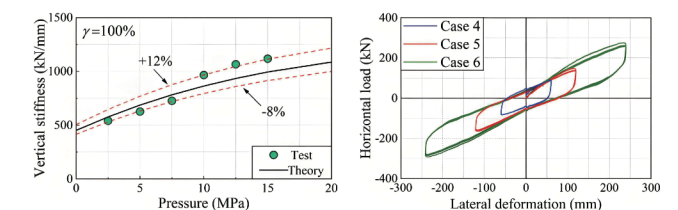
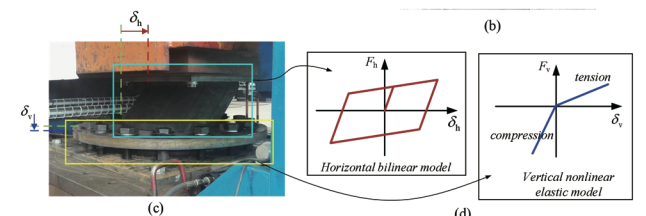
• **Thick Rubber Layer:** Acts as a cushion to isolate vibration energy, preventing it from transferring to upper floors.

• **Springs:** The springs, as the main load-bearing elements, prevent the transfer of vertical vibrations from the foundation to the building.

• **Dampers:** These prevent excessive swaying of the structure during dynamic disturbances, ensuring quick stabilization and preventing resonance during system startup or shutdown.



$$T = \frac{X_m}{X_s} = \frac{1 + (2\zeta r)^2}{\sqrt{(1 - r^2)^2 + (2\zeta r)^2}}$$



KEY FEATURES

• **Comprehensive Protection:** It provides three-dimensional vibration control, handling both vertical vibrations (from operational sources like rail systems) and horizontal seismic movements. This dual capability makes it suitable for urban buildings facing multiple dynamic forces.

- **High Seismic Efficiency:** The device not only isolates seismic energy but also dampens vertical and horizontal vibrations. By combining thick rubber components for horizontal isolation and steel springs for vertical damping, the bearing effectively minimizes the transfer of forces to the structure during earthquakes.
- **Long-Term Durability:** Using high-quality materials like 51CrV4 steel springs and natural rubber ensures that the device is durable, withstanding both seismic events and continuous operational vibrations over time. The inclusion of dampers further ensures that vibrations are quickly stabilized after disturbances.
- **Standard Compliance:** The device complies with multiple international standards, ensuring its performance is thoroughly tested and validated under real-world conditions. This adds credibility to its reliability and functionality in urban environments.

MATERIAL COMPOSITION

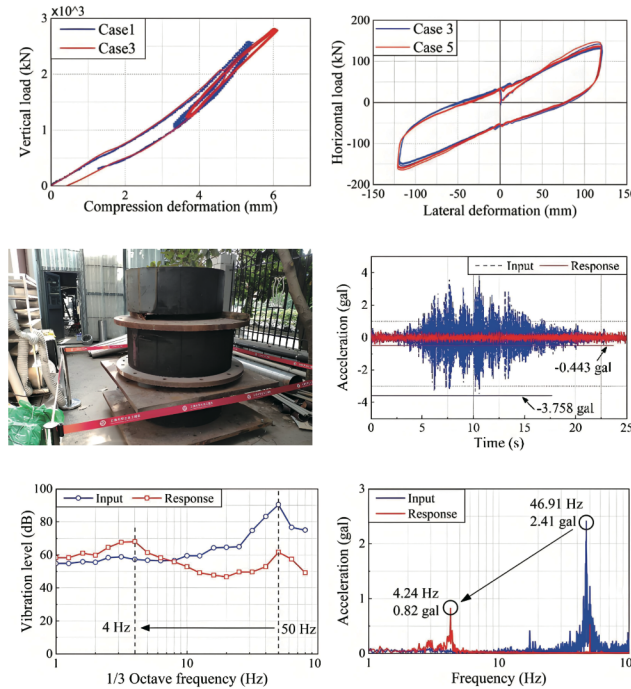
- **Rubber Components:** The thick-rubber bearings are composed of natural rubber, which meets the requirements of JGT118-2018 for seismic isolation bearings.
- **Steel Springs:** Made from 51CrV4 high-strength steel, the springs provide effective vibration isolation while maintaining durability under high stress. The remaining steel components, such as connection plates, are made from Q355B or Q235B.
- **Damping Fluid:** For spring isolators with integrated dampers, the damping fluid is stable, odorless, non-volatile, and resistant to aging. The fluid's thermal stability ensures a service life of over 60 years.

INSTALLATION AND FREQUENCY TUNING SERVICE

- The design and manufacturing of the Dual-Control Bearing adhere to the following standards:
- **JGJ/T 170-2009** – Standard for building vibration and secondary radiation noise caused by urban rail transit.
 - **GB 100070-88** – Standard for urban area environmental vibration.
 - **GB/T 50355-2005** – Indoor vibration limits and measurement methods for residential buildings.
 - **GB 50463-2008** – Vibration Isolation Design Code.

PRODUCTION, QUALITY CONTROL, AND TESTING

- The Dual-Control Bearing undergoes extensive quality control and testing procedures to ensure reliability and performance:
- **Static and Dynamic Load Testing:** Compares design values with actual test results to ensure the bearings meet load requirements under both static and dynamic conditions.
 - **Unidirectional and Bidirectional Testing:** Verifies the bearing's ability to handle both horizontal and vertical forces simultaneously.
 - **On-Site Testing:** Once installed, the bearings undergo rigorous testing to confirm their effectiveness in reducing vibrations, particularly for buildings affected by metro operations.



PRODUCTION, QUALITY CONTROL, AND TESTING

- Installation of the Dual-Control Bearing follows a carefully designed process to ensure optimal performance:
- **Pre-Installation:** Ensuring precise positioning of embedded components and fixing anchor plates.

- **Grouting and Cleaning:** Filling the isolation pedestal with concrete and ensuring that the surface is clean and level.
- **Post-Installation Testing:** After installation, vibration reduction is tested under operational conditions to ensure compliance with design specifications.

APPLICATIONS

- The Dual-Control Bearing is ideal for projects where both vibration control and seismic isolation are critical, such as:
- **Urban buildings above metro lines:** Reduces vibrations from metro operations while offering protection from seismic activity.
 - **High-tech facilities:** Ensures the stability of sensitive equipment that requires precise vibration control.
 - **Industrial complexes:** Provides comprehensive protection from both operational vibrations and seismic shocks.

NOTABLE PROJECTS



NOTABLE PROJECTS:

- **Shanghai Villa Project:** Applied for advanced vibration and seismic isolation.
- **Beijing Three-Dimensional Isolation Project:** Successfully implemented in an urban project requiring three-dimensional isolation solutions.

CONCLUSION

The Dual-Control Bearing offers a revolutionary approach to combining seismic isolation with vibration control, ensuring that structures can withstand the dual challenges of urban rail vibrations and seismic activity. With its robust design, adherence to international standards, and proven effectiveness in real-world applications, it is an ideal choice for urban infrastructure projects requiring advanced protection.

