The lift bridge is lifted off its bearings

MAURER equips both the old Kattwyk Bridge and the new Kattwyk rail bridge in Hamburg.

Hamburg. **The striking Kattwyk bridge in the Port of Hamburg now has a sister bridge bearing the same name. A special feature of the new and, at the same time, largest lift bridge in Germany is that the lifting platform is raised off the structural bearings. MAURER supplied the bearings and roadway expansion joints for the new rail bridge and also replaced bearings and joints on the re-furbished „old" Kattwyk bridge.**

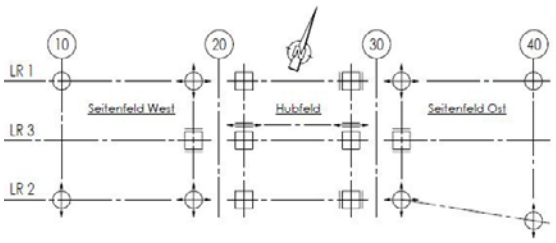
Both Kattwyk bridges across the southern Elbe (Süderelbe) in the Port of Hamburg are steelwork bridges and Hamburg landmarks. The older bridge was the largest lift bridge in the world when it was erected in 1973. Now, a 287-metre-long sister bridge, the largest lift bridge in Germany, has been built 58 m further north. The "new Kattwyk rail bridge" has a lifting height of 45.7 m and a passing width of 108 m.

When ships need to pass through, the bridges are closed to road and rail traffic, for a total of up to three hours every day. Before the new bridge was erected, road traffic had also to be stopped every time a train passed over, i.e. up to seven hours a day. The new Kattwyk rail bridge now carries the rail traffic, while the old bridge is reserved only for road traffic.

From a technical point of view, the sister bridges each consist of three partial bridges: fixed bridges on the bank sides and lift bridges in the middle. All six partial bridges are single-span structures and are thus individually supported. Two pylons each serve as supports for the fixed bridges and house the lifting equipment.

The new Bridge bearings: Restraining and recoupling

The special challenge imposed on the new 133 m long lift bridge required that the bearings separate during the lifting process, whereby the bearing upper parts move up simultaneously. After uplift, the bridge also presents a horizontal clearance of several millimetres and in addition is able to expand or contract due to heat or cold. Therefore, it has to be "recoupled" during lowering so that it comes to rest exactly on the bearings again. MAURER solved this problem by using special bearings that achieve guiding, restraining and recoupling functions within one structural element.



Bearing system (symbolic acc. EN1337-01) of the new rail bridge Kattwyk support system.
Diagram: MAURER

The Kattwyk bridges in the port of Hamburg: at the front, the new bridge for rail traffic, at the back the old bridge built in 1973, which now only carries road traffic.
Photo: MAURER

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Six steel-reinforced elastomer bearings made of chloroprene rubber were thus installed under the lift bridge.

Four of these bearings are multidirectional. Two are equipped with horizontal restraints that secure the lift bridge in the longitudinal direction. In addition to accommodating and transmitting horizontal forces, these two bearings also provide a recoupling function ensuring that the bridge slides back into the exact longitudinal position when it is lowered. For this purpose, the engagement on the bearing lower part is radiused, and tooth-shaped counterparts are fitted to the bearing upper part.

Two horizontal load bearings ensure restraining and docking in the transverse direction. These bearings are located at the ends of the lift bridge span, in the middle respectively. The multidirectional elastomeric bearings that are located directly next to the transverse guide prevent any bridge deflection. They can be considered as a bearing unit. Directly opposite, on each of the fixed bridge spans, a laterally fixed elastomer bearing is installed.

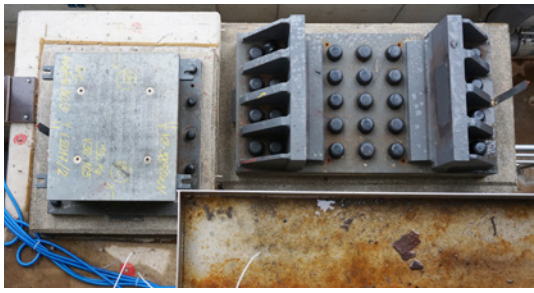
Spherical bearings for fixed lateral bridge spans

The two fixed bridge spans are supported at abutment level. Horizontally held MSM®/MSA® spherical bearings are respectively located there. Spherical bearings are sliding bearings that accommodate shear strains in all directions without noticeable resistance via an inner spherical joint. They thus transmit almost tension-free forces from the bridge deck to the substructure.

