



Good vibrations: Test tower in Rottweil sways to the rhythm of the city

- 240 ton pendulum offsets motions of tower
- Provides active simulation of building movements for realistic elevator tests

Be it the Burj Khalifa, the One World Trade Center or the next mile-tall skyscraper, the thyssenkrupp Elevator test tower in Rottweil will soon be able to imitate the natural vibrations experienced by any building due to the wind. With the new “tuned mass damper” installed in the future test tower, it will be possible to test in advance aspects that are currently only tested when a building is ready and fully equipped. This will save precious time and money as internal equipment can be adjusted well in advance to suit the real operational conditions of a building. In addition to simulating the vibrations of other buildings for test purposes, this novel technical highlight of the test tower will also act as a balance to the weather-related motions of the 246 meter-tall tower itself.

At the end of January, a huge pendulum held by electromagnetic linear motors was installed inside the tower – at a height of 193 meters – by GERB Schwingungsisolierungen GmbH. While this technology is already featured in high-rises in New York, Shanghai, and Dubai, this particular device is the first in the world to combine active and passive movement.

Despite its slender design, the test tower in Rottweil can start to sway in certain weather conditions due to so-called vortex-induced vibrations. With a pendulum mass of 240 tons, the new system offsets the movement of the tower so that visitors to the viewing platform will not feel the building swaying. The vibration damper also reduces fatigue loads in the tower.

But the real game changer is the damper’s second feature: Thanks to the active pendulum, thyssenkrupp Elevator’s development engineers can now test elevator systems under real conditions. To this end they teamed up with GERB to develop an intelligent mechanism that can artificially induce realistic vibrations in the test tower – even in calm weather.

“That means we can simulate all kinds of building heights and weather conditions,” says Andreas Schierenbeck, CEO of thyssenkrupp Elevator. “And of course, this also goes for buildings that haven’t even been built yet, so we can carry out initial tests on our elevators well before construction work is completed.”

Building vibrations represent one of the biggest challenges in elevator development. All buildings are structurally designed to bend to a certain extent with the wind, causing elevator shafts to move too. These realistic conditions give high test towers an advantage over underground test shafts.

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Following the installation of the damper, the vibrations of the tower are now being recorded and analyzed to allow precision control of the artificial vibrations. The force and timing of the artificial vibrations are computer-controlled to ensure that the giant pendulum swings in a controlled way and is tuned to the building's movements. The system also contains damping elements, known as VISCO dampers, which dissipate the energy of the moving pendulum. As a result, movements of the tower have been reduced from up to 76 centimeters in all directions to less than 15 centimeters.

For this artificial simulation, GERB used the same technology featured in thyssenkrupp's cable-less MULTI elevator system – electromagnetic linear motors. Controlled deflection of the pendulum by the motors causes it to oscillate. This requires relatively small forces of only 35 kilonewtons (roughly 50 times the force used to kick a football), provided the timing is correct, similar to someone swinging on a swing. The moving mass of the pendulum then pulls on the tower, setting it in controlled motion.

thyssenkrupp started building the test tower with the general contractor Züblin in 2014. Among the leading-edge technologies that will be tested in Rottweil is the newest-generation elevator, the MULTI. Three of the twelve shafts in the new test facility are reserved for the MULTI system which is powered by maglev technology from the Transrapid and provides a number of advantages: The cable-free design means several cabs can be operated in a single shaft. This increases passenger capacity per shaft by up to 50 percent and at the same time reduces the elevator footprint in a building by half. In addition, the elevators can move both sideways and vertically without height limitations, opening up completely new applications and architectural design possibilities.

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thyssenkrupp is a diversified industrial group with traditional strengths in materials and a growing share of capital goods and services businesses. Around 155,000 employees in nearly 80 countries work with passion and technological expertise to develop high-quality products and intelligent industrial processes and services for sustainable progress. Their skills and commitment are the basis of our success. In fiscal year 2014/2015 thyssenkrupp generated sales of around €43 billion.

Together with our customers we develop competitive solutions for the challenges of the future in the areas Mechanical, Plant and Materials. With our engineering expertise we enable our customers to gain an edge in the global market and manufacture innovative products in a cost- and resource-friendly way. For us, technical progress and innovations, allied with the combined strength of the Group, are key factors enabling us to meet current and future customer and market requirements around the world, grow on the markets of the future, and generate strong and stable earnings, cash flows and value growth.

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