

30-ton bearings for the new Danube Bridge in Bratislava

Spherical bearings accommodate 21,000 tons of vertical and 4,000 tons of horizontal forces.

Munich, Bratislava. Bratislava is about to get its fifth Danube bridge in the South. Due to the bridge weight and the main span of 210m enormous vertical forces act on the bridge bearings: up to 21,000t. Moreover, in case of an earthquake, the bearings will have to accommodate 4,000t of horizontal forces. The bearing specialist MAURER has built the bearings, being the only manufacturer capable of designing bearings with these dimensions.

Since 2016, a bypass featuring a length of 59 km has been under construction in the South and East of the Slovakian capital of Bratislava, one of the largest infrastructure projects in Europe. The abbreviation for this major project is D4R7, named after the highway D4 (27 km) and the expressway R7 (32 km). This bypass will enable easier cargo transit as well as better management of the transit traffic, with a positive impact on safety and traffic fluidity in Bratislava that will help ease off traffic on existing radials through heavily urbanized areas which will eliminate daily traffic jams for commuters travelling to the Capital.

Bridge across the Danube and its branches

The centerpiece of the project is a new highway bridge across the Danube, the fifth and Southernmost Danube bridge for Bratislava. Besides the river Danube, it spans a branch named Kayak as well as other branches. Including the access bridges in the flooded area, it features a length of 3 km.

The two main bridges spanning the Danube and the Kayak each rest on two pillars in the river, the largest span being 210 m. Together with the foreland bridges with a 70 m support span each, the bridge rests on 40 pillars with 80 bridge bearings.

The bearings of the main bridge have to accommodate extremely high forces due to its heavy weight. The bridge was built of concrete. The box girder with a length of 210 m was concreted at site in one piece, resulting in vertical forces of up to 21,000 tons.

New design regulations for earthquakes

In addition to that, new design concepts were implemented in Slovakia, according to which the seismic load case must be considered as well. The seismic accelerations of up to 0.2 g are rather moderate, however, the large mass of the two main bridges causes enormous horizontal forces of up to 4,000 tons in case of an earthquake.

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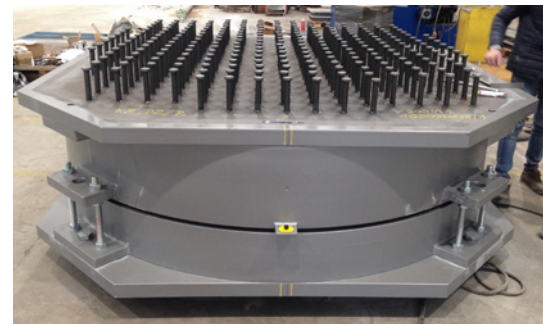
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The fifth Danube Bridge for Bratislava features a length of about 3 km, and, besides the Danube, it also spans the Kayak and further branches.

Photo: D4R7



A fixed spherical bearing for the new Danube Bridge in the South of Bratislava, designed for vertical forces up to 21,000 t and horizontal forces of 4,000 t.

Photo: MAURER

"21,000 t vertical and 4,000 t horizontal – in this combination, the bearings rank among the largest ones MAURER has ever built," reports MAURER project manager Luca Paroli. They feature a ground plan of 2.8 x 2.8 m and weigh 30 t. A total of eight bearings with these dimensions have been produced for the two main bridges.

Given the high forces, the narrow geometric specifications on the bridge piers and the limitation to two bearings per pier presented a challenge. As large as the bearings may be – in view of the forces acting on them they are small. The only way to meet this challenge was the use of spherical bearings with MSM® sliding material.

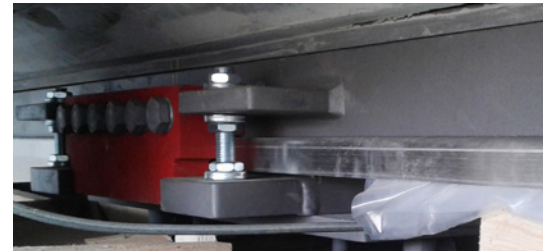
Spherical bearings are bearings that can accommodate arbitrarily large rotations in all directions without perceptible resistance and transfer them restraint-free to the substructure. Pot bearings or elastomeric bearings were not an option due to lack of sufficient space, and CE marking is not possible for bearings of this size.

The MSM® sliding material also plays an important role. Compared to customary Teflon (PTFE), it can stand at least twice the pressure, which means: the bearings could be designed smaller by 30% and thus just fitted on the piers. Moreover, MSM® features a service life of 50 years according to ETA.

Manufactured size presented a challenge

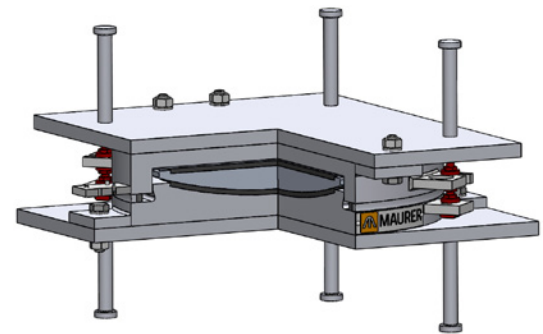
„We were the only supplier capable of delivering certified spherical bearings with an MSM® diameter of more than 1.5 m," Paroli outlines the unique selling proposition of MAURER in this field. "To build and install bearings of this size and the complete handling as well as the transport to the jobsite presented a special challenge." Individual bearing components were manufactured using sheet thicknesses of up to 300 mm, the quality of which was ultrasound-tested as usual. The bearings were assembled and accepted under supervision of MPA.

In addition, six bearings had to be designed "variable". During the construction phase, they served as a retention in transverse direction for a horizontal force of up to 180 t. After the construction period, the fixings were disengaged resulting in free-sliding or guided-sliding bearings, respectively. The large bearings are anchored to the structure with up to 170 headed studs.



Jobsite state: a guided bearing with lateral temporary retention in red. The retention prevented transverse movements during the construction phase and was disengaged thereafter.

Photo: MAURER



Schematic cross section of a fixed spherical bearing.
Graphic: MAURER

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The starting signal for the overall project was given in October 2016. The ambitious time frame requires the construction to be completed by the end of 2020. The time frame for the bearings was only seven months from conclusion of the contract to delivery, from fall 2018 to mid-2019. The installation took place in 2019/2020. Building owner is the D4R7 Construction s.r.o. Consortium, formed by Porr Bau GmbH (Austria) and Ferrovial Agroman (Spain). The D4R7 project Concessionaire – Zero Bypass Ltd., is a consortium consisting of international companies Cintra, Macquarie Capital and PORR AG. The consortium is responsible for the design, construction, financing and operation of the Southern part of the Bratislava Bypass.

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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, roadway expansion joints, seismic devices, tuned mass dampers, and monitoring systems). It also develops and produces vibration isolation of structures and machines, roller coasters and observation wheels as well as special structures in steel construction.

MAURER participates in many spectacular large-scale projects worldwide, like, for example, the world's biggest bridge bearings in Wazirabad, earthquake-resistant expansion joints for the Bosphorus bridges, tuned mass dampers in the Baku and Socar Tower, or uplift bearings for the Zenit Arena in St. Petersburg. Complete structural isolations range from the Acropolis Museum in Athens to the new major airport in Mexico. Spectacular amusement rides include, for example, umadum – the Munich observation wheel, the Rip Ride Rockit Roller Coaster in the Universal Studios Orlando, or the worldwide first duelling roller coaster at the Mirabilandia Park in Ravenna.

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