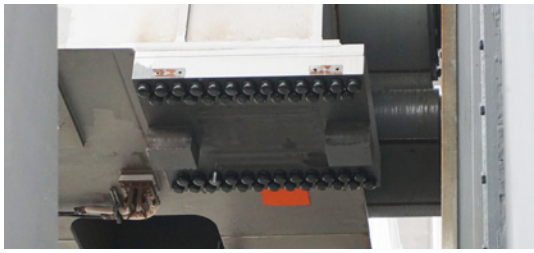
The spherical calottes are made of MSA® (MAURER Sliding Alloy), a lightweight and corrosion-resistant material. MSM® (MAURER Sliding Material) is used on all sliding surfaces. The patented sliding material has, among other qualities, the advantage that, compared to PTFE, it can accommodate at least 5 times the accumulated sliding displacements and 7.5 times the sliding speed without wear. This is relevant for the new Kattwyk rail bridge because, as a steel bridge, it moves a lot, and train crossings trigger vibrations with high oscillation frequencies. On the pylon side of the fixed bridge spans, two multidirectional spherical bearings are installed. An elastomer bearing is placed in between to reduce deflection. It also maintains the bridge span in the transverse direction using restraining structures.

In addition, MAURER supplied the roadway expansion joints for the new bridge, in the form of DB-regulated elastomer mats. These joints were installed at the bridge ends and at the transition to the pylon in order to compensate for longitudinal movements of the bridge deck and dynamic structural movements. At Expansion joints of type DB130N for gap widths of up to 130 mm are located at pylon level, and expansion joints of type DB40N for gap widths of up to 40 mm are located at abutment level.

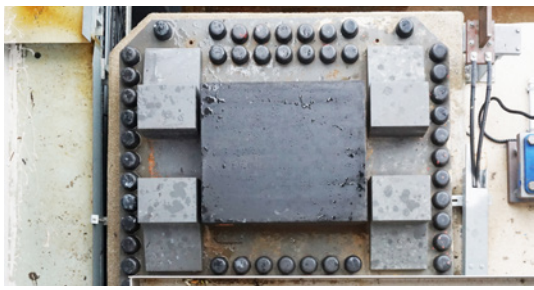
Bottom view of the opened new railway lift bridge; on the left the support surface for the multidirectional elastomer bearing, on the right the upper part for recoupling into the transversely fixed horizontal load bearing.



The two counterparts below with support surface and guide unit.



The upper part of the longitudinally fixed horizontal load bearing when the lift bridge opens: Note the two "teeth" that ensure recoupling in the longitudinal direction and transmit longitudinal forces.



Below, the counterpart with engagement for the longitudinal restraint teeth.

Photos: MAURER

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Road bridge: Swivel joints instead of elastomer

Furthermore, since 2017 the old Kattwyk bridge has been renovated and converted into a road bridge. MAURER structural bearings and expansion joints were installed in both bridges: „This shows that the bridge owner, the Hamburg Port Authority, is convinced of the quality of MAURER products," rejoices MAURER project engineer, Dirk Wilming.

Already in 2018, a total of eight pot bearings were replaced on the pylons. A enovation of the abutment followed in 2021 when the pot bearings were also replaced. In addition, the now "pure" road bridge received MAURER type DS240 swivel joists to replace the old roller shutter joints. The special feature of swivel joist expansion joints is that they are multidirectional in the transverse and longitudinal direction of travel as well as vertically. The expansion joints are 19 m long in total, including the apron plates in the walkway area. The gap width can reach up to 195 mm.

Both Kattwyk bridges have bicycle and pedestrian paths that offer a great view across the southern Elbe (Süderelbe) and the port. The new bridge was built by SEH Engineering GmbH.

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Quick facts about MAURER SE

MAURER SE 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 Bosporus 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, BOLT™ - the first roller coaster on a cruise ship, 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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