Huge bearings for the new beauty of Delhi

Signature Bridge: MAURER supplies MSM® spherical bearings for structural loads of up to 231,000 kN.

Delhi, Wazirabad. **It is both a beauty and a political issue: the Signature Bridge across the Yamuna river connecting Delhi to Wazirabad. A visual hallmark and special technical feature is the asymmetric pylon. For this pylon, MAURER has built two MSM® spherical bearings to be installed underneath the pylon footings. Accommodating 231,000 kN of structural load, these are the largest CE-marked bearings ever built. A further special feature is the pendulum bearings accommodating the tensile force of the backstay cables.**

The new bridge in the north of Delhi features a total length of 675 m, a width of 35 m and a main span of 251 m. With four traffic lanes in each direction, it will relieve the traffic load of the Wazirabad Bridge situated further to the north. The Signature Bridge was planned in 2004 and is scheduled for opening to traffic by the end of October. Already now it is considered a particularly beautiful bridge.

The Signature Bridge in Delhi in summer 2018.
Photo: MAURER

Inclined pylon, asymmetric cable arrangement

The architectural highlight of the cable-stayed bridge is its inclined pylon with a height of 156 m (above ground), the top of which is a 30 meters high steel-glass construction. This is the highest scenic outpost of Delhi, which – illuminated at night – is visible over a long distance.

The two inclined pillars merge at half height of the pylon. Above that point, the backstay cables and the inclined cables lead into the pylon. The latter are fanned out as usual; the backstay cables on the other side, however, are guided into so-called pendulum bearings. Since proper function of cable-stayed bridges can only be ensured with a prevailing equilibrium of forces, the inclined pylon acts as a counterweight. This reduces the tensile forces in the pendulum bearings to a manageable magnitude, albeit the incline causes very high longitudinal forces on the pylon footing bearings.

The largest CE-marked MSM® spherical bearing ever built with a structural load of up to 231,000 kN under one of the two pylon footings.
Photo: MAURER

Huge pylon footing bearings: moveable under construction

With dimensions of 3.0 x 3.0 mm and a height of 480 mm, the two MSM® spherical bearings underneath the pylon footings are the largest CE-marked bearings that have ever been installed in a bridge or a building. Each of them weighs 26 t; they accommodate structural loads of up to 231,000 kN and balance rotations of the pylon.

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A further challenge besides the mere size was erecting the pylons on these bearings. When the pylon gains height segment by segment, it gets continuously heavier and the two bearings push outwards. The restraint forces thus created would have been very difficult to accommodate.

This is why MAURER developed a solution that allowed for transverse movement during the construction phase: one of the two bearings was not completely fixed from the beginning but featured a temporary sliding plane transversally to the structure. This moveable bearing was locked in place after pretension of the last inclined cables. Even with this measure the horizontal forces still amount to 45,000 kN.

Eight pendulum bearings with a retaining force of 8,000 kN each

Besides the two large bearings, the pendulum bearings posed a further challenge. They are positioned in pairs underneath the eight backstay cables, with each pendulum transmitting the tensile force of one cable, approx. 8,000 kN. In total, at this point 63,800 kN are transferred into the foundations.

The pendulum bearings each consist of two steel mounting plates. These are positioned laterally at the two rod ends at the top of the steel superstructure and at the bottom at the anchoring plate. Mounting plates and rod ends were connected with large bolts. Inside the rod ends there are large axial pivoting bearings. These bearings allow for rotations and enable longitudinal displacement of the bridge.

The interface superstructure-bearing posed another challenge. The steel superstructure was manufactured in China, the pendulum including its special bearings in Munich. An intensive coordination process ensured that the bearings fit precisely into the superstructure.

Further shear keys and spherical bearings

MAURER supplied further bearings for the Signature Bridge. At the ends of the main bridge and the feeder bridge, one shear key each was installed. 34 spherical bearings have been placed on the bridge pillars.

Building owner is Delhi Tourism and Transportation Development Corporation (DTTDC), building contractor is a joint venture of Gammon (India), Construtora Cidade (Brazil) and Tensacciai (Italy).

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The pendulum bearings (gray) accommodate the tensile forces of the backstay cables (anchoring visible at the upper right of the picture) and allow for longitudinal movement of the bridge deck (lime green).

Photo: MAURER

The pairs of pendulum bearings viewed in longitudinal direction of the bridge. At the outside the two steel mounting plates, top and bottom: rod ends with axial pivotal bearings.

Photo: MAURER

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Quick facts about MAURER SE

The MAURER Group is a leading specialist in mechanical engineering and steel construction with over 1,000 employees worldwide. The company is market leader in the area of structural protection systems (bridge bearings, expansion joints, seismic devices, tuned mass dampers, monitoring systems). It also develops and produces vibration isolation of structures and machines, roller coasters and ferris wheels as well as special structures in steel.

MAURER participates at many spectacular projects worldwide, like for example the world's biggest structural bearings for the Signature Bridge in Wazirabad, Delhi, earthquake resistant expansion joints for the Bosporus bridges in Turkey, semi-active tuned mass dampers for the Donau City tower in Vienna, or uplift bearings for the Zenit-Football-Arena in St. Petersburg. Among the most prestigious steel structures are the BMW World in Munich or the Terminal 2 of Munich Airport. MAURER's most spectacular amusement rides include the world's biggest transportable Ferris wheel R80 XL in Mexico, the Rip Ride Rockit Roller Coaster in the Universal Studios Orlando or the Fiorano GT Challenge in Abu Dhabi.

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